Towards Smart City implementation as an engagement practice: The case of Cape Town, South Africa

by D.L. van Staden

Thesis submitted in fulfilment of the requirements for the degree

Doctorate of Applied Arts in Design

in the Faculty of Informatics and Design

at the Cape Peninsula University of Technology

Supervisor: Prof J Cronje

Co-supervisor: Dr Belinda Verster

Cape Town

Abstract

Keywords: Smart Cities, Citizen Participation, Engagement, Governance, City Futures, Internet of Things, Technology

This research looked at Smart City implementation as an engagement practice. It explored and reports on the components that advance Smart City implementation and engagement and how these may be developed as a broader Smart City vision for a city, such as Cape Town.

With the purpose of uncovering the key Smart City components from a Cape Town perspective, many experts were interviewed, representative of academia, government, civil society and industry across the domains of digital inclusion, digital infrastructure, digital governance and digital economy. Emergent data and findings from these interviews revealed specific 11 themes as they relate to the vision of Cape Town as a Smart City.

The findings are grouped under the following headings: 1) Access as Infrastructure, 2) Adaptive Socio-Technical Solutions, 3) Common Good Value, 4) Contextual Smartification, 5) Data as Catalyst, 6) Demonstrated Value, 7) Equitable and Sustainable Cities, 8) Stakeholder Engagement, 9) Transformative Governance, 10) Transition Dynamics, and 11) Value Modelling and Measurement. The information thus compiled changes the way we understand the variables associated with Smart City implementation for the City of Cape Town. Additionally, these findings situate the present CoCT Smart City debate within current academic literature, furthering Cape Town's Smart City trajectory and vision.

Declaration

I, David Lucian van Staden, declare that the contents of this dissertation/thesis represent my own unaided work, and that the dissertation/thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed: .....

16 January 2023

Date: .....

Acknowledgements

I wish to thank the following individuals

- To my wife, friend and inspiration, Tessa and my wonderful son Guy
- My mom and dad for always allowing us to follow our own path
- My colleagues for your continuous encouragement and support
- TERPS and DRAW team for their continuously efforts to reduce complexity
- My supervisor Prof Johannes Cronje and co-supervisor Dr Belinda Verster for guiding me on the right path. Your knowledge and support is greatly appreciated

Dedication

”It is not my knowledge to have but my knowing to share”

Tessa and Guy van Staden

Contents

List of Figures

List of Tables

1 Introduction

The Smart City concept emerged as a viable model towards improving urban management and public life through the application of ICT and the optimisation and integration of smart technologies (Madakam and Ramachandran, 2015:34). As an instrument, the Smart City aims at improving cities by mobilising all city stakeholders in the creation of sustainable and equitable cities rooted in the use of technologies to establish a co-created, intelligent and connected city (Chamoso, Gonz´alez-Briones, Rodr´ıguez and Corchado, 2018:2). In essence, the Smart City concept is an attempt to render cities more efficacious for their citizenry, utilising its ability to optimise and integrate all city functionalities and infrastructure, such as resource optimisation and the advancement of public services.However, as each city is unique, the unlocking of its Smart City potential requires an exploration of its context and variables towards understanding and improving its operational efficiencies and functionalities, such as improving urban systems and accelerating digital transformation for a broader citizenry (Caird and Hallett, 2019:189). This research looked at Smart City implementation as an engagement practice for the City of Cape Town (CoCT). It explored and reports on the components that advance Smart City implementation and engagement in the City of Cape Town and how these may be developed as a broader Smart City vision for the CoCT. Many experts, representative of academia, government, civil society and industry, and specialised across the domains of digital inclusion, digital infrastructure, digital governance and digital economy, were interviewed with the aim of uncovering the key Smart City components from a Cape Town perspective. Emergent data and the resultant findings from these interviews revealed 11 such specific themes. These findings were grouped under the following headings: 1) Access as Infrastructure, 2) Adaptive Socio-Technical Solutions, 3) Common Good Value, 4) Contextual Smartification, 5) Data as Catalyst, 6) Demonstrated Value, 7) Equitable and Sustainable Cities, 8) Stakeholder Engagement, 9) Transformative Governance, 10) Transition Dynamics, and 11) Value Modelling and Measurement. They change the way we understand the variables associated with Smart City implementation for the City of Cape Town. Additionally, they situate the present CoCT Smart City debate within current academic literature, furthering Cape Town's Smart City trajectory and vision

2 Background to the research problem

It is estimated that the number of Smart Cities globally will increase significantly with an expected expansion from around 21 (as recorded in 2013) to over 88 such cities by the year 2025. Lam and Ma (2019:146), however, point out that, despite this rise in Smart City development and implementation, there are certain mitigating factors impacting its intended outcomes, factors attributed to Smart Cities being an evolving concept, as well as the heterogeneity of the requirements of different cities and

their population. In a paper titled Smart Cities as Innovation Ecosystems sustained by the Future Internet the idea of Smart Cities as a multi-layered concept is further characterised as an "agent of change" in which the shaping of a city occurs by dint of its people and the use of ICT in enabling an urban co-created developmental strategy with its associated mechanism of change (Schaffers, Komninos, Pallot, Aguas, Almirall et al.,(*) 2012:57). Rodr´ıguez-Bol´ıvar affirms, however, that "there is in fact little evidence that Smart Cities are realizing their visions first, and even more so there is a lack of attention to engagement and empowerment of citizens, SMEs and other entities realising their needs or ambitions, and of how citizens are empowered to participate in urban development and social innovation in general. . . more emphasis on stakeholder engagement in the early stage of service development is one key element to setting up effective stakeholder innovation networks" (Rodr´ıguez-Bol´ıvar, 2015:126). Schaffers et al. (*) (2012:57) agree with Rodr´ıguez-Bol´ıvar. Chourabi, Nam, Walker, Gil-Garcia, Mellouli, Nahon, Pardo and Scholl (2012:2293) add that "the topic of people and communities as part of smart cities is critical, and traditionally has been neglected on [sic] the expense of understanding more technological and policy aspects of smart cities." Mellouli, Luna-Reyes and Zhang concur and foreground that "[t]he concept of a smart community refers to the use of information and communication technologies by local governments and cities to better interact with their citizens, taking advantage of all available data to solve important problems. However, in order to deliver the expected values, governments need not only to create new services to their citizens based on these technologies in order to improve their quality of life, but also to engage citizens in this new set of services" (Mellouli et.al, 2014:1).

3 City of Cape Town Digital City Strategy

In 2000, the City of Cape Town (CoCT) initiated its Smart City Strategy with the aim to increase citizens' engagement and develop applicable public services, specifically using technology as a means to facilitate such developmental objectives and meet public service needs. This Smart City Strategy initiative further led to the implementation of a R300 million Enterprise Resource Planning (ERP) system, providing the necessary IT backbone (or infrastructure) that would support and improve city processes by digitally integrating all organisational processes into a single platform (Unicity Initiative). Moreover, its implementation was viewed as both a means to bridging the 'digital divide' and providing public connectivity and access to technology by having a tech-driven focus towards service delivery and the creation of 'digital democracy' (Boyle and Staines, 2019:10). This CoCT vision of moving towards 'smart urbanism' was later developed into an internal CoCT Digital City Strategy that would drive the improvement of public services, service deployment, as well as increase operational efficiency. Furthermore, it focused on utilising emerging technologies, such as IoT sensors and other digital technologies, as core components for providing solutions to urban challenges and supporting urban

development. The CoCT Digital City Strategy has four dimensions, namely digital government, digital inclusion, digital economy and digital infrastructure, in order to support Cape Town's Smart City vision. The objective of the strategy drove five specific focus areas, which are: (1) determining Cape Town digital approach towards achieving competitiveness, (2) determining and prioritising focus areas in accordance with city objectives, (3) identifying transitory initiatives that support wider city objectives, (4) establishing an implementation framework that includes relevant stakeholders and their roles, and (5) determining evaluation indicators by which to measure the success of the strategy (Stelzner, 2015). Furthermore, the strategic alignment of the CoCT Digital Strategy focuses on supporting the transitory vision of OneCape 2040, detailing 6 themes and outlining 12 goals towards achieving its vision of a society which is (1) highly skilled, (2) innovative, (3) resource efficient, (4) connected, (5) enjoys a high quality of life and opportunity, and (6) engages in collaborative practices to achieve objectives. These six OneCape 2040 themes and their linked goals are illustrated in Table 1.

The four digital strategy dimensions support a developmental context, as informed by local, regional and national government, and a vision of Cape Town defined as:

- being a prosperous city that creates an enabling environment for shared economic growth and development,
- achieving effective and equitable service delivery, and
- serving the citizens of Cape Town as a well-governed and effectively run administration (City of Cape Town, 2016:9).

As a strategy, its four dimensions are implemented across the organisation as part of an overall strategy. In the following section, I briefly provide an overview of the various pillars as illustrated in Figure 1.

3.1 Analysis of the Digital City Strategy

The Digital City Strategy outlines several guiding principles towards the establishment of an effective Smart City implementation strategy. It highlights numerous key objectives suggestive of Smart City implementation as a means to solving contextually specific modern urbanisation challenges. Furthermore, listed objectives, such as the use of ICT for social transformation under the dimension of digital inclusion, illustrate a progressive city leadership which recognises the potential of ICT deployment and technological integration in solving city problems and civil services or administration. This is evidenced in the visionary investment and implementation of a R300 million Enterprise Resource Planning (ERP) system, providing the necessary IT backbone (or infrastructure) for the City of Cape Town

Table 1: OneCape 2040 vision focus areas and goals (Western Cape Government, 2012:7)

Transition	Goals
Knowledge transition (Educating Cape)	Every person will have access to a good education that will ensure he or she is appropriately skilled for opportunity
	The Western Cape will enjoy a global reputation as a location of ecological, creative scientific and social innovation excellence
Economic access transition (Enterprising Cape)	Any person who wants to be economically active is able to secure work
	The Western Cape is recognised internationally as an entrepreneurial destination of choice
Ecological transition (Green Cape)	All people have access to water, energy and waste services that are delivered on a sustainable resource-efficient manner
	The Western Cape is a recognised leader and innovator in the green economy
Cultural transition (Connecting Cape)	The communities that make up the Western Cape are confident, welcoming, inclusive and integrated
	The Western Cape is regarded as a global meeting point between East and West and an important connector with new markets of Africa, Asia and Latin America
Settlement transition (Living Cape)	The neighbourhoods and towns of the region provide good quality of life to all and are accessible, have good public services and are rich in opportunity
	The Western Cape is ranked as one of the best places to live in the world
Institutional transition (Leading Cape)	Ambitious socially-responsible leadership exists at all levels of our society
	The Western Cape is home to many world-class institutions in both the public and private spheres

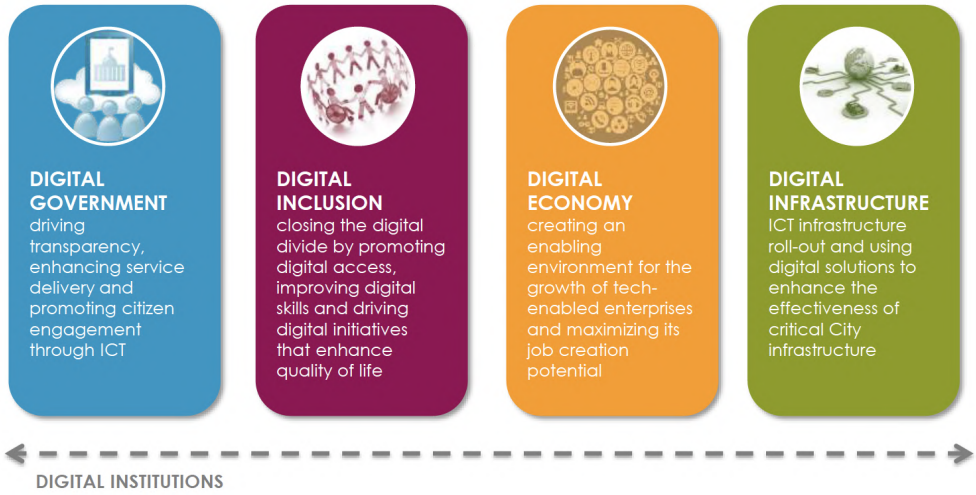

Figure 1: CoCT Digital Strategy dimensions (City of Cape Town, 2016:16)

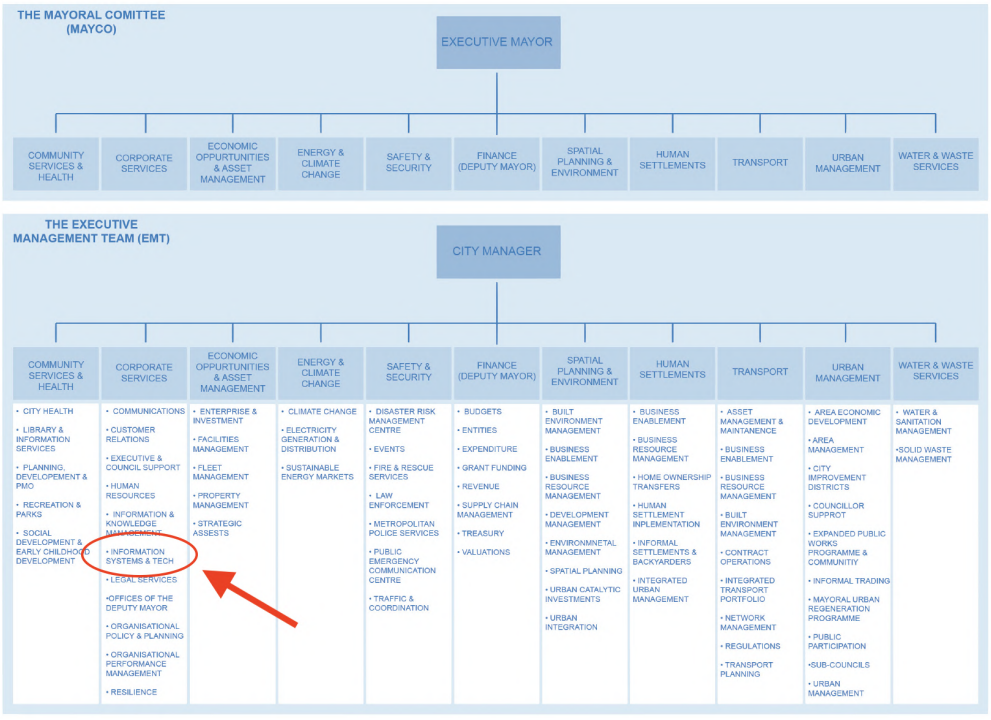

Figure 2: CoCT Executive Structure (Boyle and Staines, 2019:23)

that would support and improve city processes by digitally integrating all organisational processes into a single platform. The implementation of the ERP system provides both municipal and process integration and a digital exchange platform with a wide range of online applications or services. This digital foundation reaffirms Cape Town's digital infrastructure as being well-positioned to become the first African Smart City (City of Cape Town, 2016:27; Boyle and Staines, 2019:18). However, although the entire Digital City Strategy (just over 40 pages long) is illustrative of being driven by a Smart City vision and an awareness around its implementation requirements, lacks substance both around models and the mechanism of Smart City deployment. Furthermore, even though the strategy lists several initiatives under the various dimensions of digital government, digital inclusion, digital economy and digital infrastructure, these initiatives are often without any developed implementation plan, their envisioned outcomes or the roles of participating actors. The digital inclusion dimension recognises several initiatives linked to social transformation and the use of ICT as a catalyst for change; however, several of these listed initiatives lack a course of action. For example, one of the initiatives lists the importance of establishing public/private partnerships as a catalyst for social change; yet an indication of relevant partners is missing or vague. The strategy also lacks sufficient guidance, protocols or models of implementation for the initiation of an enabling and collaborative environment between internal and external stakeholders towards service innovation, service delivery and product development (City of Cape Town, 2016:27). Another criticism pertains to the genesis of the strategy and the implementation of the ERP (Enterprise Resource Planning) / SAP (System Analysis Program Development) system as driven by the city's IST department which is located under the Corporate Services Directorate, 1 of 11 directorates constituting the CoCT executive structure as shown in Figure 2 (Boyle and Staines, 2019:23).

Therefore, whilst the digital infrastructure, as afforded but the ERP/SAP system, is recognised as being located within the ICT department of the CoCT, Smart City implementation and its development require broader organisational and public engagement in order to ensure an implementation strategy which is inclusive and relevant. This is echoed in the following quote:

"The concept of a smart community refers to the use of information and communication technologies by local governments and cities to better interact with their citizens, taking advantage of all available data to solve important problems. However, in order to deliver the expected values, governments need not only to create new services to their citizens based on these technologies in order to improve their quality of life, but also to engage citizens in this new set of services" (Mellouli, Luna-Reyes and Zhang, 2014:1). Additionally, there is a need for a more focused and overarching Smart City implementation strategy for the CoCT. It also requires a Smart City developmental trajectory that moves beyond digital infrastructure integration. The latter needs to form the foundation for the establishment of an implementation strategy and ecosystem which enable social and economic evolution

across the organisation in accordance with wider public and city developmental objectives, such as bridging the digital divide in Cape Town (Boyle and Staines, 2019:26). It also requires an ecosystem and implementation strategy which insists on enhanced stakeholder interaction between industry, government, society and university known as the Quadruple Helix Innovation Model in which such open innovation interactions and co-created processes stimulate new city services (Paskaleva, Cooper, Linde, Peterson and G¨otz, 2015:121).

Moreover, this requires a strategy which includes the creation of a more inclusive citizenry in which citizens are perceived as prosumers (both producers and consumers of content) within the digital urban environment. This, therefore, calls for a bottom-up approach and more participatory governance models to solve urban challenges and understand the needs of city and stakeholder (Guti¨´errez, Theodoridis, Mylonas, Shi, Adeel, Diez, Amaxilatis, Choque et al., 2016:4).

3.2 Analysis of the Digital City Strategy Focus Areas

3.2.1 Digital Government

The digital governance dimension of the CoCT Digital City Strategy pivots around the city 's operational processes and public services, specifically regarding the use and deployment of technology and "harnessing digital tools to stimulate innovation in service delivery" (City of Cape Town, 2016:17). The Enterprise Resource Planning (ERP) system provides the necessary IT infrastructure that supports and improves city processes by digitally integrating all organisational processes into a single platform (Unicity Initiative). This dimension in the digital strategy outlines several key elements, such as open data and their public access, to promote open innovation and acknowledge the importance of stakeholder engagement. Other key elements include data analytics for improved operational efficiency, transparency and innovation. However, in some respects and to a large degree - the strategy lacks a coherent implementation plan towards achieving these objectives. In 2014, for example, Cape Town launched its open data policy which subsequently led to the establishment of an open data portal to provide public access to government data, the aim being to maintain government transparency, increase citizen engagement and use digital tools and open data in the development of services and applications. Dlamini (2019:34), however, points out that "the challenge is that data users are not equipped to interpret open data." Furthermore, other authors have highlighted that, despite the working functionality of an open data portal, it lacks "an Application Programme Interface (API) which would allow applications to be developed from city data" (Boyle and Staines, 2019:13). These shortcomings therefore, suggest that, despite the Enterprise Resource Planning (ERP) system, coupled with the benefits of launching Cape Town's open data portal to attain the objectives of digital governance as set out in the strategy, the CoCT's Smart City project requires a

coherent implementation plan - specifically regarding the use and deployment of technology and "harnessing digital tools to stimulate innovation in service delivery" (City of Cape Town, 2016:17).

3.2.2 Digital Inclusion

This dimension of the strategy focuses on narrowing the existing digital divide by promoting access to and the use of digital technologies in order to improve digital literacy and initiate digital projects that would enhance citizens' quality of life. This aspect is necessitated by the disparities that exist in relation to digital distribution and its access on account of unequal opportunities of access between groups, usually between the poor and rich. The strategy identifies three principles which inform an action plan by which to achieve this, namely by (1) enhancing local communities' access to ICT and digital services and the formation of partnerships with external stakeholders, (2) enhancing ICT use and focusing on end-user digital skills development, and (3) focusing on initiatives which drive and promote social transformation through ICT and investment in under-resourced areas, such as public/private partnership or sponsored hackathons, to identify and solve urban challenges. The successful SmartCape project, as guided by the above-mentioned principles and launched in 2002, is an example of an initiative addressing the digital divide. It also details the provision of free Internet access in libraries, usually in disadvantaged areas, with the aim of building a more connected and informed citizenry, providing better access to online information resources and expanding the digital infrastructure and interest access (City of Cape Town, 2016:25). The strategy also proposes a number of initiatives using ICT and mobile channels to increase socio-economic conditions and resolve urban challenges, such as the use of social media to enhance disaster responses. However, in many instances these proposed initiatives lack clear implementation strategies or the necessary detail, such as, 'Who are the relevant stakeholders?' or 'What types of citizen engagement or collaborative practices are needed in order to achieve a vision of inclusion?' The afore-mentioned points, therefore, suggest that the vision of digital inclusion as set forth by the CoCT Digital City Strategy should call for broader stakeholder involvement and protocols of engagement to reach its specified objectives of enhanced access, improved ICT skills and usage, as well as bringing about social change through ICT (City of Cape Town, 2016:14).

3.2.3 Digital Economy

As mentioned earlier, Cape Town is known as a first-rate digital ecosystem and technology hub hosting over 50 percent of South Africa's emerging 'tech' startups. Additionally, it has a well-established digital economy due to its status as a leading technology hub for startups and venture capitalists in Africa. This drives and

supports innovation and opportunities for economic growth (GDP) in the Western Cape and, as such, plays a vital role in Smart City development. This dimension, namely digital economy of the Smart City strategy focuses on stimulating and establishing an enabling environment for the growth of technology driven enterprises and startups towards the creation of employment opportunities. The underlying principles supporting this dimension are (1) boosting tech startups, (2) promoting Cape Town as a leading digital city in Africa, (3) developing ICT skills and the ICT sector, (4) developing Cape Town's digital economy and online services, (5) increasing economic competitiveness and productivity, (6) developing an enabling and regulated technology sector, and (7) developing a culture of innovation. Although these pillars (as identified in the CoCT Digital City Strategy) are conducive to the establishment of a digital economy and recognise the needs of city as it aims for Smart City status, they lack considerable implementation strategies or guides that would drive and support innovation and opportunities for economic growth (GDP) in the Western Cape (City of Cape Town, 2016:25; Boyle and Staines, 2019:13).

3.2.4 Digital Infrastructure

This dimension of the Digital City Strategy refers to the necessary IT backbone (or digital networks) that would support and improve city processes, infrastructure and services, as well as digital integration. It, therefore, positions itself as a foundation and key enabler of the other three dimensions, namely digital government, digital inclusion and digital economy. The City of Cape Town aims to realise the vision of being a leading African city in providing online access to all and stimulating an environment for economic growth, better service delivery/development and transparent governance (City of Cape Town, 2016:17). As such, it relies on the development of telecommunications infrastructure and network services or devices for city services and the use of ICT for the monitoring and management of city resources. Additionally, it demands the provision of data centres and application servers, as well as enhancing the city's web-hosting capabilities to improve reporting and service responses (City of Cape Town, 2016:41). Furthermore, it entails developing collaborative partnerships and corporate networks or services in order to leverage external resources to mitigate budget constraints or resource limitations - yet remaining responsive and relevant. The digital infrastructure dimension is more akin to a Smart City strategy and most developed in relation to the other three dimensions. It, therefore, illustrates an understanding of the role that infrastructure plays within an overarching Smart City strategy. It also highlights the importance of establishing private partnerships and collaborative engagement practices that facilitate the provision of infrastructure and address connectivity needs where such potential collaboration would assist in service deliver. This would be achieved either by sharing implementation cost or providing an enabling environment or digital infrastructure towards realising specified developmental goals. The Broadband

Project, launched in 2014, illustrates the city's attempt at expanding its fibre infrastructure across its entire metro area and thus reducing telecommunications costs and improving high data connectivity and services. This entailed connecting hundreds of public buildings with high-speed fibre connectivity, using city-owned network infrastructure, in an effort to leverage private partnerships, such as Internet Service Providers (ISP), to further digitise the city in under-resourced or impoverished areas. It also provided the opportunity to partner with third-party service providers and offer them the utilisation of spare city infrastructure capacity, illustrating the transformative capacity of ICT deployment, coupled with collaborative practices in achieving city objectives (City of Cape Town, 2010:8) and (Boyle and Staines, 2019:16). Other CoCT collaborative initiatives conducive to Smart City deployment include the SmartCape initiative which forms part of the city's vision of digital inclusion. It aims to provide free internet access, using commercial ISPs, by setting up hundreds of WI-FI access points located at various city facilities. In addition to creating city-wide Internet coverage, the SmartCape initiative also underpins the use of ICT and digital technologies for skills development, as well as initiating and developing technology-driven services and industries. From an industry perspective it also seeks to promote the use of digital technologies for improved efficiency, better service delivery and the development of innovative services using government data or open data, as evidenced by the city's Open Data Portal launched in 2015. The Open Data Portal makes available a host of city datasets to facilitate government transparency, provide public access to information and promote possibilities for innovation (Boyle and Staines, 2019). In 2013, the CoCT also launched an e-services portal allowing citizens to interact with and perform various city-related functions, such as purchasing electricity, reporting faults, account and billing services, etc. as shown in Figure 3 (City of Cape Town, 2010:16). This, therefore, suggests that the aim of a digital infrastructure as offered by the ERP/SAP system requires broader organisational and public engagement in order to ensure that its objectives are met and an implementation strategy which is inclusive and relevant for the CoCT is designed.

3.3 Additional Challenges in relation to CoCT Digital City Strategy

3.3.1 Smart City Architectures

In order to realise their vision of empowering citizens, as well as aiding urban development, social innovation, better services, sustainability and economic development, Smart Cities require the employment of architectures to ensure the effective integration of various city components. These architectures serve as a basis for the planning and functioning of Smart Cities. However, as Smart cities - and cities as a whole - are diverse, existing approaches and platforms are fragmented and

Figure 3: CoCT e-services portal (City of Cape Town, 2010:16)

lack a coherent (or standard) architecture which contains all unifying functionalities. According to Anthopoulos (2017:31), "architecture concerns a definition of the structure, relationships, views, assumptions and rationale of a system." In a literature review discussing key Smart City architectures, author Kyriazopoulou identifies six architectural principles: "Architectural Layers, Service Oriented Architecture, Event Driven Architecture, Internet of Things, Combined Architectures and Internet of Everything" (Kyriazopoulou, 2015:6).

3.3.2 Smart City Models and Evaluation

Apart from the above-mentioned Smart City architectures, which concern the potential structure and rationale of Smart Cities, there also exists a need for the establishment of Smart City models as a means to measure and evaluate, against a set of indicators, the stages of development and performance of Smart Cities. The establishment of such models assists in city benchmarking, indicating the required Smart City developmental strategies and the scale of their implementation. The IDC Smart City Maturity Model (SCM) is one such model. It also acknowledges cities as diverse, with each having its own unique SC developmental trajectory, and provides five stages of SC growth. In addition, it provides five best-practice measurements which include (1) strategy, (2) culture, (3) process, (4) technology, and (5) data), as well as nineteen SC developmental indicators (Yesner and Ozdemir, 2017:7). Another such example is put forward by Boyd Cohen and his Smart City wheel. The wheel

contains six dimensions (or components) and key indicators by which to evaluate Smart City deployment (Cohen, 2014).

4 Research problem

Literature and the Santander (See Chapter 2, Section 8.3) example suggest that Smart City implementation can play a significant role in addressing current urbanisation issues, and is the most viable and worthy instrument in achieving such objectives. This is affirmed by the CoCT vision and move towards "smart urbanism" and the R300 million investment in digital infrastructure towards Smart City development, according the CoCT Digital City Strategy. However, as pointed out, the current Digital City Strategy lacks sufficient academic grounding and substance around implementation models of and required mechanisms for Smart City deployment. Moreover, as literature suggests, its lacks sufficient guidance with regard to models of collaborative engagement practices to ensure that Smart initiatives and their deployment are well aligned and appropriate in relation to various participatory networks and community engagement practices towards a more inclusive active citizenry (Rodríguez Bolívar, 2015). In addition, the current strategy requires a better understanding and interpretation of what Smart City implementation can or should be in a Cape Town context in order to unlock its value and potential towards providing new services to citizens, improve their quality of life and enhance social and economic transformation.

4.1 Aim of the research

The building of a Smart City requires initial, active and knowledgeable involvement amongst various stakeholders, such as city managers, urban services, citizens, communities and users as a way of defining and consolidating the city's needs and the interdependencies of its residents. Consequently, due to the complex urban environment with its heterogenous context and diverse challenges such a project entails and envisions an ongoing debate aimed at establishing a co-created ecosystem that utilises IoT and the concept of the Smart City as a connected city. This will identify areas of potential service applications and the advancement of a local more inclusive environment, focusing on adaptive, scalable and practical citizen-centric solutions as part of a city's innovation strategy and ecosystem (Gutierrez, Amaxilatis, Mylonas and Munoz, 2018:668). The current CoCT Digital City Strategy, however, does not provide sufficient direction in this regard. Therefore, this research aims to explore Smart City implementation in Cape Town as an engagement practice to both understand what Smart City implementation means for Cape Town and to further unlock its potential for the City of Cape Town.

4.2 Questions that drive this study

- What are the components that lead towards Smart City implementation and engagement in the City of Cape Town?
- How are these used to develop a Smart City vision for the City of Cape Town?

5 Research Design and Methods

Below is a general description of the research design and methodological approach. The particulars will be described in the relevant chapters.

5.1 Research Paradigm

This narrative study used constructivism as a research paradigm, viewing individual knowledge and understanding as a socially constructed phenomenon influenced by individuals, their lived experiences, and their reflections on those experiences. Furthermore, a constructivist approach within a narrative, or qualitative, inquiry asserts that reality is subjective and formed as a consequence of one's interactions with others and one's interpretation of their responses – these interpretations being as grounded in one's own individual social context. This helps to understand a phenomenon and how meaning is extracted from such interaction and its varied contexts (Kim, 2005:9; Adom, Yeboah and Ankrah, 2016:5).

5.1.1 Axiological Approach

As a narrative study exploring Smart City implementation as an engagement practice, this research acknowledges that the multi-dimensionality and personal value biases of participants and their responses and values, as based within their own value system, in guiding and interpreting the research and guide and interpret its objectives. Axiology is a theory and section of philosophy dealing with the nature of values. It studies judgements associated with value, where the nature of such value is conceived as both multi-dimensional and heterogeneous. As such, axiology deals with the formation of value as either objective, subjective or transformative in order to understand the nature of value or that which is 'good' in relation to its context (Hart, 1971:30). It, therefore, positions the notion of value as a preferential outcome, based on its benefit or desirableness in terms of its nature or relatedness to other aspects of social co-existence (Bowyer, 1970).

5.1.2 Ontological Approach

The thesis is written with the perspective that reality is subjective and socially constructed. Data generation and acquisition for this study followed an interpretivist approach, combined with an intertextual reading and analysis of data. This allowed for an unveiling of the key Smart City components in Smart City implementation as an engagement practice and, more specifically, promoted a better understanding of Smart City value, its context and deployment for the CoCT (Mellouli et al., 2014:1). The Smart City concept conveys a promise of legitimacy in addressing a range of urban challenges and in empowering citizens, enhancing social innovation and service development.

5.1.3 Epistemological Approach

As a narrative study, following an inductive approach, and seeking to explore Smart City implementation as an engagement practice from a Cape Town perspective, I acknowledge my subjective relationship with the research and my active role and participation in unveiling the key Smart City components as they would apply to Cape Town.

5.2 Research Design

This study explored Smart City implementation as an engagement practice, using a narrative approach to enquire into a specific situation, its associated context and relationships (Yin, 1994:13). The study was done within a specific time frame and place in order to provide an understanding of reality as a socially constructed phenomenon, and in which individual and subjective experiences, as perceived within their social and cultural contexts, provide "contextual depth" and thus an understanding of individual activities, their motives, elements and the construction of meaning in relation to human actors. (Kim, 2005:9; Adom, Yeboah and Ankrah, 2016:5). My approach, therefore, perceives human actions or contextual specificity as valuable and occurring through social interaction (Chowdhury, 2014:433; Kelliher, 2011:123). This narrative approach aimed at providing an explanatory interpretation of a situation by examining various sources of data through individual narratives (Scapens, 2004:15).

5.3 Data collection and analysis approach

This study, although predominantly situated within the field of design and human computer interaction, draws on multiple perspectives, including academia, government, civil society and industry (The Quadruple Helix) in order to allow for a

multi-dimensional investigation of a phenomenon. As such, it employed semi-structured interviews for data collection using purposeful sampling of various participants who represent the 'civil society' dimension of the Quadruple Helix. Data collection and analysis followed an iterative process as a means of gaining 'synergy', namely to uncover the underlying relationships within a phenomenon and to align codified participant responses within the author-designed Smart City Implementation as an Engagement Practice (SCIEP) framework, the details of which will be expanded on in Chapter 3 and are illustrated in Figure 21, page 107. The research adopted an inductive approach. Thomas (2016:237) notes that the purposes for using a general inductive approach are to:

- condense raw textual data into a brief, summary format,
- establish clear links between the evaluation or research objectives and the summary findings derived from the raw data, and
- develop a framework of the underlying structure of experiences or processes that are evident in the raw data.

Data collection and analysis occurred in stages following a phased approach. Collected data were qualitatively analysed and coded in Atlas Ti by reading and re-reading the text, using a combination of both predetermined codes and the development of new code lists. This allowed for the emergence of concepts, categories and their relationships with other categories through an iterative process of theoretical sampling and constant comparison.

5.4 Methodological Outline

The study, as a holistic engagement practice, aims at exploring Smart City implementation in Cape Town, providing an improved understanding of this endeavour, as well as its potential for the City of Cape Town. Research objectives were addressed by employing the following procedures:

- A systematic literature review (SLR) and content analysis around the current academic Smart City discourse. This ensured an alignment of current CoCT Digital City Strategy themes in relation to the academic debate;
- The development, using an inductive approach, of the main categories and the analytical process of clustering, based on the SLR and the development of the SCIEP framework;
- Presentation of key Smart City components for Cape Town as informed by literature, the Digital City Strategy and semi-structured interviews with experts in the field;

- Alignment of the current academic debate in accordance with the SCIEP framework and Cape Town's Smart City trajectory.

5.5 Systematic Literature Review (SLR Process)

Sources of information for the systematic literature review came from database searches, reference searches and article abstracts including IEEE Explore, ProQuest, ACM Digital, EbscoHost and Google Scholar, which provided an overlap across the various academic databases. Inclusion criteria included peer reviewed Smart City literature written in English, between 2015 and 2020. As part of the literature content analysis phase, 127 studies were identified, based on keyword entries, of which 84 documents were analysed and coded using Atlas Ti. Database search entries included the following keywords: Smart communities, Smart Cities, Internet of Things (IoT), participatory sensing, smart environments, cyber physical systems (CPS), IoT communications and technologies. The collected data from the shortlisted 84 documents were imported, qualitatively analysed and coded in Atlas Ti by reading and re-reading of text, using a combination of both predetermined codes and the development of new code lists. This resulted in a preliminary code book containing 467 codes, broadly defining the much-contested areas in this field of study. These initial 467 codes were subsequently re-read, analysed and clustered into 76 code groups, each with its own sub-groups. A clear representation of the terms used was provided as part of the Smart City academic debate and for perusal by leading authors. The identified article codes, groups and sub-groups formed the basis and rationale of the systematic literature review, providing a subjective and constructed reality through engagement with different realities and interpretations attached to them. The development, using an inductive approach, of these main categories and the analytical process of clustering as a result of generating meaning, resulted in the Smart City Implementation as an Engagement Practice (SCIEP) model. This provided a contextual understanding of Smart Cities which, by definition, engenders participation.

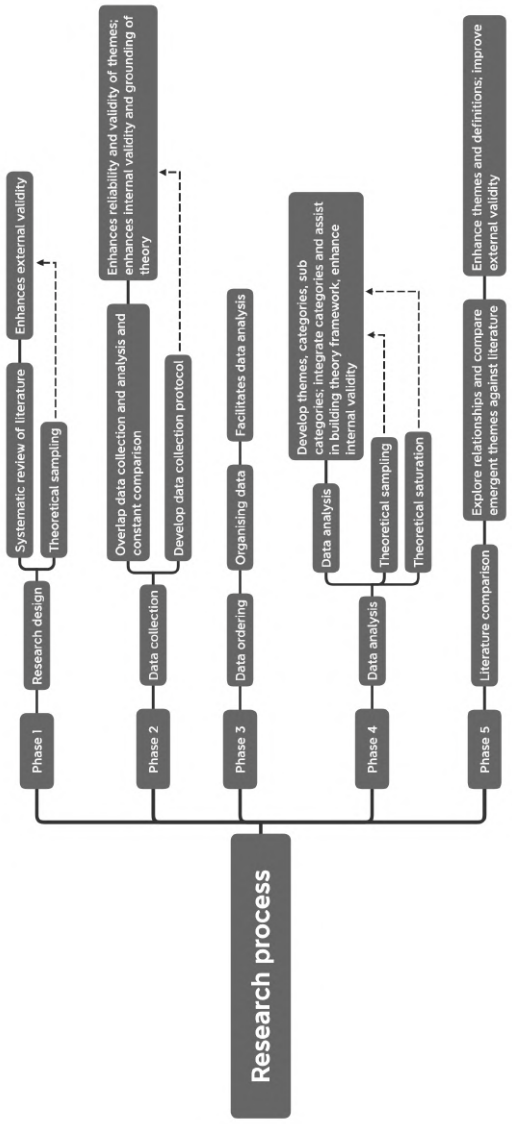

Figure 4: Data analysis process towards theoretical saturation (Adapted from Pandit, 1992:3)

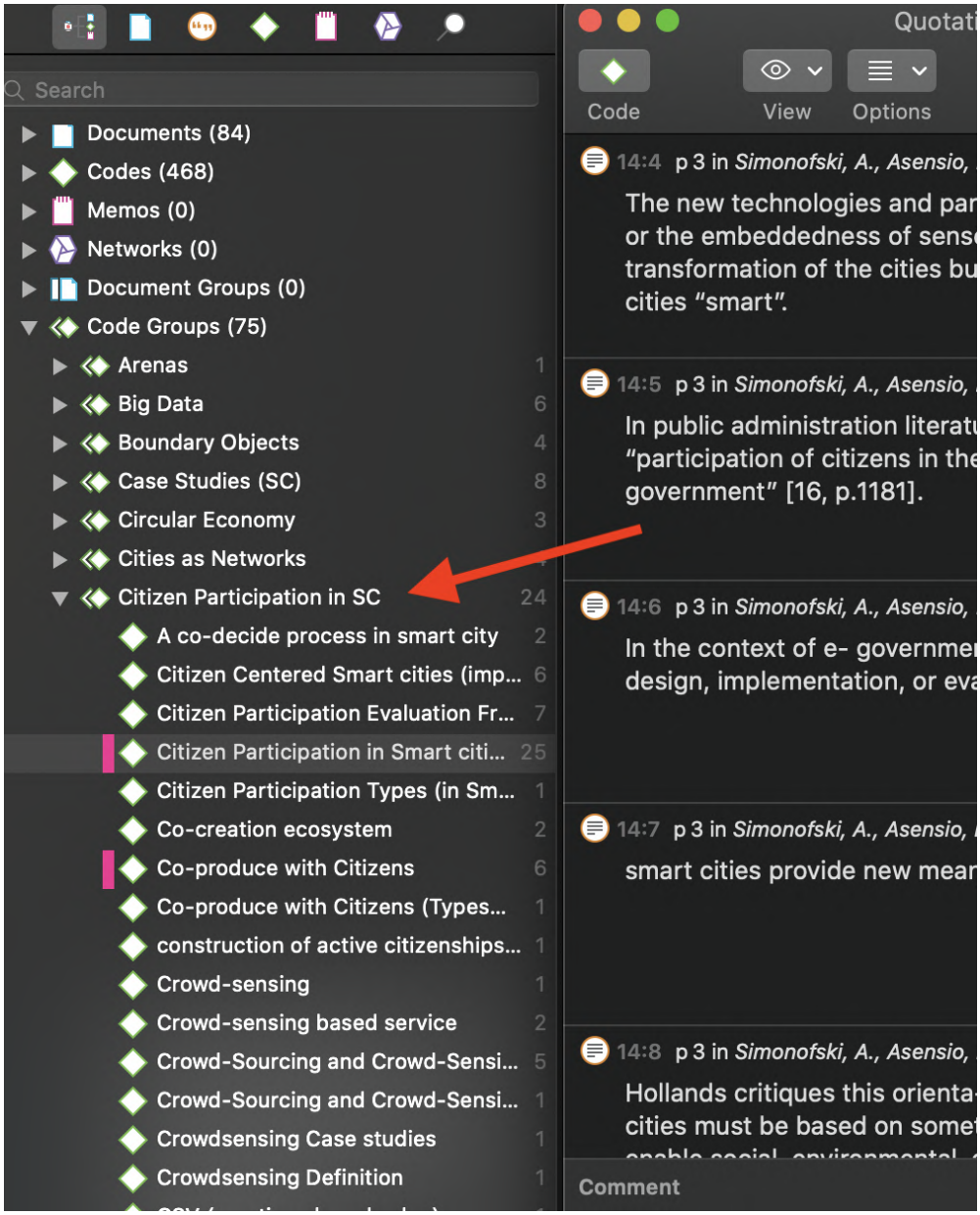

Figure 5: Data developed into themes, categories and sub categories (Author, 2020)

42:4	TQMS organizes	TQMS organizes	Ngai, E., Dressler,	Trip Qual- ity
Co-creating Smart Cities				
Number	**Name**	**Text Content**	**Document**	**Codes**
15:7	Quotation 15:7		Gutiérrez, V.,	OrganiCity
21:9	Quotation 21:9		Gutiérrez, V.,	OrganiCity
Number	**Name**	**Text Content**	**Document**	**Codes**
77:261	Roles in service co-	Roles in service co-	Anthopoulos, L.G.,	Roles in service co-
77:262	Quotation 77:262		Anthopoulos, L.G.,	Roles in service co-
Number	**Name**	**Text Content**	**Document**	**Codes**
77:263	Variables that	Variables that	Anthopoulos, L.G.,	Variables that
77:264	Quotation 77:264		Anthopoulos, L.G.,	Variables that
Cyber Physical Systems (CPS)				
Number	**Name**	**Text Content**	**Document**	**Codes**
12:9	Cyber-Physical	Cyber-Physical	Pticek, M.,	Cyber-Physical
12:10	A connected CPS	A connected CPS	Pticek, M.,	Cyber-Physical
12:14	Accordingly, CPS	Accordingly, CPS	Pticek, M.,	Cyber-Physical
20:10	“A cyber-physical	“A cyber-physical	Tokody, D. and	Cyber-Physical
20:11	Quotation 20:11		Tokody, D. and	Cyber-Physical
30:13	CYBER-PHYSICAL	CYBER-PHYSICAL	Sun, Y., Song, H.,	Cyber-Physical
30:14	IoT is a networking	IoT is a networking	Sun, Y., Song, H.,	Cyber-Physical
68:5	CPS can be	CPS can be	Santana, E.F.Z.,	Cyber-Physical
Data Valences				
Number	**Name**	**Text Content**	**Document**	**Codes**
16:15	The valence of	The valence of	Fiore-Gartland, B.	Data Valences
16:16	the discourse of	the discourse of	Fiore-Gartland, B.	Data Valences
Number	**Name**	**Text Content**	**Document**	**Codes**
16:17	Note that the	Note that the	Fiore-Gartland, B.	Data Valences
16:18	the data valence of	the data valence of	Fiore-Gartland, B.	Data Valences
Number	**Name**	**Text Content**	**Document**	**Codes**
16:23	The discovery	The discovery	Fiore-Gartland, B.	Data Valences
Number	**Name**	**Text Content**	**Document**	**Codes**
16:13	The valence of self-	The valence of self-	Fiore-Gartland, B.	Data Valences Self-
16:14	The many steps of	The many steps of	Fiore-Gartland, B.	Data Valences Self-
Number	**Name**	**Text Content**	**Document**	**Codes**
16:19	Transparency can	Transparency can	Fiore-Gartland, B.	Data Valences
16:20	People evoke the	People evoke the	Fiore-Gartland, B.	Data Valences
16:21	In patient advocacy	In patient advocacy	Fiore-Gartland, B.	Data Valences
Number	**Name**	**Text Content**	**Document**	**Codes**
16:22	truthiness as a data	truthiness as a data	Fiore-Gartland, B.	Data Valences
Number	**Name**	**Text Content**	**Document**	**Codes**
16:1	Data Valences	Data Valences	Fiore-Gartland, B.	Data Valences
16:2	the term data	the term data	Fiore-Gartland, B.	Data Valences
16:3	data valences to	data valences to	Fiore-Gartland, B.	Data Valences
16:4	However, what is at	However, what is at	Fiore-Gartland, B.	Data Valences
16:5	ncreasingly, the	ncreasingly, the	Fiore-Gartland, B.	Data Valences
16:8	We define data	We define data	Fiore-Gartland, B.	Data Valences
16:9	Data valences, by	Data valences, by	Fiore-Gartland, B.	Data Valences
16:24	the expectations	the expectations	Fiore-Gartland, B.	Data Valences
16:25	Quotation 16:25		Fiore-Gartland, B.	Data Valences
16:26	people considered	people considered	Fiore-Gartland, B.	Data Valences
16:27	Will the information	Will the information	Fiore-Gartland, B.	Data Valences,

Figure 6: Data collection and organising of data (Author, 2020)

5.6 Construct validity, Internal Validity, External Validity and Reliability

Construct validity was guaranteed by establishing specific protocols which are discussed in Chapters 2 and 3. Internal validity was ensured through a process of theoretical sampling and constant comparison, establishing relationships between categories and their causation, as well as the emergence of potential value propositions in understanding a phenomenon. External validity was established by generalising this study's findings within an existing domain. Reliability was secured by including participants representative of academia, government, civil society and industry. Member-checks were done to ensure that captured data were correct and valid and a true reflection of participants' responses.

5.7 Delineation of the research

This research was limited to exploring Cape Town's Smart City trajectory, its development and the implementation of a Smart City vision for Cape Town as an engagement practice. As a single-use case focusing on Cape Town, South Africa, results and recommendations from the study may, therefore, lack a more generalised practical application to or solution for other geographical areas or other local contexts.

5.8 Ethics

The research was ethical in its approach in that it did not harm the environment, nor did it include minors or any person unable to give personal consent. Data were gathered via semi-structured interviews, and written consent was asked of adults taking part in this study. Audio recordings and transcripts were stored in a secure location, unlabelled, to ensure anonymity of the participants. Participants were made aware of the amount of time necessary to conduct the interviews which were done online via Zoom. Data protection and sharing of personal data was kept private and securely stored digitally. Permission was asked of participants to allow any reproduction and/or sharing of personal device data. In order to preserve individual privacy and personal information personal data were anonymised, making use of pseudonyms when referring to participants (Appendix, p 250).

6 Contribution of the research

The rate at which modern urbanisation and migration patterns occur is unprecedented. As noted by Arroub, Zahi, Sabir and Sadik (2016), this rapid rise of a global urbanised population has led to an increased awareness of the associated challenges faced by urban areas. It is in view of these challenges that the Smart City concept and its development, combined with ICT, are envisioned as being able to play a crucial role in ensuring a more people-centric urbanism. In fact, many cities around the world are enhancing their attractiveness as a Smart City by using IoT in order to provide their citizens with a better quality of life (Suryanegara, Arifin, Asvial and Wibisono, 2017:21). This is also reflected in the CoCT Smart City strategy and the implementation of the R300 million Enterprise Resource Planning (ERP) strategy, providing the necessary IT infrastructure that would support and improve city processes and initiate the Smart City concept. Literature positions successful Smart City implementation as an ongoing process which requires initial, active and knowledgeable involvement of various stakeholders, such as city managers, urban services, citizens, communities and users, as a way of defining and consolidating a city's needs and interdependencies. In consequence, and due to the complex urban environment with its heterogeneous context and diverse challenges, an ongoing debate is envisioned, aimed at establishing a co-created ecosystem that utilises IoT and the concept of the Smart City as a connected city. In order to identify areas of potential service applications and the advancement of a local and more inclusive environment, the focus will be on adaptive, scalable and practical citizen-oriented solutions as part of a city's innovation strategy and ecosystem (Guti¨errez, Amaxilatis, Mylonas and Mun¨oz, 2018:668). As mentioned in Section 3.2 the current CoCT Digital City Strategy, the aim of which is to support and enable such urban transformation through Cape Town's Smart City vision, lacks focus and an overarching, academically grounded Smart City implementation strategy. The significance of the research is, therefore, both practical and theoretical. As revealed in the development of the SCIEP model, it provides a framework that is contextually grounded in understanding the Smart City concept for the City of Cape Town. From a practical perspective, this research facilitates the move towards the urban transformation (or smart urbanism) of Cape Town and its population. Furthermore, it provides a better understanding of Cape Town Smart City implementation strategies. By virtue of its applied methodological approach, this research locates the present CoCT Digital City Strategy within current academic debate, providing a better understanding of the value of the Smart City concept and the leveraging of existing infrastructure to solve urban challenges. In addition, this research provides a better and more contextually grounded understanding of the Smart City concept and its role in the development of an enabling environment for collaborative practices and partnerships that further the CoCT quest for becoming an African Smart City. Furthermore, despite the strategy's lack of substance, it is - to my knowledge - the most comprehensive attempt at spearheading Cape Town towards Smart City status. The significance of the research is, therefore, both

practical and theoretical as it will help in foregrounding the key components in unlocking Smart City value and its opportunities for urban transformation of Cape Town and its population.

7 Thesis Summary

7.1 Chapter 1

In this chapter an introduction and background to the research is provided. I discuss the research focus and background in defining Smart City implementation as a context-driven collaborative process that seeks to establish and activate broader citizenry involvement. This would lead to understanding and improving a city's operational efficiencies, functionalities, improve urban systems and assist with digital transformation (Caird and Hallett, 2019:189). This chapter also reports on the research design and methods employed, as well as the study's contribution to current relevant research.

- access as infrastructure
- adaptive socio-technical solutions
- common good value
- contextual smartification
- data as catalyst
- demonstrated value
- equitable and sustainable cities
- stakeholder engagement
- transformative governance
- transition dynamics
- value modelling and measurement

7.2 Chapter 2

This chapter reports on the process and outcomes of the structured literature survey, the purpose of which was to create a conceptual model for the analysis of citizen

engagement in Smart Cities. It reports on the data collection and methodological approach of the study. It introduces and discusses the main constructs found in literature which lead to an understanding of citizen engagement in Smart Cities and provides examples, such as the Peripheria Human orientated Smart City approach. Key concepts discussed in this chapter include (1) the process of co-production, (2) evaluating citizen participation, (3) generating value and knowledge management, (4) information and communications technology (ICT) and governance in Smart Cities, (5) dimensions of 'smartness' and governance, (6) stakeholder engagement in Smart City service creation, (7) factors influencing successful Smart City service implementation, (8) the role of ICT in Smart Cities, (9) open data in Smart Cities, and (10) Smart City development and benchmarking criteria.

7.3 Chapter 3

This chapter reports on the development of the SCIEP conceptual model towards interpreting Smart City implementation as an engagement practice for the City of Cape Town. The chapter delineates on the inductive approach undertaken towards the construction of the SCIEP conceptual model as informed by literature and the constant compression and crystallisation of raw data into a summary or codified meaning. It identifies key concepts and indicators towards imagining effective Smart City engagement and implementation that moves beyond a techno-centric adaptation to unlocking Smart City value for the broader citizenry. The SCIEP conceptual model, and its components, seeks to activate collaborative practices between governance and citizens, and to realise Smart City value and services by placing emphasis on the city's human capital (Schaffers et al., 2012:57; Mellouli et al., 2014:1; Rodr´ıguez-Bol´ıvar, 2015:126; Guti´errez et al., 2016:4). Key areas discussed in this chapter are (1) the role of data in Smart Cities, (2) co-production in Smart Cities, (3) citizen participation and co-creation in Smart Cities, (4) open innovation and stakeholder engagement in Smart Cities, (5) Smart City initiatives and service types, (6) evaluating and measuring Smart City maturity, and (7) Smart City domains and focus areas.

7.4 Chapter 4

This chapter reports on findings obtained from individual interviews and thematic content analysis in response to my research questions. Findings and emergent data are discussed under the following distinct, yet interrelated, themes, (1) access as infrastructure, (2) adaptive socio-technical solutions, (3) common-good value, (4) contextual smartification, (5) data as catalyst, (6) demonstrated value, (7) equitable and sustainable cities, (8) stakeholder engagement, (9) transformative governance, (10) transition dynamics, and (11) value modelling and measurement as it pertains to uncovering the key Smart City components from a Cape Town perspective.

7.5 Chapter 5

This chapter reports on my findings in relation to the SCIEP conceptual model. Data crystallisation for this study was achieved by applying and mapping primary findings against the SCIEP conceptual model. This revealed the key characteristics for devising a Cape Town Smart City implementation as an engagement practice and for establishing holistic "data-driven innovation" and value within the digitally driven ecosystem known as the Smart City (Abella, Ortiz-de-Urbina-Criado and De-Pablos-Heredero, 2017.). These characteristicsare discussed under the following headings: (1) data, (2) co-production, (3) citizen participation, (4) knowledge management, (5) Smart City initiatives, (6) Smart City maturity, and (7) Smart City domains. The chapter also reports on my substantive and methodological reflections on furthering Cape Tow's Smart City trajectory, as well as the contribution of this study and recommendations for further research. I also report on the tensions and focus areas (in Section 23.12) needed for establishing Cape Town's Smart City. Figures 6, 7 and 8 summarise the research and findings. In the next chapter I report on my Systematic Literature Review process and outcome.

8 Towards a framework for evaluating Smart City implementation

8.1 Smart City Value

This chapter is comprised of a systematic literature review (SLR) of Smart City implementation as an engagement practice. The SLR process and outcome served as the main source of data for developing the Smart City Implementation as an Engagement Practice (SCIEP) conceptual framework as discussed in the following chapter. The Smart City concept promises legitimacy by addressing a number of urban challenges that occur within the broader process of metropolitan development. From a global perspective this broader process of urban development entails a re-classification of urban areas due to an expected increase in the urban population (for example, cities moving from medium to mega status). Additionally, Smart City development considers this broader process of urban development by solving urban challenges and mobilising sustainable growth in the soft and hard domains. Hard domain components and related urban challenges include "inadequate physical infrastructure" and "urban density and urban slums and informal settlements". Soft domain components and related urban challenges include "low quality, unsustainable and segregated social services", "environmental vulnerability and climate change risk" and "unemployment and informal urban economy" (Slavova and Okwechime, 2016:5; Kumar and Dahiya, 2017:16). Therefore, if Smart Cities (as applied within a broader urban context) are to support a more people-centred urbanism and enable social, environmental and economic development, emphasis should be placed on a city's human capital. In addition, ICT implementation and infrastructure are seen as important factors in their capacity to create smart communities by adapting social utilisation to increase citizens' quality of life, as well as by encouraging democratic discourse and the promotion of a more active citizenry (Hollands, 2008:315). By the same token, a more inclusive and co-created city may permit additional growth by fostering a greater understanding of interrelated participatory systems and their potential in addressing the challenges of an urban ecosystem (Guti'errez et al., 2016:4). As put forward by van Deursen and Mossberger (2018:123), "[j]ust as education has promoted democracy and economic growth, the Internet has the potential to benefit society as a whole, facilitating the membership and participation of individuals within society." It is because of this drive of technological and social integration that the Smart City emerges as a multi-layered concept characterised as an 'agent of change', where the shaping of a city occurs by dint of its people and the use of ICT in enabling an urban co-created developmental strategy with its associated mechanism of change (Schaffers, Komninos, Pallot, Aguas, Almirall, et al, 2012:57).

8.2 Smart cities in Africa

In 2013, the African Union unveiled a 50-year developmental path termed Agenda 2063: The Africa We Want aimed at transforming African cities into 'smart cities' through a policy of accelerated growth and technological development (Slavova and Okwechime, 2016:1). Agenda 2063 reflects a pan-African vision and a developmental ideology embedded in inclusive transformation of social and economic growth, a major component being the elimination of extreme poverty (Turner, Cilliers and Hughes, 2014:2). Furthermore, such transformation and development is proposed as being people-centred where African citizens are leveraged as resources towards the creation of an integrated and self-reliant continent. In addition, where empowerment and autonomy occur through collaborative and active engagement with citizenry, the latter form part of social, environmental and policy decision-making. This results in the development of public-driven services, infrastructure development and a broader urban transformative process, leveraging innovative technologies to realise a unified Africa (African Union, 2020). From an urbanisation perspective, African cities present a number of urban challenges which include: (1) inadequate physical infrastructure, which negatively impacts service delivery and availability, (2) low urban density and congestion as characterised by inadequate infrastructure investment, lack of planning and urban sprawl, (3) unemployment and informal urban economy, as well as the disproportionate relationship between the urban population and growth in the formal sector, (4) urban slums and informal settlements, intensified by the lack of physical infrastructure and the informal urban economy which is unable to afford proper housing, (5) poor-quality, unsustainable and segregated social services, the result of inadequate public service delivery due to low urban density in some areas, inadequate infrastructure and service costs, and (6) vulnerability to food security, as well as environmental and climate change risks. These issues are further compounded by a lack of awareness - or implementation - of policies regarding renewable energy, sustainable development, etc. (Slavova and Okwechime, 2016:5). However, urbanisation on the African continent is set to grow by a projected 16 percent increase by 2050 (Slavova and Okwechime, 2016:8). These authors broadly group cities into three categories, namely small and new cities (population of 0.3 - 1 mil.), medium cities (population of 1 – 5 mil.) and mega cities (population of 5 – 10+ mil.). Their classification (Table 2, p.52 assists in mapping the trajectory of African cities both from an Agenda 2063 perspective and where the Smart City concept emerges as relevant in addressing several urban challenges within a broader process of urban development. From an African perspective this entails not only a re-classification of urban areas due to an expected rise in the urban population (for example, cities moving from medium to mega status) but, additionally, needs to consider Smart City development as an agent in this broader process of urban development in order to solve urban challenges and the mobilisation of sustainable growth in the soft and hard domains. Hard domain components and related urban challenges include "inadequate physical infrastructure" and "urban density and urban slums and informal settlements". Soft domain components and

related urban challenges include ”low-quality, unsustainable and segregated social services”, “environmental vulnerability and climate change risk” and “unemployment and informal urban economy”. These hard and soft domains correlate with the following Smart City application domains as suggested by Kumar and Dahiya, namely smart people, a smart city economy, smart mobility, smart governance, smart environment and smart living, which cooperatively form a Smart City system, in order to meet these hard and soft urban problems. Table 3, p.50 illustrates the related urban domains and African urban challenges with the applicable Smart City elements that form part a Smart City system, in addressing these challenges (Slavova and Okwechime, 2016:5; Kumar and Dahiya, 2017:16).

Table 3: Smart cities and African urban challenges

Domain	Urban Challenges	Smart City Elements
Hard Domain	Inadequate physical infrastructure	Natural Resources / Smart Environment (Kumar and Dahiya, 2017:16) • Smart grids • Public lighting • Green, renewable energy • Waste management • Water management • Food and agriculture
	Urban density and congestion	Transport / Smart Mobility (Slavova and Okwechime, 2016:5) and (Kumar and Dahiya, 2017:16) • City logistics • Information mobility • People mobility
	Urban slums and informal settlements	Buildings / Smart Environment (Slavova and Okwechime, 2016:5) and (Kumar and Dahiya, 2017:16) • Facility management • Building services • Housing quality
Soft Domain	Low quality, unsustainable and segregated social services	Living / Smart Living (Slavova and Okwechime, 2016:5) and (Kumar and Dahiya, 2017:16) • Entertainment • Hospitality • Pollution control • Public safety • Healthcare • Welfare and social inclusion • Culture • Public spaces management
	Environmental vulnerability and climate change risk	Government / Smart Governance (Slavova and Okwechime, 2016:5) and (Kumar and Dahiya, 2017:16) • e-government • e-democracy • Procurement • Transparency

	Unemployment and informal urban economy	Economy and People / Smart People and Smart Economy (Slavova and Okwechime, 2016:5) and (Kumar and Dahiya, 2017:16) • Innovation and entrepreneurship • Cultural heritage management • Digital education • Human capital management

8.3 Santander: An example of Smart City and Internet of Things Implementation

Santander, on the northern coast of Spain, provides an illustrative example of extensive city-wide IoT implementation and deployment with the purpose of furthering experimental research as a means of evaluating the Smart City urban context, architecture, real urban services and applications (Guti´errez et al., 2016:2). The SmartSantander facility initiated the placement of over 12 000 IoT devices of which the scope is specified as sufficiently open and scalable to enable propagation and growth of innovative services and the application for various stakeholders or end-users (Hern´andez-Mun˜oz and Mun˜oz, 2013:1). SmartSantander projects present a broad IoT testbed environment in which to establish the associated IoT testbed requirements needed to support Internet of Services and Smart City applications. Additionally, they present large-scale IoT architectural design solutions and a platform for IoT implementation within a Smart City context alongside its component parts with the required functionalities in various urban deployment scenarios (Sanchez, Mun˜oz, Galache, Sotres, Santana, Gutierrez, Ramdhany, Gluhak, Krco, Theodoridis and Pfisterer, 2014). The SmartSantander architecture, therefore, pertains to the needed IoT testbed requirements that are involved in ensuring and supporting IoT and Smart City deployment where several stumbling blocks that prevent successful and emerging IoT research are highlighted. The focus is on the creation of a holistic and integrated environment that addresses urban real-world challenges. In addressing these architectural requirements, the SmartSantander facility considers the following key points:

- Experimentation realism: evaluating real-world IoT dissemination as it occurs, and not in a simulated environment, to accelerate market-ready IoT solutions in a Smart City urban context
- Scale: ensuring sufficient scalability in line with real-world environments and populations, with access to a multitude of sensor nodes for experimentation purposes
- Heterogeneity: supporting the multiplicity of IoT with reference to service platforms, applicability, interoperability of various sensor, network and communications technologies and modalities

Table 2: Cities classification (Slavova and Okwechime, 2016:8)

	Classification	Fraction of global city population	Population	African examples
MEGA CITIES	Mega	6.4 percent	10 m or more	Cairo (19 m); Lagos (13 m); Kinshasa (12 m)
	Large	4.2 percent	5 m to 10 m	Abidjan (5 m); Dares Salam (5.4 m); Khartoum (5.3 m); Johannesburg (9.6 m); Luanda (5.7 m); Nairobi (4.1 m)
MEDIUM CITIES	Large	11.6 percent	1 m to 5 m	Casablanca (3.5); Cape Town (3.7 m); Dakar (3.7 m); Ougadougou (2.9 m)
	Small Cities	5.1 percent	0.5 m to 1 m	Bangui (0.81 m); Benghazi (0.76 m); Liberville (0.72 m); Tamale (0.51 m)
SMALL AND NEW CITIES	Smallest Cities	3.6 percent	0.3 m to 0.5 m	Calabar (0.49 m); Windhoek (0.38 m); Zinder (0.39 m)
	Other Urban	23.2 percent	Fewer than 0.3 m	Satelite Cities e.g Eko Atlantic; Waterfall; Konza

- Mobility: leveraging the pervasive and ubiquitous nature of IoT devices, of which device interaction and exchange occurs via both mobile and fixed nodes. Furthermore, the collection of data and information through participatory citizen engagement or crowd-sensing, such as tracking people's movements via a smartphone or mobile sensors tracking public vehicles.
- End-user engagement and support: This involves the deployment of an IoT infrastructure which, at its core, acts as a means of assessing and developing IoT-based Smart City services, providing service accessibility to citizens to further assess user- adoption and the performance, and social benefit, of IoT-based Smart City services.
- Reliability: Ensuring and providing a robust infrastructure in order to ensure service provision (Sanchez et. al, 2014:219-220).

The SmartSantander facility presents both a broad IoT testbed environment, as well as a large-scale IoT architectural design solution and a platform for IoT implementation within a Smart City context. It also seeks to evaluate real-world IoT dissemination as it occurs by assessing user-adoption, performance and the social benefit of IoT-based Smart City services. This is done by leveraging IoT technologies and collecting data through participatory sensing in order to provide or develop Smart City services. The following SmartSantander-use cases stimulate such deployment with its associated scenarios (Sanchez et. al, 2014:222-224):

- Environmental monitoring: i.e., employing IoT technologies to monitor and measure large urban environments by deploying various sensors which serve as environmental indicators constantly tracking pollution levels, noise levels and similar aspects of the environment.
- Public parking management and motorist instruction: i.e., the deployment of Smart City traffic management services, using asphalt-embedded wireless sensor networks (a) to track and disseminate parking occupancy to users via a subscription-based mobile application, and (b) to provide city officials with an analysis of the city's parking services requirements.
- Accurate irrigation of public gardens and parks: i.e., the establishment of an automated irrigation system using wireless sensor networks (WSN) to monitor in real-time a host of plant variables, such as humidity, soil quality, moisture and other factors in order to ensure optimal agricultural management.
- Augmented Reality (AR): The augmented reality-use case involves tagging points of interest (POI) in the city using near-field communication tags (NFC). These POIs include tourist sites, museums, galleries, public venues, etc., providing context specific information deemed useful to users, such as making them aware of trading opportunities, site information or visitor movement. POIs may be

further exploited by using NFC technologies in conjunction with captured data or information to further transparency between citizen feedback and city services.

- Participatory sensing: i.e., leveraging mobile phone technology and its sensors, such as GPS, to aggregate environmental variables directly into the SmartSantander facility, which means that individuals may become both producers and consumers of such tracked environmental data or report certain city instances as part of a subscription service model.

The concept of a SmartSantander facility illustrates the important role that Smart City implementation and deployment can play in addressing modern urbanisation issues and possible negative impacts on citizens' overall quality of life (QoL). The use of IoT technologies shows how Smart City development may assist, and ultimately drive the transformation of the current urban landscape in order to meet the needs of an increasing urban population and facilitate an urban paradigm shift towards more inclusive and sustainable city development. In another Spanish example, Barcelona's Smart City domains, aim at encouraging (1) active citizenry, (2) access to technology, (3) wireless Internet connectivity, (4) economic and sustainable development, and (5) mobility. This includes open access data and WiFi services, smart parking, smart waste management, smart lighting, smart mobility and smart water management. As an example, it is estimated that Barcelona's smart water management system saves the city an approximate $58 million annually (Madakam and Ramachandran, 2015:8).

8.4 Methodology and Data Collection

The sourcing of relevant literature followed a collection and sorting protocol. It involved the tabulation and categorisation of articles according to their subject and topic relevance. This process of categorisation involved creating a spreadsheet and a rating system from 1-5. Articles were scrutinised for subject relevance by reading article abstracts and conclusions. Articles in categories 4-5 were categorised as having the most subject and topic relevance in relation to my research focus. Articles in category 3 were also deemed relevant for their technical and contextual relevance in relation to my research focus. Articles in categories 1-2 were scrutinised and deemed as not bearing relevance to my research focus. In total my search criteria yielded 17 500 results across the 5 categories. From the initial 17500 articles, 17 312 were removed due to its content having no relevance in relation to my research topic. This left a total number of 188 articles which were further analysed for their applicability towards understanding Smart 'cities as an engagement practice. A second filter was applied to the now 188 articles, resulting in a further reduction of 61 articles, all of which were in categories 1-2 and bearing no relevance towards understanding Smart Cities and engagement. This left a total number of 127 articles across categories 3-5. A third filter was applied to these 127 articles and resulted in

another exclusion of 43 articles because of the unavailability of fulltext articles. This resulted in 84 articles which formed the basis for my literature analysis and coding. The SLR started with a content analysis of Smart City approaches as found in literature. Secondly, it realigned the CoCT Digital City Strategy principles and concepts in accordance with the current academic debate. My review was based on the assumption that the Smart City concept is a growing and important academic concern which, as yet, lacks a sufficient number of models for understanding Smart City implementation and its approach in order to unlock public and stakeholder value. Part of my objective was to seek better ways to establish and activate collaborative practices between governance and citizens and to realise Smart City value and services by placing emphasis on a city's human capital (Mellouli et.al, 2014:1; Rodriguez-Bolivar, 2015:126; Schaffers et al, 2012:57; Gutierrez et al, 2016:4). Sources of information for the SLR came from database searches, reference searches and article abstracts, including IEEE Explore, ProQuest, ACM Digital, EbscoHost and Google Scholar. This method provided an overlap across these various academic databases and yielded a larger number of search results based on keyword entries. It also affirmed my SRL inclusion criteria for peer reviewed and most relevant and up-to-date Smart City-based literature written in English and published between 2015 and 2020. As part of the SLR content-analysis phase, and based on key word entries, an initial 127 studies were identified of which 84 documents were analysed and coded using Atlas Ti. Database search entries included the following keywords: smart communities, smart cities, Internet of Things (IoT), participatory sensing, smart environments, cyber physical systems (CPS), IoT communications and technologies. Figure 10, p.56 summarises the inclusion and exclusion results of the SLR content-analysis process which was utilised to identify and demarcate more clearly the existing and contested, or influential, themes or constructs regarding Smart City implementation as an engagement practice, specifically in relation to implementation frameworks and their mechanisms. An additional 45 studies identified via reference searches, and not coded in Atlas Ti to avoid coding redundancies, further supplemented the SLR. The reviewed documents evaluate the Smart City concept as a viable and worthy instrument for achieving city objectives, as well as for calling for better understanding around Smart City implementation and its vision of supporting governance and citizens. In essence, it highlighted the need for better collaboration between governance and citizenry within a Smart City context. The collected data from the shortlisted 84 documents were imported, qualitatively analysed and coded in Atlas Ti by reading and re-reading text, using a combination of both predetermined codes and the development of new code lists. This resulted in a preliminary code book containing 467 codes, broadly defining the much-contested areas in this field of study. These initial 467 codes were subsequently re-read, analysed and developed into 76 code groups each with its own sub-groups (Figures 11 and 12, pp 57 and 58). This provided a clear representation of the terms used as part of the Smart City academic debate and its leading authors. The identified codes, groups and subgroups formed the basis and rationale of my systematic literature review. Figure 13 (p. 59): Key constructs in literature towards understanding Smart City implementation as an engagement show the main themes

#Reviewed databases and search engines (prior shortlisting process): EEE Explore, ProQuest, ACM Digital, EbscoHost and Google Scholar **Keywords**: Smart communities, Smart Cities, Internet of Things (IoT), participatory sensing, smart environments, cyber physical systems (CPS), IoT communications technologies **Period**: 2015-2020	Total # of articles: **17 500**
# of records excluded based on keywords search results	**17 312**
# of records assessed for eligibility according to shortlisting criteria 1-5	**188**
# Studies excluded as part of SLR (as represented by shortlist criteria 1-2)	**61**
# of screened records as part of SLR according to shortlisting criteria 3-5	**127**
Additional records through references *(supplemented SLR *not coded in Atlas Ti)*	**45**
# of studies included, analysed and coded as part of SLR using Atlas Ti	**84**
# of full text documents included in SLR	**84**
# Studies excluded as part of SLR (no full text availability)	**43**

Figure 7: Inclusion and exclusion (Author's construct, 2020)

found in academic literature. These themes were further developed and interpreted alongside the current CoCT Digital City Strategy objectives as illustrated in Figure 20 (p. 106). This provided a means of conceptually comparing the current CoCT Digital City Strategy with the existing academic debate, as well as clearly illustrating where current literature breaks down, both of which informed the formulation of my research questions.

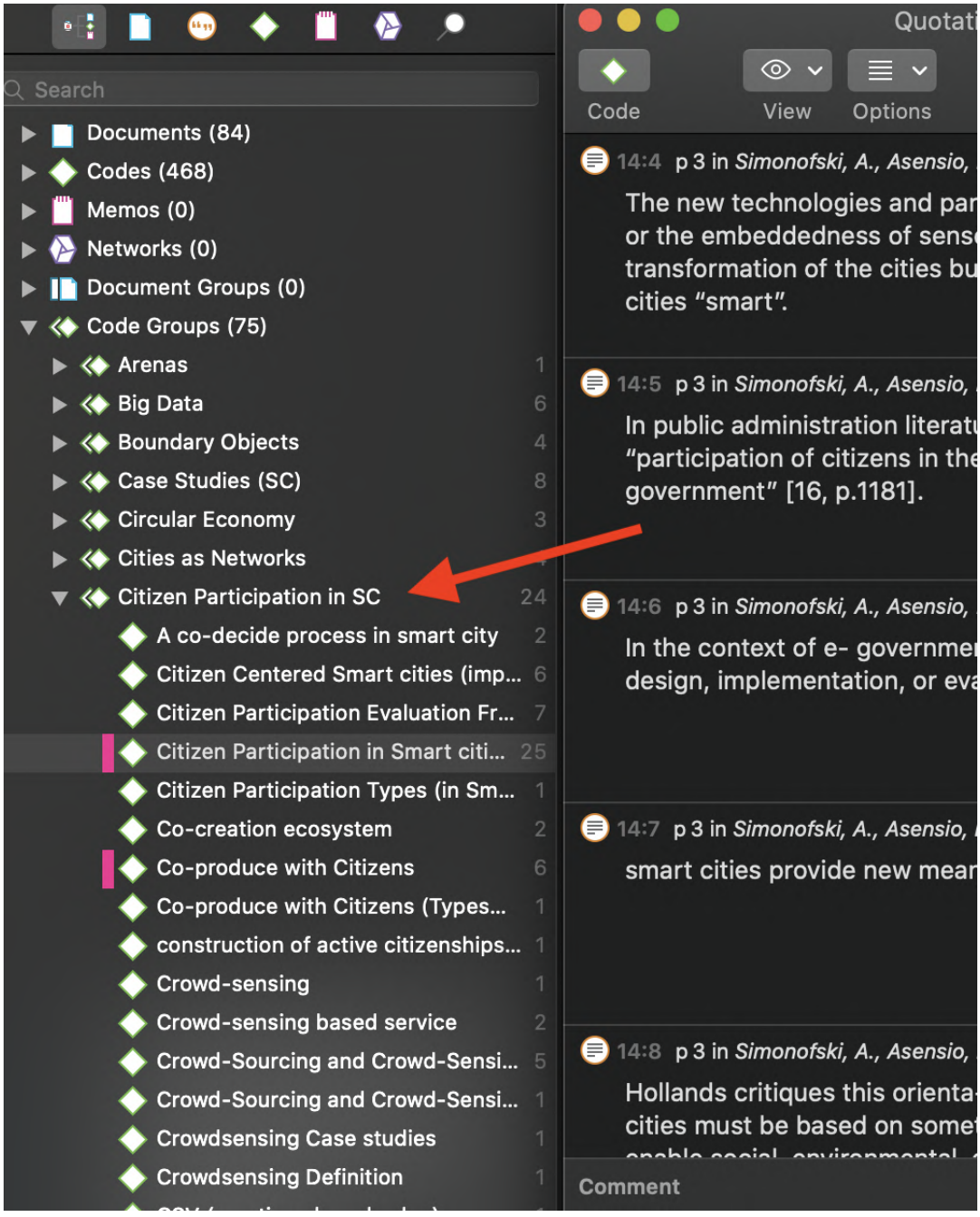

Figure 8: SLR content code group (Author's construct, 2020)

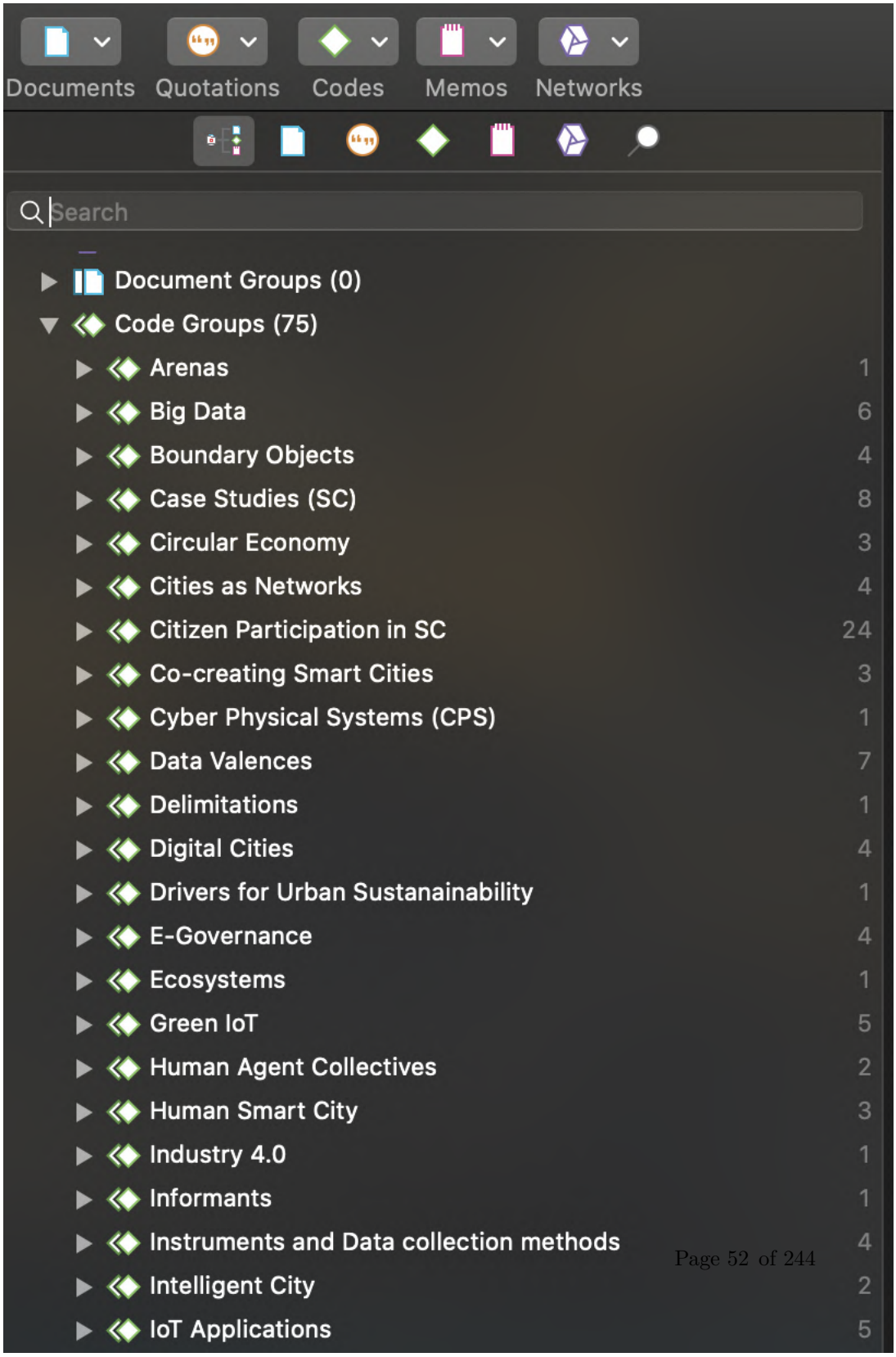

Figure 9: SLR content code group (Author's construct, 2020)

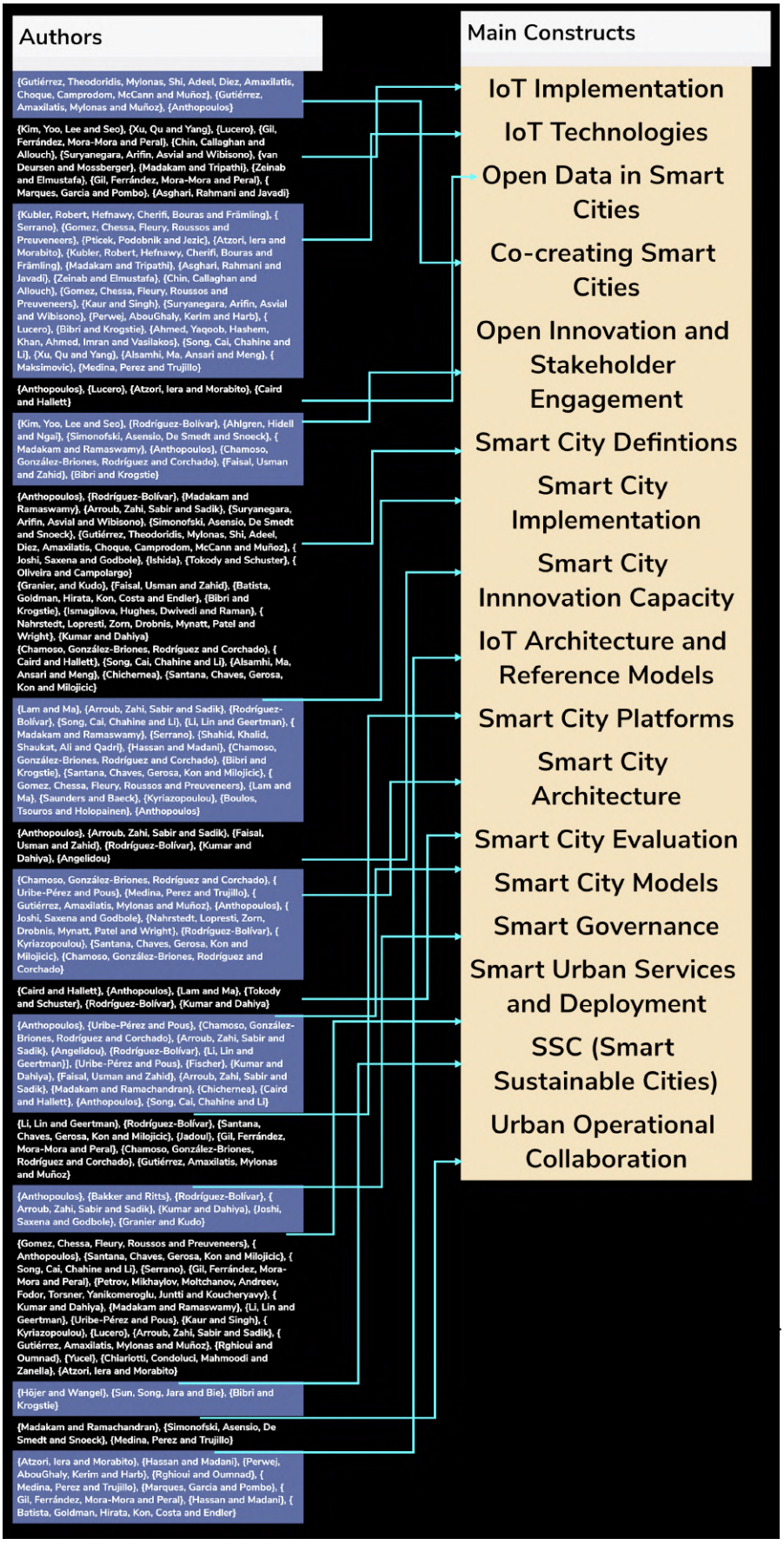

Figure 10: Key constructs in literature towards understanding Smart Cities implementation as an engagement (Author construct, 2020)

9 Literature regarding citizen engagement in Smart Cities

9.1 Citizen Participation as Engagement

A common criticism regarding the concept of a Smart City and its forms of implementation often relates to its overly technocratic focus. There is often a lack of focus on how participation is garnered and the degree of citizen participation in relation to planning and deployment of smart initiatives. Additionally, the notion of 'citizen-centricity', as rooted in the establishment of smart initiatives, often amounts to, as Cardullo and Kitchin point out, "civic paternalism" where consumption as a market-driven objective takes precedence over civil and collective rights (Cardullo and Kitchin, 2019:1). The inclusion of public participation in urban planning and design supports the ideal of good urban governance. Secondly, it provides alternative and better forms of urban governance by allowing citizenry and other stakeholders (private and public) to collaboratively be part of the design and planning of urban spaces. Thirdly, it supports the idea of sustainable urban development by attempting to acknowledge the social aspects of urban renewal and its associated stakeholders (Joss, 2014:35). As such, there is a need for cities and stakeholders to find new ways of improving citizen participation, where participation and levels of engagement prioritise the degrees of inclusion, degrees of participation and the degree of citizen empowerment. This is important and relates to rethinking the notion of smart citizenry, one that shifts citizenship from a passive consumer-oriented perspective to an active citizenry which is both a consumer and producer of smart initiatives (Cardullo and Kitchin, 2019:1). Moreover, as Cardullo and Kitchin point out, the notion of engagement within these market-driven solutions often adopts a strategy of citizen engagement that is top- down and thus does not include any real participation from the citizenry. Instead, such participation amounts to "algorithmic governance" that further promotes "neoliberal logics of urban management" (Datta, 2015; Cardullo and Kitchin, 2019:2). This means that Smart City solutions are often market-driven and do not include or consider the context of citizenry (Shelton, Zook and Wiig, (2015). The measurement of citizen engagement also requires a means of analysing the extent to which smart initiatives reinforce or mitigate forms of neoliberal urban governance and the criticism of Smart Cities' technocratic nature (Cardullo and Kitchin, 2019:2). Authors have argued that examples of companies' endeavour to be more citizen-centric often do not translate into better governmentality as their efforts still perpetuate market-driven solutions. Therefore, what is not considered in these attempts is the "model of citizenship" in terms of technology usage or the role of citizenry in the Smart City and its objectives (Hill, 2013; Kitchin, 2015; Sartori, 2015; Cardullo and Kitchin, 2019). On the role of citizen participation, Arnstein's seminal work, Ladder of Citizen Participation, provides a scaffolded approach to activating citizen participation which reflects on the issues of the role of citizenry, their level of involvement and political context. In

Arnstein's conceptual ladder eight steps are provided that correspond to "the extent of citizens' power in determining the end product" (Arnstein, 1969:217). On the bottom rung of the ladder she positions "non-participation" where citizens are perceived as passive and needing to be informed and manipulated. The second rung defines "tokenism": perceiving citizen participation as bearing a limited degree of autonomy. Here citizens are "informed", "consulted" and "placated" but play a limited role in directing the progress. The top rung of Arnstein ladder, "Citizen Power", allocates participation to citizens as a partnership in which they have "citizen control", "delegated power" and "partnership" in the launching or management of initiatives. Arnstein's ladder of participation focuses on the uncoupling of power where citizen participation takes on a significant role in directing social reform. Distributed power in the form of greater civil autonomy, delegated power and participation (partnerships) is, therefore, viewed as necessary and results in complimentary dichotomies that can work together in order to create an equitable reflection on society (Arnstein, 1967:217; Cardullo and Kitchin, 2019:4;). The model, however, does bear criticism. In order to provide a more 'improved' model, authors Cardullo and Kitchin (2019:5) offer a reframing of Arnstein ladder so that the "type, role, function, political discourse, and modality of citizen participation" is considered. Cardullo and Kitchin continue their deliberation on 'scaffolding' and suggest that, apart from the modalities of participation, careful consideration ought to be given to the levels of participation within a Smart City - especially as it relates to the context of the city and its people. Building on Arnstein's ladder of citizen participation, the authors provide four levels of citizen participation. These are (1) non-participation, (2) consumerism, (3) tokenism, and (4) citizen power.

9.2 Non-participation

Non-participation typically centres on the deployment of initiatives or services that require little to no citizen input, their purpose being driven by a need to either increase efficiencies or direct certain behaviour-change initiatives. These relate to "algorithmically-mediated service(s)", such as directing the flow of traffic or using automated and adaptive traffic control systems. In such an instance, citizenry become data producers (or generated data points) that are mediated towards an end-goal. Such forms of participation are often very techno-focused with little or no consultation with citizens in directing or influencing such initiatives (Cardullo and Kitchin, 2019:6).

9.3 Consumerism

Consumerism, as a form of citizen participation in a Smart City space, highlights the need for governments and stakeholders to perceive citizens as prosumers, being both consumers and producers of data and services. In a digitally driven age, this involves

the accumulation of data and data points that are harnessed through various mobile and computer applications to derive or provide services to users. This includes service types that leverage IoT and other digital technologies which often restrict citizens' involvement and perceive them usually only as users of the service. This type of participation tends to be techno-focused as well, typically leveraging broad IoT implementation to improve product lifecycles, commercial enterprises, generation of new markets and profitable enterprises, attracting investments and stimulating innovation in various sectors. Uber, for example, revolutionised the taxi service industry by using a technology platform to connect users with driver-partners. Launched in 2012 and operational in more than 700 cities, Uber is an example of a taxi service combined with smartphone technology and crowd-sensing to create an on-demand, safer and more convenient personal transportation service.

9.4 Tokenism

Tokenism covers the level of citizen engagement towards understanding and informing the needs of citizenry. It involves establishing ways of informing citizens around issues of open data access, usage and how cities function. It, therefore, hints at the redistribution of power and the sharing and exchange of data in order to influence and direct decision-making, as well as increasing transparency and government liability. Crowd-sourcing initiatives are an example of this. It, therefore, calls for consultation and placation which invites citizens to provide feedback and present suggestions on smart initiatives (Cardullo and Kitchin, 2019:8). However, Arnstein (1969:217) notes that, in relation to tokenism, "there is no follow through, no 'muscle', hence no assurance of changing the status quo". What should also be considered with regard to tokenism is that these initiatives, being technologically driven, often rely on the technologically savvy and thus run the risk of excluding a certain sector of the citizenry. Cadullo and Kitchin also warn against the risk that such smart technologies and the use of crowd-sourcing technologies "might deepen structural barriers to socio-political participation related to education, class, gender, age and ethnicity" (Cardullo and Kitchin, 2019:8).

9.5 Citizen Power

Citizen power calls for citizen participation that enjoys increased decision-making opportunities and autonomy in directing initiatives. Cardullo and Kitchin's scaffold includes the notion of "partnerships" which involves the sharing of responsibility in the planning and driving of projects, and in which citizens possess "delegated power" by having a majority-say and a shared power position in initiatives. It also calls for "citizen control" where citizens are active members of and contributors to the managerial and policy aspects of projects and organisations. The idea of co-creation can play a significant role in establishing collective "citizen control" in this regard as

it actively leverages citizenry as a central driver of such a services (Cardullo and Kitchin, 2019:9). Cardullo and Kitchin's "scaffold of smart citizen participation" provides several ways of framing participation in a Smart City context. Their model highlights who needs to be considered, and to what degree or form should participation occur towards ensuring citizen-centricity. Their model also advocates a type of citizen-centrality which moves away from a technologically driven Smart City that potentially reinforces neoliberal urbanisation, devoid of the wishes and needs of its citizenry.

9.6 Object-orientated sociality and Citizen Participation

Other drivers of citizen participation centre around the use of digital social tools that enable public engagement, where these digital communication objects are employed for their capacity to facilitate social conduct. As such, these tools often serve a mediating role. For example, in the application and deployment of IoT these objects and their connective affordances are aimed at transforming their "object-centred sociality" into community or human value (Niederer and Priester, 2016:137). This notion of object-centred sociality highlights the use and mobilisation of shared social norms towards engendering public or community engagement. These digital tools and their capacity to function as shared social objects could, therefore, aid in both identifying networks and their organisational conditions, as well as the "socio-material conditions" of communities or neighbourhoods (Niederer and Priester, 2016:137). This is useful in that it perceives "city-making" as driven by a "participatory society" that both understands and is able to apply the tools of participation. In reflecting on how citizens and objects are to be positioned in such a participatory society, the authors Niederer and Priester (2016) provide a definition with regard to the meaning of such participation: In essence the "object-centred sociality" of objects, devices and their environments focus on the degree to which these objects able to deliver or provide "instances of participation" (2016:139). Niederer and Priester (2016:139) provide a number of observations regarding the types of objects that are conducive to generating "instances of participation" towards improving community collaboration, process optimisation and information flow. They note social media and community websites as powerful tools, able to index and observe communities and their development over time, as well as how these websites and social media platforms serve "participatory objects" and become part of a "bottom-up initiative", i.e initiated by citizens (Niederer and Priester, 2016:139). In reviewing 40 websites as "participatory objects" in Amsterdam, Niederer and Priester (2016) list three categories of bottom-up initiatives in which websites are used to create participation. These categories are (1) community websites with a local focus on issues of citizens', (2) community websites that have a local focus but which centre their attention on their neighbourhood and (3) websites that are not linked to any specific neighbourhood but share common interests and potential for collaborations. The authors also point out that amongst these categories of

engagement the most prominent types of participation are (1) helping and asking for help, (2) informing, and (3) connecting neighbours. Additionally, target audiences of these types of participation include, "neighbours, neighbourhood initiatives, members, governments, entrepreneurs, civilians and social organisations" (Niederer and Priester, 2016:151).

9.7 Citizen Participation and Relational Context

Participation and engagement in a Smart City should be understood through what Guma and Monstadt term "relation context", namely the idea that, in understanding a city, one must acknowledge the embedded context of said city in relation to its people, realities (as shaped by citizenry), and its artefacts. Importantly, this observation highlights the need for perceiving digital technologies as enabling in as much as their application and deployment considers the situated context in which they operate or attempt to develop (Guma and Monstadt, 2021:362). The concept of 'relation context' refers to Smart City development through the contextual shaping and remodelling of digital technologies according to urban topographies. It perceives the role of digital technologies as being responsive to a shifting and ever-changing landscape, in which the roles of these ubiquitous, smart technologies function differently across city context. According to Guma and Monstadt (2021:365), the focus of such participation involves uncovering the "social embeddedness, relationality and urban co-construction" as tied to the digital integration of smart and digital technologies towards making cities, their people and infrastructure more efficient. The authors' approach also acknowledges the fragmented nature of city-making, i.e where city planning is not scientific but where ordinary realities need to be considered, together with technological positioning of city development. Participation, therefore, centres around the interchange and context of people, urban spaces and digital technologies. The authors, taking Nairobi as an example, provide a number of modalities that illustrate the use of ICT-driven initiatives within a relation context. In their analysis of Nairobi's digital infrastructures, they provide the following examples: (1) mobile money transfer, (2) mobile app payments, (3) digital metering projects, (4) mobile- based apps, (5) tech hubs, and (6) global technology. Mobile money transfers are an example in which the use of smart technologies is applied to solve context-specific problems. M-pesa, for example, allows citizens to send and receive money via a mobile phone. The use of targeted payment or mobile app payments is another example, such as eJijiPay which is an application that facilitates payment collection across a number of bills or payments. It leverages local mobile usage and coverage to establish context appropriate services and solutions. As noted by Guma and Monstadt, "eJijiPay has facilitated the collection of over KES 28 billion in revenue through the platform" (2021:376). The use of digital metering systems is another example which also relies on the use of mobile technologies in order to deliver services to citizens. Other forms of participation include the use of tech hubs towards facilitating collaborative

innovation and entrepreneurship. Moreover, these hubs also support technological incubation and software development through the lens of collaboration with a local innovation focus. Partnering with global corporations is another example of informing local practices from a global perspective by sharing ideas and knowledge around topics of smartness and best practices.

9.8 Citizen participation and public Equity

The inclusion of active citizen participation in a Smart City contributes to the development of equitable urban transformation as this leads to the uncovering of associated socio-ecological, economic and technical requirements of urban transformation and its people. As a concept, this type of Smart City has to establish and support sustainable models of urban growth whilst contending with the inherent and complex economic and power relations within a city. In essence the paradigm of the Smart City socially mediates city infrastructure, ICT and digital technologies, citizenry and the structure of political and economic urbanisation. This, according to March and Ribera-Fumaz, can generate contradictions with the Smart City paradigm itself in that smart solutions can become sanitised and market-driven under the guise of 'services', and resultant technologies may be sustainable in terms of generating private equity and not necessarily public equity (March and Ribera-Fumaz, 2016:824). Participation, therefore, in a Smart City must take care not to validate urban and sustainable advance as utility in support of capitalist and private equity. It is important to avoid "Smart Cities become[ing] an empty hollow signifier. . . built in the image of capital and of the political elites" (March and Ribera-Fumaz, 2016:826). Moreover, participation should address basic services geared towards improving the quality of life of citizens. These services should not be duplicated across all sectors of a city but shaped and deployed according to and in response to different communities and contexts, whilst remaining socially equitable (March and Ribera-Fumaz, 2016:826). This links with the need to develop a smart citizenship that performs beyond the space of digital and technological integration or territory and includes a state-orchestrated strategy to transform how citizens interact with smart initiatives. In this regard, Datta calls for the emergence of the "chatur citizen", which she labels as "a new postcolonial smart citizen who speaks both from within and beyond the structures of digital governance and smart-mentality." Datta's "chatur citizen", therefore, operates within a dual space, remaining embedded within his or her social, historical and economic context. Such duality serves as agency in that, in its subversive form, it acknowledges the power structures of governance whilst through self-governance and active citizenry seeks to improve and replicate structures of governance (Datta, 2018:416). Datta elaborates by stating that "the emergence of a vernacular smart citizen shows that citizenship and subject-hood are not binary categories, rather they are entangled and complicated through the digital turn in postcolonial urbanism" (Datta, 2018:417). This dual nature of citizenship within the construction of the Smart City also brings about, as Willis points out,

additional considerations with regard to who participates and to whose benefit. However, while calling for smart urbanism which celebrates a people-centred agency she also cautions against the potential of Smart Cities and their initiatives of reinforcing "patterns of exclusion" and marginalising communities through efforts of (1)"optimisation, automation and privatisation of urban services", and (2) the "expulsion [of] those operating in the informal urban economy" (Willis, 2019:4-). Citizen participation, therefore, in this regard extends to political participation and the right to accessing and influencing the delivery of civil liberties (Willis, 2019:5). Furthermore, the concept of citizen participation must involve a reframing of the "urban informality" as a "mode of production" in order to activate the idea of smartness towards public equity (Willis, 2019:13; Cardullo and Kitchin, 2019). Additionally, in reflecting on the Smart City as a data-driven and technocratic governance approach, using citizen and public data in order to track, monitor and inform processes and improve urban governance, authors Shelton, Zook and Wiig caution against the application of data as a "depoliticising device obscuring how data are conceived, collected and legitimised for use in urban politics and policymaking"(2015:22). Using '"Digital On-Ramps" as an example (a Smart City initiative challenge driven by IBM in 2011), they point out that digital inclusion initiatives, which sought to promote, train and empower marginalised communities for a 21st century digital landscape failed because its focus was solely on digital literacy and did not factor in the "socio-spatial inequalities" (2015:21).

9.9 Citizen participation and Data

As Wilson (2011:857) notes, the role of data in modern societies has come to represent the means by which to understand the sum of its urban landscape. As a tool, data serve to organise society by digital means, such as tracking the interplay between society and technology by managing resources, increasing automation, surveillance and the application of data towards economic competitiveness. In this sense, data promise to serve as a means of capturing the urban fabric in terms of formal and informal knowledge processes that can be applied by cities and their public. This requires the activation and application of data as a tool for citizen participation (Wilson, 2011:858), and thus he calls for consideration of what is termed "mattering" – the notion of perceiving data as descending from (social) practices where these practices are inventive, generative and varied in terms of their urban-political structure. In this sense data also serve to legitimise citizens' lived experience by means of geocoding and technological interpretation of space and place (Wilson, 2011). Activating participation in this regard requires the mapping of multiple interactions in the urban space, where these objects of interaction are "enrolled in the creation of urban space", focusing on the interconnectedness of objects (Wilson, 2011:859). As a form of urban governance through data use entails perceiving citizens as tracked data within a connected city system or the "transduction of space". The transduction of space through data entails the tracking

of "processes. . . at the intersection of diverse realities", requiring an integration of practices, people, objects, places, etc. (Wilson, 2011:862). Data use as a form of citizen-participation should focus on the objectification of citizens' lived experiences as "participatory mapping processes" that are indexed and legitimised via data coding to facilitate urban visioning (MacKenzie, 2022:18). However, this should not be done at the risk of under-representing embedded community context and interests. As Wilson (2011:868) states, "[i]t is the materialisation and the significance of data that animates. . . urban practices for those who are close to the experience." Concerning the use of data, authors Caprotti, Cowley, Datta, Cast'an Broto, Gao, Georgeson, Herrick, Odendaal and Joss (2017) voice important considerations, such as the need to disaggregate data. This relates to the mobilisation of data and their potential value as they provide insight, elucidating the context and needs of citizens. In addition to this it requires the use of more contextually relevant measurement approaches that integrate citizen-generated data and transactional data to provide accurate data applicable in a useful manner. Disaggregating data also helps to uncover the causality of data exchange and usage in relation to their generation and application, which ideally should contribute to the creation of "smart citizen[s]" as "active agents of urban transformation" (Caprotti et al., 2017:372-5). As Vanolo notes, "there are a number of ways of becoming smart citizens", stressing the importance of finding meaningful ways of imagining a symbiotic relationship between citizens and urban technologies that would empower the former (Vanolo, 2016:35).

9.10 Participation and Sustainability

The idea of sustainable urban development importantly focuses on the activation of meaningful public and citizen engagement centred around addressing public interest. Participation towards sustainability, therefore, includes the reconciliation of contextual nuances of place and space across the urban domains of economics, social factors and environment. It requires a type of urban governance that draws on multiple perspectives and levels of expertise to ascertain what is required, develop and implement solutions and track progress. From a theoretical perspective, as well as from a governance standpoint, participation can be categorised as relating to design, policy and public consultation: participation connected to design/policy typically integrates formal urban processes, whereas participation linked to the public discourse is typically informal and unspecified (Joss, 2014:40). From a practical standpoint, Joss (2014:40-50) provides the following examples of how participatory governance may function as part of sustainable urban design: (1) collaborative design, (2) participatory decision-making, (3) public discourse, (4) participatory design challenges, (5) methodological design, (6) policy integration, and (7) public resonance.

9.10.1 Collaborative Design

Collaborative design, as a form of participation, usually involves the participation of experts and professionals, this engagement being driven by professionals who wish to include stakeholder consultation, and where stakeholders may include the public, businesses and communities, etc. Participation in this sense involves ascertaining stakeholder attitudes and desires in order to provide a platform for discussing urban issues, as well as facilitating engagement between communities and professionals. Participation, therefore, serves as a collaborative process that needs to be dynamic and adaptive in order to capture the contextual nuances of the urban environment (Joss, 2014:42)

9.10.2 Participatory Decision-Making

Participatory decision-making functions as a form of public engagement to obtain input via consultation with citizens concerning policy and implementation procedures. It, therefore, includes making information available in order to allow feedback from the public. Such consultation and co-developmental processes can occur in the early stages of policy development - or at a later stage - in order to support transparency in decision-making and facilitate the formulation of better policies, informed by public viewpoint. Criticisms with regard to this approach revolve around a usually limited number of consultations with the public, and thus a more superficial engagement with public opinion, making it not necessarily representative of the actual urban landscape (Joss, 2014:42).

9.10.3 Public Discourse

Public discourse functions as citizen participation in order to "stimulate, inform and support public debate about urban sustainability" (Joss, 2014:43). It, therefore, positions sustainable urban development as a social and public matter that concerns all city stakeholders and in which particular emphasis is placed on garnering public opinion and participation in order to drive projects. Forms of participation in this regard may be less formal and involve events, such as public lectures, exhibitions, campaigns, festivals and other occasions that increase public engagement (Joss, 2014:44).

9.10.4 Participatory Design Challenges

The use of participatory design challenges to generate public engagement must be met with careful consideration around context and the arrangement of participation related

to public opinion, policy and planning. These participatory design challenges are often time-sensitive in terms of public deliberation, with public opinion seldom having an effect on the design or implementation of projects. This, as Joss points out, "creates potential power asymmetries and the risk of skewed processes" (Joss, 2014:46). To guard against such inequitable power dynamics, the following methods are provided as considerations for such participatory processes (Joss, 2014:46-47):

- Selection of participants: This should include stakeholders who are directly affected by the issue discussed. Selection of stakeholders should be randomised and representative of the urban socio-demographic (Joss, 2014:46).
- Use of expertise: Different experts and their input should be included and used as part of the process of deliberation (Joss, 2014:46).
- Choice of issue: The distillation of potential issues for discussion is important so as to allow for broad public participation and choice towards prioritising planning, policy and discourse (Joss, 2014:47).
- Nature of deliberation: The intention and reason for the deliberation and its context should be made clear, i.e whether such participation aids in gaining public consensus or negotiating urban governance processes (Joss, 2014:47).
- Process of facilitation: The process of facilitation should enable participants "to exercise their role without, . . . being unduly steered into the process of deliberation." Here the purpose of the facilitator is to adopt the role of representing participating individuals and not of the promoter or co-ordinator (Joss, 2014:47).
- Form of output: This highlights the need to include recommendations, and a process of validation by participants, as part of the outcome of a participatory procedure aimed at informing policy and planning (Joss, 2014:47).
- Agreement on ground rules: This highlights the need to specify clear participatory procedure guidelines from the start in order to agree on objectives, promote fairness and facilitate joint decision-making amongst co-ordinators and participants (Joss, 2014:47).

9.11 Policy integration

Participatory processes should also ensure relevance in terms of actual policy-making, planning and how the outcomes of public deliberations inform decision-making and outputs. It requires the integration of policy and planning and the context in which they operate. Furthermore, such integration demands a balancing act policy and planning in that "the point of intervention. . . needs to be considered carefully" (Joss, 2014:48). Such a point of intervention can thus occur as either "upstream", i.e. at

the start of discussions with multiple stakeholders to highlight problem areas, or as "downstream", i.e. when participation occurs in a focused manner in order to solidify public support and establish a process of policy implementation (Joss, 2014:48).

9.12 Public resonance

Paramount to procedures of structured citizen participation as a way to inform governance processes is the need to make such procedures of deliberation "resonate" with wider socio-cultural and political contexts in order to capture actual political discourse as it occurs through consultation, bargaining, lobbying and public disagreement. What is highlighted with the idea of "resonance" is the need to consider "structured participation" as separate from wider public engagement which, although very useful in gaining public opinion, may not account for political interest (Joss, 2014:49).

9.13 The Periphèria project (Human orientated Smart City approach)

In 2010, the European Union launched The Peripheria project. As an innovation project amongst 5 European Smart Cities across 5 arenas, it entailed using the IoT network and sensor technologies to adopt a citizen-centric and co-created approach as a means of driving service discovery and the production of smart urban services. The result would be the constitution of an innovation network that would be both based on and responsive to citizens' needs. According to Paskaleva, Cooper, Linde, Peterson and Gotz (2015:130), "...from an urban ecosystem perspective, a city street, square, park, or a neighbourhood can be labelled as an 'Arena', seen through its past, presence and future, and as a mixture of urban fabric, local communities, events and activities." Outcomes of the project assert the importance of stakeholder engagement and suggest that effective co-production initiatives should include Communities of Place, Communities of Interest and Communities of Practice. Additional outcomes of the project posit that an understanding of when and with which stakeholders to engage is crucial for effective co-production initiatives. As such, co-production within an urban arena is seen as a constructed locality born out of many Smart City components in order to initiate innovative co-produced urban services. Smart City components, as occurring within these arenas, refer to:

- "Smart Neighbourhood: where media-based social interaction occurs."
- "Smart Street: where new transportation behaviours develop."
- "Smart Square: where civic decisions are taken."

- ”Smart Museum and Park: where natural and cultural heritage feed learning.”
- ”Smart City Hall: where mobile e-government services are delivered.”(Paskaleva, Cooper, Linde, Peterson and Gotz, 2011:131).

A constructed locality may further involve numerous shared methods of engagement as a means to co-ordinate and translate between various communities. These boundary objects - and the associated and linked societal, informational, relational needs and expectations of a constructed social meaning of objects across groups or communities - make the co-creation process more inclusive of all stakeholders (Rodr´ıguez-Bol´ıvar, 2015:131; Fiore-Gartland and Neff, 2015:1470). Also to be considered is the notion of ‘boundary spanners’, or the peripheral interconnections and interchange between groups, people or communities, which implies the creation of an innovative space in an attempt to uncover the complex interconnectedness of all stakeholders. This is termed the ‘structural hole’ argument and suggests the flow of knowledge and information between groups as social capital which leads to a variety of subsequent innovations (Burt, 2001:298; Rodr´ıguez- Bol´ıvar, 2015:131).

9.14 The Organicity project (Collaborative and Experimentation as a Service approach)

According to Arroub, Zahi, Sabir and Sadik (2016:2), a city can be defined as a “System of Systems”. From a co-created ecosystem perspective, this definition requires cities to develop unique strategic visions that permit the identification, initiation and application of Smart City technologies pertaining to urban service management and the complex interdependencies among stakeholders amid diverse contexts (Arroub et al., 2016:2). In this regard, the co-created concept within a Smart City is viewed as a strategic point of contact between various city actors and data sources that are utilised in order to exploit and shape smart services collaboratively. The need for a more inclusive citizen participation approach in contemporary urban creation is pivotal, principally if we consider citizens as prosumers within the digital urban environment, and must focus on the potential of participatory systems to understand required city and stakeholder needs. The Organicity project is an example of such a co-created digital platform where the co-creation process is viewed as a way to utilise available local and community members who understand the relevant socio-economic problem, thus providing effective answers or insights (Guti´errez et al., 2016:4). Organicity, which is an Experimentation as a Service (EaaS) framework, is based on a 3-tier architecture consisting of (1) combined data sources (OC City Sites), (2) a platform layer (Organicity Platform), and (3) an experimentation layer (Eaas API). These represent an ecosystem that supports and substantiates co-created smart services. The Organicity platform layer consists of and combines assets for experimentation across other OC sites which, when combined with an asset-discovery API (application

programming interface) component, allows users to discover and explore potential services, informed by embedded and crowdsourced urban IoT device data. In addition, by using an Experimentation Management framework, new services or tools-identification apps can be run as monitored experiments, in conjunction with a community management service, to validate services and incentives thereby mobilising citizen participation. The Organicity experimentation layer includes all services and implementation components necessary for promoting service deployment through experimentation, by providing user-interfaces that support such co-creation of services and experimentation in addition to the discovery of additional assets and allied metadata. The EaaS framework encourages users to experiment with and deploy their own customised urban services which could be a web-portal, smartphone application, etc. (Guti´errez, et al., 2016:7).

9.15 The process of Co-production

The process of co-production involves the creation of public value for local communities by activating citizens as prosumers within the digital urban environment, with citizen involvement paramount in defining such co-production and value formation processes (Anthopoulos, 2017:285). Harnessing the transformational impact of co-production processes within an urban landscape (involving the redistribution of power relations between governance and citizens) requires a redefinition of the roles of such co-production processes when considering citizens as information suppliers. From a governance perspective, modes of co-production should be ”oriented outwards, interested in disseminating new ideas and translating them for wider understanding, while prepared to absorb new ideas from other networks” (Healey, 2004:16). What is needed is to enable the strategic capacity of co-production as a way of unlocking the dynamic interchange between citizens and government towards engendering creativity that supports innovation. Castelnovo ascribes such a redefinition of the co-production process to the associated role of service planning and deployment responsibility which is either (1) driven by civil servants, (2) or a combination of citizens and civil servants, or (3) is driven by citizens/communities. Here, Configurations 1 and 3 represent traditional, non-co-produced services, Paths 1 to 5 represent full co-production, and Path 9 represents a redefinition of service design and deployment, with citizens controlling such design and government taking on the role of co-ordinator of such service delivery (Castelnovo, 2015:4; Anthopoulos, 2017:285). In addition, Linders (2012:447) provides the variables that define the range of co-production. Linders also provides the ICT-aided co-production types ranging from ”citizen to government” and ”government to citizen” to ”citizen to citizen” as they relate to areas of (1) service design, (2) service delivery and execution, and (3) service monitoring.

10 Evaluating citizen participation

The adoption of a co-created Smart City engagement process is an emerging opportunity for cities to grow by using a participatory system as a way of unlocking community potential and perceive the associated challenges of an urban ecosystem (Gutierrez, et al., 2016:4). However, in addition to the above mentioned co-production types, variables and processes for optimally unlocking such potential, authors Simonofski, Asensio, De Smedt and Snoeck offer a "citizen participation evaluation framework" to compare and assess Smart Cities strategies and enable citizen participation. The model which also serves as a governance instrument where the evaluation criteria may be adopted as set implementation guidelines or as part of a community centred Smart City strategy. The following section provides a brief outline of the evaluation framework (Simonofski et al., 2017:3). The development of their framework was specifically guided by the notion of Smart City design being influenced and directed by citizens and end-users. The framework calls for activating the transformational impact of broader citizenry through democratic co-creating processes. These processes would establish smart services by proactively leveraging ICT and city infrastructure. The framework also serves as an evaluative tool to determine the degree of citizen participation in Smart Cities as assessed according to the following perspectives: (1) citizens as democratic participants, (2) citizens as co-creators, and (3) citizens as ICT users. As a citizen-driven and focused approach their framework bears practical and theoretical relevance in many contexts, including the global South and South Africa (Simonofski et al., 2017).

10.1 Citizens as Democratic Participants

It is argued that, by perceiving urban dwellers as active, democratic Smart City participants, they are provided with a means of influencing decision-making processes and directing strategic policy. This has numerous benefits, such as initiatives bearing better public relevance, improved understanding of citizen needs through social input, and enhanced use of resources through awareness of the local social context (Simonofski et al., 2017:229).

Citizen selection A considered selection process is required to ensure that participants are adequately representative of a population or community. This is shown in Simonofski et.als' model under Criterion 1 "Representative group of citizens"(Simonofski et al., 2017:229). This mitigates an over-representation of a particular population sector. The second criterion, "Support for group process", safeguards against undemocratic participation by either incentivising individuals for their participation or narrowing the ICT digital divide to ensure citizens have access to such participatory processes. Criterion 3,"Competent and unbiased group facilitators", makes sure that all participatory tasks are dealt with in an objective and unbiased manner, facilitated by skilled and socially or contextually embedded

coordinators (Simonofski et al., 2017:230).

Agreement on the goals of the smart city strategy The evaluation of democratic Smart City citizen participation also requires involved citizens to recognise and agree to pre-determined participatory goals or initiatives. To this end, "Evidence that citizens helped define goals and objectives" (Simonofski et al., 2017:230) examines the degree of citizen engagement and contribution towards defining these goals. The section "Citizen-oriented goals and objectives" conversely investigates whether these Smart City goals are citizen-centric, so that participatory goals and objectives are democratically constructed and refined (Simonofski et al., 2017:230).

Correlation between participation activities and achievement of goals To ensure instrumental participation, where collective community participation and knowledge are used to achieve a defined end-goal, requires that the participatory approach is transparent and validated so that all participating actors or stakeholders understand the attached decision-making process; hence the criterion "Formalization and transparency of the course of action"(Simonofski et al., 2017:231). Next is the criterion of "Evidence of interaction between citizens and other actors" which ascertains whether Smart City stakeholders and decision-making processes have involved community consultation and inclusion as part of a wider city strategy. Lastly, the measure "Evidence of the influence of citizens' input in priority setting of the projects" is present to ensure that the Smart City strategy and initiatives are evidenced by and according to active citizen participation, need and their input (Simonofski et al., 2017:231).

10.2 Citizens as Co-Creators

Co-creation of an urban space requires active participation from citizens as part of the service or production process, enabling a more enhanced interaction between industry, government, society and university (Quadruple Helix Model) where such interactions and co-created processes stimulate new innovations or services. The following sections outlines how such co-creation of public service processes through active citizen engagement pertain to the Smart City context (Simonofski et al., 2017:3).

Direct interaction This involves the establishment of Smart City methods that gather and organise public opinion on a range of issues, such as quality of service, user feedback, service standards, etc. Thus the criterion "General techniques applied" reflects a citizen-centric viewpoint by ensuring that Smart City methods are geared to gathering citizen input, e.g. accessing crowd-sourcing models. "Type of required engineering method applied" identifies the necessary engineering needs for developing smart services by seeking public consultation and involvement (Simonofski et al., 2017:231).

Living Lab The Living Lab methodology defines a co-created, co-designed innovation process in which people and communities are actively connected and involved in defining and developing the type of smart initiatives, citizen needs and expectations, as well as city design, at the initial stages. This renders the Living Lab an ideal method in the public realm to increase civilian participation. The "Living Lab strategy and planning" principle, therefore, ensures that the implementation of the Living Lab methodology follows a citizen-centric strategy along with the criterion "Citizen-oriented activities organized". This ensures that the Living Lab approach includes the objective of enhancing citizen engagement (Simonofski et al., 2017:231).

Online platforms Online platforms, such as social media, crowd-sensing platforms and community networking sites, are not constrained in terms of locality or time, making these online platforms ideal for gathering public opinion on city matters. However, the analysis and accumulation of public opinion may require proprietary software or custom-user interfaces that promote interaction between government and its citizens. The criterion "Use of an existing or specifically designed online platform" outlines the type of online platform required for such interaction, and the criterion "Number of citizens that participate on the platform and impact on public life" ensures that such a setting or platform, in fact, represent a real-life setting that can be monitored along with its expected outcomes (Simonofski et al., 2017:232).

10.3 Citizens as Users

As mentioned in previous sections, ICT plays a major role in defining the Smart City vision where broad ICT city integration may lead to new services. Nonetheless, excessive ICT city rollout is insufficient in stimulating citizen participation towards enabling innovative initiatives and services as part of a broader Smart City vision. The following sections describe how ICT may stimulate such citizen participation practices (Simonofski et al., 2017:232).

Infrastructure This refers to IoT cyber-enabled technologies that form part of a constant interchange between various data streams, essentially allowing for the establishment of an array of interdependent connected systems, or a collection of connected devices, such as embedded sensors and actuators with which to monitor and control an environment (Nahrstedt et al., 2016:2). The criterion "Ubiquitous computing components" serves to list and link the associated pervasive and enabling technologies that could be used to increase public participation. It is important that these technologies and their development are adapted to serve citizens. For this reason, the criterion "Innovative ICT-based projects" is included to ensure that innovative Smart City applications actually support and motivate citizens towards participatory engagement (Simonofski et al., 2017:232).

Open Data Open data are freely shared, public and generated data which, when combined with data mining and analytics, can be accessed, examined and shaped by

various public stakeholders. This promotes a more informed citizenry offering better feedback, open governmental systems and ultimately better innovative services across several domains, such as weather, traffic, tourism, etc. (Smart Cities Council, n.d.). The criterion "Open data strategy" examines a city's open data policy, taking into account both availability of all data sets and the required data processing systems needed to activate or transform publicly available open data in order to make them functional and usable by citizens and thereby stimulate collaboration. The criterion "Use of open data by citizens" represents the potential uses by citizens of published open datasets (Simonofski et al., 2017:232).

10.4 Co-Decision with Citizens

Co-decision processes, as enabled through the Internet, ICT connectivity and crowd-sourcing technologies, provide additional potential for citizens to connect actively and participate in policy-making. The use of ICT and crowd-sourcing tools facilitates the establishment of a participatory democracy and e-government by allowing citizens to be actively engage in decision-making. Participatory governance, e-democracy and e-governance refer to processes of activating citizens participation and governmental performance through electronic or ICT means (Anthopoulos, 2017:287). In their approach, these technologies seek to access the decentralised nature of collective intelligence in order to create a dynamic, distributed network of benefactors and producers geared towards finding solutions or services. In this regard, technologies, such as crowd-sourcing, are used as an "open innovation strategy" in the public domain in the hope of stimulating new ideas or in finding solutions to social problems (Bruno, 2015:15). Bruno offers such a co-design and crowd-sourcing process involving four steps, namely (1) open consultation, (2) collection of inputs, (3) draft proposal and communication to the European Parliament and Council, and (4) first reading in the European Parliament (Bruno, 2015:35). Author Anthopoulos expanded on Bruno's co-decide process and included a data-mining and analytics component to serve as the first step in gathering decentralised public thought and as a means of assessing policy or contextual priorities. Anthopoulos' addition of data-mining and analytics aims at facilitating methods of participatory democracy using smart infrastructure and services (Anthopoulos, 2017:288). In Bruno's model, "open consultation" deals with the framing of a potential problem or issue and involves a process of consultation with citizens to generate ideas and inputs. The second "collection of inputs" phase draws on the preceding step: garnered inputs and ideas are presented on a crowd-sourcing platform in order to develop purposeful proposals. This co-generating process also includes an evaluation phase (as petition) followed by another crowd-sourced feedback session and co-drafting process. The "draft proposal and communication" further draws on the crowd-sourcing model and, based on the collected public input, can develop a problem definition and policy document that can be discussed at Council. The last "first reading in the European Parliament" phase involves another

crowd-sourcing process allowing communities and their representatives to voice their concerns and evaluation, and reflect on the process of implementation (Bruno, 2015:35; Anthopoulos, 2017:288). In generating e-participation, Bruno provides the following four best practices and key priorities when developing e-participation tools for different contexts (Bruno, 2015:25):

- "ICT and Representation (To increase transparency and openness): (1) Focus on the accountability of the institutions involved and who is responsible for the monitoring. Transparent guidelines need to be developed prior to implementing the rules and accountability features."
- "ICT and Participation (To increase engagement and interactivity): (1) Policy-makers should take into consideration the digital divide and provide off-line engagement. The language barrier cannot be underestimated and only by including different languages, a wider participation can be reached. (2) Policy-makers need to be involved and use an appropriate language, free of technical jargon for laypeople to understand."
- "ICT and Deliberation (To receive opinions while limiting shouting and polarisation): (1) Timely and direct feedback to participants tends to minimise criticism, a careful and independent moderation and feedback is essential. (2) Dialogue can and should be rewarding."
- ICT and the Contestatory Model (To monitor and include social movement through online listening): (1) Focus on content quality, including background information which are attractive, clear and effective. (2) Use existing platforms and social media."

Authors Saunders and Baeck (2015:11), in viewing Smart Cities as a combination of collaborative technologies and the power of citizenry, list several peer-to-peer technologies by which to leverage citizenry through digital technologies. These include setting up "collaborative economies" by connecting decentralised communities through distributed digital technologies and online services in order to generate better services or goods. This can be accompanied by setting up urban innovation labs to explore the potential of collaborative technologies for generating and sharing knowledge. "Crowdsourced data" is another technology that can be employed utilising sensors and social networking sites in order to generate and monitor crowd-sourced environmental maps. The use of open data and the mobilisation of "collective intelligence" is another method using digital tools that assist citizenry to be part of the planning and policymaking process. Lastly, "crowdfunding" technologies can be used in order to perceive more accurately the needs of the broader citizenry and aid government in their spending decisions.

11 Generating value through knowledge management

The creation of value or innovative outcomes in a company or institution positively correlates with the organisation's knowledge management capacity. This foregrounds the need to develop applicable social interactions for communication environments as a way to control the relationship between knowledge management capacity and performance outcomes. It is suggested that social interactions should, in part, concentrate on knowledge acquisition giving rise to knowledge acquisition and dissemination processes in order to achieve performance outcomes. For example, a study based on a sample of 105 companies explored the correlation between knowledge management capacity and organisational performance from a social interactivity perspective. It found that knowledge management capacity enables better governmental or institutional performance. The same study indicates that the implementation of knowledge acquisition tasks and knowledge dissemination policies or programmes can improve its knowledge management capacity and performance. In addition, the study asserts that the establishment of coordinated knowledge management tasks and interaction processes can further improve organisational performance and that social interactions have a synergistic reaction with knowledge management capacity (Hsiao, Chen and Chang, 2011:655-656). Lichtenthaler and Lichtenthaler (2009:1322) interpret knowledge management capacity as an organisation's ability to control effectively its knowledge domains or informational awareness by restructuring the manner in which knowledge is explored (Exploration), maintained (Retention) and utilised (Exploitation) within and around that organisation. Their integrative framework includes six knowledge capacities highlighting associated challenges within internal and external knowledge management processes. An organisation's knowledge management capacity thus coordinates such internal and external processes, leading to an increase in knowledge domains or/and ultimately innovation. (Lichtenthaler and Lichtenthaler, 2009:1318).

12 Information and Communications Technology (ICT) and governance in Smart Cities

The Smart City concept and its development, combined with ICT, is envisioned as being able to play a crucial role in ensuring a more people-centred urbanism. In addition, ICT implementation and infrastructure are seen as important factors in their capacity to create smart communities by adapting utilisation (socially) in order to increase citizens' quality of life, encourage democratic discourse and help promote a more active citizenry (Hollands, 2008:315). These integrated information and communications technologies are key Smart City drivers. Yet, as Chourabi et al. state, the impact of such advantages is still ill-defined. It is from this perspective and

towards ICT implementation in cities that Chourabi et al. (2012:2291)call for consideration of the following factors in ICT application: "resource availability, capacity, institutional willingness and inequality, digital divide and changing culture and habits". Smart City initiatives require engagement practices that allow citizens and various stakeholders to participate effectively and co-creatively in directing urban progress in order to address social/stakeholder needs or the creation of public value initiatives. As a result of such required stakeholder interactions, cities have needed to find improved governance processes, where governance represents legislative, prescribed administrative or implementation processes in the interest of realising effective stakeholder participation and intended outcomes. Accordingly, governance in this respect refers to "the outcomes of interactions between all actors in the public domain" (Rodr´ıguez-Bol´ıvar, 2015:3). In a similar vein, the idea of e-governance refers to a citizen-centric approach and the use of information technologies to improve democratic discussion and government services, as well as improve and support citizen participation in service deployment (Chourabi et al., 2012:2292; Hsieh, Chen and Lo, 2015:164). Smart Cities, therefore, represent the emergence a governance structure, broadly termed as smart governance, through which interaction with stakeholders, policies and procedures is driven by the application of ICT and emerging technologies. These technologies enable the setting up of co-creating services, assist in governing actions and improve government transparency, infrastructure and citizenry (Gil-Garcia, Helbig and Ojo, 2014:17; Anthopoulos, 2017:264). Kumar and Dahiya further define smart governance as a shared, interlinked factor amongst other components which include smart people, a smart city economy, smart mobility, a smart environment and smart living, cooperatively forming a Smart City system. Smart governance, in Kumar and Dahiya's Smart City system model, features the following aspects (Kumar and Dahiya, 2017:16):

- Governance that is "accountable, responsive, and transparent"
- "Urban and city regional governance utilising big data, spatial decision support systems and related geospatial technologies"
- E-governance that is beneficial to all residents
- "The delivery of public services efficiently and effectively"
- Models that practise "participatory policy-making, planning, budgeting, implementation, and monitoring"
- "Clear sustainable urban development strategy and perspectives known to all"
- "Creative urban and regional planning with a focus on the integration of economic, social, and environmental dimensions of urban development"
- The incorporation of "effective, efficient, and people-friendly urban management"

- "The practice of E-Democracy to achieve better development outcomes for all"
- "The embrace of a Triple Helix Model in which Government, Academia and Business/Industry practice changing roles in governance"

Anthopoulos (2017:67) asserts that the Smart City paradigm is a locale for the evolution and development of smart governance, therewith positioning smart governance, in addition to the above mentioned aspects, as a component of the Smart City. This stance is supported by (Gil-Garcia, Helbig and Ojo (2014:17). Giffinger, Fertner, Kramar, Kalasek, Pichler-Milanovic and Meijers establish smart governance in Smart Cities as quantifiable by the following factors, each comprised of a list of measurable indicators (Giffinger et al., 2007:22). They include: (1) participation in decision-making as indexed or measured by (a) city counsellors in relation to citizens, (b) degree of citizens' legislative or political undertaking, (c) the importance of political or governmental affairs for citizenry, and (d) the proportion of female municipal representation; (2) public and social services as indexed by (a) municipal disbursement, (b) allocation of children in day-care, and (c) satisfactory and quality education; (3) transparent governance as indexed by (a) citizen focused, satisfactory and transparent government processes, and (b) satisfactory means of addressing corruption. Hence, smart governance involves government and public participation, citizen services and the management and functioning of government processes (Giffinger et al., 2007:11; Anthopoulos, 2017:67). Authors Harsh and Ichalkaranje expand the concept of smart governance as the subsequent evolution of e-governance and city governance as a result of government "realising the power of data. . . to improve their services, to enable an integrated, seamless service experience, to engage with citizens, co-develop policies and implement solutions for well-being of the community and transforming themselves into smart government" (Harsh and Ichalkaranje, 2015:9). Using the above converging interpretations, the concept of a Smart City governance context describes a new type of governance that is supported by the introduction and application of ICT and emerging technologies in order to facilitate public engagement, service deployment and co-ordination, and public access. This is known as e-governance. In addition, it includes governance that focuses on the optimisation and use of data in driving service deployment and administrative processes (Gil-Garcia, Helbig and Ojo, 2014:17; Glybovets and Mohammad, 2017:7). According to literature, both e-governance and smart governance call for differentiation. However, it should be emphasised here that in a Smart City context, both e-governance and smart governance share connected objectives for the above mentioned reasons.

13 Dimensions of smartness and governance

The idea of smartness in smart governance can be assumed to be a broad, multi-dimensional concept, foregrounding diverse government actions, outputs and

outcomes that are driven alongside the application of innovative ICT and emerging technologies as applied to areas of sustainability, transparency, citizen participation and open access. In an attempt to recognise or unlock smartness, and to facilitate the advancement of smart governance, authors Gil-Garcia, Zhang and Puron-Cid offer a "[d]imensions of smartness in government" framework with which to evaluate smart governance. Their framework also offers an integrative perspective, identifying the contributing aspects in the development of smart governance and the extent of its contribution. Their "Dimensions of smartness in government" framework is comprised of fourteen constituent elements, namely "integration, innovation, evidence based, citizen-centricity, sustainability, creativity, effectiveness, efficiency, equality, entrepreneurialism, citizen engagement, openness, resiliency, and technology savviness" (Gil-Garcia, Zhang and Puron-Cid, 2016:525).

I now provide a brief outline of each element as contained in the "Dimensions of smartness in government.

13.1 Integration

The Smart City concept underpins the implementation of urban intelligence - or the transformation of the urban landscape, using ICT in order to understand and value the complex connection between a place and its potential associated social capital. As such, the Smart City concept has required city governance to adopt organisational strategies and systems-interoperability to comprehend the value and connected exchange of data sources as they exist between a city's physical and digital spaces (Roche, 2016:6; Acedo, Painho, Casteleyn and Roche, 2018:1). Integration, in Gil-Garcia et al.'s model, calls for government action to ensure the integration of information to "reduce duplication of data collection, coordinate efforts, and help local, state, and national level administrations become more efficient, transparent, and deliver better quality services". Furthermore, they argue that the integration of knowledge sharing and organisational interoperability can yield additional benefits, such as better communication among stakeholders, increased collaboration, generating value by extending the boundaries of interaction through organisational interoperability and improving service coordination and provision. Therefore, the integration of knowledge includes "technology, organisational, institutional, political, economic, and social components" (Gil-Garcia et al., 2016:526).

13.2 Innovation

The Smart City encapsulates ITC and its technological deployment towards ensuring and fostering an innovative urban ecosystem in which data and emerging digital technologies are used towards creating an integrated platform to connect the city as a co-created concept aimed at continuously improving its performance and

promoting innovation across all city/stakeholder domains (Gutierrez, Amaxilatis, Mylonas and Munoz, 2017:668). Innovation, therefore, is characterised as an "agent of change" that forms part of the development of Smart Cities as a multi-layered concept and where advances in ICT support or enable an urban developmental strategy with its associated mechanism of change (Schaffers et al., 2012:57). The practice of innovation and the application of ubiquitous enabling technologies by government are, therefore, necessary in that they enable the creation of better (or new) services (Gil-Garcia et al., 2016:526).

13.3 Evidence-based decision making

The concept of a Smart City is complex and, as such, acknowledges and envisions the need for a data-driven and co-created city using an array of distributed IoT sensor technologies, data sources and data sets in order to resolve inner-city problems which would lead to better public services and an increased quality of life for citizens. Furthermore, by using IoT technologies, as well as ambient and artificial intelligence, the process of establishing smart environments may leverage other connected systems that could lead to a more human-orientated smart environment (Gomez, Chessa, Fleury, Roussos and Preuveneers, 2019:28 and 39). Evidence-based decision-making in smart governance, therefore, relates to government's ability to capture and leverage real-time sensor data, the integration of data sources from public services or platforms and the use of data analytics in order to enhance or direct policy decisions or initiatives (Gil-Garcia et al., 2016:527).

13.4 Citizen centricity

The development of e-governance refers to a citizen-centric approach and the use of information technologies to improve democratic discussion, improve government services, as well as improve and support citizen participation in service deployment (Chourabi et al., 2012:2292; Hsieh, Chen and Lo, 2015:164). The adoption of a citizen- centric approach details a Smart City policy that encourages engagement practices with diverse stakeholders and cross-sector transformation as a means to understanding supply and demand of services and drive service discovery and production of urban services. This would constitute an innovation network that is both based on and responsive to citizens' needs (Rodr´ıguez-Bol´ıvar, 2015:131). A major aspect of smart governance, therefore, highlights the importance of citizen-centricity as a method of interaction between stakeholders and governance where public value is generated by being aware of stakeholder diversity and by improving the efficiency of participatory governance and shared decision-making amongst stakeholders in order to better meet stakeholder needs (Gil-Garcia et al., 2016:527).

13.5 Sustainability

As Hassan, Khan and Madani have pointed out, "[t]he development of smart cities. . . has had a significant societal impact by improving the efficiency and sustainability of a whole range of urban services" (2018:27). Arroub et al. also note that the continuous rise of a global urbanised population has led to an increased awareness with regard to the resultant and associated urban challenges faced by urban areas. Add to this, from a societal point of view, the much needed interventions and solutions required concerning the themes of sustainability and sustainable development, education, energy, environment, public services and ensuring citizen well-being (Arroub et al., 2017:1)Consequently, the dimension of sustainability is of vital importance in smart governance as characterised by city governance which promotes, using information technologies, aspects such as government transparency, organisational heritage, public and policy management, strategy and adaptability in order to ensure viable and sustainable cities, citizens and quality of life for future generations (Gil-Garcia et al., 2016:527).

13.6 Creativity

Earlier I presented Kumar and Dahiya's Smart City system model (page 80) specifying the following six interlinked components: smart people, smart city economy, smart mobility, smart environment and smart living, which cooperatively make up their Smart City system (Kumar and Dahiya, 2017:16). In their model the dimension of smart people constitutes a core element referring to an active citizenry and its participation as crucial in having a functional Smart City (Kumar and Dahiya, 2017:55). Additionally, where smart people form part of the development of a Smart City system the latter values human capital and knowledge (Kumar and Dahiya, 2017:12). This is further supported by Boulos, Tsouros, and Holopainen who state that "IoT-driven smart cities are most successful and smartest when their focus is on people, and when they actively involve and engage their citizens in co-creating. . . co-running and co-monitoring the very smart services that are meant for them and for improving their living environment and overall quality of life" (Boulos et al., 2015:4). This notion of a Smart City functioning as interrelated urban structures where value correlates with the level of connectedness within and outside of a city further denotes the 'smart people' dimension as significant in influencing external investment (Wall, Stavropoulos, Edelenbos and Pajevic, 2015:105). Similarly, in Gil-Garcia et al.'s "dimensions of smartness in [a] government framework", creativity concerns smart governance's managerial ability to innovative by supporting and activating the creative potential linked to the city's human capital as identified in citizens, culture, knowledge and education. Also, such creativity should include an awareness of a city's knowledge pools as a means to realise its potential innovation or developmental capacity to address issues, such as urban renewal (Gil-Garcia et al., 2016:528). The importance of smart people (or a city's human capital) as a means to

shape external investments is reinforced by the following statement: "This stresses the importance that local authorities nurture and amplify the power of their people, so as to compete with more powerful cities of the world. This means improving the level of qualification, social and ethnic plurality, flexibility, creativity, cosmopolitanism, and open mindedness of smart cities. These are the types of qualities that are needed to enable entrepreneurs in Smart Cities to invest in other cities worldwide" (Wall, Stavropoulos, Edelenbos and Pajevic, 2015:108).

13.7 Effectiveness

E-governance methods in cities (governance using ICT) would seem to serve as an intelligent tool by which to gather, consolidate and manage knowledge in order to improve current conditions, facilitate innovation and reach strategic outcomes. Effectiveness, therefore, pertains to these digital governance and ICT initiatives not only in terms of technological execution but also in supporting stakeholders and policy outputs or initiatives and in achieving intended benefits, such as "improved public services, stronger accountability, increased communication based on performance information, improved collaboration between different individuals and organisations, and increased knowledge sharing" (Gil-Garcia et al., 2016:528).

13.8 Efficiency

Governance that actively uses ICT to interact better with citizens by leveraging the available accumulated data in order to understand and address social problems, as well as initiate new citizen services, is considered beneficial in furthering public reform and more inclusive policy objectives. Efficiency thus foregrounds the envisaged use of ICT as being able to maximise value whilst supply and demand drive the economy or efficiently managing the supply and demand of associated resources. Such proposed ICT efficiency benefits are also linked "to other organisational benefits like improving the decision making process, broadening professional networks, enhancing coordination, and providing higher quality services" (Gil-Garcia et al., 2016:528).

13.9 Smartness and Equality

The many Smart City definitions encapsulate many stakeholder benefits. One core element, particularly present across the definitions, underpins the implementation of urban intelligence in order to understand and value the complex connection between place and its potential associated social capital. Equally, this element highlights a crucial consideration regarding the importance of social equity and its advantage for

urban development. Equality in smart governance, therefore, focuses on smart initiatives using ICT implementation which supports and promotes "equality and accessibility across communities, groups, and individuals. . . . to reduce social exclusion and promote social justice" (Gil-Garcia et al., 2016:528).

13.10 Entrepreneurialism

The Smart City and smart governance relate to fostering an innovative economic landscape that reaffirms and highlights the importance of a knowledge economy in fostering citizen participation towards service innovation and the development of an enterprise-friendly environment. Entrepreneurialism in smart governance, therefore, relates to the integration of knowledge as an asset which, when combined with technological advances, assists in the generation of new knowledge or innovations in the realm of "urban competitiveness, welfare, growth, education, health, transportation, communications, and the use of technology innovations to foster citizen participation and the governance of cities" (Gil-Garcia et al., 2016:529).

13.11 Citizen Engagement

Smart governance emphasises the need to perceive citizens as active democratic Smart City participants in order to both develop citizens' sense of belonging and accountability in a city and as a way of understanding citizen needs or the local social context (Simonofski et al., 2017:3; Gil-Garcia et al., 2016:529). Citizen Engagement in smart governance is, therefore, included as a key dimension in that it enables communication between actors from governance and stakeholders or collaborative partners in order to foster more robust and intelligent relationships amongst citizens, stakeholders and government (Gil-Garcia et al., 2016:529).

13.12 Openness

Openness in smart governance relates to transparent governance and the public availability of and access to government knowledge or data as a means of mobilising digital tools to facilitate better city responses, improve citizen services and quality of life and strengthen citizen engagement and decision-making capacity through open data access. It also underlines the use of ICT in order to promote more democratic citizen participation processes and an openness in terms of an awareness of all participating city actors which would lead to a better understanding of how a city functions and how to improve public services (Gil-Garcia et al., 2016:529).

13.13 Resilience

The Smart City concept is embedded in the idea of creating a smart ICT and human-orientated infrastructure in which city growth is evaluated along such axes as sustainability, smartness, context-specific governance and economy and inclusiveness, as well as advocating social and environmental interrelatedness (Arroub et. al, 2016:1). Resilience in smart governance initiatives thus focuses on local and national government's ICT use, its resilience and emergency-response capacity to resume public, stakeholder or business services in the event of an emergency or disaster. Authors Scholl, Patin and Chatfield, in an analysis of emergencies or catastrophic events and local government emergency response to such events, as well as the role which ICT would play in such a situation, put forward four categories of interest. These include (a) "planning/preparedness and practical pre-event response simulation", including the use of simulations or projections; (b) "information and information needs", including the availability of open sharing of data; (c) "the organisational setup for all four phases", including inter-organisational participation and coordination; and (d) "interoperability and ICTs involved" (Scholl et al., 2012:2347). Gil-Garcia et al. (2016:530) concur with Scholl et al. on these considerations.

13.14 Technology knowledge

Technological knowledge correlates with the availability and strategic use of merging technologies, such as Big Data, open data, social media, etc., with a view to providing new opportunities, as well as "the necessary knowledge and competency to select, implement, and use information technology tools, strategies, and applications to make government smarter" (Gil-Garcia et al., 2016:530). Similarly, in understanding smartness as a strategy mitigating a range of urban challenges, authors Chourabi et al. lay out an integrative Smart City initiatives framework which outlines eight factors by which to (a) understand Smart Cities as a concept, (b) utilise an evaluative framework to direct smart initiatives, and (c) understand the relationality of these eight factors towards successful smart city initiatives. These eight factors are: (1) management and organisation, (2) technology, (3) governance, (4) policy context, (5) people and communities, (6) economy, (7) built infrastructure, and (8) natural environment. The framework points out a number of internal and external aspects which influence the design, execution and utilisation of Smart City initiatives. Chourabi et al.'s framework can be understood as a bi-directional representation, where interaction occurs between outer factors, namely "governance, people and communities, natural environment, infrastructure, and economy", and inner factors, namely "technology, management, and policy" with the purpose of affecting successful smart city efforts (Chourabi et al., 2012:2294). Considering the above corresponding interpretations, governance in a Smart City context describes a new type of governance that is supported by the introduction and application of ICT

and emerging technologies in order to facilitate public engagement, service deployment and co-ordination, as well as public access known as e-governance. Furthermore, it includes governance that focuses on the optimisation and use of data to drive service deployment and administrative processes known as smart governance (Gil-Garcia, Helbig and Ojo, 2014:17; Glybovets and Mohammad, 2017:7). The above-mentioned "dimensions of smartness in government framework" and the "Smart City initiatives framework" both depict the Smart City implementation and developmental process as containing a set of interrelated preferences and approaches as examined with factors in mind, such as city infrastructure, ICT innovation and service deployment, people and community, governance, environment, etc. It has also been shown that, due to the identified interrelated complexity of a city, the definition of smartness in a Smart City context has to be more than wide-spread ICT deployment.

14 Stakeholder engagement in Smart Cities

Stakeholder engagement in a Smart City context requires engagement practices that allow citizens and stakeholders to participate effectively, and in a co-created manner, in directing urban progress or answering to social/stakeholder needs. It, therefore, involves the formation of 'boundary objects' or shared methods of engagement as a means of co-ordinating and translating the associated and linked societal, informational, relational needs, and the expectations of a constructed social meaning of objects across groups or communities (Rodriguez-Bolivar, 2015:131; Fiore-Gartland and Neff, 2015:1470). Taking this into account in setting up Smart City services, authors Paskaleva, Cooper, Linde, Peterson and Gotz present a sequential four-step procedure for stakeholder engagement in order to ensure a co-design of services. These include: (1) stakeholder enlistment involving relevant and required stakeholders, (2) stakeholder enrolment involving the recruitment of required or needed stakeholders, (3) stakeholder dialogue involving the construction of consensus based on involved stakeholder needs or objectives, and (4) stakeholder innovation networks involving active stakeholder participation towards an approved service objective or outcome and a co-design process (Paskaleva et al., 2015:28).

15 The role of ICT in Smart Cities

The Smart City concept envisions a synergy of various factors related to technology, governance and citizenry. These factors are key in supporting a city's vision and strategic objectives as they activate collaborative practices between local governance and citizens to ensure better interaction with citizens, improved service delivery and innovation by leveraging IoT technologies and generated data (Schaffers et al.,

2012:57; Mellouli et al., 2014:1; Rodriguez-Bolivar, 2015:126; Gutierrez et al., 2016:4). The use of ICT initiatives is both important in realising Smart City potential and equally so in appreciating the existing need to discern ICT's role in supporting governance in order to understand the provision of public services. ICT can act strategically as an interconnection between organisations, communities, context or domains. To understand ICT's role in Smart Cities and e-governance (as both use ICT to improve citizen services), authors Gil-Garcia and Pardo list a number of managerial and organisational problems and strategies which need to be navigated in order to run successful e-government projects. Listed problems include ensuring adequate project scope, as well as participating stakeholder diversity. Other challenges relate to a lack of coordination between organisational objectives and the linked project, as well as instances of opposition due to independent interest or conflicts (Gil-Garcia and Pardo, 2005:192). Listed strategies include the establishment of explicit and realistic objectives. Additionally, relevant stakeholders must be identified, and the focus should be on achieving their active participation in the development of initiatives - especially as they would be end-users of a service or outcome. Other strategies involve tactical planning approaches to substantiate and measure expected outcomes, set up appropriate communication channels and track operational or institutional processes and their improvement. Lastly, adequate skills acquisition amongst participating stakeholders, including users and developers, should be ensured, as well as (to a lesser degree) the availability of investment or economic resources (Gil-Garcia and Pardo, 2005:192). Ebrahim and Irani (2005) describe a number of challenges related to the implementation of technologies in Smart Cities, or any electronic governance context. According to the authors, these IT-based challenges include the availability of sufficient resources, adequate technical infrastructure that can assist in providing reliable user-access, management support, capable IT staff with effective IT skills, training and support in order to develop and maintain services, as well as the provision of network capacity and communication infrastructure to enhance the value of services and public engagement. The authors also point out ancillary organisational barriers, such as fragmented or inadequate departmental communication, institutional culture, project and strategic buy-in from management, and lack of coordination between departments (Ebrahim and Irani, 2005:601-606).

15.1 IoT Technologies

According to Nahrstedt et al., a smart community can be classified as a "collection of interdependent human-cyber-physical systems" that make use of IoT or network-enabled technologies in order to improve services. As such, within Smart City development, IoT integration signifies a means of propagating an array of sensing or actuating cyber-physical infrastructures which aid in adapting, changing or advancing an array of systems. In order to mobilise such capabilities, an IoT system requires a number of these technologies (Nahrstedt et al., 2016:2). The

advent and proliferation of ubiquitous IoT technologies has provided additional and more efficient data analytics and data types across diverse domains, providing value-added services by utilising Big Data analytics, Cloud computing, Artificial Intelligence, Deep Learning, Cyber-Physical Systems (CPS) and Machine Learning. This has been achieved by combining IoT technologies, such as Big Data and Machine Learning, with the exchange, use and integration of heterogeneous sensor data across domains. The sensor data are then combined with data analytics to derive, automate and correlate insight from captured IoT data, which leads to improved business intelligence, analytics, platforms and services, etc. (Ahmed, Yaqoob, Hashem, Khan, Ahmed, Imran and Vasilakos, 2017:13). There are various other key enabling technologies related to ensuring network functionality within an IoT system and its array of billions of connected devices that compile, assimilate and share information in real-time, thus providing intelligent capabilities. These include RFID, Near-Field Communication (NFC), Bluetooth, Zigbee, Wireless Sensor Networks (WSN), Artificial Intelligence, Electronic Product Code, IPV4, IPV6, UCode, LTE and WiFi (Perwej, AbouGhaly, Kerim, Ali and Harb, 2019:16).

15.2 Big Data as a tool in supporting Smart City solutions

The IoT connected infrastructure allows for communication to occur between various IoT smart devices, devoid of human interaction. This results in a smart environment which generates volumes of heterogeneous Big Data. In a Smart City context, these are characterised by Santana, Chaves, Gerosa, Kon and Milojicic under the following headings (Santana et al., 2017:6):

- Volume: the associated challenges and required needs in dealing with a vast increase in generated data across distributed networks and data sources
- Variety: data from several sources, such as sensors or city traffic cameras, from which data may be structured or unstructured
- Velocity: the need for real-time data processing across city infrastructure and management, as well as user level
- Veracity: ensuring data reliability and value as gathered from several data sources

The concept of Big Data, with its above-mentioned characteristics, encompasses a set of tools or instruments. When these are combined with Big Data analytics, they can help support a number of Smart City solutions by being able to store and control extensive data sets gathered from sensor networks, city monitoring devices and open data generated by citizens through social networks or smartphone usage (Santana et al., 2017:6). Big Data analytics refers to the applied analytical and visual processes

used to transform generated data from sensors, networks and other smart devices, into usable information for Smart Cities and services, such as resource management, intelligent and predictive maintenance, smart transportation, smart healthcare, and smart grid, etc. In a data-driven Smart City context, Big Data provides numerous opportunities for city innovation and transformation. However, the means of deriving information from captured raw data for service deployment or urban transformation presents a number of challenges to realising such potential. These can include (1) managing data quality, (2) data integration, (3) privacy issues, (4) delivery versus need, and (5) access (Lim, Kim and Maglio, 2018:94). These authors put forward a data-use reference model for Smart Cities, based on the various data and knowledge interaction points in a city. In addition, it can be used to understand the variances and interdependencies between data uses. This would then facilitate a city's transformation aimed at developing a new class of service delivery that is citizen-centric. It advocates that Smart City planning and smartness move from a technological push to being more complementary to different and changing urban contexts and communities (Lim, Kim and Maglio, 2018:92).

Table 4: Benefits of Big Data analytics (Ahmed, Yaqoob, Hashem, Khan, Ahmed, Imran and Vasilakos, 2017:12)

IoT Application	**Benefits of Big Data Analytics**
Smart Transportation	(a) Reduce the number of accidents by looking into the history of mishaps (b) Minimise traffic congestion (c) Optimise shipment movements (d) Ensure road safety
Smart Healthcare	(a) Predict epidemics, cures and disease (b) Help insurance companies make better policies (c) Pick up the warning signs of any serious illnesses during their early stages
Smart Grid	(a) Help design an optimal pricing plan according to the current power consumption (b) Predict future supply needs (c) Ensure an appropriate level of electricity supply
Smart Inventory System	(a) Detect fraudulent cases (b) Strategically place an advertisement (c) Understand customer needs (d) Identify potential risks

15.3 Cyber Physical Systems (CPS), Cloud Computing, Artificial Intelligence, Deep Learning, and Machine Learning

Cyber-Physical Systems signal computation and the use of ICT to increase integration of computers or network processes and their physical counterparts, i.e embedded

sensors and actuators. This permits cyber-physical interactions with distributed data elements, combined with a physical environment. In turn, concepts, such as real-time monitoring, user feedback or alerts, service discovery, etc., are made possible. Based on this definition, I have included Cloud Computing, Artificial Intelligence, Deep Learning and Machine Learning under this umbrella, as the abilities and objectives of these technologies provide more intelligent, intuitive and autonomous connections and interactions between computers and their human or physical counterparts. Furthermore, literature calls this notion of a techno-symbiotic relationship between humans and their software agents, Human Agent Collectives (HAC). This is based on the premise of linking humans with their autonomous software proxies as information gatherers. HAC model engagement between humans and application software is seen as a dynamic, combined social collective in which the exchange and collection of crowd-sourced data and information are pooled as potential resources to address collective or public objectives. The HAC approach focuses on providing intelligent solutions by capturing, adapting, processing, combining and analysing captured human crowd-sourced or sensor data. Such captured information is characterised by structured, socially coordinated and autonomous collective actions, and correlated across other IoT technologies, wireless sensor networks (WSNs) and cyber-physical systems, resulting in applicable and socially constructed outcomes (Pticek, Podobnik and Jezic, 2016:5).

16 Open Data in Smart Cities

The Smart City concept envisions a data-driven co-created city that draws on an array of distributed IoT technologies, data sources and data sets in order to resolve inner-city problems and offer better public services and increase citizens' quality of life. One way of achieving this objective is by leveraging open data as a freely shared and distributed online resource that, when combined with data mining and analytics, can be accessed, examined and shaped by various public stakeholders. This, in turn, promotes a more informed citizenry and ultimately more innovative services (Smart Cities Council, n.d.). Governance that actively makes use of ICT (known as smart governance) is required to interact more effectively and efficiently with citizens or communities by leveraging the available accumulated data in order to understand and address social problems, as well as initiate new citizen services that are more interactive and democratic, including citizen involvement in policy decision-making processes (Mellouli, Luna-Reyes and Zhang, 2014:1). From a policy perspective, and to encourage both open data publishers and users, authors Nugroho, Zuiderwijk, Janssen and de Jong specify open data according to the following criteria (Nugroho et al., 2015:301):

- Published institutional data that are machine readable and facilitate use and reuse
- Data that are easily accessible on a publicly available online platform
- Published data that follows proper regulatory standards and formats in order to ensure interoperability between various data sets

- Published data sets that have an audit trail indicating the original, intended use and that can be interpreted to facilitate use and reuse

In an open data comparative policy framework analysis across five countries, authors Nugroho et al. provide additional lessons regarding the required infrastructural changes, working policies, frameworks and various stakeholder needs that can stimulate open data use and thus operationalise its public value. These lessons include (Nugroho et al., 2015:303):

- The need for a legal regulatory open data government framework that governs published data according to stakeholder concerns
- The need to define operational processes as a collective in order to regulate published data, as well as ensure data use, reuse and interoperability across data sets
- The need to generate and facilitate data interaction points between users in order to foster data supply and demand, as well as ensure data relevance and quality
- The need for a designated group of stakeholders that manages a city's open data processes
- The need to create and increase data demand in order to promote such aspects as government transparency, efficiency improvement, and social and economic development.

The distributed and decentralised nature of open data, i.e., how information is aggregated and shared across system nodes, allows for data analysis across an array of data components, such as structured, semi-structured or unstructured data, machine data, spatiotemporal data (GPS), real-time data, operational or process data and business data. This provides opportunities for meaningful connections between a city and its stakeholders (Anthopoulos, 2017:40).

17 Smart City Development and Benchmarking Criteria

Authors Anthopoulos, Janssen, Weerakkody, identified and synthesised over twenty Smart City developing or benchmarking criteria, resulting in six benchmarking categories addressing (1) smart city progress, (2) smart city monitoring, (3) city capacity, (4) city sustainability, (5) resilience, and (6) policy impact (Anthopoulos et.al, 2016:9). Their paper included an analysis of existing Smart City conceptual models and, consequently, derived a "Unified Smart City Model" (USCM) composed of eight categories which address smart city "architecture, governance, planning and management, data and knowledge, energy, health, people and environment" (Anthopoulos et.al, 2016:12). Their USCM summarises and recognises existing Smart City dimensions and conceptual viewpoints (Anthopoulos et.al, 2016:12). Anthopoulos

categorised city assets with each containing a hierarchical structure or subsections. For example, 'Utilities' would be a top-level component or city asset with energy, water, waste, etc. as subsections in the hierarchy (Anthopoulos, 2017:220).

18 Smart City Evaluation Models

Smart Cities also require a means of measuring and evaluating Smart City stages of development and performance against a set of indicators. The establishment of such models assists in city benchmarking, indicating the required Smart City developmental strategies and the scale of implementation. The IDC Smart City Maturity Model (SCM) is one such model, which offers a city benchmarking tool by which to determine a city's Smart City developmental phase with reference to its associated Smart City strategies and state of development. It also acknowledges the diversity of cities, with each having their own unique Smart City developmental trajectory. It provides five stages of Smart City growth, in addition to its five best practice measurements which are (1) strategy, (2) culture, (3) process, (4) technology, and (5) data, as well as nineteen Smart City developmental indicators (Yesner and Ozdemir, 2017:7). The five stages of the IDC Smart City Maturity Model are (1) ad hoc, (2) opportunistic, (3) repeatable, (4) managed, and (5) optimised, with each stage built sequentially on the preceding capabilities. The ad hoc stage attempts to demonstrate the value of Smart City deployment by implementing pilot Smart City projects without the required strategic or organisation shift in terms of structure, governance and coordination. As such, it focuses on and utilises technological integration to ensure project success and justification. The opportunistic stage identifies initial successful pilot projects as opportunities for understanding success factors, as well as to generate stakeholder buy-in and to encourage collaborative practices, by developing open data policies and making open data publicly available. The repeatable stage seeks to enhance and integrate Smart City strategies across projects and organisations to improve data and information usage and to establish standardised processes amongst various stakeholders with the purpose of improving services and performance. The management stage highlights the Smart City strategy as a formalised strategy whose implementation requires the participation of internal and external stakeholders. This stage perceives Smart City investment and deployment as a sustainable city model involving and requiring interaction and support from citizens, academia and private enterprises. It is in this stage that the Smart City needs to form part of the urban design and structure. The optimised stage emphasises the need for a system that is integrated across various systems and which is conducive to an innovative landscape that uses emerging technologies and collaborative practices in order to improve services and citizens' quality of life, support Smart City objectives and attract investments (Yesner and Ozdemir, 2017:6). The five best practice measurements are described as follows (Yesner and Ozdemir, 2017:6):

- Strategy: Strategy deals with the Smart City vision, namely management, budget, strategic development, etc. The vision should also be publicly accessible and communicated by city officials.

- Culture: Culture focuses on innovation, citizen participation and transparency. It requires the availability and ability of processes and instruments to facilitate collaborative practices between citizens, businesses and government in order to establish new services, as well as foster stakeholder innovation and experimentation with ideas and services, relationships and processes.
- Process: Process explores the restructuring of governance focusing on existing systems, alliances and organisational design. This allows for more innovative authority and collaboration practices by all city actors or stakeholders to realise Smart City services, solutions and ecosystems by using emerging ICT. It, therefore, also stresses Smart City governance as a partnership or co-development process between many stakeholders taking into account the outcomes of such stakeholder interactions in developing the Smart City and solutions.
- Technology: This aspect includes architectures, platforms, IoT adoption, citizen or crowd-sourced data architectures where technology, in the Smart City context, is deemed the enabler of Smart City development. It also considers the integrity and availability of data as acquired through "connectivity technologies" and the analysis and extraction of information from such collected data towards service deployment and better decision making (Yesner and Ozdemir, 2017:14).
- Data: This dimension includes all citizen data, open data, data discovery and its analysis, data protection, as well as the integration and sharing of such data, in order to facilitate better decision-making and planning, new services and business innovation. Additionally, it deals with the availability of open data for more transparent governance practices.

The Smart City Reference Model (SCR) is another example intended to identify the associated policies and planning-related requirements that support Smart City and long-term urban development. It explores a range of concepts, such as sustainable innovation, innovative city ecosystems and broad connectivity as needed for Smart City development. Its seven-layer model approach includes integrating ICT technologies and developmental infrastructure that support urban intelligence and services innovation. The model consists of the following: (1) The City Layer, (2) The Green City Layer, (3) The Interconnection Layer, (4) The Instrumentation Layer, (5) The Open Integration Layer, (6) The Application Layer, and (7) The Innovation Layer (Zygiaris, 2013:219).

19 Summary

This chapter reported on the process and outcome of the structured literature survey. The purpose of the structured literature survey was to create a model for the analysis of citizen engagement in Smart Cities. The chapter reported on the methodological approach to data collection undertaken, and introduced the main constructs in literature towards understanding citizen engagement in Smart Cities. Key literature

regarding citizen engagement in Smart Cities was discusses, providing examples, such as the Periph'eria Human orientated Smart City approach. Key concepts discussed in this chapter are (1) the process of co-production, (2) evaluating citizen participation, (3) generating value through knowledge management, (4) information and communications technology (ICT) and governance in Smart Cities, (5) dimensions of smartness and governance, (6) stakeholder engagement in Smart City service creation, (7) the role of ICT in Smart Cities, (8) open data in Smart Cities, (9) Smart City development and benchmarking criteria, and (10) Smart City evaluation models. This chapter also outlined the process undertaken to understand Smart Cities as a form of people-centred collaborative engagement requiring dynamic interaction between various participatory systems in order to enhance social and economic transformation. The chapter illustrated the mechanism that enables the creation of an inclusive and co-created city by leveraging citizens through digital technologies and collaborative experimentation. It also illustrated how, in a Smart City, value may be generated through processes of co-production and citizen participation. With regard to citizen participation, this chapter highlighted several methods that can activate the transformational impact of the broader citizenry by considering citizens as both users and co-creators of solutions. Furthermore, the role of ICT and digital technologies within a Smart City context were discussed in their relation to matters, such as e-governance, generating collective intelligence, fostering innovation and the application of data and analytics in supporting smart solutions.

20 A Conceptual Model: Smart City implementation as an engagement practice

20.1 Cape Town as a City

In 2000, the City of Cape Town (CoCT) initiated its Smart City strategy with the aim of increasing its citizens' engagement and the development of applicable public services, specifically using technology as a means to facilitate such developmental objectives and meet public service needs. This CoCT vision of moving towards "smart urbanism" was later developed into an internal CoCT Digital City Strategy that would drive the improvement of public services, service deployment and increase operational efficiency. Cape Town is a South African port city and the capital of the Western Cape with an estimated population of 4 617 560 million. It forms part of the larger City of Cape Town which includes the Cape Metropolitan Council, Blaauwberg, Cape Town CBD, Helderberg, Oostenberg, South Peninsula and Tygerberg (City of Cape Town, 2021). Its population size and distribution make it a medium-sized African city with entangled economies, a high population density with diverse demographics, services and commodities. Furthermore, its definition as a medium-sized city conforms to Henderson's (1997) interpretation of medium-sized cities as "typically collections of contiguous urban places" characterised as either containing a high level of primacy, equating to growth, or as a highly specialised urban space. As Giffinger, Fertner, Kramar and Meijers point out, this often requires medium-sized cities to identify opportunities for business, as well as seek and extend their competitive advantages by using key resources for internal development or the establishment of niche activities in opposition to other cities (Giffinger et al., 2007:5). In the context of South Africa and Cape Town, such niche activities include Cape Town's tourism (Figure 15, p. 100) and the "We are open" domestic tourism campaign in partnership with the Western Cape Government and Wesgro (DA, 2020). As a country, South Africa has the third largest Internet-user base totalling 24.9 million users compared to other African countries. Household Internet access in the Western Cape equates to approximately 62.1 percent, outperforming other provinces. Furthermore, recent research conducted by the GSMA Foundation identified 314 active technology hubs in Africa of which 54 are located in South Africa. Research conducted by the World Bank Group suggests that the majority of those 54 South African technology hubs are led by civil society (Kelly and Firestone, 2016; Bayen and Giuliani, 2018). In addition, Cape Town has emerged as a first-rate digital ecosystem and technology hub hosting over 50 percent of South Africa's emerging tech startups. Cape Town also has extensive 4G fibre network infrastructure with over 1600 public access wi-fi hotspots, rolled out as part of the WCG-LTSA Public Wi-Fi Hotspot project. The project was initiated in 2016 with a focus on (1) providing citizens with reliable access to Internet, (2) providing unlimited access to Government websites, and (3) providing broadband access towards the development of ICT skills and improved digital literacy. Since its inception, over 910 000 devices have accessed the network with a data usage rate of over 12 terra-bytes (12TB) per month illustrating the

provision of an enabling and connected environment aimed at stimulating growth. Additionally, it indicates an openness and responsiveness to providing access by harnessing opportunities, such as by increasing skills (or decreasing the digital divide) with the use of digital technologies (Western Cape Government, 2020; Wesgro, 2020). Cape Town holds several key public infrastructure resources which, when leveraged, promote inclusive economic growth and transformative city development through initiatives of digital governance and widespread ICT deployment. It also boasts a well-established digital economy due to its status as a leading technology hub for startups and venture capitalists in Africa. This drives and supports innovation and opportunities for economic growth (GDP) in the Western Cape. As a city, Cape Town's strategic alignment and focus attempt to "stimulate a transition towards a more inclusive and resilient economic future for the Western Cape region", as laid out in the OneCape 2040 integrated development plan for the Western Cape (Western Cape Government, 2012:2). Similar to the National Development Plan (NDP), OneCape 2040 is a citizen-focused vision and strategy the successful implementation of which requires strategic engagement amongst local, provincial and national governments in order to advance innovative thinking and practice, provide general guidelines for collaborative engagement between the public, civil society and private institutions, enhance Government and private partnerships, respond to a changing local and global context, and meet the development, sustainability and competitiveness needs of the city (Western Cape Government, 2012:2). Such need for change as affirmed by OneCape 2020 was born out of a globalised context and a perspective which recognises (1) the current "geo-economic shifts" and resurgence of Asian and African economies, (2) "socio-digital transition and the role of technology as a driver of economic growth", and (3) the current global environmental challenges and the depletion of natural resources which require new forms of sustainable transformation and development (Western Cape Government, 2012:5). The above portrays Cape Town and its trajectory as a leader in smart urbanism on the African continent. It details a vision of establishing a decentralised urban management approach and a future urbanism in which digital technologies drive urban development, providing a more responsive approach to solving urban challenges, and generating a more inclusive society through ICT deployment (Marvin, Luque-Ayala and McFarlane, 2015:27). This approach to smart urbanism, coupled with the consolidation of the seven municipalities into one municipality through the establishment of the Unicity Initiative in 2000, further demonstrates the willingness and commitment of Cape Town's leadership to encourage the creation of a more modern and digital city with an integrated digital system that could blend/merge and automate operational and business processes and facilitate the enhancement of service delivery. The Unicity Initiative focused on improving citizen engagement, enhancing service delivery and stimulating economic growth by activating technology (as evidenced by the subsequent implementation of the Enterprise Resource Planning system) as the driving agent in realising these objectives. The Unicity Initiative, therefore, served as a technology-driven strategy to attain Cape Town's developmental objectives and thus laid the foundation for Cape Town's Smart City strategy (Stelzner, 2015; Boyle and Staines, 2019).

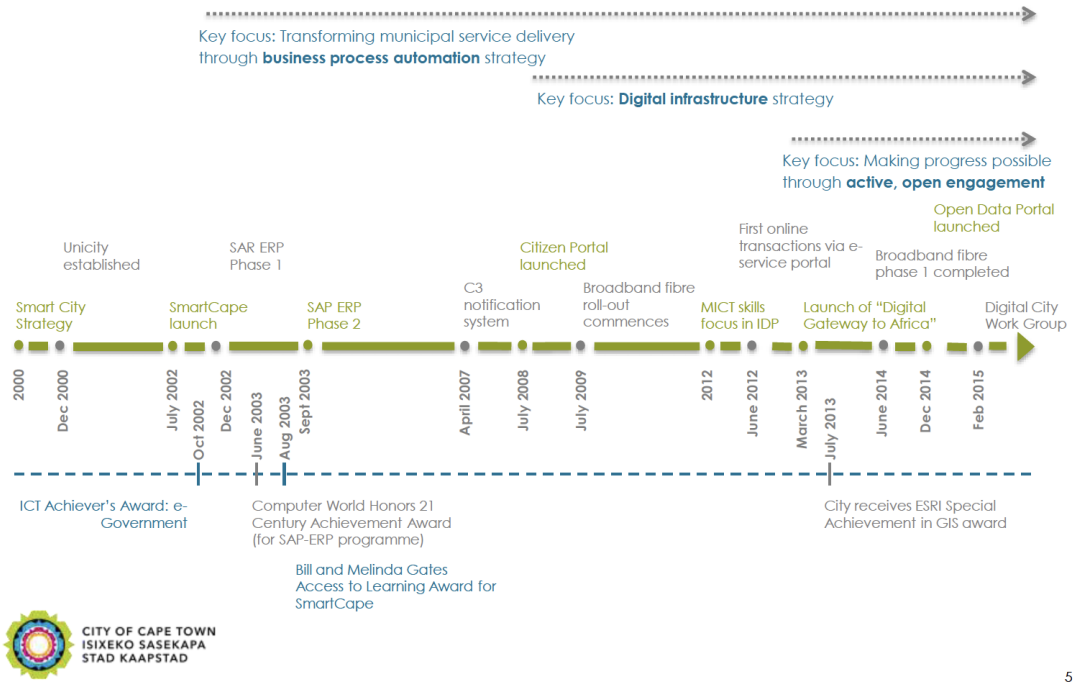

Figure 11: City of Cape Town Smart City trajectory (City of Cape Town, 2016:5) Source: City of Cape Town

PROVINCIAL TOURISM PERFORMANCE, 2018				
Province	**International Tourist Arrivals (millions)**	**Total Foreign Direct Spend (billions)**	**Bed nights (millions)**	**Length of stay (nights)**
Gauteng	3.8	R28.2	40.3	10.5
Western Cape	1.7	R16.3	23.3	12.9
Limpopo	2.2	R5.5	7.9	4.0
Mpumalanga	1.6	R10.7	15.4	10.0
Free State	1.3	R9.0	12.8	10.8
KwaZulu-Natal	0.8	R5.7	8.1	9.5
North West	0.7	R3.1	4.5	6.9
Eastern Cape	0.4	R3.5	5.0	9.9
Northern Cape	0.1	R0.8	0.2	7.1

Figure 12: Provincial tourism performance (Wesgro, 2020:25) Source: Wesgro

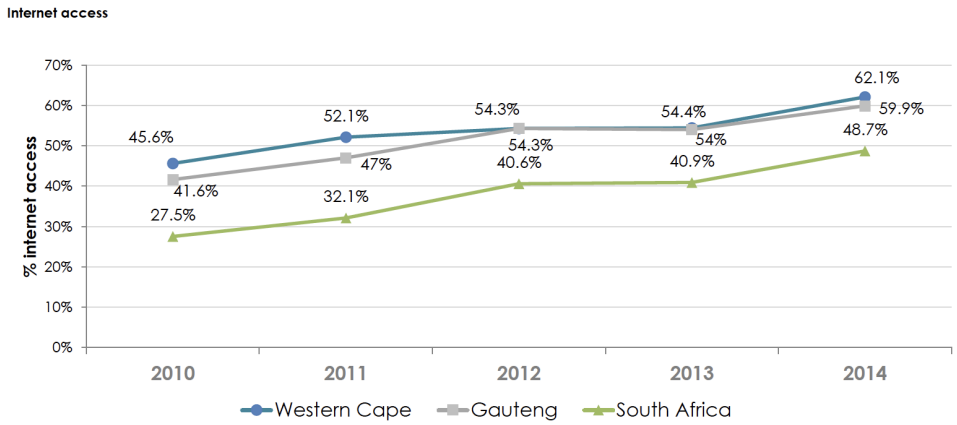

Figure 13: Internet users in Africa (Statista, 2020) Source: Statista

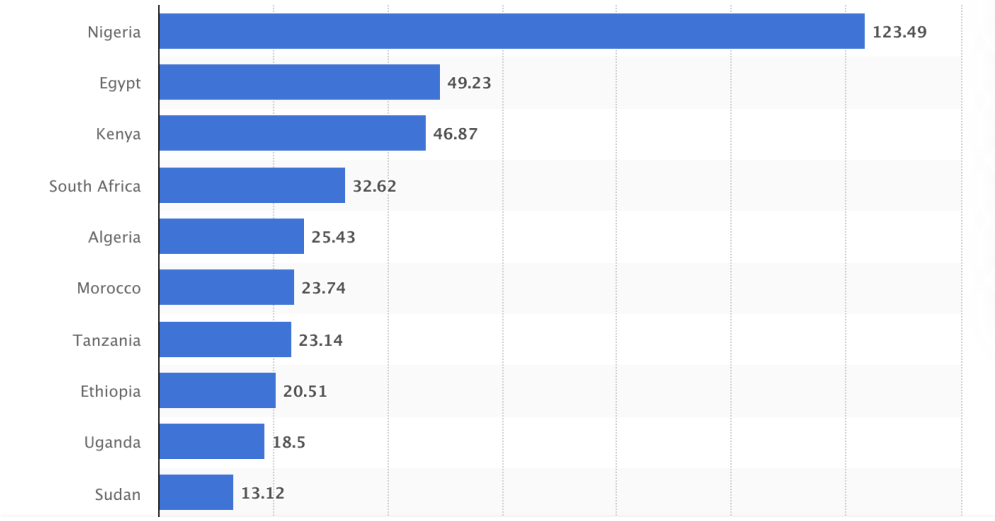

Figure 14: South Africa household Internet access (City of Cape Town, 2016:12) Source: City of Cape Town

20.2 Cape Town and an Example of Open Data Deployment

The distributed and decentralised nature of open data, i.e, how information is aggregated and shared across system nodes, allows for data analyses across an array of data components, such as structured, semi-structured or unstructured data, machine data, spatiotemporal data (GPS), real-time data, operational or process data and businesses data. This provides opportunities for meaningful connections within a city and its stakeholders (Anthopoulos, 2017:40). Figure 18 (p. 103) illustrates the City of Cape Town's open data portal which, according to the city's open data policy No. 27781 serves as a public resource towards achieving the following desired outcomes (City of Cape Town, 2016:4):

- "[E]stablish and incrementally populate a single online open data portal for information and data generated by the organisation that is free and accessible to members of the public."
- "[A]ssist citizen engagement with the City by making it easier for members of the public to access data and enhancing transparency that will empower citizens to hold the City to account."
- "[M]ake available information that is useful and empowering to citizens and that can enable innovative entrepreneurial activity."

Between 2015 and 2017, the City of Cape Town saw a significant reduction in seasonal rainfall culminating (in early 2018) in Cape Town being declared a disaster area, having experienced the worst drought in a century, leaving the city's over 4 million residents with water storage levels at less than 25 percent and with it signalling an imminent "Day Zero", defined as when water supply runs out (Richman and Leslie, 2018:249). In an attempt to avoid "Day Zero" and ensure Cape Town's drought durability the city implemented a Critical Water Shortages Disaster Plan. This involved several water restriction levels being imposed on citizens with the worst occurring in January 2018, when water usage was limited to 87 litres a day per individual (Level 6 water restriction). A core strategic initiative that helped Cape Town become more drought resilient involved the use of open data modelling and crowd-source data which involved publicly releasing detailed water usage statistics, as well as detailed GIS and visual mapping of data known as a "Water Map" (Figure 19, p.103) which showed household water usage, as well as consumptions patterns across different suburbs. In addition, the City made use of crowd-sourced data by allowing citizens to report leaks or losses of water via an online webform, SMS, social media or telephone call. These initiatives provided both transparency and a reduction in citizens' consumption patterns of more than 60 percent in 6 months, illustrating the benefits of open data strategies (Van Belle and Hlabano, 2019:7).

This chapter outlines the development of a model towards interpreting Smart City implementation as an engagement practice. As a qualitative study its developmental process followed an inductive approach, involving the constant compression and crystallisation of raw data into a summative or codified meaning. Another objective of

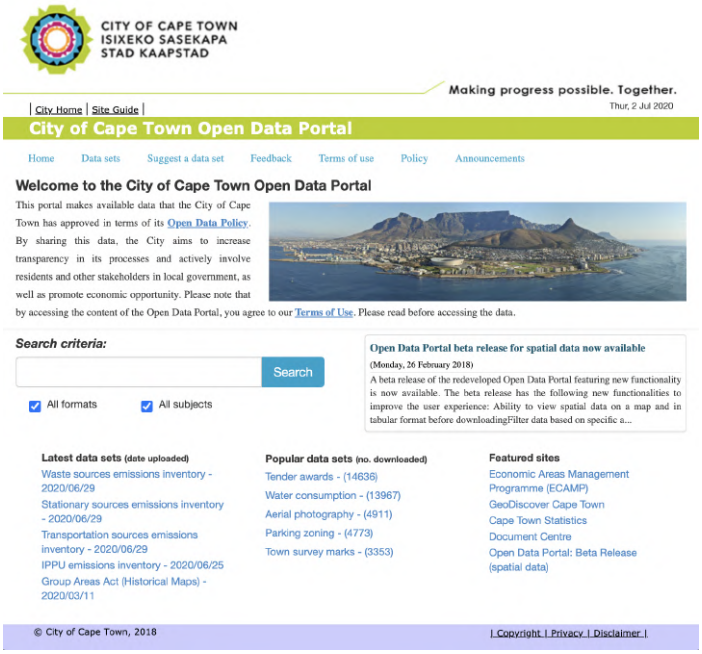

Figure 15: City of Cape Town Open Data Portal (City of Cape Town, 2020 Source: City of Cape Town)

generating the SCIEP conceptual model was to explore and benchmark existing Smart City implementation models and their factors, to assist in identifying key elements and indicators towards imagining effective Smart City engagement initiatives for the City of Cape Town. In part, the objective was to explore better ways of establishing and activating collaborative practices between governance and citizens, and to realise Smart City value and services by placing emphasis on the city's human capital and people (Schaffers et al., 2012:57; Mellouli et al., 2014:1; Rodr´ıguez-Bol´ıvar, 2015:126; Guti´errez et al., 2016:4).

20.3 Aligning City of Cape Town Digital City Strategy with current academic Debate

Permission was obtained via the CCT director of Policy and Strategy from the City of Cape Town to conduct doctoral research investigating Smart City implementation for the CoCT. The letter can be viewed in the appendix (Figure 55).

The inductive approach undertaken in this study involved aligning the City of Cape Town Digital City Strategy with current academic debate. It entailed repositioning its four pillars of digital inclusion, digital infrastructure, digital governance and

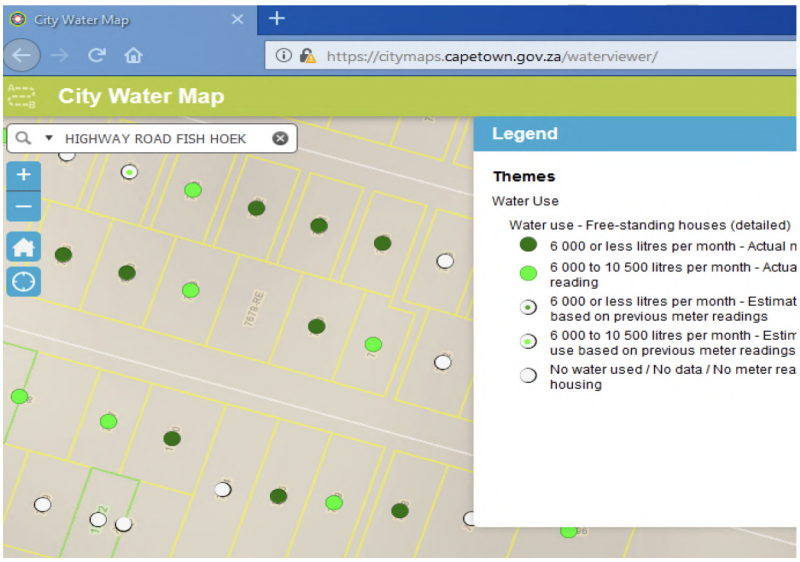

Figure 16: City of Cape Town Water Map (Van Belle and Hlabano, 2019:6) Source: City of Cape Town

digital economy in relation to corresponding literature as identified by the following themes: (1) smart urban services and deployment, (2) IoT implementation, (3) IoT technologies, (4) big data, (5) cyber-physical systems, (6) open data in Smart Cities, (7) co-creating Smart Cities, (8) Living Lab, and (9) open innovation and stakeholder engagement. Specifically, its alignment aimed at exploring and identifying the key components that would enable or activate the Digital City Strategy mandate of (1) promoting digital access, improving digital skills and driving digital initiatives that enhance quality of life, (2) enabling digital solutions that enhance the effectiveness of critical City infrastructure, (3) enhancing service delivery and promoting citizen engagement through ICT, and (4) creating and enabling an environment for the growth of tech-enabled enterprises to maximise job creation potential. This process of alignment also contributed towards developing the interview questions and line of enquiry. The outcomes of this process revealed the key recommendations needed to reframe the current City of Cape Town Digital City Strategy as a Smart City vision for the City of Cape Town. These recommendations circled around four key observations:

- The CoCT Digital City Strategy should involve broader protocols and stakeholder engagement in order to reach its specified objectives of enhanced access, improved ICT skills and use, and the realisation of social change through ICT (City of Cape Town, 2016:14).
- The vision of digital infrastructure as afforded by the ERP/SAP system requires more comprehensive organisational and public engagement in order to ensure its objectives and to gain an implementation strategy which is inclusive and relevant

to the CoCT. The CoCT Digital City Strategy requires stratagems or guidelines that drive and support innovation and opportunities for economic growth (GDP) in the Western Cape which, in turn, play a part in Smart City development.

- The CoCT Digital City Strategy requires stratagems or guidelines that drive and support innovation and opportunities for economic growth (GDP) in the Western Cape which, in turn, play a part in Smart City development.
- Attaining the objectives of Digital Government as set out in the strategy requires a coherent implementation plan.

20.4 Constructing the SCIEP conceptual model

The SCIEP conceptual model uses data collected from the shortlisted 84 structured literature survey documents which were imported, qualitatively analysed and coded in Atlas Ti, using a combination of both predetermined codes and the development of new code lists. This resulted in a preliminary code book containing 467 codes, broadly defining the most contested areas in this field of study. These initial 467 codes were subsequently developed, using Atlas Ti, into 76 code groups, each with its own sub-groups as illustrated in Figures 11 (p.57) and Figures 12 (p.58). The initial findings provided a broad overview of the main discussion themes which would lead to an understanding of Smart Cities in relation to citizen participation, data valences, IoT architecture and reference models, IoT implementation, IoT technologies, open innovation and stakeholder engagement, Smart City implementation, Smart City architecture, smart governance and smart urban services and deployment. The findings were subsequently exported from Atlas Ti, further edited and analysed, and revealed 63 core constructs. These 63 core constructs were cleaned, mapped, grouped and developed into seventeen main constructs relating specifically to understanding Smart Cities from an engagement perspective (Figure 13, p. 59). The accumulation of inferred meaning provided "potential indicators of a phenomenon" and, through constant comparison and analysis, identified the unit of analysis that informs the theory (Pandit, 1996:1). The structured and analytical process of constant comparison of the data served to identify groups or abstract representations of Smart phenomena which involved the clustering of concepts into categories pertaining to these Smart indicators. My process, and the development of data, was further enhanced by employing a data collection protocol and mapping findings to identify data overlap and to enhance internal validity through data grounding. The data were further organised and developed into themes, categories and sub-categories which were subsequently explored, using emerging data, and compared with literature, codified knowledge and the Cape Town Digital City Strategy. The preliminary findings of the content analysis were further developed and clustered, providing a birds-eye view of the current Smart City discourse, specifically around a Smart City's ability to mobilise for the sake of the City and its citizenry. The mapped findings were grouped according to key themes and their codified meaning, labelled in order to capture the mechanisms that enable engagement within a Smart City context. For example, the initial theme

CoCT Digital City Strategy dimensions	CoCT Digital City Strategy focus areas	Corresponding literature and authors
Digital Inclusion	• Closing the digital divide by promoting digital access, improving digital skills and driving Digital initiatives that enhance quality of life	• **Smart Urban Services and Deployment**: {Gomez, Chessa, Fleury, Roussos and Preuveneers}, {Anthopoulos}, {Santana, Chaves, Gerosa, Kon and Milojicic}, {Song, Cai, Chahine and Li}, {Serrano}, {Gil, Ferrández, Mora-Mora and Peral}, {Petrov, Mikhaylov, Moltchanov, Andreev, Fodor, Torsner, Yanikomeroglu, Juntti and Koucheryavy}, {Kumar and Dahiya}, {Madakam and Ramaswamy}, {Li, Lin and Geertman}, {Uribe-Pérez and Pous}, {Kaur and Singh}, {Kyriazopoulou}, {Lucero}, {Arroub, Zahi, Sabir and Sadik}, {Gutiérrez, Amaxilatis, Mylonas and Muñoz}, {Rghioui and Oumnad}, {Yucel}, {Chiariotti, Condoluci, Mahmoodi and Zanella}, {Atzori, Iera and Morabito} • **IoT Implementation:** {Kim, Yoo, Lee and Seo}, {Xu, Qu and Yang}, {Lucero}, {Gil, Ferrández, Mora-Mora and Peral}, {Chin, Callaghan and Allouch}, {Suryanegara, Arifin, Asvial and Wibisono}, {van Deursen and Mossberger}, {Madakam and Tripathi}, {Zeinab and Elmustafa}, {Gil, Ferrández, Mora-Mora and Peral}, {Marques, Garcia and Pombo}, {Asghari, Rahmani and Javadi}
Digital Infrastructure	• ICT infrastructure roll-out and • Using digital solutions to enhance the effectiveness of critical City infrastructure	• **IoT Technologies**: {Kubler, Robert, Hefnawy, Cherifi, Bouras and Främling}, {Serrano}, {Gomez, Chessa, Fleury, Roussos and Preuveneers}, {Pticek, Podobnik and Jezic}, {Atzori, Iera and Morabito}, {Kubler, Robert, Hefnawy, Cherifi, Bouras and Främling}, {Madakam and Tripathi}, {Asghari, Rahmani and Javadi}, {Zeinab and Elmustafa}, {Chin, Callaghan and Allouch}, {Gomez, Chessa, Fleury, Roussos and Preuveneers}, {Kaur and Singh}, {Suryanegara, Arifin, Asvial and Wibisono}, {Perwej, AbouGhaly, Kerim and Harb}, {Lucero}, {Bibri and Krogstie}, {Ahmed, Yaqoob, Hashem, Khan, Ahmed, Imran and Vasilakos}, {Song, Cai, Chahine and Li}, {Xu, Qu and Yang}, {Alsamhi, Ma, Ansari and Meng}, {Maksimovic}, {Medina, Perez and Trujillo} • **Big Data**: {Ahmed, Yaqoob, Hashem, Khan, Ahmed, Imran and Vasilakos}, {Maksimovic}, {Zeinab and Elmustafa}, {Santana, Chaves, Gerosa, Kon and Milojicic}, {Maksimovic} • **Cyber Physical Systems**: {Pticek, Podobnik and Jezic}, {Tokody and Schuster}, {Sun, Song, Jara and Bie}, {Santana, Chaves, Gerosa, Kon and Milojicic}
Digital Government	• Driving transparency, • Enhancing service delivery and promoting citizen engagement through ICT	• **Open data in Smart Cities**: {Anthopoulos}, {Lucero}, {Atzori, Iera and Morabito}, {Caird and Hallett} • **Co-creating Smart Cities**: {Gutiérrez, Theodoridis, Mylonas, Shi, Adeel, Diez, Amaxilatis, Choque, Camprodom, McCann and Muñoz}, {Gutiérrez, Amaxilatis, Mylonas and Muñoz}, {Anthopoulos} • **Living Lab**: {Simonofski, Asensio, De Smedt and Snoeck}, {Oliveira and Campolargo}, {Rodríguez-Bolívar}
Digital Economy	• Creating an enabling environment for the growth of tech enabled enterprises and • Maximising its job creation potential	• **Open Innovation and Stakeholder Engagement**: {Kim, Yoo, Lee and Seo}, {Rodríguez-Bolívar}, {Ahlgren, Hidell and Ngai}, {Simonofski, Asensio, De Smedt and Snoeck}, {Madakam and Ramaswamy}, {Anthopoulos}, {Chamoso, González-Briones, Rodríguez and Corchado}, {Faisal, Usman and Zahid}, {Bibri and Krogstie}

Figure 17: Aligning CoCT DSC (Author's construct, 2020)

Domains (Quadruple Helix)	**Data (Lim, Kim and Maglio, 2018:94)**	**Co-Production (Castelnovo, 2015:4)**	**Citizen Participation (Simonofski et al., 2017:3)**	**Knowledge Management (Lichtenthaler and Lichtenthaler, 2009:1318)**	**Smart City Initiatives (Chourabi, Nam, Walker, Gil-Garcia, Mellouli, Nahon, Pardo and Scholl, 2012:2294)**	**Smart City Maturity IDC Smart City Maturity Model (SCM) (Alliance, 2014)**	**Smart City Domains (Cohen Boyd , 2012)**
Inclusion	Local Network Development	Driven by Civil Society	Citizen as Democratic Participant	Knowledge exploration, Retention and Exploration	People and Community	Strategic Intent Data Use Technology Governance Stakeholder Engagement	People and Living
Infrastructure	Local Operational Management	Combination between Civil Servants and Citizens	Citizen as Users	Knowledge Exploration, Retention and Exploitation	Natural Environment and Infrastructure	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Environment and Mobility
Governance	Preventative Local Administration	Combination between Civil Servants and Citizens	Citizens as Co-Creators	Knowledge exploration, Retention and Exploitation	Governance	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Government
Economy	Local Information Diffusion	Driven by Citizens and Communities	Citizens as Co-Creators and Users	Knowledge exploration, Retention and Exploitation	Economy	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Economy
Approach / Indicators (serves as interview protocol)	1. Managing Data 2. Integration 3. Privacy Issues 4. Delivery versus Need 5. Access	1. Experiment portal 2. Lessen Isolation 3. Annotation of Data 4. City Scale Opportunistic Data Collection 5. EaaS Framework		Knowledge Capacities 1. Inventive 2. Transformative 3. Innovative 4. Absorptive 5. Connective 6. Desorptive	1. Context 2. Co-Design 3. Deployment	1. Stage 1 2. Stage 2 3. Stage 3	1. Understands Smart City concept 2. Provides Evaluative Framework 3. Understands Relationality of Factors

Figure 18: SCIEP conceptual framework (Author's construct, 2020)

of "open data in Smart Cities" was re-labelled "Data", in order to encapsulate its meaning, mechanism and indicators or approaches. This phased process contributed significantly to the development of the SCIEP conceptual model, grounded in literature and informed by the City of Cape Town Digital City Strategy. Whetten (1989:492) and Pandit (1996:2) affirm that "relationships, not lists, are the domain of theory." Therefore, the above outlined approach sought to uncover the conceptual relationships within this Smart City phenomenon and provide a clear representation of the terms used as part of the Smart City academic debate and its leading authors, as well as its relation and relevance to the CoCT DCS and its focus areas of digital inclusion, digital infrastructure, digital governance and digital economy. Thus, a means by which to align conceptually the CoCT Digital City Strategy with current academic debate and in the development of the SCIEP conceptual model grounded in literature, was provided. Figure 24 (p. 110) shows the third developmental phase and preliminary SCIEP conceptual model. The validity of the data set represented by the SCIEP conceptual model involved the crystallisation and holistic integration of all factors as identified by literature and in accordance with the CoCT Digital City Strategy focus areas. The process of theoretical saturation involved the accumulation, analysis and interpretation of primary sources and raw data. Additionally, it involved the grouping of constructs and the establishment of codified themes in relation to existing knowledge (Nascimento, de Souza, Oliveira, Moraes, de Aguiar and da Silva, 2018). The SCIEP conceptual model further answers a call for Smart Cities to be defined as "the use of information and communication technologies by local governments and cities to better interact with their citizens"(Mellouli, Luna-Reyes and Zhang, 2014:1). It foregrounds that, in order to deliver the expected values, governments not only need to create new services for their citizens based on these technologies to improve their quality of life, but also need to engage citizens in this new set of services (Mellouli, Luna-Reyes and Zhang, 2014:1). The SCIEP conceptual model serves as the analytical lens for this study. Figure 25 (p.112) shows the core elements of the SCIEP conceptual model on which I expand in the following sections, namely (1) data, (2) co-production, (3) citizen participation, (4) knowledge management, (5) Smart City Initiatives, (6) Smart City Maturity, and (7) Smart City Domains.

20.5 The role of Data in Smart Cities

The implementation of Smart Cities signifies the integration of a host of IoT technologies as a means of propagating, sensing or actuating cyber-physical infrastructures, in order to facilitate further adaptation and redirection of the advancement of an array of systems (Nahrstedt et al., 2016:2). The advent and proliferation of ubiquitous IoT technologies has provided additional and more efficient data analytics and data types across diverse domains, and has offered value-added services by utilising Big Data analytics, Cloud Computing, Artificial Intelligence, Deep Learning, Cyber-Physical Systems (CPS) and Machine Learning. This is achieved by applying IoT technologies in the utilisation of Big Data and Machine Learning, and the exchange, use and integration of heterogeneous sensor data across domains. These are combined with data analytics to derive, automate and correlate insights from captured

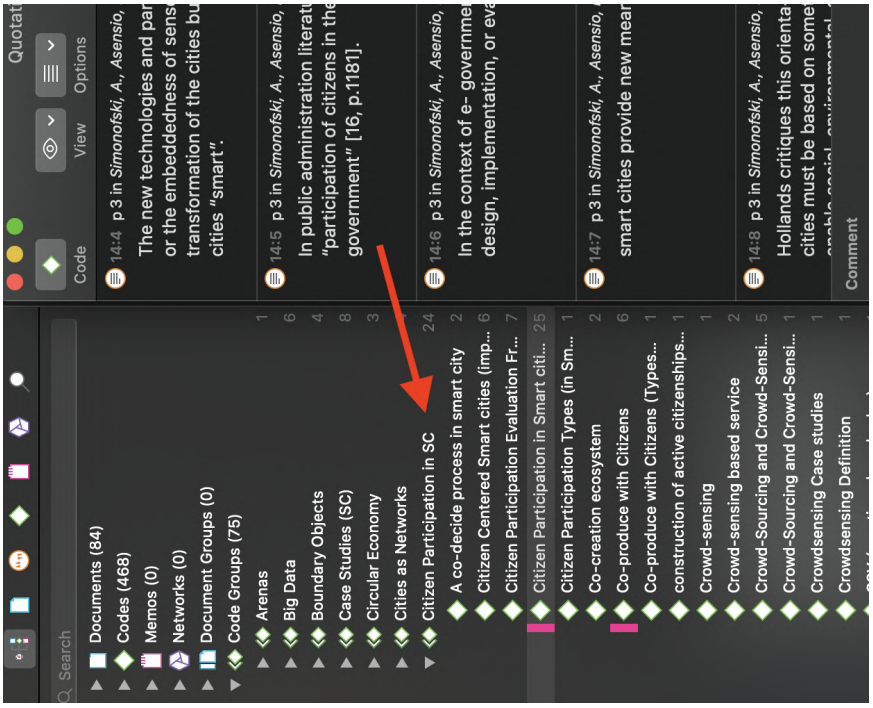

Figure 19: Data developed into themes, categories and sub categories (Author, 2020)

IoT data for improved business intelligence, analytics, platforms and services, etc. (Ahmed et al., 2017:13). Data analytics within a Smart City context serves as a key enabling technology or focus area that allows for a connected infrastructure between various IoT smart devices. The resulting smart environment generates volumes of heterogeneous Big Data which, in a Smart City context, are categorised under the following headings by Santana et al. (2017:6):

- Volume: This relates to the associated challenges and required needs in dealing with a extraordinary increase in generated data across distributed networks and data sources within a Smart City.
- Variety: Variety concerns data gathered from several sources, such as sensors or city traffic cameras, where such data may be structured or unstructured.
- Velocity: Velocity registers the need for real-time data processing across city infrastructure, city management and user level.
- Veracity: This speaks to ensuring data reliability and value when gathered from several data sources.

Therefore, as represented in the SCIEP conceptual model, the concept of data encompasses a set of tools which, when combined with Big Data analytics, aid in

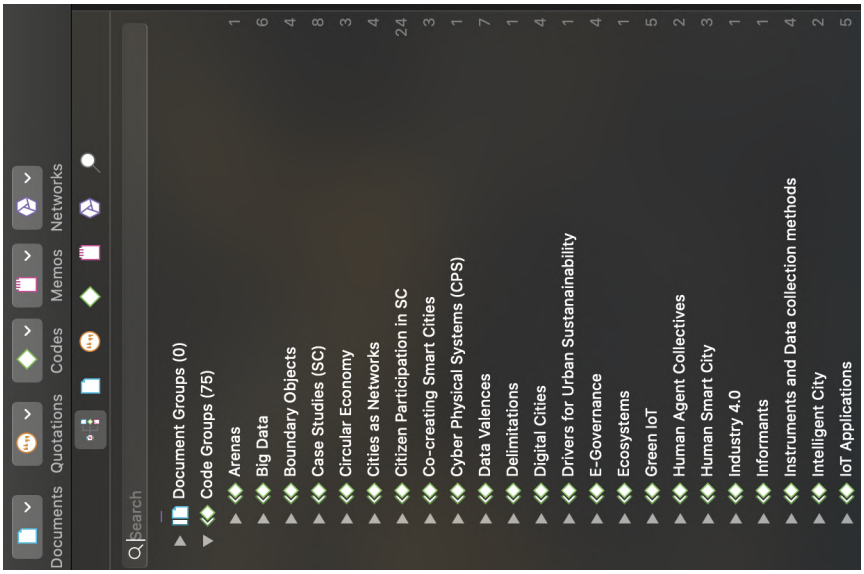

Figure 20: Development of code groups containing key categories (Author, 2020)

supporting a number of Smart City solutions by being able to store and control vast data sets gathered from sensor networks, city monitoring devices and open data generated by citizens through social networks or smartphone usage (Santana et al., 2017:6). Furthermore, in the data domain, the model includes a data-use reference model for Smart Cities, based on the various interaction points in a city. Additionally, it facilitates understanding the variances and interdependencies among data users, thus furthering a city's transformation with new service delivery that is citizen-centric. It advocates a move from technologically focused Smart City planning to a more complementary approach to different and changing urban contexts and communities. These are outlined upon in the sections (1) local network development, (2) local operations management, (3) preventative local administration, and (4) local information diffusion (Lim et al., 2018:92). In addition, the model provides a means of testing the application of data and data analytics in establishing opportunities for city innovation and transformation within a Smart City context. These challenges and considerations include (1) managing data quality, (2) data integration, (3) privacy issues, (4) delivery versus need, and (5) access (Lim et al., 2018:94). The challenge of "managing data quality" entails making sure that captured urban data are of high quality, accurate and understood by providers or potential users. It also insists on finding ways that will enhance data quality and their usefulness in smart projects. Data integration "refers to the integration of data from different sources" and highlights the need to connect different data sources to support knowledge production and service creation by government and the broader citizenry. "Privacy issues" highlight data security and confidentiality concerning the establishment of protocols that guarantee

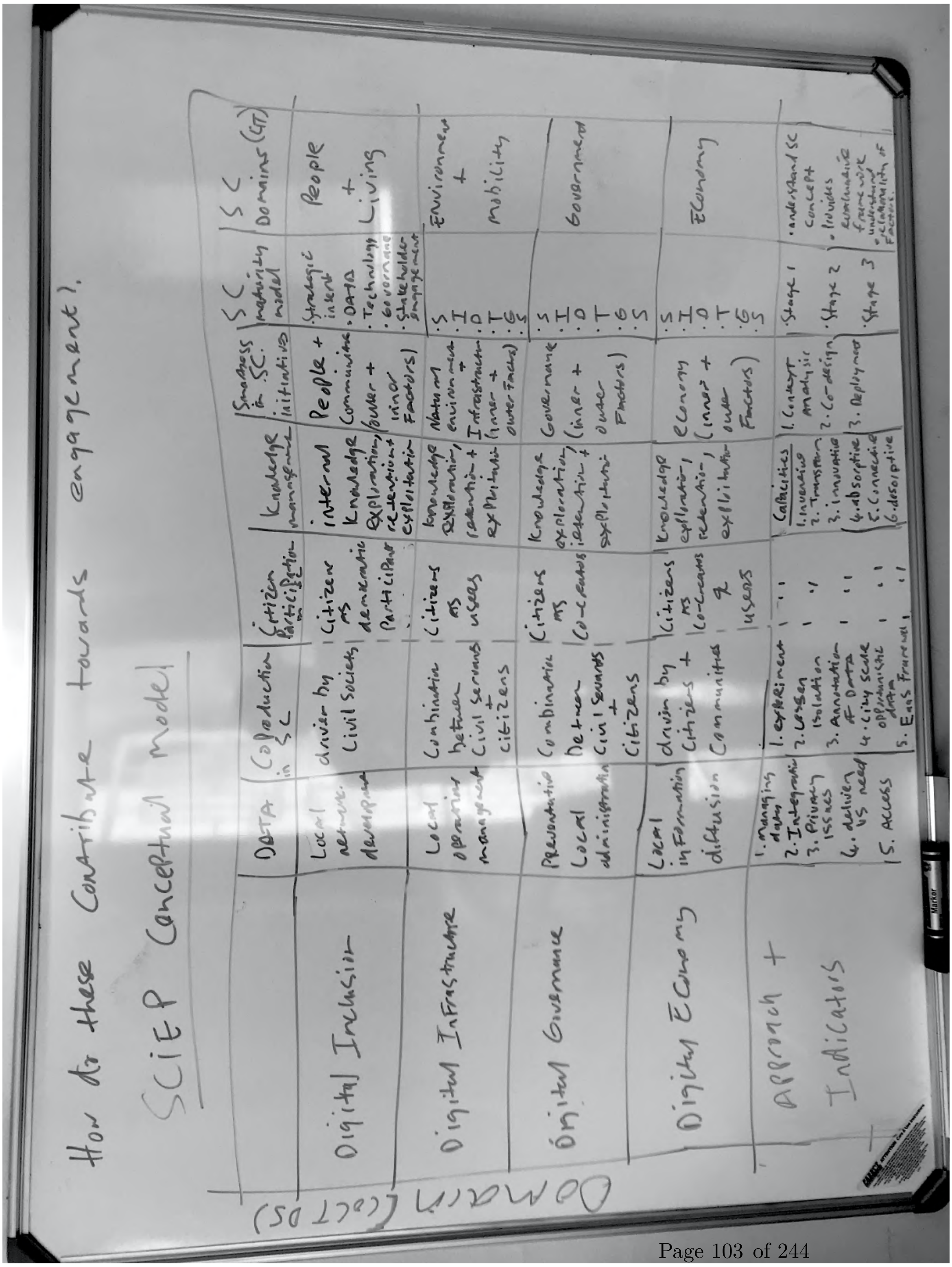

Figure 21: Third phase developing the SCIEP conceptual model in relation to the CoCT DCS (Author's construct, 2020)

Figure 22: SCIEP core elements (Author's construct, 2022)

or address users' data privacy issues in service creation or data-driven Smart City deployment. "Delivery versus need" pertains to making sure that the needs of citizens and stakeholders are understood. "Access" in a data driven Smart City entails ensuring that participating groups and individuals have access to the right information (Lim et al., 2018:94).

21 Co-production in Smart Cities

The process of co-production involves the creation of public value for local communities by activating citizens as prosumers within the digital urban environment. Citizen involvement is paramount in defining such co-production and value formation processes (Anthopoulos, 2017:285). The co-production section in the SCIEP conceptual model offers a definition for the process by indicating the associated role of service planning and deployment responsibility as either (1) driven by civil servant, (2) a combination of citizens and civil servant or (3) driven by citizens/communities where (in Castelnovo's model) configuration 1 and 3 represents traditional, non-co-produced services, Paths 1 to 5 represent full co-production, and Path 9 represents a redefinition of service design and deployment with citizens controlling service delivery and government taking on the role of coordinator of delivery (Castelnovo, 2015:4; Anthopoulos, 2017:285). The variables that define the range of co-production are defined by Linders (2012:447-450) as "government-citizen" and "public service delivery partnerships", supporting contextual needs and generating public value by activating citizens as prosumers.

21.1 Citizen participation and co-creation in Smart Cities

Attention needs to be focused on scalable and practical citizen-centric solutions as part of a city's innovation strategy and ecosystem. In essence, as captured under the domain of co-production, Smart City implementation should seek to permit engagement in collaborative digital practices and environments between citizens and the city by leveraging citizens as a city's partners on an urban innovation platform (Madakam and Ramaswamy, 2015:3). This is important in ensuring that smart services are contextually appropriate. This also relates to the peripheral interconnections and interchanges between groups, people and communities that imply the creation of an innovative space by attempting to uncover the complex interconnectedness of all involved (Paskaleva et al., 2015:131; Burt, 2001:298). However, apart from technological integration, achieving such a co-created reality demands public participation and stakeholder education, i.e. the consolidation of the different communities within a city's innovation system, to engage users in defining new and better urban services (Gutierrez et al., 2017:668). As a city is a "System of Systems", the stimulation of a co-created ecosystem requires cities to develop unique strategic visions that permit the identification, initiation and application of Smart City technologies to urban service management and its complex relationship with diverse stakeholders (Arroub et al., 2016:2). Consequently, in the SCIEP conceptual model, citizen participation is included in the governance and implementation approach to

enable citizen participation and unlock associated potential or value. These include the following approaches: (1) citizens as democratic participants, (2) citizens as co-creators, (3) citizens as users, and (4) citizens as users and co-creators (Simonofski et al., 2017:3). Importantly, in the SCIEP conceptual model, co-production and citizen participation domains are included as a set of variables or approaches by which to test or evaluate such participatory approaches and Smart City contextual needs. These include the following indicators: (1) experiment portal, (2) lessening isolation, (3) annotation of data, (4) city scale opportunities data, and (5) a EaaS framework. I now provide an outline of these indicators.

21.1.1 Experiment portal towards service creation

Drawing from the Organicity platform, the SCIEP model includes and advocates an experimentation portal (or layer) capable of containing or combining assets for experimentation from across other platforms or communities which, when integrated with an Asset Discovery API component, allows users or communities to discover and explore potential services as informed by embedded and/or crowd-sourced urban IoT device data. In addition, by using an Experimentation Management framework (EaaS framework) new services or tool identification can be run as monitored experiments in conjunction with a community management service by which to validate services and incentivise experimental subjects, thereby mobilising citizen participation (Guti´errez et al., 2016:7).

21.1.2 Lessening isolation through participation

Smart Cities require the development of a highly connected urban society aimed at encouraging (1) active citizenry, (2) access to technology, (3) wireless Internet connectivity, (4) economic and sustainable development, and (5) mobility. This would include open access data and WiFi services, smart parking, smart waste management, smart lighting, smart mobility and smart water management (Madakam and Ramachandran, 2015:8). Such a definition requires a Smart City to aim at establishing a connected infrastructure driven by sustainable urban and economical models and development which support and enhance its citizenry and their quality of life. As such, wide-spread participation should be perceived as an important policy and cultural undertaking that serves as a vehicle for engagement to ensure context-appropriate intervention and the mobilisation of citizens in the creation of smart initiatives. Participation in this regard, as Arnstein (1969) points out, becomes valuable in that it advocates a redistribution of power and the consideration of who participates and when (Castelnovo, 2016:103). With reference to Arnstein's Ladder of Participation, participation therefore involves not necessarily an increase in public engagement but what where the mode of participation is considered in order to allow for the interaction of different contexts and stakeholders at different times. The notion of 'lessening isolation', therefore, relates to Arnstein's participation processes. These include the use of participatory modalities that enable citizen to voice their concerns (informing and consultation). It also entails the redistribution of power and

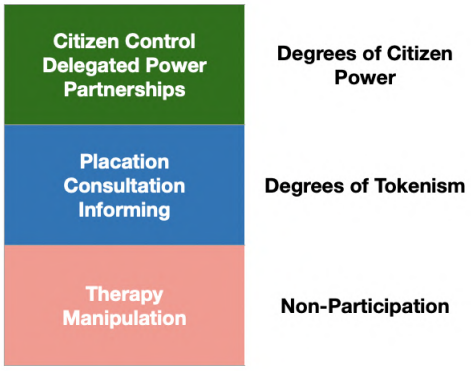

Figure 23: A ladder of citizen participation (Arnstein, 2000:141)

establishment of greater civil autonomy to allow citizens to engage with stakeholders in joint decision-making or planning (partnerships, delegated power and citizen control) (Arnstein, 2000:241). Thus, participation in a Smart City context should also serve as a measure (or indicator) of the degree of co-production within a Smart City strategy or initiative. Furthermore, from a strategic point of view such consideration may permit the identification, initiation and application of Smart City technologies regarding urban service management and its complex interdependencies between stakeholders and diverse contexts (Arroub et al., 2016:2). In this regard the concept of co-creation in the Smart City context is viewed as a strategic point of contact between various city actors and data sources that are utilised in order to shape smart services in a collaborative manner. The SCIEP conceptual model includes awareness of the need to lessen mechanisms of isolation to facilitate broader citizen participation. As mentioned previously, indicators in this regard, therefore, include the following questions: 1) What is the degree of tokenism (i.e, how are citizens informed and consulted)? 2) What is the degree of citizen participation with regard to autonomy, delegated power and degree of partnerships and influence in establishing and/or directing smart initiatives and their benefits (Castelnovo, 2016:103; Arnstein, 1969). Such participation or synergies also require the need to address issues of privacy, security, policies, connectivity models, access to technology, business aims, etc. in order to make cities smart and improve quality of life by using ICT to deliver relevant and efficient smart urban services (Rose, Eldridge and Chapin 2020:4; Suryanegara et al., 2017:21).

21.1.3 Annotation of data and open data towards co-creation

Open data, as a freely shared and distributed online resource, need to answer to certain criteria (or characteristics) for their potential to be mobilised for participating stakeholders or groups towards service creation and innovation (Smart Cities Open Data Guide, 2020:8). This necessitates governance that purposefully uses ICT to interact more effectively with citizens or smart communities by utilising the available

accumulated data to understand and address social problems, as well as initiate new citizen services that are more interactive and democratic, including involving citizens in policy decision making processes (Mellouli et al., 2014:1). Published data, therefore, should bear the following characteristics, according to Nugroho et al. (2015:301):

- Published institutional data should be machine readable to facilitate use and reuse.
- Data should be easily accessible on an online publicly available platform.
- Published data need to abide by proper regulatory standards and formats in order to ensure interoperability between various data sets.
- Published data sets must have an audit trail indicating their original and intended use, as well as a means of interpreting them to facilitate their use and reuse.

21.1.4 EaaS framework

The Organicity project is an Experimentation as a Service (EaaS) framework based on a 3-tier architecture consisting of (1) combined data sources (OC City Sites), (2) a platform layer (Organicity Platform), and (3) an experimentation layer (Eaas API) which represents an ecosystem that supports and substantiates co-created smart services (Gutierrez et al., 2016:4). In addition to an Asset Discovery API component as part of its platform, it also uses an Experimentation Management framework. By employing such a framework, as included in the SCIEP model, a new service or tool identification can be run as monitored experiment in conjunction with a community management service by which to validate services. The experimentation portal should, therefore, include all services and implementation components to promote service deployment through service experimentation by providing user interfaces that support such co-creation of services and experimentation, as well as the discovery of additional assets and allied metadata. As such, the EaaS framework encourages users to experiment with and deploy their own custom urban services which could be a web portal, smartphone application, etc. (Gutierrez et al., 2016:7).

21.2 Open Innovation and Stakeholder Engagement in Smart Cities (Knowledge management)

The Smart City concept insists on enhanced stakeholder interaction between industry, government, society and university. Open innovation constitutes the establishment of value, sustainability and high living standards by activating extensive networking and collaborative engagement amongst all participating city actors and stakeholders, which contributes to a focused innovative action or goal (Paskaleva, Cooper, Linde, Peterson and Gotz, 2015:121). Taking this into account, the SCIEP conceptual model includes knowledge-management capacity as a means of foregrounding the development of applicable social interactions for the communications environment as a way to

control the relationship between knowledge-management capacity and performance outcomes. Taking from Lichtenthaler and Lichtenthaler's (2009:1317) integrative framework, such knowledge management relates to both internal and external management processes. External knowledge exploration outlines the acquisition of external knowledge resources. Internal knowledge exploration relates to an organisation's ability to generate new knowledge by connecting different levels of understanding, where the organisational resources serve as knowledge potentials which, when validated or tested, are transformed into new understanding (Smith, Collins and Clark, 2005:347; Lichtenthaler and Lichtenthaler, 2009:1317). The three organisational resources influencing an organisation's knowledge creation ability are (1) individual or latent knowledge, (2) relational connections and the flow of knowledge amongst stakeholders, and (3) an organisation's knowledge processes and how they activate said knowledge (Hargadon and Fanelli, 2002:299; Smith et al., 2005:347). Furthermore, according to Lichtenthaler and Lichtenthaler (2009:1317), internal knowledge retention is the action of obtaining and preserving an organisation's long-term knowledge, such as a competitive advantage. External knowledge retention, on the other hand, results in preserving knowledge outside an organisation or through inter-organisational connections. Internal knowledge exploitation outlines an organisation's innovative practices and product outcomes as a result of their knowledge application undertakings. External knowledge exploitation involves external or outward-bound knowledge, such as software licensing, technological partnerships, etc. In their knowledge-management model, these authors present six knowledge capacities as a way of capturing and categorising an organisation's internal and external knowledge-management exploration, retention, and exploitation procedures. These six knowledge capacities are: inventive, absorptive, transformative, connective, innovative, and desorptive capacities (Lichtenthaler and Lichtenthaler 2009:1318). Knowledge management processes highlight the importance of activating all producers of knowledge within the urban landscape. As such, these processes attempt to provide an inclusive space in which levels of participation prioritise the generation of opportunities for engagement or agency that can uncover the 'relational context' of a city. In this regard knowledge-management processes may serve as a way of understanding the urban landscape by acknowledging its embedded value (context) as shaped by its citizens (Guma and Monstadt, 2021:362). I now provide an explanation of these capacities.

21.2.1 Inventive capacity

Inventive capacity involves the procedures by which an organisation internally generates and incorporates knowledge into existing structures or expertise. Additionally, the degree of such inventive capacity relates to an organisation's familiarity regarding a particular knowledge domain or recognised need (Lichtenthaler and Lichtenthaler, 2009:1319).

21.2.2 Absorptive Capacity

Absorptive capacity pivots around knowledge acquisition: an organisation's ability to examine outside knowledge and incorporate it into its own knowledge domains. As such, absorptive capacity necessitates that an organisation is able to recognise and relate to potential absorptive knowledge sources (Lichtenthaler and Lichtenthaler, 2009:1319).

21.2.3 Transformative Capacity

This refers to the procedures and levels at which an organisation preserves knowledge as part of its internal knowledge domains, which involves the internal retention and management of knowledge. Transformative capacity requires an ability to reactivate internally retained knowledge in order to generate more knowledge (Lichtenthaler and Lichtenthaler, 2009:1320).

21.2.4 Connective Capacity

Connective capacity refers to the management of external networks that allows for the ability and relational potential of knowledge retention outside an organisation's boundaries. Connective capacity entails the stages connectivity or "interfirm relationships" that support acquisition and retention of knowledge between organisations to the point where such inter-organisational knowledge and connections are even increased. In this light the degree of connective capacity results in an expanded base of knowledge via the involvement of multiple partners (Lichtenthaler and Lichtenthaler, 2009:1321).

21.2.5 Innovative Capacity

Innovative capacity pertains to an organisation's potential to exploit and modify knowledge into value or services. However, the activation of such potential or services from internal and external knowledge exploitation necessitates foregoing knowledge so as to identify available opportunities for innovation (Lichtenthaler and Lichtenthaler, 2009:1321).

21.2.6 Desorptive Capacity

Desorptive capacity includes the identification of potential external knowledge prospects or options, as well as their utilisation for monetary or strategic gain, and how these opportunities can be delivered to beneficiaries through outward knowledge transference (Lichtenthaler and Lichtenthaler, 2009:1322).

21.3 Smart City initiatives and service types

The concept of smart services relates to a city's innovation capacity and capability of providing various service types, products and utilities to stakeholders, by utilising city

infrastructure and resources to improve citizens' quality of life (Anthopoulos, 2017:86). As mentioned previously, in examining Smart City service types the following service classes can be classified:

- Smart energy et al.: smart grids and the use of sensor and wireless networks to monitor an entire city's energy consumption (Rghioui and Oumnad, 2017)
- Smart transportation et al.: decrease traffic congestion by using GPS and sensor networks to track vehicles and road use (Rghioui and Oumnad, 2017)
- Smart healthcare et al.: using sensor and wireless networks to remotely monitor patients' health and provide access to care services (Anthopoulos, 2017)
- Smart safety et al.: the use of digital safety cards to assist in online safety (Anthopoulos, 2017)
- Smart education et al.: the use of online or e-learning platforms that allow for extended or remote access to learning material (Anthopoulos, 2017)
- Smart environment et al.: the use of sensor and wireless networks to monitor and track air quality (Rghioui and Oumnad, 2017)
- Smart planning et al.: developing a Smart City plan to promote sustainability and efficient use of resources (Anthopoulos, 2017)
- Smart tourism et al.: city development of online renting services for unused spaces (Anthopoulos, 2017)
- Smart waste management et al.: the use of sensor and wireless networks to monitor waste containers in order to facilitate optimised collection times and routes (Rghioui and Oumnad, 2017)
- Smart buildings et al.: making use of location- and context-aware services to monitor environmental conditions, such as pollution levels which are then related to users for action (Petrov, Mikhaylov, Moltchanov, Andreev, Fodor, Torsner, Yanikomeroglu, Juntti and Koucheryavy, 2018:2)
- Smart economy et al.: the development of an open data framework to support citizens and economic growth (Anthopoulos, 2017)
- Smart people et al.: investing in the development of a Smart City system that values human capital and knowledge (Kumar and Dahiya, 2017:12)
- Smart living et al.: deployment of sensor and wireless networks for service optimisation, such as monitoring of street lights according to weather, time and movement (Rghioui and Oumnad, 2017)

ISO	ITU
1. E-government	1. Smart water
2. Transport	2. Smart energy
3. Logistics	3. Smart transportation
4. Public safety	4. Smart healthcare
5. Healthcare	5. Smart safety/emergency
6. Energy and resources	6. Smart education
7. Environmental protection	7. Smart tourism
8. Climate change adaptation	8. Smart waste management
9. Community and household	9. Smart buildings
	10. E-government
	11. E-commerce

Figure 24: ISO and ITU smart service classes (Anthopoulos (2017:87)

Figure 27 (p.120) shows smart city service types and service groups (Anthopoulos, 2017:87).
Based on the above-mentioned service classes and types, the SCIEP conceptual model lists the relevant Smart City paradigms that serve as new ways of activating public and participant engagement within an urban setting. This allows for more inclusionary platforms to serve as catalysts for empowering citizens, in order to transform in a bottom-up city management approach and its developmental procedures. These Smart City paradigms include (1) community and people, (2) natural environment and infrastructure, (3) governance, and (4) the economy. It is within these paradigms, and with the establishment of these urban ecosystems, that social interaction occurs within diverse contexts, across different urban settings with multiple associated social, infrastructural and technological characteristics, and that smart services may be realised through a blending of co-created social innovation practices based on actor or user needs (Aurigi and Odendaal, 2022:2). The SCIEP conceptual model includes a set of three indicators as a way to (1) ensure that Smart City initiatives include all inhabitants, (2) enable urban development which responds to the human and functional needs of its people as opposed to sanitised market-driven solutions, and (3) support urban development which captures the texture, complexity and contextual richness of people and places (Aurigi and Odendaal, 2022:9). These three indicators are (1) context, (2) co-design, and (3) deployment. They support the creation of a Smart City - "a participatory innovation ecosystem in which citizens and communities interact with public authorities and knowledge developers" (Oliveira and Campolargo, 2015:2336). Furthermore, they advocate that "cities are smart when they take full advantage of the human capital of its [sic] citizens, create innovation ecosystems where the new dynamics of wealth and jobs creation takes [sic] place and promote new forms of participatory governance" (Oliveira and Campolargo, 2015:2336). I now provide an outline of these indicators.

21.3.1 Context

Context and its analytical phase consist of identifying and emphasising all relevant and participating stakeholders, their current associated initiatives and their contributing factors as these relate to the social context and objectives. Incorporating a measure by which to gauge context within smart city initiatives allows for the identification of citizens' wishes, interests and needs (WIN methodology). The Peripheria project illustrates such a WIN methodology: It adopted a citizen-centric and co-created approach as a means to driving service discovery and the production of urban services which constituted an innovation network that was based on and responsive to citizens' needs (Oliveira and Campolargo, 2015:2338).

21.3.2 Co-design

Co-design should follow the application of the WIN methodology which identifies wishes, interests and needs of citizens and stakeholders and develops solutions through an approach of co-creation in order to develop answers or services with regard to these needs. This involves community collaboration and facilitation which includes (1) rebuilding neighbourhoods, (2) empowering neighbourhoods, and (3) scaling up neighbourhood value. The phase of rebuilding neighbourhoods could involve the availability and use of open data sets across sectors, such as environment, planning, administration and community services by allowing residents to connect with each other and enabling them as users, in order to promote services or improve neighbourhoods (Oliveira and Campolargo, 2015:2340). The empowering neighbourhood phase aims at the establishment of a platform on which data can be annotated or understood against possible outcomes or solutions in a collaborative manner. This may involve the use of crowd-sourcing models, reflecting a citizen-centric viewpoint where service delivery and execution involve and encourage citizens to harness their expertise towards solving government challenges (Linders, 2012:448-450; Oliveira and Campolargo, 2015:2340). The scaling up of the neighbourhood value phase calls for the availability of a platform or experimenter portal which enables citizens to gauge their local context and provide adaptable intelligence that make a host of data sets or local information sources available in order to facilitate better, contextually relevant service creation and improve citizens' quality of life.

21.3.3 Deployment

Deployment should serve to ensure (and evaluate) that the proposed Smart City initiatives, their concepts and implementation strategy - with associated services, products and technologies - are tailored to citizens' needs. It includes the above-mentioned community collaboration and facilitation phases, as well as all stakeholders, i.e academia, civic organisations, industry and citizens, as collaborative partners for the purpose of a co-designed implementation process and accepted model (Oliveira and Campolargo, 2015:2342).

21.4 Measuring and evaluating Smart City Maturity

Smart Cities require a means by which to measure and evaluate, against a set of indicators, their own stages of development and performance. Thus, in the SCIEP conceptual model, I include a set of five variables to be applied as Smart City maturity measures and benchmarking tools. These indicators serve to determine a city's developmental stages in relation to its Smart City trajectory, as well as to ensure best practice and evaluation of Smart City projects. The measurements are (1) strategic intent, (2) data use, (3) technology, (4) governance, and (5) stakeholder engagement. These variables can also be thought of as stage-based or sequential in nature, as they build on the preceding indictor or measurement in order to move towards full Smart City implementation.

21.4.1 Strategic intent

According to Yesner and Ozdemir (2017:2), investment in Smart Cities and their overall development is driven by, and responsive to, a broad set of key variables that include (1) a growing urban population, (2) environmental and climate changes, (3) the adoption of enabling technologies, such as AI, Big Data analytics and other emerging, transformative technologies for improved service delivery and creation of new services and product, and (4) the need to remain relative and resilient in a changing technologically driven world with the creation of services and products that are responsive to citizens' needs (Yesner and Ozdemir, 2017:2). These authors caution that Smart City initiatives require a new form of digital urbanism which should include (1) better funding and partnership or wider stakeholder engagement, such as academia, industry and civil society, (2) providing access to expertise to facilitate understanding the dynamics and interrelatedness of cities and their heterogenous context and thus improve operational efficiency, (3) the mobilisation of citizen engagement and transparency in the setting up of Smart City initiates in order to promote government transparency and trust, as well as active citizen participation and co-creation processes, and (4) the development of new skills or 'smart' people in data sciences, data analytics, security, etc. which would support and drive Smart City projects (Yesner and Ozdemir, 2017:3). This also relates to the development of Smart City systems that value human capital and knowledge (Kumar and Dahiya, 2017:12). As such, the measure of strategic intent gauges Smart City maturity against a set of 5 descriptors. These are (1) ad hoc, (2) opportunistic (3) repeatable, (4) managed, and (5) optimised (Yesner and Ozdemir, 2017:3). I now provide an explanation of these five descriptors.

Ad hoc In the ad hoc stage, projects are initiated as tactically or departmentally based without the required strategic or organisational shift in terms of structure, governance and coordination. The ad hoc stage attempts to demonstrate the value of Smart City deployment by implementing pilot Smart City projects and is largely driven by technologies as opposed to context.

Opportunistic In the opportunistic stage, Smart City initiatives are further supported by stakeholders and driven by a strategic direction. Another purpose of the opportunistic stage is to identify initial successful pilot projects as opportunities

for understanding success factors, as well as for generating stakeholder buy-in and encouraging collaborative practices by developing open data policies and making open data publicly available. This stage also initiates the restructuring of governance focusing on sustainable governance, alliances and organisational design and allowing for more innovative governance and collaboration practices amongst all city actors or stakeholders in the attempt to realise the Smart City and its ecosystems (Yesner and Ozdemir, 2017:5).
Repeatable The repeatable stage seeks to enhance and integrate Smart City strategies across projects and organisations as a way of improving the application of data and information/data usage and to establish standardised processes, as well as collaboration, amongst various external stakeholders in order to upgrade services, performance and products.
Management The management stage highlights the Smart City strategy as a formalised strategy the implementation of which requires the participation of internal and external stakeholders. This stage perceives Smart City investment and deployment as a sustainable city model involving and requiring interaction and support from citizens, academia and private enterprises as the Smart City needs to form part of the urban design and structure. This stage should include all formalised KPIs, documentation and specified outcomes with sustainable business models involving wider stakeholder engagement (i.e. Quadruple Helix) (Yesner and Ozdemir, 2017:6).
Optimsed The optimised stage emphasises the need for a system that is integrated across various other systems and which is conducive to an innovative landscape that uses emerging technologies and collaborative practices in order to improve services, enhance citizens' quality of life, support Smart City objectives and attract investments. This stage should also allow for autonomy "within an integrated system of system" (Yesner and Ozdemir, 2017:6).

21.4.2 Data use

The data-use indicator includes all citizen data, open data, data discovery and its analysis, and data protection, as well as the integration and sharing of such data in order to facilitate better decision-making and planning, in addition to new service implementation and business innovation. It also deals with the availability of open data for more transparent governance practices in an urban environment. Smart Cities and their linked platforms operate within a data-driven environment which generates large quantities of data by managing the following: (1) data quality, (2) data integration, (3) privacy issues, (4) delivery versus need, and (5) access. These data offer citizens and stakeholders value in their (the data's) ability to facilitate the creation of services or products. This is echoed by Abella, Ortiz-de-Urbina-Criado and De-Pablos-Heredero who state that "[t]he reuse of Smart Cities' data to create added value and innovative services is a key element, advising that cities need to consider the implementation of ecosystems which support services that cultivate all-inclusive value" (Abella et.al., 2017:51).

21.4.3 Technology

The technology indicator includes an evaluation of architectures, platforms, IoT adoption, citizen or crowd-sourced data architectures where relevant technology is deemed the enabler of Smart City development. This indicator also deals with the integrity and availability of data as acquired through "connectivity technologies", and the analysis and extraction of information from such collected data towards service deployment and better decision-making (Yesner and Ozdemir, 2017:14). This is important, especially in perceiving smart service offerings as being initiated and transferred through several and varied subsystems, each of which with its own infrastructure, software and functional requirements. From this perspective the following types of transactions within a Smart City architecture are noted as occurring between users and subsystems (Anthopoulos, 2017:36):

- "Information and service requests (demand side end-users)"
- "Information and service delivery (supply side end-users and subsystems)"
- "Information and service requests (demand side subsystems)"
- "Information and service delivery (supply side subsystems)"
- "Information storage (demand side subsystems)"
- "Information retrieval (supply side subsystems)"

21.4.4 Governance

Smart Cities aim at enhancing the performance and sustainability of an array of urban services including an evaluation of context-specific governance, economy and inclusiveness, and the advocation of social and environmental interrelatedness (Arroub et. al, 2016:1). Thus, Smart Cities and the creation of smart environments are considered complex endeavours due the many associated domains and challenges, including governance, energy, environment, mobility, multi-actor economy, stakeholders, citizenry, service providers, objectives, etc. In the SCIEP conceptual model, governance, combined with IoT and its ubiquitous systems, serves as an indicator of Smart City maturity and is the foundation for establishing smart environments. Furthermore, by using IoT technologies, as well as ambient and artificial intelligence, the process of establishing smart environments may leverage other connected systems that could lead to a more human-orientated smart environment (Gomez et al, 2019:28 and 39). Better governance within a Smart City is required in order to ensure and operationalise Smart City implementation. One such issue pivots around what van Deursen and Mossberger call a "paradox of skills" which refers to a potential lack of individual digital skills needed to both address the rapid rate of evolution of cyberspace and the required means to navigate such increasing complexity (van Deursen and Mossberger, 2018:124). More specifically, these skills deficits relate to (1) operative skills, (2) formal expertise and characteristics, (3) an

ability to select, analyse and interpret information, (4) an ability to communicate information, (5) an ability to generate content, and (6) an ability to apply knowledge and information strategically towards an improved quality of life or services (van Deursen and Mossberger, 2018:127). Governance represents the emergence of a so-termed smart governance structure by which interaction with stakeholders, policies and procedures is driven by the application of ICT and emerging technologies in setting up co-creating services, assisting with governing actions, and improving government transparency, infrastructure and citizenry (Gil-Garcia et al., 2014:17; Anthopoulos, 2017:264). Kumar and Dahiya further describe smart governance as one shared and interlinked component amongst other components which include smart people, a smart city economy, smart mobility, smart environment and smart living, to form cooperatively a Smart City system. Smart governance, in Kumar and Dahiya's Smart City model, features the following aspects, as also incorporated in the SCIEP model (Kumar and Dahiya, 2017:16):

- Governance that exhibits "accountability, responsiveness, and transparency"
- "Urban and city regional governance utilising big data, spatial decision support systems and related geospatial technologies"
- E-governance that is beneficial to all residents
- "Deliver[s] public services efficiently and effectively"
- Practises "participatory policy-making, planning, budgeting, implementation, and monitoring"
- Establishes "clear sustainable urban development strategy and perspectives known to all"
- "Utilises creative urban and regional planning with focus on the integration of economic, social, and environmental dimensions of urban development"
- Incorporates "effective, efficient, and people-friendly urban management"
- "Practices E-Democracy to achieve better development outcomes for all"
- "Embraces a Triple Helix Model in which government, academia and business/industry practice changing roles in governance"

21.4.5 Stakeholder engagement

From a Living Labs perspective, open innovation represents and includes a citizen-guided innovation approach. Through the use of ICT, this is aimed mainly at establishing conditions for self-governing (democratic) innovation and co-creating city services within the Smart City context (Oliveira and Campolargo, 2015:2336). This, according to Paskaleva et al. (2015:116), includes and advocates the "importance of social and relational capital in urban development" by digitally including citizens

in the creation of services that address their needs and improve their quality of life. Therefore, stakeholder engagement in the SCIEP model contains a set of indicators or variables by which to manage such innovative engagements and the development of collaborative innovation practices needed to move towards "a smart open innovation urban ecosystem" (Paskaleva et.al., 2015:116). This is important as it locates open innovation as a citizen-driven, context-sensitive approach seeking to unlock the social capital and interstices of people and place as supported through ICT implementation to generate new value or services. Such engagement also insists on enhanced stakeholder interaction in the Quadruple Helix Innovation Model where such open innovative interactions and co-created processes stimulate new city services. Therefore, in the setting up of Smart City services, authors Paskaleva et al. present a sequential four-step engagement procedure for stakeholder engagement towards ensuring the co-design of services. These include (1) stakeholder enlistment involving relevant and required stakeholders, (2) stakeholder enrolment involving the recruitment of required or needed stakeholders, (3) stakeholder dialogue involving the construction of consensus based on involved stakeholder needs or objectives, and (4) stakeholder innovation networks involving active stakeholder participation in both an approved service objective or outcome and a co-design process (Paskaleva et al., 2015:128). I now provide an outline of the sequential four-step engagement procedure towards the establishment of co-designed services.

Stakeholder enlistment This aspect takes cognisance of the need to integrate and develop a smart citizenry where such integration and development forms part of the development of Smart City systems that value human capital and knowledge (Kumar and Dahiya, 2017:12). Furthermore, smart citizenry constitutes a core element as it refers to active citizenry and participation as crucial for a functional Smart City (Paskaleva et al., 2015:131; Kumar and Dahiya, 2017:55;). Additionally, it advocates that an understanding of when and which stakeholders to engage is vital for effective co-production initiatives. This suggests that stakeholder engagement processes not only involve experts but stakeholder communities as well, such as Communities of Place, Communities of Interest and Communities of Practice (Paskaleva et al., 2015:132).

Stakeholder enrolment Stakeholder enrolment includes and considers all identified and participating stakeholders as it pertains to specific outcomes or service objectives. This would ensure active citizenship within the co-design process, as well as motivate stakeholders through "shared or desired outcomes" (Paskaleva et al., 2015:132). These "shared outcomes" also serve as success indicators tied to specific co-produced services or objectives. Stakeholder enrolment also considers the contextual variances of all participating stakeholders to ensure and implement adaptable and appropriate strategies within the co-design and co-production process (Paskaleva et al., 2015:135).

Stakeholder dialogue This aspect includes and considers all methods of engagement to stimulate the mobilisation of stakeholder input, as well as focus on improved transparency and trust by engaging with stakeholders through channels and technologies that are available to them. This includes considerations regarding specific strategies of engagement amongst various stakeholders, i.e., whether direct or indirect communication is advisable to understand stakeholder needs and to improve trust and transparency "through social interaction and participatory activities" (Paskaleva et

al., 2015:135). The use of ICT and other emerging technologies can play a significant role in supporting such dialogue.
Stakeholder innovation network This aspect takes into account the associated governance structure as linked with various co-design objectives and outcomes. It also considers, and should make visible, the associated structures and interrelatedness of co-design services as a means of encouraging innovation, communication and exchange across networks which should be influenced by or based on a city's larger developmental narrative and its objectives. For instance, it should list or make evident related domains, its associated projects and focus areas, user groups and partners (Paskaleva et al., 2015:137). I now provide an outline of the 3-stage indicators by which to assess Smart City maturity as a data-driven innovation and value creation process within a Smart City context, as put forward by Abella et al. (2017).

21.4.6 Stage one: reusability

This evaluative aspect of the framework highlights the importance of the reusability of published open data which facilitates value creation. This "reusability degree" and its analysis also help to uncover the conditions that incentivise data reuse. It emphasises the need for channels that will allow comment and user-feedback as part of the process of value creation. Moreover, it includes evaluation metrics named MELODA (Metric for the Evaluation of Open Data) and containing six dimensions, namely (1) legal, (2) access, (3) technical standard, (4) data model, (5) geo-location, and (6) real-time metrics by which to assess data reusability (Abella et.al., 2017:49). The first dimension refers to the legal rights and privileges associated with data and their impact on providing access to such data. The second aspect deals with access to data, its channels and associated technological requirements. The third aspect includes the technical standards applied to data and, as such, also underscores data interoperability across networks. The fourth dimension evaluates data regarding their reusability and the structuring of data that facilitates service creation or improved processes. Thus, this dimension also deals with the annotation and publishing of data. The fifth aspect concerns the analysis of data sets, such as geographical data and other systematised data sets in order to promote their reuse and facilitate urban connectivity. The sixth and last dimension incorporates the use of real-time data in order to drive innovation (Abella et al., 2017:49).

21.4.7 Stage two: innovation

This aspect of the framework focuses on the degree of innovation as a consequence of data reuse and its potential. It also attends to the organisational structure of networks or the associated interrelatedness of stakeholders and city participatory networks which drive the creation of innovative services through data reuse. Another central point to this dimension is it concern with the legality of data reuse towards enabling the innovation of services. It considers a city's topology, such as the availability of digital resources, infrastructure, population, location, etc. and how it affects the ability to innovate. Measurable indicators include an analysis of the degree of service usage

along with user or citizen feedback regarding the usability of city data (Abella et al., 2017:50).

21.4.8 Stage three: evaluation

The third evaluative stage identifies a data-driven Smart City as a context-based ecosystem in which the creation of innovative services and products is analysed and measured alongside their social, economic and human impacts. As such, its approach allows for the analysis of multiple context-specific ecosystems as part of a larger Smart City ecosystem which consists of three core factors, namely (1) the city as data source, (2) citizens as active users of products and service deployment, and (3) stakeholders that use and reuse data. These core factors are further analysed with regard to three dimensions, namely their economic impact, social impact and the degree of direct or indirect involvement of participating actors or stakeholders. Measurable indicators in the domain of economics could include a reduction of costs or an increase in income as consequence of data use and re-use within a Smart City ecosystem. The social indicators relate to (1) the level of direct or indirect engagement, (2) level of experience, (3) trust, and (4) security. It is important to note that this dimension may require an assessment of stakeholder ecosystems and city infrastructure in order to prioritise innovative initiatives, their focus and to unlock real value (Abella et.al., 2017:51).

21.5 Smart City domains and Focus Areas

It is worth noting that the Smart City concept defies a precise definition as different cities hold unique and underlying ideological differences. Despite these theoretical variants, literature recognises three core factors in defining the Smart City concept and its aim of resolving inner-city problems linked to public service availability, environmental sustainability, congestion, population density, inequality and liveability, infrastructure and management, and smart services. These factors are (1) technological implementation, hardware and software frameworks, (2) the use of technological solutions to improve people and communities, emphasising creativity, heterogeneity and education, and (3) institutional governance and policy assistance (Lee et.al, 2014:82; Anttiroiko et.al, 2014:325). Smart City implementation and its developmental processes contain a set of interrelated preferences and approaches, as examined along factors including city infrastructure, ICT innovation and service deployment, people and community, governance, environment, etc. Additionally, authors Anthopoulos et al. identified and synthesised over twenty Smart City developing or benchmarking criteria, resulting in six benchmarking categories which address (1) smart city progress, (2) smart city monitoring, (3) city capacity, (4) city sustainability, (5) resilience, and (6) policy impact (Anthopoulos et al., 2016:9). Their paper also included an analysis of existing Smart City conceptualisation models, consequently arriving at a "Unified Smart City Model" (USCM), composed of eight classes addressing Smart City "architecture, governance, planning and management, data and knowledge, energy, health, people and environment". Their USCM summarises and recognises existing Smart City dimensions and conceptualisation viewpoints (Anthopoulos et al., 2016:12).

An overview of Smart City dimensions, as captured in the SCIEP model, is provided below.

21.5.1 People and Living

The clustering of people and living supports the concept of a Smart City as the implementation of urban intelligence, or the transformation of the urban landscape, using ICT to understand and value the complex connection between place and its potential social capital. As such, it signals the representation of various city stakeholders as linked to urban places and social practices that are complex and embodied through a connected exchange of data sources that exist between a city's physical and digital spaces (Roche, 2016:6; Acedo, Painho, Casteleyn and Roche, 2018:1). Therefore, as a domain, People and Living includes several factors pertaining to (1) an investment in the development of a Smart City system that values human capital and knowledge (Kumar and Dahiya, 2017:12), (2) the use of online or e-learning platforms that can allow for extended or remote access to learning material or smart education, as well as support lifelong learning (Anthopoulos, 2017; Giffinger et al., 2007:12), (3) the improvement of citizens' quality of life, encouraging democratic discourse and helping promote a more active citizenry that addresses other aspects, such as security, health, housing, tourism, etc. (Hollands, 2008:315; Giffinger et al., 2007:12), and (4) social integration across various other systems which is conducive to an innovative landscape that uses emerging technologies and collaborative practices in order to improve services, enhance citizens' quality of life, support Smart City objectives and attract investments (Yesner and Ozdemir, 2017:6; Giffinger et al., 2007:12).

21.5.2 Environment and Mobility

In tandem with the advancement of the urban environment, the overall developmental needs of cities have increased in complexity as well. This is ascribed to an increase in population density which brings with it an intricate interchange between the economic, spatial and social structures (Madakam and Ramachandran, 2015:34). Such complexity and concentration are marked by a city's spatial and operational requirements by which it seeks to validate and support its existence through various production, proliferation and dissemination processes (Anttiroiko, 2015:23). From a technical standpoint, the complex ecosystem of a city is composed of a myriad of systems, subsystems and multi-level heterogeneous and collective processes and data sources. The result is that a city manifests aspects of exponential growth, technological heterogeneity, structural complexity, external interchange, interoperability with new and legacy systems and continuous development. The domain Environment and Mobility, therefore, includes several factors pertaining to (1) the use of smart mobility or e-vehicles combined with Geographical Information Systems (GIS) in order to ease city congestion and lower pollution (Medina, Perez and Trujillo, 2017:702-703; Rghioui and Oumnad, 2017), (2) smart resource management systems that monitor and collect data through a number of sensors with a view to reducing wastage and maintenance

costs (Medina, Perez and Trujillo, 2017:702-703), (3) infrastructure leveraging the pervasive and ubiquitous nature of IoT devices to facilitate device interaction and exchange via both mobile and fixed nodes (Sanchez et al., 2014:222-224), (4) environmental monitoring, i.e., leveraging IoT technologies to monitor and measure large urban environments in which various sensors are deployed as environmental indicators constantly tracking pollution levels, noise levels, etc. (Sanchez et al., 2014:222-224), (5) the use of participatory sensing, i.e., making use of mobile phone technology and its sensors, such as GPS, to aggregate environmental variables where individuals may become both producers or consumers of such tracked environmental data or report certain city instances as part of a subscription service model (Sanchez et al., 2014:222-224), (6) smart buildings and smart services, i.e., making use of location and context aware services to monitor environmental conditions, such as pollution, traffic levels which are then related to users for action (Petrov, Mikhaylov, Moltchanov, Andreev, Fodor, Torsner, Yanikomeroglu, Juntti and Koucheryavy, 2018:2), and (7) the integration of e-services and access to a variety of city services, such as tolls or transportation systems, etc. (Giffinger et al., 2007:12; Madakam and Ramaswamy, 2015:3).

21.5.3 Governance

The Smart City context and its initiatives require engagement practices that allow citizens and various stakeholders to effectively participate in directing urban progress. As a result cities have needed to find improved governance processes (Chourabi et al., 2012:2292; Rodriguez-Bolivar, 2015:3; Hsieh, Chen and Lo, 2015:164). Therefore, governance, as a domain, includes several factors pertaining to the integration and utilisation of a host of enabling technologies, such as sensors, heterogeneous IoT networks/architectures and human-computer interfaces. Technology, governance and citizenry need to be considered to achieve the synergy known as a Smart City in order to support a city's vision and strategic objectives. In the SCIEP model, governance concerns actively making use of ICT (known as smart governance) to better interact with citizens or smart communities by leveraging the available accumulated data in order to understand and address social problems, as well as initiate new citizen services that are more interactive and democratic, including involving citizens in policy decision-making processes (Mellouli et al., 2014:1). It, therefore, also highlights the transformational impact of co-production processes within an urban landscape involving the redistribution of power relations between governance and citizens (Castelnovo, 2015:4; Anthopoulos, 2017:285).

21.5.4 Economy

Economy, as a domain, relates to and includes the concept of the Smart City as fostering an innovative economic landscape that reaffirms and highlights the importance of a knowledge economy in fostering citizen participation towards service innovation and the development of an enterprise friendly environment. It relates to the integration of knowledge as an asset which, when combined with

technological advances, assists in the generation of new knowledge or innovations in the realm of "urban competitiveness, welfare, growth, education, health, transportation, communications, and the use of technology innovations to foster citizen participation and the governance of cities" (Gil-Garcia et al., 2016:529). In the SCIEP conceptual model, economy relates to other factors as well, such as (1) the development of an open data framework to support citizens and economic growth, as pertaining to innovation, competitiveness, reducing social exclusion and entrepreneurialism (Anthopoulos, 2017; Gil-Garcia et al., 2016:529); (2) city development of online renting services for unused spaces or resources (Anthopoulos, 2017), and (3) smart people - investing in the development of a smart city system that values human capital and knowledge (Kumar and Dahiya, 2017:12). In addition to the above-mentioned factors, the SCIEP conceptual model proposes measures which would support stakeholders and communities in (1) "understanding how cities operate, (2) defining city objectives and stakeholder roles, and (3) understanding the role of ICT within physical city assets" (Falconer and Mitchell, 2012:3). CISCO's Smart City Framework, as shown in Figure 28 (p. 133) represents a logical and four-layered approach, starting with city objectives, by which to evaluate city projects in consideration with other associated variables, such as design and implementation requirements, best practices, policy requirements, funding and benchmarking. Layer 1 establishes top-level city objectives in relation to stakeholders, city management, policies and initiatives. The second layer allocates a set of existing and defined city indicators by which to assess and benchmark city objectives and their success. As cities are complex and varied in nature, the appropriateness of such defined methodologies or indicators needs to be aligned with both the focus of the objectives and a city's overall goals. CISCO mentions the Global City Indicators Facility (GCIF), Mercer Quality of Living Survey and the Green City Index as potential indexes. Figure 29 (p.134) illustrates the SCIEP conceptual model. The model highlights seven key factors to consider when initiating or deploying Smart Cities. These top level factors are (1) data, (2) co-production, (3) citizen participation, (4) knowledge management, (5) Smart City initiatives, (6) Smart City maturity, and (7) Smart City domains. Second level domains, such as "Local Network Development", etc., pertain to unlocking strategic objectives. The model also provides a third level under the heading of "Approach/Indicators" by which to evaluate or track Smart City initiatives or deployment either as an overarching strategy or a stage-based model.

21.6 Conclusion

21.6.1 Significance and contribution of SCIEP conceptual Model

The SCIEP conceptual model is a framework by which to imagine or characterise what a Smart City and its initiatives can be when focused as an engagement practice involving all participating city stakeholders and users. It contributes to understanding Smart City implementation as a data-driven approach. Additionally, the establishment of urban intelligence, through widespread ICT deployment and exchange, serves as agency, combined with co-production and collaborative practices, towards the uncovering and establishment of "data-driven innovation" and value (i.e. creating

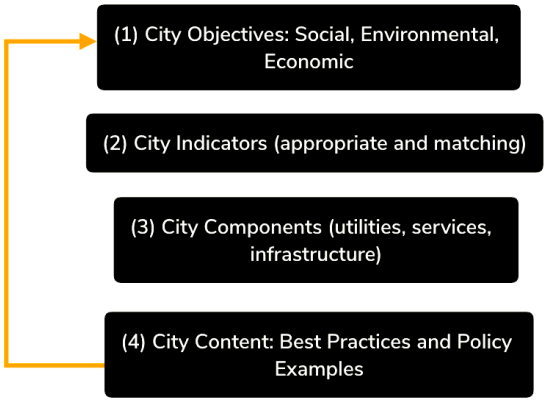

Figure 25: CISCO Smart City Framework Layers (Falconer and Mitchell, 2012:5)

new products and services) within a digitally driven ecosystem known as the Smart City (Abella et.al., 2017:51). The SCIEP conceptual model also takes into account the complexity and heterogeneous nature of modern urbanisation and the challenges many cities face in establishing relevant Smart City solutions. The model also offers the mechanisms and processes to be included in the creation of services, specifically in understanding how data - and access to data - within the Smart City concept add societal value through the synergy created by the exchange of data paired with citizen participation, a co-creation process and knowledge management approaches (Abella et.al., 2017:51). The SCIEP model adds to current academic debate by gaining a better understanding of the role that data, and producers and consumers of data, play in supporting various stakeholder engagements and governance practices when developing Smart City services. It offers a model which foregrounds collaborative engagement practices to ensure that smart initiatives and their deployment are well aligned and appropriate in relation to various participatory networks and community engagement practices to establish a more inclusive and active citizenry (Anttiroiko, 2015:26). It also offers a way to interpret Smart City implementation by considering the context in which it operates in order to unlock its value and potential for providing new services to citizens, to improve their quality of life and enhance social and economic transformation.

21.6.2 SCIEP Axis and its Meaning

The SCIEP conceptual model imagines Smart City implementation as being citizen-centric in its approach, involving participation by all city stakeholders in the establishment of co-created and data-driven ecosystem known as the Smart City. It does this by considering Smart City implementation as the establishment of urban

Domains (Quadruple Helix)	Data (Lim, Kim and Maglio, 2018:94)	Co-Production (Castelnovo, 2015:4)	Citizen Participation (Simonofski et al., 2017:3)	Knowledge Management (Lichtenthaler and Lichtenthaler, 2009:1318)	Smart City Initiatives (Chourabi, Nam, Walker, Gil-Garcia, Mellouli, Nahon, Pardo and Scholl, 2012:2294)	Smart City Maturity IDC Smart City Maturity Model (SCM) (Alliance, 2014)	Smart City Domains (Cohen Boyd , 2012)
Inclusion	Local Network Development	Driven by Civil Society	Citizen as Democratic Participant	Knowledge exploration, Retention and Exploration	People and Community	Strategic Intent Data Use Technology Governance Stakeholder Engagement	People and Living
Infrastructure	Local Operational Management	Combination between Civil Servants and Citizens	Citizen as Users	Knowledge Exploration, Retention and Exploitation	Natural Environment and Infrastructure	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Environment and Mobility
Governance	Preventative Local Administration	Combination between Civil Servants and Citizens	Citizens as Co-Creators	Knowledge exploration, Retention and Exploitation	Governance	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Government
Economy	Local Information Diffusion	Driven by Citizens and Communities	Citizens as Co-Creators and Users	Knowledge exploration, Retention and Exploitation	Economy	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Economy
Approach / Indicators (serves as interview protocol)	1. Managing Data 2. Integration 3. Privacy Issues 4. Delivery versus Need 5. Access	1. Experiment portal 2. Lessen Isolation 3. Annotation of Data 4. City Scale Opportunistic Data Collection 5. EaaS Framework		Knowledge Capacities 1. Inventive 2. Transformative 3. Innovative 4. Absorptive 5. Connective 6. Desorptive	1. Context 2. Co-Design 3. Deployment	1. Stage 1 2. Stage 2 3. Stage 3	1. Understands Smart City concept 2. Provides Evaluative Framework 3. Understands Relationality of Factors

Figure 26: SCIEP conceptual framework (Author's construct, 2020)

intelligence through widespread ICT deployment and exchange, combined with co-production and collaborative practices towards the uncovering and establishment of "data-driven innovation" and value (i.e creating new products and services) within a digitally driven ecosystem (Abella et.al., 2017:51). As such, the SCIEP model provides a set of variables by which to activate or establish Smart City implementation which enables social and economic evolution, taking into account the contextual nuances of a city and its wider developmental objectives, such as bridging the digital divide (Boyle and Staines, 2019:26). As such, the SCIEP model also advocates Smart City implementation that facilitates the creation of a more inclusive citizenry and in which citizens are perceived as prosumers (both producers and consumers of content) within the digital urban environment, therefore calling for a bottom-up approach and more participatory governance models to solve urban challenges and understand required city and stakeholder needs (Gutierrez et al., 2016:4). The SCIEP model and its axis, which I discuss below, offer a multi-dimensional approach by which to imagine Smart City implementation as either an overarching strategy from which to work or as a stage-based implemented model towards initiating and driving Smart City initiatives or measure projects, taking into account the needed considerations as they pertain to the contextual interstices, people, domains and associated resources towards mobilising public and stakeholder value.

21.6.3 The vertical axis of the SCIEP model

The vertical axis of the SCIEP conceptual model serves as a stage-based model for Smart City implementation. It can be thought of as a means of initiating scalable and practical citizen centric solutions, that form part of a city's innovation strategy and ecosystem. For example, in the domain of citizen participation, implementation could have as its focus seeking to permit engagement of collaborative digital practices and environments with citizens and the city, by leveraging citizens as city partners of an urban innovation platform (Madakam and Ramaswamy, 2015:3). As captured in the domain, this could be achieved either through perceiving citizens as (1) democratic participants, (2) citizens as users, or (3) citizens as creators of services. This is important as successful Smart Cities and their service delivery require new ways of public and participant engagement within an urban setting, that allow for more inclusionary platforms to serve as catalysts towards empowering citizens and to transform city management services (Burt, 2001:298; Paskaleva et al., 2015:131). Similarly, as captured in the "Data" component, the model highlights the potential usage of data as they relate to (1) developing a local community and how citizen-generated data can be reused to help users, (2) local operational management and how data from service providers can be used to improve government and company processes through improved data interoperability, (3) preventive local administration and how data from various companies, users or service providers are captured and leveraged in order to better understand the urban context and problem areas, as well as increase operational efficiencies, and (4) local information diffusion and how data from service providers and customers are leveraged for their usefulness to wider citizenry or stakeholders (Lim et al., 2018:93). These components can also work in

tandem in the sense that the overall focus could be on data-use and the development of local network whilst being responsive to how it relates to aspects, such as knowledge management and how knowledge is leveraged for innovation or transformation.

21.6.4 The horizontal axis of the SCIEP model

The horizontal axis of the SCIEP model, therefore, highlights all key Smart City components as they relate to understanding Smart City implementation as a citizen-centric practice that operates within and contends with complex urban environments bearing diverse heterogenous contexts and urban challenges. Its components (horizontal axis), therefore, serve as essential recommendations in perceiving or modelling Smart City implementation as a co-created ecosystem through an ongoing urban debate that utilises these components of Data, Co-production, Citizen Participation, Knowledge Management, Smart City Initiatives, Smart City Maturity and Smart City Domains, in order to ensure that smart initiatives and their deployment are well aligned and appropriate in relation to various inclusive participatory networks and community engagement practices (Rodr´ıguez-Bol´ıvar, 2015). Furthermore, these key components and their activation as a framework for deployment ensure a better understanding and interpretation of what Smart City implementation should be in order to unlock its value with regard to providing new services to citizens, improving their quality of life and enhancing social and economic transformation and the advancement of a local more inclusive environment, while also focusing on adaptive, scalable and practical citizen-centric solutions as part of a city's innovation strategy and ecosystem (Guti¨errez, Amaxilatis, Mylonas and Mun¨oz, 2018:668). For example, the "Data" dimension calls for a data-driven Smart City approach where the activation of data is used as a tooling sport of Smart City initiatives. This dimension calls for consideration of issues, such as (1) associated challenges and required needs in dealing with a vast increase in generated data across distributed networks and data sources, (2) the structuring of data from several sources, such as sensors or city traffic cameras, etc., (3) the need for real-time data processing across city infrastructure and management, and user level, and (4) ensuring data reliability and value as gathered from several data sources (Santana et al., 2017:6). Furthermore, the "Data" domain considers the application of data analytics that support the application of IoT in matters, such as smart transportation, smart healthcare, the smart grid, etc. It also calls for a data-driven co-created city drawing on an array of distributed IoT technologies, data sources and data sets in order to resolve inner-city problems linked to better public services and an improvement in citizens' quality of life. This includes the leveraging of open data and the needed considerations with regard to making sure that (1) data are machine readable and facilitate use and reuse, (2) data are easily accessible on a publicly available online platform, (3) published data follow proper regulatory standards and formats in order to ensure interoperability between various data sets, (4) published data sets have an audit trail indicating the original, intended use which facilitates the interpretation of data sets and their use and reuse, (5) the need for a legal regulatory open data government framework that governs published data according to stakeholder concerns,

(6) the need to define operational processes as a collective in order to regulate published data, as well as ensure data use, reuse and interoperability across data sets, (7) the need to generate and facilitate data interaction points between users in order to foster data supply and demand, as well as ensure data relevance and quality, (8) the need for a designated group of experts who manage a city's open data processes, and (9) the need to create and increase data demand in order to promote such issues as government transparency, efficiency improvement, and social and economic development (Nugroho et al., 2015:303). The components of Co-Production and Citizen Participation relate to garnering citizens participation in relation to planning and deployment of smart initiatives. As a set of recommendations, it centres around the need to establish collaborative citizen engagement and alternative forms of urban governance that allow citizenry and other stakeholders to collaboratively be part of the design and planning of urban spaces. This set of components supports a number of modalities of participation, as well as understanding the levels of participation within a Smart City, especially with regard to the context of the city and its people (Cardullo and Kitchin, 2019:5). Furthermore, citizen participation is seen as the means by which to enable public engagement, where digital communication tools are leveraged for their capacity to facilitate social conduct. As such, these tools often serve a mediating role towards activating aspects, such as co-production driven by citizens and communities, or citizen participation where citizens are co-creators and users of services (Niederer and Priester, 2016:137). Co-production and citizen participation, therefore, supports the application of digital tools to function as shared social objects towards identifying networks and their organisational conditions, as well as the "socio-material conditions" of communities or neighbourhoods (Niederer and Priester, 2016:137). Additionally, co-production and citizen participation reinforces sustainable forms of participation, and public and citizen engagement, centred around addressing public interests. Participation towards sustainability, therefore, includes the reconciliation of contextual nuances of place and space across the urban domains of economics, social factors and environment. It also supports participation, such as collaborative design, participatory decision-making, public discourse, participatory design challenges, policy integration and public resonance (Joss, 2014:49). The component Knowledge Management highlights the need to unlock latent urban value by supporting enhanced stakeholder interaction between industry, government, society and university. It, therefore, includes considerations around matters, such as open innovation and facilitating collaborative engagement amongst all participating city stakeholders towards a focused innovative action or goal (Paskaleva, et al., 2015:121). It includes a number of ways by which to leverage such engagement including inventive, absorptive and transformative capacities, etc. (Lichtenthaler and Lichtenthaler, 2009:1321). The Smart City Initiatives component highlights key Smart City paradigms. These Smart City paradigms include (1) community and people, (2) natural environment and infrastructure, (3) governance, and (4) economy. It is within these paradigms, and with the establishment of these urban ecosystems in which social interaction occurs in diverse contexts, across different urban settings and with multiple associated social, infrastructural and technological characteristics, that smart services may be brought about through a blending of co-created social innovation practices

based on actor or user needs (Aurigi and Odendaal, 2021:2). The Smart City Maturity measures as part of the domain ways to determine a city's developmental stages in relation to its Smart City trajectory, as well as to ensure best practice and evaluation of Smart City projects. These measurements are (1) strategic intent, (2) data use, (3) technology, and (4) governance and stakeholder engagement. These variables can also be thought of as stage-based or sequential in nature, building on the preceding indictor or measurement in order to move towards full Smart City implementation. The component Smart City Domains highlights the key focus areas and factors towards establishing a Smart City that aims at resolving inner-city problems linked to public service availability, environmental sustainability, congestion, population density, inequality and liveability, infrastructure and management, and smart services. These domains relate to (1) technological implementation, hardware and software frameworks; (2) the use of technological solutions to improve people and communities, emphasising creativity, heterogeneity and education; and (3) institutional governance and policy assistance (Lee et al., 2014:82; Anttiroiko et al., 2014:325). The bottom row titled "Indicators" provides a set of variables or guidelines by which to test or measure the extent or successful implementation of initiatives according to their corresponding SCIEP components. For example, under the "Data" component five variables are highlighted by which to test data-driven Smart City deployment. These variables are used to measure aspects, such as how data are managed in relation to local network development, and to what degree they are accessed, integrated and delivered.

21.6.5 Summary

This chapter reported on the development of the SCIEP conceptual model towards interpreting Smart City implementation as an engagement practice for the City of Cape Town. The chapter outlined the inductive approach undertaken towards the construction of the SCIEP conceptual model as informed by literature and the constant compression and crystallisation of raw data into a summary or codified meaning. It identified key concepts and indicators towards imagining effective Smart City engagement and implementation that move beyond a techno-centric adaptation and strive to unlock Smart City value for broader citizenry. The SCIEP conceptual model and its component parts seek to activate collaborative practices between governance and citizens, and to realise Smart City value and services by placing emphasis on the city's human capital (Schaffers et al., 2012:57; Mellouli et al., 2014:1; Rodriguez-Bolivar, 2015:126; Gutierrez et al., 2016:4). Key areas discussed in this chapter are (1) the role of data in Smart Cities, (2) co-production in Smart Cities, (3) citizen participation and co-creation in Smart Cities, (4) open innovation and stakeholder engagement in Smart Cities, (5) Smart City initiatives and service types, (6) evaluating and measuring Smart City maturity, and (7) Smart City domains and focus areas. In the following chapter I report on my findings as gained from conducting interviews with experts.

22 Findings

22.1 The Implementation of the Components that lead towards Smart City Implementation and Engagement in the City of Cape Town

This chapter reports on my findings as obtained from individual interviews and thematic content analysis in response to the following research questions:

- What are the components that will lead towards Smart City implementation and engagement in the City of Cape Town?
- How can these be used to develop a Smart City vision for the CoCT?

In answering the above questions, my methods involved compiling a structured literature review in order to identify the key investigable Smart City components as reported on in Chapter 2. Secondly, an analysis of the City of Cape Town Digital City Strategy documents was carried out in order to determine the extent to which it resonates with the current academic debate. Below is my analysis of the CoCT Digital City Strategy in relation to current literature. This is followed by a report on the findings from interviews with key stakeholders to determine how these components facilitate the development of a Smart City vision for the CoCT.

22.2 Literature in relation to CoCT Digital City Strategy

As stated in Chapter 1, the Digital City Strategy outlines several guiding principles towards the establishment of an effective Smart City implementation strategy. However, the current strategy requires better understanding and interpretation of what Smart City implementation can or should be within a Cape Town context. This will be necessary in order to unlock the value and potential for providing new services to citizens, improving their quality of life and enhancing social and economic transformation. An important factor contributing to this centres around the point that the Digital City Strategy lacks sufficient academic grounding with regard to implementation models and the mechanism of Smart City deployment. As such, my analytical process sought to situate the current CoCT Digital Strategy and its broadly defined themes within the current academic debate and its associated themes or constructs. It involved the grouping and mapping of literature and its themes relating to Smart City implementation, specifically engagement. This entailed extracting and summarising the DCS dimensions and their focus areas, and then mapping those against corresponding themes in literature as illustrated in Figure 30 (p.141) : Themes developed and interpreted alongside the current CoCT Digital City Strategy (Author's construct, 2020).

22.3 Digital Inclusion / Smart Urban Services and Deployment

The building of a Smart City requires initial, active and knowledgeable involvement of various stakeholders, such as city managers, urban services, citizens, communities

CoCT Digital City Strategy dimensions	CoCT Digital City Strategy focus areas	Corresponding literature and authors
Digital Inclusion	• Closing the digital divide by promoting digital access, improving digital skills and driving Digital initiatives that enhance quality of life	• **Smart Urban Services and Deployment**: {Gomez, Chessa, Fleury, Roussos and Preuveneers}, {Anthopoulos}, {Santana, Chaves, Gerosa, Kon and Milojicic}, {Song, Cai, Chahine and Li}, {Serrano}, {Gil, Ferrández, Mora-Mora and Peral}, {Petrov, Mikhaylov, Moltchanov, Andreev, Fodor, Torsner, Yanikomeroglu, Juntti and Koucheryavy}, {Kumar and Dahiya}, {Madakam and Ramaswamy}, {Li, Lin and Geertman}, {Uribe-Pérez and Pous}, {Kaur and Singh}, {Kyriazopoulou}, {Lucero}, {Arroub, Zahi, Sabir and Sadik}, {Gutiérrez, Amaxilatis, Mylonas and Muñoz}, {Rghioui and Oumnad}, {Yucel}, {Chiariotti, Condoluci, Mahmoodi and Zanella}, {Atzori, Iera and Morabito} • **IoT Implementation:** {Kim, Yoo, Lee and Seo}, {Xu, Qu and Yang}, {Lucero}, {Gil, Ferrández, Mora-Mora and Peral}, {Chin, Callaghan and Allouch}, {Suryanegara, Arifin, Asvial and Wibisono}, {van Deursen and Mossberger}, {Madakam and Tripathi}, {Zeinab and Elmustafa}, {Gil, Ferrández, Mora-Mora and Peral}, {Marques, Garcia and Pombo}, {Asghari, Rahmani and Javadi}
Digital Infrastructure	• ICT infrastructure roll-out and • Using digital solutions to enhance the effectiveness of critical City infrastructure	• **IoT Technologies**: {Kubler, Robert, Hefnawy, Cherifi, Bouras and Främling}, {Serrano}, {Gomez, Chessa, Fleury, Roussos and Preuveneers}, {Pticek, Podobnik and Jezic}, {Atzori, Iera and Morabito}, {Kubler, Robert, Hefnawy, Cherifi, Bouras and Främling}, {Madakam and Tripathi}, {Asghari, Rahmani and Javadi}, {Zeinab and Elmustafa}, {Chin, Callaghan and Allouch}, {Gomez, Chessa, Fleury, Roussos and Preuveneers}, {Kaur and Singh}, {Suryanegara, Arifin, Asvial and Wibisono}, {Perwej, AbouGhaly, Kerim and Harb}, {Lucero}, {Bibri and Krogstie}, {Ahmed, Yaqoob, Hashem, Khan, Ahmed, Imran and Vasilakos}, {Song, Cai, Chahine and Li}, {Xu, Qu and Yang}, {Alsamhi, Ma, Ansari and Meng}, {Maksimovic}, {Medina, Perez and Trujillo} • **Big Data**: {Ahmed, Yaqoob, Hashem, Khan, Ahmed, Imran and Vasilakos}, {Maksimovic}, {Zeinab and Elmustafa}, {Santana, Chaves, Gerosa, Kon and Milojicic}, {Maksimovic} • **Cyber Physical Systems**: {Pticek, Podobnik and Jezic}, {Tokody and Schuster}, {Sun, Song, Jara and Bie}, {Santana, Chaves, Gerosa, Kon and Milojicic}
Digital Government	• Driving transparency, • Enhancing service delivery and promoting citizen engagement through ICT	• **Open data in Smart Cities**: {Anthopoulos}, {Lucero}, {Atzori, Iera and Morabito}, {Caird and Hallett} • **Co-creating Smart Cities**: {Gutiérrez, Theodoridis, Mylonas, Shi, Adeel, Diez, Amaxilatis, Choque, Camprodom, McCann and Muñoz}, {Gutiérrez, Amaxilatis, Mylonas and Muñoz}, {Anthopoulos} • **Living Lab**: {Simonofski, Asensio, De Smedt and Snoeck}, {Oliveira and Campolargo}, {Rodríguez-Bolívar}
Digital Economy	• Creating an enabling environment for the growth of tech enabled enterprises and • Maximising its job creation potential	• **Open Innovation and Stakeholder Engagement**: {Kim, Yoo, Lee and Seo}, {Rodríguez-Bolívar}, {Ahlgren, Hidell and Ngai}, {Simonofski, Asensio, De Smedt and Snoeck}, {Madakam and Ramaswamy}, {Anthopoulos}, {Chamoso, González-Briones, Rodríguez and Corchado}, {Faisal, Usman and Zahid}, {Bibri and Krogstie}

Figure 27: Aligning CoCT DSC (Author's construct, 2020)

and users in order to define and consolidate a city's needs and interdependencies. Consequently, due to the heterogeneity and diverse challenges of urban environments, this entails an ongoing debate aimed at the establishment of a co-created ecosystem that utilises IoT and the concept of a connected Smart City in order to identify areas of potential service applications and the advancement of a local and more inclusive environment. This can be achieved by focusing on adaptive, scalable and practical citizen-centric solutions as part of a city's innovation strategy and ecosystem (Gutierrez et al., 2018:668). In essence, engagement with collaborative digital practices and environments by citizens and the city is sought by leveraging citizens as city partners through the use of IoT technologies, such as crowd- sensing (Madakam and Ramaswamy, 2015:3).

22.3.1 IoT Implementation

IoT implementation, which supports Smart City growth, can be understood as a complex ecosystem necessitating the integration and utilisation of a host of enabling technologies, such as sensors, heterogeneous IoT networks/architectures and human-computer interfaces. Factors, such as technology, governance and citizenry, are considered when aiming for Smart City synergy. These factors support a city's vision and strategic objectives, and are grouped under labels, such as smart mobility, smart environment, smart governance, and smart people (Suryanegara et al., 2017:21). In addition, this integration or synergy requires addressing certain issues of privacy, security, policies, connectivity models, access to technology, business aims, etc. This is to ensure that cities are smart and quality of life (QOL) is improved by using ICT to deliver relevant and efficient smart urban services (Suryanegara et al., 2017:21; Rose, Eldridge and Chapin, 2020:4). The afore-mentioned considerations, therefore, suggest that the vision of digital inclusion, as set forth by the CoCT Digital City Strategy, should involve broader protocols and stakeholder engagement in order to reach its specified objectives of enhanced access, the improvement of ICT skills and use, and social change through ICT (City of Cape Town, 2016:14).

22.4 Digital Infrastructure / IoT Technologies

According to Nahrstedt et al. (2017:15), a smart community can be classified as a " collection of interdependent human-cyber-physical systems" that make use of IoT or network-enabled technologies in order to improve services. Within Smart City development, IoT integration signifies a way of propagating an array of sensing or actuating cyber-physical infrastructures which, in turn, aid in adapting, changing or advancing an array of systems. In order to mobilise such capabilities, an IoT system requires a number of sensing and actuating technologies. The advent and proliferation of ubiquitous IoT technologies has provided additional and more efficient data analytics and data types across diverse domains, providing value-added services by utilising Big Data analytics, Cloud computing, Artificial Intelligence, Deep Learning, Cyber-Physical Systems (CPS) and Machine Learning (Nahrstedt et al., 2016:2). Integration is achieved by combining the IoT technologies outlined above with the exchange, use

and assimilation of heterogeneous sensor data across domains that are subsequently combined with data analytics in order to derive, automate and correlate insights from captured IoT data for improved business intelligence, analytics, platforms and services, etc. (Ahmed et al., 2017:13). Other key enabling technologies relate to ensuring network functionality within an IoT system and its array of billions of connected devices that compile, assimilate and share information in real time, providing intelligent capabilities, include RFID, Near-Field Communication (NFC), Bluetooth, Zigbee, Wireless Sensor Networks (WSN), Artificial Intelligence, Electronic Product Code, IPV4, IPV6, UCode, LTE and WiFi (Perwej, AbouGhaly, Kerim and Harb, 2019:16).

22.4.1 Big Data

The IoT connected infrastructure allows for communication to occur between various IoT smart devices, devoid of human interaction, which results in a smart environment that generates volumes of heterogeneous Big Data. In a Smart City context, this is characterised by Santana, Chaves, Gerosa, Kon and Milojicic under the following headings:

- Volume: the associated challenges and required needs in dealing with a vast increase in generated data across distributed networks and data sources
- Variety: data from several sources, such as sensors or city traffic cameras, of which some may be structured or unstructured
- Velocity: the need for real-time data processing across city infrastructure, city management and user level
- Veracity: ensuring data reliability and value as gathered from several data sources

Big Data, with its above-mentioned characteristics, encompasses a set of tools or instruments which, when combined with Big Data analytics, aid in supporting a number of Smart City solutions by being able to store and control vast data sets gathered from sensor networks, city monitoring devices and open data generated by citizens through social networks or smartphone usage (Santana et al., 2017:6).

22.4.2 Cyber Physical Systems (CPS), Cloud Computing, Artificial Intelligence (AI), Deep Learning and Machine Learning

Cyber-physical systems signal computation and the use of ICT to increase integration of computers or network processes with their physical counterparts, i.e, embedded sensors and actuators. This permits cyber-physical interactions over distributed data elements which, when combined with a physical environment, make possible such activities as real-time data monitoring, user feedback or alerts and service discovery. Based on this definition I have included other concepts such as Cloud Computing, Artificial Intelligence, Deep Learning and Machine Learning, under this

umbrella as a result of the ability of these technologies to provide intelligent, intuitive and autonomous connections and interactions between computers and their human or physical counterparts. The afore-mentioned, therefore, suggests that the vision of Digital Infrastructure, as afforded by the ERP/SAP system, requires broader organisational and public engagement in order to realise its objectives and formulate an implementation strategy which is inclusive and relevant for the CoCT.

22.5 Digital Governance / Open Data in Smart Cities

The Smart City concept envisions a data-driven and co-created city that draws on and uses an array of distributed IoT technologies, data sources and data sets in order to resolve inner-city problems and thus render better public services and enhance citizens' quality of life. One way of achieving this objective is by leveraging open data as a freely shared and distributed online resource that, when combined with data mining and analytics, can be accessed, examined and shaped by various public stakeholders thereby promoting a more informed citizenry and ultimately better, more innovative services (Smart Cities Council, n.d). This requires governance that proactively uses ICT (known as smart governance) to interact more effectively with citizens and smart communities by leveraging the available accumulated data in order to understand and address social problems, as well as initiate new citizen services that are more interactive and democratic due to citizens' involvement in policy decision-making processes (Mellouliet al., 2014:1). From a policy perspective, in order to encourage both open data publishers and users, authors Nugroho, Zuiderwijk, Janssen and de Jong (2015:301) specify open data according to the following criteria:

- Published institutional data that are machine readable to facilitate use and reuse
- Data that are easily accessible on an online publicly available platform
- Published data following proper regulatory standards and formats in order to ensure interoperability between various data sets
- Published data sets that have an audit trail indicating the original and intended use, as well as offering a means of interpreting the data to facilitate their use and reuse

In an open data comparative policy framework analysis across five countries, authors Nugroho et al. provide additional lessons regarding the required infrastructural changes, working policies, frameworks and various stakeholder needs that can stimulate open data use in order to operationalise its public value. These lessons include (Nugroho et al., 2015:303):

- The need for a legal regulatory open data government framework that governs published data depending on stakeholder concerns
- The need to define operational processes as a collective in order to regulate published data, as well as to ensure data use, reuse and interoperability across data sets

- The need to generate and facilitate data interaction points between users in order to foster data supply and demand in addition to ensuring data relevance and quality
- The need for a designated group of experts who manage a city's open data processes
- The need to create and increase data demand in order to promote such things as government transparency, improved efficiency, social and economic development

22.5.1 Co-creating Smart Cities

Sections 9.3 (p. 72) and 12 (p. 80) indicate the importance of ITC and its technological deployment which aim at ensuring and fostering an innovative urban ecosystem in which people, data, digital technologies and infrastructure are used to creating an integrated platform which transforms the city into a co-created concept, aimed at improving city performance and the promotion of innovation across all city domains. However, apart from technological integration, achieving such a co-created reality demands public participation and stakeholder education, i.e., the consolidation of the different communities within a city's innovation system in order to engage users in defining new and better urban services (Gutierrez et al., 2017:668). If we accept the definition of cities as representing a "System of Systems", the stimulation of such a co-created ecosystem requires cities to develop unique strategic visions that permit the identification, initiation and application of SC technologies pertaining to urban service management and the complex interdependencies between stakeholders and diverse contexts (Arroub et al., 2016:2). In this regard, the co-created concept is viewed as a strategic point of contact between various city actors and data sources that are utilised in order to exploit and shape smart services in a collaborative manner. The Organicity project models a digital co-created platform where the co-creation process is viewed as a way of exploiting available local assets and engendering a community which understands its socio-economic problems, thereby providing effective answers or insights to such issues. Principally, this need for a more inclusive citizen participation approach in contemporary urban creation is vital if we consider citizens as prosumers within the digital urban environment. It, therefore, calls for a bottom-up approach to solving urban challenges, focusing on the potential of participatory systems in order to understand city and stakeholder needs (Gutierrez, et al., 2016:4). The above considerations, therefore, suggest that, despite the Enterprise Resource Planning (ERP) system, a coherent planning system is required to provide the necessary infrastructure to improve city government, governance models and processes. Coupled with the benefits of launching Cape Town's open data portal, attaining the objectives of digital governance as set out in the strategy requires a clear implementation blueprint, specifically when referring to the use and deployment of technology and "harnessing digital tools to stimulate innovation in service delivery" (City of Cape Town, 2016:17).

22.6 Digital Economy / Open Innovation and Stakeholder Engagement

The Smart City concept insists on enhanced stakeholder interaction between industry, government, society and academia known as the Quadruple Helix Innovation Model, in which open innovation interactions and co-created processes stimulate new city services. Thus, open innovation establishes value, sustainability and high living standards by activating extensive networking and collaborative engagement by all participating city actors and stakeholders to contribute towards a focused innovative action or goal (Paskaleva et al., 2015:121). Therefore, open innovation and stakeholder engagement outline related governmental, business or administrative processes as it involves stakeholder engagement in both inbound and outbound information seeking, and supply processes which transform information into institutional, organisational or social value. The literature suggests that the creation of value, or innovative outcomes, in a company or institution positively correlates with an organisation's knowledge management capacity. This foregrounds the need to develop applicable social interactions for communications environments and contexts as a way of controlling the relationship between knowledge management capacity and performance outcomes. Furthermore, it suggests that social interactions should, in part, concentrate on promoting knowledge acquisition and dissemination processes as factors that promise performance outcomes. For example, a study drawn from a sample of 105 companies, which explored the correlation between knowledge management capacity and organisational performance from a social interactivity perspective, found that knowledge management capacity enables governmental or institutional performance. The same study indicates that the implementation of knowledge acquisition tasks and knowledge dissemination programmes can improve an organisation's knowledge management capacity and performance. In addition, the study asserts that the establishment of coordinated knowledge management tasks and interaction processes can further improve organisational performance where social interactions have a synergistic reaction with knowledge management capacity (Hsiao, Chen and Chang, 2011: 655-656). Lichtenthaler and Lichtenthaler interpret knowledge management capacity as an organisation's ability to control its knowledge domains or informational awareness effectively by restructuring the manner in which knowledge is explored (Exploration), maintained (Retention) and utilised (Exploitation) within that organisation (2009: 1322). In the same study, the authors provide a unifying framework on how to manage an organisation's internal and external knowledge in open innovation activities. This integrative framework includes six knowledge capacities which highlight associated challenges within internal and external knowledge management processes. An organisation's knowledge management capacity, therefore, coordinates such internal and external processes, leading to an increase in knowledge domains and ultimately in innovation.

22.6.1 Smart City Architectures

In order to realise its vision of citizen empowerment, improved urban development, social innovation, better services, sustainability and economic development, a Smart City requires the employment of architectures to ensure the effective integration of various city components. These architectures serve as recommendations around the planning and functioning of Smart Cities. However, as Smart Cities (and cities as a whole) are diverse, existing approaches and platforms are fragmented and lack a coherent or standard architecture that contains all unified functions. According to Anthopoulos, "architecture concerns a definition of the structure, relationships, views, assumptions and rationale of a system" (2017:31). In a literature review discussing key Smart City architectures, Kyriazopoulou (2015:6) identifies six perspectives on architecture, namely "Architectural Layers, Service Oriented Architecture, Event Driven Architecture, Internet of Things, Combined Architectures and Internet of Everything."

22.6.2 Smart City Models and Evaluation

Apart from the above-mentioned Smart City architectures which deal with the potential structure and rationale of Smart Cities, there also exists a need for the establishment of Smart City models as instruments for measuring and evaluating the stages of development and performance of Smart Cities against a set of indicators. Furthermore, the establishment of such models assists in city benchmarking, indicating the required Smart City developmental strategies and the scale of implementation. The IDC Smart City Maturity Model (SCM) is one such model which offers a city benchmarking tool with which to determine a city's Smart City trajectory in conjunction with its associated planned SC strategies. It also acknowledges cities as diverse, each having its own unique SC developmental trajectory and, therefore, provides five stages of SC growth. In addition, it provides five best-practice measurements which include (1) strategy, (2) culture, (3) process, (4) technology, and (5) data, as well as 19 SC developmental indicators (Yesner and Ozdemir, 2017:7). Another such example is put forward by Cohen (2013) with his Smart City wheel. The wheel contains six dimensions (or components) and key indicators by which to evaluate Smart City deployment. The afore-mentioned analysis therefore suggests that, although this dimension of evaluation as evidenced in the CoCT Digital City Strategy, recognises the importance of establishing a digital economy to drive Smart City status, it lacks considerable implementation strategies or guidelines that would stimulate and support innovation and opportunities for economic growth (GDP) in the Western Cape.

22.7 CoCT DCS analysis summary

An analysis and alignment of the current DCS against academic discourse provided a contextually grounded understanding of Smart City implementation and its potential for the City of Cape Town. Collectively, these inductive undertakings made evident the seven constructs or components that support the development of an inclusive Smart

City vision. These findings, namely 1) data, 2) co-production, 3) citizen participation, 4) knowledge management, 5) Smart City initiatives, 6) Smart City maturity, and 7) Smart City domains, amalgamate and root the current DCS within academic literature. Additionally, the analysis located the DCS dimensions and focus areas within corresponding academic themes and greatly assisted in the development of the SCIEP model, as illustrated in Figure 29 (p. 134). These findings and the associated categories were further tested by conducting semi-structured interviews with experts as a means of gauging their resonance with the establishment of a Smart City vision for the City of Cape Town. This is further reported on in "Interview Findings"(p.160).

Domains (Quadruple Helix)	Data (Lim, Kim and Maglio, 2018:94)	Co-Production (Castelnovo, 2015:4)	Citizen Participation (Simonofski et al., 2017:3)	Knowledge Management (Lichtenthaler and Lichtenthaler, 2009:1318)	Smart City Initiatives (Chourabi, Nam, Walker, Gil-Garcia, Mellouli, Nahon, Pardo and Scholl, 2012:2294)	Smart City Maturity IDC Smart City Maturity Model (SCM) (Alliance, 2014)	Smart City Domains (Cohen Boyd , 2012)
Inclusion	Local Network Development	Driven by Civil Society	Citizen as Democratic Participant	Knowledge exploration, Retention and Exploration	People and Community	Strategic Intent Data Use Technology Governance Stakeholder Engagement	People and Living
Infrastructure	Local Operational Management	Combination between Civil Servants and Citizens	Citizen as Users	Knowledge Exploration, Retention and Exploitation	Natural Environment and Infrastructure	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Environment and Mobility
Governance	Preventative Local Administration	Combination between Civil Servants and Citizens	Citizens as Co-Creators	Knowledge exploration, Retention and Exploitation	Governance	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Government
Economy	Local Information Diffusion	Driven by Citizens and Communities	Citizens as Co-Creators and Users	Knowledge exploration, Retention and Exploitation	Economy	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Economy
Approach / Indicators (serves as interview protocol)	1. Managing Data 2. Integration 3. Privacy Issues 4. Delivery versus Need 5. Access	1. Experiment portal 2. Lessen Isolation 3. Annotation of Data 4. City Scale Opportunistic Data Collection 5. EaaS Framework		Knowledge Capacities 1. Inventive 2. Transformative 3. Innovative 4. Absorptive 5. Connective 6. Desorptive	1. Context 2. Co-Design 3. Deployment	1. Stage 1 2. Stage 2 3. Stage 3	1. Understands Smart City concept 2. Provides Evaluative Framework 3. Understands Relationality of Factors

Figure 28: SCIEP conceptual framework (Author's construct, 2020)

22.8 Interview data

I conducted semi-structured interviews with key stakeholders. This involved a line of inquiry representative of academia, government, civil society and industry, across the domains of digital inclusion, digital infrastructure, digital governance and digital economy in order to uncover key Smart City components from a Cape Town perspective. Additionally, this was necessary to gain a better insight into how these Smart City components could be used in developing a Smart City vision for the CoCT. The use of semi-structured interviews for data collection, which employed snowball sampling, contributed significantly towards gaining access to insider peer knowledge and the recruitment of informants with relevant subject scope and knowledge. Potential informants were contacted via email requesting an hour of their time to discuss their professional experience with regard to foregrounding the key components in unlocking Smart City value, and its opportunities for urban transformation for Cape Town and its population. Informants were provided a letter of consent, assuring them that their participation would be voluntary and not subject to any obligation. Additionally, they were sent a copy of the interview questions, as well as the SCIEP conceptual framework which gave background to the questions, ahead of the scheduled interview date. This ensured that informants had time to reflect on subject responses. The interview questions had been developed by applying an inductive approach towards synthesising and crystallising key constructs gained from the SCIEP model, academic literature and their interrelationship with the CoCT Digital City Strategy. (See Figures 32, 33 and 34 on pages 151, 152 and 153 respectively.) The average interview time was approximately 1h30min.

Themes	Line of inquiry	Indicators	Focus areas (line of inquiry)	CoCT online services	Literature counterpart
data	• local network development • local operations management • preventative local administration	• managing data • data integration • privacy issues • delivery and access versus need	• Promoting digital access • Closing the digital divide (How and Who and Why) • Improve skills towards digital initiatives • Drive digital initiatives to increase quality of life • Develop and promote ICT infrastructure towards community informatics • Develop and promote digital urbanism and digital solutions for improved efficiency and equitable services • Enhancing service delivery through ICT and other emerging technologies • Promoting and develop citizen and stakeholder engagement using ICT and enabling technologies • Creating an enabling environment for business and innovation and drive equitable economic growth (local and global) • Improve operational efficiency and resources through the use of ICT • Increase and improve transparency through the use of ICT (open innovation, open data etc.) • Improve city governance and effective administration through the use of ICT better stakeholder engagement and citizen participation. • Develop high level of local and global connectivity • Optimise and simplify (better access) business processes • Develop ICT driven innovation ecosystem and culture • Enhance decision and public policy through ICT and evidenced based analyses • Improve and promote access and dissemination of information through ICT (digital procurement, open data, datasets etc.) • Develop and maintain citizen engagement and interaction • Encourage and enable community development and social transformation • Develop smart citizenry and the use of city data for improved services and the creation of new opportunities or services • Develop human capital and creating an enabling environment for a more skilled and smart citizenry, businesses and business development • Promote and utilise digital solutions, networks, services and ICT for effective city management • Promote and utilise digital solutions and ICT for resource management and management of city service • Leverage resources and infrastructure to drive stakeholder participation and investment (access to data centres, network monitors, public cameras, smart meters etc.) • Incentivise the development of digital infrastructure and usage	• e-services • Service requests • Procurement • Tenders • Invest Cape Town • Housing needs • Smart Cape (Smartcape Cadets Skills Development Programme, Expanded Public Works Program) • Expanded Public Works Program (EPWP) Job Seekers database • ECAMP • Public participation • Waste and recycling **Open Data Portal** • City budgets • ECAMP • Planning portal • Tenders Awarded • Tourism • GIS Information • Stats and reports • City Data Other factors ERP/SAP System (R300million) Cape Town is known as tech hub	• Smart urban services and deployment • IoT implementation and infrastructure • ICT and digital technologies • Data, Big Data and analytics • Open innovation and stakeholder engagement • Co-creation and production (services, platforms, infrastructure, architecture, knowledge etc.)
co-production	• driven by civil society (organisations, NGO's) • between civil society (organisations, NGO's) and citizens • combination between	• experiment portal • lessen isolation • annotation of data • city scale opportunistic data collection • EAAS Framework (test bed)			
citizen participation	• citizen as democratic participant • citizen as users • citizens as co-creators • citizens as co-creators and users	• experiment portal • lessen isolation • annotation of data • city scale opportunistic data collection • EAAS Framework (test bed)			
knowledge management (i.e knowledge collection, integration and utilisation towards improvement)	• knowledge exploration • knowledge retention • knowledge exploitation	• inventive capacities • transformative capacities • innovative capacities • absorptive capacities • connective capacities • desorptive capacities			
Smart City initiatives	• people and community • natural environment and infrastructure • governance • economy	• context • co-design • deployment			
Smart City maturity	• strategic intent • data usage and strategies • ICT technologies and digital urbanism • governance	• stage 1 / ad hoc • stage 2 / opportunistic • stage3 / purposeful and contextually relevant • stage 4 / operationalised • stage5 / optimised			
domain/context	• people and living environment • environment and mobility • government • economy	• Understands Smart City concept • Provides evaluative framework • Understands relationality of factors			

Figure 29: Mapping of main constructs as informed by SCIEP model and SLR towards developing interview questions (Author, 2021)

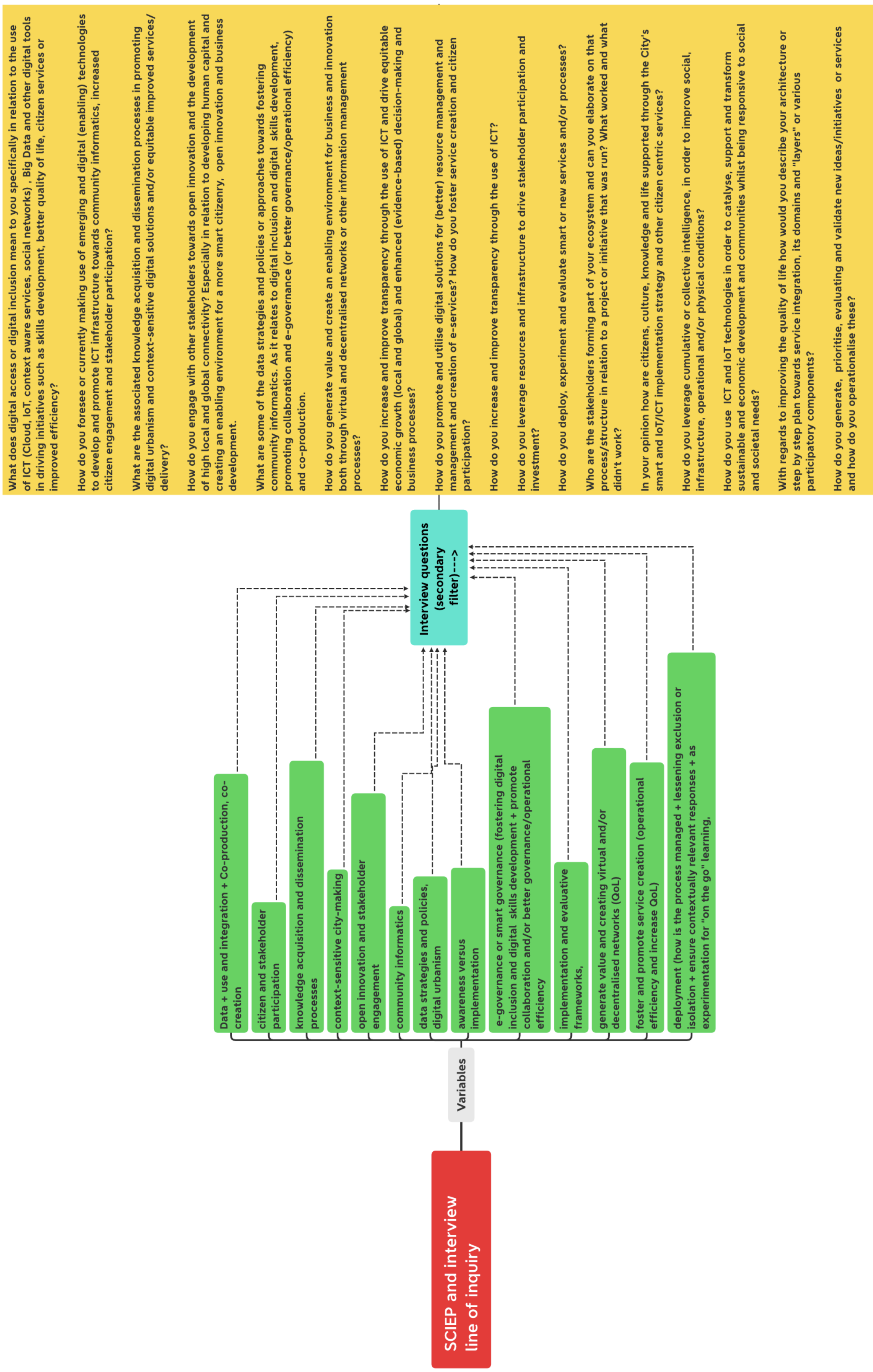

Figure 30: Mapping of main constructs as informed by SCIEP model and SLR towards developing interview questions (Author, 2021)

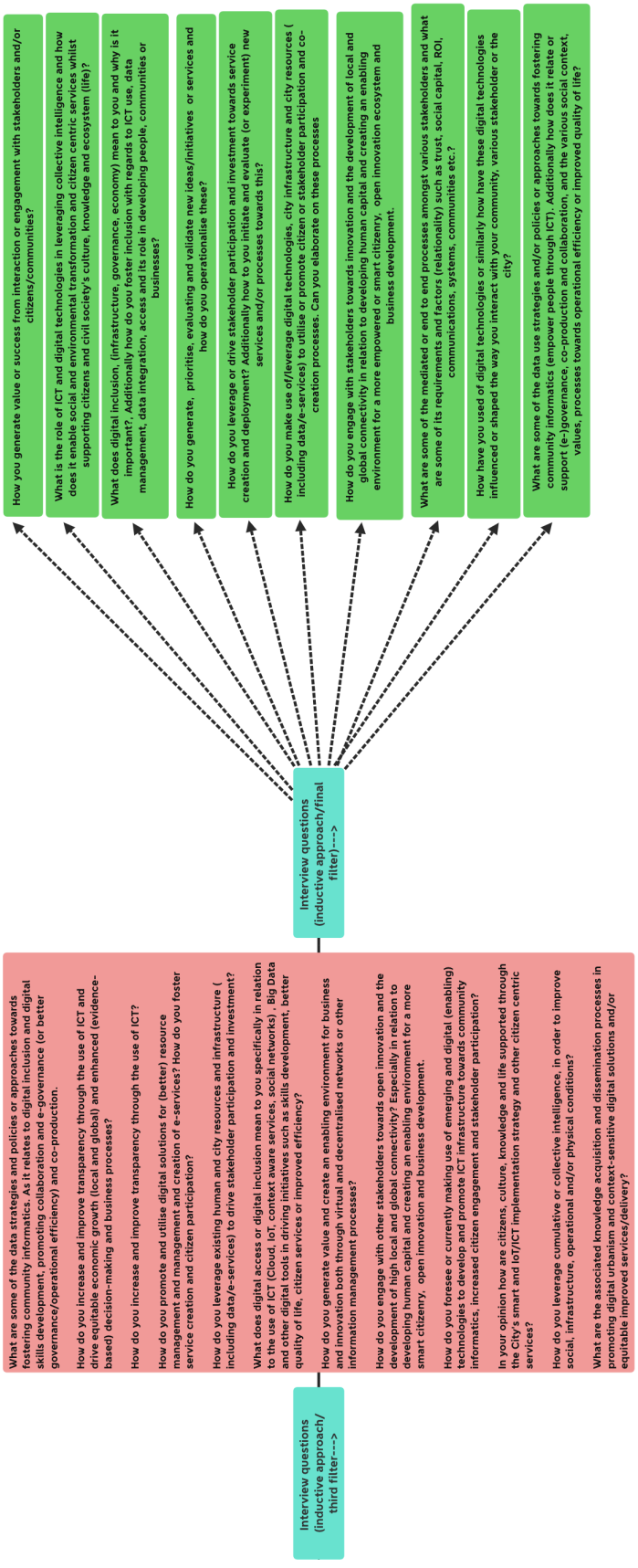

Figure 31: Final phase (continued) mapping of main constructs towards developing interview questions (Author, 2021)

22.9 Analysis of interview data

This research adopted an inductive approach. Thomas (2006:237) notes that the purposes for using a general inductive approach are to:

- (a) condense raw textual data into a brief, summary format,
- (b) establish clear links between the evaluation of research objectives and the summary of findings derived from the raw data,
- (c) develop a framework of the underlying structure of experiences or processes that are evident in the raw data.

The analysis of the interview data followed an inductive and phased approach. Collected data were qualitatively analysed and coded in Atlas Ti by reading and re-reading the text, using emergent themes from literature and as encapsulated within the SCIEP model. In addition, emergent data and preliminary findings were mapped as networks in order to demarcate broadly the interrelatedness of concepts and their meaning. Figure 36 (p. 156) illustrates such an overarching network. Themes and interview data were further mapped, as illustrated in Figure 37 (p. 157) and subsequently developed into summary form as illustrated in Figure 38 (p. 158). This process of constant comparison of interview data to achieve data crystallisation, culminated in the emergence of 11 themes: 1) Access as Infrastructure, 2) Adaptive Socio-Technical Solutions, 3) Common Good Value, 4) Contextual Smartification, 5) Data as Catalyst, 6) Demonstrated Value, 7) Equitable and Sustainable Cities, 8) Stakeholder Engagement, 9) Transformative Governance, 10) Transition Dynamics, and 11) Value Modelling and Measurement.

Figure 32: Preliminary findings from interview data phase (Author, 2021)

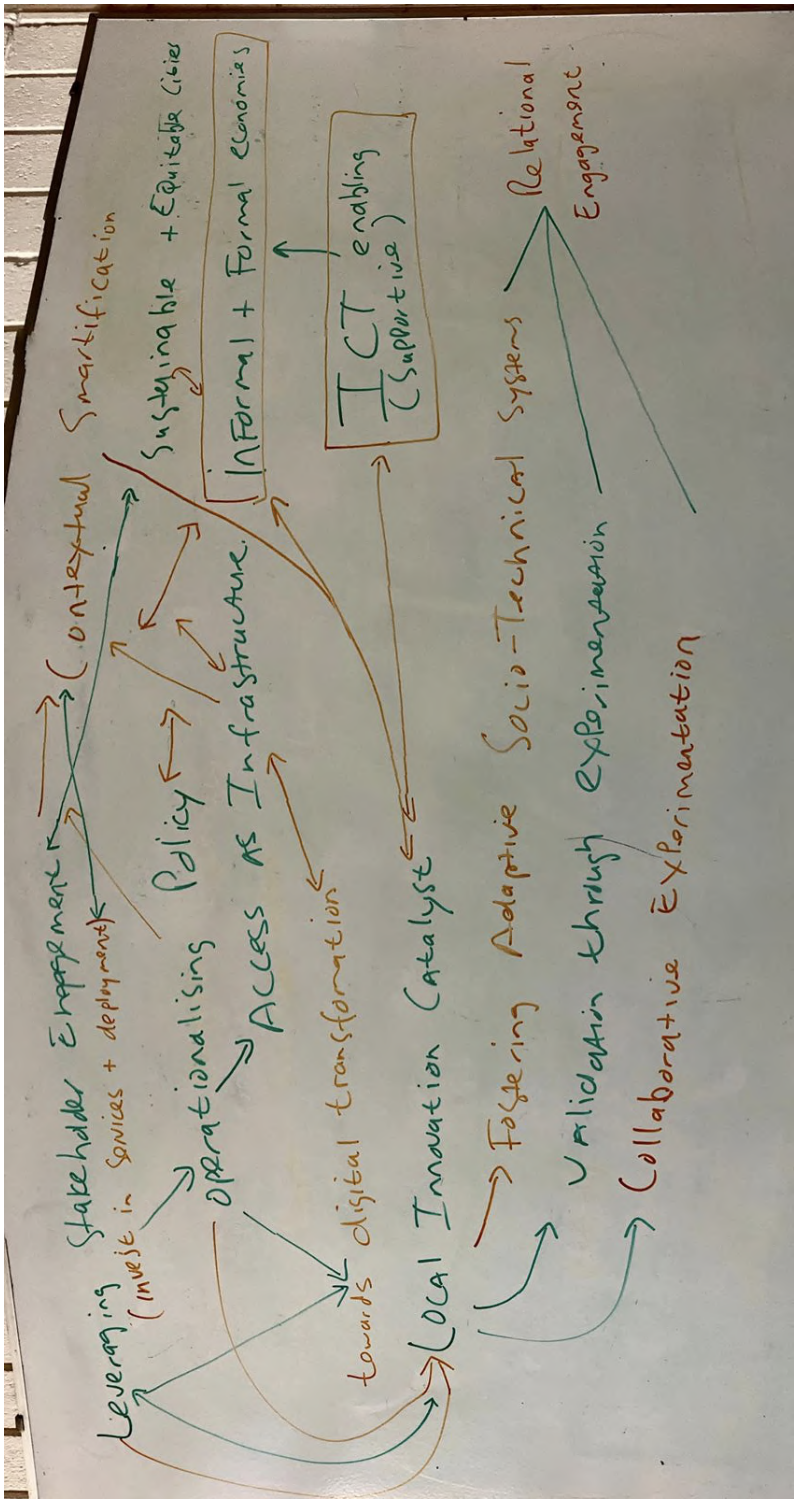

Figure 33: Example of initial mapping of preliminary findings from interview data phase (Author, 2021)

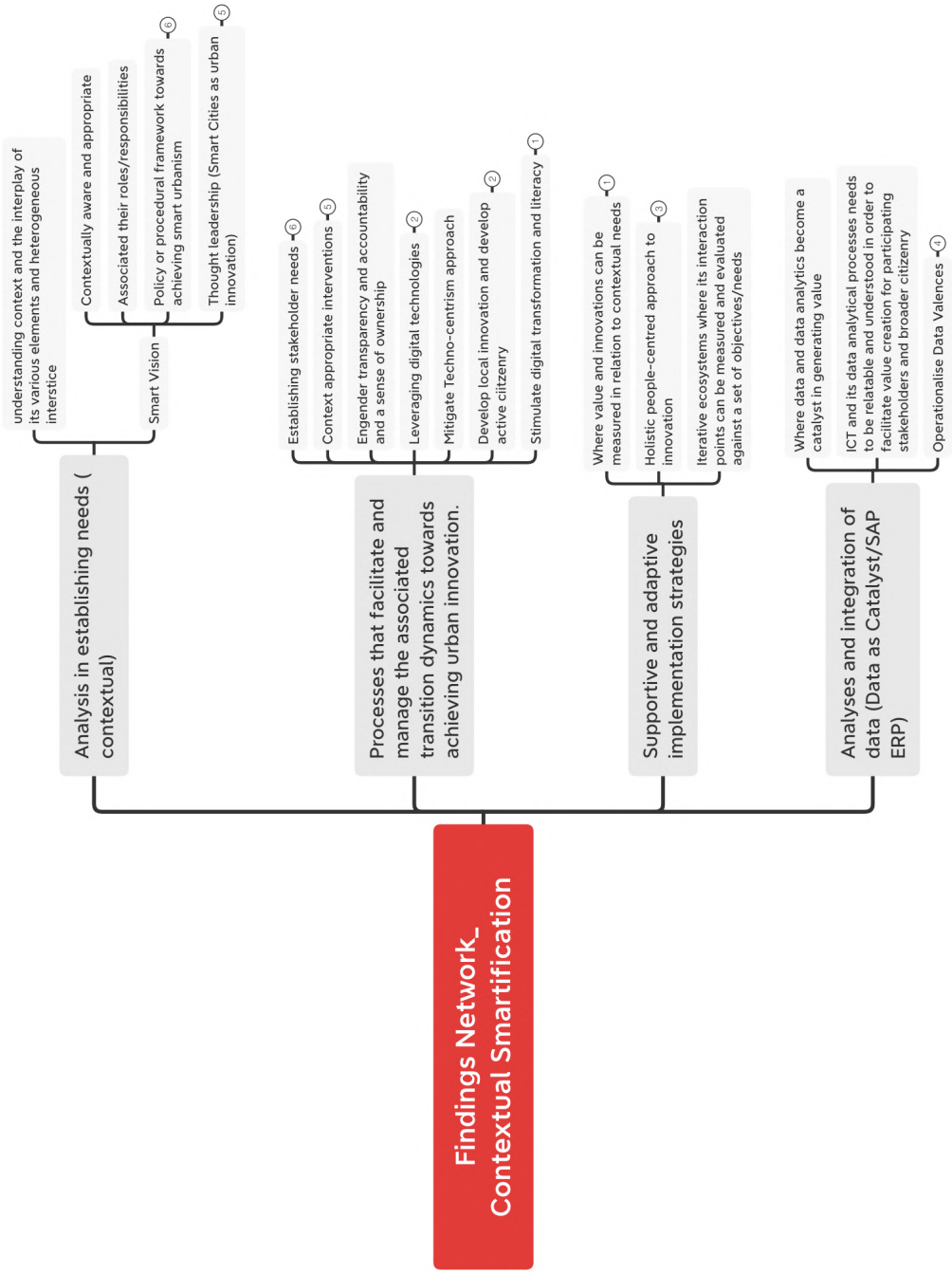

Figure 34: Mapping of interview data according to theme (Author, 2021)

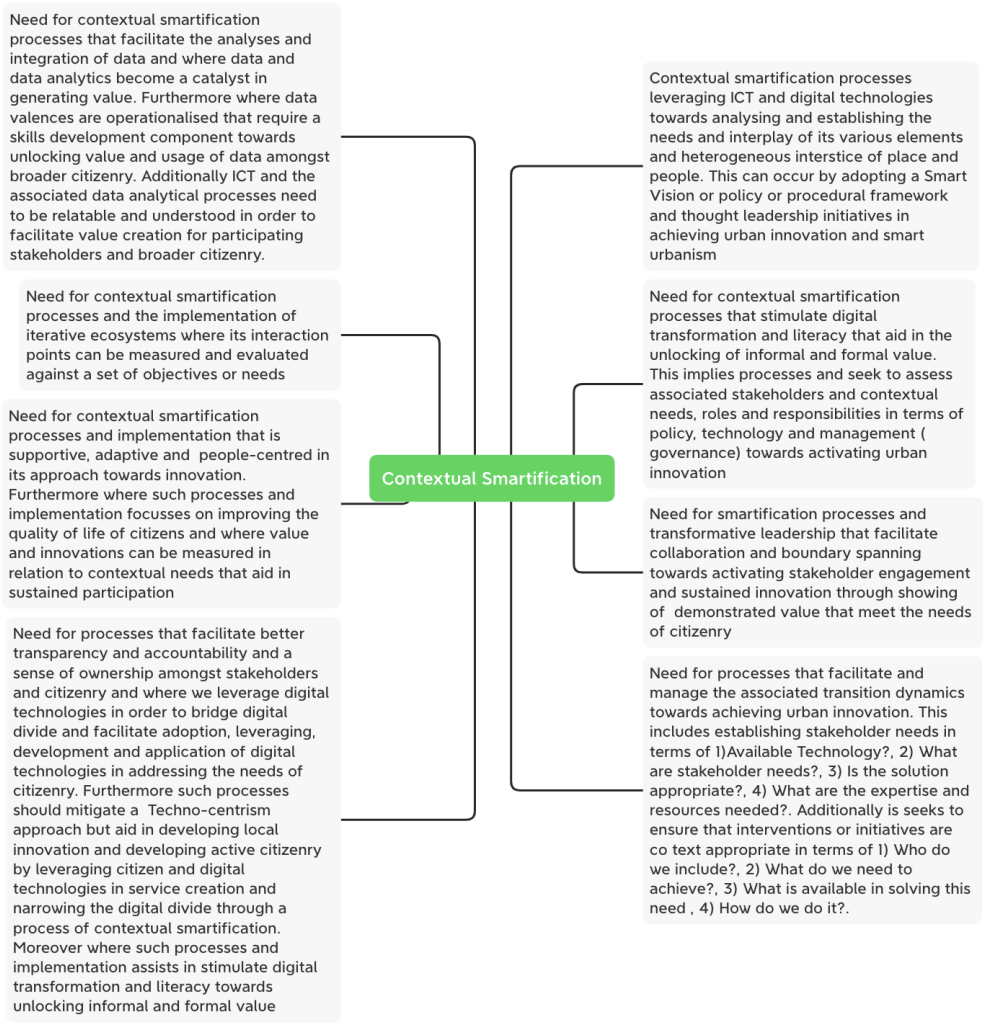

Figure 35: Summary of interview data with theme, Contextual Smartification (Author, 2021)

22.10 Interview findings

22.10.1 Access as Infrastructure

The notion of regarding 'access as infrastructure' has emerged as a key driver in activating the potential for Smart City implementation in Cape Town. More specifically, it refers to and perceives access as the activation of and allowance for pervasive broadband connectivity to facilitate digital transformation and contextual smartification processes.

". . . everything related to Smart Cities is only really possible if you have pervasive connectivity, right. So you need broadband connectivity. It's a basic necessity these days. It's not a 'nice to have' or luxury anymore. It's a basic necessity, much like water, electricity." Participant, DD

Such access and its methods will be responsible for mitigating the digital divide and enabling data access and interaction that permit innovation and service creation. It, therefore, should serve as an economic enabler that supports private and public stakeholders with alternative economic models, promoting better access and inclusion. This relates to the idea of access supporting and promoting the use of data analytics and open data to unlock potential value, collaboration, stakeholder- and relational engagement. This notion of access as an enabler is echoed in the quote below.

"There was the recognition then that broadband is an economic enabler and, obviously, a lack of broadband is an economic inhibitor. . . There's a lot of talent out there, but people need access to facilities, particularly infrastructure." Participant EE

Such access should aim to influence stakeholder engagement and involve a process of contextual smartification to unlock informal economies and enable economic transformation, local innovation and the development of an active citizenry. This entails leveraging citizens through the use of digital technologies that support user-driven innovation and collaborative practices to promote service innovation and new or better governance processes (Oliveira and Campolargo, 2015:2336-2344). This point of view is reiterated below:

"So to my mind really, where these technologies should be applied is to address some of the current challenges that we are facing. . . You know there are a lot of challenges that we have across the City; Day Zero, obviously from a water supply perspective, was one of them, but it was an area where access to information, sharing of data more broadly across the whole community, but also sharing the right types of data which landed in relevance for people was immensely valuable in effecting the kind of behavioural change that we needed." Participant DD

The activation of such access involves the development of adaptable and supportive systems that can coordinate the transitory dynamics needed to unlock contextually

relevant and real or useful value. This requires access that reimagines or operationalises existing infrastructures in order to unlock new value or contextual value processes.

". . . It's useful to remember that Cape Town still has the highest GINI coefficient on the planet, so that means Cape Town is the most unequal society in the world. So we have to be extremely cautious with respect to how we adopt these digital technologies and to not just rush headlong into this brave new world because the challenge is that we're going to leave most of our citizenry behind." Participant DD

Access that enables and facilitates the unlocking of demonstrative value by using digital technologies, such as crowd-sourcing and context-aware technologies, is called for, where data serve as a catalyst in establishing humanistic and smart urbanism to promote holistic inclusion.

"We can't, (address) the one at the cost of the other. We can't not focus on advancing the those (who are) already advanced, because that leads to innovation and growth and all those things. But you also can't focus only on the side that is excluded. So our interventions have to be quite consciously staggered to address both things at the same time and not one at the expense of the other." Participant CC

Moreover, there is a call for access which fosters a contextually relevant process of smartification that is relatable in order to foster development, learning, innovation and the formation of partnerships. This includes access that facilitates or cultivates a sense of ownership and responsibility amongst participating stakeholders relevant to their shared objectives. This would require the activation of mechanisms that facilitate the democratisation of information, such as open data portals, to promote and support holistic and horizontal integration, diversification, digital literacy and the narrowing of the digital divide. As such, it seeks to establish access that enables collaborative experimentation and the generation of collective value, leading to a more informed citizenry, through crowd-sourcing technologies, with the ultimate aim of improving people's lives.

"The big disruptors in the information spaces have been the networks and the smart phones, whereas fibre optic you know has this amazing ability to carry more and more capacity using exactly the same infrastructure." Participant AA

This idea was supported by Participant EE:

"You know the other part of that is saying, well, you need to help people understand what the benefits are and you need to train them."

The notion of generating collective value through experimentation is further supported.

"So I don't think this is a linear process or even a clearly defined cyclical process.

Think of a lot of little cycles running parallel to one another: some are testing new ideas, and some are implementing working ideas. You would have to monitor closely what you were busy doing, so in the same way, we want to implement sensors, we need to look at the people and say are we making this better? Is the environment healthier after we are done and do we have a baseline to work off?" Participant AA

Access as infrastructure implies employing data analytics and the integration of data to facilitate the transformation of said data through a level of applied intelligence, into meaningful and contextually relevant information to establish value for the broader citizenry. This requires the use of data, and the application of data analytics to establish humanistic smart urbanism. It aims to include those who are traditionally economically excluded, by harnessing ICT and digital technologies that support and enable human actors in a broad range of citizen-centric applications:

"You can't engage without a phone, without a computer, without a laptop. Then also, access to the information that comes... , but together with that you need the skills to know (and say), 'Ok. Now I've got all this information. I've got all this access. So now what?' And once you have the skills to know this is what the wide world of technology holds and leverages for me as an individual, as community, as business. Only once that happens you can get to the point where agency kicks in; when it comes to adoption of more technologies or more use of tech and how you start engaging in a smart space. Because then it's about using technology to share information to grow, to develop, to engage, and so without access and skills it will never lead to the point of agency and adoption or uptake." Participant CC

22.10.2 Adaptive Socio-Technical Solutions

As a system composed of many subsystems, the Smart City concept, in its approach, requires adaptable implementation strategies and the creation of smart environments to allow for discovery, exploration and scalability of solutions or initiatives. It prescribes the use of implementation strategies that drive and include experimentation, as well as enabling contextually appropriate technologies, by adopting an overarching Smart City vision and an approach. This is geared towards understanding the City's wider needs and objectives pertaining to and in consideration of 1) Whom do we include? 2) What do we need to achieve? 3) What is available for solving a need? 4) How do we do it? 5) What is the best way to do it? This is identified as Stakeholder Engagement which will be discussed later. Adaptable socio-technical solutions which are responsive are needed.

"On the technology, initially I thought 'Okay, so let's design the system' and I came up with several designs and I noticed that it's unmaintainable and it's just too complex; you'll lose control. Then I started opting for well-integrated - what I call Swiss army knives. These are platforms that already provide a stack of functionality, well integrated, and by taking your Swiss army knives and integrating them with each other, it's a much shorter route to success, easier to accomplish, and then the

availability of skills would be easier to manage as well." Participant AA

This is further supported by Participant CC who states:

"But you also can't focus only on the sides that are excluded. So our interventions have to be quite consciously staggered to address both things at the same time and not one at the expense of the other". Participant, CC

Implementation and its method should, therefore, consider and respond to issues of policy implementation, management and technology to foster contextually relevant solutions that assist in establishing and auditing the associated variables and needs in relation to 1) available technology, 2) needs of citizens, 3) possible solutions and appropriateness, and 4) available expertise or resources. This notion of responding to context in its implementation approach is supported by the quote below:

"You need a sort of stratified approach, I guess, which is there's a premier league and then a championship and first and second division. So there are going to be the big players, the corporates and we know who they are, the famous people throughout the world based on their digital platforms and innovation. . . Below that there's a whole series of people acting as individuals who are making fundamental differences to their own lifestyles, their own household, their own opportunity in life based on those things. . . We need to recognise that even within a Cape Town, for example, up to 25-30 percent of households are living within an informal arrangement, by that, it could be an informal settlement or it could be a back yard in a less formal township." Participant BB

Accordingly, implementation should involve a needs assessment of participating stakeholders and the associated heterogeneous context, taking into account the associated transition dynamics and value-modelling processes needed to ensure buy-in or demonstrate value. This involves catalysing adaptive solutions by utilising ICT and digital technologies that support and enable the solving of practical problems and that assist with 1) mapping and assessing the needs of participating stakeholders, 2) enhancing citizenry autonomy in solving challenges, and 3) increasing relational engagement methods to ensure solutions are context appropriate.

". . . So, if we could model at that particular point in time the impacts on all of society, all of our systems, all of our people, and we could understand what different trajectories would have caused, I think we could have taken better decisions. This for me, is if we achieve the ultimate outcome here, we will achieve that kind of platform." Participant AA

This is further supported by Participant CC:

"So technology can play a role in terms of practical applications in solving problems in society, and for that you need a combination of community input, technology and

then understanding where the problem is and then testing solutions. . . It's what you do, how you live and how they engage with society. So I think there's a variety of ways, but the main thing is that it must be practical and (it must be) something that people can actually experience because technology and ICT is very often this mystical thing that nobody really understands. So if you give it more tangibility and can see how it can affect peoples' lives directly and in a safe way, then I think it has a huge role to play there." Participant CC

Furthermore, implementation calls for adaptive socio-technical solutions and contextually appropriate engagement methods that leverage data analytics and data integration strategies to activate data as a catalyst in generating value. Data processes and technologies, therefore, need to enable and assist in developing solutions based on needs, mitigating the associated skills deficit in the achievement of objectives or needs. This requires the utilisation of understandable ICT, data analytical processes and relatable communications methods in order to facilitate value creation for participating stakeholders and the broader citizenry. It also aims at facilitating active collaboration and participatory governance solutions that promote trust and legitimacy, as well as leveraging ICT and digital technologies to generate economic opportunities and stimulate digital literacy through an assisted process of contextual smartification:

"I think where we fall short, not with the (ecosystem) because the ecosystem is quite strong (and) by the ecosystem I mean engagements between businesses who are already in the tech sector. I think where we do fall short, this very evident is that we have an extreme gap between the opportunities that that ecosystem offers for employment and the level of skills that are actually prevalent in or available in our society. So there is a big gap cause if we are able to bridge that gap, I think it will open up a lot of new innovation. It will create jobs. The ripple effect is just huge." Participant CC

Additionally, we need responsive socio-technical solutions that engender and support knowledge management processes to facilitate contextual smartification procedures and to enable local innovation through increased access and the application of data analytics and data integration. This includes leveraging the broader citizenry through the use of pervasive digital technologies and connectivity in order to operationalise concepts, such as crowd-sourcing, Open Data, etc. Also included are the effects of innovation or value measured in relation to contextual needs and the progress made in addressing the technical or adaptive challenges needed to ensure inclusion and sustained participation. This relates to the use of ICT and digital technologies that are able to map stakeholder and citizen needs in terms of 1) whose needs are being served and for what purpose, 2) how people or groups are represented, 3) what theme or domain is being focused on, 4) which components need to be interactive or responsive, 5) what technical skills or resources are needed, and 6) what the governance structure and level of participation amongst stakeholders is. This foregrounds the need for solutions and strategies, where ICT and digital technologies

foster contextually appropriate interventions and methods that facilitate dynamic collaboration, trust, legitimacy and user buy-in.

". . . it really requires a very sensitive and careful collaboration between both technical and adaptive approaches to this, because something which is adaptive only may sometimes not lead to anything practical or implementable. . . So before you even get to new ideas, initiatives and services and operationalise it, I think that area of skill and expertise or work around adaptive issues, the dialogue, the discussion, the action research, the human-centred design, the communities of practice that work has to happen in parallel or before your technical aspects kicked in because the technical aspect is part of a toolbox to solve something and not everything requires a technical solution. Even if you generate 1000 ideas, but you don't have a critical mass of role players agreeing to what should be done or what those ideas are or who those ideas serve because remember in communities, whether it's poor communities or more affluent communities, it doesn't mean it's a homogenous group where everybody wants the same thing. So until you put in that work to understand the needs, understand the dynamics, understand the power structures within that, any ideas you generate may still fall flat because you may not enjoy the support of a critical mass. But once you have that which is really a science in itself, then I think technical solutions in a Smart City context can kick in because people will then understand why it's there." Participant CC

Participant, CC goes on by stating:

"So you can invest R10 billion in it but if people don't trust it, if there's no legitimacy, and it's not transparent, then it will also fall flat on the floor. . . I do think there is an art and a science to whoever drives such a process to understand what level of measure from a technical, from a governance and community and stakeholder side and from a resource side is required. Because every project or context requires a different level of inputs, but the main theme is that they all need to be present in some form or the other. I think maybe that's what I'm trying to say." Participant CC

22.10.3 Common Good Value

Principal in achieving successful and transformative Smart City implementation is the need for holistic inclusion and the creation of iterative and interactive ecosystems that aim to develop ecological economies and collective value representative of citizens' needs. This requires a process of establishing collective value that is both transitory and responsive to context, and where value is activated by identifying and defining the "common good value" objectives and practices amongst stakeholders:

"So with this blue dot taxi system, you can actually track who's driving off route, are the taxis sticking to their designated association routing, and so on. So it's a very very good example of how you can use these sorts of Smart City initiatives to really engage an active citizenry to start creating data that becomes useful around taxi

behaviour. Similarly for the water crisis, as I mentioned, we're also seeing a lot of interesting e-learning initiatives in this region." Participant DD

This is further supported by Participant CC:

"I believe one of the strongest roles that ICT and digital tech can play is to have practical applications. Something that could change their lived experiences daily and I think that's where the tech for good can be a really important tool or mechanism that can enable social environmental transformation and services to citizens and build knowledge and systems and ecosystems and all those things. But unless you can prove that there is a practical application to improve the lived experience of a citizen there will be no need for them to engage or invest in it." Participant CC

This necessitates the establishment of value that increases transparency amongst participating stakeholders in order to engender trust and legitimacy. Furthermore, it facilitates value creation which aids in generating greater civil autonomy, ownership, governance, awareness and access whilst remaining responsive to context. It requires the development of participatory governance processes and structures where value is generated and measured alongside shared or common good value practices of participating stakeholders. Such participatory governance processes give rise to collective and shared value through the use of ICT and digital technologies and platforms that allow for experimentation and facilitate innovation, as well as service creation - all advanced by access to data and technologies. This links to transitory value processes echoed in the quote below:

"I think in any of these things you need a combination of technical skills with resources, whether that's political will or financial resources or something else. You need resources together with stakeholder engagement and participation and ongoing participation. Those three things I think are fundamental. You can't have one without the other because, then everything will just get wonky. Very often even the flipside is also true, that even if you have fantastic stakeholder participation, engagement and you can leverage good will, build legitimacy, build trust, if you don't have the technical aspects and resources to click in when action needs to start happening, that is also a problem. So it can be if you are too heavy loaded on one side on either of these things it can still fall flat. So it's not just about the technicians and the technocrats coming to the party it's also about do you need them as a very important cog in the wheel to actually deliver something at the end of the day." Participant CC

In essence, the leveraging of these digital technologies and ICT towards activating and facilitating collaborative experimentation and the operationalising of data is required. This implies the necessity for a certain level of applied intelligence and skills development to transform data into useful information for citizenry and stakeholders. Data can serve as a catalyst to develop an active citizenry, by generating demonstrated value through crowd-sensing, crowd-sourcing, etc. This view of activating value through data and collaborative experimentation is supported below:

"So to really get good stakeholder participation and better levels of investment you really need to identify and define common interest and relevance, right? If there's a common interest in something and if it's relevant for all those stakeholders, then the participation and the investment tend to take care of itself. Where you try and artificially create interest in something because you know as a City maybe it has some value to you and now you're trying to get business to fund it but actually there's no clear benefit or value proposition to that business. Then you're going to battle to get good participation. Participation will be at what I call a polite level, so they'll come to the meeting, they'll have the chat, but they're not going to take it beyond that. Once you can land that with a common interest, then you can really demonstrate the value proposition and they've bought into that value proposition for themselves or for the community in which they operate. Then I think you'll get much better traction and they would be much more willing to invest in that, assuming there's a return on investment of some sort for them. But I think it really has to land with a common interest in relevance, beyond that you can't sustain their interest in those initiatives." Participant DD

22.10.4 Contextual Smartification

Contextual smartification processes that facilitate the analysis and integration of data are needed, specifically where data and analytics serve as catalysts for generating value. Data valences are operationalised, requiring a skills development component to unlock data usage and value amongst all participants and the population as a whole. Additionally, this calls for the application of ICT and digitally mediated processes that are relatable and understood by collaborators or communities in order to facilitate value creation. Such contextual smartification processes further advocate the implementation of iterative ecosystems, where the interaction points amongst participating stakeholders can be measured and evaluated against a set of objectives or needs. This involves ensuring that contextual smartification processes and the implementation of initiatives are supportive, adaptive and people-centred in their approach to activate innovation. It is here that processes and implementation focus on improving citizens' quality of life and where value and innovation can be measured in relation to contextual needs that support sustained participation:

"It's no point coming in with a solution no matter how good your intentions are and no matter how good the solution is, no matter (in) saying we've got all of this technology and all of these solutions and trying to argue that with someone who's hungry. Or trying to do that with someone who actually doesn't need anything from you." Participant CC

Participant CC goes on:

"So that whole thing about the context is important and that the context shifts also is that what may be applicable one year may shift to the next depending on power,

depending on where the community as a collective or aggregated locus of control lies, which in our language nowadays is referred to as agency or self-agency, but at an aggregated level. So the context also shifts, and that's why the technical solution, while it may on paper, be the best thing, without an adaptive mindset that you can adjust to, to how things move in society, may also fall flat. I think that's why many ideas never get to fruition because the emphasis is placed too much on technical aspects and not on the more adaptive stuff." Participant CC

The notion of contextual smartification demands practices that enhance transparency, accountability and a sense of ownership amongst stakeholders and citizenry; where digital technologies are leveraged in order to bridge the digital divide and facilitate adoption, application and the development of initiatives that address the needs of people. Such practices should mitigate techno-centrism; instead digital technologies and citizens are leveraged in order to stimulate digital transformation and literacy to unlock informal and formal value in service creation and to narrow the digital divide. This seeks to assess the associated stakeholders' and contextual needs, roles and responsibilities in terms of policy, technology and management (governance) to move towards activating urban innovation. It also requires transformative leadership that facilitates collaboration and boundary spanning, activating stakeholder engagement and sustained innovation by managing the associated transition dynamics for achieving urban innovation. This includes establishing stakeholder needs in terms of 1) what technology is available, 2) what the needs are of stakeholders, 3) whether the proposed solution is context appropriate, and 4) what expertise and resources are needed to achieve the objective. Additionally, it is necessary to ensure governance structures and initiatives are contextually grounded in relation to participating stakeholders and targeted objectives. This is echoed by the following comment:

"So when it comes to human capital and creating an enabling environment, it's really about how are you able to take what people do in physical smaller groups and elevate it to a much higher level of engagement but where there are different rules of engagement." Participant CC

Participant EE adds:

"You need communities of interest, communities of practice that are at a manageable level. . . Unfortunately, there's a clear correlation between what you put in and what you get out here. As good as any initiative is, people get fatigued, so the process again, the thing that you need to build, trustable social capital, all of those things, you need investment, you need a sponsor and you need human resource who are prepared to drive these things." Participant EE

Participant CC confirms this observation stating:

"So until you put in that work to understand the needs, understand the dynamics, understand the power structures within that, any ideas you generate may still fall flat

because you may not enjoy the support of a critical mass." Participant CC

Participant CC reiterates this:

"When we speak about Smart City to an established business or to people with resources or who have access to skills and stuff. When you start (that conversation) within the digital space or a technological space and let's talk about the haves. That level of conversation, about Smart City is 'Ok.So how do we use data and data analysis to inform decisions to inform spatial development frameworks, planning, infrastructure decisions, budget allocations, pedestrian areas, areas which are just for vehicles? And how do we use things like Internet of Things? How do we use 5G? How do we use all this to integrate services? Immediate access to information? Weather patterns,' - the whole works. When you talk about have nots, their Smart City thing is 'How do we use digital platforms for communication? How do we use a digital platform to access up and running efficient transport routes on any given day? What's happening in terms of retail, in terms of safety and security?' It's very different; it all forms part of a Smart City but what different sectors of society would need or would not just consume but also produce in terms of content and information and data in a Smart City concept is very different." Participant CC

The processes of contextual smartification can be furthered by adopting a Smart Vision or policy framework tailored towards establishing the needs of people, and by indicating the interplay and heterogeneous interstice of place and people to ensure transformative urban innovation and smart urbanism.

". . . we had an initiative with Cape Town tourism where we were looking at developing a tourism SIM card. So travellers will have a SIM card preloaded with points of interest and all that kind of stuff. But the real intention behind that was actually to mine the data that we could generate off of those SIM cards. So you can actually start tracking where the tourist goes, what they search for, what types of activities are of interest for them, and you know, tourism Cape Town could then mine that data to determine where the gaps are with respect to (our) tourism offering. So those were just some of the initiatives we had started but like I said, it all lost traction once the people within the City changed and then we were effectively back to square one." Participant DD

22.10.5 Data as Catalyst

The mobilisation of data serves as a core component in managing effective Smart City implementation. More specifically, it relates to data as a catalytic element in unlocking value through the utilisation of data integration, analytics and technologies that enable and assist in developing and implementing context appropriate solutions. Consequently, the leveraging of such data technologies should facilitate (a) collaborative engagement by helping groups or communities to become both producers and consumers of information, and (b) ultimately innovation and

service creation by mobilising data as a catalyst. Furthermore, such engagement is aimed at supporting both formal and informal value processes as a means of engendering a sense of agency amongst participating stakeholders and communities.

". . . something which is also very important in the innovation space and working with communities in the tech space, coming back to your thesis around Smart City, is that communities and stakeholders have to be both consumers and producers of knowledge. Because generally we just consume but you have to become producers also because it's in production of knowledge where a lot of value lies and with that said we mustn't discard tried and tested methods." Participant CC

Concurrently, this requires the need to operationalise data valences or the potential social value of data through improved data governance models. These aid in unlocking value, taking into account the associated variables such as: 1) purpose of data, 2) data requirements, 3) data content and interpretability, 4) data access, and 5) data lifecycle. As a prerequisite, the activation of such potential requires pervasive connectivity and the activation of data-driven models that are adaptable and measurable, where implementation focuses on the management and integration of data in order to further experimental evaluation and service creation:

". . . I think that, while there's a great ability to collect data, government doesn't know what to do with it or how to work with it, and they don't have the data analyst or data analysis capacity to actually use it. And, as I said, there might be a variety of reasons for that, but I do think when it comes to the further part of your question, when it comes to e-governance, co-production collaboration, if you are not able to analyse a work effectively with the data that you have or shared with those who can, there is a huge lost opportunity." Participant CC

This notion of data as catalyst is further supported by Participant EE:

"I think we're pulling in the right direction. You can read things straight off statements from Premier Winde. . . we have a view to being data decision led and decisions are data led. To do that, you've got to collect information in various places. You've gotta do it in a structured way in a professional way. With POPIA, there's now some extra considerations, but it can all be done." Participant EE

The establishment of better data governance and use policies should support the broad discovery and mobilisation of data (boundary spanners), thus encouraging idea generation and service creation, developing active citizenry through the leveraging of digital technologies and their ability to demonstrate value for all concerned. Operationalising data-driven models and better data governance should, therefore, also promote better descriptive, predictive and prescriptive analytics across a host of urban ecologies, essentially improving data performance. The introduction of data analytical processes, therefore, requires relatable and intelligible methods in order to facilitate value creation for all participating stakeholders.

"I think there's a lot of thinking to do before we start and there are some clues out there that are interesting thoughts that one can start working with. And then I think the second stage, implementing what I would describe as the knowledge system where you would want to bring in data-driven decision-making at the heart of society's functioning. And making information available to people for good decisions can be influenced; so again, one would have to think through how you do governance." Participant AA

This is echoed by Participant CC:

"If you have data sets that are open for use by tech companies or just communities who have the ability to analyse it, new knowledge production and opportunities for collaboration in specialist areas are huge. So I do think, while the policies may be solid, maybe not perfect or amazing, it's solid but solid for a reason. Without being able to engage in the analysis and application and sharing of data with other social partners, I think we fall short on data-use strategies majorly." Participant CC

The activation and transformation of data should also assist in furthering transparency and more participatory data governance structures pertaining to a more people-centred urbanism that facilitates the provision of contextually relevant solutions. This may, therefore, be more likely sustained by participating groups or stakeholders. Data and related analytical processes should, therefore, facilitate the unlocking of potential through open data portals, collaboration, relational engagement, knowledge management processes and the sharing of knowledge.

"It was actually an interesting point when we did the Big Data workshop. This notion of data versus information was something we paid quite a lot of attention to because there's a level of intelligence that needs to be applied in order to convert raw data into meaningful or useful information. And actually what we encouraged during that Big Data workshop was to say, oftentimes we might try and pre-empt which data is useful or which data is important, but by doing that you effectively kill a lot of that creativity that could be applied to Big Data." Participant DD

This is further reiterated by Participant DD in the same interview:

". . . you can't even talk about Smart Cities if people don't have connectivity. Even if people had connectivity, but you hadn't educated them on how to use data, it's also a pointless activity." Participant DD

22.10.6 Demonstrated Value

Findings show that, whilst enabling pervasive ICT and digital technologies is fundamental to Smart City implementation, its effects are more likely sustained if such digital tools are able to demonstrate value to the general population. This is

especially pertinent when it allows collaborative experimentation and local innovation through the democratisation of information and the transformation of data into meaningful extraction or application. These technologies, combined with an active citizenry , help to enable solutions that move beyond commercial gain to where value is transitory. This is discussed in Section 22.10 (p. 194). Participant DD acknowledges importance of demonstrating the beneficial use of ICT:

"I think for the broader citizenry, they'll participate and adapt to new technologies if it demonstrates value added in their lives. So in the same way you get company participation, if they can understand how it will benefit their business. You get citizenry to participate where they can see how it impacts their daily lives. So if you take, for example, the Pothole Initiative. I don't know if it's operating in Cape Town, but I know it's quite vibrant in Joburg. Where citizens are able to when they come across a pothole you can record it and you can flag that pothole via an app." Participant DD

Participant DD goes on to say:

"Communities and other stakeholders are looking for improvements in their daily lives. They're not looking for engagement with government. Government is looking for engagement because they count that as a KPI. The community doesn't count that meeting with government as a win. They are only looking for improvements in their daily lives. If you really want to tie them in and you want to generate success from these engagements and interactions, then those interactions need to be followed up with positive impacts for that community." Participant DD

The value in the use and application of these digital tools should culminate in being able to support or enhance alternative and responsive governance structures, such as collaborative governance, by adopting a needs-based approach to generating value. Similarly, use should be made of value models that are able to index the contextual needs of citizenry towards developing an active citizenry and solutions that are needs-responsive:

"So idea generation is a lot more effective when it's centred around an existing problem; so you start with the need and the problem you're trying to solve. You use these methodologies to surface ideas and so on, and then you operationalise, based on a market demand, or based on the commercial prospects of that particular solution. Or also, within a South African context, I think it is very relevant beyond the commercial prospects are the social impacts that could potentially derive from that, you know, and so you would need to operationalise and prioritise based on those factors." Participant DD

Participant DD goes on:

"If people were able to feed intelligence into the police services in a way where

they knew they wouldn't be victimised or it would be acted on it, it could really improve the manner in which the City operates. So for me, collective intelligence is really about data flow and making sure that relevant data is extracted from quality sources and then is distilled and analysed and shared in a meaningful way with the users of that data." Participant DD

This is echoed by Participant CC:

"So technology can play a role in terms of practical applications in solving problems in society, and that you need a combination of community input, technology and then understanding where the problem is and then testing solutions. It can also create new forms of knowledge, by informal ways (and) by people working in companies that employ technology and from that it can allow you to generate a whole new body of information and knowledge form of engagement. That, in the end, in the long run can have a dramatic impact on how communities live which is what culture stems from. . . So if you give it more tangibility and can see how it can affect people's lives directly and in a safe way then I think it has a huge role to play there." Participant CC

Demonstrated value, as a result of uncovering the contextual needs of citizenry, must involve the unlocking of value through digital technologies, such as crowd-sourcing and crowd-sensing, in order to gain a better understanding of and to achieve the city's broader developmental objectives, or to assist in enhancing its operational efficiency. Additionally, by supporting collaborative practices geared towards operationalising data-use policies and strategies, a better understanding of the city's needs is generated.

"So if you take, for example, the Pothole Initiative. I don't know if it's operating in Cape Town, but I know it's quite vibrant in Joburg. Where citizens are able to, when they come across a pothole, you can record it and you can flag that pothole via an app. And it does geo-locations that will mark that location where you're standing if you're standing at that pothole; And it feeds it up into a central database and then the municipality is able, from that, to prioritise which roads need to be fixed and you know they can just become a lot more efficient at fixing potholes and so on. Now, in a situation like that for that citizen who actually sees that pothole getting fixed after they've logged it, that citizen is locked in effectively for as long as that system will be around because the system has demonstrated benefit to that citizen, and I think that's how you really get broader citizenry to participate and (to) believe in these initiatives; .... is if they can actually see the value in their lives, you know? So whether that's a pothole, whether that's a leaking pipe, again using the Day Zero scenario where people were encouraged to report leaks, and again, this is, you know if you look at (it) from a city perspective, there are in the City's water reticulation system, there are approximately between six and a half million potential failure points in the City water reticulation system, right. So that's all the connections, the valves, the junctions, all that kind of stuff, and it would be almost impossible for the City to track all of that in real time on a daily basis, but if you have citizenry who are active in participating and can flag, here's a leak, there's a

leak, and as that data comes through you can overlay it with your reticulation system. It allows the City to understand immediately where the problems are in their system, and again makes them a lot more efficient at attending to those issues." Participant DD

Furthermore, demonstrated value entails establishing engagement methods that are contextually appropriate in ensuring that potential initiatives or interventions have properly assessed the needs of stakeholders and their associated parameters: such as 1) Is the appropriate technology available? 2) What are the needs? 3) Is the solution appropriate in terms of contexts? 4) What expertise (or resources) is required? (Yaqoob, Hashem, Mehmood, Gani, Mokhtar and Guizani , 2017). Demonstrated value, as an outcome, should further the ability to leverage stakeholder engagement that is accountable and responsive in enabling digital access, inclusion and broad local innovation. In addition, such engagement should be measurable against a set of criteria for more transparent governance and to generate trust and legitimacy amongst participating stakeholders. This requires transitory value processes and relational engagement methods which foster holistic inclusion. The promotion of engagement targeting holistic inclusion and the establishment of iterative and interactive ecosystems, aids in generating transitory value where value is activated by identifying and defining common good values and objectives between engaged stakeholders. This is supported by the following quote:

"So to generate value I think whether you are a planner, a designer or someone in the municipality who engages with stakeholders is once you listen, listen again, ask questions. Make sure you understand what your users or your stakeholders are saying, and once you've done that, actually use it or explain why you can't do it. Because, let's be fair, sometimes people just have a whole long wish list of stuff they would like, but which you actually cannot do, but then be transparent and fair as to how you use that information. Once that is done it demonstrates that there is value, firstly in what people are saying to you or that you value as a researcher or planner or designer you value what people are saying and that you respect what people say." Participant CC

22.10.7 Equitable and Sustainable Cities

The development of a Smart City should prioritise implementation approaches and strategies that seek to support the formation of equitable and sustainable cities and that enable local innovation centred around societal needs. This entails driving humanistic advancement with supportive ICT, from a practical and innovation-spawning perspective, towards developing and facilitating transitory value through relational engagement methods that minimise exclusion and social marginality and mitigate techno-anxiety. Additionally, innovation, in the modelling of equitable and sustainable cities, should aim at improving the lived experience of the broader citizenry by using ICT to democratise information and to leverage stakeholder engagement by unlocking informal economies. It, therefore, includes the need for the application of purposeful, pervasive digital technologies that facilitate implementation. In addition to this, there is a necessity for the mobilisation of broadband that fosters

access, inclusion and opportunities for economic growth. This drives the digital adoption strategies that connect businesses, government, academia and civil society – the Quadruple Helix (Vanolo, 2016; Pols, Pasveer and Willems, 2018). Participant AA refers to this:

"We've got very skilled people that are in operational roles. We've got organisations with lots of experience and knowledge and you want to start at the knowledge core. So you want to leverage what you have and a sort of an asset-based development approach, and then build onto that the disruptive ideas that you need because you know that there are certain things that you will need to break in time. And so what is the transition from where we are to where we need to go and how do we construct these changes. Sudden changes are harmful and distracted always; so how do you do this transition with the minimum loss and destruction." Participant AA

This is further supported by Participant CC:

"Nowadays people are talking about the digital economy and (the) digital economy is not a sector. It's actually something that's quite transversal that cuts across sectors. As I said, those four terms that you have used here, they all are connected in some way. I think the underlying theme from a developmental, more social economic perspective for me would be, how do you - and the underlying issue of who are the active and included role-players, because in all those aspects, the issue of inclusion actually cuts across." Participant CC

Furthermore, as part of a Smart City approach to achieving equitable and sustainable cities, attention should be paid to driving digital adoption strategies towards the holistic integration of smart technologies to unlock additional or new ecological economies that promote collaborative innovation (Carlsson, 2004). Consideration ought to be given to the narrowing of the digital divide by developing skills and focusing on initiatives that enable citizens to make use of digital technologies to ensure approaches and objectives that are contextually relevant and informed by an active citizenry. Holistic integration of smart technologies, therefore, also considers Smart City initiatives and their potential to perpetuate the digital divide, as well as measures to mitigate such potential consequences (Lam and Ma, 2019). In this regard, emphasis should be placed on developing humanistic smart urbanism. This entails the application of ICT and digital technologies that allow people to thrive and to support knowledge management processes in order to allow for the discovery, mobilisation and exchange of data, giving rise to prosumers and establishing appropriate value models, innovation and service creation.

"We know this country is good at entrepreneurship - we know it. Where it gets lost is - that I certainly would think that there would be more entrepreneurs who are multi-millionaires in South African rands that come from a privileged background than from the townships and therein lies the challenges that this next generation coming out are not just born-frees but born in an Internet age. There's no equalisation of that;

there's just a further insult to their equality that's there. So I'm not really helping in answering your question but if we are not going to talk about this in terms of the informal settlement upgrading program and recognising that that's probably where the action is, the lowest end of the market and where public sector plays the biggest role then we are probably in serious trouble." Participant BB

The need also exists for more equitable community and social interaction that is less exploitative and more holistic in terms of value generation. This can occur by leveraging stakeholder engagement through contextual smartification, and unlocking informal economies by using disruptive technologies to solve challenges as part of a broader sustainability agenda. The establishment of ecological economies should foster the development of trust and legitimacy where social factors, such as fairness and justice within a social setting, are managed and culturally appropriate. Therefore, to enable ecological urbanism, social and environmental transformation should promote social justice and equitable value generation, as well as engender guidelines that support objectives of inclusion and intervention that mitigates environmental and biological hazards and techno-centrism. This is supported by the quote below.

"So when you talk about trust and social capital, ROI, that all immediate speaks to that economic model which is: There is no trust. It is based on social and capital in a real sense of what does our balance-sheet say and what do our shareholders say and 'please don't fire me as a board member'. Those are the things that we have so traditionally monitored and judged: our corporate efficiency and, to a lesser extent, governance for that matter. I just think those need to be turned on its head and more and more we are seeing the social and environmental elements being pulled into the scorecard methodology. . . this whole idea of what does a corporate fit-for-purpose scorecard look like? Which turns some of these things on its head and would demand a far greater reach and drive to not just reflect on 'Look how big our bank balance is!' – 'Look how big our dividends are that we are sharing with you as our shareholders!' You and I, I'm sure, have got shares or interest in corporate entities which will determine whether we can retire; so I'm not being naive about the model that's in play. I'm saying: Is there a way to leverage more from it? and I've used the example of classic parasitical arrangement of MTN and Vodacom all calling them out saying with major degrees of where we can get a lot more out of them for what they want which is air waves and infrastructure on the ground to be able to reap their rewards. I'm saying they've reaped enough now and they need to start ploughing back in." Participant BB

Participant CC continues:

"So it is about an inherent value attached to knowledge of communities and societies and how you engage with that first and then build your solution on top of that. And not saying okay you have no idea what your reality is; you have no idea how to solve your problems. Let me solve them for you. That is why I said tech is simply a way of leapfrogging many of the kind of structural challenges we had with

innovation across communities or across societies or across countries. It allows us to leapfrog a lot of the barriers to entry - and not just barriers to entry, barriers per se, but the fundamental things, like indigenous knowledge systems and value that people already have in terms of how they see reality and their own solutions to their own problems, that shouldn't be left by the wayside." Participant CC

22.10.8 Stakeholder Engagement

Stakeholder engagement, from a Cape Town Smart City implementation perspective, requires the activation and matching of engagement methods that drive holistic inclusion. In particular, this will be towards increasing participation and collaborative practices among stakeholders, generating transitory value, where value is activated by identifying and defining common good values and objectives. This entails establishing iterative and interactive ecosystems that are able to yield and demonstrate value to participating stakeholders. Such value should address the needs of citizenry and requires co-ordinated engagement along with the integration of digital processes, technologies and infrastructure that facilitate engendering economic growth. The following associated participation dynamics need to be considered: 1) consultation with participants, 2) engendered transparency with stakeholders, 3) appropriate collaboration and co-production processes, 4) appropriate joint decision- making and accountability processes, 5) required technical skills , 6) appropriate governance structures and levels of participation amongst stakeholders, 7) the involved communities and stakeholders, 8) which resources are needed, and 9) the context: Whose needs are being served and for what purpose? This is echoed in the following comments:

"You need these things on parallel race tracks. I use race tracks deliberately because it needs to be at a speed. And so you need someone looking at the corporates, you need someone looking at governance element and then you need somebody looking at these access issues." Participant BB

"So there are very few people who are actually taking a holistic, systemic perspective on this and understanding how the different components fit together. So the stakeholder engagement becomes really difficult because you always have to try and land the conversation in relevance for that particular stakeholder." Participant DD

Inclusive engagement, therefore, also necessitates the need for better collaborative governance and legislative processes that foster transparency, as well as accountability in generating transitory value. This will require piloting an assessment of the City's wider developmental needs, objectives and resources prior to the initiation of projects or policy implementation. It also calls for platforms on which engagement can occur to foster needs-driven or contextually appropriate interventions as part of an ongoing or overarching contextual smartification process. It, therefore, should consider aspects such as 1) With whom are we dealing? 2) What do they need or want? 3) How will they be assisted in achieving their objective? Moreover, it demands establishing

appropriate value models and measurements that are relevant in addressing the needs of citizenry or communities. These should leverage data, and drive data-orientated decision-making processes and methods that are adaptable and quantifiable in terms of needs and goals, or can be understood either through experimentation or through pilot projects. This includes aspects, such as proper data management, analysis, integration, access, etc.:

"Governance is a tricky thing because, I think, governance is something which is usually in the control of those who are in control. And that's really about how resources are shared, who makes decisions, what the implications are, who keeps control of resources. And who makes the shots and then in governing how those decisions have an impact on society and on the various stakeholders. But, to be a stakeholder, you have to be in the game in the first place and very often governance is the domain of those who already have control, and by definition it's the 'haves'. So that sets the agenda. It sets a particular tone of the agenda." Participant CC

Participant CC goes on to say:

"The leadership and the facilitators has to be, I suppose, empathetic is a word I could use, but needs to see perspectives of all the stakeholders and you need to have technical knowledge but you cannot rely on that. It needs to be a transformative type of leadership, because I think the leadership in a process like this in a Smart City context is critical. Because you can say Smart City, but Smart City, for whom? So in that compact that's where the mediation happens. That's where the process is iterated. It is in itself an iterative process and by definition of what a compact is, I think all the other kind of values and principles that go together will be self-evident." Participant CC

For sustained stakeholder participation, engagement should seek to establish trust through processes of active collaboration and participatory governance solutions using relatable communications and ICT strategies to achieve a transformative Smart City vision. This includes developing smart environments that are grounded in policy and context. These smart environments should incorporate flexibility in their approach and execution, utilising adaptive and iterative ecosystems, where interaction points can be measured and evaluated against a set of objectives. Taking into account the associated transition dynamics, interstices of place and value modelling to ensure stakeholder buy-in and the potential value thereof, experimental implementation should be permitted. This includes developing communities of practice that have a common interest and vision to promote trust and legitimacy, and to stimulate collaborative practices amongst participating stakeholders (Gherardi, 2009). Collaborative engagement should involve the operationalising of data and data-use policies that facilitate digital transformation, as directed by City policy. Additionally, it pertains to increasing digital access, where such access is viewed as necessary infrastructure to ensure contextually appropriate collaborative and value-driven practices. Data analytics can play a particularly valuable role in unlocking potential value through activating and leveraging open data portals, co-production

processes and stakeholder engagement, etc. This also includes the need for strategies which will ensure policy management and digital transformation continuity as part of the City's wider urban innovation objectives. One such strategy could pilot thought leadership programs and experimentation that promotes contextual smartification processes and innovation (Nam and Pardo, 2011; Cranefield and Pries-Heje, 2019).

"So it's really about creating a sense of comfort that you trust and I think a bit of mutual, as I said coming back to the second point, about the rules of engagement for collectives and groups of different to individual. And if those things about mutual respect and seeing somebody else's perspectives, and you know, and all those things and disagreeing, but without breaking stuff. Then I think it goes a long way too engaging." Participant CC

Participant, CC continues:

"I really think it's about creating some sort of compact and whether we call it a social compact or business compact. I'm not sure what the right term would be. But a compact where the different players in society do come together and figure this out together. It's not one player that can do it." Participant CC

Collaborative experimentation engagement requires leveraging stakeholders through community partnership formation and specialised skills sharing to develop service creation. The leveraging of such engagement can lead to better data-use strategies, where data serve as a catalyst in generating value. This requires enhanced and co-ordinated relational engagement methods that facilitate transparency and legitimacy, and which are perceived as adaptable in support of value creation for participating stakeholders and, additionally, which mitigate a techno-centric approach.

"The first thing I would say is make it relatable. Whatever you do, make it relatable. Because technological innovations, and innovation in general - not all innovation has to be high. Technology can be low-tech also as I'm sure you know or not know, but appreciate also. The thing is if it is not relatable then people have difficulty engaging with it. I always believe that one should not underestimate people's fear of technology and this cuts across (demographics)." Participant CC

Participant CC continues:

"I think that's where it definitely requires a partnership at a corporate and in a non-corporate business, government and society and community level, because it's really about looking at the entire skills pipeline. Because technology is one of those things where there really are stepping stones and if you don't understand the basic, it's very difficult for you to progress through to more advanced levels. It's going to be highly specialised. It's huge, just by definition if you imagine (where) the skills level is (and) where we would like it to be and the innovations that can come out of that purely by means of people ability and the resources to become technologically

innovative, you can't quantify that. But that is definitely a space where all society's partners have to come together and say this is how we address it and also this is how we address it in an equitable way." Participant CC

This requires facilitated engagement or an intermediary who takes into account the type of stakeholders involved and their context, processes and platforms to establish access amongst participants. Such facilitated engagement assists in generating agency and cultivating a sense of ownership which invites experimentation and ultimately innovation based on shared objectives. This is supported by the following:

". . . the role of an intermediary or facilitator becomes a very powerful tool to unlock ideas, unlock knowledge and then also to make sense of it and capture it and then know how to use it. Without that kind of intermediary, or facilitative role, things could also just go into the ether, and nobody can keep control of what's happening." Participant CC

The afore-mentioned reflections further warrant engagement that can navigate the contextual variances of participating stakeholders in order to improve participation and digital transformation that supports collective value generation. This involves initiating and stimulating collaborative practices through activating data as catalyst and the use of adaptive socio-technical solutions.

"So a big mistake that a lot of these big companies and government makes is they look at a community or a township and something like that. They see a problem but they're not solving it from the perspective of the user, which is the person who lives there. They are solving it from their perspective as a white collar worker or government official. So what that means is they don't take into account the realities that that citizen is facing in that space." Participant DD

Facilitated engagement should also include and support methods that allow citizens and stakeholders to voice their needs and objectives – and then acknowledges these. Furthermore, such engagement should also facilitate the integration of digital processes, technologies and infrastructure that support holistic inclusion. These processes include platforms on which contextually appropriate engagement can occur, as a way of analysing and finding relevant solutions that both engender economic growth and improve people's lives.

"What other social partners are saying is if you give us open access to that data with all the provisors in place, we can use that, analyse the data and see what's going on and in that way develop solutions via tech solutions or non-tech solutions." Participant CC

22.10.9 Transformative Governance

Smart City implementation calls for transformative governance which utilises ICT and digital technologies to stimulate and unlock digital literacies for the broader citizenry, through facilitated contextual smartification. Such governance fosters active and holistic inclusion of participating stakeholders by leveraging the mobilisation of data and digital technologies to increase public decision-making and service creation. Smart City implementation therefore calls for equitable and transformative governance that enables collaborative practices and the integration of smart technologies to facilitate broader economic and social transformation in order to 1) decrease inefficiencies, 2) improve resource management, 3) advance data analytics and application, 4) aid and support data exchange/use, and 5) assist in service innovation (Ku, Chien and Ma, 2020). This suggests a type of e-governance that promotes the use and adaptation of purposeful, pervasive digital technologies and the mobilisation of broadband to foster access, inclusion and opportunities for economic growth.

"Things like the idea behind blockchain which introduces the concept of a trustless system which could potentially replace the representative democracy, sort of a democracy by algorithm rather than a democracy by representation. That is a definite opportunity, and I think the dissemination of information and communication tools." Participant AA

Governance, therefore, should include a mandate that enables the use of digital information and communications technologies (ICT) to support 1) increased public participation and collaboration, 2) better interaction between public and government, 3) creation and delivery of new services, and 4) better management and integration of processes (Chadwick, 2003). This involves using methods that establish common good values and makes use of communications methods that are relatable and contextually relevant as a means of ensuring transparent and sustained transitory participation amongst stakeholders and communities. Such sustained transitory participation and governance structures promote the generation of buy-in and a sense of ownership by government and citizens.

"You need to establish a sense of ownership. To get the ownership, the steps prior to ownership is consultation, transparency, collaboration and joint decision-making. It doesn't have to be equal levels because you can never satisfy all stakeholders. That's a very romanticised view. But all those steps, whatever it may require, should emphasise this point of ownership." Participant CC

Additionally, the digital approach of governance should foster and support interactions to transform leadership and allow citizens to engage with and access City and other stakeholder resources in order to address a need or objective. This necessitates a governance approach that is aware of both the formal and informal dynamics and that aims at operationalising value through collaborative processes and methods. It also aligns with the need to foster a governance that ensures continuity and adaptability,

and that accommodates shifts in context, leadership and policy. An approach is called for that guards against both disruptive governance and the prohibition of the continuity of the Smart City concept, in terms of technology, policy and management.

"City and Province definitely can take a lead because that's why public servants are there. Communities who engage in these things don't get paid to do it, so we mustn't underestimate the impact of resource or resourcing or resourceful or access to resources. So it may take the lead, but at the same (time) it must be ROI and communicating and engaging with communities. The methodology or the approach is very important when you (are) taking the lead." Participant CC

Governance should support transformative leadership that enables social change by activating the mechanisms and social drivers that generate self-agency, knowledge, civil autonomy, co-creation and participatory governance between government and citizens (Montuori and Donnelly, 2017). This highlights the need for governance to be accountable and responsive to concepts such as 1) bias or inequity, 2) misuse of resources, 3) group dynamics and politics, and 4) organisational, community or group agency and influence. Governance and its methods should be representative of groups with both high and low agency and of diverse contexts (Kachanoff, Kteily, Khullar, Park and Taylor, 2020).

"The leadership and the facilitators has to be I suppose empathetic is a word I could use, but needs to see perspectives of all the stakeholders and you need to have technical knowledge but you cannot rely on that. It needs to be a transformative type of leadership, because I think the leadership in a process like this in a Smart City context is critical. Because you can say Smart City, but Smart City, for whom. . . " Participant CC

Participant, DD added:

"Digital governance really needs to take into account the impact to a large extent that that digital activity and presence is having on not only your own company or your own organisation, but also the broader community in which you operate." ....."There's a tendency to also want to copy paste what's been successful in other parts of the world and oftentimes, when we do that we neglect the local context, and we don't take into account all the local factors and prohibited or constraints that we should. We also don't take into account some of the unintended consequences and negative effects of just replicating what's been done in other parts of the world. I absolutely believe in managing that transition in a way that doesn't increase the inequality." Participant, DD

Additionally, the role of governance ought to support the development of a better understanding of the various contextual needs of society, communities and stakeholders. This includes the recognition of informal governance structures that are contextually appropriate as a way of establishing appropriate value models

and measurements for service creation and to address the needs of society. This mitigates tensions that prohibit equitable and fair governance within an ecosystem by considering factors such as 1) availability of and access to technologies, 2) citizen control or level of autonomy in decision-making and, 3) individual and collective incentives. Governance processes that monitor and manage the impact of digital technologies on communities are involved. This emphasises the need for "humanistic governance" that attempts to alleviate the negatives effects of pervasive technologies, such as technological anxiety, and helps build trust and legitimacy amongst participating stakeholders (Revilla Munoz, Alpiste Penalba, Fernandez Sanchez and Santos, 2017).

"So for me, digital governance really needs to take into account the impact to a large extent that that digital activity and presence is having on not only your own company or your own organisation, but also the broader community in which you operate." Participant DD

Governance and its approach should activate collaborative governance models. This refers to the need to support and facilitate the formation of partnerships between communities and stakeholders towards service creation by sharing specialised skills. Such relationships can help develop active citizenry and capture the interplay and interchange between stakeholders as a means of generating and facilitating alternative value systems, thereby increasing legitimacy, transparency, self-agency and ownership amongst participating stakeholders and communities. It thus highlights the need for governance that is holistic and transitory in its approach towards addressing needs or objectives of the broader citizenry. Furthermore, it calls for a type of governance that is underpinned by a transformative Smart City vision geared towards active and sustained participatory governance solutions that are responsive and can demonstrate contextually relevant solutions and a common good value for all concerned. Governance and its approach should facilitate and support better or increased civil and collective autonomy, mitigating factors that hinder collective action. This entails a governance approach that is geared towards generating self-agency and an innovative environment. Additionally, it demands governance that, by making use of ICT and pervasive digital technologies, is decentralised and dynamic, therefore more likely to achieve sustainable and equitable urban development, relevant to context.

"There's also been a lot of initiatives that business have tried under their own steam, but it doesn't always gain traction and so it becomes a very expensive experimentation. Whereas it's far more preferable to do something which is already conceptualised under a broader vision and a bigger idea that has multiple stakeholders." Participant, DD

Participant, CC supports this:

"When you actually have real ownership of some form that there's something

vested from whichever stakeholder and I'm talking from both sides of the pendulum, the 'haves' and the ' have-nots' to use that terminology again. If you're not able to sustain stakeholder participation, you may be able to leverage it or drive it initially, but you need something that will keep people there."..... "When a sense of self-agency kicks in then. . . that's when things become a bit more equitable, when the playing fields are levelled and then their own sense of agencies, communities or individuals starts kicking in and development and growth can happen at a greater pace." Participant CC

22.10.10 Transition Dynamics

The process of Smart City implementation and its transitory requirements call for stakeholder participation that activates and uses data, digital technologies and collective intelligence to unlock demonstrative value through crowd-sourcing and context-aware technologies, for example. Moreover, it necessitates the use of relational engagement strategies and the provision of context-appropriate data, combined with the application of ICT and digital technologies, to facilitate transitory value processes. Relational engagement methods and communications strategies must ensure that involvement occurs in a coordinated and adaptable manner that supports value creation for contributing stakeholders by focusing on participation which embraces both formal and informal value processes as a means of engendering a sense of agency and ownership. Additionally, relational engagement strategies foster better decision-making, and data can serve as a catalyst in creating a more people-centred urbanism:

"Someone with an internal locus of control, which would be typically as example of such a persona, someone who is middle-class, who's employed, who has all the comforts and conveniences of (being) middle-class. If they have a problem with the municipality, then they go to the municipality and say 'I want to see the mayor now!' or 'I want to see the town engineer now!' They have that internal locus of control from a social psychological perspective. Whereas someone who is disenfranchise who lives on the marginalised parts of society, they don't have an internal locus. They will say 'Oh, but who am I going to complain to?' or 'I must go to my ward councillor but nobody will listen to me; so I will wait until the state gives what it says is going to give.' So that whole thing about the context is important and that the context shifts also." Participant CC

Participation amongst groups or stakeholders should seek to generate iterative and interactive ecosystems. This involves the need for stakeholder engagement that promotes holistic inclusion, operationalising broadband infrastructures, in order to unlock new value or contextually appropriate value processes for stakeholders. This underlines the need for advancing adaptable and supportive systems that can coordinate the transitory dynamics needed in order to unlock contextually relevant or useful value. Additionally, it calls for the generation of transitory value where value is activated by identifying and defining "common good" value objectives and practices

held by stakeholders.

"One needs to understand the complexity of the landscape. You need to understand the different catalytic things that can be done to improve, and then you need to measure before you introduce more catalytic change. So I don't think this is a linear process or even a clearly defined cyclical process." Participant AA

Group and stakeholder engagement participation should facilitate better engagement, with communities becoming both producers and consumers of information. Ultimately, data mobilisation becomes the catalyst for local innovation and service creation centred around societal needs. The internal and external loci of control amongst stakeholders should be considered as transitory methods of engagement, contributing to the conditions of change that ultimately support the citizenry and provide the civil and collective autonomy necessary for the improvement of citizens' quality of life (Kormanik and Rocco, 2009). Implementation should also engender participation that tracks the degree of engagement by stakeholders, remaining cognisant of and responsive to the fact that participation shifts over time. Therefore, the variables and dynamic nature of stakeholder participation need to be properly understood, as well as contextually apt and transparent in terms of roles, responsibilities and goals.

22.10.11 Value Modelling and Measurement

The Smart City relies on the activation and advancement of value through knowledge management processes that aid in the discovery and mobilisation of data in order to generate prosumers. Such processes assist with the identification of knowledge and the establishment of appropriate value models for innovation and service creation. It, therefore, highlights the need for the application of data and analytics to improve data-driven decisions, as well as the design processes that facilitate better data management, - integration, - delivery and - access for the broader citizenry. Value within a Smart City context, therefore, refers to an interchange between stakeholders that enables local innovation through the application of data, knowledge and digital technologies in order to generate a more people-centred urbanism.

"So essentially for me it starts off with people and our.... there are two things political and our economic lives as individuals and as a community, and our interaction with the planet, right? So when we talk about Smart Cities, it's actually a misdemeanour (misnomer) because it's like (saying), let's take the city as it is assumed everything's fine and if we digitalise it, it's going to be better." Participant AA

In establishing value, focus needs to be placed on the leveraging of digital technologies to stimulate digital literacy and transformation that aids in the unlocking of informal and formal value. Such value supports collaborative experimentation and the generation of collective value, as well as mitigating embedded or negative hierarchical systems that hinder organisational and societal change or the facilitation of common good value. Value should be evaluated by its ability to operationalise collaborative

practices and knowledge sharing that can aid in the development of an active citizenry:

". . . a lot of your...financial services companies, and so on have a very keen interest in township economies at the moment because there are a lot of unbanked, uninsured people in those communities. So it's seen as a big growth area for most of the bigger companies and so they'd be very keen to have a stronger presence in those communities and to start building a better brand profile in those communities. But it's often difficult to do that unless it's fully collaborative and with the support of the City and under the umbrella of a broader vision." Participant DD

Participant AA agrees:

"How does everything thrive in an ecosystem and in a civilisation, right? Is it at all possible for us to imagine a non-hierarchical system or are we bound to a hierarchy and we always have to have a hierarchy. If we are bound to a hierarchy, how just can we make the hierarchy? I think those are essential."

Value generated through the utilisation or application of knowledge, therefore, requires an understanding of the various contextual needs of society, communities and stakeholders, as well as how to establish appropriate value models and measurements that address the needs of society. This calls for the creation of value that improves the development and integration of communities and digital technologies, and that creates better governance processes to increase transparency. This integration helps generate a sense of ownership and agency by the larger population, through processes of digital transformation and in defining communities of practice.

"So it is about an inherent value attached to knowledge of communities and societies and how you engage with that first and then build your solution on top of that. And not saying 'Okay, you have no idea what your reality is. You have no idea how to solve your problems. Let me solve them for you." Participant AA

There is a need for the establishment of value which improves digital access to collaborative experimentation, innovation and service creation. As such, we need to perceive value as a form of applied intelligence that facilitates the transformation of data into information and where experimental evaluation makes use of relatable engagement methods in order to foster trust, legitimacy and innovation. This also necessitates the use of supportive and adaptive implementation strategies where value and innovation can be measured against community and stakeholder needs, using an iterative design approach, demonstrating value between participating stakeholders.

". . . creating those spaces where experiments (can happen) and where you can prove the value of working in this way. I think that's one way to get into that space and get into it in a safe way. As I said: Corporates, they don't like to share because there is monetary value to it and they don't want to share corporate secrets, spending a lot of money gathering the data. The public sector, have data which is

public, but they don't want to share because of so many compliance and regulatory issues. They are just too scared and they don't know what's going to happen to it and they don't have control over it. But if you can bridge that with a kind of sandbox environment with clear rules of engagement, I think that's a step in the right direction." Participant CC

22.10.12 Summary

This chapter reported on the findings obtained from individual interviews and thematic content analysis in response to my research questions. These findings and emergent data were discussed under the following distinct yet interrelated themes: 1) Access as Infrastructure, 2) Adaptive Socio-Technical Solutions, 3) Common Good Value, 4) Contextual Smartification, 5) Data as Catalyst, 6) Demonstrated Value, 7) Equitable and Sustainable Cities, 8) Stakeholder Engagement, 9) Transformative Governance, 10) Transition Dynamics, and 11) Value Modelling and Measurement as they pertain to uncovering the key Smart City components from a Cape Town perspective. In the following chapter I discuss these findings in relation to the SCIEP conceptual model. I also report on the tensions and focus areas needed for establishing Cape Town as a Smart City.

23 Discussion

23.1 Conclusions

This chapter reports on unlocking and furthering Cape Town's Smart City trajectory. More specifically, it outlines such a trajectory as an active and engaged process that involves the mobilisation of various participating stakeholders as a way of defining and revealing such potential for the City of Cape Town. Findings and data crystallisation for this study were achieved by applying and mapping primary findings against the SCIEP conceptual framework. These revealed the key characteristics necessary for establishing Cape Town's Smart City implementation as an engagement practice and for establishing holistic "data-driven innovation" and value within the digitally-driven ecosystem known as the Smart City (Abella et al., 2017:51). In addition, as highlighted by the SCIEP conceptual framework, this study grounds the Cape Town Smart City discourse in current academic literature. The SCIEP model offers a multi-dimensional approach, imagining Smart City implementation as an overarching strategy that takes into account the contextual interstices, people, domains and associated resources needed to mobilise public and stakeholder value. The study has explored Smart City implementation in Cape Town as a holistic engagement practice. It provides an improved understanding of the ramifications of Smart City implementation in Cape Town as well as its potential for the City of Cape Town. This chapter also reports on my methodological and substantive reflections and recommendations for future studies. Research objectives were addressed by employing the following procedures:

- A systematic literature review (SLR) and content analysis around the current academic Smart City discourse. This also ensured an alignment of current CoCT Digital City Strategy themes in relation to the academic debate.
- The development, using an inductive approach, of the main categories and the analytical process of clustering, based on the SLR, and the development of the SCIEP model.
- Presentation of key Smart City components for Cape Town as informed by literature, the Digital City Strategy and semi-structured interviews with experts in the field.
- Alignment of the current academic debate in accordance with the SCIEP Model and Cape Town's Smart City trajectory.

23.2 Summary

In 2000, the City of Cape Town (CoCT) initiated its Smart City strategy. This culminated in the implementation of a R300 million Rand SAP/ERP system, providing the necessary IT infrastructure that would support and improve city processes by digitally integrating all organisational processes into a single platform. This CoCT vision of moving towards smart urbanism was later developed into an internal CoCT Digital City Strategy, the focus of which included digital government, - inclusion, -

economy and - infrastructure as a way of supporting Cape Town's Smart City vision. However, whilst demonstrating a Smart City vision, the Digital City Strategy's models and mechanisms lack substance in terms of Smart City deployment. This research has focused on exploring an all-encompassing Smart City implementation strategy for the CoCT. Additionally, it locates Cape Town's Smart City developmental objective and trajectory within a collaborative engagement practice, ensuring that smart initiatives and their deployment are well aligned in relation to the various participatory networks needed to achieve a more inclusive, active citizenry (Anttiroiko, 2015:26).

23.3 Questions that drove this study

- What are the key Smart City components from a Cape Town perspective towards Smart City implementation as an engagement practice?
- How are these used to develop a Smart City vision for the CoCT?

23.4 Systematic Literature Review (SLR Process)

Sources of information for the systematic literature review came from database searches, reference searches and article abstracts, including IEEE Explore, ProQuest, ACM Digital, EbscoHost and Google Scholar. These sources provided an overlap across these various academic databases. Inclusion criteria included peer-reviewed Smart City literature, written in English between 2015 and 2020. As part of the literature content analysis phase, 127 studies were identified (based on keyword entries) of which 84 documents were analysed and coded using Atlas Ti. Database search entries included the following keywords: Smart Communities, Smart Cities, Internet of Things (IoT), participatory sensing, smart environments, cyber-physical systems (CPS), as well as IoT communications and technologies. The collected data from the short-listed 84 documents were imported, qualitatively analysed and coded in Atlas Ti by reading and re-reading of text, using a combination of both predetermined codes and the development of new code lists. This resulted in a preliminary code book containing 467 codes, broadly defining the much-contested areas in this field of study. These initial 467 codes were subsequently further read, analysed and developed into 76 code groups, each with its own sub-groups. This provided a clear representation of both the terms used as part of the Smart City academic debate and its leading authors. The identified articles, codes, groups and sub-groups formed the basis and rationale of the systematic literature review. The development, using an inductive approach, of these main categories and their analytical process of clustering resulted in the Smart City Implementation as an Engagement Practice or SCIEP model.

23.5 Smart City discourse and its approaches in literature

As a study exploring Smart City implementation as an engagement practice for the city of Cape Town, South Africa, this research started with a systematic literature review (SLR) and content analysis. The review was based on the assumption that Smart City

implementation can play a significant role in addressing current urbanisation issues; however, the associated mechanism for unlocking its potential is unclear. The objective of the first-phase content and document analysis was to identify the central Smart City discourse and associated constructs and approaches in literature. Results from this content analysis process revealed 63 key elements which pertain to the Smart City discourse and enable a broadly defined overview of the components that lead towards Smart City implementation and engagement. These constructs were further refined regarding their purpose, process and objectives related to the conceptualisation of data through a process of constant comparison, analysis and labelling of raw data as a way of inferring meaning. The accumulation of such inferred meaning provided "potential indicators of a phenomenon" and, through constant comparison and analysis, identified the unit of analysis that informs the theory (Pandit, 1996:1).

23.6 Towards understanding Smart Cities as an engagement practice

This systematic approach and analytical process of constant comparison of the data served to identify abstract representations of a phenomenon. It involved the clustering of concepts into categories as they pertain to a phenomenon. The outcomes of this process of constant comparison disclosed 17 constructs, explicitly related to understanding Smart City implementation as a co-created ecosystem. Moreover, the outcomes uncovered the components that lead to Smart City implementation, engagement and the advancement of a local, more inclusive environment. The 17 constructs were further developed and interpreted using an inductive approach of constant comparison in order to understand and develop a Smart City vision that is geared towards engagement. Seven main concepts, specific to Smart City implementation as an engagement process, emerged from this process: 1) data, 2) co-production, 3) citizen participation, 4) knowledge management, 5) Smart City initiatives, 6) Smart City maturity, and 7) Smart City domains. These were further developed into the Smart City Implementation as an Engagement Practice model (SCIEP) which served as the analytical lens for this study.

23.7 Aligning CoCT Digital City Strategy against current academic debate

Permission was obtained via the CCT director of Policy and Strategy from the City of Cape Town to conduct doctoral research investigating Smart City implementation for the CoCT. The letter can be viewed in the appendix.

This inductive approach involved a process of constant comparison and document analysis towards aligning the current CoCT Digital City Strategy with the current academic debate. It involved the positioning of its four pillars of digital inclusion, - infrastructure, - governance and - economy in relation to corresponding literature as identified by the following themes: 1) smart urban services and deployment, 2) IoT implementation, 3) IoT technologies, 4) big data, 5) cyber-physical systems, 6)

open data in Smart Cities, 7) co-creating Smart Cities, 8) Living Lab, and 9) open innovation and stakeholder engagement. Specifically, its alignment aimed at exploring and identifying the key components that would enable or activate the DCS mandate of 1) promoting digital access, improving digital skills and driving digital initiatives that enhance quality of life, 2) enabling digital solutions that enhance the effectiveness of critical City infrastructure, 3) enhancing service delivery and promoting citizen engagement through ICT, and 4) creating and enabling an environment for the growth of tech-enabled enterprises to maximise job creation potential as illustrated in Figure 30 (p. 141). Outcomes of this process revealed the key recommendations needed to reframe the current CoCT DCS strategy as a Smart City vision for the CoCT. These recommendations involved four key observations:

- The CoCT Digital City Strategy should involve broader protocols and stakeholder engagement in order to reach its specified objectives of enhanced access, improved ICT skills and use, and the achievement of social change through ICT (City of Cape Town, 2016:14).
- The vision of Digital Infrastructure as afforded by the ERP/SAP system requires more comprehensive organisational and public engagement in order to ensure its objectives and to gain an implementation strategy which is inclusive and relevant to the CoCT.
- The CoCT Digital City Strategy requires stratagems or guidelines that drive and support innovation and opportunities for economic growth (GDP) in the Western Cape which, in turn, plays a part in Smart City development.
- Attaining the objectives of digital governance as set out in the strategy requires a coherent implementation plan.

23.8 Interview data

Semi-structured interviews with experts in the field served as the primary source of data for this study. These involved a line of inquiry and approach representative of academia, government, civil society and industry across the domains of digital inclusion, - infrastructure, - governance and - economy in order to uncover the key Smart City components from a Cape Town perspective. The analysis of interview data followed an inductive approach. Collected data were qualitatively analysed and coded in Atlas Ti by reading and re-reading of the text, using emergent themes from literature and as encapsulated within the SCIEP model. In addition, emergent data and preliminary findings were mapped as networks in order to demarcate broadly the interrelatedness of concepts and their meanings.

23.9 Towards a Smart City strategy for the CoCT as an Engagement Practice

The SLR and document analysis process culminated in the development of the SCIEP model which provides an analytical lens for interpreting engagement practices as a

result of Smart City implementation. Additionally, an analysis and alignment of the current CoCT DCS with the academic discourse provided a contextually grounded understanding of Smart City implementation and its potential for the City of Cape Town. Collectively, these inductive undertakings made evident the seven constructs or components that aid in developing an inclusive Smart City vision. These findings and their associated categories were further tested in semi-structured interviews with experts as a means of gauging their resonance in the establishment of a Smart City vision for the City of Cape Town. Outcomes, through a process of constant comparison and data saturation, revealed eleven key Smart City components from a Cape Town perspective. These are 1) Access as Infrastructure, 2) Adaptive Socio-Technical Solutions, 3) Common Good Value, 4) Contextual Smartification, 5) Data as Catalyst, 6) Demonstrated Value, 7) Equitable and Sustainable Cities, 8) Stakeholder Engagement, 9) Transformative Governance, 10) Transition Dynamics, and 11) Value Modelling and Measurement. Combined with the SCIEP model, we are thus provided with a better and more contextually grounded understanding of how to develop a Smart City vision for the CoCT.

23.10 Methodological reflection

This study was bound by an inductive approach and involved the constant compression and crystallisation of raw data into summary or codified meaning. The chosen inductive approach and protocols employed allowed for the uncovering and establishment of meaning through a process of evaluation and inference gained from findings and collated data. This also assisted with the development of a model, representative of an underlying structure of processes evident in the synthesised data (Thomas, 2006:237). This process of objective discovery greatly enhanced construct validity by establishing specific literature-informed protocols, as illustrated in the creation of the SCIEP conceptual model. Through a process of theoretical sampling and constant comparison, relationships were established between categories and their causation relative to each other (and the emergence of potential propositions), thereby appreciably enhancing internal validity. External validity was ensured by generalising this study's findings within existing and established knowledge domains. The use of semi-structured interviews for data collection, which employed purposeful sampling, contributed significantly towards gaining access to insider peer knowledge and the recruitment of informants with relevant subject scope and knowledge. Potential informants were sent an email requesting an hour of their time to discuss their experience as professionals in foregrounding the key components for unlocking Smart City value and opportunities for the urban transformation of Cape Town to benefit its population. Informants were also sent a letter of consent which informed them that their participation was voluntary and without any obligation. Additionally, and ahead of the scheduled interview date, they received a copy of the interview questions, and of the SCIEP conceptual framework which provided background to the questions, to ensure that they had enough time to reflect on subject responses. The interview questions were developed by applying an inductive approach which synthesised and crystallised key constructs gained from the SCIEP conceptual model,

academic literature and its interrelationship with the CoCT Digital City Strategy. Themes were tabulated and summarised in order to elucidate key focus areas that would translate into interview questions, as illustrated in Figure 50 (p. 204). These key focus areas were further developed and summarised into key talking points as illustrated in Figures 51 and 52 (pages 205 and 206 respectively). Interview times averaged 1h30min. The chosen approach of adhering to a process of constant data comparison to achieve data crystallisation greatly assisted in the discovery of new and significant perspectives. It facilitated the uncovering of new meaning which mitigated bias and allowed for the location of new findings within the current academic debate. The methodological approach of this study, therefore, led to the discovery of nuances and the bridging of additional concepts that are well aligned in addressing all key perspectives in Cape Town's Smart City trajectory. This approach and its outcomes provide a better and contextually grounded understanding of the Smart City concept and its role in the development of an environment that enables collaborative practices and partnerships which will further the City of Cape Town's quest to become an African Smart City.

Themes	Line of inquiry	Indicators	Focus areas (line of inquiry)	CoCT online services	Literature counterpart
data	• local network development • local operations management • preventative local administration	• managing data • data integration • privacy issues • delivery and access versus need	• Promoting digital access • Closing the digital divide (How and Who and Why) • Improve skills towards digital initiatives • Drive digital initiatives to increase quality of life • Develop and promote ICT infrastructure towards community informatics • Develop and promote digital urbanism and digital solutions for improved efficiency and equitable services • Enhancing service delivery through ICT and other emerging technologies • Promoting and develop citizen and stakeholder engagement using ICT and enabling technologies • Creating an enabling environment for business and innovation and drive equitable economic growth (local and global) • Improve operational efficiency and resources through the use of ICT • Increase and improve transparency through the use of ICT (open innovation, open data etc.) • Improve city governance and effective administration through the use of ICT better stakeholder engagement and citizen participation. • Develop high level of local and global connectivity • Optimise and simplify (better access) business processes • Develop ICT driven innovation ecosystem and culture • Enhance decision and public policy through ICT and evidenced based analyses • Improve and promote access and dissemination of information through ICT (digital procurement, open data, datasets etc.) • Develop and maintain citizen engagement and interaction • Encourage and enable community development and social transformation • Develop smart citizenry and the use of city data for improved services and the creation of new opportunities or services • Develop human capital and creating an enabling environment for a more skilled and smart citizenry, businesses and business development • Promote and utilise digital solutions, networks, services and ICT for effective city management • Promote and utilise digital solutions and ICT for resource management and management of city service • Leverage resources and infrastructure to drive stakeholder participation and investment (access to data centres, network monitors, public cameras, smart meters etc.) • Incentivise the development of digital infrastructure and usage	• e-services • Service requests • Procurement • Tenders • Invest Cape Town • Housing needs • Smart Cape (Smartcape Cadets Skills Development Programme, Expanded Public Works Program) • Expanded Public Works Program (EPWP) Job Seekers database • ECAMP • Public participation • Waste and recycling **Open Data Portal** • City budgets • ECAMP • Planning portal • Tenders Awarded • Tourism • GIS Information • Stats and reports • City Data Other factors ERP/SAP System (R300million) Cape Town is known as tech hub	• Smart urban services and deployment • IoT implementation and infrastructure • ICT and digital technologies • Data, Big Data and analytics • Open innovation and stakeholder engagement • Co-creation and production (services, platforms, infrastructure, architecture, knowledge etc.)
co-production	• driven by civil society (organisations, NGO's) • between civil society (organisations, NGO's) and citizens • combination between	• experiment portal • lessen isolation • annotation of data • city scale opportunistic data collection • EAAS Framework (test bed)			
citizen participation	• citizen as democratic participant • citizen as users • citizens as co-creators • citizens as co-creators and users	• experiment portal • lessen isolation • annotation of data • city scale opportunistic data collection • EAAS Framework (test bed)			
knowledge management (i.e knowledge collection, integration and utilisation towards improvement)	• knowledge exploration • knowledge retention • knowledge exploitation	• inventive capacities • transformative capacities • innovative capacities • absorptive capacities • connective capacities • desorptive capacities			
Smart City initiatives	• people and community • natural environment and infrastructure • governance • economy	• context • co-design • deployment			
Smart City maturity	• strategic intent • data usage and strategies • ICT technologies and digital urbanism • governance	• stage 1 / ad hoc • stage 2 / opportunistic • stage3 / purposeful and contextually relevant • stage 4 / operationalised • stage5 / optimised			
domain/context	• people and living environment • environment and mobility • government • economy	• Understands Smart City concept • Provides evaluative framework • Understands relationality of factors			

Figure 36: Mapping of main constructs as informed by SCIEP model and SLR towards developing interview questions (Author, 2021)

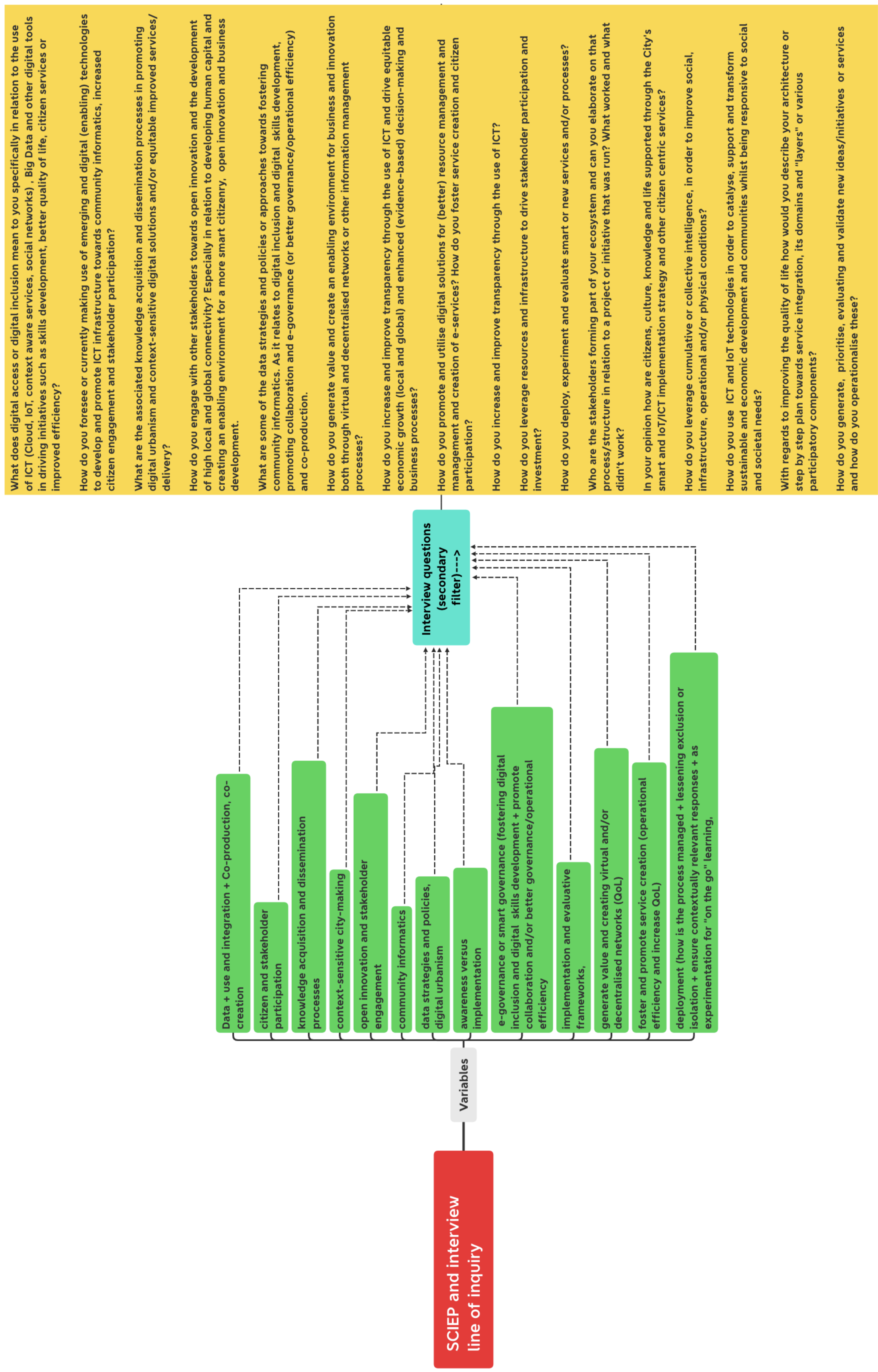

Figure 37: Mapping of main constructs as informed by SCIEP model and SLR towards developing interview questions (Author, 2021)

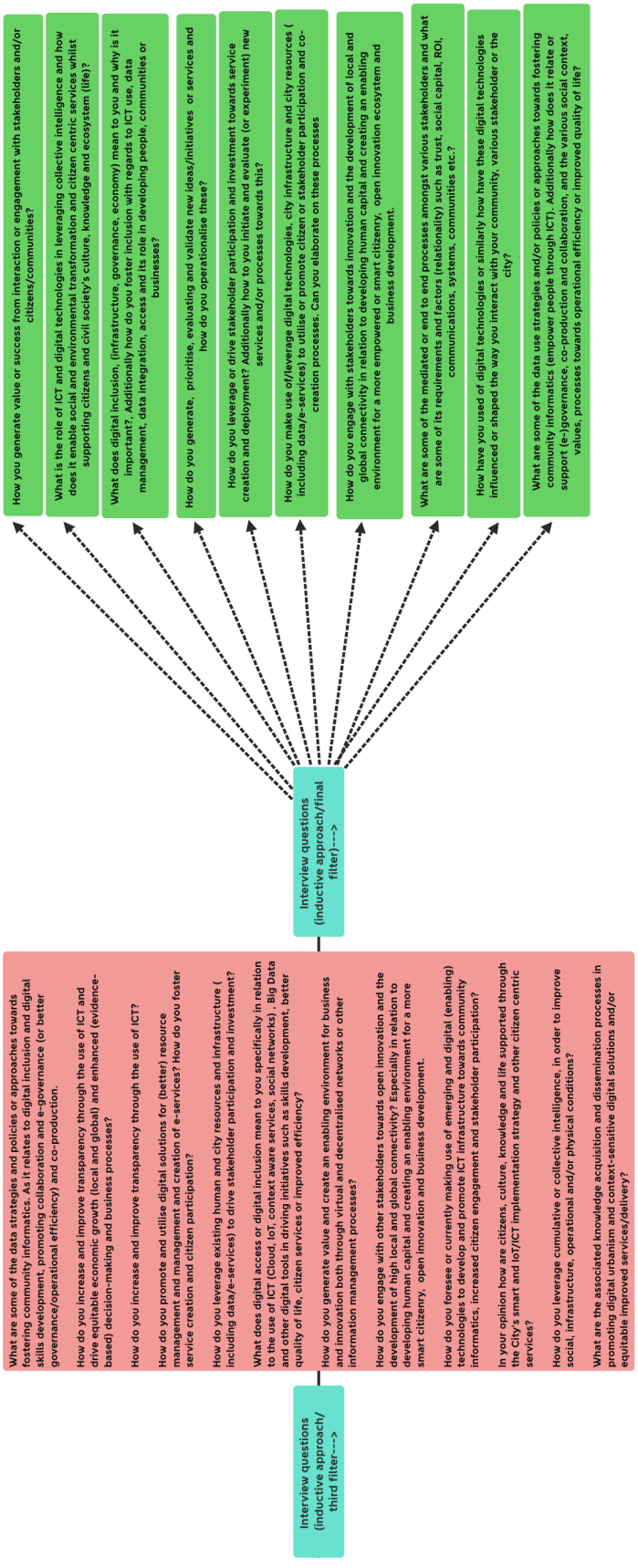

Figure 38: Second phase (continued) mapping of main constructs towards developing interview questions (Author, 2021)

23.11 Substantive reflection

23.11.1 Access as Infrastructure

This study found that pervasive access to broadband and digital technologies ought to be considered as necessary City infrastructure in order to activate Cape Town's potential for Smart City implementation. More specifically, findings from this study confirm that the notion of access for citizenry should facilitate digital transformation and contextual smartification processes, which means that the facilitation of access, in turn, activates the use of data analytics. This is supported by literature which describes Smart City implementation as the integration of a host of IoT technologies propagating an array of sensing or actuating cyber-physical infrastructures, which aid in adapting, changing or advancing an array of systems (Nahrstedt et al., 2016:2). This access should also activate mechanisms that further the democratisation of information in order to promote and support holistic and horizontal integration and diversification. This calls for the application of IoT technologies, combined with the utilisation of Big Data analytics, machine learning and the exchange, use and integration of heterogeneous sensor data across domains, in order to derive, automate and correlate insights from captured data to improve business intelligence, analytics, platforms and services (Ahmed et al., 2017:13). Such data access serves as a key enabling technology or focus area that allows for a connected infrastructure between various IoT smart devices, resulting in a smart environment (Santana et al., 2017:6). Access for all stakeholders, therefore, should aid in establishing a data-driven and co-created city that draws on and uses an array of distributed IoT technologies, data sources and data sets in order to resolve inner-city problems by improving public services and citizens' QOL. One way of achieving this objective is by leveraging open data as a freely shared and distributed online resource that, when combined with data mining and analytics, can be accessed, examined and shaped by various public stakeholders, promoting a more informed citizenry and ultimately effective and more innovative services (Smart Cities Council, n.d.). Consequently, establishing access should be responsive in order to diminish the digital divide and enable data access and interaction that permits innovation and service creation - in effect, serving as an economic enabler. According to literature, this entails initiating a process of co-production which involves the creation of public value for local communities by activating citizens as prosumers within the digital urban environment. This identifies citizen involvement as paramount in defining co-production and value formation processes (Anthopoulos, 2017:285). Broader access should support private and public stakeholders with alternative economic models to promote better access and inclusion. This relates to the concept of access which supports and promotes the use of data analytics and open data to unlock potential value, collaboration, stakeholder- and relational engagement. Literature supports this by stating that Smart City implementation should seek to permit citizen and city engagement with collaborative digital practices and environments. This can be achieved by leveraging citizens as city partners through the use of IoT technologies, thereby developing the city into an urban innovation platform (Madakam and Ramaswamy, 2015:3). This

is important as smart services constitute a fundamental element in a Smart City as they underpin the implementation of urban intelligence in order to understand the complex connections between place and its potential associated social capital. Access should, therefore, recognize the allegiance between urban places and complex social practices as representative of a connected exchange of the data sources which exist in a city's physical and digital spaces (Roche, 2016:6; Acedo et al., 2018:1). This requires governance that actively makes use of ICT to interact more effectively with citizens and to develop an active citizenry that leverages available accumulated data to understand and address social problems. Such governance should also initiate new citizen services that are more interactive and democratic and involve citizens in policy decision-making processes (Mellouli et al., 2014:1). From a policy perspective this encourages the use of decentralised open data, allowing for data analysis across an array of data components, such as structured, semi-structured or unstructured data, machine data, spatiotemporal data (GPS), real-time data, operational or process data and businesses data. This provides opportunities for meaningful connections within a city and its stakeholders (Anthopoulos, 2017:40). It, therefore, speaks of access that facilitates the unlocking of demonstrative value by using digital technologies. Furthermore, effective access depends on enhanced stakeholder interaction between industry, government, society and academia where open innovation interactions and co-created processes stimulate new city services. Open innovation constitutes the establishment of value by activating extensive networking and collaborative engagement by all participating city actors or stakeholders as contributors to a focused innovative action or goal (Paskaleva et al., 2015:121). Access, therefore, also relates to the establishment of coordinated knowledge management tasks and interaction processes which can further improve organisational performance as social interactions synergise with knowledge management capacity (Hsiao et al., 2011:655-656). This necessitates the leveraging of stakeholder engagement and involves a process of contextual smartification to unlock informal economies, enabling economic transformation, local innovation and the development of active citizenry. Through the use of digital technologies that support user-driven innovation and collaboration, citizens can be involved in service innovation and improved governance processes (Oliveira and Campolargo , 2015: 2336-2344). The activation of access must also involve the development of adaptable and supportive systems that can coordinate the transitory dynamics needed to unlock contextually relevant or useful value. This requires access that reimagines or operationalises existing infrastructures in order to unlock new value or contextual value processes This correlation between smart services and city innovation capacity and capability is supported by literature which recommends the provision of various service types, products and utilities to stakeholders, by utilising city infrastructure and resources, to improve citizens' quality of life (Anthopoulos, 2017:86). This study found that access which engenders a process of contextually relevant and relatable smartification, in turn, fosters development, learning, innovation and the formation of partnerships. This includes access that facilitates or cultivates a sense of ownership and responsibility amongst participating stakeholders relevant to their shared objective. According to Anthopoulos (2017:87), Smart City service provision is an innovation trio largely driven by (1) urban innovation, (2) planning, and (3) supportive technology.

Access, therefore, should allow more inclusionary platforms serving as catalysts for empowering citizens to create a bottom-up approach to city management services and developmental procedures. These Smart City paradigms include 1) community and people, 2) natural environment and infrastructure, 3) governance, and 4) economy. A Smart City and its initiatives and strategy should arguably aim to increase citizens' engagement and their involvement in the development of applicable public services by using technology as a means of facilitating such developmental objectives and meeting public service needs. This growing global move towards smart urbanism and the implementation of smart initiatives, however, should move beyond achieving mere "technology-embedded urbanism" and should also consider and explore what Aurigi and Odendaal (2022:2) call "a socially progressive and sustainable smart city."

23.11.2 Adaptive Socio-Technical Solutions

The Smart City concept in its approach requires adaptable implementation strategies and the creation of smart environments that allow for discovery, exploration and scalability of solutions or initiatives. As confirmed by this study, to achieve this, implementation strategies are recommended that include and drive experimentation and enable contextually appropriate technologies by adopting an overarching Smart City vision and an approach geared towards understanding the City's wider needs and objectives. This is echoed by literature which defines the Smart City concept as an envisioned synergy involving various factors of technology, governance and citizenry which support a city's vision and strategic objectives through activating collaborative practices between local governance and citizens, thus ensuring better interaction with citizens, the improvement of service delivery and innovation by leveraging IoT technologies and generated data (Schaffers et al, 2012:57; Mellouli et al., 2014:1; Rodriguez-Bolivar, 2015:126; Gutierrez et al., 2016:4). Implementation and its methods should, therefore, consider and respond to issues of policy implementation, management and technology to foster contextually relevant solutions that assist in establishing and auditing the associated variables and needs in relation to 1) available technology, 2) citizen needs, 3) possible solutions and appropriateness, and 4) available expertise or resources. Equally so the need exists to recognise ICT's role in supporting governance in order to understand the provision of public services, as well as ICT's strategic role as an interconnection between organisations, communities, contexts and domains. According to Gil-Garcia and Pardo, listed strategies may include the establishment of explicit and realistic objectives. They add the importance of identifying relevant stakeholders and achieving their active participation in the development of initiatives especially as end-users of a service or outcome. Other strategies could involve strategic planning approaches with which to substantiate and measure expected outcomes, communication channels and the tracking of operational or institutional processes and their improvement. Furthermore, it would be necessary to ensure the adequate acquisition of skills amongst participating stakeholders, including users and developers in addition to, although to a lesser degree, the availability of investment or economic resources (Gil-Garcia and Pardo, 2005:195; Chourabi et al., 2012:2291). Accordingly, implementation should involve

a needs assessment of participating stakeholders and the associated heterogeneous context, taking into account the associated transition dynamics and value modelling processes needed to ensure buy-in and demonstrated value. This involves catalysing adaptive solutions, and utilising ICT and digital technologies that support and enable the solving of practical problems. Chourabi et al. call for consideration of the following factors of "resource availability, capacity, institutional willingness and inequality, digital divide and changing culture and habits" in ICT application to ensure that the impact of these integrated information and communications technologies are well defined Smart City drivers (Chourabi et al., 2012:2291). Ebrahim and Irani confirm this, stating that these IT domain challenges include the availability of sufficient resources, adequate technical infrastructure that assists in providing reliable user access, management support, capable IT staff and effective IT skills, training and support necessary to develop and maintain services, as well as the provision of network capacity and communication infrastructure to enhance the value of services and public engagement. The authors also point out ancillary organisational barriers, such as fragmented or inadequate departmental communication, institutional culture, the resistance to project and strategic buy-in from management and a lack of coordination between departments (Ebrahim and Irani, 2005:601-606). Data processes and technologies, therefore, need to enable and assist the development of solutions based on needs, mitigating the skills deficit associated with achieving an objective or need. This requires the utilisation of ICT, data analytical processes and relatable communications methods that are understood, in order to facilitate value creation for participating stakeholders and citizens. It also aims at facilitating active collaboration and participatory governance solutions that promote trust and legitimacy, as well as using ICT and digital technologies to generate economic opportunities and stimulate digital literacies through an assisted process of contextual smartification. This relates to e-governance adopting to a citizen-centric approach, using information technologies to improve democratic discussion, government services, and to support citizen participation in service deployment (Chourabi et al., 2012:2292; Hsieh et al., 2015:164). Smart Cities, therefore, represent the emergence of a governing structure broadly termed smart governance. The interaction between stakeholders, policies and procedures is driven by the application of ICT and emerging technologies which set up co-creating services that assist in governing actions and improving government transparency, infrastructure and citizenry (Gil-Garcia et al., 2014:17; Anthopoulos, 2017:264). Kumar and Dahiya further describe smart governance as one shared, interlinked component amongst other components including smart people, smart city economy, smart mobility, smart environment and smart living, which cooperatively form a Smart City system (Kumar and Dahiya, 2017:16). Smart City initiatives require engagement practices that allow citizens and stakeholders to participate effectively and in a co-created manner in directing urban progress to address social/stakeholder needs, or create public value initiatives. As a result, cities have needed to find improved governance processes, where governance represents legislative, administrative and implementation processes in the interest of realising effective stakeholder participation and the intended outcomes. Accordingly, governance refers to "the outcomes of interactions between all actors in the public domain" (Rodr´ıguez-Bol´ıvar, 2015:3).

This requires responsive socio-technical solutions that support or engender knowledge management processes to facilitate contextual smartification procedures and to enable local innovation through increased access and application of data analytics and data integration. The effects of innovation and newly acquired value can be measured relative to contextual needs and the degree in which addressing the technical or adaptive challenges of ensuring inclusion and sustained participation have been met.

23.11.3 Common Good Value

This study found that successful and transformative Smart City implementation centres around the need for holistic inclusion and the creation of iterative and interactive ecosystems, developing ecological economies and collective value representative of citizens' needs. This requires a process of establishing collective value that is transitory and responsive to context and is activated by identifying and defining the "common good value" objectives and practices amongst stakeholders. According to Aurigi and Odendaal, this calls for "a socially progressive and sustainable Smart City where the implementation of smart initiatives moves beyond achieving mere 'technology-embedded urbanism' " (Aurigi and Odendaal, 2021:2). Such a call emerges from a need to provide smart solutions that are "contextually embedded" and where the Smart City represents a new form of urbanism and urban development that focuses on the vision of its people and place (Aurigi and Odendaal, 2021:9). In generating value, Smart City initiatives should, therefore, focus on and include the city's inhabitants, enabling urban development which responds to the human and functional needs of its people. Additionally, it should support urban development which captures the texture, complexity and contextual richness of people and place (Aurigi and Odendaal, 2021:9). This also necessitates the establishment of value that increases transparency amongst participating stakeholders, engendering trust and legitimacy. Value creation should be facilitated, which facilitates the generation of greater civil autonomy, ownership, governance, awareness and access, whilst remaining responsive to context. As such, it requires the development of participatory governance processes and structures where value is generated and measured by the shared or common good value practices of participating stakeholders. Such participatory governance processes should give rise to collective and shared value through the use of ICT and digital technologies, processes and platforms, allowing for experimentation that can facilitate innovation and service creation, and where access to data and technologies advances value creation.

23.11.4 Contextual Smartification

The Smart City requires contextual smartification processes that facilitate the analysis and integration of data - more specifically, data and analytics which serve as catalysts for generating value. Where data valences are operationalised, a skills development component is required in order to unlock data usage and value amongst all participants. This notion of smartness as a strategy in mitigating a range of urban challenges, considers the associated factors as captured in Chourabi et al.'s Smart City initiatives framework. Their framework outlines eight factors by which to (1) understand Smart

Cities as a concept, (2) provide an evaluative framework to direct smart initiatives, and (3) understand the relationality of these eight factors towards successful smart city initiatives. These eight factors are: (1) management and organisation, (2) technology, (3) governance, (4) policy context, (5) people and communities, (6) economy, (7) built infrastructure, and (8) natural environment. Similarly, the notion of contextual smartification processes should encompass an awareness - and facilitation - of the bi-directional interactions that occur between 'outer factors' (governance, people and communities, natural environment, infrastructure and economy) and 'inner factors' (technology, management and policy) which affect successful Smart City efforts by unlocking value (Chourabi et al., 2012:2294). This involves the formation of boundary spanners or shared methods of engagement as a means of co-ordinating and translating the linked societal, informational and relational needs and expectations between various communities. A constructed social meaning of objects across groups or communities is necessary in order to foster effective contextual smartification processes and capacity-building (Rodriguez-Bolivar, 2015:131; Fiore-Gartland and Neff, 2015:1470; Paskaleva et al., 2015:28). Such practices should alleviate techno-centrism; instead, digital technologies and citizens are engaged in order to stimulate digital transformation and literacy and thus unlock informal and formal value in service creation and in narrowing the digital divide. This seeks to assess the associated contextual and stakeholders' needs, and the roles and responsibilities in terms of policy, technology and management (governance) needed to activate urban innovation. It also requires transformative leadership that facilitates collaboration and boundary spanning, activating stakeholder engagement and sustaining innovation by managing the associated transition dynamics necessary for achieving urban innovation. Therefore, in the setting up of Smart City services, authors Paskaleva et al. present a sequential four-step procedure for stakeholder engagement to ensure service co-designing. These include (1) stakeholder enlistment, recognising relevant and required stakeholders, (2) stakeholder enrolment, recruiting required stakeholders, (3) stakeholder dialogue which leads to consensus based on involved stakeholder needs and objectives, and (4) stakeholder innovation network involving active stakeholder participation towards an approved service objective or outcome, as well as the co-design process (Paskaleva et al., 2015:128).

23.11.5 Data as Catalyst

This study confirms that the mobilisation of data is a core component in managing effective Smart City implementation. More specifically, data serve as a catalytic component in unlocking value through the utilisation of data integration, analytics and technologies that enable and assist with developing and implementing context appropriate solutions. As literature suggests, the advent and proliferation of IoT ubiquitous technologies has offered additional and more efficient data analytics and data types across diverse domains, providing value-added services by utilising Big Data analytics, Cloud computing, Artificial Intelligence, Deep Learning, Cyber- Physical Systems (CPS) and Machine Llearning. This occurs when IoT technologies, including Big Data, Machine Learning and the exchange, use and integration of heterogeneous

sensor data, are combined across domains linked by data analytics in order to derive, automate and correlate insights derived from captured data to improve business intelligence, analytics, platforms and services. (Ahmed et al., 2017:13). Data are a key enabling technology that allows for a connected infrastructure between various IoT smart devices resulting in a smart environment which generates volumes of heterogeneous Big Data. In a Smart City context, Santana et al. (2017:6) characterise this under the following headings:

- Volume: the associated challenges and required needs in dealing with a vast increase in generated data across distributed networks and data sources.
- Variety: data from several sources, such as sensors or city traffic cameras. These data may be structured or unstructured.
- Velocity: the need for real-time data processing across city infrastructure, at city management and user level.
- Veracity: ensuring data reliability and value as gathered from several data sources.

The concept of Big Data with its above-mentioned characteristics, encompasses a set of tools or instruments which, when combined with Big Data analytics, supports a number of Smart City solutions by being able to store and control exceptionally large data sets gathered from sensor networks, city monitoring devices and open data generated by citizens through social networks or smartphone usage (Santana et al., 2017:6). Big Data, in a data-driven Smart City context, provide numerous opportunities for city innovation and transformation. For deriving information from captured raw data for service deployment or urban transformation, Lim et al. (2018:94) put forward a data-use reference model for Smart Cities based on the various data and knowledge interaction points in a city. Their model also assists with uncovering the variances and interdependencies between data uses, advocating that Smart City planning and smartness move from a technological push to being more complementary with regard to different and changing urban contexts and communities. Consequently, the leveraging of such data technologies should facilitate collaborative engagement, assisting groups and communities to become both producers and consumers of information, innovation and service creation by mobilising data as the catalyst. This notion of a techno-symbiotic relationship between humans and their software agents is further promoted by what literature terms Human Agent Collectives (HAC). This is based on the idea of using humans, combined with their autonomous software proxies, as information gatherers. In a HAC model, engagement between humans and application software is seen as a dynamic, integrated social collective where the collection and exchange of crowd-sourced data and information are pooled as potential resources to address collective or public objectives. The HAC approach focuses on providing intelligent solutions by capturing, adapting, processing, combining and analysing human crowd-sourced or sensor data, and where such information is characterised by structured, socially coordinated and autonomous collective action.

This is then correlated across other IoT technologies, WSN and Cyber-Physical Systems and results in applicable and socially constructed outcomes (Pticek et al., 2016:5). Concurrently it requires the need to operationalise data valences, or the potential social value of data, through improved data governance models that help unlock value. These should take into account the associated variables, such as: 1) purpose of data, 2) data requirements, 3) data content and interpretability, 4) data access, and 5) data lifecycle (Lim et al., 2018:94).

23.11.6 Demonstrated Value

This study found that value within a Smart City context should be flexible, where digital technologies help enable solutions that go beyond commercial gain. Value, in The use and application of these digital tools, should, therefore, culminate in supporting or enhancing alternative and responsive governance structures, such as collaborative governance, to generate value. This requires making use of value models that are able to index the contextual needs of citizenry, and in this way develop active citizenry and solutions responsive to needs. Moreover, it necessitates successful implementation of a ubiquitous IoT network array, with enabled and connected devices that can compile, analyse, distribute and assimilate data for collaborative experimentation and local innovation through the democratisation of information and the development of data into meaningful extraction and application. Authors van Deursen and Mossberger, however, caution against a "paradox of skills", detailing a potential lack of individual digital skills needed to both address the rapid rate of evolution of cyberspace and navigate its increasing complexity (van Deursen and Mossberger, 2018:124). More specifically, these skills deficits relate to (1) operative skills (2) formal expertise and characteristics, (3) the ability to select, analyse and interpret information, (4) the ability to communicate information, (5) the ability to generate content, and (6) the ability to strategically apply knowledge and information towards improving QOL and services (van Deursen and Mossberger, 2018:127). Demonstrated value should, therefore, involve a process that uncovers and addresses the contextual needs of urban dwellers in developing an active citizenry and unlocks value from digital technologies, such as crowd-sourcing and crowd-sensing technologies. Furthermore, demonstrated value entails establishing engagement methods that are contextually appropriate to ensure that potential initiatives or interventions are properly assessed in terms of the needs of stakeholders and their associated parameters. The related questions to be considered are: 1) Is the appropriate technology available? 2) What are the needs? 3) Is the solution appropriate in terms of contexts? 4) What resources or expertise are required? (Yaqoob et al., 2017). As an outcome, demonstrated value should influence stakeholder engagement to be accountable and responsive in enabling digital access, inclusion and local innovation for city inhabitants. In addition, such engagement is measurable against a set of criteria for more transparent and legitimate governance, and trust initiation. This requires transitory value processes and relational engagement methods which foster holistic inclusion. The process of co-production involves the creation of public value for local communities by activating citizens as prosumers within the digital urban environment and views

citizen involvement as paramount in defining such co-production and value formation processes (Anthopoulos, 2017:285). Therefore, to harness the transformational impact of co-production processes within an urban landscape by involving the redistribution of power between governance and citizens, requires a redefinition of the roles of such co- production processes when considering citizens as information suppliers or co-production partners (Linders, 2012:447-450; Castelnovo, 2015:4).

23.11.7 Equitable and Sustainable Cities

The Smart City approach should support the formation of equitable and sustainable cities that enable local innovation, based on societal needs. From a practical and innovation spawning perspective, human-centred innovation is needed, supported by ICT. This will develop and facilitate transitory value through relational engagement methods that minimise exclusion or social marginalisation. Additionally, in the modelling of equitable and sustainable cities, innovation should be aimed at improving the lived experience of citizens, by using ICT to democratise information and using stakeholder engagement to unlock informal economies. Therefore, there is a need for the application of purposeful pervasive digital technologies that facilitate the implementation and mobilisation of broadband that fosters access, inclusion and opportunities for economic growth, and which drives digital adoption strategies that connect businesses, government, academia and civil society (Vanolo, 2014; Huston et al., 2015; Pols, Pasveer and Willems, 2018; Zhang, 2021). This is supported by literature which calls for enhanced stakeholder interaction between industry, government, society and university to expand innovation interactions and co-created processes in order to stimulate new city services. In accordance with this, open innovation constitutes the establishment of value, sustainability and high living standards by activating extensive networking and collaborative engagement among all participating city actors and stakeholders as contributors towards a focused innovative action or goal (Paskaleva et al., 2015:121). As part of a Smart City approach to achieving equitable and sustainable cities, attention should be paid to driving digital adoption strategies in order to holistically integrate smart technologies. This would unlock additional or new ecological economies that promote collaborative innovation (Carlsson, 2004). Furthermore, the digital divide must be narrowed by developing skills and focusing on initiatives that enable citizens to engage with digital technologies – which would ensure that approaches and objectives are contextually relevant and informed by an active citizenry. At the same time, the Smart City project must also foresee the risk of its initiatives perpetuating the digital divide and must consider how to mitigate such consequences (Lam and Ma, 2019). Emphasis should be placed on developing humanistic smart urbanism. This is supported by Hollands, who asserts that Smart Cities, if they are to support a more people-centred urbanism and enable social, environmental and economic development, should begin by focusing on their human capital and people. In addition, ICT implementation and infrastructure can be seen as important factors not only in themselves, but in their capacity to create smart communities by adapting social utilisation to increase citizens' quality of life, encourage democratic discourse and promote a more active citizenry (Hollands, 2008:315). By

the same token, a more inclusive and co-created city may permit additional city growth through having a greater understanding of the interrelated participatory systems and their potential to address the challenges of an urban co-created ecosystem (Gutierrez et al., 2016:4). The need exists for a more equitable community and social interaction that is less exploitative and where value generation is universal. This can occur by leveraging stakeholder engagement through processes of contextual smartification to unlock informal economies by using disruptive technologies to solve challenges, or as part of a broader sustainability agenda.

23.11.8 Stakeholder Engagement

This study found that prior to initiating engagement, considerable thought should be given to activating and matching engagement methods that drive holistic inclusion, particularly with regard to increasing participation and collaborative practices that generate transitory value - where value is activated by identifying and defining common good values or objectives. This is supported by literature, as activating open innovation constitutes value establishment, sustainability and higher living standards through extensive networking and collaborative engagement by all city actors and contributors, towards a focused innovative action or goal (Paskaleva et al., 2015:121). Literature also suggests that the creation of value or innovative outcomes within a company or institution positively correlates with its knowledge management capacity. This foregrounds the necessary development of applicable social interactions within the communications environment as a way of controlling the relationship between knowledge management capacity and performance outcomes. Furthermore, it suggests that social interactions should, in part concentrate on interactions that give rise to knowledge acquisition and dissemination processes as likely factors towards achieving performance outcomes (Hsiao et al., 2011:655-656). Such interactions, therefore, involve the formation of boundary objects or shared methods of engagement as a means of translating and co-ordinating the associated societal, informational and relational needs and expectations of the constructed social meaning of objects across groups and communities (Rodriguez-Bolivar, 2015:131; Fiore-Gartland and Neff, 2015:1470). Taking this into account in setting up Smart City services, authors Paskaleva et al. (2015:28) present a sequential four-step engagement procedure for stakeholder engagement to ensure the co-design of services. These include (1) stakeholder enlistment - recording relevant and necessary stakeholders, (2) stakeholder enrolment - the recruitment of essential stakeholders, (3) stakeholder dialogue - the construction of consensus based on involved stakeholder needs or objectives, and (4) stakeholder innovation network - active stakeholder participation in an approved service objective or outcome and a co-design process. It also necessitates, as this study found, the establishment of iterative and interactive ecosystems that are able to yield and demonstrate value to participating stakeholders. Furthermore, such value must address the needs of citizens. It requires co-ordinated engagement and the integration of digital processes, technologies and infrastructure that will aid in engendering economic growth, by considering the associated participation dynamics, such as 1) establishing consultation with participants, 2) prompting transparency

with stakeholders, 3) defining appropriate collaboration and co-production processes, 4) ascertaining appropriate joint decision- making and accountability processes, 5) outlining required technical skills, 6) determining appropriate governance structures and level of participation amongst stakeholders, 7) describing involved communities and stakeholders, 8) demarcating necessary resources, and 9) finalising the context: Whose needs are being served and for what purpose? Stakeholder engagement should embrace inclusivity, which necessitates the need for better collaborative governance and legislative processes that foster transparency, as well as accountability in generating transitory value. This demands piloting an assessment of the city's wider developmental needs, objectives and resources prior to project initiation or policy implementation. It also calls for platforms where discussion can occur towards fostering needs-driven or contextually appropriate interventions as part of an ongoing or overarching contextual smartification process. From a city management and organisational perspective, this envisions a synergy between technology, governance and citizenry in supporting a city's vision and strategic objectives. This can be achieved through leveraging IoT technologies and generated data to activate collaborative practices between local governance and citizens, thus ensuring better mutual interaction and improved service delivery and innovation (Schaffers et al., 2012:57; Mellouli et al., 2014:1; Rodriguez-Bolivar, 2015:126; Gutierrez et al., 2016:4). In addition to the above, facilitated or mediated engagement is required that takes into account the type of stakeholders involved, along with their context, processes and platforms, before establishing access amongst participants. Where such enabled engagement assists in generating agency, cultivating a sense of ownership will allow for experimentation, and ultimately innovation, to occur based on shared objectives. Facilitated engagement should also include and support methods that allow and acknowledge citizens and stakeholders to voice heir, as well as facilitate the integration of digital processes, technologies and infrastructure that support overall inclusion. These include communication platforms that are contextually appropriate in approach, delivery, resources and smartification processes in order to discover contextually relevant, analysable solutions that stimulate economic growth and improve people's lives. By using ambient and artificial intelligence alongside IoT technologies, the process of establishing smart environments may influence other connected systems that could lead to a more human-orientated smart environment (Gomez et al., 2019:28 and 39). Evidence-based decision-making in smart governance, therefore, relates to governments' ability to capture and leverage real-time sensor data, and integrate data sources from public services or platforms. This, with the use of data analytics can enhance or direct policy decisions or initiatives (Gil-Garcia et al., 2016:527).

23.11.9 Tranformative Governance

This study concedes that Smart City implementation calls for transformative governance, utilising ICT and digital technologies in order to stimulate and unlock digital literacy through a facilitated process of contextual smartification. Such governance aids in establishing active and holistic inclusion amongst participating stakeholders by mobilising data and digital technologies to increase public decision-

making and service creation. As literature suggests, in this respect, governance refers to "the outcomes of interactions between all actors in the public domain" (Rodriguez-Bolivar, 2015:3). In a similar vein, the idea of e-governance refers to a citizen-centric approach and the use of information technologies to improve democratic discussion, government services and improve and support citizen participation in service deployment (Chourabi et al., 2012:2292; Hsieh, Chen and Lo, 2015:164). Smart Cities, therefore, represent the emergence of a governance structure broadly termed as smart governance. This is defined as the application of ICT and emerging technologies to create interaction between stakeholders, policies and procedures which, in turn, assists in co-creating services, which leads to improved government transparency, better infrastructure and citizen satisfaction (Gil-Garcia et al., 2014:17; Anthopoulos, 2017:264). Equitable and transformative governance, that enables collaborative practices and the integration of smart technologies, is called for to move towards broader economic and social transformation in the realms of 1) decreasing inefficiencies, 2) improving resource management, 3) refining data analytics and application, 4) aiding and supporting data exchange/use, and 5) benefitting in service innovation (Ku et al., 2020). A type of e-governance is suggested that promotes the use and adaptation of purposeful, pervasive digital technologies and the mobilisation of broadband to nurture access, inclusion and opportunities for economic growth. Kumar and Dahiya further describe smart governance as a shared, interlinked component amongst others including smart people, smart city economy, smart mobility, smart environment and smart living, which cooperatively form a Smart City system (Kumar and Dahiya, 2017:16). Governance, therefore, should include a mandate that enables the use of digital information and communications technologies (ICT) to support 1) increased public participation and collaboration, 2) better interaction between public and government, 3) creation and delivery of new services, and 4) improved management and integration of processes (Chadwick, 2003). This requires the use of methods that establish common good values, and that make use of relatable and contextually relevant communications methods to ensure transparent and sustained participation by stakeholders and communities. Giffinger et al. consider smart governance in Smart Cities to be quantifiable by the following factors, with each comprising a list of measurable indicators. These include: (1) participation in decision-making, as indexed or measured by (a) city counsellors in relation to citizens, (b) the degree of citizens' legislative or political undertaking, (c) the importance of political or governmental affairs for citizenry, (d) the proportion of female municipal representation;, (2) public and social services as indexed by (a) municipal disbursement, (b) allocation of children in day-care, (c) satisfactory and quality education; (3) transparent governance, as indexed by (a) citizen satisfaction in and transparency of government processes, (b) satisfactory means of addressing corruption. Smart governance, in this sense, involves government and public participation, citizen services and the management and functioning of government processes (Giffinger et al., 2007:11; Anthopoulos, 2017:67). Harsh and Ichalkaranje further expand the concept of smart governance as the evolution of e-governance and city governance, resulting from government "realising the power of data. . . to improve their services, to enable an integrated, seamless service experience, to engage with citizens, co-develop policies and implement

solutions for well-being of the community and transforming themselves into smart government" (Harsh and Ichalkaranje, 2015:9). Based on the above corresponding interpretations, Smart City governance describes a new type of governance that is supported by the introduction and application of ICT and emerging technologies to facilitate public engagement, service deployment and co-ordination, as well as public access (e-governance). In addition, it includes governance that focuses on the use and optimisation of data in driving service deployment and administrative processes (smart governance) (Gil-Garcia et al., 2014:17; Glybovets and Mohammad, 2017:7). In this regard, governance and its digital approach should foster and support interactions to transform leadership and allow citizens to engage with and access city and other stakeholder resources to address a need or objective. This recommends governance approaches that are aware of both formal and informal dynamics and that aim at operationalising value through collaborative processes and methods. Governance should support transformative leadership that enables social transformation by activating transformative mechanisms and social drivers that generate self-agency, knowledge, civil autonomy, co-creation and participatory governance (Montuori and Donnelly, 2017). This highlights the need for governance that is accountable and responsive to realities, such as 1) bias or inequity, 2) misuse of resources, 3) group dynamics and politics, and 4) organisational, community or group agency and influence. Furthermore, governance and its methods must be representative of groups with both high and low agency and diverse contexts (Kachanoff, Kteily, Khullar, Park and Taylor, 2020).

23.11.10 Transition Dynamics

In order to realise its vision of citizen empowerment, urban development, social innovation, improved services, sustainability and economic development, Smart Cities - from a Cape Town perspective - require certain transitory dynamics to ensure the effective integration of various city components. One such requirement calls for stakeholder participation that activates and makes use of data, digital technologies and collective intelligence to unlock demonstrative value through tools, such as crowd-sourcing and context-aware technologies. From a literature perspective, this is contingent on Smart City architectures and platforms which serve the planning and functioning of Smart Cities. According to Anthopoulos, "architecture concerns a definition of the structure, relationships, views, assumptions and rationale of a system" (Anthopoulos, 2017:31). It necessitates the use of relational engagement strategies and the provision of context appropriate data, combined with the application of ICT and digital technologies, in order to facilitate transitory value processes. The Smart City, therefore, requires an appropriate communications architecture, a viewpoint derived from perceiving smart service offerings as being initiated and transferred via several, varied subsystems, each with its own infrastructure, software and functional requirements. Consequently, the following types of transactions within a Smart City architecture are noted as occurring between users and subsystems (Anthopoulos, 2017:36):

- "Information and service requests (demand side end-users)"
- "Information and service delivery (supply side end-users and subsystems)"
- "Information and service requests (demand side subsystems)"
- "Information and service delivery (supply side subsystems)"
- "Information storage (demand side subsystems)"
- "Information retrieval (supply side subsystems"

Relational engagement methods and communication strategies must, therefore, ensure that participation occurs in a coordinated and adaptable manner that supports value creation for participating stakeholders. This can be achieved by focusing on participation which embraces both formal and informal value processes to stimulate a sense of agency and ownership. Relational engagement strategies facilitate better decision-making, and data serve as a catalyst for creating prosumers and a more people-centred urbanism. Methods of engagement should consider the internal and external loci of control amongst stakeholders as transitory and part of the conditions of change which support citizenry by providing a more civil and collective autonomy that will help improve lives (Kormanik and Rocco, 2009).

23.11.11 Value Modelling and Measurement

Apart from the above-mentioned Smart City Architectures and Platforms which deal with the potential structure and rationale of Smart Cities, there also exists a need for the establishment of Smart City models as a means of measuring and evaluating, against a set of indicators, a Smart City's stages of development and performance. The establishment of such models assists in city benchmarking, indicating the required Smart City developmental strategies and the scale of its implementation. The IDC Smart City Maturity Model (SCM) is one such model which offers a city benchmarking tool by which to determine a city's Smart City developmental phase in reference to its associated SC strategies and state of development. It also acknowledges cities as diverse with each having their own unique Smart City developmental trajectory and provides five stages of Smart City growth. In addition, it provides five best practice measurements which include: (1) strategy, (2) culture, (3) process, (4) technology, and (5) data, as well as 19 Smart City developmental indicators (Yesner and Ozdemir, 2017:7). This study found that the Cape Town Smart City model should focus on the activation and advancement of value through knowledge management processes that aid in the discovery, mobilisation and exchange of data in order to generate prosumers. Furthermore, such processes will facilitate the identification of knowledge and the establishment of appropriate value models to encourage innovation and service creation. It, therefore, highlights the need for the application of data and analytics to improve data-driven decisions, making possible processes that facilitate better data management, - integration, - delivery and - access for the wider population. Value within a Smart City context refers to an interchange amongst stakeholders that enables

local innovation through the application of data, knowledge and digital technologies to generate a more people-centred urbanism. This is supported by literature and the five stages of the IDC Smart City Maturity Model which are (1) ad hoc, (2) opportunistic, (3) repeatable, (4) managed, and (5) optimised, with each stage built sequentially on the preceding capabilities. The ad hoc stage attempts to demonstrate the value of Smart City deployment by implementing pilot Smart City projects without the required strategic or organisational shift in terms of structure, governance and coordination. As such, it utilises and focuses on technological integration to ensure project success and justification. The opportunistic stage identifies initial successful pilot projects as opportunities for understanding success factors, as well as to generate stakeholder buy-in and encourage collaborative practices by developing open data policies and making open data publicly available. The repeatable stage seeks to enhance and integrate Smart City strategies across projects and organisations in order to improve data and information usage and establish standardised processes amongst stakeholders to improve services and performance. The management stage formalises the Smart City strategy, the implementation of which requires the participation of internal and external stakeholders. This stage perceives Smart City investment and deployment as a sustainable city model, involving and requiring interaction and support from the Quadruple Helix and where the Smart City needs to form part of the urban design and structure. The optimised stage emphasises the need for a system that is integrated across various other systems and which is conducive to an innovative landscape that uses emerging technologies and collaborative practices to improve services, enhance citizens' quality of life, support Smart City objectives and attract investments (Yesner and Ozdemir, 2017:6). According to Yesner and Ozdemir (2017:6) a description of the five best practice measurements is:

- Strategy: This deals with the Smart City vision, management, budget, strategic development, etc. The vision should also be publicly accessible and communicated by city officials.
- Culture: Culture focuses on innovation, citizen participation, as well as transparency, and requires the availability and ability of processes and instruments to facilitate collaborative practices between citizens, businesses and government in order to establish new services, foster innovation, as well as ideas- and services experimentation by various stakeholders, relationships or processes.
- Process: Process explores the restructuring of government, focusing on governance, alliances and organisational design. It allows for more innovative governance and collaboration practices amongst all city actors in realising SC services, solutions and ecosystems through the use of emerging ICT. It, therefore, also stresses Smart City governance as a partnership or co-development process between many stakeholders and should take into account the outcomes of stakeholder interactions when developing Smart City and SC solutions.
- Technology: The technology aspect includes architectures, platforms, IoT adoption, citizen or crowd-sourced data architectures and so forth, where

technology is deemed the enabler of Smart City development. It also deals with the integrity and availability of data as acquired through "connectivity technologies" and the analysis and extraction of information from such collected data for service deployment and better decision-making (Yesner and Ozdemir, 2017:14).

- Data: This dimension includes all citizen data, open data, data discovery and its analysis, data protection, as well as the integration and sharing of such data in order to facilitate better decision-making and planning, as well as new service and business innovation. It also considers the availability of open data for more transparent governance practices.

Focus needs to be placed on the use of digital technologies to stimulate digital literacy and transformation that will aid in the unlocking of informal and formal value. This supports collaborative experimentation and the generation of collective value, as well as mitigating embedded or negative hierarchical systems that hinder organisational and societal change and may interfere with achieving a common good value. Value, therefore, should be evaluated on its ability to operationalise collaborative practices and the sharing of knowledge that can contribute to the development of an active citizenry.

23.12 Tensions and focus Areas towards activating Engagement and Cape Town's Smart City

23.12.1 Access as Infrastructure

With regard to access as infrastructure, key considerations ought to be given to mitigating certain tensions that prohibit activating the associated value attached to mobilising digital technologies within the Smart City. These tensions, or contentious factors of implementation, centre around the leveraging of digital technologies and 'access' and how these can be used as economic enablers. Such tensions, in a Cape Town context, require finding ways of including the traditionally marginalised and informal sector into traditional and formal stakeholder engagement with a focus on economic transformation. Furthermore, these tensions can be reduced by establishing opportunities for local innovation that does not necessarily map against formal processes of innovation. In this regard it is also crucial to explore how citizens are to be transformed into an active citizenry that can drive and inform collaborative experimentation and innovation. This, however, also requires making use of strategies or systems that are adaptable and supportive in their ability to uncover and index the latent value of communities, as well as the issues that communities contend with. Uncovering the contextual nuances of place and space can also serve to operationalise broader citizenry through processes of relational engagement, where such engagement uses applied intelligence with the help of digital technologies and data to transform data into meaningful and contextually relevant information that provides value to users and citizenry. Whereas digital innovation usually occurs within corporate and well-funded spheres, access within the Smart City context should

involve processes that mitigate the digital divide and encourage partnerships between formal and informal economics in order to foster development, learning, innovation and further partnerships. Access should also cultivate a sense of ownership and responsibility amongst participating stakeholders. This can be achieved by establishing shared objectives and by incorporating alternative economic models that promote better digital access and democratise information through, for example, open data portals and crowd-sourcing initiatives based on citizens' needs. As such, access as infrastructure entails using digital tools and their capacity to function as shared social objects in order to both identify networks and their organisational conditions, as well as the "socio-material conditions" of communities or neighbourhoods (Niederer and Priester, 2016:137). This is useful in that it perceives "city-making" as driven by a "participatory society" that both understand and are able to apply the tools of participation. In thinking about how citizens and objects are to be positioned in such a participatory society authors Niederer and Priester (2016) provides a definition around the meaning of such participation. In essence the "object-centred sociality" of objects, devices and their environments focus on the degree that these objects able to deliver or provide"instances of participation" Niederer and Priester (2016:139). Authors Niederer and Priester (2016:139) provide a number of observations around the types of objects that are conducive to generating "instances of participation", towards improving access, community collaboration, process optimisation and information flow. They note social media and community websites as powerful tools, able to index and observe communities and their development over time and where these website or social media platforms serve "participatory objects" and part of a "bottom-up initiative", i.e initiated by citizens (Niederer and Priester 2016:139).

23.12.2 Adaptive Socio-Technical Solutions

Adaptive socio-technical solutions from a Cape Town Smart City perspective entails needing to find opportunities and strategies by which the use of data, its discovery, exploration and scalability can be understood by broader citizenry in order to provide opportunities for usage and collaborative experimentation. This causes additional tensions in that participation by citizenry may require a process of up-skilling and expertise prior to engagement with formal or corporate stakeholders, proving additional concerns around who to include, how they participate and why. Additionally processes of strategic collaboration may be driven by corporate agendas and not necessarily a vision of sustainable urban or human centred urbanism. As such there also needs to be consideration given around how policy and planning responds to the provision of access and adaptive systems that foster contextually relevant solutions. Other tensions to contend with centres around the need to find ways to measure collaborative interactions amongst stakeholders and how participation relates to solving practical problems and support citizen empowerment. Additionally there is a need to ensure that interaction amongst participating stakeholders are contextually appropriate and where information flow and exchange contributes to increased trust, legitimacy and is supportive of informal and formal knowledge processes. This also includes an analyses of the associated technical and digital needs of participants and

the use of responsive strategies that are able to map and track represented groups or communities, the theme or objective being addressed, the required resources needed, governance structure and participants various level of participation. Adaptive socio-technical solutions are needed because it increases possibilities of inclusion and public participation. The use of adaptive-socio technical approaches must seek to include public participation in urban planning and design as it supports the ideal of good urban governance. In addition it provides alternative and better forms of urban governance by allowing citizenry and other stakeholders (private and public) to collaboratively be part of the design and planning of urban spaces. Thirdly it supports the idea of sustainable urban development by attempting to acknowledge the social aspects of urban renewal and its associated stakeholders (Joss, 2014:35). As such there is a need for Cape Town and its stakeholders to find adaptive socio-technical solutions towards improved citizen participation, where participation and levels of engagement prioritises the degrees of inclusion, degrees of participation and the degree of citizen empowerment. This is important and relates to rethinking the notion of smart citizenry, one that shifts citizenship from a passive consumer oriented perspective to an active citizenry that are both consumers and producers of smart initiatives (Cardullo and Kitchin, 2019:1).

23.12.3 Common Good Value

Common good value from a Cape Town Smart City perspective entails the establishment of both formal and informal ecologies economies that is representative of wider citizens needs and goals. As such it requires the creation of value that is not directly linked with corporate agendas or current policy. Tensions therefore may present itself by having to find ways by which to index and establish the "common good" both as a value proposition but also as a transitory process that is responsive to context. This causes additional considerations around how value is perceived by participating stakeholders and how such interactions and potential value creation processes encourage more civil autonomy, ownership, awareness and access to opportunities. This also links with having to find ways to establish sustained participation by adopting an approach of shared value generation, collective value and an active citizenry. This links with the need to develop a smart citizenship that performs beyond the space of digital and technological integration or territory but includes a state orchestrated strategy by which to transform how citizens interact with smart initiatives. In this regards Datta calls for the emergence of the "chatur citizen", which she labels as "a new postcolonial smart citizen who speaks both from within and beyond the structures of digital governance and smart-mentality". Datta's "chatur citizen" therefore operates within a dual space, remaining embedded within its social, historical and economic context. Such duality serves as agency in that in its subversive form it acknowledges the power structures of governance whilst through self governance and active citizenry seeks to improve and replicate structures of governance (Datta, 2018:416). Datta furthers this by stating, "the emergence of a vernacular smart citizen shows that citizenship and subject-hood are not binary categories, rather they are entangled and complicated through the digital turn in postcolonial urbanism"Datta, 2018:417).

23.12.4 Contextual Smartification

Contextual smartification from a Cape Town Smart City perspective requires facilitating the empowerment of citizens through the use of digital technologies that are able to aid in developing digital competencies and social value. Potential tensions in this regards entails needing to find ways of developing iterative systems or interactions points by which citizens and co-ordinators (stakeholders) are able to model, apply and create knowledge or value. In addition it requires supportive structure that focus on innovation that go beyond the corporate or techno-centric model but where innovation as a focus includes methods that allow for the adoption, leveraging, development and application of digital technologies in addressing the needs of citizenry. Additional tensions also relate to establishing procedures of governance and procedural frameworks that form part of a larger Smart City vision and policy perspective. This requires making use of citizen participation processes that contribute towards understanding the interplay and heterogeneous interstice of place and people. It also highlights additional tensions in that processes of participation should seek to assess participants contextual needs, roles and responsibilities in terms of policy, technology and management (governance) towards activating sustainable urbanism, requiring thought leadership and sustained innovation where outcomes can be measured. Participation and engagement within a Smart City should be understood through what Guma and Monstadt terms, as "relation context" and the idea that in understanding a city one must acknowledge the embedded context of said city in relation to its people, realities (as shaped by citizenry), and its artefacts. This observation highlights the need in perceiving digital technologies as enabling in so much that its application and deployment considers the situated context that it operates in or attempts in developing (Guma and Monstadt, 2021:362).The concept of contextual smartification therefore refers to Smart City development through the contextual shaping and remodelling of digital technologies according to urban topographies. It perceives the role of digital technologies as being responsive to a shifting and ever changing landscape, where the roles of these ubiquitous, smart technologies functions differently across city contexts. According to Guma and Monstadt the focus of such relational participation involves uncovering the "social embeddedness, relationality and urban co-construction" as tied to the digital integration of smart and digital technologies towards making cities, its people and infrastructure more efficient (Guma and Monstadt, 2021:365). Their approach also acknowledges the fragmented nature of city-making, i.e where city planning is not scientific but where ordinary realities need to be considered together with the technological positioning in city development. Participation and contextual smartification therefore centres around the interchange and context of people, urban spaces and digital technologies.

23.12.5 Data as Catalyst

Activating the data driven Smart City for Cape Town requires governance structures that promote a people centred urbanism. It entails driving the implementation of policies around the mobilisation of data and its associated data use policies detailing

best practice approaches. This however assumes the availability of high quality data which in a city space are often fragmented and varied and from multiple sources of information. Furthermore it also provides additional challenges in that data use policies should aim at supporting or activating the mobilisation of data in an effort to make citizens prosumers of information, i.e both producers and users of useful information. For Cape Town this also entails needing to find ways by which to leverage partnerships, digital technologies and their infrastructure in order to operationalise data driven models towards service creation, descriptive analytics, predictive analytics, resource management, contextual smartification processes etc. This includes adopting an approach of governance that prioritises better data governance models in relation to things such as what is the purpose of the data?, what are the data requirements?, what data content and interpretability is needed?, what, who and how is the data accessed? and what is the associated data lifecycle? Furthermore consideration should be given as to how data is analysed and integrated across the urban landscape in a manner that is related to its context and the communities involved. Data in this sense promises to serve as a means of capturing the urban fabric in terms of formal and informal knowledge processes that can be used and applied by cities and its public. This requires the activation and application of data as a tool for citizen participation (Wilson, 2011:858). In this sense Wilson calls for consideration of what is termed "mattering". It is the concept of perceiving data as descending from practices (social) where these practices are inventive, generative and varied in terms of its urban-political structure. In this sense data also serves as a means of legitimising citizens lived experience through means of geocoding and technological interpretation of space and place (Wilson, 2011). Activating participation in this regard requires the mapping of multiple interactions of the urban space, where these objects of interaction are "enrolled in the creation of urban space", focussing on the interconnectedness of objects (Wilson, 2011:859). As a form of urban governance through data use it entails perceiving citizens as tracked data within a connected city system or the "transduction of space". The transduction of space through data entails the tracking of "processes. . . at the intersection of diverse realities", requiring an integration of practices, people, objects, places etc. (Wilson, 2011:862; Mackenzie, 2022:18). Data as a catalyst should therefore perform as a form of citizen-participation focussing on the objectification of citizens lived experiences as "participatory mapping processes" that can be indexed and legitimised via data coding in order to facilitate urban visioning. However not at the expense of under representing embedded community context and interests. As Wilson states, "It is the materialisation and the significance of data that animates. . . urban practices for those who are close to the experience" Wilson, 2011:868).

23.12.6 Demonstrated Value

The working towards demonstrated value from a Cape Town Smart City perspective requires governing structures that are responsive to citizens needs and where the defining of such value depends on collaborative engagement between wider city stakeholders and the public. In other worlds it requires the leveraging of corporate infrastructure and expertise and an understanding of how partnerships can assist

in addressing a city's wider developmental objectives. It therefore poses tensions in that such partnerships should yield formal and commercial benefit and attract investment whilst remaining responsive to developing active citizenry and where technological implementation facilitates in matching the generation of demonstrated value by considering the availability of technology in regards to establishing value, what is else is needed towards establishing value and how appropriate the solution is in relation to context. Demonstrated value should also include the desire to develop an active citizenry. This requires initiating citizen participation and collaborative efforts which contributes to the development of equitable urban transformation as linked with uncovering the associated socio-ecological, economic and technical requirements of urban transformation and its people. This also relates to mitigating inherent tensions within a city and its complex economic and power relations, requiring ways by which to support sustainable and equitable models of urban growth. Participation therefore must take care not to validate sustainable models as utility that only support capitalist or private equity. This is important to avoid "Smart Cities become(ing)an empty hollow signifier. . . built in the image of capital and of the political elites" March and Ribera-Fumaz, 2016:826). Moreover demonstrated value through participation should address basic citizen services geared towards improved citizens quality of living and where services are not only duplicated but shaped and deployed according to and in response to different communities and contexts, whilst remaining socially equitable (March and Ribera-Fumaz, 2016:826).

23.12.7 Equitable and Sustainable Cities

The Cape Town Smart City should have a focus on equitable development and humanistic innovation that support the solving of practice problems. Tensions in this regards centres around the need to develop and facilitate transitory value processes that minimise exclusion of wider citizenry. This however requires needing to find ways of applying digital technologies that purposefully drive opportunities for economic growth and digital adoption strategies that connects businesses, government, academia and civil society. The establishment of an equitable Smart City for Cape Town also necessitates perceiving citizenry as binary. This binary nature of citizenship within the construction of the Smart City also brings about, as Willis points out, additional consideration around who participates and to whose benefit. In calling for smart urbanism or equitable cities which celebrates a people centred agency she cautions against the potential to which the Smart City and its initiatives may reinforce and marginalise through efforts of (1)"optimisation, automation and privatisation of urban services" and (2) the "expulsion (of) those operating in the informal urban economy (Willis, 2019:4).Citizen participation and the generation of a equitable cities therefore in this regards extends to political participation and the right to accessing and influencing the delivery of civil liberties (Willis, 2019:5). Furthermore the concept of citizen participation and equitable cities must involve a reframing of the "urban informality" as a "mode of production" in order to activate the idea of smartness towards public equity (Willis, 2019:13; Cardullo and Kitchin, 2019). The idea of sustainable urban development should focus on the activation of meaningful public and

citizen engagement centred around addressing public interest. Participation towards sustainability therefore includes the reconciliation of contextual nuances of place and space across the urban domains of economics, social factors and environment. It requires a type of urban governance that draws on multiple perspectives and levels of expertise in order to ascertain what is required, develop solutions, implement solutions and track progress (Joss, 2014:40).

23.12.8 Stakeholder Engagement

Wide and active stakeholder participation serves s a crucial component in establishing the Smart City. For Cape Town it centres around the need for engagement that facilitate collaborative governance and legislative processes that foster inclusion and transparency as well as accountability in generating transitory value. Furthermore it requires that engagement is framed in relation to a city's wider needs and objectives, calling for a needs-based approach in directing stakeholder engagement. For Cape Town it also highlights the need to consider who are the stakeholders, what is needed from them and how will they assist in achieving a specified outcome or goal. This relies on active collaboration amongst stakeholders and collaborative design. Collaborative design as a form of participation involves the use of expert and professionals where engagement is driven by professionals wishing to involve stakeholder consultation, where stakeholders may include, public, businesses, communities etc. Stakeholder participation in this sense involves extracting stakeholder attitudes and desires in order to provide a platform for discussion around urban issues as well as facilitate engagement between communities and professionals. Stakeholder participation therefore should serves as collaborative processes that are dynamic and adaptive in order to capture the contextual nuances of the urban environment (Joss, 2014:42).

23.12.9 Transformative Governance

For Cape Town transformative governance entails needing to find governance approaches that stimulate digital literacies through facilitated processes of contextual smartification. Governance in this regards should also facilitate interactions between stakeholder and public that support community and skills development initiatives. Additionally governance should facilitate and enable the use of digital information and communications technologies that support things such as public participation and collaboration, better interaction between public and government, creation and delivery of new services and better management and integration of city processes. Governance and citizen participation in the creation of the Cape Town Smart City therefore relates to establishing citizen power. From a governance perspective this means as Arnstein points out, the uncoupling of power where citizen participation takes on a significant role in directing social reform. Distributed power in the form of more civil autonomy, delegated power and participation (partnerships) therefore should be viewed as necessary and complimentary dichotomies that can work together in order to gain an equitable reflection on society (Cardullo and Kitchin, 2019:4; Arnstein, 1967:217). Transformative governance also considers the role of citizens

as “partnerships” that share the responsibility of planning and the driving of projects. Furthermore where citizens possess “delegated power” having a majority say and a shared power position in initiatives. It also calls for “citizen control” where citizens are active members and contributors in the managerial and policy aspects of projects and organisations. The idea of co-creation can play a significant role in establishing collective “citizen control” in this regard as it actively leverages citizenry as a central driver of such a service (Cardullo and Kitchin, 2019:9). Cardullo and Kitchin “Scaffold of smart citizen participation” provides several ways by which to frame participation in a Smart City context. Their model highlights who needs to be considered and to what degree or form should participation occur towards ensuring citizen-centricity. Their model also advocates for a type of citizen-centrality that moves away from a technologically driven Smart City that potentially reinforces neoliberal urbanisation, devoid of the wishes and needs of its citizenry.

23.12.10 Transition Dynamics

A key factor towards unlocking Cape Town Smart City value pivots around the need to mobilise collective intelligence in the imaging and driving of sustainable urbanism. This includes making use of digital technologies and stakeholders collectively working together towards a people centred urbanism. As such it requires active public and stakeholders engagement, seeking out point of interactions that can generate potential value or usage. For Cape Town it entails facilitating city wide citizen engagement towards understanding and informing the needs of citizenry. It involves establishing ways by which to inform citizens around issues of open data access, usage and how cities function. It therefore highlights at the redistribution of power and the sharing of data and exchange in order to influence and direct decision-making as well as increasing transparency and government liability. Crowdsourcing initiatives are an example of this. It therefore calls for “consultation” and “placation” by which citizens can provide feedback and present suggestions on smart initiatives (Cardullo and Kitchin, 2019:8). Furthermore it requires of government and stakeholders to perceive citizens as prosumers, that of being both consumers and producers of data and services. In a digitally driven age this involves the accumulation of data and data points that are harnessed through various mobile and computer applications in order to derive or provide services to users. This includes service types that leverage IoT and other digital technologies and where citizens often have restricted involvement and are usually only users of the service (Cardullo and Kitchin, 2019:8-9).

23.12.11 Value Modelling and Measurement

Value in a Cape Town Smart City context involves enabling local innovation through data and digital access and the application of knowledge towards solving public need. Furthermore it involves operationalising value through collaborative processes and the sharing of knowledge and exchange. It therefore requires enabling processes that aid in the discovery and mobilisation of data and exchange in order to generate prosumers. Value should be measured by how digital technologies and stakeholders

are leveraged towards digital transformation and literacies. Value and measurement therefore should not only equate to "algorithmically-mediated service(s)" such as directing the flow of traffic or using automated and adaptive traffic control systems (Cardullo and Kitchin, 2019:6). Additionally in thinking about the Smart city as a data driven and technocratic governance approach, using citizen and public data in order to track, monitor, inform processes and improve urban governance, authors Shelton, Zook and Wiig, cautions against the application of data as a "depoliticising device obscuring how data are conceived, collected and legitimised for use in urban politics and policymaking"(2015:22). Using '"Digital On-Ramps" as an example, a Smart City initiative challenge driven by IBM in 2011, they point out how digital inclusion initiatives which sought to promote, train and empower marginalised communities for a 21st failed because its focus was solely on digital literacy and did not factor in the "socio-spatial inequalities" (2015:21). Value should also relate to participatory processes and make evident the relevance of participation in terms of actual policymaking, planning and how the outcomes from public deliberation informs decision-making and outputs. It requires the integration of policy and planning and the context that it operates in. In addition value within the Cape Town Smart City should have as a focus the activation of meaningful public and citizen engagement centred around addressing public interest. Participation towards sustainability and the measurement of value therefore includes the reconciliation of contextual nuances of place and space across the urban domains of economics, social factors and environment. It requires a type of urban governance that draws on multiple perspectives and levels of expertise in order to ascertain what is required, develop solutions, implement solutions and track progress (Joss, 2014:40-50).

23.13 The contribution of this study

From a theoretical perspective, this research foregrounds the key components in unlocking Smart City value for the City of Cape Town. As evidenced by the development of the SCIEP model, it provides a framework that is contextually grounded in understanding the Smart City concept for the City of Cape Town. From a practical perspective, this research aids in moving towards urban transformation or smart urbanism for Cape Town and its population. It provides a better understanding of Cape Town Smart City implementation strategies. This research, through its applied methodological approach, locates the current CoCT Digital City Strategy within contemporary academic debate, providing a better understanding of Smart City value and the leveraging of existing infrastructure in solving urban challenges. From a methodological standpoint, this research provides a more contextually grounded understanding of the Smart City concept and its role in the development of an enabling environment for collaborative practices and partnerships that can further the CoCT quest to become an African Smart City. This research culminated in the development of the SCIEP model. It is a framework by which to imagine or characterise what a Smart City and its initiatives can be when focused on engagement practices involving all participating city stakeholders and users. As a framework, it contributes to the understanding of Smart City implementation as a data driven approach. Additionally,

the establishment of urban intelligence through widespread ICT deployment and exchange serves as agency, combined with co-production and collaborative practices to uncover and establish "data-driven innovation" and value (i.e. creating new products and services) within a digitally driven ecosystem known as the Smart City (Abella et.al., 2017:51). The model also takes into account the complexity and heterogeneous nature of modern urbanisation and the challenges many cities face in establishing relevant Smart City solutions. It therefore offers a multi-dimensional approach that can be imagined as either an overarching Smart City implementation strategy to work off, or as a framework for a stage-based model with which to drive Smart City initiatives or pilot projects. This takes into account the necessary considerations as pertaining to contextual interstices, people, domains and associated resources needed to mobilise public and stakeholder value. The model also offers the mechanisms and processes to be included in the creation of services. This is specifically pertinent in understanding how data and its access within the Smart City concept adds societal value through a synergy between the exchange of data, citizen participation, co-creation processes and knowledge management approaches (Abella et.al., 2017:51). The SCIEP model adds to current academic debate by offering a better understanding of the role that data, its producers and consumers play in supporting various stakeholder engagement and governance practices in the development of Smart City services. It offers a model which foregrounds collaborative engagement practices that ensure smart initiatives and their deployment are well aligned and appropriate in relation to the various participatory networks and community engagement practices (Anttiroiko, 2015:26). It also provides a way of interpreting Smart City implementation by considering the context in which it operates in order to unlock its value and potential thus providing new services to citizens, improving their quality of life and enhancing social and economic transformation. Methodologically and initiating such potential, I've also developed a conversation framework as illustrated in Figure 53 (p. 234) geared towards aiding in uncovering such contextual variables. The framework may assist in locating key starting points for activating or driving Smart City initiatives and pilot projects. This includes taking into account the needed considerations related to the contextual interstices, people, domains and associated resources necessary for mobilising public and stakeholder value.

Data	Co-Production	Citizen Participation	Knowledge Management	Smart City Initiatives	Smart City Maturity	Smart City Domains
How do you use data? (Please elaborate using the supplied keywords words as a starting or reference point)	**How do you co-produce amongst various stakeholders or commuity members? (Please elaborate using the supplied keywords words as a starting or reference point)**	**How do you participate or foster participation amongst various stakeholders or community members? (Please elaborate using the supplied keywords words as a starting or reference point)**	**How is knowledge collected, integrated and utilised within an organisation towards improvement and amongst various stakeholders or community members?)**	**Can you please elaborate regarding the context, design and deployment process of smart initiatives?**	**How would you describe and evaluate smart initiatives?**	**Can you please elaborate regarding the context, evaluative framework and relational factors of your smart domain and initiatives?**
Focus areas: Local Development, Operational Management, Administration, Local Information Diffusion	**Focus areas:** Civil Society, Civil Servants and Citizens, Combination between Civil Servants and Citizens, Driven by Citizens and Communities	**Focus areas:** Citizen, Citizen as Users, Citizens as Co-Creators, Citizens as Co-Creators and Users	**Focus areas:** Civil Society, Citizens, Public sector and Citizens, Citizens and Communities	**Focus areas:** People and Community, Natural Environment and Infrastructure, Governance, Economy	**Focus areas:** ad hoc, opportunistic, purposeful and contextually relevant , operationalised, optimised	**Focus areas:** understands city objectives, defines city objectives, understands relationality of factors and ICT use
Data use	Co-production (citizens)	Co-creation (citizens)	Knowledge acquisition (process and types)	Context-sensitive city-making (process and types)	Foster and promote service creation	Skills development
Data integration	Co-production (civil society)	Co-creation (civil society)	Knowledge dissemination (process and types)	Open innovation	Lessening exclusion or isolation	Operational efficiency
Data co-production	Co-production (stakeholders)	Co-creation (stakeholders)	Stakeholder engagement	Community informatics towards social, cultural, and economic development	Promote collaboration	Virtual and decentralised networks
Data co-creation	Data strategies	Digital urbanism	E-governance	Generate value	Experimentation for learning	End to end processes
People and living	Community	Environment and Mobility	Economy	Governance		

Figure 39: SCIEP Conversation framework (Author, 2022)

23.14 Recommendations

This study uncovered the key Smart City components that lead towards engagement in the City of Cape Town. These are 1) Access as Infrastructure, 2) Adaptive Socio-Technical Solutions, 3) Common Good Value, 4) Contextual Smartification, 5) Data as Catalyst, 6) Demonstrated Value, 7) Equitable and Sustainable Cities, 8) Stakeholder Engagement, 9) Transformative Governance, 10) Transition Dynamics and 11) Value Modelling and Measurement. With regards to policy and practice recommendations for further research should include piloting projects and discussion with stakeholders or communities utilisation the SCIEP conceptual by which to uncover and understand Smart City requirements and implementation strategies for the City of Cape Town.

24 Bibliography

References

[1] Abella, Ortiz-de-Urbina-Criado and De-Pablos-Heredero. (2017). A model for the analysis of data-driven innovation and value generation in smart cities' ecosystems. Cities, 64, pp.47-53.

[2] Acedo, Painho, Casteleyn and Roche. (2018). Place and City: Toward Urban Intelligence. ISPRS International Journal of Geo-Information 2018, Vol. 7, Page 346, 7(9), 346.

[3] Achmad, Nugroho, Djunaedi. (2018). Smart City Readiness based on Smart City Council's Readiness Framework. International Journal of Electrical and Computer Engineering (IJECE), 8(1), 271–279.

[4] Adom, Yeboah and Ankrah. (2016). Constructivism philosophical paradigm: Implication for research, teaching and learning. Global journal of arts humanities and social sciences, 4(10), pp.1-9.

[5] Afzal, Umair, Shah and Ahmed. (2019). Enabling IoT platforms for social IoT applications: Vision, feature mapping, and challenges. Future Generation Computer Systems, 92, 718–731.

[6] Ahlgren, Hidell and Ngai. (2016). Internet of Things for Smart Cities: Interoperability and Open Data; Internet of Things for Smart Cities: Interoperability and Open Data.

[7] Ahmed, Yaqoob, Abaker Targio Hashem, Khan, Ibrahim Abdalla Ahmed, Imran and Vasilakos. (2017). The role of big data analytics in Internet of Things. Computer Networks, 129, 459–471.

[8] Alavi, Jiao, Buttlar and Lajnef (n.d.). Internet of Things-enabled smart cities: State-of-the-art and future trends.

[9] Alawadhi, Aldama-Nalda, Chourabi, Gil-Garcia, Leung, Mellouli, Nam, Pardo, Scholl and Walker. (2012). Building understanding of smart city initiatives. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 7443 LNCS, 40–53.

[10] Almeida and Kurniawan. (2017). 4.0.Concept and dimensions of web 4.0. International journal of computers and technology, 16(7).

[11] Alsamhi, Ma, Ansari and Meng. (2019). Greening internet of things for greener and smarter cities: a survey and future prospects. Telecommunication Systems, 72, 609–632.

[12] Andreini, Crisciani, Cicconetti and Mambrini. (2011). A scalable architecture for geo-localized service access in Smart Cities. In 2011 Future Network and Mobile Summit (pp. 1-8). IEEE.

[13] Angelidou. (2015). Smart cities: A conjuncture of four forces. Cities, 47, 95–106.

[14] d'Aquin, Davies and Motta. (2015). Smart cities' data: Challenges and opportunities for semantic technologies. IEEE Internet Computing, 19(6), pp.66-70.

[15] Arnstein. (1969). A ladder of citizen participation: Journal of the American institute of planners. The City Reader, 290–302.

[16] Anthopoulos. (2014). The implementation model of a Digital City The implementation model of a Digital City.The case study of the Digital City of Trikala, Greece: e-Trikala. Journal of e-Government, 2(2), pp.91-109.

[17] Anthopoulos. (2017). Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?. (Vol. 22, p. 293). Cham: Springer International Publishing.

[18] Anthopoulos and Fitsilis. (2010). From Digital to Ubiquitous Cities: Defining a Common Architecture for Urban Development. In 2010 Sixth international conference on intelligent environments (pp. 301-306). IEEE.

[19] Anthopoulos, Janssen and Weerakkody. (2019). A Unified Smart City Model (USCM) for smart city conceptualization and benchmarking. Smart cities and smart spaces: Concepts, methodologies, tools, and applications, pp.247-264.

[20] Anthopoulos. (2015). Understanding the smart city domain: A literature review. Transforming city governments for successful smart cities, pp.9-21.

[21] Anttiroiko. (2015). Smart cities: Building platforms for innovative local economic restructuring. In Transforming city governments for successful smart cities (pp. 23-41). Springer, Cham.

[22] Anttiroiko, Valkama and Bailey. (2014). Smart cities in the new service economy: building platforms for smart services. AI and society, 29(3), pp.323-334.

[23] Arroub, Zahi and Sadik. (2016). A literature review on Smart Cities: Paradigms, opportunities and open problems. In 2016 International conference on wireless networks and mobile communications (WINCOM) (pp. 180-186). IEEE.

[24] Asghari, Rahmani and Javadi. (2019). Internet of Things applications: A systematic review. Computer Networks, 148, 241–261.

[25] Asimakopoulou and Bessis. (2011). Buildings and crowds: Forming Smart Cities for more effective disaster management. In 2011 Fifth International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (pp. 229-234). IEEE.

[26] Atzori, Iera and Morabito. (2017). Understanding the Internet of Things: definition, potentials, and societal role of a fast evolving paradigm. Ad Hoc Networks, 56, 122–140.

[27] Aurigi and Odendaal. (2022). From "Smart in the Box" to "Smart in the City": Rethinking the Socially Sustainable Smart City in Context. Sustainable Smart City Transitions, 53–68.

[28] A Walking City: Archigram and Ron Herron. Rowlings. Medium. (n.d.). Retrieved October 31, 2022, from https://medium.com/@emilyrowlings/a-walking-city-archigram-and-ron-herron-7dbf2c8fae99.

[29] Bacco, Delmastro, Ferro and Gotta. (2017). Environmental Monitoring for Smart Cities. IEEE Sensors Journal, 17(23), 7767.

[30] Bakker and Ritts. (2018). Smart Earth: A meta-review and implications for environmental governance. Global Environmental Change, 52, 201–211.

[31] Batista, Goldman, Hirata, Kon, Costa and Endler. (2016), November. Interscity: Addressing future internet research challenges for smart cities. In 2016 7th International Conference on the Network of the Future (NOF) (pp. 1-6). IEEE.

[32] Bayen and Giuliani. 2018. Africa: A look at the 442 active tech hubs of the continent. Mobile for Development (blog), March, 22.

[33] Benamrou, Mohamed, Bernoussi and Mustapha. (2016). Ranking models of smart cities. In 2016 4th IEEE International Colloquium on Information Science and Technology (CiSt) (pp. 872-879). IEEE.

[34] Bera, Pradhan, Liu, Dhar and Sur. (Eds.). (2019). Advances in Communication, Devices and Networking Proceedings of ICCDN 2019. In Conference proceedings ICCDN (p. 8).

[35] Bibri and Krogstie. (2017). On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society. Sustainable Cities and Society, 29, 219–246.

[36] Bowyer. (1970). Philosophical perspectives for education. Scott, Foresman and Co. Glenview, Illinois.

[37] Boyle and Staines. (2019).Overviews and Analysis of Cape Town's Digital City Strategy. (URERU Smart City Series). Cape Town: Urban Real Estate Research Unit.

[38] Bruno. (2015). Co-deciding with citizens: Towards digital democracy at EU level. ECAS Brussels.

[39] Burt. (2002). The social capital of structural holes. The new economic sociology: Developments in an emerging field, 148(90), p.122.

[40] Caird and Hallett. (2019). Towards evaluation design for smart city development. Journal of urban Design, 24(2), pp.188-209.

[41] Campos, Cugnasca, Hirakawa, Sidnei and Martini. (2016). Towards an IoT-based system for Smart City; Towards an IoT-based system for Smart City. 2016 IEEE International Symposium on Consumer Electronics (ISCE).

[42] Caprotti, Cowley, Datta, Castán Broto, Gao, Georgeson, Herrick, Odendaal and Joss. (2017). The New Urban Agenda: key opportunities and challenges for policy and practice. Urban research and practice, 10(3), pp.367-378.

[43] Cardullo and Kitchin. (2019). Being a 'citizen'in the smart city: Up and down the scaffold of smart citizen participation in Dublin, Ireland. GeoJournal, 84(1), pp.1-13.

[44] Carlsson. (2004). The Digital Economy: what is new and what is not?. Structural change and economic dynamics, 15(3), pp.245-264.

[45] Castelnovo. (2015). Public Services Coproduction: From Users' Engagement to the State 2.0., International Conference on Public Policy.

[46] Castelnovo and Savoldelli. (2015). "Citizen's Engagement and Value Co-production in Smart and Sustainable Cities", International conference on public policy, 2015, pp. 1-16

[47] Chadwick. (2003). Bringing e-democracy back in: Why it matters for future research on e-governance. Social science computer review, 21(4), pp.443-455.

[48] Chamoso, González Briones, Rodríguez. (2018) Tendencies of technologies and platforms in smart cities: a state-of-the-art review', Wireless. Commun. Mob. Comput., 2018, pp. 1–17

[49] Chiariotti, Condoluci, Mahmoodi and Zanella. (2018). SymbioCity: Smart cities for smarter networks. Transactions on Emerging Telecommunications Technologies, 29(1), e3206.

[50] Chichernea. (2015). Smart cities communities and Smart ICT platform. From: Journal of Information Systems and Operations Management, 9(1).

[51] Cilliers, Turner and Hughes. (2014). Reducing poverty in Africa-realistic targets for the post-2015 MDGs and Agenda 2063. Institute for Security Studies Papers, 2014(10), p.28.

[52] Chin, Callaghan and ben Allouch. (2019). The Internet-of-Things: Reflections on the past, present and future from a user-centered and smart environment perspective. Journal of Ambient Intelligence and Smart Environments, 11(1), 45–69.

[53] City of Cape Town. (2021). Socio Economic Profile. https://www.westerncape.gov.za/.

[54] Chon, Lane, Li, Cha and Zhao. (2012), September. Automatically characterizing places with opportunistic crowdsensing using smartphones. In Proceedings of the 2012 ACM conference on ubiquitous computing (pp. 481-490).

[55] Chourabi, Walker, Gil-Garcia, Mellouli, Nahon, Pardo and Scholl. (2012). January. Understanding smart cities: An integrative framework. In 2012 45th Hawaii international conference on system sciences (pp. 2289-2297). IEEE.

[56] Chowdhury. (2014). Interpretivism in aiding our understanding of the contemporary social world. Open Journal of Philosophy,4(03), 432-438.

[57] City of opportunity. (n.d.). Retrieved October 31, 2022, from https://www.pwc.co.za/en/publications/city-of-opportunity.html

[58] Civerchia, Bocchino, Salvadori, Rossi, Maggiani and Petracca. (2017). Industrial Internet of Things monitoring solution for advanced predictive maintenance applications. Journal of Industrial Information Integration, 7, 4–12.

[59] Cocchia. (2014). Smart and Digital City: A Systematic Literature Review. Smart city, pp.13-43.

[60] Cohen. (2013). The smart city wheel. Retrieved from SMART and SAFE CITY: http://www. smartcircle. org/smartcity/blog/boyd-cohen-the-smart-city-wheel.

[61] Cohen and Read. (2015). Methodology for 2014 Smart Cities benchmarking. https://www.fastcompany.com/3038818/the-smartest-cities-in-the-world-2015-methodology[20.

[62] Čolaković and Hadžialić. (2018). Internet of Things (IoT): A review of enabling technologies, challenges, and open research issues. Computer Networks, 144, 17–39.

[63] Datta and Odendaal. (2019). Smart cities and the banality of power. Environment and Planning D: Society and Space, 37(3), pp.387-392.

[64] Datta. (2018). The digital turn in postcolonial urbanism: Smart citizenship in the making of India's 100 smart cities. Transactions of the Institute of British Geographers, 43(3), 405–419.

[65] Datta. (2015). New urban utopias of postcolonial India: 'Entrepreneurial urbanization' in Dholera smart city, Gujarat. Dialogues in Human Geography, 5(1), 3–22.

[66] Delmastro, Arnaboldi and Conti. (2016). People-centric computing and communications in smart cities. IEEE Communications Magazine, 54(7), pp.122-128.

[67] Democratic Alliance (DA). (2020). Retrieved November 22, 2022, from https://www.da.org.za/

[68] Dlamini. (2019). Data driven urbanism: challenges in implementing open data policy and digital transparency in the City of Cape Town. (Master's thesis, Faculty of Science).

[69] Dlodlo and Kalezhi. (2015). The internet of things in agriculture for sustainable rural development. In 2015 international conference on emerging trends in networks and computer communications (ETNCC) (pp. 13-18). IEEE.

[70] Domingue, Galis, Gavras, Zahariadis, Lambert, Cleary, Daras, Krco, Müller, Li, Schaffers, Lotz, Alvarez, Stiller, Karnouskos, Avessta and Nilsson (Eds.). (2011). The Future Internet: Future Internet Assembly 2011: Achievements and Technological Promises. Springer Nature.

[71] Du, Song and Zhu. (2019). Social-Feature Enabled Communications Among Devices Toward the Smart IoT Community; Social-Feature Enabled Communications Among Devices Toward the Smart IoT Community. IEEE Communications Magazine, 57.

[72] Ebrahim and Irani. (2005). E-government Adoption: Architecture and Barriers, Business Process Management Journal, 11, 5, 589-611.

[73] Energy, sustainability and innovation — Enel Group. (n.d.). Retrieved October 31, 2022, from https://www.enel.com/

[74] Evaluation of the Smart Cape Access Pilot Project A City of Cape Town digital divide initiative Smart Cape Access Project. (2003).

[75] Fagundes. (2017). Smart Community Development Framework and Design for Responsible Engineering. (Doctoral dissertation, Faculty of Graduate Studies and Research, University of Regina).

[76] Faisal, Usman and Zahid. (2018). In what ways smart cities will get assistance from internet of things (IOT). International Journal of Education and Management Engineering, 8(2), pp.41-47.

[77] Falconer and Mitchell. (2012). Smart city framework. Cisco Internet Business Solutions Group (IBSG), 12(9), pp.2-10.

[78] Faria, Brito, Baras and Silva. (2017.). Smart mobility: A survey. In 2017 International conference on internet of things for the global community (IoTGC) (pp. 1-8). IEEE.

[79] Filipponi, Vitaletti, Landi, Memeo, Laura and Pucci. (2010). Smart city: An event driven architecture for monitoring public spaces with heterogeneous sensors. In 2010 Fourth International Conference on Sensor Technologies and Applications (pp. 281-286). IEEE.

[80] Fiore-Gartland and Neff. (2015). Communication, Mediation, and the Expectations of Data: Data Valences Across Health and Wellness Communities. International Journal of Communication, 9(0), 19.

[81] Fischer. (2015). The internet of things: frequently asked questions (Vol. 13). Congressional Research Service.

[82] Focus Group on Smart Sustainable Cities. (n.d.). Retrieved October 31, 2022, from https://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx

[83] Foth, Brynskov and Ojala. (2015). Citizen's right to the digital city. Berlin: Springer. doi, 10, pp.978-981.

[84] Frost and Sullivan. (n.d.). Our methodology process. Retrieved October 31, 2022, from https://www.frost.com/wp-content/uploads/2019/01/SmartCities.pdf

[85] Gherardi. (2009). Knowing and learning in practice-based studies: An introduction, Learning Organization, 16(5), 352–359.

[86] Giffinger, Fertner, Kramar and Meijers. (2007). City-ranking of European medium-sized cities. Cent. Reg. Sci. Vienna UT, 9(1), pp.1-12.

[87] Gil, Ferrández, Mora-Mora and Peral. (2016). Internet of things: A review of surveys based on context aware intelligent services. Sensors, 16(7), p.1069.

[88] Gil-Garcia, Helbig and Ojo. (2014). Being smart: Emerging technologies and innovation in the public sector. Government Information Quarterly, 31(S1), I1–I8.

[89] Gil-Garcia, Pardo and Aldama-Nalda. (2013). June. Smart cities and smart governments: Using information technologies to address urban challenges. In Proceedings of the 14th Annual International Conference on Digital Government Research (pp. 296-297).

[90] Gil-Garcia, Zhang and Puron-Cid. (2016). Conceptualizing smartness in government: An integrative and multi-dimensional view. Government Information Quarterly, 33(3), 524–534.

[91] Gil-García and Pardo. (2005). E-government success factors: Mapping practical tools to theoretical foundations. Government Information Quarterly, 22(2), 187–216.

[92] Glybovets and Mohammad. (2017). E-government versus smart government: Jordan versus the United States. EUREKA: Social and Humanities, (3), p.3

[93] Gomez, Chessa, Fleury, Roussos and Preuveneers. (2019). Internet of Things for enabling smart environments: A technology-centric perspective. Journal of Ambient Intelligence and Smart Environments, 11(1), 23–43.

[94] Gould. (2012). Open innovation and stakeholder engagement. Journal of technology management and innovation, 7(3), pp.1-11.

[95] Graham and Aurigi. (1997). Virtual Cities, Social Polarization, and the Crisis in Urban Public Space Virtual Cities, Social Polarisation and the Crisis in Urban Public Space All rights of reproduction in any form reserved. Article in Journal of Urban Technology, 4(1), 19–52.

[96] Granier and Kudo. (2016). How are citizens involved in smart cities? Analysing citizen participation in Japanese “Smart Communities”. Information Polity, 21(1), 61–76.

[97] Guarda, Leon, Augusto, Haz, De la Cruz, Orozco and Alvarez. (2017), June. Internet of Things challenges. In 2017 12th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-4). IEEE.

[98] Guma and Monstadt. (2021). Smart city making? The spread of ICT-driven plans and infrastructures in Nairobi. Urban Geography, 42(3), 360–381.

[99] Gupta, Mustafa and Kumar. (2017). Smart people for smart cities: A behavioral framework for personality and roles. In Advances in Smart Cities (pp. 23-30). Chapman and Hall/CRC.

[100] Gutiérrez, Amaxilatis, Mylonas, Muñoz. (2017). Empowering citizens toward the co-creation of sustainable cities. IEEE Internet of Things Journal, 5(2), pp.668-676.

[101] Gutiérrez, Theodoridis, Mylonas, Shi, Adeel, Diez, Amaxilatis, Choque, Camprodom, Mccann, Muñoz, Zanella and Mahmoodi. (2016). Co-creating the cities of the future. Sensors, 16(11), p.1971.

[102] Hamann-Burney and Frank. (2020). Buffalo Main Street: Smart Corridor Plan (No. NYSERDA Report 20-24). Buffalo Niagara Medical Campus, Incorporated.

[103] Hargadon and Fanelli. (2002). Action and possibility: reconciling dual perspectives of knowledge in organizations. Organization Science, 13(3), 290–304.

[104] Harsh and Ichalkaranje. (2015). Transforming e-Government to Smart Government: A South Australian Perspective. Advances in Intelligent Systems and Computing, 308 AISC(VOLUME 1), 9–16.

[105] Hassan, Khan and Madani. (2018). Internet of Things: Challenges, Advances, and Applications. Chapman and Hall/CRC computer and information science series' (CRC Press, Boca Raton, Florida).

[106] Hart. (1971). Axiology–theory of values. Philosophy and phenomenological research, 32(1), pp.29-41.

[107] Healey. (2004). Creativity and urban governance. disP-The Planning Review, 40(158), pp.11-20.

[108] Henderson. (1997). Medium size cities. Regional Science and Urban Economics, 27(6), 583–612.

[109] Hernández-Muñoz and Muñoz. (2013). The smartsantander project. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 7858 LNCS, 361–362.

[110] Hlabano and van Belle. (2019). Tracing the impact of the city of cape town's open data initiative on communities and development. IFIP Advances in Information and Communication Technology, 551, 284–294.

[111] Höjer and Wangel. (2014). Smart sustainable cities: Definition and challenges. Advances in Intelligent Systems and Computing, 310, 333–349.

[112] Hollands. (2008). Will the real smart city please stand up?. City, 12(3), pp.303-320.

[113] Hsiao, Chen and Chang. (2011), "Knowledge management capacity and organizational performance: the social interaction view", International Journal of Manpower, Vol. 32 Nos 5/6, pp. 645-660.

[114] Hsieh, Chen and Lo. (2015). An investigation of leadership styles during adoption of E-government for an innovative city: perspectives of Taiwanese public servants. In Transforming city governments for successful smart cities (pp. 163-180). Springer, Cham.

[115] Hussain, Wenbi, da Silva, Nadher and Mudhish. (2015). Health and emergency-care platform for the elderly and disabled people in the Smart City. Journal of Systems and Software, 110, 253–263.

[116] IBM - IBM Intelligent Operations Center for Smarter Cities - United States. (n.d.). Retrieved October 31, 2022, from https:www.ibm.com

[117] Hussain. (2017). Internet of Things: challenges and research opportunities. CSI transactions on ICT, 5(1), pp.87-95.

[118] IRENA – International Renewable Energy Agency. (n.d.). Retrieved October 31, 2022, from https://www.irena.org/

[119] Ishida. (2017), April. Digital city, smart city and beyond. In Proceedings of the 26th International Conference on World Wide Web Companion (pp. 1151-1152).

[120] Ismagilova, Hughes, Dwivedi and Raman. (2019). Smart cities: Advances in research—An information systems perspective. International Journal of Information Management, 47, 88–100.

[121] Jadoul. (2016). Smart practices for building smart cities. e and i Elektrotechnik und Informationstechnik, 133(7), pp.341-344.

[122] Jain, Patnaik and Ichalkaranje. eds., (2014). Intelligent Computing, Communication and Devices: Proceedings of ICCD 2014, Volume 1 (Vol. 308). Springer.

[123] Joshi, Saxena, Godbole and Shreya. (2016). Developing Smart Cities: An Integrated Framework. Procedia Computer Science, 93, 902–909.

[124] Joss, S. (2014). Rising to the challenge: public participation in sustainable urban development. in Hofmeister, Rueppel and Fook, eds, Eco-cities: Sharing European and Asian Best Practices and Experiences (Singapore: Select Books, 2014) 35–51.

[125] Kachanoff, Kteily, Khullar, Park and Taylor. (2020). Determining our destiny: Do restrictions to collective autonomy fuel collective action?. Journal of personality and social psychology, 119(3), p.600.

[126] Kamel Boulos, Tsouros and Holopainen. (2015). 'Social, innovative and smart cities are happy and resilient': insights from the WHO EURO 2014 International Healthy Cities Conference. International Journal of Health Geographics, 14(1), pp.1-9.

[127] Kaur and Singh. (2016). A survey report on Internet of Things applications. International Journal of Computer Science Trends and Technology, 4(2), pp.330-335.

[128] Kaur and Maheshwari. (2016). Building smart cities applications using IoT and cloud-based architectures. In 2016 International Conference on Industrial Informatics and Computer Systems (CIICS) (pp. 1-5). IEEE.

[129] Kelly and Firestone. (2015). How tech hubs are helping to drive economic growth in Africa. Background paper to the World Development Report 2016: Digital Dividends.

[130] Kelliher. (2011). Interpretivism and the pursuit of research legitimisation: an integrated approach to single case design. Leading issues in business research methods, 1(2), pp.123-131.

[131] Khan and Kiani. (2012). A Cloud-based architecture for citizen services in smart cities. Proceedings - 2012 IEEE/ACM 5th International Conference on Utility and Cloud Computing, UCC 2012, 315–320.

[132] Kapoor. (2017). Self-Sustainable Integrated Township: A Resource-Based Planning to Improve the Quality of Urban Life. In Advances in Smart Cities (pp. 31-48). Chapman and Hall/CRC.

[133] Kim, Yoo, Lee and Seo. (2017). The innovation of the internet: a semantic network analysis of the Internet of Things. Asian Journal of Technology Innovation, 25(1), pp.129-139.

[134] Kim. (2005). The effects of a constructivist teaching approach on student academic achievement, self-concept, and learning strategies. Asia pacific education review, 6(1), pp.7-19.

[135] Kitchin and Cardullo. (2019). Being a 'citizen'in the smart city: Up and down the scaffold of smart citizen participation in Dublin, Ireland. GeoJournal, 84(1), pp.1-13.

[136] Kormanik and Rocco. (2009). Internal versus external control of reinforcement: A review of the locus of control construct. Human Resource Development Review, 8(4), pp.463-483.

[137] Ku, Chien and Ma. (2020). Digital transformation to empower smart production for Industry 3.5 and an empirical study for textile dyeing. Computers and Industrial Engineering, 142, p.106297.

[138] Kubler, Robert, Hefnawy, Cherifi, Bouras and Främling. (2016), November. IoT-based smart parking system for sporting event management. In Proceedings of the 13th International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (pp. 104-114).

[139] Kumar and Dahiya. (2017). Smart economy in smart cities. In Smart economy in smart cities (pp. 3-76). Springer, Singapore.

[140] Kyriazopoulou. (2015), May. Smart city technologies and architectures: A literature review. In 2015 International Conference on Smart Cities and Green ICT Systems (SMARTGREENS) (pp. 1-12). IEEE.

[141] Labun and Wittek. (2014). Structural holes. In Encyclopedia of Social Network Analysis and Mining (pp. 2075-2083). Springer.

[142] Lam and Ma. (2019). Potential pitfalls in the development of smart cities and mitigation measures: An exploratory study. Cities, 91, 146–156.

[143] Lane, Koka and Pathak (2006). The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the Construct.Academy of management review, 31(4), pp.833-863.

[144] Lee and Lee. (2014). Developing and validating a citizen-centric typology for smart city services. Government Information Quarterly, 31, pp.S93-S105.

[145] Lee, Hancock and Hu. (2014). Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. Technological Forecasting and Social Change, 89, 80–99.

[146] Lekamge and Marasinghe. (2013), July. Developing a smart city model that ensures the optimum utilization of existing resources in cities of all sizes. In 2013 International Conference on Biometrics and Kansei Engineering (pp. 202-207). IEEE.

[147] Li, Lin and Geertman. (2015), July. The development of smart cities in China. In Proc. of the 14th International Conference on Computers in Urban Planning and Urban Management (pp. 7-10).

[148] Lichtenthaler and Lichtenthaler. (2009). A capability-based framework for open innovation: Complementing absorptive capacity. Journal of management studies, 46(8), pp.1315-1338.

[149] Lim, Kim and Maglio. (2018). Smart cities with big data: Reference models, challenges, and considerations. Cities, 82, 86–99.

[150] Linders. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. Government Information Quarterly, 29(4), 446–454.

[151] Logvinov, Kraemer, Adams, Heiles, Stuebing, Nielsen and Mancuso. (2016). Standard for an Architectural Framework for the Internet of Things (IOT) IEEE p2413. IEEE-P2413 Working Group. Technical Report.

[152] Lucero. (2016). March. IoT platforms: Enabling the Internet of Things. Retrieved from https://cdn.ihs.com/www/ pdf/enabling-IOT.pdf.

[153] Madakam, Lake, Lake and Lake. (2015). Internet of Things (IoT): A literature review. Journal of Computer and Communications, 3(05), p.164.

[154] Madakam and Ramachandran. (2015). Barcelona Smart City: The Heaven on Earth (Internet of Things: Technological God). ZTE Communications, 13(4), 3–9.

[155] Madakam and Ramaswamy. (2015), February. 100 New smart cities (India's smart vision). In 2015 5th National Symposium on Information Technology: Towards New Smart World (NSITNSW) (pp. 1-6). IEEE.

[156] Madakam and Ramaswamy. (2015), February. 100 New smart cities (India's smart vision). In 2015 5th National Symposium on Information Technology: Towards New Smart World (NSITNSW) (pp. 1-6). IEEE.

[157] Maksimovic. (2017). The Role of Green Internet of Things (G-IoT) and Big Data in Making Cities Smarter, Safer and More Sustainable. International Journal of Computing and Digital Systems, 6(4), 2210–142.

[158] Malche and Maheshwary. (2015) "Harnessing the Internet of things (IoT): A review," Int. J. Adv. Res. Comput. Sci. Softw. Eng., vol. 5, no. 8, pp. 320–323.

[159] Manville, Cochrane, Jonathan, Millard, Pederson, Thaarup, WiK and WiK. (2014). Mapping smart cities in the EU.

[160] Maple. (2017). Security and privacy in the internet of things. Journal of Cyber Policy, 2(2), 155–184.

[161] March and Ribera-Fumaz. (2016). Smart contradictions: The politics of making Barcelona a Self-sufficient city. European Urban and Regional Studies, 23(4), 816–830.

[162] Marques, Garcia and Pombo. (2017). A Survey on IoT: Architectures, Elements, Applications, QoS, Platforms and Security Concepts. Studies in Big Data, 22, 115–130.

[163] Marvin, Luque-Ayala and McFarlane. eds., (2015). Smart urbanism: Utopian vision or false dawn?. Routledge.

[164] Medina, Pérez and Trujillo. (2017), June. IoT paradigm into the smart city vision: a survey. In 2017 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData) (pp. 695-704). IEEE.

[165] Mellouli, Luna-Reyes and Zhang. (2014). Smart government, citizen participation and open data. Information Polity, 19(1-2), pp.1-4.

[166] Misra, Das and Das. (2018). Review on Internet of Things (IoT): Making the World Smart. Lecture Notes in Electrical Engineering, 462, 827–836.

[167] Mitton, Papavassiliou, Puliafito and Trivedi. (2012). Combining Cloud and sensors in a smart city environment. EURASIP journal on Wireless Communications and Networking, 2012(1), pp.1-10.

[168] Montuori and Donnelly. (2017). Transformative leadership. Inj. Neal (Ed.), Handbook of personal and organizational transformation (pp. 1-33).

[169] Mulas, Minges and Appelebaum. (2015). Boosting tech innovation ecosystems in cities: A framework for growth and sustainability of urban tech innovation ecosystems. Washington, DC: World Bank; abridged version in Innovations: Technology, Governance, Globalization, 11(1-2), 98–125.

[170] Munir. (2016). State-of-the-art of Internet of Things ontologies. Tech. Univ. Berlin.

[171] Muñoz, Penalba, Sánchez and Santos. (2017). Reducing techno-anxiety in high school teachers by improving their ICT problem-solving skills. Behaviour and Information Technology, 36(3), pp.255-268.

[172] Nahrstedt, Lopresti, Zorn, Drobnis, Mynatt and Wright. (Apr. 2016). “Smart Communities Internet of Things.” [Online]. Available: https://arxiv.org/abs/1604.02028.

[173] Nam and Pardo. (2011), June. Conceptualizing smart city with dimensions of technology, people, and institutions. In Proceedings of the 12th annual international digital government research conference: digital government innovation in challenging times (pp. 282-291).

[174] National Development Plan 2030 — South African Government. (n.d.). Retrieved October 31, 2022, from https://www.gov.za/issues/national-development-plan-2030

[175] Nascimento, Souza, Oliveira, Moraes, Aguiar, and Silva. (2018). Theoretical saturation in qualitative research: an experience report in interview with schoolchildren. Revista Brasileira de Enfermagem, 71(1), 228–233.

[176] Niederer and Priester. (2016). Smart citizens: Exploring the tools of the urban bottom-up movement. Computer Supported Cooperative Work (CSCW), 25(2), pp.137-152.

[177] Nugroho, Zuiderwijk, Janssen and de Jong. (2015). A comparison of national open data policies: Lessons learned. Transforming Government: People, Process and Policy.

[178] One Cape 2040 The long-term vision and plan for Western Cape Draft 1. (n.d.). Retrieved October 31, 2022, from https://www.slideshare.net/CTP/one-cape-2040-refined-180612

[179] Oliveira, Campolargo and Martins. (2014), October. Human smart cities: A human-centric model aiming at the wellbeing and quality of life of citizens. In eChallenges e-2014 conference proceedings (pp. 1-8). IEEE.

[180] Oliveira and Campolargo. (2015), January. From smart cities to human smart cities. In 2015 48th Hawaii International Conference on System Sciences (pp. 2336-2344). IEEE.

[181] Pandit. (1996). The creation of theory: A recent application of the grounded theory method. The qualitative report, 2(4), pp.1-15.

[182] Paskaleva, Cooper, Linde, Peterson and Götz, (2015). Stakeholder engagement in the smart city: Making living labs work. In Transforming city governments for successful smart cities (pp. 115-145). Springer, Cham.

[183] Perera, Liu and Jayawardena. (2015). The Emerging Internet of Things Marketplace from an Industrial Perspective: A Survey. IEEE Transactions on Emerging Topics in Computing, 3(4), 585–598.

[184] Perwej, AbouGhaly, Kerim and Harb. (2019). An extended review on internet of things (iot) and its promising applications. Communications on Applied Electronics (CAE), ISSN, pp.2394-4714.

[185] Petrov, Mikhaylov, Moltchanov, Andreev, Fodor, Torsner, Yanikomeroglu, Juntti and Koucheryavy. (2018). When IoT Keeps People in the Loop: A Path Towards a New Global Utility; When

IoT Keeps People in the Loop: A Path Towards a New Global Utility. IEEE Communications Magazine, 57.

[186] Petrova-Antonova and Ilieva. (2019), June. Methodological framework for digital transition and performance assessment of smart cities. In 2019 4th International Conference on Smart and Sustainable Technologies (SpliTech) (pp. 1-6). IEEE.

[187] Pols, Pasveer and Willems. (2018). The particularity of dignity: relational engagement in care at the end of life. Medicine, Health Care and Philosophy, 21(1), pp.89-100.

[188] Powell and Snellman. (2004). The knowledge economy. Annual Review of Sociology, 30, 199–220.

[189] Pries-Heje and Cranefield. (2019). "Moving beyond showcasing. The five faces of leadership in smart city transformation," in European Conference on Information Systems, pp. 1-16.

[190] Pticek, Podobnik and Jezic. (2016). Beyond the internet of things: the social networking of machines. International Journal of Distributed Sensor Networks, 12(6), p.8178417.

[191] Rathore, Paul, Ahmad and Jeon. (2016). IoT-Based Big Data: From Smart City towards Next Generation Super City Planning. International Journal on Semantic Web and Information Systems (IJSWIS), 13(1), 28-47.

[192] Rghioui and Oumnad. (2017). Internet of Things: Surveys for Measuring Human Activities from Everywhere. International Journal of Electrical and Computer Engineering (IJECE), 7(5), 2474–2482.

[193] Richman and Leslie. (2018). The 2015-2017 Cape Town drought: Attribution and prediction using machine learning. Procedia Computer Science, 140, 248–257.

[194] Robert, Kubler, Kolbe, Cerioni, Gastaud and Främling. (2017). Open IoT ecosystem for enhanced interoperability in smart cities—Example of Métropole de Lyon. Sensors, 17(12), p.2849.

[195] Roche. (2016). Geographic information science II: Less space, more places in smart cities. Progress in Human Geography, 40(4), 565–573.

[196] Rodríguez-Bolívar. (2015). Transforming city governments for successful smart cities. Springer.

[197] Rose, Eldridge and Chapin. (2015). The internet of things: An overview. The internet society (ISOC), 80, pp.1-50.

[198] Rouland. (2015). Smart cities: weighing the risks and rewards of connecting communities. Risk Management, 62(10), 26–31.

[199] Sadoway and Shekhar. (2014). (Re) prioritizing citizens in 'smart cities' governance: Examples of smart citizenship form India. Journal of Community Informatics, 10(3).

[200] Saha, Auddy, Chatterjee, Pal, Sarkar, Singh, Singh, Sharan, Banerjee, Sarkar and Maity. (2017). IoT solutions for smart cities. 2017 8th Industrial Automation and Electromechanical Engineering Conference, IEMECON 2017, 74–80.

[201] Sanchez, Muñoz, Galache, Sotres, Santana, Gutierrez, Ramdhany, Gluhak, Krco, Theodoridis and Pfisterer. (2014). SmartSantander: IoT experimentation over a smart city testbed. Computer Networks, 61, 217–238.

[202] Santana, Chaves, Gerosa, Kon and Milojicic. (2017). Software platforms for smart cities: Concepts, requirements, challenges, and a unified reference architecture. ACM Computing Surveys (Csur), 50(6), pp.1-37.

[203] Saunders and Baeck. (2015). Rethinking smart cities from the ground up. London: Nesta.

[204] Scapens. (2004). Doing case study research. In The real life guide to accounting research (pp. 257-279). Elsevier.

[205] Scellato, Mascolo, Musolesi and Latora. (2010). Distance matters: geo-social metrics for online social networks. In 3rd Workshop on Online Social Networks (WOSN 2010).

[206] Schaffers, Komninos and Pallot. (2012) Smart Cities as Innovation Ecosystems Sustained by the Future Internet, FIREBALL White Paper, EU. [55] A. Schulze and M. Hoegl, Organizational.

[207] Scheerder, van Deursen and van Dijk. (2017). Determinants of Internet skills, uses and outcomes. A systematic review of the second- and third-level digital divide. Telematics and Informatics, 34(8), 1607–1624.

[208] Scholl, Barzilai-Nahon, Ann, Popova and Re. (2009), January. E-Commerce and e-Government: How do they Compare? what can they Learn from each Other?. In 2009 42nd Hawaii International Conference on System Sciences (pp. 1-10). IEEE.

[209] Scholl, Patin and Chatfield. (2012), January. ICT-enabled city government field operations: Resiliency during extreme events. In 2012 45th Hawaii International Conference on System Sciences (pp. 2346-2356). IEEE.

[210] Scholl and Scholl. (2014). Smart Governance: A Roadmap for Research and Practice. IConference 2014 Proceedings, 163–176.

[211] Serrano. (2018). Digital systems in smart city and infrastructure: Digital as a service. Smart Cities, 1(1), 134–154.

[212] Shahid, Khalid, Shaukat, Ali and Qadri. (2018). Internet of Things Shaping Smart Cities: A Survey. Studies in Big Data, 30, 335–358.

[213] Shaping Europe's digital future. (n.d.). Retrieved October 31, 2022, from https://digital-strategy.ec.europa.eu/en

[214] Shelton, Zook and Wiig. (2015). The 'actually existing smart city.' Cambridge Journal of Regions, Economy and Society, 8(1), 13–25.

[215] Simonofski, Asensio, de Smedt and Snoeck. (2017). Citizen Participation in Smart Cities: Evaluation Framework Proposal; Citizen Participation in Smart Cities: Evaluation Framework Proposal. 2017 IEEE 19th Conference on Business Informatics (CBI), 01.

[216] Slavova and Okwechime. (2016). African smart cities strategies for agenda 2063. Africa Journal of Management, 2(2), pp.210-229.

[217] Smart Cities Maturity Model and Self-Assessment Tool — Smart Cities LibraryTM. (n.d.). Retrieved November 24, 2022, from https://www.smartcitieslibrary.com/urbantide-smartcities-maturity-self-assessment-tool/

[218] Smart Cities Council, (n.d.). Smart Cities Open Data Guide: Advice, best practices and tools for creating a data-driven city. Retrieved November 24, 2022, from https://smartnet.niua.org/sites/default/files/resources/Open-Data-Guide-8-24-2015.pdf

[219] Smart Cities Readiness Guide — Smart Cities Council. (n.d.). Retrieved October 31, 2022, from https://www.smartcitiescouncil.com/resources/smart-cities-readiness-guide

[220] Smith, Collins and Clark. (2005). Existing Knowledge, Knowledge Creation Capability, and the Rate of New Product Introduction in High-Technology Firms. Academy of management Journal 48.2 (2005): 346-357.

[221] Song, Cai, Chahine and Li. (2017). Towards Smart Cities by Internet of Things (IoT)-a Silent Revolution in China. J Knowl Econ, 12, 578–594.

[222] Sterman. (2006). Learning from evidence in a complex world. American Journal of Public Health, 96(3), 505–514.

[223] Statista, (2020) Available at: https://www.statista.com/topics/9813/internet-usage-in-africa/#topicOverview. (Accessed: 11 May 2020).

[224] Stelzner. (2015). City of Cape Town Digital City Strategy. Retrieved October 31, 2022, from https://docplayer.net/28971739-City-of-cape-town-digital-city-strategy.html.

[225] Su, Li and Fu. (2011), September. Smart city and the applications. In 2011 international conference on electronics, communications and control (ICECC) (pp. 1028-1031). IEEE.

[226] Sun, Song, Jara and Bie. (2016). Internet of things and big data analytics for smart and connected communities. IEEE access, 4, pp.766-773.

[227] Sundaravadivel, Kougianos, Mohanty and Ganapathiraju. (2017). Everything you wanted to know about smart health care: Evaluating the different technologies and components of the internet of things for better health. IEEE Consumer Electronics Magazine, 7(1), pp.18-28.

[228] Suryanegara, Arifin, Asvial and Wibisono. (2017), October. A system engineering approach to the implementation of the Internet of Things (IoT) in a country. In 2017 4th International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE) (pp. 20-23). IEEE.

[229] Sawatzky. (2022). Competencies for Success in Remote and Hybrid Working Contexts.

[230] The Fundamental Differences between SaaS and DaaS - AbacusNext. (n.d.). Retrieved November 1, 2022, from https://www.abacusnext.com/blog/fundamental-differences-between-saas-and-daas/

[231] The Most Important Social Media Metrics to Track — Sprout Social. (n.d.). Retrieved October 31, 2022, from https://sproutsocial.com/insights/social-media-metrics/

[232] The New Urban Economy: Opportunities and Challenges. (n.d.). Retrieved October 31, 2022, from https://www.brookings.edu/research/the-new-urban-economy-opportunities-and-challenges/

[233] The Smartest Cities In The World 2015: Methodology. (n.d.). Retrieved November 1, 2022, from https://www.fastcompany.com/3038818/the-smartest-cities-in-the-world-2015-methodology

[234] The Smart City Nervous System — Huawei Enterprise. (n.d.). Retrieved October 31, 2022, from https://e.huawei.com

[235] Thomas. (2006). A general inductive approach for analyzing qualitative evaluation data. American journal of evaluation, 27(2), pp.237-246.

[236] Tokody and Schuster. (2016). Driving forces behind Smart city implementations-The next smart revolution. Journal of Emerging research and solutions in ICT, 1(2), pp.1-16.

[237] Top Ten Urban Innovations — World Economic Forum. (n.d.). Retrieved October 31, 2022, from https://www.weforum.org/reports/top-ten-urban-innovations/

[238] Uribe-Pérez and Pous. (2017). A novel communication system approach for a Smart City based on the human nervous system. Future Generation Computer Systems, 76, 314–328.

[239] van Deursen and Mossberger. (2018). Any Thing for Anyone? A New Digital Divide in Internet-of-Things Skills. Policy and Internet, 10(2), 122–140.

[240] Vanolo. (2016). Is there anybody out there? The place and role of citizens in tomorrow's smart cities. Futures, 82, 26–36.

[241] Vilajosana, Llosa, Martinez, Domingo-Prieto, Angles and Vilajosana. (2013). Bootstrapping smart cities through a self-sustainable model based on big data flows. IEEE Communications Magazine, 6(51), 128–134.

[242] Vitale. (2017). Smart Urbanism: Utopian Vision or False Dawn? Marvin, Luque-Ayala and McFarlane, (Eds.). (2015). Routledge.

[243] Wall, Stavropoulos, Edelenbos and Pajević. (2015). Evaluating the performance of smart cities in the global economic network. In Transforming city governments for successful smart cities (pp. 87-113). Springer, Cham.

[244] Wan, Li, Zou and Zhou. (2012), October. M2M communications for smart city: An event-based architecture. In 2012 IEEE 12th International Conference on Computer and Information Technology (pp. 895-900). IEEE.

[245] Weber, Lučić and Lovrek. (2017), October. Internet of Things context of the smart city. In 2017 International Conference on Smart Systems and Technologies (SST) (pp. 187-193). IEEE.

[246] Wesgro, 2020 Wesgro, Cape Town, Western Cape Tourism. Retrieved October 31, 2022, from https://www.wesgro.co.za/corporate/home.

[247] Western Cape Government (2012) ONECAPE2040 From vision to action The Western Cape agenda for joint action on economic development. Retrieved April 12, 2019, from https://www.westerncape.gov.za

[248] Western Cape Government (2019). Provincial Strategic Plan 2019-2024. Retrieved October 31, 2022, from https://www.westerncape.gov.za

[249] Whetten. (1989). What constitutes a theoretical contribution?. Academy of management review, 14(4), pp.490-495.

[250] Willis. (2019). Whose right to the smart city?. In The right to the smart city. Emerald Publishing Limited.

[251] Wilson. (2011). Data matter(s): Legitimacy, coding, and qualifications-of-life. Environment and Planning D: Society and Space, 29(5), 857–872.

[252] Wirtz, Weyerer and Schichtel. (2019). An integrative public IoT framework for smart government. Government Information Quarterly, 36(2), 333–345.

[253] Wu, Guo, Huang, Liu and Xiang. (2018). Information and communications technologies for sustainable development goals: state-of-the-art, needs and perspectives. IEEE Communications Surveys and Tutorials, 20(3), pp.2389-2406.

[254] Xu, Qu and Yang. (2016). A tutorial on the internet of things: from a heterogeneous network integration perspective. IEEE network, 30(2), pp.102-108.

[255] Yesner and Ozdemir, (2017). Understanding smart city transformation with best practices. Paper, White, pp.1-24.

[256] Yin. (1994). Discovering the future of the case study. Method in evaluation research. Evaluation practice, 15(3), pp.283-290.

[257] Zeinab and Elmustafa. (2017). Internet of things applications, challenges and related future technologies. World Scientific News, 67(2), pp.126-148.

[258] Zygiaris. (2013). Smart city reference model: Assisting planners to conceptualize the building of smart city innovation ecosystems. Journal of the knowledge economy, 4(2), pp.217-231.

25 Appendix

P.O. Box 652 • Cape Town 8000 South Africa •Tel: +27 21 469 1012 • Fax +27 21 469 1002
80 Roeland Street, Vredehoek, Cape Town 8001

Office of the Research Ethics Committee	**Faculty of Informatics and Design**

11 November 2020

This serves to confirm that ethics approval was granted to David van Staden, student number 218343426, for research activities related to the Doctor of Applied Arts in Design in the Faculty of Informatics and Design, Cape Peninsula University of Technology.

Title of the thesis:	Towards Smart City implementation as an engagement practice: The case of Cape Town, South Africa

Comments

Research activities are restricted to those detailed in the ethics application.

Signed: Faculty Research Ethics Committee	**11 November 2020** **Date**

Figure 40: Ethics approval

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

Date	: 29 September 2021
To	: Director: Policy & Strategy
Reference	: PSRR- 0373

Research Approval Request

In terms of the City of Cape Town System of Delegations (May 2019) - Part 29, No 8 Subsection 4, 5 and 6

"*Research:*

(4) To consider any request for the commissioning of an organizational wide research report in the City and to approve or refuse such a request.

(5) To grant authority to external parties that wish to conduct research within the City of Cape Town and/or publish the results thereof.

(6) To after consultation with the relevant Executive Director: grant permission to employees of the City of Cape Town to conduct research, surveys etc. related to their studies, within the relevant directorate

The Director: Policy & Strategy is hereby requested to consider, in terms of sub-section 5, the request received from

Name	: David van Staden
Designation	: Doctoral candidate in Applied Arts
Affiliation	: Cape Peninsula University of Technology
Research Title	: "Towards Smart City implementation as an engagement practice: The case of Cape Town, South Africa".

Taking into account the recommendations below (see Annexure for detailed review):

Recommendations

The CCT via the Director: Policy & Strategy grants permission to David van Staden, in his capacity as a registered Doctoral candidate in Applied Arts at the Cape Peninsula University of Technology (CPUT), to conduct research subject to the following conditions:

- National, Provincial and City COVID-19 protocols and regulations are to be adhered to for all engagements;
- Face to face engagements to be limited and online platforms to be used for interviews;
- The willingness and/or availability of the individual CCT staff member to participate in the research study in a voluntary capacity;
- Researcher to contact IS&T Director Omeshnee Naidoo via Omeshnee.Naidoo@capetown.gov.za;
- Interview schedule to be shared with the relevant official 48 hours before the interview commences;
- Interviews to adhere strictly to scope and scale and is limited to one official interview, not to exceed 60 minutes;
- City official's inputs are to be anonymised;
- Clear acknowledgement in the research report that the views of the interviewed official are not regarded as official CCT policy;
- Any City data, information, and resources are appropriately referenced;
- The use of direct quotations in the report to be agreed in advance and in writing by the respondent concerned, and any text for direct quotation/s must be verified and signed off individually, ahead of any publication of the case study, policy briefing and/or research report;
- The City branding and logo not being used in the research report;

Figure 41: CoCT Interview approval letter

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

Date	: 29 September 2021
To	: Director: Policy & Strategy
Reference	: PSRR- 0373

Research Approval Request

In terms of the City of Cape Town System of Delegations (May 2019) - Part 29, No 8 Subsection 4, 5 and 6

"*Research:*

(4) To consider any request for the commissioning of an organizational wide research report in the City and to approve or refuse such a request.

(5) To grant authority to external parties that wish to conduct research within the City of Cape Town and/or publish the results thereof.

(6) To after consultation with the relevant Executive Director: grant permission to employees of the City of Cape Town to conduct research, surveys etc. related to their studies, within the relevant directorate

The Director: Policy & Strategy is hereby requested to consider, in terms of sub-section 5, the request received from

Name	: David van Staden
Designation	: Doctoral candidate in Applied Arts
Affiliation	: Cape Peninsula University of Technology
Research Title	: "Towards Smart City implementation as an engagement practice: The case of Cape Town, South Africa".

Taking into account the recommendations below (see Annexure for detailed review):

Recommendations

The CCT via the Director: Policy & Strategy grants permission to David van Staden, in his capacity as a registered Doctoral candidate in Applied Arts at the Cape Peninsula University of Technology (CPUT), to conduct research subject to the following conditions:

- National, Provincial and City COVID-19 protocols and regulations are to be adhered to for all engagements;
- Face to face engagements to be limited and online platforms to be used for interviews;
- The willingness and/or availability of the individual CCT staff member to participate in the research study in a voluntary capacity;
- Researcher to contact IS&T Director Omeshnee Naidoo via Omeshnee.Naidoo@capetown.gov.za;
- Interview schedule to be shared with the relevant official 48 hours before the interview commences;
- Interviews to adhere strictly to scope and scale and is limited to one official interview, not to exceed 60 minutes;
- City official's inputs are to be anonymised;
- Clear acknowledgement in the research report that the views of the interviewed official are not regarded as official CCT policy;
- Any City data, information, and resources are appropriately referenced;
- The use of direct quotations in the report to be agreed in advance and in writing by the respondent concerned, and any text for direct quotation/s must be verified and signed off individually, ahead of any publication of the case study, policy briefing and/or research report;
- The City branding and logo not being used in the research report;

Figure 42: CoCT Interview approval letter...continued

Cape Peninsula
University of Technology

FACULTY OF INFORMATICS AND DESIGN

Title of the study: **Towards Smart City implementation as an engagement practice: The case of Cape Town, South Africa.**

Name of researcher: David Lucian van Staden
Contact details: email: dlvanstaden@gmail.com phone: 072 040 0472

Name of supervisor: Prof. Johannes Cronje
Contact details: email: CronjeJ@cput.ac.za phone: 082 558 5311

Name of supervisor: Dr Belinda Verster
Contact details: email: VersterB@cput.ac.za phone: 072 111 8769

Purpose of the Study: This research aims to explore Smart City implementation in Cape Town as an engagement practice as a way to both understand what Smart City implementation means for Cape Town and to further unlock its potential for the City of Cape Town.

Interview questions:

1	What does digital inclusion, infrastructure, governance and economy mean to you and why is it important?, Additionally how do you foster these with regards to ICT use, data management, data integration, access and its role in developing people, communities or businesses?
2	What should the role of ICT and digital technologies be in leveraging collective intelligence and how does it enable social and environmental transformation and citizen centric services whilst supporting citizens and civil society's culture, knowledge and ecosystems?
3	In your opinion how does one generate, prioritise, evaluate and validate new ideas/initiatives or services and how do you operationalise these?
4	In your opinion how does one leverage or drive stakeholder participation and investment towards service creation and deployment? Additionally how do you initiate and evaluate or experiment new services and/or processes towards this?
5	How does one make use of/leverage digital technologies, city infrastructure and city resources (including data and e-services) to utilise or promote citizen or stakeholder participation and co-creation processes.
6	In your opinion how does one generate value or success from interaction or engagement with stakeholders and/or citizens/communities?
7	How do you engage with stakeholders towards innovation and the development of local and global connectivity? Furthermore how does it relate to developing human capital and creating an enabling environment for a more empowered or smart citizenry, open innovation ecosystem and business development.
8	How have you made use of digital technologies and similarly how have these digital technologies influenced or shaped the way you interact with your community, various stakeholder and/or the city?
9	What are some of the mediated or end to end processes amongst various stakeholders (in relation to inclusion, governance, economy and infrastructure)? Additionally what are some of its requirements and relational factors such as facilitating trust, social capital, ROI, communications, systems and communities development etc.?
10	What are some of the data use strategies and/or policies or approaches towards fostering community informatics (empower people through ICT). Additionally how does it relate or support (e-)governance, co-production and collaboration, and the various social context, values, processes towards operational efficiency or improved quality of life?

Figure 43: Interview questions

Cape Peninsula
University of Technology

FACULTY OF INFORMATICS AND DESIGN

David Lucian van Staden
072 040 0472
dlvanstaden@gmail.com / vanstadend@cput.ac.za
20 Ventnor road
Muizenberg
Cape Town
7950

Dear Dr Barclay

I am currently doing a doctorate (PhD) in Design of which the purpose of the study is to explore Smart City implementation in Cape Town as an engagement practice.

The research focuses on Smart City implementation and its role in addressing current urbanisation issues, moreover as a worthy instrument in achieving such objectives. This is evidenced in the CoCT vision and move towards "smart urbanism" and the R300 million rand investment in digital infrastructure towards Smart City development as evidenced in the CoCT Digital City Strategy.

However the current Digital City Strategy lacks sufficient academic grounding and substance around implementation models and mechanism of Smart City deployment. Moreover the strategy lacks sufficient guidance around models of collaborative engagement practices in ensuring that smart initiatives and its deployment are well aligned and appropriate in relation to various participatory networks and community engagement practices towards a more inclusive, active citizenry (Anttiroiko, 2015:26).

In addition, the current strategy requires a better understanding and interpretation around what Smart City implementation can or should be in a Cape Town context in order to unlock its value and potential towards providing new services to citizens, improve their quality of life and enhance social and economic transformation.

This research aims to explore Smart City implementation in Cape Town as an engagement practice as a way to both understand what Smart City implementation means for Cape Town and to further unlock its potential for the City of Cape Town.

The significance of the research is therefore both practical and theoretical as it will aid in foregrounding the key components in unlocking Smart City value and its opportunities towards urban transformation for Cape Town and its population.

The research study forms part of the Faculty of Informatics and Design at the Cape Peninsula University of Technology, which research is under the supervision of Prof. Johannes Cronje and Dr Belinda Verster.

I am hoping that I could interview you to discuss your experience as a professional in relation to the above. If this would be possible, could you please indicate your earliest availability.

Thank you.

Regards

David van Staden
072 040 0472
dlvanstaden@gmail.com
vanstadend@cput.ac.za

Figure 44: Interview request letter

Smart Cities definitions				
Authors	**Year**	**Quote from literature**	**Page number**	**Article title**
Arroub, Zahi, Sabir and Sadik	2016	Smart City is rooted in intelligent infrastructures' creation and ICTs-Human connection, where the city growth must respect these three axes [3] : sustainability ; by improving the city/environment relationship and using green economy. Smartness ; context aware economy and governance. Inclusiveness ; by fostering a high-employment, economy delivering social and territorial cohesion.	P1	A literature review on Smart Cities: Paradigms, opportunities and open problems.
	2016	The city is really smart when we highlight is not just the technology, but also the people and the communities	P2	A literature review on Smart Cities: Paradigms, opportunities and open problems.
Batista, Goldman, Hirata, Kon, Costa and Endler	2016	A Smart City is a city in which its social, business, and technological aspects are supported by Information and Communication Technologies to improve the experience of the citizen within the city. To achieve that, the city must provide public and private services that operate in an integrated, affordable, and sustainable way	P1	Interscity: Addressing future internet research challenges for smart cities
Bibri and Krogstie	2017	Smart City emphasize the pervasiveness of ICT, an aspect which characterizes the prevalent ICT visions of the new wave of computing, as well as the inte- gration of ICT with urban design and planning	P224	On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society
		Piro et al. (2014, p. 169) describe it 'as an urban environment which, supported by perva- sive ICT systems, is able to offer advanced and innovative services to citizens in order to improve the overall quality of their life.'	P224	On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society
Caird and Hallett	2019	The smart city has integrated ICT infrastructure and technologies (BSI 2014c) for improving city functioning (Hollands 2008) and achieving the digital transformation of urban systems.	P189	Towards evaluation design for smart city development
Chamoso, González-Briones, Rodríguez and Corchado	2018	SC as an instrumented, interconnected, and intelligent city. Instrumented referred to the collection and integration of real data in real time from the use of sensors, applications, personal devices, and other resources. Interconnected referred to the integration of all such data into a computing platform that provides a set of services. Finally, intelligent referred to the complex elements, such as analyti- cal calculations, modeling, optimization, and visualization of services for better operational decisions	P2	Tendencies of technologies and platforms in smart cities: A state-of-the-art review
Faisal, Usman and Zahid	2018	Smart City is a concept to achieve the goal utilizing all the available technology for the people's benefit. Smart city is just an application of the concept of IOT in which different technologies are integrated with the current communication system to support the automated working of devices of our everyday use for better city administration and provide more benefits for their citizens	P42	In what ways smart cities will get assistance from internet of things (IOT)
Granier and Kudo	2016	Caragliu et al. believe a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance	P66	How are citizens involved in smart cities?
	2016	innovative features of Smart Communities, namely the participation of all stakeholders among which the citizens, and behavioural change through lifestyle innovation	P62	How are citizens involved in smart cities?
Gutiérrez, Theodoridis, Mylonas, Shi, Adeel, Diez, Amaxilatis, Choque, Camprodom, McCann and Muñoz	2016	Smart cities are unique ecosystems in co-creating the cities of the future	P25	Co-creating the cities of the future
Ishida	2017	Smart Cities apply technologies of self-monitoring and self-response systems to complex social problems including scarcity of resource, inadequate and poor infrastructure, energy shortages and price instability, global environment, and human health.	P1152	Digital city, smart city and beyond
Ismagilova, Hughes, Dwivedi and Raman	2019	Ortiz-Fournier, Márquez, Flores, Rivera-Vázquez, and Colon (2010) defines smart cities in the context of their smart inhabitants, educational degree, quality of social interac- tion, integration with public life and openness to the wider world	P89	Smart cities: Advances in research—An information systems perspective
Joshi, Saxena and Godbole,	2016	Smart cities are an endeavour to make cities more efficient, sustainable and liveable. In other words, a smart city is a city that can monitor and integrate functionality of all the critical infrastructure like roads, tunnels, airways, waterways, railways, communication power supply, etc., control maintenance activities and can help in optimizing the resources while keeping an eye on the security issues as well	P902	Developing smart cities: An integrated framework

Figure 45: Smart City definitions (Author, 2021)

Kumar and Dahiya	2017	The use of smart computing technologies to make the critical infrastructure components and service of a city—which include city administration, edu- cation, health care, public safety, real estate, transportation, and utilities— more intelligent, interconnected, and efficient. A city well performing in a forward-looking way in economy, people governance, mobility, environment, and living built on the smart combination of endowments and activities of self-decisive, independent, and aware citizens A city striving to make itself smarter, more efficient, sustainable, equitable, and liveable A city that monitors and integrates conditions of all of its critical infrastructure including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens [21]. An instrumented, interconnected, and intelligent city instrumentation enables the capture and integration of live real-world data through the use of sensors, kiosks, meters, personal devices, the Web, appliances, camera, smartphones, implanted medical devices, and other similar data acquisition system including social networks as networks of human sensors interconnected means the integration of those data into an enterprise computing platform and the communication of such information among the various city services intelligent refers to inclusion of complex analytics, modelling, optimization and visualization in the operational business processes to make better operational decision A city that gives inspiration, shares culture, knowledge, and life, a city that motivates, its inhabitant to create and flourish in their own lives A city where ICTs strengthen the freedom of speech and the accessibility to public information and services A city that monitors and integrates conditions of its entire critical infrastructure A city connecting the physical infrastructure, the IT infrastructure and social infrastructure, and the business infrastructure to leverage the collective intelligence of the city A city combining ICT and web 2.0 technologies with other organizational design and planning efforts to dematerialize and speed up bureaucratic process and help identify new innovative solutions to city management complexity, in order to improve sustainability and liveability Smart cities are 'systems of people interacting with and using flows of energy, materials, services, and financing to catalyse sustainable economic development, resilience, and high quality of life; these flows and interactions become smart through making strategic use of information and communication infrastructure and services in a process of transparent urban planning and management that is responsive to the social and economic needs of society' Smart city as a 'knowledge based city that develops extra ordinary capabilities to be self-aware, how it functions 24 h and 7 days a week and communicate, selectively, in real time knowledge to citizen end users for satisfactory way of life with easy public delivery of services, comfortable mobility, conserve energy, environment and other natural resources, and create energetic face to face communities and a vibrant urban economy even at a time there is National economic downturns	P38	Smart economy in smart cities
Madakam and Ramachandran	2015	A smart city is a new idea and model for urban construction, management, and development to improve urban management efficiency, facilitate public life, and promote technological in- novation using information and communications technologies (ICTs), such as high - speed Internet, big data, Internet of Things (IoT), and cloud computing	P34	Barcelona smart city: the Heaven on Earth (internet of things: technological God)
	2015	A Smart City is a city well performing built on the'smart'combination of endow- ments and activities of self - decisive, independent, aware citi- zens	P4	Barcelona smart city: the Heaven on Earth (internet of things: technological God)
Madakam and Ramaswamy	2015	Smart City is one that uses technology to transform its core systems and optimize the return from largely finite resources	P2	100 New smart cities (India's smart vision
	2015	According to Giffinger, R et al. [14], Smart Cities can be identified into six main axes or dimensions. These axes are (1) Smart Economy (2) Smart Mobility (3) Smart Environment (4) Smart People (5) Smart Living (6) Smart Governance. And these six axes are based on traditional regional and neoclassical theories of urban growth and development.	P66	100 New smart cities (India's smart vision
Oliveira and Campolargo	2015	Cities can only be smart if they exploit data analytics with the purpose of ensuring smartness, not only in terms of the automation of routine functions, but also in understanding, monitoring, analyzing and planning the city, improving the quality of life of its citizens and building a trusted governance model engaging and empowering the citizens in the co-creation of solution for collective social challenges.	P2338	From smart cities to human smart cities
Rodríguez-Bolívar,	2015	the idea of smart cities is rooted in the creation and connection of human capital, social capital and ICTs infrastructure to generate greater and more sustainable economic development and a better quality of life	P1	Transforming city governments for successful smart cities
Simonofski, A., Asensio, E.S., De Smedt, J. and Snoeck, M	2017	A city can be defined as 'smart' when investments in human and social capital and traditional (transport) and mod- ern (ICT) communication infrastructure fuel sustainable eco- nomic development and a high quality of life, with a wise man- agement of natural resources, through participatory governance	P2	Citizen participation in smart cities
Suryanegara, Arifin, Asvial and Wibisono	2017	[a] smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects	P21	A system engineering approach to the implementation of the Internet of Things (IoT) in a country.
Tokody and Schuster	2016	A smart sustainable city (SSC) is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects. The "smartness" of a city means its ability to bring together all its resources, to effectively and seamlessly achieve the goals and fulfil the purposes it has set itself. In other words, it describes how well all the different city systems, and the people, organisations, finances, facilities and infrastructures involved in each of them, are: • individually working efficiently; and • acting in an integrated way and coherent way, to enable potential synergies to be exploited and the city to function holistically, and to facilitate innovation and growth	P7	Driving forces behind Smart city implementations-The next smart revolution
Wall, Stavropoulos and Edelenbos	2015	Considered (SC) definitions have been, the role of technology in linking people and institutions (Belissent and Giron 2013; IBM 2013; Nam and Pardo 2011; Coe et al. 2000); the importance of human capital in bridging the gap between education and productivity (Florida and Mellander 2012; Storper and Scott 2009; Shapiro 2005); and the need for great- er environmental consideration in city planning (Fitzgerald 2010).	P88	Evaluating the Performance of Smart Cities in the Global Economic Network

Figure 46: Smart City definitions (Author, 2021)...continued

Domains (Quadruple Helix)	Data (Lim, Kim and Maglio, 2018:94)	Co-Production (Castelnovo, 2015:4)	Citizen Participation (Simonofski et al., 2017:3)	Knowledge Management (Lichtenthaler and Lichtenthaler, 2009:1318)	Smart City Initiatives (Chourabi, Nam, Walker, Gil-Garcia, Mellouli, Nahon, Pardo and Scholl, 2012:2294)	Smart City Maturity IDC Smart City Maturity Model (SCM) (Alliance, 2014)	Smart City Domains (Cohen Boyd , 2012)
Inclusion	Local Network Development	Driven by Civil Society	Citizen as Democratic Participant	Knowledge exploration, Retention and Exploration	People and Community	Strategic Intent Data Use Technology Governance Stakeholder Engagement	People and Living
Infrastructure	Local Operational Management	Combination between Civil Servants and Citizens	Citizen as Users	Knowledge Exploration, Retention and Exploitation	Natural Environment and Infrastructure	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Environment and Mobility
Governance	Preventative Local Administration	Combination between Civil Servants and Citizens	Citizens as Co-Creators	Knowledge exploration, Retention and Exploitation	Governance	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Government
Economy	Local Information Diffusion	Driven by Citizens and Communities	Citizens as Co-Creators and Users	Knowledge exploration, Retention and Exploitation	Economy	Strategic Intent Data Use Technology Governance Stakeholder Engagement	Economy
Approach / Indicators (serves as interview protocol)	1. Managing Data 2. Integration 3. Privacy Issues 4. Delivery versus Need 5. Access	1. Experiment portal 2. Lessen Isolation 3. Annotation of Data 4. City Scale Opportunistic Data Collection 5. EaaS Framework		1. Knowledge Capacities 2. Inventive 3. Transformative 4. Innovative 5. Absorptive 6. Connective Desorptive	1. Context 2. Co-Design 3. Deployment	1. Stage 1 2. Stage 2 3. Stage 3	1. Understands Smart City concept 2. Provides Evaluative Framework 3. Understands Relationality of Factors

Figure 47: SCIEP model (Author, 2021)

Data	Co-Production	Citizen Participation	Knowledge Management	Smart City Initiatives	Smart City Maturity	Smart City Domains
How do you use data? (Please elaborate using the supplied keywords words as a starting or reference point)	**How do you co-produce amongst various stakeholders or commuity members? (Please elaborate using the supplied keywords words as a starting or reference point)**	**How do you participate or foster participation amongst various stakeholders or community members? (Please elaborate using the supplied keywords words as a starting or reference point)**	**How is knowledge collected, integrated and utilised within an organisation towards improvement and amongst various stakeholders or community members?)**	**Can you please elaborate regarding the context, design and deployment process of smart initiatives?**	**How would you describe and evaluate smart initiatives?**	**Can you please elaborate regarding the context, evaluative framework and relational factors of your smart domain and initiatives?**
Focus areas: Local Development, Operational Management, Administration, Local Information Diffusion	**Focus areas:** Civil Society, Civil Servants and Citizens, Combination between Civil Servants and Citizens, Driven by Citizens and Communities	**Focus areas:** Citizen, Citizen as Users, Citizens as Co-Creators, Citizens as Co-Creators and Users	**Focus areas:** Civil Society, Citizens, Public sector and Citizens, Citizens and Communities	**Focus areas:** People and Community, Natural Environment and Infrastructure, Governance, Economy	**Focus areas:** ad hoc, opportunistic, purposeful and contextually relevant , operationalised, optimised	**Focus areas:** understands city objectives, defines city objectives, understands relationality of factors and ICT use
Data use	**Co-production (citizens)**	**Co-creation (citizens)**	**Knowledge acquisition (process and types)**	**Context-sensitive city-making (process and types)**	**Foster and promote service creation**	**Skills development**
Data integration	**Co-production (civil society)**	**Co-creation (civil society)**	**Knowledge dissemination (process and types)**	**Open innovation**	**Lessening exclusion or isolation**	**Operational efficiency**
Data co-production	**Co-production (stakeholders)**	**Co-creation (stakeholders)**	**Stakeholder engagement**	**Community informatics towards social, cultural, and economic development**	**Promote collaboration**	**Virtual and decentralised networks**
Data co-creation	**Data strategies**	**Digital urbanism**	**E-governance**	**Generate value**	**Experimentation for learning**	**End to end processes**
People and living	**Community**	**Environment and Mobility**	**Economy**	**Governance**		

Figure 48: SCIEP Conversation framework (Author, 2022)

...end of document

David Van Staden
Lecturer : Product and Industrial Design
Department of Design (District Six Campus)
Cape Peninsula University of Technology
vanstadend@cput.ac.za
dlvanstaden@gmail.com
www.vanstadendavid.co.za