NELSON MANDELA UNIVERSITY

A VALUE ALIGNMENT SMART CITY STAKEHOLDER MODEL

Anthea van der Hoogen

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Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Computer Science in the Faculty of Science at the Nelson Mandela University

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TITLE OF PROJECT: A Value Alignment Smart City Stakeholder Model

DECLARATION:
In accordance with Rule G5.11.4, I hereby declare that the above-mentioned thesis is my own work and that it has not previously been submitted for assessment to another University or for another qualification.

SIGNATURE: ____________________

DATE: 16 November 2021

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Publications as outputs of this study

Appendix B: Van Der Hoogen, A., Scholtz, B., & Calitz, A. (2019). A Smart City Stakeholder Classification Model. In *2019 Conference on Information Communications Technology and Society (ICTAS)* (pp. 1–6). Durban: IEEE.

Appendix C: Van der Hoogen, A., Scholtz, B., & Calitz, A. P. (2020). Using Theories to Design a Value Alignment Model for Smart City Initiatives. In M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. Dwivedi, & M. Mäntymäki (Eds.), *Responsible Design, Implementation and Use of Information and Communication Technology. I3E 2020. Lecture Notes in Computer Science* (Vol. 12066, pp. 55–66). Springer, Cham. https://doi.org/10.1007/978-3-030-44999-5_5

Appendix D: Van Der Hoogen, A., Scholtz, B., & Calitz, A. (2020). Drivers, Benefits and Challenges to Improve Access to Smart City Data in Developing Countries. In *19th Global Information Technology Management Association (GITMA) World Conference 2020* (pp. 250-256). Virtual Conference.

Appendix E: van der Hoogen A., Scholtz B., Calitz A.P. (2021) Innovative Digitalisation Initiatives for Smart Communities and Smart Cities in a Developing Country. In: Halberstadt J., Marx Gómez J., Greyling J., Mufeti T.K., Faasch H. (eds) Resilience, Entrepreneurship and ICT. CSR, Sustainability, Ethics & Governance. Springer, Cham. https://doi.org/10.1007/978-3-030-78941-1_3.

Appendix F: Fashoro I., Scholtz B., van der Hoogen A. (2021) Identifying Stakeholder Value in Smart City Implementation in Nelson Mandela Bay Municipality. In: Halberstadt J., Marx Gómez J., Greyling J., Mufeti T.K., Faasch H. (eds) Resilience, Entrepreneurship and ICT. CSR, Sustainability, Ethics & Governance. Springer, Cham. https://doi.org/10.1007/978-3-030-78941-1_8.

Summary

The concept of a Smart City has evolved over the last three decades and has attracted the increasing interest of the scientific research community. Unfortunately, many Smart City projects and initiatives do not provide the value expected by all the stakeholders. Many of the reasons for this relate to a lack of data management, data integration, data access and stakeholder participation. People are an integral part of any city's ecosystem, and the Smart City concept was introduced to address the challenges of an ever-growing global population leading to the risk of depletion of economic, environmental and social resources.

The problem addressed in this study is based on the challenges preventing the creation of the value of smart cities for stakeholders. Limited research has been published on the status of Smart City initiatives or on the impact of various success factors on the potential value creation for stakeholders including citizens. Studies on initiatives in developing countries, such as South Africa are even less. Whilst some challenges and constraints related to smart cities in Africa have been reported, there are no studies reporting on initiatives across the data value chain that consider all types of stakeholders, nor the impact of these initiatives.

This study addressed this gap in research and designed a theoretical Value Alignment Smart City Stakeholder (VASCS) Model based on a Systematic Literature Review and a review of related theories. The model has important components that should form part of any Smart City project or Smart City initiative. These five main components are: 1) nine Smart City dimensions with related success factors; 2) four stakeholder roles (enablers, providers, utilisers and users); 3) the data value chain; and 4) the five phases of stakeholder benefits/value realisation that can be linked to; 5) stakeholder value alignment. This study applied the VASCS Model to Smart City initiatives in two case studies in the Eastern Cape Province of South Africa, which were the Nelson Mandela Bay and Buffalo City to investigate and understand the status of such initiatives and the alignment of value thereof. The stakeholder interviews were conducted in two rounds with various stakeholders of Smart City initiatives, referred to as cases in the two case studies.

An expert review of the VASCS Model was conducted with eight experts in the field of Information Systems and Smart Cities. The findings of this review served to confirm the components of the model, with only minor improvements recommended. It was confirmed that all of the components need to be considered in planning Smart City projects.

The first round consisted of six interviews with enablers and providers and the second round consisted of 22 interviews with users, utilisers and citizens. The interviews investigated the value and impact experienced by stakeholders of these initiatives, with a particular focus on the users, utilisers and citizens of the cases. The interview data was transcribed and qualitatively analysed by using Atlas.ti and Excel. The data was analysed according to the Technological, Organisational and Environmental theory constructs and other identified themes.

The interview analysis findings revealed several drivers for these initiatives, which were primarily cost reduction, integration and quality assurance. The results also highlighted access to resources, such as technical skills as a challenge. Another challenge identified was connectivity related to access to data and the digital and physical divide that can impact decision making. The main benefits of Smart City initiatives highlighted were the provision of infrastructure, education and training and digitalisation.

The theoretical contribution of this study is the VASCS Model, which can assist other researchers and practitioners with knowledge of the factors, drivers, challenges and value obtained in Smart City initiatives. The model has two supplementary components: A Stakeholder Classification Model and a Smart City Success Factor Evaluation Template. The practical contribution of this study is the potential use of the VASCS Model by practitioners, city management, researchers and other stakeholders, who can use the model, with the related model and template for planning and evaluating Smart City initiatives. The model can be used to classify the digital activities according to a Smart City's success factors while evaluating the value created by these activities. The impact of these initiatives can then be assessed through value realisation and alignment for stakeholders.

The scientific contribution is the adoption of the model to the cases in the Eastern Cape. To reveal in depth, rich, interview findings that provide important lessons learnt relating to the value created for the stakeholders and the addition of these findings to the body of knowledge.

Keywords: Smart Cities, Alignment of Value, Success Factors, Smart City Dimensions, Stakeholder Classification, Data Value Chain.

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Glossary

AI – Artificial Intelligence

AT – Agreement Technologies

BCMM – Buffalo City Metropolitan Municipality

CCTV – Close Circuit Television

CKAN – Comprehensive Knowledge Archive Network

CRD – Centre for Reviews and Dissemination

DLT – Distributed Ledger Technology

ELIDZ – East London Industrial Development Zone

EV – Electric Vehicle

FP – Foundational Premises

FraIM – Framework for an Integrated Methodology

GDPR – General Data Protection Regulation

GIS – Geographic Information System

GITMA – Global Information Technology Management Association

ICT – Information and Communication Technologies

ICTAS – Conference on Information Communications Technology and Society

IDZ – Industrial Development Zone

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical and Electronics Engineers

IoE – Internet of Everything

IoT – Internet of Things

IR4.0 – Industry Revolution 4.0

IS – Information Systems

IT – Information Technology

KPI – Key Performance Indicators

LBS – Location-based Services

LP – Localisation and Proximity

MK – Milton Keynes

NGO – Non-Governmental Organisation

NMB – Nelson Mandela Bay

NMBM – Nelson Mandela Bay Municipality

OPC – Open Platform Communications

POPIA – Protection of Personal Information Act

QCA – Qualitative Content Analysis

QDA – Qualitative Data Analysis

REC-H – Research Ethics Committee - Human

RFID – Radio Frequency Identification

RSCAF – Reconciled Smart City Assessment Framework

SALGA – South African Local Government Association

S-D – Service-dominant

SDG – Sustainable Development Goal

SLR – Systematic Literature Review

SME – Small and Medium-Sized Enterprise

TOE – Technology, Organisation and Environmental

UN – United Nations

US – United States

VASCS – Value Alignment Smart City Stakeholder

WiFi – Wireless Fidelity

WoS – Web of Science

Chapter 1 - Introduction

1.1 Background

The population in the world is growing, particularly in urban areas (Kumar et al., 2020) and the projection over the next 20 years is that it will continue to grow (BSI, 2014). The United Nations (UN) predicted that by 2050, the population in cities will have increased by 70% (BSI, 2014). As a result, many questions are being asked about problems, solutions and opportunities related to managing a city's resources efficiently (Khatoun & Zeadally, 2016; Nam & Pardo, 2011a). Joshi et al. (2016) proposed a multi-domain conceptual framework for discovering research agendas and the related practical implications and they highlight that cities have economic, political and technological responsibilities to manage their resources. Several studies report that the Smart City concept has become increasingly popular (Alawadhi et al., 2012; Cocchia, 2014; Nam & Pardo, 2011a). Therefore, city management, with the help of other stakeholders, are trying to manage their resources more efficiently (Joshi et al., 2016). These stakeholders include large organisations in the private and public sectors, research and development groups, investors and citizens, city employees and city mayors (Alawadhi et al., 2012; Washburn & Sindhu, 2010).

Many different definitions for smart cities exist, since they are tailored per city for individual cities across the world (Albino et al., 2015; Cocchia, 2014). A comprehensive definition of a Smart City is yet to be developed amongst researchers (Albino et al., 2015). Khatoun and Zeadally (2016: 48) state that a Smart City is "*a complex system, meaning even a single vulnerability could affect all citizens' security*", whereas Nam and Pardo (2011b, p. 185) refer to a Smart City as "*one with a comprehensive commitment to innovation in technology, management and policy*". Washburn and Sindhu (2010, p. 2) reported the definition of a Smart City as being "*the use of Smart Computing technologies to make the critical infrastructure components and services of a city — which include city administration, education, healthcare, public safety, real estate, transportation, and utilities — more intelligent, interconnected, and efficient*". These authors illustrate that a Smart City consists of different features, technologies and components and that all of these should be connected for the city to operate efficiently.

Research has been done on smart cities, but there are few studies that have analysed Smart City initiatives that consider the alignment of stakeholder value. There is therefore a need to study and understand Smart City initiatives (Alawadhi et al., 2012; Hämäläinen & Tyrväinen, 2018). Nam and Pardo (2011b) agree that the Smart City initiative has not been fully conceptualised. They proposed three conceptual dimensions of a Smart City, technology, people and community. The technology dimension relates to concepts such as a digital city, a wired city or an information city. The Internet of Things (IoT) is one of the most disruptive technologies that influences smart cities (Deloitte, 2015; Hwang et al., 2016). Fleisch (2010) describes the IoT as every physical thing that is connected to the Internet. The people dimension considers concepts such as a creative city, a learning city and a knowledge city. The last dimension is the community and considers concepts such as a smart community.

Albino et al. (2015) also emphasise people as the most important factor of all by stating that the label 'Smart City' should refer to clever people who can generate clever solutions to solve urban problems. The study also identifies the importance of governance as a factor, which allows different stakeholders to be part of decision-making. Information and Communication Technologies (ICT)-mediated governance (e-governance) is important to realise a Smart City initiative for its citizens by keeping decision making processes transparent. Spaans and Waterhout (2016) state that the consideration of smart and resilient cities requires governance systems with systematic capacities to handle such complexities.

Yadav et al. (2017) presented findings from nine smart cities in developed countries (three North American and six European) on mobility open data initiatives. They indicate that when the factors of a Smart City concept are integrated, such as ICT, urban infrastructures and stakeholder participation, equitable and sustainable solutions can then be developed to face city challenges. Therefore, for a Smart City to realise its benefits, a plan of action is needed to align its factors that influence the initiative. Such a plan of action is summed up as a Smart City framework or model, in some studies (Alawadhi et al., 2012; Albino et al., 2015; Yadav et al., 2017). Other examples of Smart City frameworks can be found in studies by Balakrishna (2012), BSI (2014) and Deloitte (2015). However, most of these studies on smart cities were done in developed countries. Common factors included in these Smart City framework factors are, amongst others: the city strategy, stakeholders, skills, data, technologies and applications.

It is important to note that even though there is no comprehensive definition for a Smart City, thus indicating how diverse cities are, therefore a Smart City framework should therefore have the facility to be tailored to the individual specifications of a city (Alawadhi et al., 2012; Albino et al., 2015; BSI, 2014; Giffinger, 2011).

Research findings show that few Smart City studies have been conducted in developing countries such as South Africa and other African countries (Backhouse, 2015; Estevez et al., 2016). Cocchia (2014) reported that only 2% of Smart City studies had been conducted in Africa. Estevez et al. (2016) reported that of the most published research, only 12% are from developing countries. Further findings also illustrate that for smart cities in developing countries to realise their benefits and add value to stakeholders, investors and other stakeholders are needed to form partnerships (Backhouse, 2015; Olliero, 2017). Research also shows that there is a lack of valuable information and research regarding emerging smart cities, especially in developing countries (Backhouse, 2015; Estevez et al., 2016; Washburn & Sindhu, 2010). This lack of information prevents stakeholders from making informed decisions, such as how to manage the city resources more efficiently or how to attract potential investors.

Two independent studies of smart cities completed in Indonesia by Mayangsari and Novani (2015) and in Europe by Wendt and Dübner (2017) reported that successful smart cities are based on the co-creation of knowledge (Wendt & Dübner, 2017) and the co-creation of value (Mayangsari & Novani, 2015). This co-creation results from collaboration between different stakeholders and partnerships and between different cities. Value co-creation is trending in Smart City research, where the service science concept is used to illustrate complex resource configurations (Vargo et al., 2008). This co-creation of value concept highlights the importance of the involvement of all stakeholders in Smart City projects. However, few studies investigating the value of initiatives have been conducted.

In the extensive literature review done in this study, only two studies were found that proposed models that consider stakeholder value for initiatives that can be used to classify digital activities. One from Hwang et al. (2016), who stated that adopting new technologies is an important resource for a business to create value and therefore value can be created through technology configurations for a specific business context.

Hwang et al. (2016) also proposed that technology can create value for a business by using a value chain to show IoT application activities in different business contexts. However, most of the countries reported by Hwang et al. (2016) were developed countries. The second study was a data value chain proposed by e-Madina (2016), to show the flow of data in smart cities, but this report is a white paper and has no empirical evidence.

The creation of value in an organisation can be classified according to a value chain, which is a set of activities that a firm, operating in a specific industry, performs to deliver a valuable product or service for the market (Porter, 1985). For the data and information value of such organisational activities, Curry (2016) defines the Big Data Value Chain founded in Curry et al. (2014) as being activities of an Information Systems (IS), which include data access, data analysis, data curation, data storage and data usage. The value chain and Big Data Value Chain are considered to be important theoretical concepts in this study.

A more recent Smart City study identified that there are still limited efforts implemented to build multidisciplinary theories to deal with changing human conditions, especially in Smart City research (Bibri, 2019). Therefore, this study uses the normative view to address efforts about stakeholder theory and the co-creation value theory to support this Smart City research. This thesis is intended to contribute to the theoretical understanding of the influence of certain factors on the creation of value and ultimately, the success of a Smart City initiative.

The Oxford definition of value is given as follows (Waite, 2012):

- The importance or usefulness of something;
- The amount of money that something is worth; and
- (Values) standards of behaviour.

The Oxford definition of value is applicable in this study, because the importance and usefulness of the Smart City initiatives for each stakeholder need to be identified. Also, that value linked to monetary worth could be important to some stakeholders, such as investors and that standards of behaviour must be in place for stakeholders to be able to collaborate and achieve value. Research is required to determine the factors that influence the success of Smart City initiatives and the value experienced by stakeholders.

It is important to deepen the understanding of IoT technologies, because the interaction between connected objects and human decision makers is thought to be valuable by researchers, system developers and users (Hwang et al., 2016; Lea & Blackstock, 2014). The main factors that influence the success of smart cities are investigated in this study and include people (citizen and stakeholder involvement) and technology (related to IoT and data) (Hwang et al., 2016). It can therefore be deduced that it is important to understand how aligning these factors and concepts could add value to stakeholders and achieve success of Smart City projects linked to different initiatives.

1.2 Problem Statement

Investors and other stakeholders do not have valuable and reliable data and information to make informed decisions to invest in smart cities (Grant Thornton, 2016; Yadav et al., 2017). Research studies related to smart cities in developing countries are limited (Yadav et al., 2017). In South Africa, little is known about the status of Smart City initiatives, or the influence (impact) of various factors on the potential creation of value to all the stakeholders (including citizens). In Africa, further empirical studies are required to investigate Smart City agendas, especially in assessing who the stakeholders of such agendas are, as well as who will benefit from these Smart City agendas (Backhouse, 2015). Digital constraints related to smart cities in Africa have been reported (e-Madina, 2016); however, there is little evidence of available models that address the influence of Smart City initiatives and the value experienced by stakeholders in smart cities in Africa. In summary, the problem statement of this study is: "*City management in developing countries does not align stakeholder value and analyse and classify Smart City initiatives for all stakeholders".*

1.3 Thesis Statement

The thesis statement that focuses this research is:

> *A value alignment smart city stakeholder model can be used to analyse and classify Smart City initiatives and assess the influence of certain factors on value creation for the stakeholders and ultimately, on the success of a Smart City Project. In this study, the scope will be limited to the Eastern Cape IoT technological and data initiatives and the influence they have on the stakeholders in each city.*

1.4 Research Aims

The establishment of the status of smart cities in the Eastern Cape, South Africa, will contribute to an increase in the number of empirical studies from the country. No further, more recent studies could be found at the time of writing, since Cocchia (2014) and Mora et al. (2017). Cocchia (2014) reported only 2% of Smart City studies and Mora et al. (2017) showed that only 19 publications on Smart City research between 1992 to 2012, had been reported in Africa. Smart cities in South Africa have many challenges regarding the integration of services and the exchange of information amongst governmental departments within the cities. This prevents the creation of value to the end-users, such as citizens and investors, for example, to make informed decisions (Du Plessis & Marnewick, 2017). A lack of efficient data and information prevents the realisation of value co-creation between different stakeholders within a city.

The **main research aim** for this study is: *To develop a Smart City stakeholder model for value alignment in smart cities in developing countries.* To address this main research aim, the following specific research aims of this study are grouped under the theoretical, scientific and social/practical aims as follows:

- **The theoretical aim** is to design a theoretical Value Alignment Smart City Stakeholder (VASCS) Model that can be used to classify digital activities, Smart City projects and initiatives and to identify the value created by the identified activities;
- **The scientific aim** is to analyse the value created by the activities identified in the case of the Eastern Cape province, which is in a developing country where the VASCS Model can be used to guide the analysis. The in-depth, rich, interview findings provided important lessons learned relating to the value created for the stakeholders and these can add to the body of knowledge; and
- **The practical aim** of this study is to provide empirical evidence from the selected cases and initiatives selected in the Eastern Cape province. These initiatives can influence the creation of value for stakeholders such as citizens in the two cities. The identified success factors can be used to measure the value created by the Smart City initiatives and related projects for all the relevant stakeholders.

To achieve the aims, this study analysed existing digital activities related to Smart City initiatives in South Africa and specifically, in the Eastern Cape. These initiatives were analysed to identify those that can contribute to the quality of information required to create value within such cities.

1.5 Research Question and Objectives

In the previous sections, the background to the problem was identified. The main research question for this study is RQ_m: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?*

The following research objective(s) will be used to answer the main research question and to address the problem statement:

- **RO_1:** Identify the success factors of a Smart City;
- **RO_2:** Analyse existing frameworks and models for smart cities;
- **RO_3:** Identify the stakeholders for smart cities;
- **RO_4:** Analyse and classify digital activities, benefits and challenges for smart cities in a developing country;
    - **$RO_{4.1}$:** Identify the data and IoT initiatives;
    - **$RO_{4.2}$:** Determine what makes data smart;
- **RO_5:** Determine the influence of the initiatives on the creation and alignment of value to a Smart City in a developing country;
    - **$RO_{5.1}$:** Identify the criteria for value creation in a Smart City in a developing country; and
    - **$RO_{5.2}$:** Determine the alignment of data and IoT initiatives on the value creation for stakeholders in the city.

1.6 Scope and Limitations

The data for this study were collected from two case studies, the Nelson Mandela Bay (NMB) and Buffalo City, which are cities in the Eastern Cape Province. Port Elizabeth and the two towns, Uitenhage and Despatch and the surrounding rural areas, all form part of NMB. Buffalo City incorporates the towns of East London, Bhisho, King William's Town and its surrounding rural areas.

1.7 Ethics

An application for ethics approval was submitted to the Nelson Mandela University Research Ethics Committee - Human (REC-H) for consent and approval was given (REF-H18-SCI-CSS-004). An ethics clearance letter was obtained (Appendix A) and more details on the ethical consideration and processes are provided in Section 3.9.

1.8 Research Methodology, Design and Chapter Structure

The research methodology described by Plowright (2011) and adopted in this research was the research framework for an integrated methodology (FraIM). The case study strategy (Yin, 2014) was adopted in conjunction with FraIM. The first step in FraIM was to contextualise the research question. Therefore, the main research question (Section 1.5) was framed within the five contexts of FraIM.

The first context is the Professional context, which is the information about the researcher (author), subject or professional area in which the research is placed and helps the researcher identify why a particular topic has been chosen and can also help discover any possibilities of bias (Plowright, 2011). The author, in this study, has a background in the IS field and resides in the NMB, while working at one of the largest comprehensive universities, the Nelson Mandela University in the Eastern Cape. The relevant and broader research areas of this study are from the professional background of Computer Science, Engineering and Telecommunications, linked to the Smart City topic and field.

The Organisational context is based on the organisation where the research is undertaken (Plowright, 2011). The researcher should be aware of what is acceptable, or not, within the specific organisational context and cultures. Furthermore, the organisational context can drive the types of questions to be asked in a case study or, the actual research question. For example, if the researcher is working at a school, the researcher should be more aware of the culture and context in order to collect data from the pupils and teachers (Plowright, 2016). In this study, the organisational context and culture are investigated in more detail in Chapter 3 and in Chapter 5.

The Political context is important for some research studies, as governmental, organisational or global policies may impact a research study (Plowright, 2011, 2016). Understanding which policies might influence a research study is valuable.

It can help the researcher formulate research questions directly linked to issues involving policies to have an informed perspective of the research study at hand. In this research the policies referred to are important, therefore the data, policies and the relationship of such policies in smart cities are reported on in Chapter 5.

The National context is of importance, especially if the readers are not from the same country, city, or community in which the research is based (Plowright, 2011, 2016). Therefore, providing the background of the study from a local or national viewpoint is important for the readers' understanding of how certain perspectives might have developed within a study. Examples can include economic, social, cultural, or historical perspectives. Chapter 5 reports on an investigation into the status of Smart City initiatives from an international and from a national (South Africa) background and places more focusses more on the local viewpoints of smart cities in the Eastern Cape province.

The Theoretical context is also referred to at times as a conceptual framework (Plowright, 2011; Trafford & Leshem, 2008). The theoretical context, which starts with a search of literature about what others in the field have said and written about in a field of study, can help the researcher to find what undergirds the ideas and concepts in their study (Plowright, 2011; Trafford & Leshem, 2008). "*Their ideas will have given you theoretical perspectives that can guide your thinking about exactly what it is that you will investigate*" (Trafford & Leshem, 2008, p. 44). Therefore, creating a conceptual or theoretical framework can help to organise the concepts from theories for a research study (Plowright, 2011, 2016). For this reason, Chapter 2 contains the preliminary literature reviews, the Systematic Literature Reviews (SLRs) and the broader theoretical framework of this research. Chapter 4 addresses the theories that are applicable in this study.

Chapter 2: Smart City Theoretical Concepts

Chapter 2 reviews dimensions and the factors (RO_1) linked to each dimension; international studies are reviewed first and then the search is refined to gain a comparative view of Africa and then South Africa. This chapter also reviews the topic further for Smart City frameworks and models (RO_2). The stakeholders of smart cities are identified (RO_3), as well as the benefits and challenges faced by smart cities (RO_4). The concepts discussed in this chapter are used as the components of the theoretical framework of this study.

Chapter 3: Research Methodology and Research Design

The research design includes the methodology, philosophy, approach and strategy adopted, as well as the data collection and analysis methods used in this research. The participants of this study were the stakeholders in the Smart City cases in the Eastern Cape (RO_3).

Chapter 4: Theoretical Context

Chapter 4 analyses value and alignment theories in the domain of smart cities (RO_3, $RO_{5.1}$, $RO_{5.2}$). The theories were used to confirm and extend the theoretical concepts of the proposed Value Alignment Smart City Stakeholder (VASCS) Concept Model.

Chapter 5: Internet Search for Smart City Initiatives

Chapter 5 investigates Smart City initiatives and digital activities globally by using Internet Searches with a focus on a developing country (RO_4). The data and IoT initiatives identified are reported on in this chapter ($RO_{4.1}$). In this thesis, the initiatives identified in the Eastern Cape, based on the Internet Searches, are referred to as the cases or initiatives interchangeably for the two case studies in the Eastern Cape namely, NMB and Buffalo City.

Chapter 6: Expert Reviews of VASCS Model V1

Chapter 6 reports on an expert review of the proposed VASCS Model Version 1 (V1). The findings of the review were used to update the model to VASCS Model Version 2 (V2) to meet RO_m.

Chapter 7: Application of VASCS Model V2 in Case Studies (Round 1)

Chapter 7reports on the application of the VASCS Model to the case studies; thus, addressing RO_5, data was collected from five cases in two rounds of interviews. The analysis of the results of the Round 1 interviews were classified into the benefits and challenges faced by smart cities and their influence on value for stakeholders in the cities (RO_1, RO_3, RO_4, $RO_{4.2}$, $RO_{5.1}$, $RO_{5.2}$).

Chapter 8: Application of VASCS Model V2 in Case Studies (Round 2)

Chapter 8 reports on the feedback from the Round 2 interviews (RO_4, RO_5, $RO_{5.1}$, $RO_{5.2}$), which were conducted with the users, utilisers and citizens of the initiatives identified in Chapter 7.

Chapter 9: Conclusions and Recommendations

This chapter confirms the contributions of this study, which are primarily the VASCS Model that can be used by practitioners and researchers in the scientific field as empirical evidence to add to the body of knowledge. Recommendations for future research are made as part of this research topic. Conclusions are made based on the findings from the cases, literature reviews and the Internet searches.

Table 1.1 outlines the strategies and methods in the research design that were followed to meet the objectives and to collect the secondary and primary data for this study.

Table 1.1: Research Design and Chapter Structure

Research Objectives (RO)	Strategies and methods	Chapter	Deliverables
RO_1: Identify the factors of a Smart City	Systematic Literature Review	Chapter 2	• Success Factors and Dimensions for smart cities • Success Factor Assessment Template
	Case Study and Interviews	Chapter 5/7	• Factors and Dimensions for smart cities in the Eastern Cape
RO_2: Analyse existing frameworks and models for smart cities	Literature review	Chapter 2	• Components of a Theoretical Framework
RO_3: Identify the stakeholders for smart cities	Systematic Literature Review	Chapter 2	• Smart City Stakeholder Classification Model • Stakeholder Roles and Types
	Conceptual analysis of theories	Chapter 4	• VASCS Concept Model
	Literature Review Internet Searches Case Study and Interviews	Chapter 5 Chapter 3 Chapter 7/8	• Smart City Initiatives (Cases) in the Eastern Cape • Target profile of Stakeholders in the Eastern Cape • Classification of Stakeholders and Initiatives in the Two Case Studies
RO_4: Analyse digital activities, benefits and challenges for smart cities in a developing country	Literature review Case Study and Interviews-(Application of VASCS Model V2 in Eastern Cape Cases)	Chapter 2/4 Chapter 5 Chapter 7/8	• TOE Classification of Goals, Drivers, Benefits and Challenges of Smart City Initiatives in the Cases • Digital and Data Activities, Technologies, and Sources in the Cases • Success Factors for the Cases
RO_5: Determine the influence of the initiatives on the creation and alignment of value to a Smart City in a developing country	Case Study and Interviews	Chapter 7/8	• Impact/Value (economy, social and environmental) for Stakeholders
	Conceptual analysis of theories	Chapter 4	• VASCS Concept Model
	Case Study and Interviews	Chapter 7/8	• Alignment Criteria for Value Creation for Stakeholders
RO_m: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?*	Expert Review Conclusions and Recommendations	Chapter 6/9	• Value Alignment (= benefits) • Alignment/Gap of VASCS Model V1 • Recommendations for proposed VA SCS Model V2

Figure 1.1 illustrates the structure of the chapters according to four major sections, namely:

- Section A: Backround and Literature (Chapter 1, Chapter 2);
- Section B: Research Design (Chapter 3, Chapter 4);
- Section C: Application of Model (Chapter 5, Chapter 6, Chapter 7, Chapter 8); and
- Section D: Conclusions and Recommendations (Chapter 9).

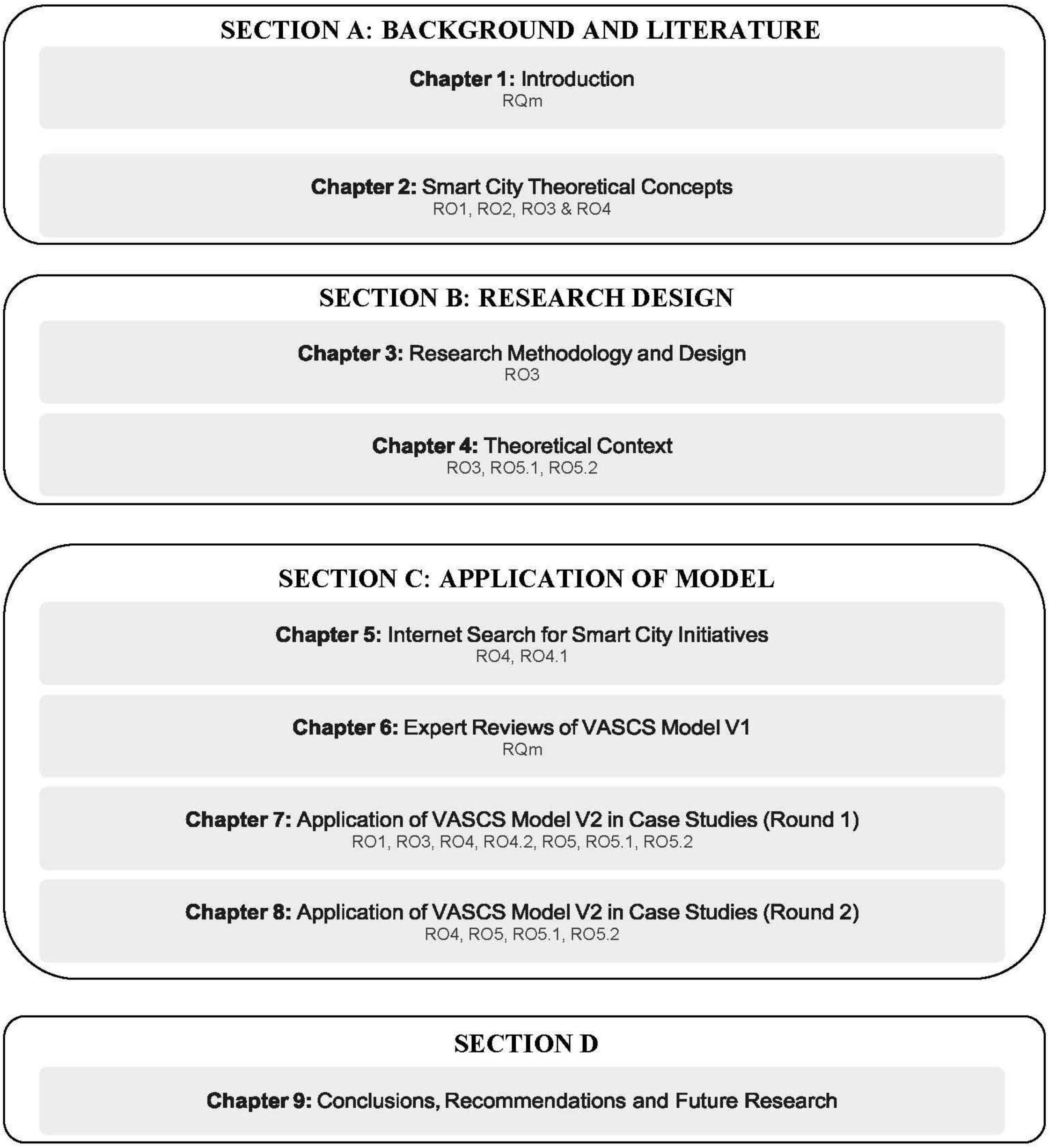

Figure 1.1: Chapter Design

Chapter 2 - Smart City Theoretical Concepts

2.1 Introduction

The previous chapter highlighted some important aspects contributing to why Smart City research is growing. Smart cities are influenced by urbanisation and technologies that are used to help with planning smart cities. Frameworks and models are used as a structure or a map to indicate what the important components in a Smart City are, and includes factors and dimensions of various aspects in such a city. The four research objectives addressed from a theoretical perspective in this chapter are therefore:

- Identify the success factors of a Smart City (RO1);
- Analyse existing frameworks and models for smart cities (RO2);
- Identify the stakeholders for smart cities (RO3); and
- Analyse and classify digital activities, benefits, and challenges for smart cities in a developing country (RO4).

This chapter reports on Stage 1 of this research which consisted of the literature review, the Systematic Literature Review (SLR) and Stage 2, which was the Internet searches. A review of existing literature was carried out to investigate the status of research done on smart cities in both developed and developing countries.

The literature review highlighted several trends in Smart City research (Section 2.2). A rigorous SLR process was then followed to achieve the research objectives (Section 2.3). The first part of the SLR identified and analysed seven Smart City frameworks and models that can guide Smart City initiatives (Section 2.4). The second part of the SLR focused on identifying success factors that can influence value or success in smart cities (Section 2.5). The third part of the SLR analysed the roles and types of stakeholders in smart cities and their initiatives (Section 2.6). The importance of technologies and data in smart cities was highlighted (Section 2.7). The value of smart cities was investigated and several benefits experienced by some studies were identified (Section 2.8). Several components of the theoretical framework in this study were proposed (Section 2.9) and a summary of the reviews presented (Section 2.10). Figure 2.1 illustrates the structure and the deliverables of this chapter.

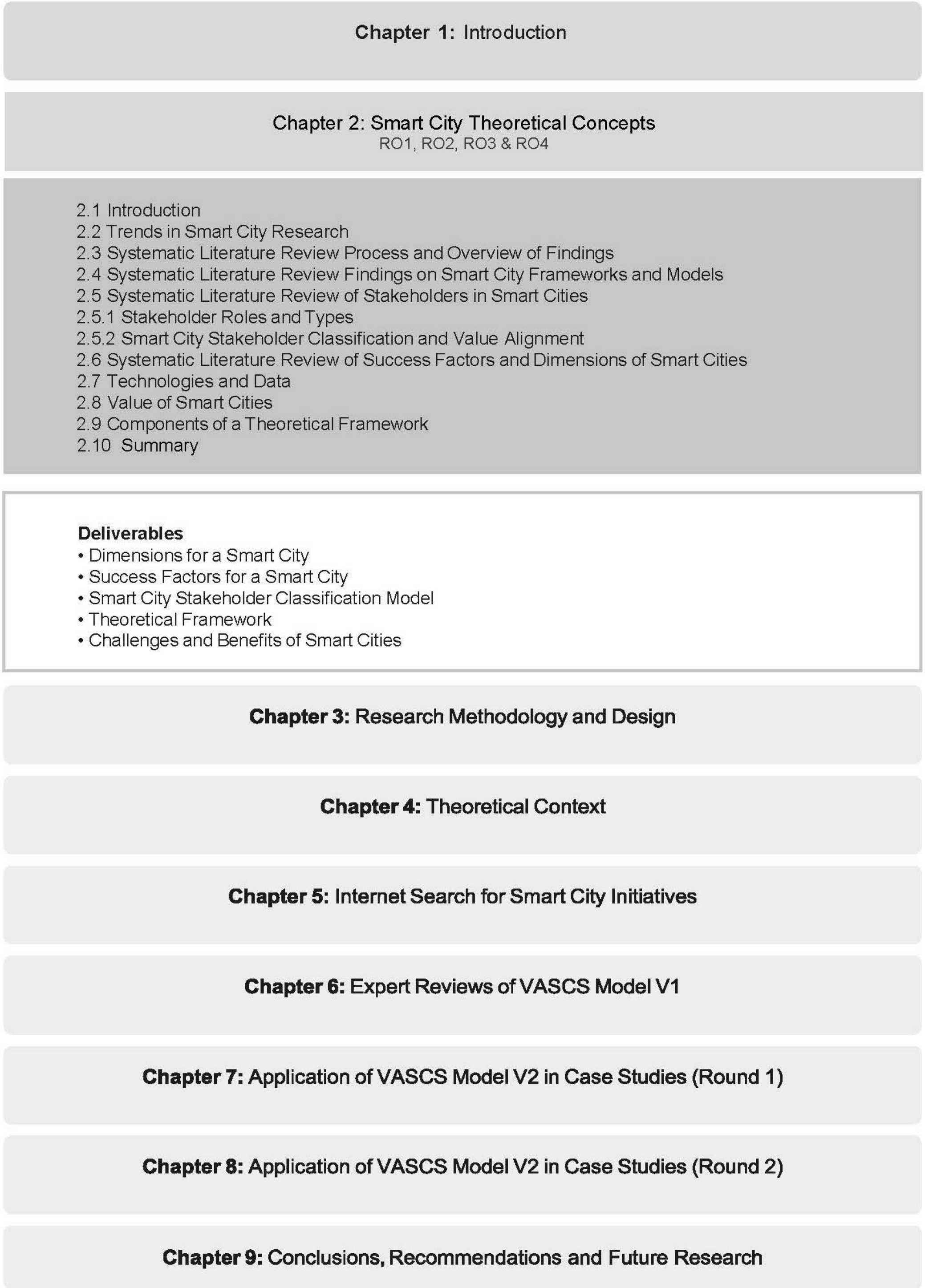

Figure 2.1: Chapter 2 Structure

2.2 Trends in Smart City Research

In Section 1.1, it was discussed how Smart City definitions have become fragmented and unclear due to many variations. Albino et al. (2015) conducted a study on Smart City definitions. They identified the factors of a Smart City and the information flow between such factors as the important components of a Smart City definition. Their definition will be adopted for this study and states that (Albino et al., 2015, p. 6):

> *“A Smart City is based on intelligent exchanges of information that flow between its many different subsystems. This flow of information is analyzed and translated into citizen and commercial services. The city will act on this information flow to make its wider ecosystem more resource-efficient and sustainable. The information exchange is based on a Smart Governance operating framework designed to make cities sustainable”.*

Another study illustrated two decades (1992 to 2012) of Smart City research, showing the peak of Smart City research in different fields and over different continents (Mora et al., 2017). Figure 2.2 shows the types of document sources and the time frame when these documents were published. The document sources consisted of abstracts, books, book chapters, editorials, journal articles, conference papers and grey literature.

The source documents included many different types of organisations that were involved in the production from different continents. The study by Mora et al. (2017) strived to achieve a cohesive view of where in the world, Smart City publications took place. In Figure 2.3, it is shown to have been in Africa, America, Asia, Australia and Europe and the publications were from fields such as research and business (B), research and education (E), research and government (G), and other (O). The top three continents that led Smart City research were Europe, Asia and America and the continent with the least number of publications in the mentioned fields was Africa with a total of 19 publications over the two decades. On all continents, E exceeded all other categories (B, G and O).

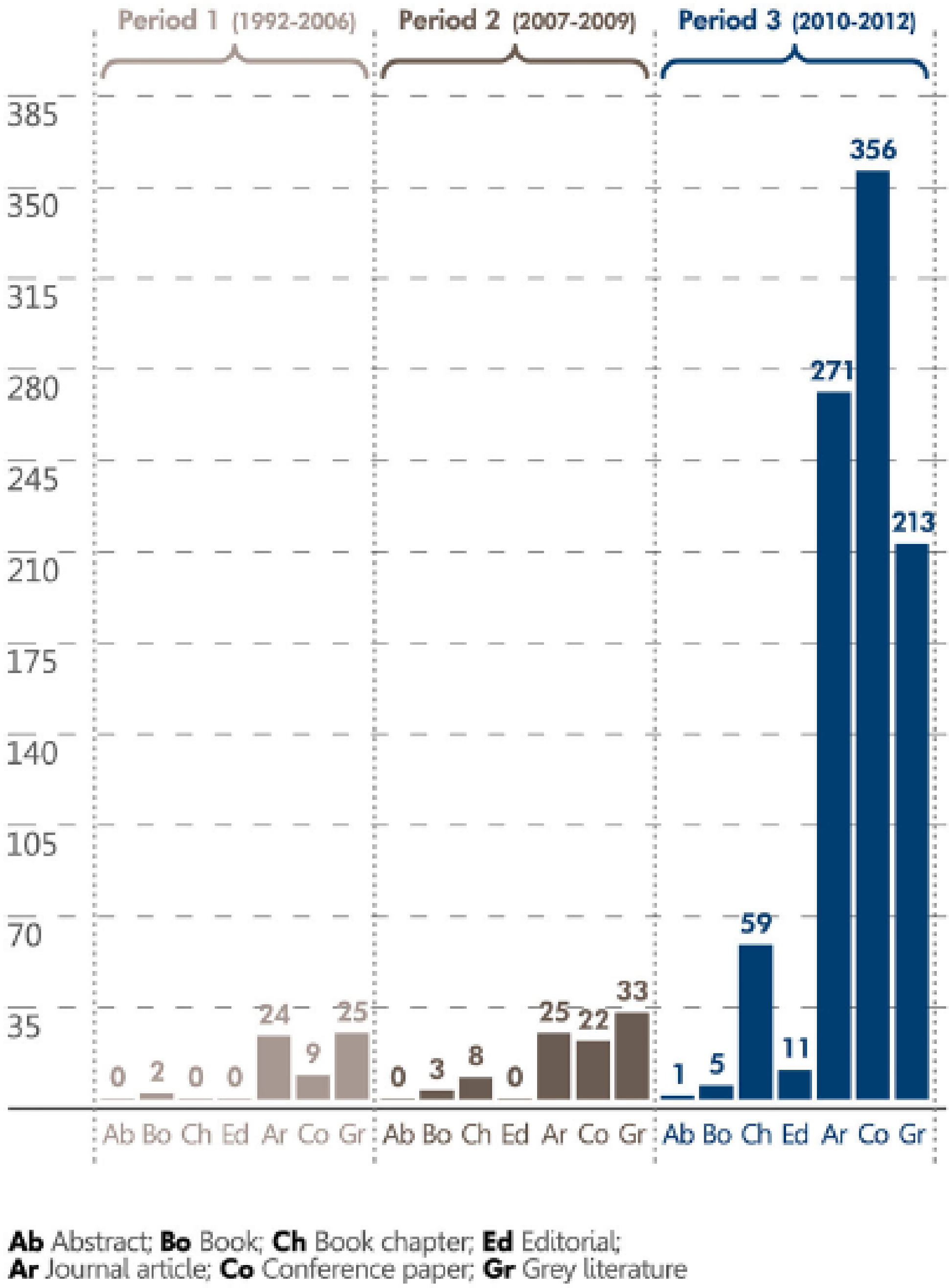

Figure 2.2: Source Documents by Type and Period of Publication (Mora et al., 2017)

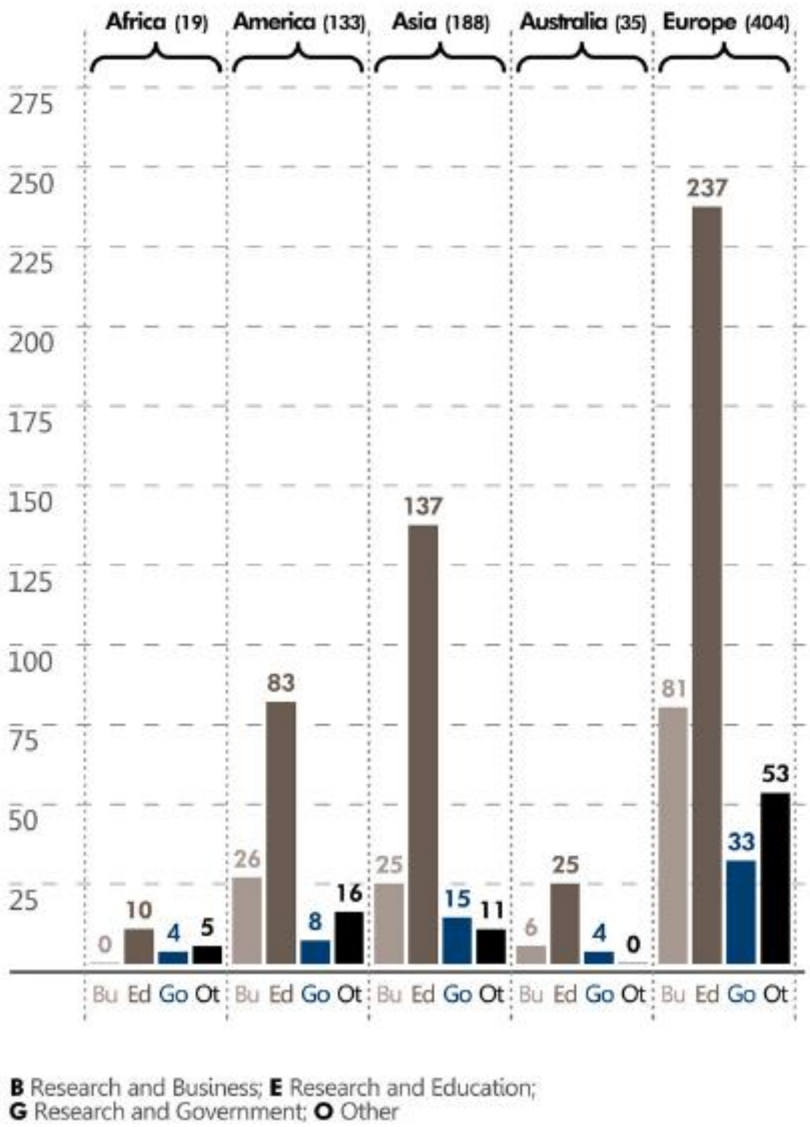

Figure 2.3: Organisations by Type and Location (Mora et al., 2017)

A Harvard Business Review indicated the predictions that Africa's digital economy would grow exponentially due to having some of the youngest populations globally (Chakravorti & Chaturvedi, 2019). The review indicated that economic growth in Africa had dropped instead of increasing. Their study further explored the need for digital growth in six African countries and that South Africa was showing momentum toward growing digitally in terms of metrics such as medium-skilled digital jobs, basic infrastructure, governance, and online freedom. However, it has been indicated that in South Africa Internet access and the quality of access is not reaching the broader population, digital payment capabilities need to be more inclusive, for job creation, digital businesses are required and that on the skillset requirements show that the focus should be on creative and multimedia skills.

The creation of a technology roadmap consisting of four ascending layers namely sensor, integrations, intelligent and application layers achieved successful research on technology in a Smart City (Lu et al., 2019). In the same study, a survey amongst 36 experts helped in the assessment of maturity, the connections that exist amongst Smart City technologies, of the markets and the industries within cities. The authors in this study believed that by applying the Smart City technology roadmap by applying it to the related industries could unveil the trends for key technology and application development for smart cities. Applications that are used in smart cities to monitor, for example use of, water, power and energy use rely on digital activities and technologies to allow sharing of information via networks (Lu et al., 2019).

Jucevičius et al. (2014) confirm that the digital dimension is important as a Smart City dimension. Their study emphasises that, while the digital dimension does not dominate in any of the main characteristics and factors of smart cities, it is important to all of them. Examples of such success factors are shown in Section 2.5. Smart City frameworks entail many factors which have an impact on Smart City success (Manupati et al., 2018).

2.3 Systematic Literature Review Process and Overview of Findings

Kitchenham et al. (2009, p. 8) indicates that the aim of an "*SLR is not just to aggregate all existing evidence on a research question; it is also intended to support the development of evidence-based guidelines for practitioners*". From this it can be deduced that the outcomes of the SLR in this research should be useful not only to researchers in the Smart City field but also to practitioners in the Smart City field who use frameworks or models as a guide.

Smart City frameworks and models are being reported on universally (Table 2.1). There is a problem, however, when cities want to refer to a standardised framework as each city has its initiatives and requires unique components suited for these initiatives (Albino et al., 2015; Giffinger, 2011). However, frameworks and the classification of a Smart City's initiatives are important for a city to use it as a means of communication with its stakeholders regarding the Smart City's successes and value (Cocchia, 2014). Monzon (2015) agrees with the importance of a framework to represent one project of a Smart City at a time, which focuses on the applicable dimensions of the project and thus achieves a comprehensive view of the Smart City.

Alawadhi et al. (2012) also identify the importance to a Smart City of having a framework. They indicate that the framework should be used to help understand a city's initiatives in a systematic way, which can lead to a city being more efficient, effective, attractive, competitive, sustainable, equitable and livable. It is clear from the literature that authors identify that having a Smart City framework or model is important (Table 2.1). It is like having a map for a city.

Frameworks and models are being used for different purposes in smart cities, based on what they want to achieve. Frameworks are also being used to measure and evaluate the effectiveness of smart cities in terms of their success factors or Key Performance Indicators (KPIs). Dameri and Rosenthal-Sabroux (2014) state that when components are used descriptively in a framework, it makes it easier to show different benefits and value according to each measured KPI.

The process for the SLR was based on the Centre for Reviews and Dissemination (CRD) book at the University of York (CRD, 2009). The CRD is used as a practical guide, especially in health research and health technology institutions, to encourage high standards in conducting reviews. The following set of criteria from CRD (2009) was selected and used to guide the SLR process in this study as follows:

- Review questions/objectives for the search;
- Inclusion and exclusion criteria and the process followed;
- Studies selected as part of the final list for review;
- Identification of the research evidence;
- The synthesis of the data and keywords;
- The data extracted from the studies; and
- Dissemination of the data.

Review questions/objectives for the search

The review objectives which formed part of the SLR for this study were the first three research objectives as follows:

RO_1 - Identify the success factors of a Smart City.

RO_2 - Analyse existing frameworks and models for smart cities.

RO_3 - Identify the stakeholders for smart cities.

Inclusion and exclusion criteria and the process followed

The list of articles, papers, books, white papers, reports and other documents were added to the Mendeley reference manager database within the folder named "*PhD Proposal and Thesis*". The journal articles, conference papers and reports were selected from Google Scholar, Google, Web of Science (WoS) and Research Gate. The books used in the list of references were either referred to from Google books and the Sage research methods database. The studies considered for the SLR were those added to the Mendeley database between September 2017 to August 2019 and with a publication date between 2011 and 2018. The date range for the SLR was selected since it was shown by Mora et al. (2017) that Smart City research started to boom from 2010 onward.

The initial search included broader terms based on RO_1 and RO_2 related to Smart City factors and Smart City frameworks and models. The keywords searched includes phrases such as: "smart city frameworks", "models", "smart city dimensions", and "factors".

Figure 2.4 shows the summary of the selection process steps followed for the relevant SLR in this chapter.

The preliminary selection process steps of the SLR were as follows:

1) Identified 196 relevant studies;
2) Removed a total of 176 studies;
3) 20 core/foundational studies remained;
4) Removed an additional five studies not related to the Smart City framework and models analysis, leaving 15 studies remaining for deeper analysis (n = 15).

In Step 2, the 176 studies removed included 133 that on closer examination were not directly related to Smart City frameworks or models that considered either factors, dimensions, goals or stakeholders. A further 43 documents were then removed which included white papers, reports, bulletins and forums.

The next set of the selection process steps constituted the four main parts of the SLR as follows:

5) Part 1: Seven of the 15 studies identified were Smart City frameworks or models and were used as foundational studies for the SLR (n=7);

6) Part 2: The 15 studies formed the comparison of dimensions and factors of smart cities (n=15);
7) Part 3: A comparison and classification of stakeholder roles and types based on the 15 studies from Step 4 (n =15);
8) Part 4: Removed two more studies (that had no additional factors) from the 15, leaving 13 remaining for the detailed comparison of factors (n =13).

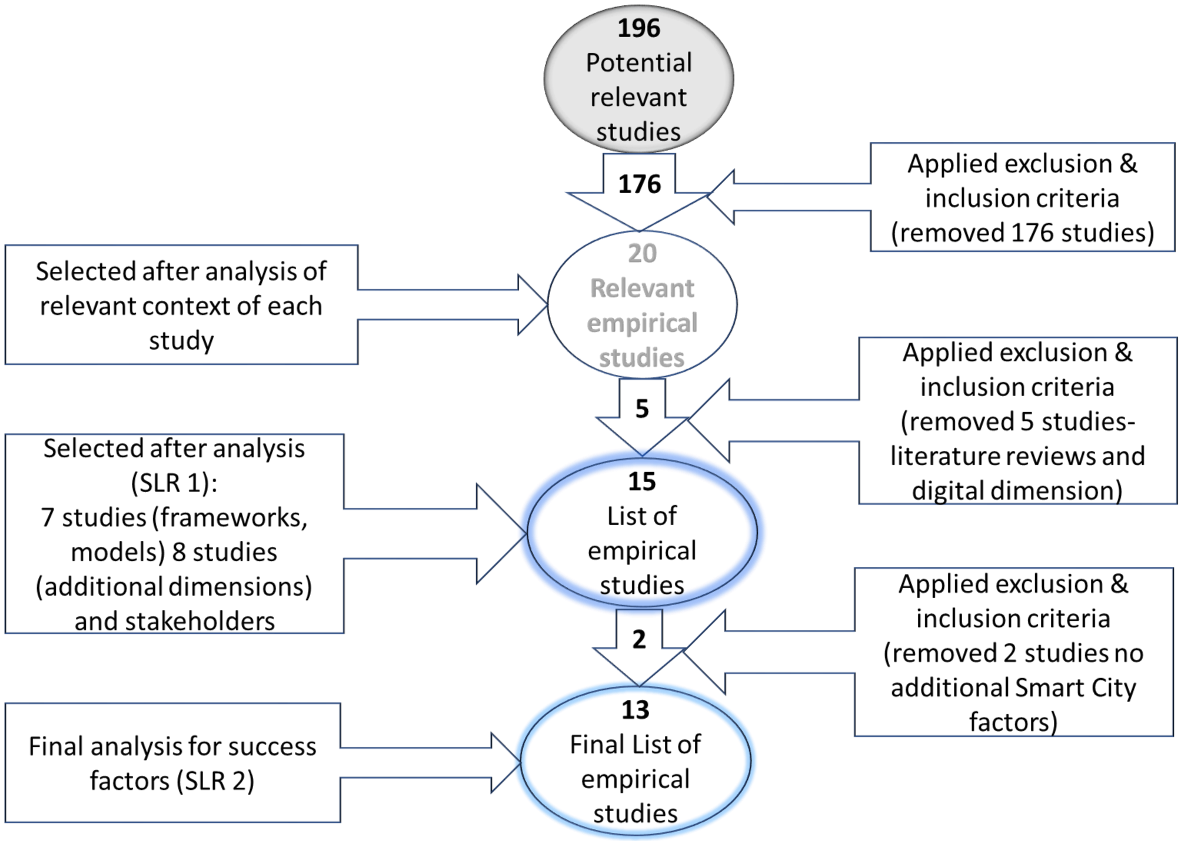

Figure 2.4: SLR Selection Process (Author's own construct)

The first five study removed in Step 4 was that of Giffinger et al. (2007), since although it was classified as the foundational study of Smart City dimensions it was found that in Giffinger (2011) the dimensions and related factors were updated and therefore the 2007 study could be removed from the list. The next two removed were those of Albino et al. (2015) and Cocchia (2014) as these two studies were classified as extensive literature reviews of smart cities. Joshi et al. (2016) was the next one removed, since even although their study focused on a conceptual framework it is a literature review of other studies investigating domain-related Smart City initiatives. Jucevičius et al. (2014) was also removed as their study addressed the digital dimension, which is used to refer to the overall digital data component in this research.

From the list of remaining 15 studies, seven of these (Alawadhi et al., 2012; Balakrishna, 2012; Calderón et al., 2017; Hamzah et al., 2016; Huovila et al., 2016; Manupati et al., 2018; Wendt & Dübner, 2017)[1] were based on Smart City frameworks or models and therefore used as the foundational studies of the SLR on Smart City framework analysis. They are summarised in Table 2.1. The other eight studies (Garg et al., 2017; Giffinger, 2011; Kassen, 2017; Khatoun & Zeadally, 2016; Nam & Pardo, 2011a, 2011b; Spaans & Waterhout, 2016; Yadav et al., 2017) from the remaining list of 15 studies were part of the comparison of dimensions in Table 2.4. The analysis of the eight studies plus the seven frameworks/models were added to Table 2.4 and revealed that they applied or used Smart City dimensions empirically.

Studies selected as part of the final list for review

In Step 4, another two studies (Balakrishna, 2012; Hamzah et al., 2016) were removed from the list of 15 studies as they did not add or contribute to additional factors other than those proposed by Giffinger (2011).

Identification of the research evidence

Therefore, only 13 empirical studies remained and formed part of the SLR for Smart City factors per dimension; these are summarised in Table 2.5.

The synthesis of the data and keywords

Using the final list of studies (Steps 1 to 4), a more detailed analyses of each study was conducted. For example, if the term 'factor' was searched and found within a document; then the context in which the factor is used and the type of factor was determined before adding or confirming it as an existing factor or a new factor related to one of the nine Smart City dimensions. The details of the SLR findings are discussed in Section 2.4 and Section 2.5.

The data extracted from the studies

Nine dimensions (Table 2.4) were found to be prominent within smart cities, and 39 factors (Table 2.5) related to these nine dimensions were identified from the 13 studies. Further extraction of data took place, and based on RO_3 the stakeholder roles and types within a Smart City were identified, as indicated in Table 2.2.

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[1]Wendt & Dübner (2017) was added here as a snowball study form reviewing current literature, and was excluded from the analysis reported on and published in the ICTAS conference proceedings (refer to Appendix B).

The stakeholder types were classified from 14 of the 15 studies (Table 2.2), since Giffinger (2011) was removed as no stakeholders were classified in this study. However, another study, Monzon (2015), was added as a snowball study identified in current studies from the list and was added to Table 2.2 as both public, and private investors were classified as stakeholders in a Smart City. Therefore, 58 stakeholder types were identified from the 15 studies in Table 2.2.

Four major stakeholder roles were identified by Mayangsari and Novani (2015) and these were therefore used as the foundational study from which to compare the 15 studies identified in Part 3 of the SLR. This comparison revealed 58 stakeholder types, which were then reduced to 30 (Table 2.3). The explanation of how the 58 stakeholder types were reduced to 30 stakeholder types is provided in Section 2.5.1.

Dissemination of the data

Some of the SLR results were published and received well by an international audience (Section 6.8). The publications were all peer-reviewed and included conference papers, journal papers and book chapters.

2.4 Systematic Literature Review Findings on Smart City Frameworks and Models

The following discussions are based on the seven Smart City frameworks listed in Table 2.1 and follow the chronological order of the table. Each framework is discussed to show the Smart City aspects that were addressed in these studies.

Table 2.1: Analysis of Smart City Frameworks and Models (Author’s own construct)

Author		Description	Contribution	Method	Country/ Continent
1.	Alawadhi et al. (2012)	Smart City Initiative Framework: focusses on building an understanding of concepts and factors for a Smart City’s initiatives.	A systematic understanding of Smart City initiatives.	Semi-structured interviews	North America: United States; Canada; Mexico
2.	Balakrishna (2012)	Mobile Sensing-based Smart City Framework: focusses on identifying the critical role of IoT (mobile phone sensors) and data analytics	Conceptual Mobile Sensing-based Smart City Framework.	Literature Review	European perspective
3.	Hamzah et al. (2016)	The Reconciled Smart City Assessment Framework (RSCAF): considers the stakeholder and citizen requirements vs the planned Smart City initiatives to determine the gaps and thus showing the smartness ideal for a city.	An assessment framework to assess a city’s smartness with regard to the development initiatives (actual vs ideal).	Questionnaire survey	Malaysia
4.	Huovila et al. (2016)	Citykeys Performance Management Framework consist of the ultimate goals and KPIs needed to be considered within a city, namely; people, planet, prosperity and governance.	Prototype performance measurement tool.	Survey	Partner countries: Finland, Austria, Netherlands, Croatia and Spain
5.	Calderón et al. (2017)	Determined the state of smart cities in Latin America and the Caribbean (LAC) areas (most of which are developing countries) and found that if cities apply ICT solutions to the six dimensions, it would be considered a Smart City.	State of smart cities development and its technical readiness in the LAC region.	Survey	Latin America
6.	Wendt and Dübner (2017)	SMARTER TOGETHER Project: focus on stakeholder and citizen engagement to form stronger partner networks between different cities in Europe. Their process is to establish co-creativity of knowledge exchange for all relevant stakeholders.	Envisioned contribution, to use the project as a tool amongst cities involved in Smart City projects.	Reporting questionnaire	European cities in France, Germany and Austria
7.	Manupati et al. (2018)	Seven Pillar Hierarchical Framework: a guide for policy decision makers in their urban renewal process of decision making.	Criteria for urban renewal and the cause and effect relationship among the identified criteria and sub-criteria.	Questionnaire	Southern India

Alawadhi et al. (2012) refer to a Smart City initiative framework (Figure 2.5) from the study of Chourabi et al. (2012) with eight factors. The framework consists of three core factors, namely technology, policy and organisation. The other five factors are the natural environment, Smart Governance (citizen involvement and transparency), economy, built infrastructure and people and communities.

Regarding people and communities, social and human capital is a core component and factor of smart cities. The framework shows the relationships and influences between the eight factors by using a double-headed arrow as a two-way impact on a Smart City initiative. These factors are sometimes referred to as dimensions in other studies and are discussed in more detail in Section 2.6. This study was done in three cities in developed countries (North America, Canada and Mexico). Alawadhi et al. (2012) used semi-structured interviews with stakeholders involved in Smart City initiatives to gain a qualitative understanding of the concepts and factors that characterise Smart City initiatives.

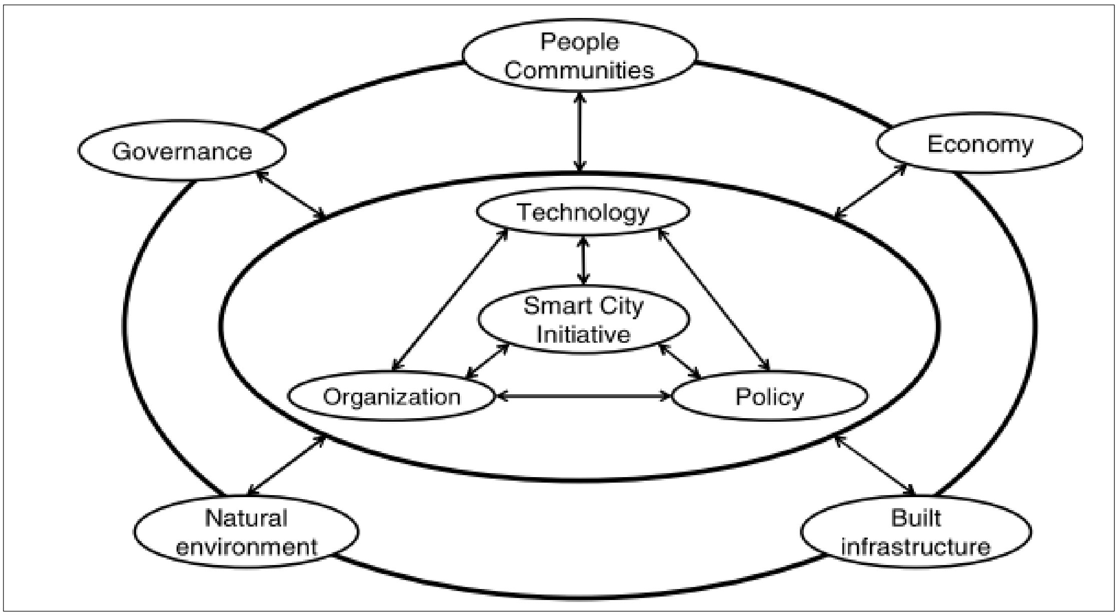

Figure 2.5: Smart City Initiative Framework (Alawadhi et al., 2012)

Balakrishna (2012) proposed a three-plane conceptual Smart City framework based on a study done in Europe, which focused on the mobile technology perspective of a Smart City (Figure 2.6). This framework focusses on identifying the critical role of mobile phone sensors in a Smart City. The three-plane Smart City framework has three main components, namely:

- The Gather plane – focusses on learning about the physical world information by using mobile sensing devices and other portable and wearable sensors based on Radio Frequency Identification (RFID) tags;
- The Share plane – focusses on sharing and collecting data; and
- The Govern plane – governs the creation of smart services and applications that can help govern a Smart City agenda.

The Gather plane focusses on the strength of mobile devices being connected to the mobile cloud. It is allowing the ability to collect large-scale sensor data which is then refined and disseminated through mobile applications. It enables knowledge engineering; which is the approach to make sense of real-world data and thus is used to add smartness to the applications and services.

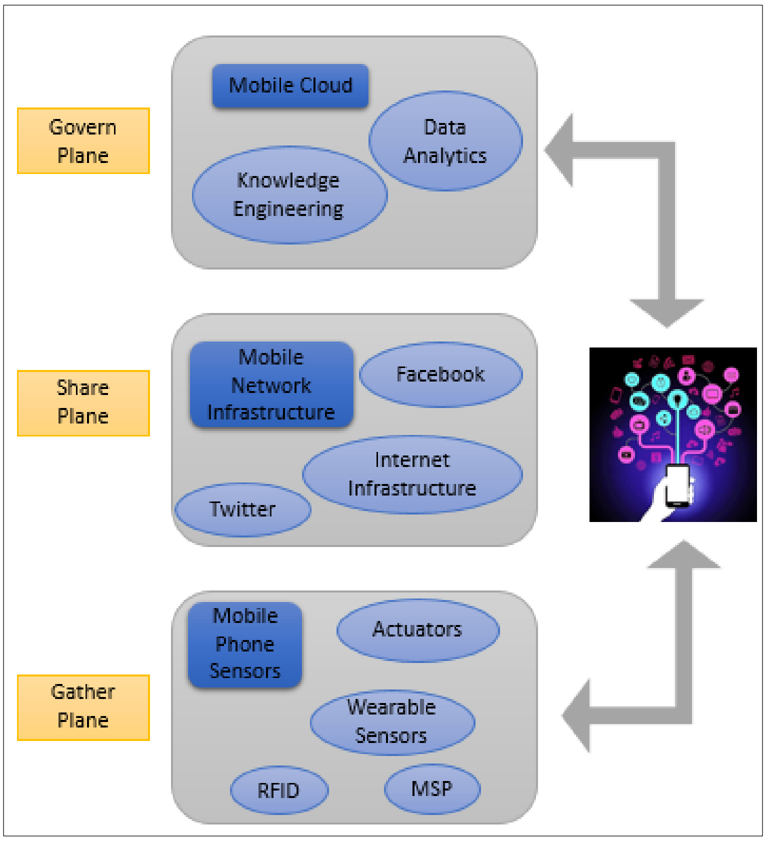

Figure 2.6: Mobile Sensing-based Smart City Framework (Balakrishna, 2012)

Frameworks are also used to show how to measure a Smart City's actions and to apply KPIs to check its effectiveness. A measurement framework called The Reconciled Smart City Assessment Framework (RSCAF) was proposed by Hamzah et al. (2016) to measure and determine the gap between what a Smart City wants to achieve against what the Smart City achieved (Figure 2.7). This study highlights the importance of including in this framework, the stakeholder and citizen requirements by using a questionnaire.

The RSCAF framework includes the six dimensions from Giffinger et al. (2007), the city's main function, the city's planned smart initiatives, the city's stakeholders, the actual requirements and on-the-ground smart initiatives. The city's main function is used to determine a working Smart City initiative for a city and is unique to each city. The gap that is determined through the measurement of the city's smartness ideal and the city's smartness actual achievement allows for the city to identify what they need to improve to become a smarter city according to its main function.

The RSCAF framework (Figure 2.7) consists of the smartness ideal, which is the process used to determine a Smart City ideal (Hamzah et al., 2016). The smartness ideal consists of the planned or vision-based Smart City initiatives (PSCI), by using a questionnaire to examine the city's stakeholders Actual or Needs-based Smart City Requirements (ASCR). The questionnaire consists of Likert scale ratings so that the stakeholders can rate their satisfaction of the PSCI as this also helps to identify the stakeholders' expectation levels. An analysis was completed based on the results from the ASCR to indicate the Smart City Ideal (SCI). The smartness actual is also determined from the questionnaire results indicating the city's current smartness level. The difference between the smartness ideal and the smartness actual is calculated to determine the gap of a city's smartness. The on-the-ground data can include initiatives which may have been planned or new initiatives.

Hamzah et al. (2016) say that these on-the-ground initiatives can be identified and determined through site visits, photograph documentation, field notes, etc., and this process is part of document analysis (Bowen, 2009).

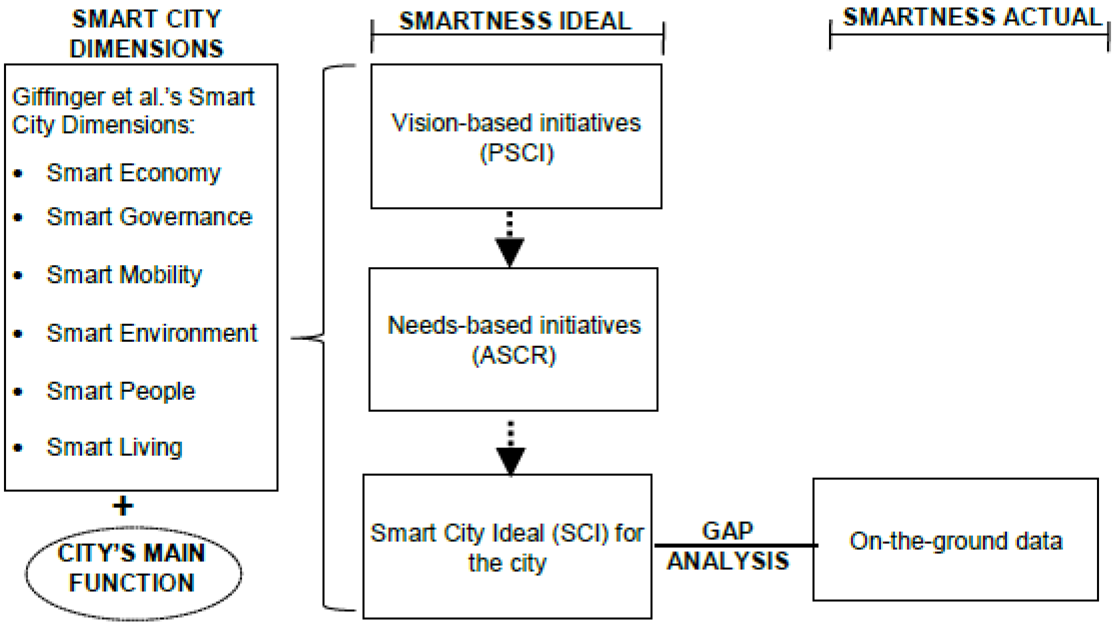

Figure 2.7: The Reconciled Smart City Assessment Framework (RSCAF) (Hamzah et al., 2016)

A more recent framework was proposed by Huovila et al. (2016) is the Citykeys Performance Measurement Framework (Figure 2.8); which will be referred to as Citykeys. The term Citykeys is based on the development of KPIs that are used to measure the city's performance. The Citykeys framework was co-designed as a project by five smart cities (Rotterdam, Tampere, Vienna, Zagreb and Zaragoza) in Europe. An additional 30 European cities and other partners helped by being actively involved in the project workshops and by giving feedback on draft project reports. The framework allows for cities to monitor and compare the implementation of all the Smart City solutions within the project. The aim of the project is for all the participating cities and stakeholders to learn and benefit from each other's solutions; these lessons can form part of assessments for projects in cities. The assessments include measurements and KPIs for short term progress that are based on the impact indicators such as reduced energy consumption.

The Citykeys framework consists of Smart City ultimate goals which include improving the quality of urban life and low carbon, resource-efficient cities. The ultimate goals are supported by Smart City intermediate goals that are (Huovila et al., 2016):

- People: improving the quality of life of its inhabitants, commuting workers and students, and other visitors;

- Planet: significantly improving its resource efficiency, decreasing its pressure on the environment and increasing resiliency;
- Prosperity: building an innovation-driven and green economy; and
- Governance: fostering a well-developed local democracy.

The Citykeys framework is seen from a project view where the project is integrated and is a co-creation with citizens and other end-users. The Citykeys mission consists of the Performance Measurement Framework that is used for monitoring and comparing the implementation of Smart City solutions. It is where the cities involved in the project can learn from each other, create trust in solutions and monitor progress. The beneficiaries that form part of the projects are the cities, solution providers (gives insight into business opportunities), and industrial stakeholders (they give recommendations for needed new businesses).

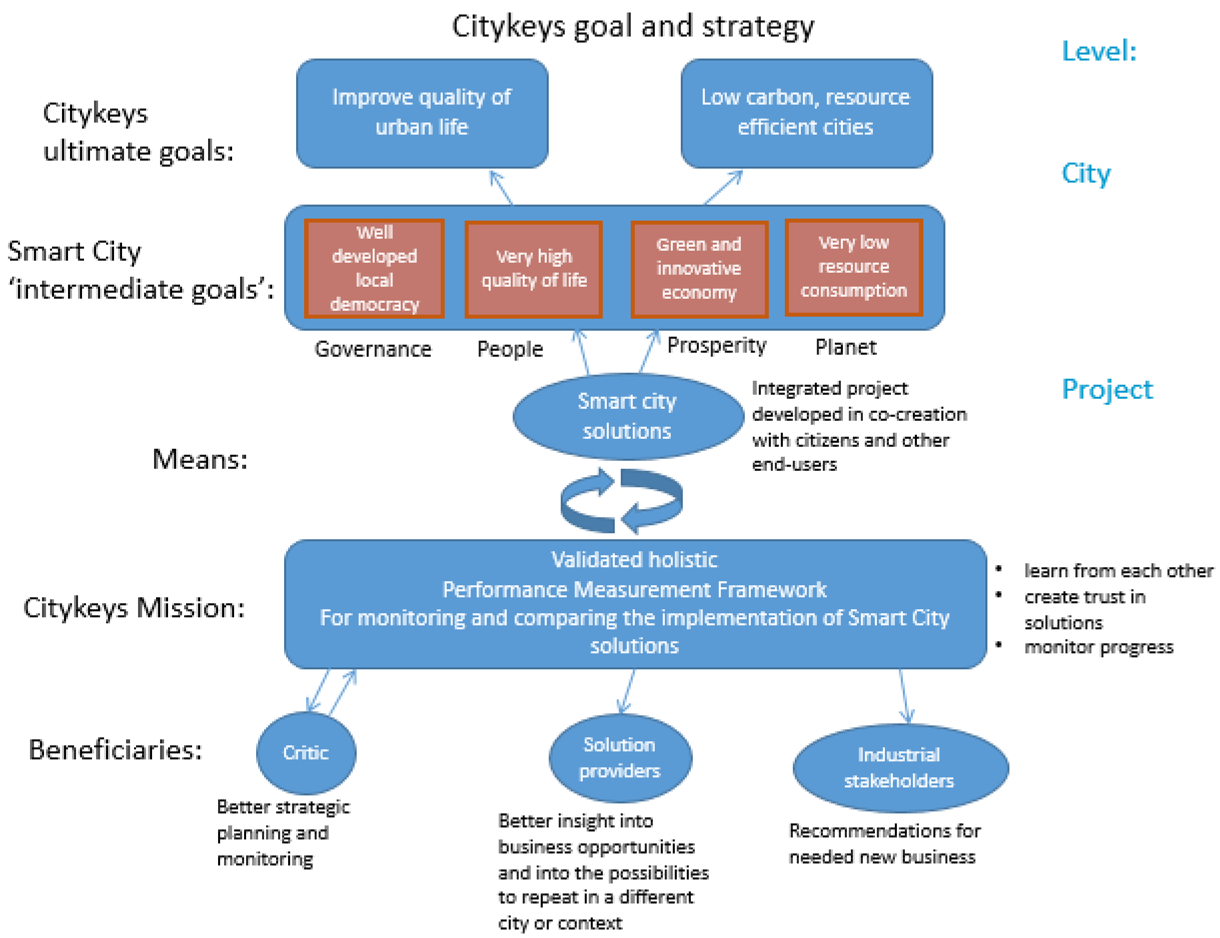

Figure 2.8: Citykeys Goals and Strategy (Huovila et al., 2016)

The next study that proposed recommendations about domain specific modelling for smart cities is Calderón et al. (2017) and was done in Latin America and Caribbean cities where they used the six dimensions from Giffinger et al. (2007) and Giffinger (2011). A survey was used to determine the state of smart cities development and the technical readiness of these cities (Calderón et al., 2017). They first established a list of determinants from literature for a city, to be considered and labelled as ‘smart’. It was found that if a city applies ICT based solutions to all six dimensions, it would be considered a Smart City.

Wendt and Dübner (2017) focused their study on the integration of several Smart City factors to achieve smart and integrated solutions for low energy districts, sustainable mobility, integrated ICT infrastructures and citizen engagement. The study was done in three cities in Europe, namely; Lyon, Munich and Vienna, which are all in developed countries. The project established from the study by Wendt and Dübner (2017) is called SMARTER TOGETHER.

The project is an online representation of the three cities frameworks, which include the methods and processes for each of the Smart City factors that form part of the integrated solution for SMARTER TOGETHER. Their process is refined to establish co-creativity of knowledge exchange within and between these cities and regional administrations and all relevant stakeholders. They wanted to create and share knowledge amongst these cities as a creation of value and to propose the established methods and processes from their study as transferable to other cities. The reported benefit was stronger partner networks between these cities. One shortcoming from their study was the high reporting efforts and requirements to capture and collate the data about the three cities.

Manupati et al. (2018) proposed a Seven Pillar Hierarchical Framework (Figure 2.9) for the evaluation of urban renewal in Southern India, a developing country. The framework was created to help policy decision makers in their urban renewal process. Through their study, a set of criteria and sub-criteria were identified to help guide these decision makers. The framework consists of seven pillars, which are based on three KPIs that were identified from a socio-technical theoretical perspective. These seven pillars are the main criteria, which are the dimensions in the study. The seven main criteria are divided into 27 sub-criteria, that were used as part of the evaluation process in the questionnaire of their study.

The seven dimensions (criteria) are economic conditions, infrastructure, utilities, social framework, business, governance and sustainable environment. Five out of the seven dimensions are similar to the dimensions discussed in Table 2.5, except for utilities and social framework. The three KPIs in the study were:

- Quality of life: described as urbanisation being characterised by a higher quality of life with better facilities when compared to rural areas, therefore ‘quality of life’ can be considered a metric to measure urbanisation in a developing country;
- Economic opportunities: consist of economic order (opportunities available to do business, i.e. ease of doing business) and business models (ownership and financing structures) in a city, therefore this KPI is used to assess urban planning a renewal; and
- Sustainable development: involves actions to achieve the global goals (eliminate poverty, take corrective actions towards the environment and ensure that all people enjoy comfort and peace) set out by the United Nations (2015). Therefore, this KPI is becoming a mandatory performance measure in smart cities.

The seven dimensions that were addressed in the questionnaire of Manupati et al.'s (2018) study consisted of sub-criteria for each dimension, as indicated below:

- Economic Conditions: ease of doing business, livelihood opportunities for all, and skills development;
- Infrastructure: robust Information Technology (IT) infrastructure, industrial zoning, commercial real estate, and public transport;
- Utilities: power and gas, telecommunication network, access to water and sanitation;
- Social Framework: residential real estate, affordable housing, community service, disaster management, and affordable education and healthcare;
- Business Models: public-private partnership, service monetisation, municipality finance;
- Governance: efficient operations, service level promises, regulatory framework, inclusive growth, simpler organisation structure, autonomy to the local-self government; and
- Sustainable Environment: green cover, pollution tracking strategies and waste treatment facilities.

The study by Manupati et al. (2018) illustrated that the KPIs and the criteria should be incorporated into the city planning process. Their results from the questionnaire showed the influences amongst certain criteria, but more importantly that the economic conditions and the sustainable environment criteria influenced all the other criteria in the framework. Their results indicated that the development of a sustainable environment is one of the most preferred criteria of urban renewal and that all the other criteria can be regarded as the causes of urban renewal.

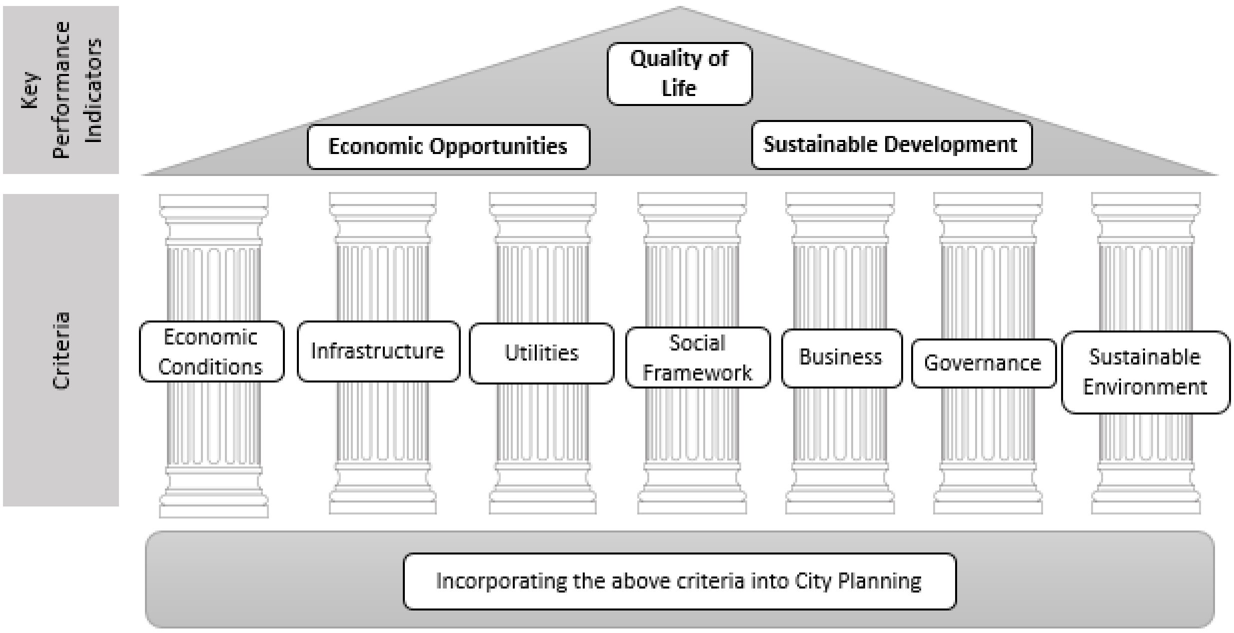

Figure 2.9: Seven Pillar Hierarchical Framework (Manupati et al., 2018)

2.5 Systematic Literature Review of Stakeholders in Smart Cities

Stakeholders have been identified as a common and important factor amongst many Smart City studies. Stakeholders were categorised under the Smart People dimension in many of the studies shown in Table 2.2. The stakeholder types and roles should be considered at the beginning and planning stages of any such initiatives. It is therefore important in this study to identify the key stakeholders that should be part of a Smart City's initiative.

2.5.1 Stakeholder Roles and Types

Four key roles for stakeholders, that focus on serving within the city to achieve the city's shared goals were established by Mayangsari and Novani (2015). The roles were created to incorporate all relevant stakeholders, including governments, business sectors, civil society, academics, technical experts, and citizens. These roles are:

- **Enabler** – Enablers create a vision, allocate resources, provide strategic leadership, and promote networking;
- **Provider** – Providers engage academics and professionals as innovators, provide innovative research and design (R&D) methods, augment knowledge and manage knowledge distribution systematically;
- **Utiliser** – Utilisers create suitable products and services, set small-scale objectives derived from the vision, learn new practices to produce accessible knowledge and innovate; and
- **User** – Users participate in experiments, empower citizens through co-creation and produce place-based experience.

The 58 relevant stakeholder types found within each of the 15 studies reviewed in the SLR are shown in chronological order in Table 2.2. Nam and Pardo (2011a) identified that to have a demand-focused Smart City initiative is of utmost importance to involve stakeholders as this involvement often leads to successful innovative solutions. Nam and Pardo (2011b) state that considering stakeholders such as citizens, end-users, IT experts and policy experts is key to the architecture of a Smart City.

Furthermore, Alawadhi et al. (2012) in their study showed evidence that the interviewees said that if a city wants to know their people better, that they should understand the needs and wants of all stakeholders by involving those stakeholders in Smart City initiatives. The interviewees also said that involving all stakeholders will improve the citizen-government relationship. They reported six stakeholders, namely governments in other jurisdictions, non-profits, companies, schools, universities and citizens. Balakrishna (2012), on the other hand, identified five stakeholders, namely, users, the public, administration, vendors and government. Monzon (2015) agreed that all investors (public and private) are important stakeholders in a Smart City.

Residents and workers are the stakeholders found in the study by Hamzah et al. (2016). Huovila et al. (2016) recognise that citizens are key to be engaged in a Smart City project to establish their needs, but also identifies industrial stakeholders as important as the study reported that these stakeholders make the recommendations needed for new businesses. An assessment framework is regarded as important for a Smart City but should consider the strategy as well as the interests of all relevant stakeholders (Khatoun & Zeadally, 2016).

Spaans and Waterhout (2016) identified the task to create a resilient city, requires stakeholders such as public government, Non-Governmental Organisations (NGOs), private companies, as well as individual citizens. Calderón et al. (2017) reported three stakeholders as the citizens, government, and businesses as important in a Smart City and that a significant challenge faced by smart cities is to efficiently articulate the relationship between the key stakeholders and the city management (Calderón et al., 2017).

Garg et al. (2017) state that the perspective of stakeholders such as individuals, data controllers, data processors, and third parties are important to big data privacy approach and can be classified under the Policy dimension (D7). Kassen (2017), on the other hand, addressed the open data phenomena and identified the key stakeholders of an open data movement to brainstorm innovative ideas. These stakeholders could be independent developers, technically savvy citizens, academic communities, or non-governmental organisations. Open data is part of smart cities, and it can be argued that Smart City stakeholders should include stakeholders from open data projects (Kassen, 2017).

Yadav et al. (2017) identify that stakeholder participation is key to address Smart City challenges. They also indicate that city managers and government must provide accessibility and interactions for users like developers and citizens to understand the open data datasets. They can help identify ways toward sustainable open data systems. Manupati et al. (2018) agree with Yadav et al. (2017), that citizens and government are key stakeholders in a Smart City. Interestingly enough, amongst all the studies, common stakeholders are recognised, yet different studies refer to the same stakeholders using different terms.

Table 2.2: Stakeholder Types (Author's own construct)

Empirical studies		Stakeholder types (n=58)
1.	Nam and Pardo (2011a)	• Governments • Firms • Non-profits • Citizens
2.	Nam and Pardo (2011b)	• End-users • IT experts • Policy/service domain experts • Public managers
3.	Alawadhi et al. (2012)	• Governments in other jurisdictions • Non-profits • Companies • Schools • Universities • Citizens
4.	Balakrishna (2012)	• Users • Public administration • Vendors • Government
5.	Monzon (2015)	• Investors (public and private)
6.	Hamzah et al. (2016)	• Residents/Citizens • Workers
7.	Huovila et al. (2016)	• Citizens • Industrial stakeholders
8.	Khatoun and Zeadally (2016)	• Performance evaluators
9.	Spaans and Waterhout (2016)	• Public government • Private companies • NGOs • Citizens
10.	Calderón et al. (2017)	• Citizens • Government • Businesses
11.	Garg et al. (2017)	• Individuals • Data controllers • Data processors • Third parties
12.	Kassen (2017)	• Public officials • Independent developers • Technically savvy citizens • NGOs • Academic communities • Media communities
13.	Wendt and Dübner (2017)	• Industrial players • Business players • Dynamic small and medium-sized enterprises (SMEs) • Building owners • Universities • Research & technology organisations • Major standardisation institutes • Government • Citizens • Local experts • External domain experts
14.	Yadav et al. (2017)	• Citizens • City managers • Developers • Governments
15.	Manupati et al. (2018)	• Citizens • Government

An analysis of the definitions, taken from Mayangsari and Novani (2015) of the types and roles was conducted and each stakeholder type was classified according to the most relevant role. The initial list of 58 stakeholder types was reduced to 30 overall stakeholder types across the 15 studies and the four stakeholder roles (R1 to R4). For example, company types such as private, public, firms and small and medium-sized enterprises (SMEs) were combined into one type.

Table 2.3 provides the classification of Smart City stakeholders based on their roles. It is important to note the two stakeholder types (city mayor, think tanks/incubators) are in italics, since these are not from Table 2.2 but taken from the Mayangsari and Novani (2015) study as equally important stakeholders required for this study. Citizens as a stakeholder type were reported amongst 11 of the 15 studies, making this the most popular type identified. Six studies reported government and four studies reported companies both as important stakeholder types to consider in a Smart City. It is clear that when a city wants to co-create smart solutions that have value to the stakeholders, that many different types of stakeholders have to be considered. Wendt and Dübner (2017) had the highest number of stakeholder types (n=11) across all four stakeholder roles.

Table 2.3: Smart City Stakeholder Classification (Author's own construct)

Stakeholder Roles (Mayangsari & Novani, 2015)		Stakeholder Types		Nam and Pardo (2011a)	Nam and Pardo (2011b)	Alawadhi et al. (2012)	Balakrishna (2012)	Monzon (2015)	Hamzah et al. (2016)	Huovila et al. (2016)	Khatoun and Zeadally (2016)	Spaans and Waterhout (2016)	Calderón et al. (2017)	Garg et al. (2017)	Kassen (2017)	Wendt and Dübner (2017)	Yadav et al. (2017)	Manupati et al. (2018)	Total number of studies per type
R1	Enabler	T1	*City Mayor*/Managers														x		1
		T2	Government	x			x						x			x	x	x	6
		T3	Governments in other jurisdictions			x													1
		T4	Businesses										x			x			2
		T5	Public administration (managers)		x		x												2
		T6	Public government (state owned organisations)									x							1
		T7	Performance evaluator/Standardisation institutes								x					x			2
		T8	Policy/service domain expert		x											x			2
		T9	Building owners													x			1
		T10	Public officials												x				1
R2	Provider	T11	Research/Design and Technology organisations													x			1
		T12	Schools			x													1
		T13	Universities (Academic communities)			x									x	x			3
		T14	Third parties											x					1
		T15	Data processors											x					1
		T16	Data controllers											x					1
		T17	IT experts		x														1
		T18	Local experts													x			1
		T19	Independent developers *(Think tanks/Incubators)*												x		x		2

Stakeholder Roles (Mayangsari & Novani, 2015)		Stakeholder Types		Nam and Pardo (2011a)	Nam and Pardo (2011b)	Alawadhi et al. (2012)	Balakrishna (2012)	Monzon (2015)	Hamzah et al. (2016)	Huovila et al. (2016)	Khatoun and Zeadally (2016)	Spaans and Waterhout (2016)	Calderón et al. (2017)	Garg et al. (2017)	Kassen (2017)	Wendt and Dübner (2017)	Yadav et al. (2017)	Manupati et al. (2018)	Total number of studies per type
R3	Utiliser	T20	Non-profit organisations (NPOs)	x		x													2
		T21	Companies (private-and-public, firms, SMEs)	x		x						x				x			4
		T22	Vendors				x												1
		T23	Industrial stakeholders							x						x			2
R4	User	T24	Citizens (local, national, technical savvy)	x		x			x	x		x	x	x	x	x	x	x	11
		T25	Investors (public and private)					x											1
		T26	NGOs									x			x				2
		T27	Users		x		x												2
		T28	Residents						x										1
		T29	Workers						x										1
		T30	Media communities												x				1
	Frequency count			4	4	6	4	1	3	2	1	4	3	4	6	11	4	2	

2.5.2 Smart City Stakeholder Classification and Value Alignment

While thirteen studies (Table 2.5) proposed dimensions and factors of smart cities, few have indicated how to classify the stakeholders according to the common dimensions (Table 2.4). A Smart City Stakeholder Classification Model is proposed that outlines the common dimensions of smart cities with their related factors and the roles of the stakeholders in these dimensions (Figure 2.10). The model includes the nine dimensions derived in Table 2.4, with example related factors from Table 2.5 for each dimension and maps these to the stakeholder roles derived in Table 2.3.

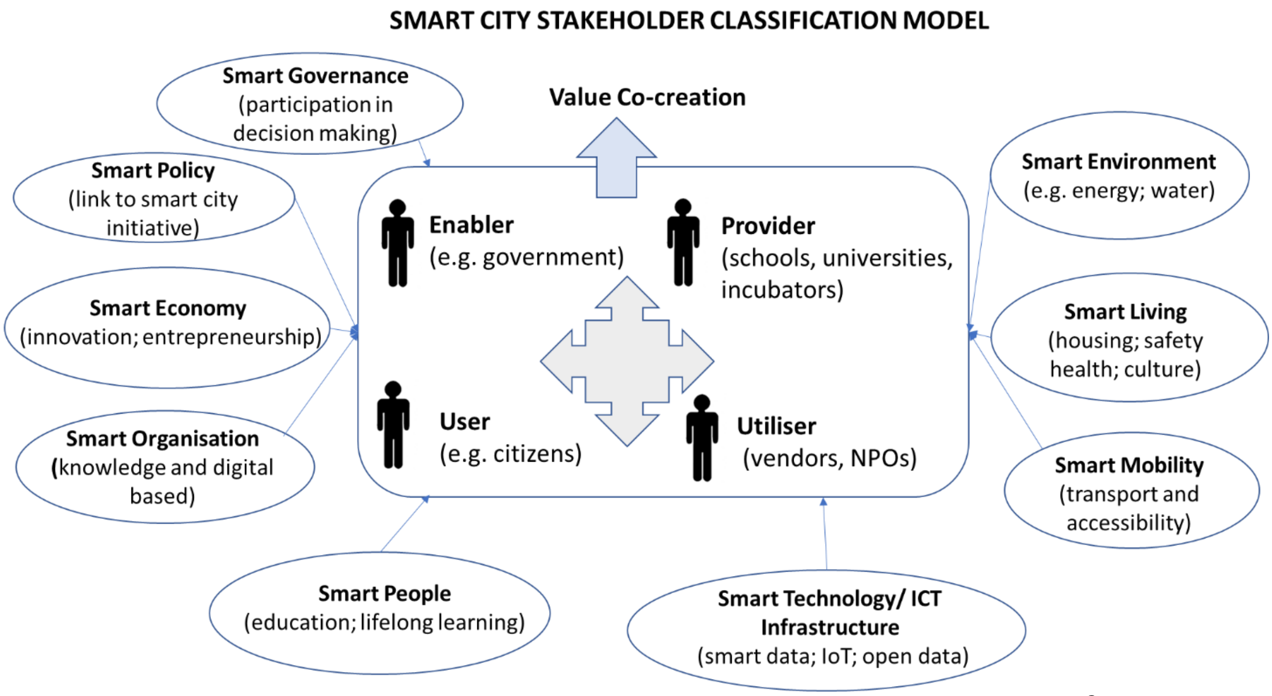

Figure 2.10: A Smart City Stakeholder Classification Model (Author's own construct)[2]

The model is used to show that not only are the dimensions and factors a key aspect of a Smart City, but all stakeholders must be considered in all aspects of a Smart City initiative if a city wants to provide value to these stakeholders. Therefore, the model includes four key stakeholder roles that have been identified as important, namely: enabler, provider, user and utiliser in a Smart City. These roles have been assigned to different types of stakeholders such as government, universities, schools, incubators, citizens and vendors as well as Non-Profit Organisations (NPOs) that are regarded as important in a Smart City.

[2]This figure is reported on and published in the ICTAS conference proceedings (refer to Appendix B)

Studies (Alawadhi et al., 2012; Cocchia, 2014; Huovila et al., 2016; Kassen, 2017) have also shown that a lack of efficient data and information prevents the co-realisation of value or benefits between different stakeholders within a Smart City. The co-creation process for Smart City solutions identified by Wendt and Dübner (2017) reiterates how important the involvement of all stakeholders (industrial and business players to external domain experts) are to achieve Smart City success. The model therefore proposes that, if these stakeholders collaborate and participate in a Smart City's dimensions, value can be created amongst these stakeholders and within the Smart City. Only then will a Smart City be able to identify the value of each dimension in an integrated manner, and therefore align the value of a Smart City as a whole. The co-realisation of the benefits process consists of several phases as discussed by Flak et al. (2015), whereby value is regarded as part of realising benefits.

2.6 Systematic Literature Review of Success Factors and Dimensions of Smart Cities

Table 2.4 provides an analysis of dimensions identified from 15 empirical studies found at the time of the SLR, It includes dimensions from the seven framework/model studies in Table 2.1 and includes additional studies of dimensions applied or referred to as contributors to a Smart City. The 'x' represents the dimensions that are applied or mentioned in the relevant empirical study as a contributor to a Smart City. The studies are listed in increasing chronological order with one study per column. The SLR process identified six common dimensions of smart cities, coded as D1 to D6 in Table 2.4.

These six were first proposed by Giffinger et al. (2007) and updated by Giffinger (2011), and are:

- D1 – Smart People;
- D2 – Smart Governance;
- D3 – Smart Economy;
- D4 – Smart Environment;
- D5 – Smart Mobility; and
- D6 – Smart Living.

These were extended by the three dimensions proposed by Alawadhi et al. (2012), namely:

- D7 – Smart Policy;
- D8 – Smart Organisation; and
- D9 – Smart Technology and-ICT-Infrastructure.

Khatoun and Zeadally (2016) and Calderón et al. (2017) are the only studies from the list that reported findings within the context of all nine dimensions. Smart Economy and Smart Living with 11 studies were the top two dimensions reported. The second-highest dimensions reported were those of Smart People; Smart Policy; and Smart Technology-and-ICT Infrastructure with ten studies reporting on factors for these dimensions within cities. The dimensions that were least reported on within its context of being applied within smart cities are Smart Mobility and Smart Organisation.

The starting point of Part 2 of the SLR was the seven frameworks in Table 2.1. The purpose was to identify the most commonly reported factors and dimensions from literature. A list of 31 factors were reported for D1 to D6 by Giffinger (2011) are shown in Table 2.5. An additional factor was identified by several studies as part of the Smart Environment dimension, namely "Future Proof", which is considered important in this study, and therefore, was added (Alawadhi et al., 2012; Calderón et al., 2017; Huovila et al., 2016; Khatoun & Zeadally, 2016; Manupati et al., 2018; Spaans & Waterhout, 2016).

Table 2.4: Comparison of Dimensions from Giffinger (2011) vs Frameworks and other Empirical studies (Author's own construct)

Dimension (D)		Giffinger (2011)	Nam and Pardo (2011a)	Nam and Pardo (2011b)	Alawadhi et al. (2012)	Balakrishna (2012)	Hamzah et al. (2016)	Huovila et al. (2016)	Khatoun and Zeadally (2016)	Spaans and Waterhout (2016)	Calderón et al. (2017)	Garg et al. (2017)	Kassen (2017)	Wendt and Dübner (2017)	Yadav et al. (2017)	Manupati et al. (2018)	**Total number of studies**	**Total number of studies with factors**
D1	SMART PEOPLE	x		x	x	x	x	x	x		x			x		x	10	8
D2	SMART GOVERNANCE	x		x	x	x	x	x	x		x				x		9	7
D3	SMART ECONOMY	x		x	x	x	x	x	x	x	x		x	x			11	9
D4	SMART ENVIRONMENT	x			x	x	x	x	x	x	x					x	9	7
D5	SMART MOBILITY	x		x		x	x		x		x				x		7	5
D6	SMART LIVING	x		x		x	x	x	x	x	x		x		x	x	11	9
D7	SMART POLICY		x	x	x				x	x	x	x	x	x	x		10	10
D8	SMART ORGANISATION		x	x	x				x		x			x		x	7	7
D9	SMART TECHNOLOGY & ICT INFRASTRUCTURE		x	x	x				x	x	x	x		x	x	x	10	10
Total number of dimensions		6	3	7	7	6	6	5	9	5	9	2	3	5	5	5		

Both Giffinger et al. (2007) and Giffinger (2011) could not collect sufficient data for the following two factors namely "*Ability to transform*" and "*Political strategies & perspectives"*, and therefore, these are excluded from Table 2.5. Balakrishna (2012) and Hamzah et al. (2016) have been excluded from Table 2.5 as they did not show evidence of any specific factors reported in their findings other than that of Giffinger et al. (2007) and Giffinger (2011).

A total of 12 empirical studies was therefore included in the analysis of the 31 factors found by (Giffinger, 2011) plus, the additional seven factors extended by the studies shown in Table 2.5. These seven factors are future proof, the relationship between the Smart City initiative and the city's policy, policy integration, organisational culture, innovative leadership and management, smart technologies, smart data, and available infrastructure (including Built & ICT). Therefore, making it a total list of 39 factors. The analysis shows all the related factors reported on by smart cities across the world within the 12 empirical studies. Calderón et al. (2017) reported, 27 factors, which is the highest number of factors across the nine dimensions. In their study, the application of all the related factors for D2, D5, D6 and D9 were reported for smart cities from Latin America, which are developing countries.

Table 2.5: Smart City Dimensions and Factors (Author's own construct)

Dimension (D)		Factor (F)		Giffinger (2011)	Nam & Pardo, (2011a)	Nam & Pardo, (2011b)	Alawadhi et al. (2012)	Huovila et al. (2016)	Khatoun and Zeadally (2016)	Spaans and Waterhout (2016)	Calderón et al. (2017)	Garg et al. (2017)	Kassen (2017)	Wendt and Dübner (2017)	Yadav et al. (2017)	Manupati et al. (2018)	Total number of studies
D1	SMART PEOPLE	F1	Level of qualification	x		x	x	x	x		x						6
		F2	Affinity to life long learning	x					x					x			3
		F3	Social and ethnic plurality	x			x				x						3
		F4	Flexibility	x													1
		F5	Creativity	x		x		x			x			x			5
		F6	Cosmopolitanism/Open-mindedness	x													1
		F7	Participation in public life and Smart City initiatives	x			x							x			3
		F8	Synergies through partnerships and collaborations	x										x		x	3
D2	SMART GOVERNANCE	F9	Participation in decision-making	x		x	x	x			x				x		6
		F10	Public and social services	x		x	x		x		x						5
		F11	Transparent governance	x		x	x				x				x		5
D3	SMART ECONOMY	F12	Innovative spirit	x		x	x	x	x		x		x	x			8
		F13	Entrepreneurship	x							x		x				3
		F14	Economic image & trademarks	x			x	x					x				4
		F15	Productivity	x			x				x						3
		F16	Flexibility of labour market	x						x							2
		F17	International embeddedness	x			x				x		x				4
D4	SMART ENVIRONMENT	F18	Attractiveness of natural conditions	x			x										2
		F19	Pollution	x				x								x	3

Dimension (D)		**Factor (F)**		Giffinger (2011)	Nam & Pardo, (2011a)	Nam & Pardo, (2011b)	Alawadhi et al. (2012)	Huovila et al. (2016)	Khatoun and Zeadally (2016)	Spaans and Waterhout (2016)	Calderón et al. (2017)	Garg et al. (2017)	Kassen (2017)	Wendt and Dübner (2017)	Yadav et al. (2017)	Manupati et al. (2018)	Total number of studies
		F20	Environmental protection	x			x										2
		F21	Sustainable resource management	x			x	x	x	x	x					x	7
		F22	Future proof				x	x	x	x	x					x	6
D5	SMART MOBILITY	F23	Local accessibility	x							x				x		3
		F24	(Inter-)national accessibility	x							x				x		3
		F25	Sustainable, innovative and safe transport systems	x		x			x		x				x		5
D6	SMART LIVING	F26	Cultural facilities	x							x						2
		F27	Health conditions	x				x	x		x				x	x	6
		F28	Individual safety	x				x	x	x	x				x		6
		F29	Housing quality	x				x	x		x					x	5
		F30	Education facilities	x					x		x		x			x	5
		F31	Touristic attractiveness (smart tourism)	x					x		x				x		4
		F32	Social cohesion	x		x		x	x		x					x	6
D7	SMART POLICY	F33	Relationship between the Smart City initiative and the city's policy		x	x	x		x	x	x	x	x	x	x		10
		F34	Policy integration		x				x								2
D8	SMART ORGANISATION	F35	Organisational culture				x							x			2
		F36	Innovative leadership and management		x	x	x		x		x					x	6
D9	SMART TECHNOLOGY & ICT INFRASTRUCTURE	F37	Smart technologies		x	x	x		x		x			x	x		7
		F38	Smart data		x	x			x		x	x		x	x		7
		F39	Availability infrastructure (including Built & ICT)		x	x			x	x	x			x	x	x	8
Frequency count				31	6	13	18	12	19	6	27	2	6	10	12	10	

Smart People is the first (D1) important dimension, identified by several Smart City studies (Alawadhi et al., 2012; Calderón et al., 2017; Giffinger, 2011; Huovila et al., 2016; Khatoun & Zeadally, 2016; Manupati et al., 2018; Nam & Pardo, 2011a; Wendt & Dübner, 2017). This dimension recognises that people who are stakeholders can contribute to a Smart City's success. Some of the factors related to people are the level of qualification, affinity to lifelong learning, social and ethnic plurality, creativity, and synergies through partnerships and collaborations.

Studies that reported on the Smart Governance (D2) as an important dimension, included factors that drive a Smart City namely: participation in decision making, public and social services and transparent governance (Alawadhi et al., 2012; Calderón et al., 2017; Giffinger, 2011; Huovila et al., 2016; Khatoun & Zeadally, 2016; Nam & Pardo, 2011a; Yadav et al., 2017).

The dimension commonly cited in Smart City studies is Smart Economy (D3) (Alawadhi et al., 2012; Calderón et al., 2017; Giffinger, 2011; Huovila et al., 2016; Kassen, 2017; Khatoun & Zeadally, 2016; Nam & Pardo, 2011a; Spaans & Waterhout, 2016; Wendt & Dübner, 2017). This dimension refers to activities that encourage innovation, entrepreneurship spirit, productivity and international embeddedness.

Seven studies reported about the importance of Smart Environment (D4) as a dimension (Alawadhi et al., 2012; Calderón et al., 2017; Giffinger, 2011; Huovila et al., 2016; Khatoun & Zeadally, 2016; Manupati et al., 2018; Spaans & Waterhout, 2016). The related factors are the attractiveness of natural conditions, environmental protection policies, being able to have sustainable resource management, and making sure that a city is 'future proof'. Having a sustainability strategy to address social-economic, political and environmental aspects of a city will help to contribute. Interestingly, sustainable resource management and a future proof city were reported amongst the same seven studies as important for a Smart City. Spaans and Waterhout (2016) and Stumpp (2013) agree that a sustainable strategy enables an integrated view of socio-economic, political and environmental visions.

Smart Mobility (D5) is the dimension that focusses on factors involving sustainable, innovative and safe transport systems that are accessible locally, nationally and internationally (Calderón et al., 2017; Giffinger, 2011; Khatoun & Zeadally, 2016; Nam & Pardo, 2011a; Yadav et al., 2017).

The sixth dimension (D6) is Smart Living which includes factors such as cultural facilities, health conditions, individual safety, housing quality and education facilities. The Smart Policy (D7) dimension has the highest number of studies (ten) reporting on a single factor for this dimension, where studies considered the importance of a close relationship between the Smart City initiative and the city's policy (Calderón et al., 2017; Garg et al., 2017; Kassen, 2017; Khatoun & Zeadally, 2016; Nam & Pardo, 2011b; Spaans & Waterhout, 2016; Wendt & Dübner, 2017; Yadav et al., 2017). In this dimension (D7), it is also important to have an innovative policy.

The Smart Organisation dimension was identified as the eighth dimension (D8) since organisational culture and innovative leadership and management can influence the success of a Smart City (Alawadhi et al., 2012; Calderón et al., 2017; Khatoun & Zeadally, 2016; Manupati et al., 2018; Nam & Pardo, 2011a, 2011b; Wendt & Dübner, 2017).

The ninth dimension (D9) is Smart Technology and ICT-infrastructure. It refers to the different types of smart technologies that are used in a Smart City; it also involves relating all the data in smarter ways. This is possible when the availability of an ICT-infrastructure is known in a Smart City (Alawadhi et al., 2012; Calderón et al., 2017; Garg et al., 2017; Khatoun & Zeadally, 2016; Manupati et al., 2018; Nam & Pardo, 2011a, 2011b; Spaans & Waterhout, 2016; Wendt & Dübner, 2017; Yadav et al., 2017).

2.7 Technologies and Data

Many drivers exist for smart cities; digital aspects related to technologies and data are included amongst such drivers (Hämäläinen & Tyrväinen, 2018; Ismagilova et al., 2019; Van Den Bergh et al., 2018). Brennen and Kreiss (2014) define digitisation as "*the material process of converting individual analogue streams of information into digital bits*" and digitalisation as "*the way in which many domains of social life are restructured around digital communication and media infrastructures*".

Therefore, based on these definitions, it is clear that digitisation is the process of converting physical data into electronic data and digitalisation includes this process and can be used where aspects of communication and information are required to be improved.

Borgia (2014) highlighted the importance of connectivity to facilitate accurate digital records and states that everyday objects are turned into smart objects when intelligence is put into these objects. Olliero (2017) reported that connectivity was a success factor in a Smart City. Therefore, smart objects are now able to facilitate accurate digital records through the Internet from its physical world and different environments. The connectivity and intelligence of smart objects are related to the concept of the IoT. The IoT is also referred to as an "*emerging paradigm consisting of a continuum of uniquely addressable things communicating with one another to form a worldwide dynamic network*" (Borgia, 2014, p. 1).

IoT is regarded as an enabling technology of big data, however, big data is only valuable once accurate data is produced, which is required for intelligent decision making to contribute to sustainable smart cities (Bibri, 2019). Many smart cities use their technologies for the creation of Smart City applications (Balakrishna, 2012).

To apply and use these technologies, a city needs to customise their envisioned Smart City framework to the needs and vision of the city (Alawadhi et al., 2012; Albino et al., 2015). Research shows that there is still a lack of understanding in the business environment of how to apply the IoT concept (Hwang et al., 2016).

Consideration of technologies in a Smart City is necessary, as the use of technologies is part of the measure of whether a Smart City can operate effectively and efficiently. One example of smart technologies is in smart energy use where it is "*designed for a smart consumer or user - one who is interested, immersed, and engaged in managing their energy demand, and willing and able to embrace new Smart Technologies and strategies to achieve energy-management goals*" (Strengers, 2014, p. 5).

Research shows that in order to create a smart solution in a city, disruptive technologies are needed (Deloitte, 2015). Examples of such technologies are shown in Figure 2.11 and include big data, digital platforms and co-creation.

Data are indicated as a key element of all the technologies in a Smart City (Allam & Dhunny, 2019) and can be used to assess where value can be realised for all stakeholders (European Commission, 2014; Flak et al., 2015).

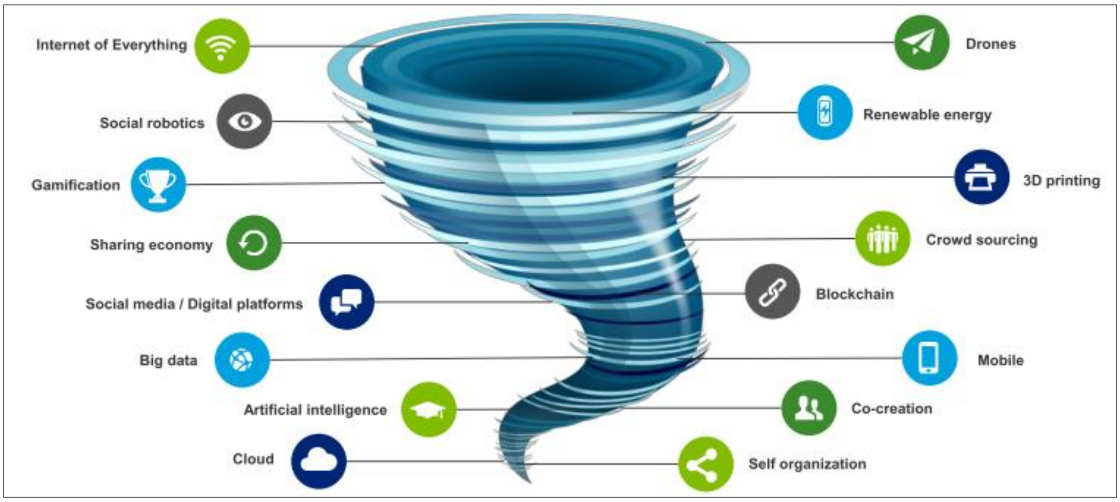

Figure 2.11: Disruptive Technologies for Smart City Innovation (Deloitte, 2015)

It is important to note that the Smart City dimensions and their related initiatives are shown around structures and policies that are required to make sense to a Smart City. Therefore, the following section shows the benefits and challenges of smart cities reported globally.

2.8 Value of Smart Cities

In Section 1.1, it was shown that value can be measured by the importance or usefulness of Smart City initiatives for stakeholder benefit. Constraints or challenges encountered will hinder or reduce these benefits, therefore it is important to identify these potential challenges encountered by previous initiatives. The SLR confirmed the findings in Table 2.5 of the importance of Smart City dimensions as part of a Smart City initiative, and highlighted that measures should be in place to ensure that cities continue to find smarter ways and solutions for dealing with challenges (Albino et al., 2015; Cocchia, 2014). For these reasons, this section reports on some of the main challenges identified in the literature reviewed.

Monzon (2015) identified 29 challenges faced by cities in Europe and 20 challenges faced by South and East Mediterranean cities according to D1 to D6. These are, People, Governance, Economy, Environment, Mobility, and Living. The North Mediterranean Region cities are those located in countries of the European Union.

The developing countries (United Nations, 2020) in the South and East Mediterranean region that have been considered in their study are Morocco, Algeria, Tunisia, Libya, Egypt, Jordan, Israel, Lebanon, Syria and Turkey.

The challenges faced by cities in Europe reported for the six dimensions are as follows (Monzon, 2015):

- People: unemployment, social cohesion, poverty, ageing population, social diversity as a source of innovation, and cyber-security;
- Governance: flexible governance, shrinking cities, territorial cohesion and combination of formal and informal government;
- Economy: unemployment, shrinking cities, economic decline, territorial cohesion, mono-sectoral economy, sustainable local economies, social diversity as a source of innovation, and ICT infrastructure deficit;
- Environment: energy saving, shrinking cities, holistic approach to environmental and energy issues, urban ecosystems under pressure, climate change effects, and urban sprawl;
- Mobility: sustainable mobility, inclusive mobility, multimodal transport system, urban ecosystem under pressure, traffic congestion, non-car mobility, and ICT infrastructure deficit; and
- Living: affordable housing, social cohesion, health problems, emergency management, urban sprawl, safety and security, and cyber-security.

The challenges faced by cities in South and East Mediterranean cities reported for the six dimensions are as follows (Monzon, 2015):

- People: urban poverty and inequality, shortage in access to technology, specific problems of urban youth, threats to cultural identity, and low educational level;
- Governance: low urban institutional capacities, instability in governance, the gap between government and governed, unbalanced geographical development, and a deficit of social services;
- Economy: high infrastructure deficit, shortage in access to technology, economy weaknesses and lack of competitiveness, specific problems of urban youth, and limited urban-based industries, and unbalanced geographical development;

- Environment: a scarcity of resources, water scarcity, climate change effects, pollution, and rapid growth and urban sprawl;
- Mobility: lack of public transport, high infrastructure deficit, pollution, and rapid growth; and
- Living: slum proliferation, urban violence and insecurity, rapid growth and urban sprawl, deficit of social services, threats to urban identity, and urban poverty and inequality.

A study was conducted by Cocchia (2014) of 162 case studies done in different smart cities across Asia, Europe, North America, Middle/South America and Africa. The case studies in Asia, Europe and North America, which are considered developed countries, found that ICT Infrastructure provided the following benefits:

- An increased use of the Internet amongst citizens;
- Affordable Internet becoming available to more citizens that helped overcome the digital divide;
- A focus on e-government services (more relevant in cities in Europe) through data sharing and open data;
- A focus on improved public services and e-services using Web 2.0 technology for public administration;
- A increased innovation and entrepreneurship in order to increase urban wealth; and
- A increased social unity.

The case studies conducted in Middle/South America and Africa (Cocchia, 2014), which are classified as developing countries, according to United Nations (2020) used the ICT Infrastructure to achieve benefits such as:

- Attract foreign investment in order to promote local advantage and to improve cultural, economic and social development;
- Enable service delivery and economic development;
- Enable the transition to a knowledge economy; and
- Focus on ICT access in rural and periphery urban areas.

The cases in Asia, Europe and North America found that the adoption of Green Policies in a city provided benefits such as (Cocchia, 2014):

- Help cities reduce issues around urban crowding, i.e. to reduce pollution;
- Improve urban planning around safety and sanitary conditions; and
- Manage the electricity demand sustainably.

The motivations for green policy adoption found in these case studies amongst cities in Asia, Europe and North America were to achieve the following benefits (Cocchia, 2014):

- Reduce CO2 emissions and greenhouse gases;
- Improve mobility services to reduce traffic congestion and then pollution; and
- Achieve sustainable urban development and a better urban landscape.

2.9 Components of a Theoretical Framework

Kivunja (2018) highlights that a theoretical framework consists of concepts and theories. These are developed from previous 'tested and published knowledge' and it should be used to guide the researcher and can be used as the basis for data 'analysis and interpretation' to express the meanings of the empirical data.

Therefore, based on the explanation of a theoretical framework, it is seen as appropriate when referring to the concepts and theories used to guide the researcher in analysing and interpreting the meanings of the SLR data, to use the term theoretical framework.

This section outlines the theoretical components identified in the SLR reported on in the previous sections (Section 2.3, Section 2.5, Section 2.6). From an analysis of the seven frameworks conducted in Section 2.4 and Section 2.5, it is evident that the first two theoretical components, factors and stakeholders were addressed by each of the seven frameworks to some extent. Several highlighted technology as a success factor (see Smart Technology and ICT Infrastructure dimension in Table 2.5, Section 2.5).

In this study, the theoretical framework consists of five main concepts that were identified in the SLR and contributed to answer the main research question (Section 1.5). These were:

- Success factors linked to dimensions (Section 2.6);
    - Nine dimensions (D1 to D9) and factors (F1 to F39)

- Stakeholder roles and types (Section 2.5);
  - Stakeholder roles are Enabler, Provider, Utiliser and User (Figure 2.10)
  - Types of stakeholders (Table 2.2 and Table 2.3)
- Technology and data (Section 2.7);
  - Digital dimension (Technology/digital must be in every dimension)
- Value;
  - Benefits/value realisation and co-creation (Section 2.5.2); and
- Alignment of value to stakeholders (Section 2.6, Section 2.8).

Therefore, these five concepts are depicted in the theoretical framework as important components that are believed to influence the success of a Smart City project. The theoretical framework is presented in Figure 2.12. The term project is used to refer to a group of initiatives undertaken to achieve a Smart City.

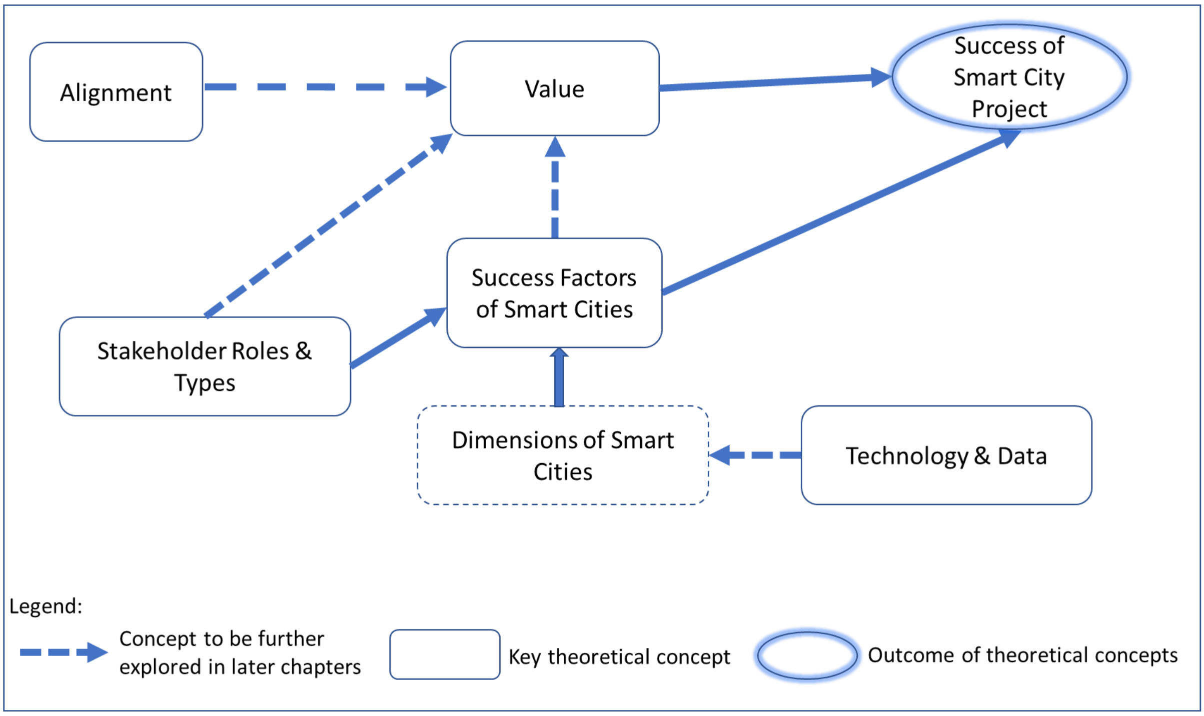

Figure 2.12: Theoretical Framework (Author's own construct)

Table 2.6 provides a summary of the list of success factors for each of the Smart City dimensions identified in Table 2.5. In this study, D1-Smart People and D9-Smart Technology-and-ICT Infrastructure were classified as support dimensions for all the other primary dimensions (D2 to D8).

This classification was based on the similarities with the well-known support activities in an organisation, which include IT and Human Resource Management (Porter, 1985). For this reason, these two dimensions are shaded in grey and shown at the bottom in the table.

Table 2.6: Dimensions and Factors of Smart Cities (Author's own construct)

No	Factors for each Dimension
D2	SMART GOVERNANCE • Participation in decision-making • Public and social services • Transparent governance
D3	SMART ECONOMY • Innovative spirit • Entrepreneurship • Economic image & trademarks • Productivity • Flexibility of labour market • International embeddedness
D4	SMART ENVIRONMENT • Attractiveness of natural conditions • Pollution • Environmental protection • Sustainable resource management • Future proof
D5	SMART MOBILITY • Local accessibility • (Inter-)national accessibility • Sustainable, innovative and safe transport systems
D6	SMART LIVING • Cultural facilities • Health conditions • Individual safety • Housing quality • Education facilities • Touristic attractiveness (smart tourism) • Social cohesion
D7	SMART POLICY • Relationship between the Smart City initiative and the city's policy • Policy integration
D8	SMART ORGANISATION • Organisational culture • Innovative leadership and management
D1	SMART PEOPLE • Level of qualification • Affinity to lifelong learning • Social and ethnic plurality • Flexibility • Creativity • Cosmopolitanism/Open-mindedness • Participation in public life and Smart City initiatives • Synergies through partnerships and collaborations
D9	SMART TECHNOLOGY & ICT INFRASTRUCTURE • Smart technologies • Smart data • Availability of infrastructure (including Built & ICT)

With regards to the Value component, few studies have investigated the need for guidance regarding value alignment amongst stakeholders and none of them comprehensively addressed value alignment in Smart City initiatives. Whilst one study (Wendt & Dübner, 2017) did identify the possibility of gaining value through the establishment of informal knowledge amongst the cities through improved organisational culture, the authors did not include related success factors, nor the alignment thereof.

A study conducted in Bundung in Indonesia proposed the concept of value co-creation from the stakeholder perspective (Mayangsari & Novani, 2015). The Smart City project in Bundung adopted the service science concept to analyse multi-stakeholder co-creation in Smart City management. Mayangsari and Novani (2015) reported that multi-stakeholders should work together to develop common rules and schemes for value co-creation and to deliver activities and services for the benefit of all. Although the concept of co-creation can be linked to that of alignment, Mayangsari and Novani (2015) did not provide a framework of success factors for smart cities, nor do they guide how alignment could be assessed using these factors.

Alawadhi et al. (2012) show that achieving the government's goals and objectives is a critical success factor (CSF) in a Smart City. To achieve these objectives; therefore, Smart City projects should align with the governments' goals and objectives (Alawadhi et al., 2012). One study by Calderón et al. (2017) highlighted the importance of citizens and understanding their concerns, thereby emphasising some consideration of aligning the requirements of all stakeholders, including the citizens. Kassen (2017) emphasised the importance of having government and other key stakeholders (including citizens) collaborate on open data movements to realise important contributions for many aspects in a city or societies.

Alignment of value is explored in more detail in Chapter 4 and the technology and data component in Chapter 5. Since both of these are components in the proposed theoretical framework where it was revealed that there are research gaps.

2.10 Summary

The literature review and the SLR revealed that the success factors of Smart City projects could be viewed in nine dimensions. The first seven dimensions represent the primary dimensions namely: Smart Economy, Smart Governance, Smart Environment, Smart Mobility, Smart Living, Smart Organisation and Smart Policy. The two support dimensions are Smart Technology-and-ICT Infrastructure and Smart People.

A theoretical framework (Figure 2.12) was designed to assist and guide the research and development of the model. One of the components in this framework are the 39 success factors across the nine dimensions (Table 2.6), which can be used as guidelines for planning Smart City projects and or for assessing or measuring the success of these projects. Therefore, the theoretical aspect of RO_1 was achieved.

The analysis of seven foundational studies of frameworks and models for smart cities identified key concepts or components that should be considered; thus meeting the second research objective (RO_2).

The importance of identifying and considering all stakeholders and aligning value amongst them is evident. Therefore, a Smart City Stakeholder Classification Model (Figure 2.10) was proposed that classifies the roles and types of stakeholders, thus meeting the theoretical aspect of RO_3.

The benefits and challenges faced by smart cities were identified in Section 2.8 by a literature review (RO_4). These and the digital activities aspect of RO4 will be investigated in more detail in Chapters 5, 7 and 8.

It is therefore clear that the first four research objectives have been met from a theoretical perspective. The following chapter will present the research methodology and design that was adopted for this study.

Chapter 3 - Research Methodology and Design

3.1 Introduction

The previous chapter laid the foundation of the concepts and field of study for this research. The research objective addressed in this chapter is RO_3**:** *Identify the stakeholders for smart cities*. The process for the participants and cases selection are identified in this chapter.

This chapter describes the resesearch methodology and the research design of this research. Singh (2010, p. 210) states that "*philosophy is a disciplined study of experience*". The philosophy of the research for this study is a pragmatic view (Section 3.2). The mixed methods adopted in this study allows the research study to focus on answering the main research question (Plowright, 2011; Saunders et al., 2009; Saunders & Tosey, 2013).

The Frameworks for an Integrated Methodology (FraIM) was adopted in this study (Section 3.3) and the FraIM structure was followed and applied (Section 3.4) The selected philosophy of this study allowed mixed data collection techniques (Section 3.5) consisting of interviews with the use of a questionnaire template, as well as the analysis techniques required (Section 3.6). The Reliability and Validity of this study and the process of the data collected is regarded as important as part of the research process followed (Section 3.7) as well as the ethical consideration taken when using humans in a research study (Section 3.8). A summary of the research design is provided (Section 3.9). The chapter structure is presented in Figure 3.1.

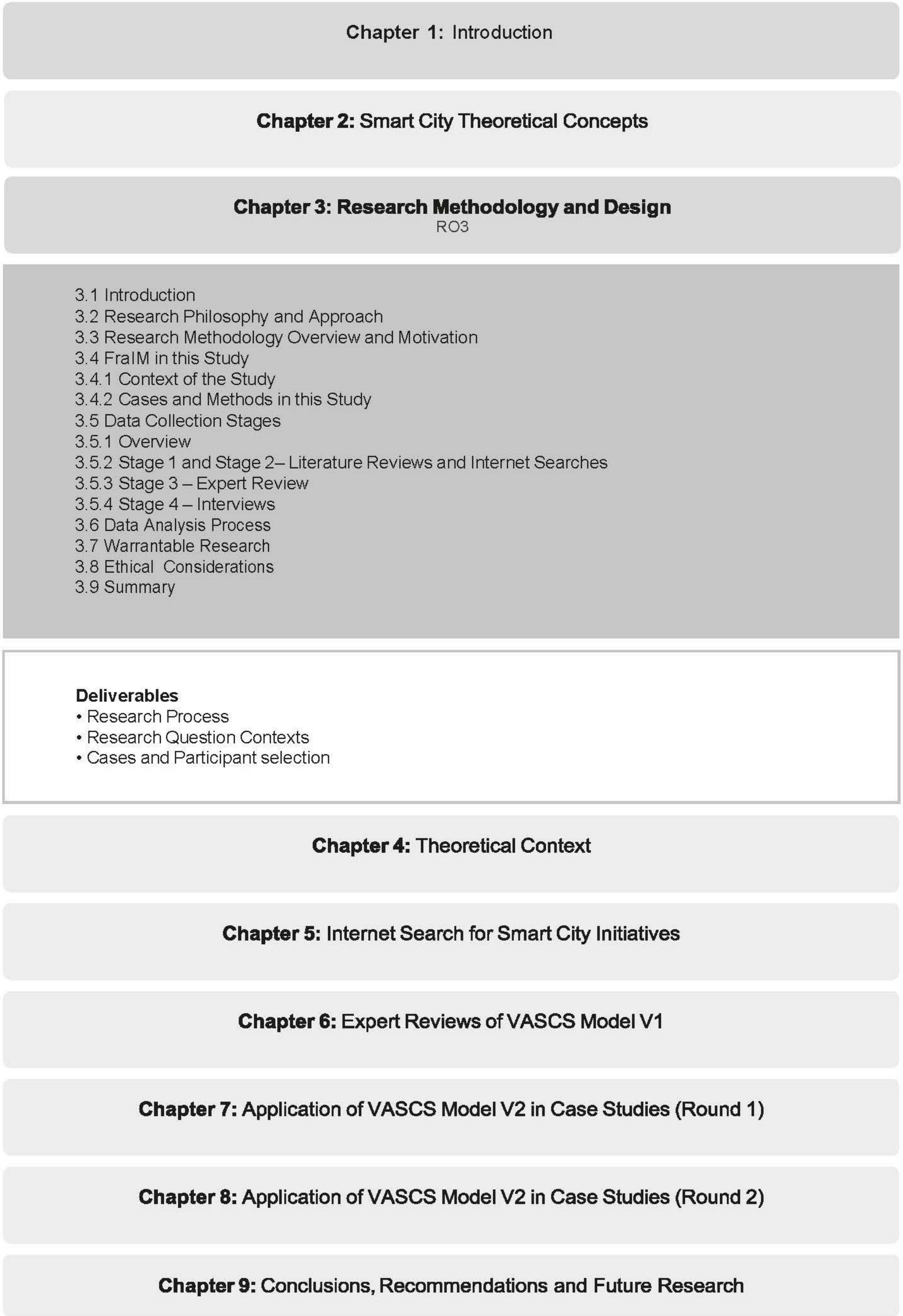

Figure 3.1: Chapter 3 Structure

3.2 Research Philosophy and Approach

Research philosophy is important in research studies as it helps the researcher identify the sources and the development of knowledge (Saunders et al., 2019). Further, it is important as it outlines the belief and assumptions about a phenomenon for which the researcher collects and analyses data (Saunders et al., 2019). The creation of knowledge is referred to as the way to answer the research question within a study, through the collection and analyses of data, even though in some cases the collected data does not always provide these answers (Plowright, 2011).

The four diverse and well-known research philosophies, namely: pragmatism, positivism, realism and interpretivism have been identified and used across different domains (Saunders et al., 2019). Table 3.1 summarises the purpose or assumptions of each philosophy, and the data collection methods associated with each.

Table 3.1: Four Research Philosophies (Author's own construct)

Philosophy	Purpose/Assumption	Data collection method
Pragmatism	Research question should drive the data collection methods (Onwuegbuzie & Leech, 2005). Importance of research is in the data findings and the practical outcomes (Saunders et al., 2019).	Mixed (qualitative and quantitative).
Positivism	A researcher is independent of the subject of the research (Saunders et al., 2009).	Hypothesis testing. Structured quantitative data such as a survey or qualitative data as originally collected in in-depth interviews.
Realism	The sensation is a key role player; what the subject experiences through senses (Saunders et al., 2009).	Methods should match subject matter (qualitative or quantitative methods).
Interpretivism	Researches people in their natural environment, rather than using objects (Saunders et al., 2019).	In-depth interviews, samples can be small. Provides new world views.

The pragmatism philosophy supports the position of uncovering practical knowledge for a specific situation (Biesenthal, 2014). Pragmatism captures the philosophy where the data collection is driven by the research question (Onwuegbuzie & Leech, 2005) and thus the importance of the practical outcomes of the data findings (Saunders et al., 2019). These data collection methods are mixed methods and collect both qualitative and quantitative data.

The IS discipline is referred to as a pragmatic discipline, because of the focus given to applied research, as well as the practical and theoretical implications (Ågerfalk, 2010). Saunders et al. (2019) describe one of the pragmatic beliefs as looking at 'acceptable knowledge' also, known as epistemology; this is when the focus is on problems, practices and relevance. Ågerfalk (2010), reports that pragmatism can be achieved when the key contribution is from problem-solving and informed future practices. This can then be linked to the belief that human activity is supported through IT and IS, which is based on the core value of collaboration and communication solutions.

Positivism data analysis methods involve hypothesis testing using mostly quantitative data collection methods. However, qualitative data collected through in-depth interviews can also be used. The purpose of positivism is for the researcher to be independent of the subject being researched (Saunders et al., 2009). The positivist's belief is based on facts from happenings that can be gathered and studied from a scientific or an empirical view, and can be illuminated through simplistic analyses (Aliyu et al., 2014).

A realism philosophical stance is driven by a scientific investigation where the purpose of the philosophy is captured by the senses surrounding the person, to show the reality as the truth in that the object exists independent of the mind of a person (Saunders et al., 2009). Philosophers describe two types of realism, namely direct and critical realism. Direct realism is the experience through the human senses as a correct representation. Whereas critical realism is where the first senses experienced are processed independently of the mind (Saunders & Tosey, 2013).

Researchers using Interpretivism use qualitative methods such as in-depth interviews where samples can be small, to collect data which uncovers the experiences, perceptions and understandings of the interviewers to interpret the data (Thanh & Thanh, 2015). The contributions can be classified as new understandings or new worldviews (Saunders et al., 2019).

The selected philosophy of this study is pragmatic. The characteristics of this philosophy are appropriate because this study is driven by answering the main research question and the objectives set out to discover the answer.

The following general pragmatic characteristics were selected as appropriate for this study (Johnson & Onwuegbuzie, 2004, p. 18):

- *"**Knowledge** is viewed as being both constructed and based on the reality of the world we experience and live in"*;
- *"**Theories** are viewed instrumentally (they become true and they are true to different degrees based on how well they currently work; workability is judged especially on the criteria of predictability and applicability)"*;
- *"Takes an explicitly **value-oriented approach** to research that is derived from cultural values; specifically endorses shared values such as democracy, freedom, equality, and progress"*; and
- Undergird **mixed methods,** it is seen that using a pragmatic view can provide a solution supported by the insights from mixed methods (Johnson & Onwuegbuzie, 2004; Maxcy, 2003).

Qualitative research is sometimes referred to as narrative research and quantitative research as numeric research (Plowright, 2011). The characteristics applicable to this study for quantitative and qualitative research were identified, with the strengths and the weaknesses of both approaches. Recommendations are also made to overcome the weaknesses as far as possible in this study. In this thesis, the terms narrative and numeric instead of qualitative and quantitative will be used based on FraIM as proposed by Plowright (2011).

Strengths of numeric research:

- Testing and validating already constructed theories about how (and to a lesser degree, why) phenomena occur;
- Testing hypotheses that are constructed before the data are collected. Can generalise research findings when the data are based on random samples of sufficient size;
- Useful for obtaining data that allow numeric predictions to be made;
- Data collection using some numeric methods is relatively quick (e.g., telephone interviews; surveys);
- Data analysis is relatively less time consuming (using statistical software); and
- The research results are relatively independent of the researcher (e.g., effect size, statistical significance).

Strengths of narrative research:

- The data are based on the participants' own categories of meaning;
- It is useful for studying a limited number of cases in depth;
- It is useful for describing complex phenomena;
- Provides individual case information;
- Provides understanding and description of people's personal experiences of phenomena (i.e., the "emic" or insider's viewpoint);
- Can describe, in rich detail, phenomena as they are situated and embedded in local contexts;
- The researcher identifies contextual and setting factors as they relate to the phenomenon of interest;
- Narrative approaches are responsive to local situations, conditions, and stakeholders' needs;
- Narrative researchers are responsive to changes that occur during the conduct of a study (especially during extended fieldwork) and may shift the focus of their studies as a result; and
- Narrative data in the words and categories of participants lend themselves to exploring how and why phenomena occur.

Weaknesses of numeric research:

- The researcher's categories that are used may not reflect local constituencies' understandings;
- The researcher's theories that are used may not reflect local constituencies' understandings;
- The researcher may miss out on phenomena occurring because of the focus on theory or hypothesis testing rather than on theory or hypothesis generation (called the confirmation bias); and
- Knowledge produced may be too abstract and general for direct application to specific local situations, contexts, and individuals.

Weaknesses of narrative research:

- Knowledge produced may not generalise to other people or other settings (i.e., findings may be unique to the relatively few people included in the research study);

- It is difficult to make numeric predictions;
- It is more difficult to test hypotheses and theories;
- It generally takes more time to collect the data when compared to numeric research;
- Data analysis is often time-consuming; and
- The results are more easily influenced by the researcher's personal biases and idiosyncrasies.

Recommendation to overcome numeric weaknesses:

- Having different stakeholder types as part of the interview groups, aid in researching a vast majority of local constituencies' perspectives;
- The theories used in this study cover three domains, namely, smart cities, value, and alignment. Theoretical perspectives for each of the domains have been classified, ranging from dimensions in a Smart City, Smart Policy, stakeholder roles, benefits realisation and alignment of stakeholder roles and responsibilities; and
- The use of a case study strategy aids in having examples from the findings that apply to more direct and specific local contexts.

Recommendation to overcome narrative weaknesses:

- The data collected for Smart City studies is unique to a particular city or community; therefore, lessons learnt can be adopted from city to city or from stakeholder roles to others, based on similar contexts;
- Using the numeric method with a questionnaire template in a case study strategy and the numeric analysis of narrative data in this study, aids in making numeric predictions;
- Using theoretical perspectives to influence the components of the proposed model and having these components as part of a questionnaire template with an evaluation section, aids in testing what constructs are found within the data;
- Data analysis techniques such as co-independent coders, professional interview transcribers and tools such as Atlas.ti (ATLAS.ti, 2020) and Excel aided in the time-consuming process; and
- Using triangulation characteristics where data is collected and analysed from different sources of data/information and different independent coders involved with the analysis reduces researchers' biases.

Two common research approaches exist, namely, deductive and inductive approaches (Saunders et al., 2009; Wynn & Williams, 2012). The deductive approach is explained by Saunders et al. (2009) as mostly commonly adopted amongst scientific researchers where the subjected theory is tested. Singh (2010, p. 24) argues the same concept about the deductive research approach, that it is "*hypothesizing the anticipated consequences to events*" and Saunders et al. (2009) confirms this concept. The inductive approach involves building a theory from the collected data through analysis (Saunders et al., 2009). Thomas (2006) states that the purpose of the inductive approach is to allow for research findings to emerge from the raw data through frequent, dominant, or significant themes.

For this research study, both the inductive and deductive approaches were adopted. First, a deductive approach was adopted for the identification of existing theories and best practice within the Smart City research field to create the theoretical model of this study. Then an inductive approach was followed to collect data for this study. The inductive approach allowed for the data to be observed to identify the themes and categories, to assist in a theory-driven coding frame consisting of the themes and categories identified. An example of such theories is the stakeholder theory and a best practice example is the data value chain proposed by Curry (2016).

3.3 Research Methodology Overview and Motivation

Researchers design their research to address a problem and to find answers to research questions in a validating format by using different approaches to provide the needed direction (Creswell, 2014; Saunders & Tosey, 2013). The research design for this study was structured according to an integrated framework for mixed-method research (FraIM), proposed by Plowright (2011), who uses the concept of mixed methods illustrated using FraIM to plan and design small scale empirical research.

FraIM was adopted in this study as the research methodology to achieve the research objectives and to use the collected data to answer the main research question as best as possible. FraIM is referred to as a structure that can be applied to any research project, meaning that the structure can represent the activities and processes of any research in an abstract and generalised manner (Plowright, 2011).

The FraIM methodology has a basic linear structure and process as represented in Figure 3.2, that is used to carry out research. The principles which undergird FraIM are based on the pragmatism philosophy (Plowright, 2011). The pragmatic integrated methodology, relativist social epistemology, realist social ontology, and realist object ontology, are paradigms which also undergird the FraIM methodology. Using a paradigm is important as it offers a theoretical structure or framework to help the researcher explain coherently and cohesively the decisions made during the research process. The pragmatic integrated methodology paradigm is based on one of the pragmatic fundamentals. This fundamental is that the research question should be the start of the research process and should thus drive the research approach (Plowright, 2011) and data collection methods (Onwuegbuzie & Leech, 2005).

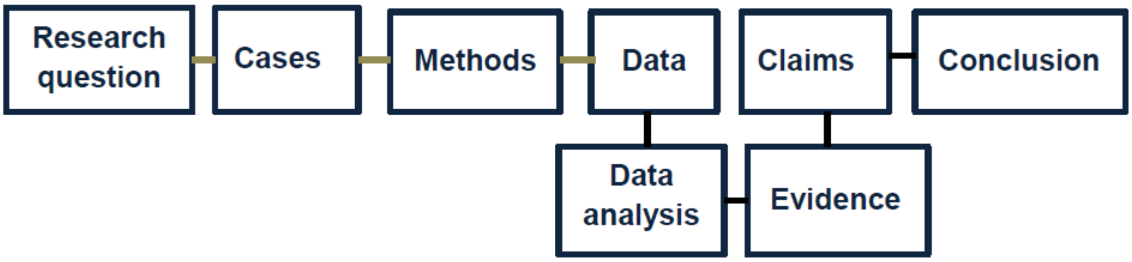

Figure 3.2: The Basic Structure of the FraIM (Plowright, 2011)

The basic FraIM structure consists of eight components which start with the main research question upon which the other components are based. Plowright (2011) describes that once the research question has been determined, then the researcher can decide on the cases or participants to be selected, the methods for data collection, the types of data and how the data will be analysed. Hereafter, the claims can be made based on the evidence found and which leads to the conclusions of a study.

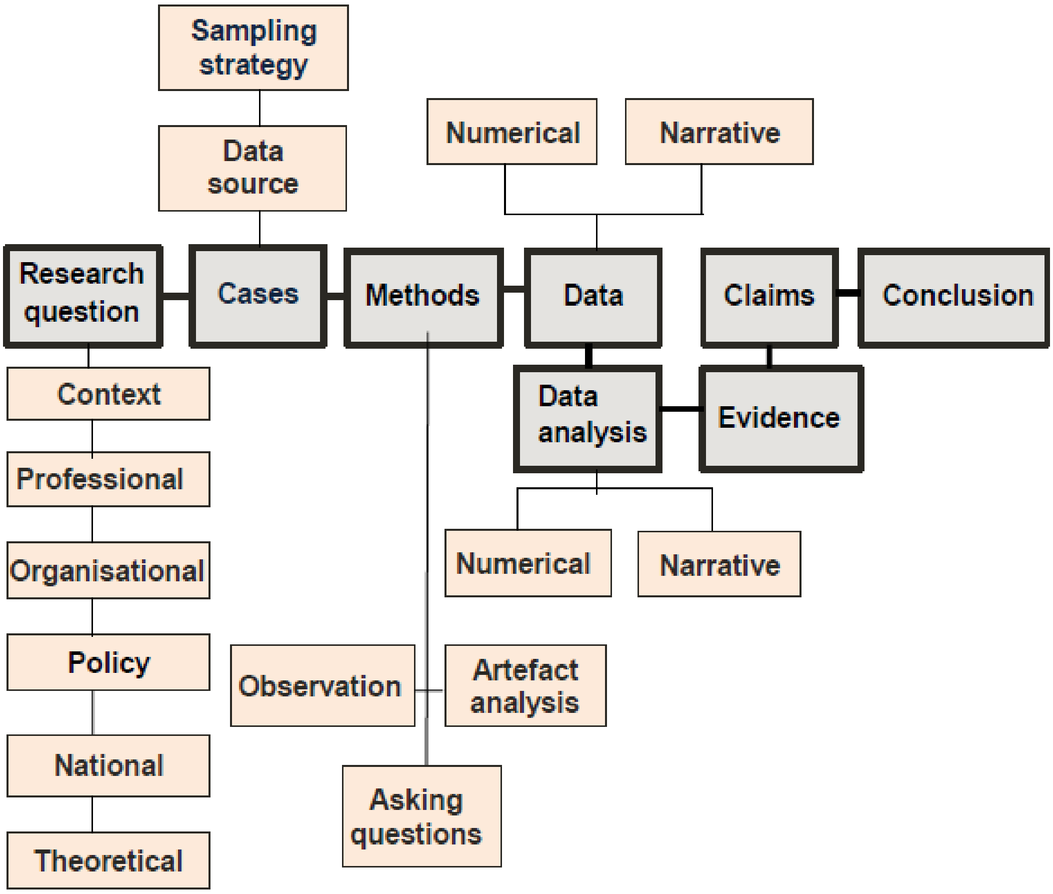

Figure 3.3: The extended Structure of FraIM (Plowright, 2011)

The extended FraIM structure in Figure 3.3 shows all the elements that make up each of the eight components (Plowright, 2011). The **first component, the research question** is made up of five contexts in which research can be conducted, and some contexts might have a greater importance over others. The five contexts of this research are introduced in Section 1.8 and elaborated on in Section 3.4.1.

The cases are the second component where the data sources and sampling strategy must be considered. Examples of data sources are individuals, organisations, systems, etc. (Plowright, 2011, 2016). For data source management, three strategies exist, namely case study, survey and experiment (Hammersley, 1992; Plowright, 2011). Yin (2014, p. 4) states that a case study "*allows investigators to focus on a "case" and retain a holistic and real-world perspective- such as in studying individual life cycles, small group behaviour, organisational and managerial processes, neighbourhood change, school performance, international relations, and the maturation of industries*".

The cases have to be organised according to three aspects namely (Plowright, 2011):

- The number of cases in the research;
- The degree of control of the researcher as to which cases are allocated to a specific data source management strategy (number of cases per strategy); and
- The degree of naturalness or the ecological validity of the groupings (the level according to the most natural environment in which the research is conducted, if it is artificially setup it would have a lower level of ecological validity).

One example is pupils being studied in their school environment with minimum disruption (high level of ecological validity) versus participants taking a test in a laboratory to '*determine the de-motivating/motivating effects of being told the tests are difficult*' (Plowright, 2011, p. 30). On the other hand, using this example, generalisability would be low for a case study strategy and high for an experimental strategy.

The sampling strategy relates to the procedures used to select participants for a research study, and these are linked to the sampling procedures that can be used to choose which cases to include. Probability and non-probability sampling exist, and for each, there are different sampling techniques associated. Probability sampling is the selection of cases at random which is representative of a population. Non-probability sampling is based on selecting the cases based on meeting a set of criteria to form part of a sample (Plowright, 2011) and referred to as judgemental sampling (Saunders et al., 2009).

According to Cohen et al. (2007) non-probability sampling involves the researcher considering a sample as it might meet the criteria or contain information to answer the research questions of a study and that the sample might not be representative outside the particular study. Non-probability sampling is described according to four techniques, namely purposive sampling, convenience sampling, quota sampling and viral (snowball) sampling. Purposive sampling involves determining a purpose for selecting specific cases to form part of a sample. Convenience sampling is where the participants are located conveniently, and the researcher can access the participants conveniently, one example is if a researcher has worked at a school previously and can access teachers and students at that school.

Quota sampling is where the selected cases for a sample should be split according to a specific criterion (Plowright, 2011). Quota sampling can be used, based on the idea that the sample will represent a population. It is efficient when sufficient responses are obtained from each quota in the sample for statistical analysis to be made (Saunders et al., 2009). Viral sampling is the term used by Plowright (2011) for snowball sampling. The term was coined because of the practice of communication through technology where a virus can be passed from one computer to the next, so in like manner researchers, are passed from one participant to the next by way of referral to gain more participants for the sample. Plowright (2011) agrees with the idea of integrating sampling techniques when it is appropriate to answer the research question, as it is used in cluster sampling also known as multi-stage sampling (Saunders et al., 2009).

Methods for data collection is the third component. There are three methods for data collection, namely (Plowright, 2011):

- Observations;
- Asking questions and
- Artefact analysis.

These three methods are characterised by two criteria: level of mediation and degree of structure. *Level of mediation* refers to the proximity of the research or how close or distant the researcher is to the topic being investigated. For example, observation has a lower level of mediation if the researcher is close to the case being observed. Whereas asking questions or collecting data through surveys has higher levels of mediation. This is because the participant has more time to recollect information from memory or respond in open-ended questions or through selection options to best interpret the answers given from the respondent.

Artefact analysis has the greatest level of mediation as the process involves more elements to collect the data. The example here is a set of magazine articles as the artefact. The fundamentals of data collection are the *event/situation/experience* being interpreted by an individual, the *producer of the artefact*. The researcher has to then *create or present* an interpretation of the data or artefact sources through their own mediation; therefore, *artefact analysis* is even further away from the initial event/situation/experience being studied and lastly is the *data being available*.

The *degree of structure* influences the data collection in terms of the type of data, the responses from the participant and researcher control. For the *method of asking questions*, the degree of structure is either low when the questions are open-ended or high when the questions are closed-ended. For open-ended questions the participant has an increased choice when responding to the questions and those responses are not pre-determined. The researcher also has more control over how the data is collected, managed and analysed. The opposite is where the questions are closed-ended, the responses of the participant are predetermined and the participant has low control over how to respond to questions (example, rating questions). For open-ended questions, the researcher has little control over how the data is collected, managed and analysed.

The *observation and artefact analysis method* has a low degree of structure when predictability is low over the data that is collected. Data is mainly open coded, and the researcher has more control over what data can be recorded during data collection. The degree of structure is higher for observation and artefact analysis as predictability is higher for data being collected. This is for closed/pre-coded data, and therefore, the researcher has a limited choice of what data can be recorded during data collection.

Data is the fourth component and is required for the **fifth component, data analysis**, which has two categories of data, namely narrative and numerical data (Plowright, 2011, 2016). Once numerical data is collected, the analysis is focused on counting and measuring. When narrative data is collected, the analysis will be linked to the codes of meaning assigned to the data (Plowright, 2011). When analysing data, numerical data can also be used to describe narrative data and vice versa.

Evidence is the sixth component and **claims are the seventh component** where the data evidence can be used to make claims about the participants, data sources or cases (Plowright, 2011). Using the claims can provide the researcher with ideas of reaching **conclusions** about the research question, which is the eighth and **last component**.

3.4 FraIM in this Study

The FraIM was chosen in this study to provide a flexible integrated design by using mixed data collection techniques to achieve the overall research aims (Plowright, 2011). Mixed methods design is the concept of integrating qualitative and quantitative methods and data to address a problem in a research project (Creswell, 2014).

The integrated design for this study started with the first component in the FraIM methodology to formulate the main research question (Section 1.5). The main research question was contextualised through professional, organisational, national and theoretical contexts, helping to justify the research question for this study and is explained in the following sections. Each of these contexts can take on more or less importance depending on the research being done, in justifying the research question (Plowright, 2011).

3.4.1 Context of the Study [3]

The main research question is: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?* The context of smart cities, their stakeholders and initiatives is addressed in this section according to the professional context, the organisational context, the policy context, the national and international context, and the theoretical context as recommended in FraIM.

3.4.1.1 Professional Context

The fields of Smart City research is relevant in several disciplines. Batty et al. (2012) reported the importance of professionals from different disciplines as key to contributing to smart cities of the future. These professionals include urban planning, transport planning, and computer science. Chourabi et al. (2012) highlighted that even though the phrase, the Smart City, has become popular at the time, there was still a lack of consistent understanding amongst academia and practitioners. Townsend (2013, p. 165) indicated that one of the keys of building thriving smart cities was to integrate industrial engineering and 'grassroots tinkering', meaning that integration should start within the context of where Smart City solutions must be applied.

[3]Some of the results in this section have been reported on and published in a Springer book chapter (refer to Appendix F)

More recent studies on smart cities give more attention to the disciplines involved in these projects, and professionals seem to be a default part of such disciplines. One example is the use and implementation of IS and technologies in smart cities is critical, especially for the design and development thereof (Allam & Dhunny, 2019; Ismagilova et al., 2019; Ning et al., 2019). Today, when looking at optimal and innovative Smart City solutions, research professionals and experts are being consulted more to evaluate what is required in transforming a city to a Smart City (Kumar et al., 2020). The contributions of this research are potentially significant and were highlighted in Section 1.4.

3.4.1.2 Organisational Context

The profession of the author of this study is based in Information Systems and Business Management, who is a citizen in the Eastern Cape province and is employed by the Nelson Mandela University, that is the case of a Smart City context. The Smart City can be viewed as an organisation that enables new forms of planning and analysis in ways to benefit from the impact of technologies (Batty et al., 2012). Smart City initiatives have many stakeholders and many interdependencies exist, leading to several challenges especially regarding the misalignment of goals for projects to solve city problems (Chourabi et al., 2012). Based on the SLR, the organisational context needs planning to consider all the stakeholders required to contribute to and benefit from Smart City initiatives (Section 2.6).

Two approaches exist for planning and implementing Smart City initiatives, namely the top-down approach also known to be government driven, and the bottom-up approach which is said to be citizen and community driven (Estevez et al., 2016). In developing countries, both these approaches should be used, where Smart City initiatives are mostly government led and potential issues occur when the local relevance of sustainability initiatives are misaligned in context. The top-down approach, should focus on building foundations and the bottom-up approach, should focus on local initiatives where innovative services should be delivered by the local SMEs by using open data to help alleviate the challenges in developing countries.

Some of these challenges in developing countries, stem from a background of colonisation, segregation and in South Africa, apartheid (SAHO, 2019). Apartheid was rooted as a law which incorporated the system of segregation according to a person's race. People who were classified as non-white were moved away from their homes and land in towns and further away from their places of work to areas that were undeveloped and became known as the townships and rural communities in South Africa.

Due to these apartheid laws most of the population were disadvantaged, and these communities could not access resources such as equal education, housing and utilities. Therefore, urbanisation is causing pressure on cities, where the population of many of these communities is moving to cities where they can utilise and access better resources (Joshi et al., 2016). However, resource scarcity and management have become a crisis in South Africa due to the high demand and supply of water and electricity (Colvin & Muruven, 2017). The weather variation, drought and pollution were identified as a key driver contributing to the scarcity of resources such as clean water for citizens in South Africa.

3.4.1.3 Political Context

Technology in smart cities is seen as a resource that enables access and has given different stakeholders, especially policy makers, opportunities to collect data about different city issues, and therefore there is a need to design responsive city and urban policies. One example is by using Artificial Intelligence (AI) technologies in this regard (Allam & Dhunny, 2019). The calls for liveable, sustainable and inclusive governance are some of the trending issues which were identified in a study done by (Allam, 2018); however, the study also shows that this is only achievable at a country policy level.

It is important to note that the majority of Smart City policy development has been done in developed countries and only eight percent was conducted in developing countries, and none from African countries was included (Estevez et al., 2016). The risks highlighted in their study is that the context and local context gets lost, especially those indigenous policies as more developing countries adopt policies created by developed countries.

Developing country policies related to technologies and data are very relevant for this study and are applicable to the country in which the cities are located, for example the data related policies of South Africa such as the Protection of Personal Information Act (POPIA) discussed further in Section 5.5. Lea and Blackstock (2014), Albino et al. (2015), Kassen, (2017), Scriney et al. (2017) and Yadav et al. (2017) have all recognised the importance of data and data sources and access to city data to enable the successful provision of services in a Smart City (Section 5.2).

Lea and Blackstock (2014) and Yadav et al. (2017) argue that open data is another important factor to allow access to city data and for a successful Smart City. The State of South African Cities Networks (SACN, 2016) report, emphasised a Smart City driver as, 'access to city data which should be provided for improved city planning and city management'. However, unreliable data sources and insufficient city data will hinder access to accurate records of city data. Accurate records refer to accurate digital records that will allow accurate information, for example on the infrastructure within a city, the exact location, space and capacity (Olliero, 2017). Such accurate records could allow for successful infrastructure sharing and partnerships.

3.4.1.4 National and International Context – Smart Cities

The Republic of South Africa consists of nine provinces namely, Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West and the Western Cape (RSA, 2020). The Gauteng province is said to be the smallest and most urbanised region, and the Northern Cape province is made up of a third of the total land area of South Africa. The country also consists of three capital cities namely, Cape Town in the Western Cape, Bloemfontein in the Free State and Pretoria in Gauteng.

The South African Local Government Association (SALGA) issued its first publication in 2015, where it reported the efforts of smart cities across South Africa (SALGA, 2015). The focus of the report was to showcase the municipalities, their innovations, excellence and partnerships. The report indicated that most of the municipalities have one question in common, that is how to use the Smart City concept to make their municipalities better for the future. Nonetheless, municipalities should apply Smart City thinking today, by approaching economic and social problems in different and new ways.

Integrated Development Plans (IDPs) are principles and processes to move towards better economic and social conditions for local communities in South Africa (Local Government: Municipal Systems Act, No. 32 of 2000) (Polity, 2000). These IDPs are set to be used as a guideline by local communities to illustrate their initiatives to achieve economic and social enhancements in an integrated format. SALGA (2015) reported that this is not always achieved and reported that insufficient data, faulty data collection processes and inaccurate data sources are still common issues amongst cities in South Africa.

Cities and countries have to bridge the data gap and align their local and national Smart City initiatives to those set at a global level by the United Nations through the Sustainable Development Goals (SDGs). The United Nations (2015, p. 14) set out the 2030 World Agenda which entails the 17 SDGs and its related targets which focus on people, the planet and prosperity. These goals are set for all countries and all stakeholders to implement. In this context Goal 11 is to "*Make cities and human settlements inclusive, safe, resilient and sustainable*" (United Nations, 2015, p. 21). Cities should address models such as Urban Systems Models to help them to align their Smart City initiatives.

The Urban Systems Model consists of theoretical concepts based on smart cities (Harrison & Donnelly, 2011). The model includes five layers that can be used to illustrate the Urban IS and it consists of information from social systems, services, resources, infrastructure and the natural environment. Harrison and Donnelly (2011) illustrate the hypothesis of the Urban System Collaborative, which indicates that "*increasing accessibility of information will enable us to develop Urban Systems models that are capable of helping citizens, entrepreneurs, civic organisations, and governments to see more deeply into how their cities work, how people use the city, how they feel about it, where the city faces problems, and what kinds of remediation can be applied*" (p. 1). Their hypothesis is still valid today, and smart cities still face issues around data and information access. Their study confirms the importance of using data and information to enable and develop systems for helping all stakeholders in a city.

3.4.1.5 Theoretical Context

The theoretical context of this study started with a literature review (Chapter 2) of the topic for this study as well as the theoretical concepts, which are explained in detail in Chapter 4. The theoretical framework (Figure 2.12) illustrated these concepts.

The different theoretical concepts were selected from different domains that influenced the selection of the components on the VASCS Model. Three domains which are core to this study are the Smart City, value and alignment domains. For the Smart City domain, concepts were selected from three theories namely, the Hexagonal Dimension Theory, the Strategic Priority Areas Theory (Kishore & Sodh, 2015), and the Triple Helix Model Theory (Etzkowitz & Leydesdorff, 1995). Theoretical concepts for the value domain were selected from the Complex Value Typology Theory (Rescher, 1969) and the Value Chain Analysis Theory (Porter, 1985).

The alignment domain included concepts from the Structural Alignment Theory (Rose et al., 2015), the Strategic Perspective of Alignment theory (Avison et al., 2004) and for value alignment, the Theory of Value Co-Creation (Galvagno & Dalli, 2014). These theories are explained in more detail in Chapter 4.

3.4.2 Cases and Methods in this Study

Any source used to collect data for this research is referred to as a case as recommended by FraIM (Plowright, 2011). For the case selection process of this research study the case study strategy was adopted for the following reasons highlighted by Yin (2014):

- To contribute to the knowledge of the related phenomena such as the citizen, investors and other stakeholders; and
- Because it has been adopted in fields where businesses reside and where planning is involved regarding communities.

Yin (2014) further explains the twofold definition of a case study. The first, is about the scope of the case study being an empirical inquiry where the case is part of an in-depth investigation which is in a real-world context. The second part is linked to the phenomenon and the context of a case study, especially where it is difficult to distinguish a case in a real-world situation. Case studies can provide analytical findings rather than a statistical generalisation; therefore, they can also allow for theory to be developed, which can aid researchers' understanding of other similar cases and scenarios (Robson, 2002).

Therefore, Yin (2014, p. 17) describe the methodological characteristics as relevant features of a case study inquiry namely:

- *"copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result"*;
- *"relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result"*; and
- *"benefits from the prior development of theoretical propositions to guide data collection and analysis"*.

Although the results may apply to the context (that is the Eastern Cape and possible other South African cities), the aim is that it can provide insights for the broader Smart City research community. Therefore, several cases were investigated within the following two cities (Section 7.3 and Section 8.3):

1) The NMB city from various stakeholders designing, planning and implementing Smart City projects in the NMB city.

2) The Buffalo City where the East London Industrial Development Zone (ELIDZ) is situated and focusing on Smart City initiatives around the city.

The cases were organised according to the three aspects of FraIM (Plowright, 2011) as follows:

- The number of cases in the research – these are the cases in NMB and Buffalo City;
- The degree of control of the researcher – one data source management strategy i.e. case study was used, with several cases within the two case studies; and
- The degree of naturalness or the ecological validity of the groupings - The degree of naturalness for Round 1 was medium since they were conducted face to face but not in the participants actual work environment. For Round 2 it was low since they were conducted online and therefore not close to or in the natural environment of the participants.

The *level of mediation* always relatively high since the asking questions method was used to gather data from stakeholders in smart city initiatives and IS researchers. The artefact analysis method used also accounted for the high level of mediation as the process involved more elements to collect the data such as Internet Searches and Expert Reviews.

The *degree of structure* was low to medium since the asking questions method consisted of both closed and open-ended questions and since some of the codes were apriori codes.

The third component in the FraIM structure is the methods component, and in this study, the a**sking questions** and **artefact analysis methods** were integrated with the case study strategy. More detail on the cases, the data sources and the sampling strategy used is provided in the next section.

3.5 Data Collection Stages

3.5.1 Overview

Table 3.2 summarises the four stages of this research study. A case study strategy can involve both qualitative and quantitative data, therefore the research methodology design of this study is based on mixed methods (Saunders et al., 2009; Yin, 2014). Both narrative data and numeric data were collected to be able to answer the main research question of this study.

Table 3.2: Research Design (Author's own construct)

Research Stage	**Methods of data collection**	**Data Source Management Strategy**	**Types of Data Collected and Analysed**	**Categories for data collection**
RQ$_m$: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?*				
Stage 1 - Literature Review				
RO$_1$: Identify the success factors of a Smart City	• SLR		• Narrative • Numeric	• Smart City dimensions and success factors • Smart City frameworks
RO$_2$: Analyse existing frameworks and models for smart cities				
RO$_3$: Identify the stakeholders for smart cities	• SLR & Literature Review		• Narrative • Numeric	• Stakeholder roles and types
RO$_{5.1}$: Identify the criteria for value creation in a Smart City in a developing country			• Narrative	• Criteria for value creation
Theoretical framework design				

Research Stage	Methods of data collection	Data Source Management Strategy	Types of Data Collected and Analysed	Categories for data collection
RQ$_m$: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?*				
Stage 2 – Internet Search				
RO$_3$: Identify the stakeholders for smart cities	• Internet searches/Artefact analysis		• Narrative • Numeric	• Stakeholder roles and types
RO$_{4.1}$: Identify the data and IoT initiatives	• Internet searches/Artefact analysis • Literature Review		• Narrative	• Data and IoT initiatives for smart cities
Stage 3: Expert Reviews				
RQ$_m$: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?*	• Asking questions /Expert Reviews		• Narrative • Numeric	• Validation of VASCS Model V1
Stage 4: Semi-structured Interviews (Round 1 and Round 2)				
RO$_4$: Analyse and classify digital activities, benefits and challenges for smart cities in a developing country	• Literature Review		• Narrative	• Digital activities for smart cities
	• Asking questions/ Interviews	• Case Study	• Narrative • Numeric	• Verify Smart City success factors • Align digital activities
RO$_{4.2}$: Determine what makes data smart	• Asking questions/ Interviews	• Case Study	• Narrative • Numeric	• Digital data
RO$_5$: Determine the influence of the initiatives on the creation of value to a Smart City in a developing country.				• Verify the impact of value creation
RO$_{5.1}$: Identify the criteria for value creation in a Smart City in a developing country	• Asking questions/ Interviews	• Case Study	• Narrative • Numeric	• Identify the criteria for value creation
RO$_{5.2}$: Determine the alignment of the data and IoT initiatives on the value creation for stakeholders in the city.	• Asking questions/ Interviews	• Case Study	• Narrative • Numeric	• Identify the technologies, data/open data sources and value of use

3.5.2 Stage 1 and Stage 2 – Literature Reviews and Internet Searches

In Stage 1, a literature review was conducted within the five contexts of this study (Section 3.4.1) to confirm the need for this study and to answer the main research question and address the research objectives. Then the process of an extensive SLR was followed (CRD, 2009; Kitchenham et al., 2009) to determine the dimensions and success factors of a Smart City (Table 2.5), the stakeholders classified per dimension (Table 2.3 and Figure 2.10) and the other key theoretical concepts relevant to this study (Section 2.9).

The results of Stage 1 were extended to identify any recent, relevant research and were used as input for the classification of initiatives in Stage 2: Internet Search. The process of the Internet Search consisted of the following steps:

- Step 1. Searched for articles and web sites using the keywords: Smart City initiatives, Smart City projects, Smart City goals in all nine provinces of South Africa;
- Step 2. Then the search was refined and updated for articles and web sites using the keywords: Smart City initiatives, Smart City projects and/or Smart City goals AND Eastern Cape/NMB/Buffalo City;
- Step 4. Identified stakeholders in different roles and types mentioned in the articles or web sites which became the target profile; and
- Step 5. Identified relevant initiatives/cases and activities.

In Stage 2, the Internet Searches determined which initiatives were active in the Eastern Cape at the time of the investigation. The initiatives/cases were then classified in a bottom-up approach at a higher-level in order to group together related Smart City projects/initiatives.

Once the initiatives and stakeholders were identified, contacts were obtained from what was provided online and from available networks, to confirm their roles and job descriptions. Once these were confirmed, then the Smart City Stakeholder Classification Model (Figure 2.10) was used to classify the initiatives/cases per stakeholder type and role in the Eastern Cape.

These initiatives included those from five key economic industries or organisations in the Eastern Cape. These are the educational institutions such as the large comprehensive university, the Nelson Mandela University; municipalities such as the Nelson Mandela Municipality and related community initiatives such as incubators; the manufacturing and automotive industry; the Industrial Development Zones (IDZs) and the ICT sector.

3.5.3 Stage 3 – Expert Review

The empirical data collection process started with identifying the experts to review VASCS Model V1 components (Bogner et al., 2018). The theoretical concepts addressed in Section 2.9 were refined to the categories used in the Expert Review questions constructed in Stage 3. The expert review took place as part of Stage 3 and simultaneous with the Stage 4 interviews. The participants were selected based on the following four criteria from Skulmoski et al. (2007):

- Knowledge and experience relevant to the research;

- Capacity and willingness to participate;
- Sufficient time to participate; and
- Effective communication skills.

These four criteria were used as the target profile for this study as follows:

- The experts had to have five years or more research experience in the fields of ICT and or smart cities or had to be involved in Smart City studies. The experts were approached and were delegates from one of the largest conferences in IS, the 2019 Americas Conference in Information Systems (AMCIS), held in Cancun Mexico;
- The researcher introduced herself to the prospective experts to find out if they were willing to participate in the gathering of information, and outlined the background of the request and gave a brief introduction to why the study was being done and how their input would benefit the process;
- The researcher then requested their contact details of the expert and exchanged invitations through email to formally introduce the study and set up a time and location to conduct and record the interview. The experts were informed that taking part in the interview gave consent to use their input in this study and were informed about the anonymity and confidentiality of information shared (Appendix G4); and
- The researcher determined whether the participants understand and speak English and the expert interviews were recorded by using a voice recorder and the recordings were shared with a professional interview transcriber to transcribe the interview recordings. The transcriptions were loaded into Atlas.ti where these documents/artefacts were then analysed to establish different types of codes, themes and sub-themes.

The expert reviews consisted of questions about how appropriate the components of the VASCS Model V1 was for this study before conducting the interviews with the participants (Bogner et al., 2018). The experts were interviewed individually to identify attributes related to the components for the VASCS Model V1 and the model as a whole. More detail is provided in Section 6.2.

3.5.4 Stage 4 – Interviews

In Stage 4, interviews were conducted with stakeholders from smart city initiatives in the cases of the Eastern Cape. The interviews took place in two rounds (Round 1, followed by Round 2).

Purposive sampling and convenience sampling were used. The purposive sampling technique was most suited as it provided an opportunity to select participants based on a specific purpose that needed to be met (Saunders et al., 2009). Convenience sampling was best suited to select the participants based on the researcher's network of contacts (Saunders et al., 2009).

The specific purpose for the participants from the cases was based on their knowledge of Smart City initiatives. The participants had to understand what information was required for their Smart City initiatives and the digital activities that form part of their initiatives. These were used as data collection requirements for this study. For Round 1, gatekeepers were contacted for each of the Smart City initiatives/cases from Stage 2, and these were the target participants for Round 1 interviews. The target profile for these participants were that they had to be providers or enablers in the initiative/s. These gatekeepers were again contacted when Round 2 interviews started to identify possible users and utilisers for Round 2 interviews.

The procedure followed for the interviews was as follows:

- The researcher provided the selected participants with an introduction to the research, the purpose of the study and a brief description of the interview process via a telephone call and email (Appendix J4);
- Participants were informed of an estimated time frame of the interview;
- Participants were asked to sign a consent form and their right to withdraw from the study at any time was stated (Appendix H2). It was also emphasised verbally that all information shared would be confidential and anonymous. The interviews took place at a confirmed time, date and place;
- The interviews in Round 1 that took place during November 2019 as part of a summer school, which addressed the topic of "*Digital Transformation for Sustainability in Smart Cities*". This allowed the summer school delegates to attend the interviews as a live interview setup. The setup provided the delegates with an opportunity to engage with the participants after the interviews about their initiatives;
- Round 2 interviews took place from November 2020 to January 2021 and were conducted via Microsoft Teams due to the Covid-19 travel and social distance restrictions;
- The Round 2 interviews were recorded by using a voice recorder (Round 1) and automatically stored on the Microsoft Stream platform;

- When all the recordings were collected, these were shared with a professional interview transcriber (Round 1) to transcribe the interview recordings. Round 2's automated caption transcription files were downloaded from the Microsoft Stream platform. These were checked and updated accordingly by the researcher;
- The transcription documents for Round 1 and Round 2 interviews were loaded into Atlas.ti, where these documents/artefacts were then analysed to establish different types of codes, themes and sub-themes. The Atlas.ti files had to be exported to Excel for further data handling and imported from Excel to map to the codes in Atlas.ti; and
- The research instrument was the interview guide (Appendix I2, Appendix J1). More details of how the interview questions were derived and the list of questions are provided in Section 7.3.

3.6 Data Analysis Process

The analysis methods in this study were mostly narrative with some numeric analysis using frequency counts of codes and themes from the narrative data. The Qualitative Content Analysis (QCA) method proposed by Schreier (2013) was used to analyse the narrative data. Content analysis is the process of transforming large volumes of text in an organised manner into results that are concise and understandable (Erlingsson & Brysiewicz, 2017). QCA is a method "*systematically describing the meaning of qualitative data*" (Schreier, 2013, p. 170). The features of QCA help with reducing data, since the process is done systematically, allows flexibility and focuses on the aspects related to the research question in a study. Schreier (2013) proposes eight steps of QCA to describe the meaning within the context of which a study is conducted. These steps are summarised in Table 3.3, together with how they were followed in this research. More detail is provided in the relevant chapters in Section C of this thesis.

Table 3.3: QCA Steps in this Study (Author's own construct)

Steps in QCA process Schreier (2013)	**Application in this study**
Step 1: Deciding on a research question	Proposal process, study background and relevance (see Chapter 1).
Step 2: Selecting material	Use of transcribed data from expert reviews (Chapter 6) and interviews (Chapter 7 and Chapter 8).
Step 3: Building a coding frame	Steps followed: • selecting material (i.e. transcriptions); • structuring and generating categories or themes; • defining themes (main and sub-themes); and • revising and expanding the frame (until saturation is reached-no additional new concepts found).
Step 4: Segmentation	The transcriptions were divided into units (i.e. interview questions) so that each unit fits into exactly one sub (theme) of the coding frame. Dividing

Steps in QCA process Schreier (2013)	Application in this study
	the transcriptions into themes requires formal (words, sentences or paragraphs in the text) and thematic (changes in topic) criteria.
Step 5: Trial coding	The expert review data was analysed before conducting the main analysis on transcriptions from the interviews. An example of how the coding process was applied is: a unit will be entered into a row, a main category/theme will be the column and the cell data will be the formal and thematic criteria (sentences, quotes from the transcriptions).
Step 6: Evaluating and modifying the coding frame	The evaluation of codes in Chapter 6, Chapter 7 and Chapter 8 involved the examination (by coders that were not the researcher) of the trial code sheet results to ensure validity and reliability. This included the units of coding being assigned to both rounds of coding. Higher consistency between the rounds of coding result in higher quality of the coding frame.
Step 7: Main analysis	All transcriptions were coded. The results of the coding were organised so that it could answer the research question.
Step 8: Presenting and interpreting the findings	Chapter 6, Chapter 7 and Chapter 8 present the coding frame as the main result with references to the text matrices in the form of sample quotes. The sample quotes for Chapter 7 and Chapter 8 were selected (by coders that were not the researcher) the second and third coder. The data were also presented in a numeric way by reporting coding frequencies, and percentages analysis where applicable.

3.7 Warrantable Research

Plowright (2011) emphasises the fact that once the FraIM methodology is followed and each component or stage has been outlined in detail by the researcher, the research can be regarded as warrantable research, also referred to as valid or authentic research. Overall, it is important to highlight the four criteria for trustworthy qualitative data analysis (QDA) that are still relevant today (Lincoln & Guba, 1985). These criteria are listed below and were applied in Chapter 6, Chapter 7 and Chapter 8 and described in the context of Saunders et al. (2009) as follows:

- Internal validity: the respondent understands the intended question from the researcher and the answer given is de-coded by the researcher as intended by the respondent;
- External validity: findings are applicable and generalisable in other contexts;
- Reliability: the findings are shown to be consistent and transparent; and
- Objectivity: the findings must be unbiased and representative of the respondents and care must be taken when data to be recorded is subjectively selected.

One method of ensuring validity is triangulation, which is a method used to collect and analyse narrative data and to ensure validity within studies. Some of the triangulation characteristics include data collection and analysis from various sources of data or information as well as from different independent coders who are involved with the analysis of the data to reduce researchers' biases (Johnson & Onwuegbuzie, 2004). There are five types of triangulation, of which only the following four were deemed relevant in this study, namely (Guion, 2002):

- Data triangulation: the use of multiple data or information sources, categorisation of stakeholder groups or types and ensuring that a comparable number of each group is represented by the data collected through interviews. This ensures that triangulation happens from each stakeholder group for an evaluation of a study;
- Investigator triangulation: where multiple investigators or evaluators form part of an evaluation team. The evaluation team is made up of those colleagues within the area, programme or field of study. These evaluators have to follow the same set of observation or coding frame in order to establish the validity of the findings;
- Theory triangulation: the use of multiple professional perspectives is referred to for interpreting a single data or information set. Validity is established where the same conclusions are drawn; and
- Methodological triangulation: where more than one data collection and analysis methods are used, both narrative and numerical. The example described by Guion (2002) is where, within a case study, interviews can be used as well as surveys can be used and where it is established that the findings have the same conclusions. This is how validity can be confirmed.

In addition to triangulation, the following strategies were used to ensure the reliability and validity of the qualitative research in this study:

- Coding consistency (independent parallel coding): This strategy involves a parallel check by two or more coders/researchers checking the raw data and finding reliability when high levels of agreement occur in their categories or themes (Thomas, 2006). The different sets of categories/themes are then compared with each other to eliminate any overlapping then the sets can be merged. In this study, this process was followed where three coders (the researcher and two other coders) checked the raw data using a coding framework as part of the QCA process (Section 3.6) and whereby a third coder eliminated overlapping themes and merged the themes. The second and third coder also selected which sample quotes to include for Round 1 and Round 2 interviews and then based on their selections, the researcher selected one or two participant sample quotes to present in the chapters (Chapter 7 and Chapter 8); and

- Chain of evidence: A chain of evidence provides the researcher with an opportunity to trace the process of the research, from the research question formulation through to the objectives and the findings thereof, hence ensuring reliability presented throughout the study (Yin, 2014). In this study the chain of evidence was methodically followed. Information was shared with the participants beforehand to check the objectives of the study and interview structure. Also peer reviewer feedback was considered throughout this study (Section 6.8).

3.8 Ethical Considerations

Plowright (2011, p. 155) encourages the focus of a research study to consider the following six ethical considerations when research participants are involved

- Informed consent: the researcher has to provide explanations or information about the research and what is expected of the participant so that the participant can make an informed decision to take part in the study;
- Right of refusal to take part, without penalty: the researcher should make it clear to the participants that they have the opportunity to decline participation in the study and that there is no penalty for their decision;
- Right to withdraw without penalty: this is where the participant is given information with their consent and that they have the right to withdraw from the study at any given time without any penalty;
- Confidentiality and anonymity: the researcher has a responsibility to protect the identity of the participants and their organisations throughout the study, and this the participants should be assured of this before they partake in the study;
- Deception: deceiving participants is unethical, for example posing as a customer or employee while collecting data through observation without consent is an example of intentional deception. On the other hand, an example of unintentional deception could be when the researcher attempts to find the balance between providing too much or to little information to the participants, without causing any frustration; and
- Security and safety to prevent any emotional or physical harm: it is also important that a researcher does not present the participant with any physical or emotional risks. This is why it is important to provide the participant with enough information of what the research will entail and how it will be conducted in order for them to make an informed decision to participate.

Protocols based on the requirements from REC-H were adhered to for conducting interviews with participants from industry and communities within the cities (the two cases NMB and Buffalo City). The data collected throughout this study is stored on a hard drive of the researcher, and a copy will be available on the Nelson Mandela University OneDrive network where the researcher and Principal Investigator of this study will have assigned access for a timeframe of five years.

3.9 Summary

Figure 3.4 illustrates another way of viewing a summary of the research design by using the integrated three-dimensional representation proposed by Plowright (2011). The different cells numbers 1 to 18 are used as combinations to represent a research design. The circles in Figure 3.4 represent the cell combinations (research methods) used in this study. Both narrative data and numeric data were collected to be able to answer the main research question of this study.

A case study was used as the data source management strategy in this research. The data source management strategy that was used in this study was a case study strategy, and the case of the Eastern Cape was investigated where two cases were identified as smart cities, namely NMB and Buffalo City.

The two data collection methods used in this study are asking questions through interviews and artefact analysis through Internet searches were used to collect narrative data which were analysed using both narrative and numeric data analysis techniques.

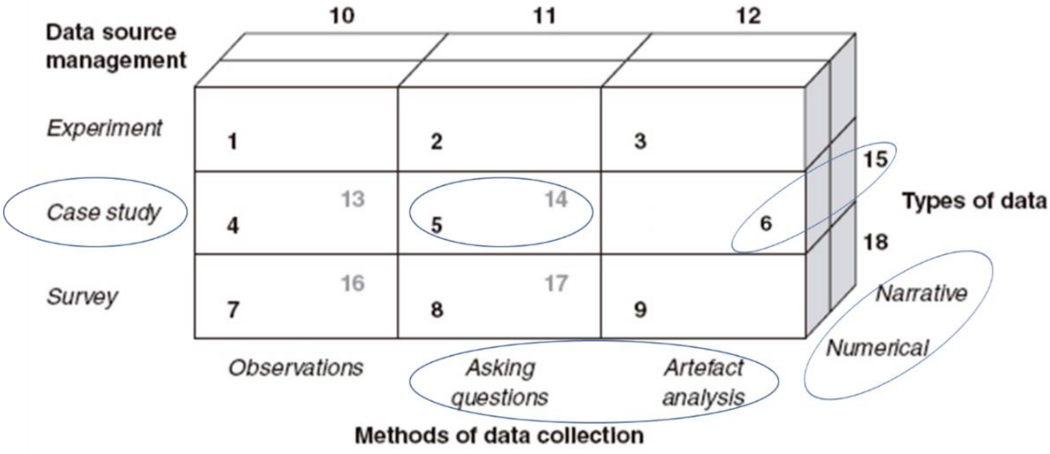

Figure 3.4: Simple Three-dimensional Model of an Integrated Approach to Designing Research (Adapted-Plowright, 2011, p. 19)

Table 3.2 illustrates the four stages of this research study. Stage 1 involved a literature review and an SLR that helped to address and identify some important aspects of smart cities for the purpose of this research study. The SLR was used to collect data to identify the success factors that should be considered in a Smart City for any related Smart City project addressing Smart City initiatives. Using the SLR also helped to analyse empirical studies where Smart City frameworks were used, proposed, or applied in a Smart City.

Stakeholders were identified and classified for Smart City dimensions by using the SLR. A literature review helped to identify other important aspects in this research such as identifying the criteria of value that should be included in any Smart City project to align the value to Smart City dimensions and initiatives appropriately.

In Stage 2, Internet searches were conducted as a form of artefact analysis as referred to in the FraIM methodology, since the internet sites and related documents can be considered as artefacts. In this stage actual stakeholders of initiatives and projects in smart cities in the Eastern Cape Province of South Africa were identified.

In Stage 3 and 4, interviews or asking questions, as shown in the FraIM were conducted. In Stage 3 the interviews were with experts and in Stage 4 with stakeholders in initiatives of the cases identified in Stage 2. Narrative data were collected, and narrative data analysis, such as QCA techniques, were used to classify important codes and themes in the data. Then numeric analysis was applied to cout the frequencies of codes within these themes. The numeric analysis was also used to analyse the responses of the success factors template where Likert scales were used, and important frequency counts were calculated based on who agreed, disagreed, or had a not applicable response.

The following chapter investigates theories related to the main theoretical concepts identified in Chapter 2 related to the Smart City domain, value and alignment.

Chapter 4 - Theoretical Context

4.1 Introduction

In Chapter 2, Smart City frameworks and models were identified as an important aspect of a city considering Smart City initiatives, as the frameworks can be used as a guide or a map, directing the city to achieve successful initiatives. The importance of stakeholders and alignment of value were highlighted as two of the main theoretical concepts of the theoretical framework (Figure 2.12). Chapter 3 consisted of the research design and methodology components that guided this study. This chapter will investigate in more detail appropriate theories related to the theoretical components of the theoretical framework (Figure 2.12), namely:

RO_3: Identify the stakeholders for smart cities;

$RO_{5.1}$: Identify the criteria for value creation in a Smart City in a developing country; and

$RO_{5.2}$: Determine the alignment of data and IoT initiatives on the value creation for stakeholders in the city.

The theories were used to identify the important concepts that should be considered when dealing with stakeholders and aligning the value for each Smart City initiative with all relevant stakeholders in a Smart City. These concepts were used as a normative lens for viewing stakeholder importance in a Smart City (Section 4.2). The most relevant theories selected are the three key domains of this research, namely, smart cities, value and alignment. The normative lens helped to verify which theory applied to selecting appropriate stakeholders for initiatives in smart cities (Section 4.3), and investigating the value co-creation theory in the context of smart cities. To make important abstractions that can illustrate the theoretical constructs for stakeholder value from Smart City initiatives, the alignment concepts were confirmed (Section 4.4). The Technology, Organisation, and Environment (TOE) theory was identified to be used for the classification of categories (Section 4.5). Data value is regarded as important as data are collected ubiquitously in smart cities (Section 4.6). The VASCS Concept Model is presented after the verification through the use of the theoretical concepts (Section 4.7). A summary of this chapter is presented (Section 4.8). The Chapter 4 structure is presented in Figure 4.1.

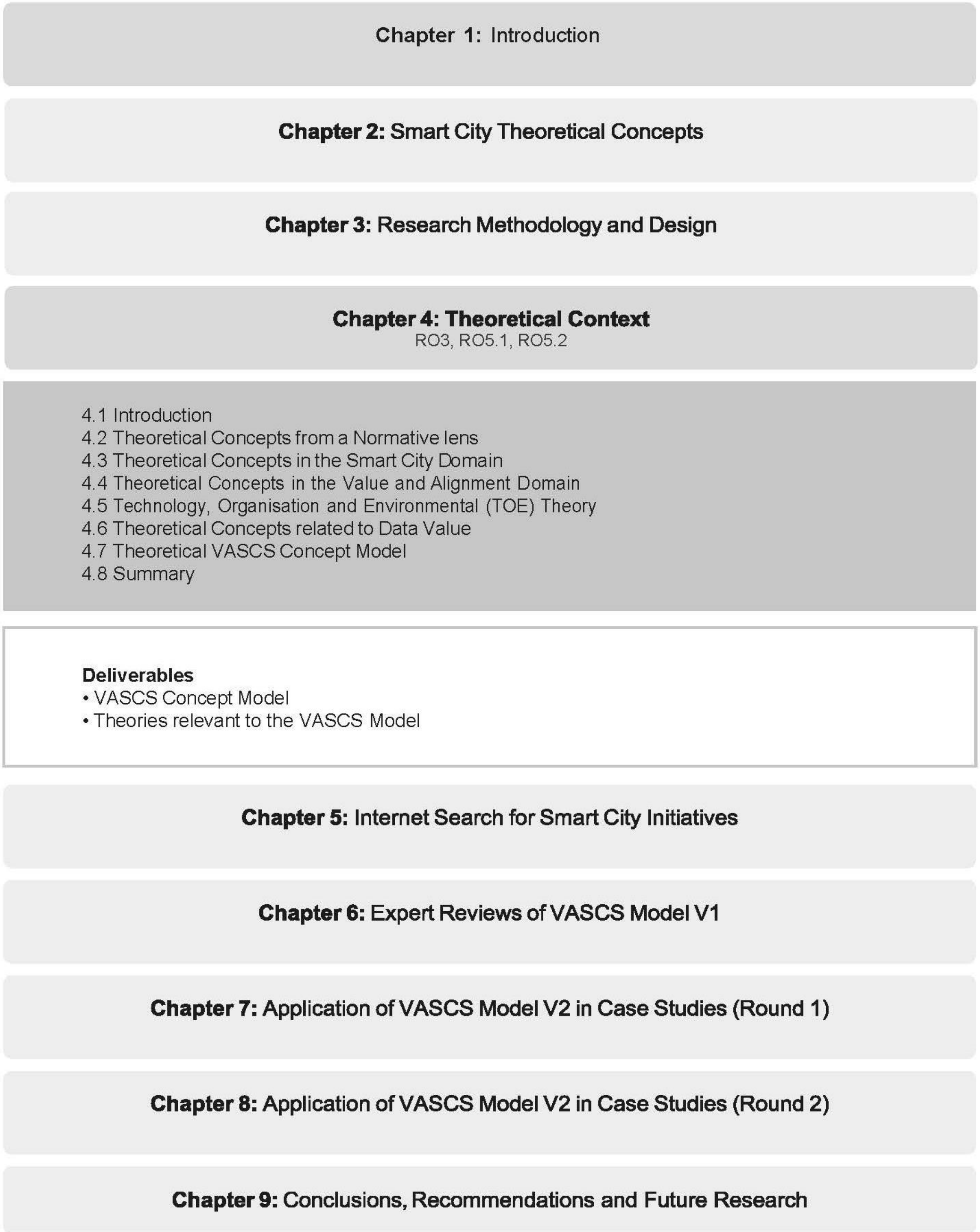

Figure 4.1: Chapter 4 Structure

4.2 Theoretical Concepts from a Normative Lens

Gregor (2006) indicates that when a theory is used as a lens, it is a theory with the force of as statements which can provide the lens for viewing and explaining the world. Authors in the IS field that are known for using theories as a lens are Orlikowski and Robey (1991) for their structuration theory and Walsham (1997) for the actor-network theory. These theories can be used as a lens to view the emergent theory or emerging concepts in the IS field (Urquhart et al., 2010). Gregor (2006) identified the following five theory types in IS research:

- Type I – Analysis: Says what is. The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.
- Type II – Explanation: Says what is, how, why, when, and where. The theory provides explanations but does not aim to predict with any precision. There are no testable propositions.
- Type III – Prediction: Says what is and what will be. The theory provides predictions and has testable propositions but does not have well-developed justificatory causal explanations.
- Type IV – Explanation and Prediction (EP): Says what is, how, why, when, where, and what will be. Provides predictions and has both testable propositions and causal explanations.
- Type V – Design and action: Says how to do something. The theory gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artefact.

The selected theory type for this study is Type II Explanation, which will allow for the theoretical concepts to be used as a guide in this research. Normative theory, through the political views, was seen to retake the scene after John Rawls' theory of justice was published (Rawls, 1999). Studies that explore normative theories also recognised the influence of the ancient Greek philosophers, Plato and Aristotle. From their establishments around the understanding of human nature, laws and politics, they have also been referred to as the founders of normative political theory (Friedman & Miles, 2006; Gregor, 2006; Mansell, 2013; Pietrzyk-Reeves, 2017).

Pietrzyk-Reeves (2017, pp. 117–118) states that normative theory "*provides a value-based view about what the social world ought to be like or how it ought to work*" and that it "*tries to determine what standards ought to be followed in a political community (domestic or international)".* Routio (2007) reports that a normative study involves ways in which the object of the study can be improved, or existing problems related to the object can be removed. Therefore, it indicates that the values and goals of people related to the object also need to be studied. Routio (2007) reported the following two situations for when to do normative research, as follows:

- **An extensive study** is the general or nomothetic study of a class of objects. The goal is to find ways of improving the entire class. Instruments for this are "***theories of practice***" or "***theories of design***" which are universally applicable; and
- **An intensive** study is project-specific, or idiographic studies that assist in developing only the case that was being studied, or other exactly similar cases.

An ***intensive*** study was followed for this study, as it involves situations where project specific cases can be studied from the two cases in the Eastern Cape. This study involves broader concepts such as stakeholders and alignment of value amongst stakeholders involved in Smart City initiatives. Therefore, it is necessary to investigate theories such as the Triple Helix Model Theory, that highlights the three main types of stakeholders at a national and a multi-national level for innovative strategies (Etzkowitz & Leydesdorff, 1995). These stakeholders are academia, industry, and government. The Complex Value Typology Theory is also relevant since it confirms that value is the nature of the benefits experienced by stakeholders (Rescher, 1969).

Freeman and McVea, (2001, p. 16) say that a normative theory "*would describe why firms should give consideration to their stakeholders*". This is an important description to consider in this study, seeing that smart cities could be the substitute for firms and therefore smart cities should consider the stakeholders in a Smart City. On the other hand, Vargo and Lusch (2008) have come up with foundational premises (FPs) to classify the Service-dominant (S-D) logic. There are studies that interpret some of their FPs as normative statements.

Their view of this is stated as (Vargo & Lusch, 2008: p. 8):

> *"Similarly, in S-D logic, "relational" is not a normative option. The "co-creation of value" premise (FP5) makes value creation inherently relational. That is, value cannot be created any other way". "To emphasize this normative/positive distinction, we have added the word "inherently" to FP8: "A service-centered view is inherently customer oriented and relational".*

From this definition it can be deduced that Vargo and Lusch (2008) identified the importance of co-creation of value as being relational. It also confirms studies highlighting stakeholder importance in smart cities (Section 2.6).

Freeman is known as the father of stakeholder theory and published his landmark book in 1984 to address Strategic Management: A Stakeholder Approach (Freeman, 1984). In this book, he revealed the history of the concept around stakeholders. A stakeholder is defined in the Oxford English dictionary as "*a person with an interest or concern in a business, project*" (Waite, 2012, p. 709). The stakeholder theory as captured by Freeman (1984) states that all stakeholders, namely government, competitors, customers, employees, civil society, suppliers and shareholders and their interest are important in the success of a project in a firm (Figure 4.2). A stakeholder is defined by Reed (1999, p. 7) and interpreted by Friedman and Miles (2006) as "*those with an interest for which a valid normative claim can be advanced*". Whereas normative stakeholders are defined by Phillips (2003, p. 3) as those "*for whose benefit should the firm be managed*".

Figure 4.2: Stakeholder Map (Freeman, 1984)

Thacher (2006) expressed the definition of normative claims through his study about how case study strategies can contribute to normative theory. In his research, he investigates various contributors to the normative research field. He tries to tackle the questions posed by Flyvbjerg (2003) about the "we" being the organisation's researchers and the people being part of the organisation or the organisation being the case in the study. Thacher (2006, pp. 1652–1653) extends the answers by looking at it from the definition of a normative claim: the "*importance of perspective in the study of values*" in two different ways as follows:

- first, the claim that different groups have different needs, interests, and obligations; and
- second, the claim that different people may disagree about what the needs, interests, and obligations of each group are.

The normative analysis of these claims can help those who form part of groups, with their views; for example, the first claim involves groups who value different things. Their views can be about "*how well different kinds of neighbourhoods meet their needs, interests, or even obligations, but the answers for one group may differ from those for other groups*" (Thacher, 2006, p. 1653). The second claim is where people may disagree about the answer to the normative questions. These questions can involve answers to the "*needs, interests, or obligations of a particular group*" (Thacher, 2006, p. 1653). Therefore, a normative claim involves the perspectives of different people forming part of different groups and what they value as significant. In this study, these groups would be those stakeholders giving answers to what it is that they expect from their smart cities and what their roles are to help meet their expectations.

Studies contributing to the understanding of stakeholder theory especially from a normative perspective are listed in Table 4.1. For an in-depth discussion on the theories of these authors refer to Friedman and Miles (2006). Evan and Freeman (1988, p. 97) in their later work also justified the stakeholder theory from a normative view, by indicating that all stakeholder groups have a right to "*participate in determining the future direction of the firm in which [it has] a stake,*". In this study the firm is the Smart City.

Table 4.1: Stakeholder Theory – Key Authors (Author's own construct)

Author	Theory	Contribution
Freeman (1984)	Stakeholder concept defined for management strategy	Stakeholder map
Evan and Freeman (1988)	Kantian Capitalism	All stakeholders have a right to participate in the direction of that in which it has a stake
Donaldson and Preston (1995)	Three aspects of stakeholder theory	D-Descriptive; I-Instrumental; N-Normative
Mitchell et al. (1997)	Three salient attributes of stakeholders (Normative Theory)	Power, Legitimacy, Urgency
Phillips (2003)	Stakeholder fairness principle (four conditions)	The source of moral obligation toward stakeholders
Friedman and Miles (2006)	A guide to stakeholder theories and practice	Update of Freeman (1984) to the development of the stakeholder concept up to 2005
Mansell (2013)	Critique to make stakeholder theory better in that, it will contribute to "to make business and capitalism a system of value creation and trade that is truly fit for human beings."	Critique of stakeholder theory Value creation

Donaldson and Preston (1995) point out that the normative perspective is the base for the critical underpinning of stakeholder theory. They identify three aspects of stakeholder theory (Figure 4.3). The external aspect circle, the D-Descriptive aspect is the representation of how the observed relationships in the external world can be explained through corporate behaviours and characteristics. The second circle is the I-Instrumental aspect representing the predictive value of the relationships and explanations between that of the stakeholder management and the objectives of the corporation, meaning that for every practice observed results are expected.

Finally, the centre is the N-Normative aspect that represents the presumptions from the descriptive and instrumental aspects that managers and other agents act in the sense that all stakeholder interests have *instinctive value*. Without the normative aspect, stakeholder theory will not be representative and would be merely a shareowner theory if the normative aspect is left out. The authors show that the normative theory can be used in three ways:

- To interpret the function or goals of the corporation (i.e. the smart cities in this study);
- To identify the moral guidelines for the operation and management (i.e. city management in this study) of the corporation (smart cities); and
- To guide actions and policies (i.e. for smart cities in this study).

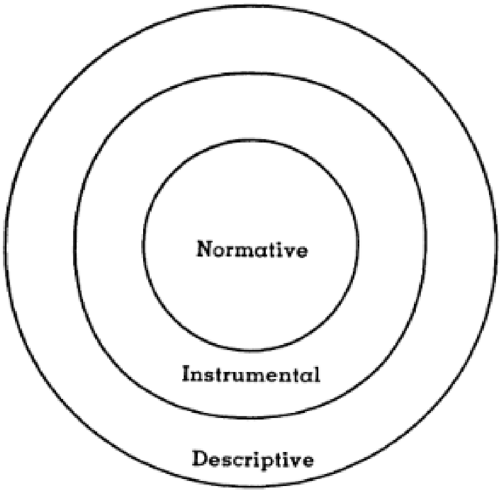

Figure 4.3: Three Aspects of Stakeholder Theory (Donaldson & Preston, 1995)

Mitchell et al. (1997) in their study show how three relationship attributes namely Power, Legitimacy and Urgency can contribute to the theory to identify stakeholders and their relevance ("*salience"* in their study*)*. Their contribution to the relationship attributes of stakeholder theory was "*Urgency*" as one of the three attributes and also contributed to the idea that all the attributes should be regarded as "*Salient*" to managers. Urgency is referred to in their study as the urgent stakeholder claims. Salience is described in their study as to how managers prioritise the stakeholder claims. The "*Power"* attribute between the stakeholder-manager relationship is explained in their study as a variable, which means that power can be gained or lost. "*Legitimacy*" as an attribute is said to be normative in that the stakeholder should be regarded according to the type of stakeholder and that it can be different depending on the position of the stakeholder in the organisation. These attributes can be considered in this study from the view that smart cities have many stakeholders to satisfy. Therefore, to have guiding attributes to determine the *Urgency* of a claim or need as well as the *Priority* that should be assigned to such as claim or need is important.

Phillips (2003) identified that when normative thinking is omitted from the stakeholder theory, then the moral justification for obligations toward stakeholders are missing (Table 4.1). Normative thinking in this regard can be linked to the moral obligation of a city toward its stakeholders.

Friedman and Miles (2006) suggest that the broader the normative claims are, the more extensive the inclusion of stakeholders involved are. Therefore, the narrower the normative claims are, the more specific the stakeholders become. For this study, it is important to note that because of the chosen normative lens, and the fact that a Smart City has many stakeholders that should be considered it is necessary to justify this by viewing stakeholders from a broader normative claim to be able to cover all possible stakeholders in a Smart City. The idea from Mansell (2013, p. 8) is to use the stakeholder theory for "*value creation that is fit for human beings*". To achieve this is to make businesses and capitalism a system of value creation.

4.3 Theoretical Concepts in the Smart City Domain

The main theoretical concepts from the Smart City domain (Section 2.9) were used to identify relevant theories. These are summarised in Table 4.2. The three theories that were investigated and deemed relevant are as follows:

- The Hexagonal Dimension Theory proposed by Kishore and Sodh (2015) used cases to show how to apply the theory in a Smart City domain. These cases were Giffinger et al. (2007) and Giffinger (2011). The theory is based on models that address relationships between the dimensions and the related indicators or factors of the six Smart City dimensions. Therefore, the theory was used to confirm the first six dimensions for the VASCS Concept Model;
- The Strategic Priority Areas Theory from Kishore and Sodh (2015) proposed that models can include or focus on more than one of the strategic priority areas in a Smart City; which are policy, economics, technological and environmental. In this study the term dimension is used to relate to a strategic priority area. The Strategic Priority Areas Theory therefore guided the confirmation of the additional dimensions in this study, adopted from Alawadhi et al. (2012) namely Smart Policy; Smart Organisation, and Smart Technology-and-ICT Infrastructure;
- The process for adopting and implementing technological innovation is represented by the Technology, Organisation and Environment (TOE) theory (DePietro et al., 1990). The TOE theory is presented in (Section 4.5); and
- The Triple Helix Model Theory was first proposed by Etzkowitz and Leydesdorff (1995) and emphasised the importance of academia, industry, and government in any innovative strategy at a national or multi-national. Leydesdorff and Deakin (2011) then used the theory to illustrate how important the roles of academia, industry and government are to supply innovative strategies and innovation systems in smart cities.

Therefore, the Triple Helix Model Theory was used to verify the component of stakeholder roles and stakeholder types in the VASCS Concept Model, and how each of these roles play an integral part to achieve successful Smart City projects and related initiatives.

Table 4.2 Smart City Theories (Author's own construct[4])

Theoretical Concepts	Applied in Smart City studies	Components confirmed in the VASCS Concept Model
Hexagonal Dimension Theory Kishore and Sodh (2015)	Giffinger et al. (2007) Giffinger (2011)	Original dimensions: Smart People; Smart Governance; Smart Economy; Smart Environment; Smart Mobility; and Smart Living
Strategic Priority Areas Theory Kishore and Sodh (2015)	Alawadhi et al. (2012)	Extra dimensions: Smart Policy; Smart Organisation; and Smart Technology-and-ICT Infrastructure
Triple Helix Model Theory Etzkowitz and Leydesdorff (1995)	Leydesdorff and Deakin (2011)	Stakeholder roles and types

4.4 Theoretical Concepts in the Value and Alignment Domain

Table 4.3 list the six relevant theories related to value in chronological order. These theories are:

- Value Chain Analysis Theory;
- Service System;
- Service Science and Service-Dominant Logic;
- Theory of Value Co-creation;
- Service Eco-System Theory; and
- Complex Value Typology Theory.

Table 4.3: Value Theory – Key Authors (Author's own construct)

Theory	Contribution
Value Chain Analysis Theory Porter (1985)	Value chain activities.
Service System Maglio and Spohrer (2008)	Service system and service science theoretical perspectives.
Service Science and Service-Dominant Logic Vargo et al. (2008)	Service science involves reconceptualising value and value creation.
Theory of Value Co-creation Galvagno and Dalli (2014)	Impacts on theory building, management decision making and teaching.
Service Ecosystem Theory Pellicano et al. (2019)	The perspective of value in the urban context.
Complex Value Typology Theory Rescher (1969)	Extended the VASCS Concept Model in this study with the five phases of benefits' realisation.

[4]These results were published in Lecture Notes in Computer Science (refer to Appendix C)

Porter (1985) illustrated the **Value Chain Analysis Theory** through primary and support activities, which became a standard value chain that was used by businesses to determine value creation in two ways namely: cost advantage or differentiation. Cost advantage was achieved when a business reduced the cost of their activities and the cost of their products or services. Differentiation allowed businesses to sell their competitive products and services at higher prices. Therefore, Porter's theory of value chain analysis showed the monetary worth of something as value.

Maglio and Spohrer (2008) indicate that to properly use service-for-service exchange, it should reflect the **Service System**, which allows the configuration of resources (including people, information, and technology) that is connected to other systems using value propositions.

Vargo et al. (2008, p. 8) show that value-co-creation exists at a Service System level as: A service system represents any value-co-creation configuration of people, technology, value propositions connecting internal and external service systems, and shared information (e.g., language, laws, and measures). The smallest service system centers on an individual as he or she interacts with others, and the largest service system comprises the global economy. Cities, city departments, businesses, business departments, nations, and national agencies are all service systems.

Vargo et al. (2008) show that the perspective of **Service Science** is the study of service systems where a complex configuration of resources to co-create value is involved. The intersection of **Service Dominant (S-D) Logic** is seen as the foundation of service science and value creation in service systems. Their study views value as: "*co-created through the combined efforts of firms, employees, customers, stockholders, government agencies, and other entities related to any given exchange, but is always determined by the beneficiary (e.g., customer)*" (p. 148). Their view of value co-creation shows the importance of different stakeholders having to collaborate efforts to see this value and that there is always a beneficiary of this value.

Value configuration is desribed by Osterwalder and Pigneur (2002) shown when a business undergoes a process of creating value by arranging their activities using a business model. A business can create value when it integrates and applies its resources in a specified context (Vargo et al., 2008).

Vargo et al. (2008) state that traditionally, value creation was based on a firm's output and its monetary value. Their study presents an alternative view on value creation, that it is the integration and application of resources in a specific context and is not based on the traditional view of value creation of service-for-service exchange. They also report that Service Science involves service systems and value co-creation of complex configurations of resources. They recommended that future studies should focus on the processes of value co-creation and measurements of the value-in-use, other than service-oriented disciplines such as economics. Co-creation is defined as "*the joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically*" (Galvagno & Dalli, 2014, p. 664). These authors argue that for a clear purpose for co-creation to take place, value should be regarded as the centre. This view is the **Theory of Value Co-creation**.

Pellicano et al. (2019) draws from two studies that illustrate the value co-creation in service ecosystems (Vargo & Lusch, 2010) and value co-creation and service systems with an ecosystem view (Vargo & Akaka, 2012), and illustrates a Smart City **Service Ecosystem Theory** perspective. Based on the above illustration of a service system, a Smart City can be regarded a Service Ecosystem and can be linked to the perspective from Pellicano et al. (2019) indicating the importance of normative practices in a Smart City. Their study shows that practices based on normative views can help to regulate exchange between actors (stakeholders) through appropriately defined guidelines and rules; and regulate the respective responsibilities between the stakeholders (Pellicano et al., 2019).

Sarker et al. (2012), in their study, confirmed that many organisations, at the time were turning to processes to co-create value with the relevant stakeholders involved. Their study reported on results from two large Enterprise Resource Planning (ERP) vendors showing how to systematically examine value co-creation in a business-to-business (B2B) case. The partners/firms had resources that would form part of the value co-creation process and only then could co-creation value be achieved for all the relevant stakeholders from these organisations.

Flak et al. (2015) applied the framework established by Sarker et al. (2012) and used a government case study in Norway to validate their approach to co-realisation of IT value in a collaborative setting. The main registrar centre was a partner in the benefits realisation process for the Norwegian government. Flak et al. (2015), replaced the value co-creation process with five phases for benefits realisation (Figure 4.4). The five phases were successfully adopted as follows:

- Phase 1 – *Articulate benefits*. Was responsible with the help of the service owner to identify the benefits area, to support existing benefit areas and thus to explore potential benefit area for new services;
- Phase 2 – *Plan benefits realisation.* Elaborating ideas into a detailed benefits plan with action steps to ensure that the benefits would be realised;
- Phase 3 – *Implement plan.* Implement the plan according to the benefit plan from phase 2;
- Phase 4 – *Measure benefits realised*. The service owner has to measure the benefits according to the measurements from the benefit plan in Phase 2, and report these to the registrar centre; and
- Phase 5 – *Evaluate benefits, gaps and needs*. The registrar evaluates all the reports from all service owners and decides on corrective measures to be taken where delays in services are evident.

Flak et al. (2015) reported that these phases could be applied to any IT development initiative and any size project. Their model gives a good indication of how to identify the factors that could affect value co-creation as well as the major stakeholders that should be involved and that the phases can be used as a guiding process for achieving co-created value.

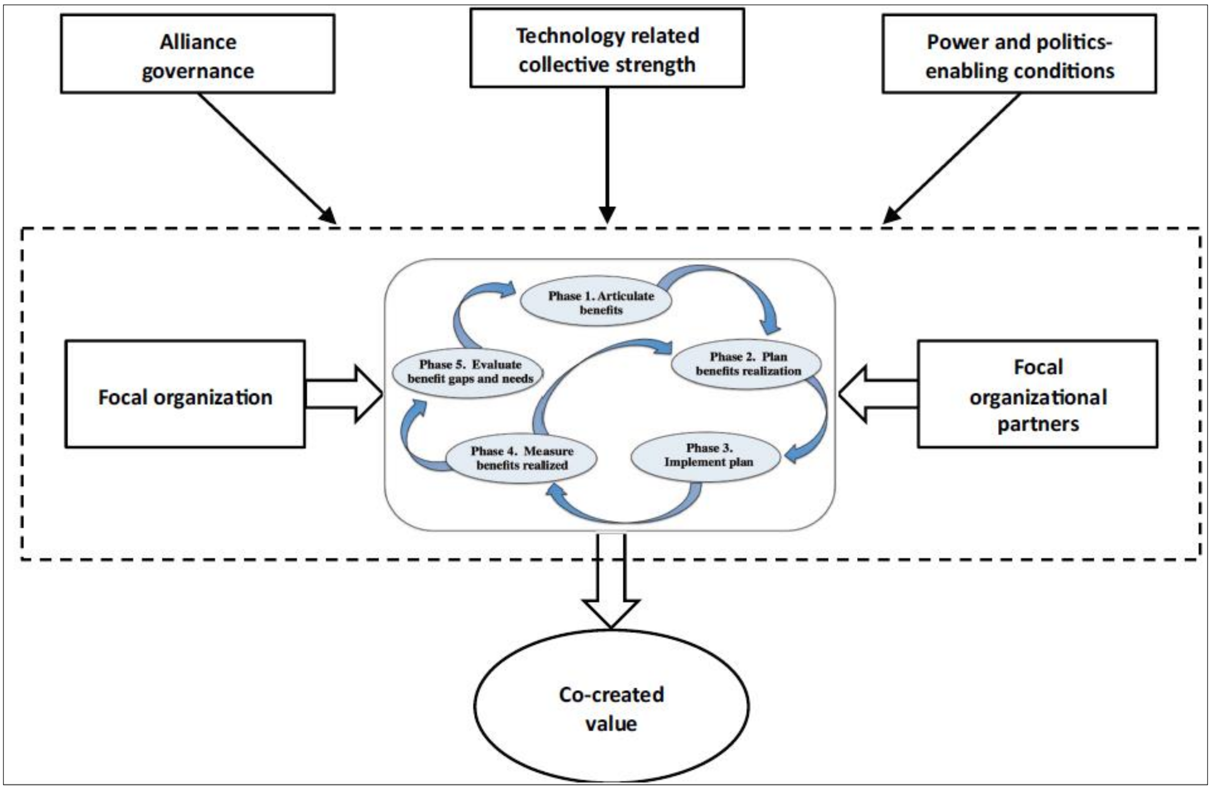

Figure 4.4: Integrated Process Model for Co-realisation of Value (Flak et al., 2015)

The complex value typologies explained by Rescher (1969) summarise the understanding of value in this study as value is the nature of the benefits gained by stakeholders. This typology is adopted as the **Complex Value Typology Theory.**

The importance of value alignment for stakeholders is captured by Freeman (2018) as follows: "*The 21st Century is one of "Managing for Stakeholders." The task of executives is to create as much value as possible for stakeholders without resorting to tradeoffs. Great companies endure because they manage to get stakeholder interests aligned in the same direction.*"

Freeman (1994) uses the 'normative core' perspective for stakeholder theory and explains that the value creation activity is a *"contractual process among Financiers, customers, suppliers, employees, and communities".* The alignment theories are two theories related to the concept of alignment. The Strategic Perspective of Alignment Theory illustrated by Avison et al. (2004) is based on the alignment of business and technology strategies. Their findings contributed to the understanding that alignment can be achieved, but in organisations that have a dynamic environment into which strategic planning must be integrated at all levels of a firm.

The alignment perspectives found by Campbellet al. (2005) are that researchers and practitioners need to work together when creating alignment strategies, and these should be a priority when planning any strategy but alignment should also be ensured during implementation of the strategies. Burn and Szeto (2000) stated that one of the key success factors that should be considered when aligning business and IT strategies, is that management should ensure the appropriate selection of an alignment approach. The Structural Alignment Theory outlines the design and structure of roles and responsibilities of an organisation (Rose et al., 2015). Rose et al. (2015) stated that the major perspectives of alignment should include the processes of any organisational structure internal and external, that relational aspects should exist between these processes and stakeholders, and that the strategic views should be articulated in terms of what needed to be achieved.

Strategic Perspective of Alignment was used in this study to confirm the importance and understanding of the alignment perspectives from the view that a Smart City's components need to be aligned according for achieving success in any Smart City project (Figure 4.6). The Structural Alignment Theory was used to confirm that the stakeholder roles were strategically selected (Torraco & Swanson, 1995) and need to be aligned according to the Smart City initiatives in order to realise value and benefits for all stakeholders while creating a '*strategic fit*' (Chorn, 1991). The next section outlines how the theoretical contexts for the TOE theory that can be used as categories to classify relevant findings accordingly.

4.5 Technology, Organisation and Environmental (TOE) Theory

The Technological context relates to all the technologies of a firm or organisation and these are technologies that are used by the organisation or those that are marketed (Baker, 2012; DePietro et al., 1990). The adoption of technology innovations needs to be planned accordingly, as these innovations can have major or minor impacts on firms and industries (Baker, 2012).

The Organisational context is characterised by resources of an organisation such as size and others which integrates employee structures, the communication processes and slack resources (Baker, 2012; DePietro et al., 1990). The focus is to structure these resources to promote innovation, but it can also deter innovation if not well structured (Baker, 2012). The Environmental context is focused on how the industry is structured and whether or not technology providers exist and the industry's governmental regulations (Baker, 2012).

Technology is one of the key drivers of innovation in smart cities (Irungbam, 2016; Joshi et al., 2016). Previously, Dewi et al. (2018) used the TOE theory to measure Smart City readiness's adoption decisions. They show that data management and analytics as one of the technology enablers in smart cities. Therefore, the technology context in smart cities consists of both data and non-data related technologies. Since technological innovations are key elements to all nine dimensions of a Smart City, it was deemed relevant to use the TOE theory as it is embedded in the model (Figure 4.6) and illustrated by the three dimensions (Smart Technology and-ICT-Infrastructure, Smart Organisation, Smart Environment). In this study, the TOE theory is used to undergird the findings from the interviews from the cases according to the TOE constructs (Chapter 7 and Chapter 8).

4.6 Theoretical Concepts Related to Data Value

The value of data and information is evident when it is used and translated into services which can be successfully used by stakeholders such as citizens. (Section 2.8). In Curry (2016) the European Big Data Ecosystem is used to illustrate the importance of having all key stakeholders' part of the ecosystem to be successful and to clearly indicate the benefits for each stakeholder. The Data Ecosystem is classified as successful if all stakeholders can interact seamlessly in a digital market, while gaining access to data knowledge and beneficial business opportunities (European Commission, 2014).

Curry (2016) indicates that if industries of Smart City initiatives collaborate and co-create their data, that the value returned can be greater for all stakeholders. The importance of data value chain activities (Curry, 2016) in this research is that it should be considered to understand what valuable information can be obtained from various data sources and how best to inform Smart City initiatives. The Big data value chain (Figure 4.5) can be used to understand the '*value-creation of data technologies*' (Curry et al., 2014, p. 1), and is said to be similar to the value chain proposed by (Porter, 1985) that is applied to an Information System.

The data value chain shown in Figure 4.5 consists of a set of five activities that includes sub-activities (Curry, 2016). The activities are described as follows (Curry et al., 2014, pp. 1–2):

- Data Acquisition includes the process of *gathering, filtering and cleaning data* prior to adding it *in a data warehouse,* analytical storage solutions and other relevant storage which allows data analysis;

- Data Analysis is the activity where the raw acquired data is modified to *use in decision-making as well as domain-specific usage*;
- Data Curation involves processes where data are actively managed over the data lifecycle in order to *ensure it meets the necessary data quality requirements for its effective usage*;
- Data Storage includes activities of *storing and managing data in a scalable way* for applications to access the data; and
- Data Usage is where the data can be accessed for analysis and integration purposes for decision-making activities.

The data value chain lends its sub-activities to what is required in collecting smart and digital data in smart cities. The example used in Curry et al. (2014) illustrates the data analysis activity where the collection of big data volumes from Smart City data were used to provide traffic and emergency response applications. The Smart City data were collected from sensors, social media, citizen mobile reports, and municipality tax data.

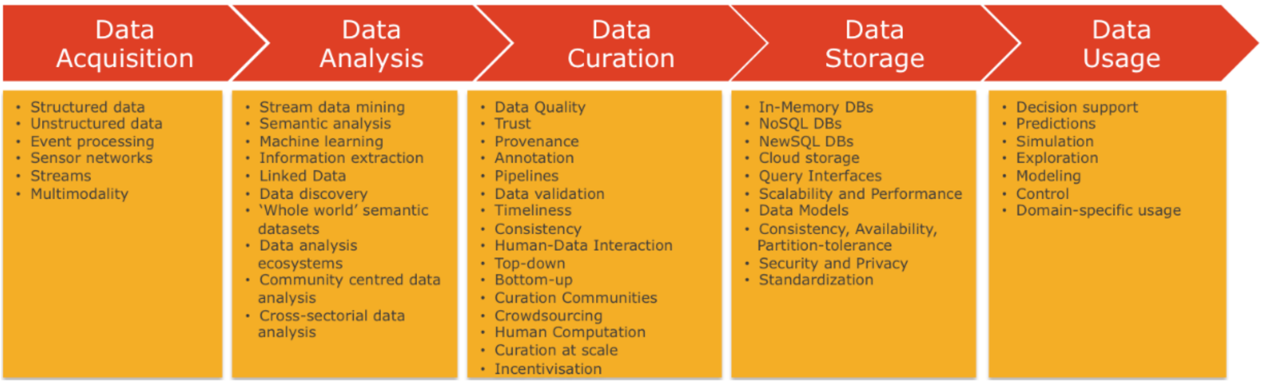

Figure 4.5: Big Data Value Chain (Curry et al., 2014)

4.7 Theoretical VASCS Concept Model

The initial theoretical framework was presented in Figure 2.12. The findings from the SLRs in Chapter 2 and from the selected theories (Section 4.2; Section 4.3; Section 4.4; and Section 4.6) were used to verify the components of the VASCS Concept Model, which is shown in Figure 4.6. Table 4.4 summarises the theories used to confirm the VASCS Concept Model.

Table 4.4: Summary of Theories confirming VASCS Concept Model components

Component in Figure 4.6	Confirming Theory
Alignment	Strategic Perspective of Alignment Theory; Structural Alignment Theory
Value Alignment	Theory of Value Co-creation; Complex Value Typology Theory
Dimensions (with success factors)	Hexagonal Dimension Theory; Strategic Priority Areas Theory
Stakeholder roles and types	Triple Helix Model Theory
Benefits/Value Realisation	Five Phases for Benefits Realisation
Digital Value Chain	Porter's Value Chain Analysis Theory
Technology Oranisation Environment Theory Embedded in the Entire Model	

Two types of models, namely process models and action models were identified by Nilsen (2015, p. 3) as part of theoretical approaches. An action model type is used in this study and is described as follows:

> **An action model** "*is a type of process model that provides practical guidance in the planning and execution of implementation endeavours and/or implementation strategies to facilitate implementation*".

Based on the explanation of an action model when referring to the proposed model of this study, it is seen as appropriate to use the term model. This will help to illustrate how the proposed model can be used in practice, from a theoretical view based on the concepts and theories from the Smart City field and from the value and alignment domains (Chapter 4). These theories have been used and applied to confirm the framework components and thus proposed a model in this study.

Figure 4.6consists of the five core theoretical components illustrated in Figure 2.12 and confirmed by the theories listed in Table 4.4. The difference between Figure 2.12 and Figure 4.6 is that the model was extended by adding the benefits realisation for the five value phases to indicate the phases and steps that can be followed in order to identify value for all stakeholders in a Smart City. The five benefit realisation phases are (Flak et al., 2015):

- Phase 1 – *Articulate benefits;*
- Phase 2 – *Plan benefits realisation*;
- Phase 3 – *Implement plan*;
- Phase 4 – *Measure benefits realised*; and
- Phase 5 – *Evaluate benefits, gaps and needs.*

The other component added is the Digital Value Chain activities. These activities are proposed to identify the digital activities from all the Smart City initiatives and which of the data value chain activities can be classified.

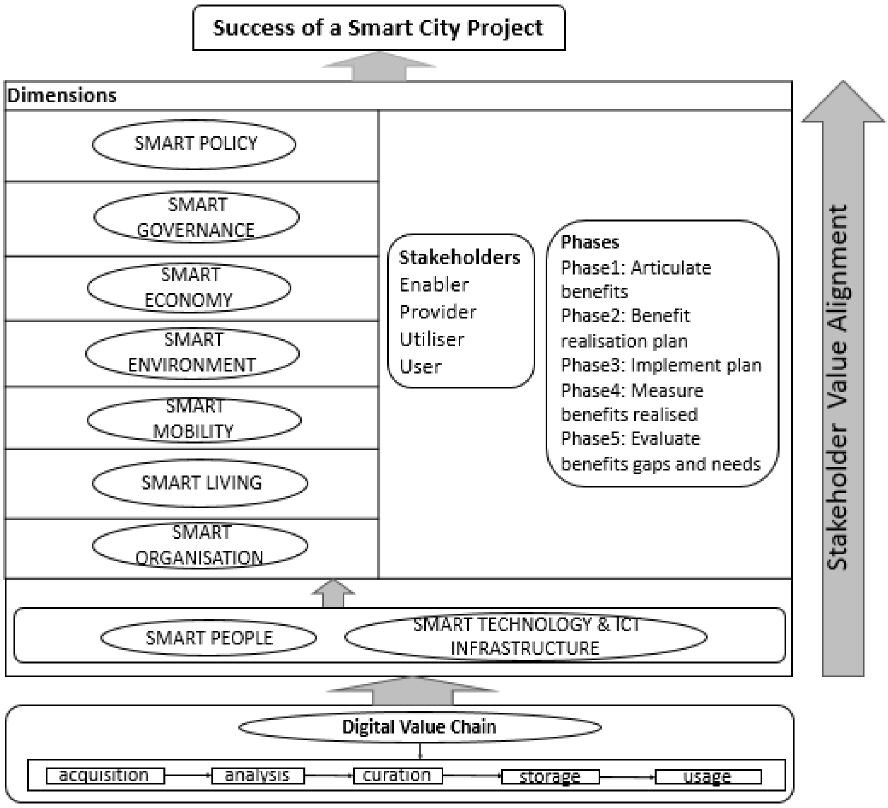

Figure 4.6 VASCS Concept Model[5]

The term 'digital value chain' was selected to use in the VASCS Concept Module instead of the term 'data value chain', in order to identify where digital data activities occur and to exclude manual activities related to the value chain. It is found that when referring to data in Smart City literature that the term digital is commonly used to reflect that the data is collected by using sensors. Rouse and Chala (2016) confirm this in their definition of smart data, as:

> *"Smart data is digital information that is formatted so it can be acted upon at the collection point before being sent to a downstream analytics platform for further data consolidation and analytics"*.

[5]These results were published in Lecture Notes in Computer Science (refer to Appendix C)

Rouse and Chala (2016) reported that the term 'smart data' is directly linked to IoT related smart sensors that are connected to objects and where data entry occurs. They further explain that the 'smart' term is where data entry is handled in an intelligent manner where decision making about the data takes place on its entry points.

From the above, it can be deduced that smart cities depend on information flow in order to create collaboration and integration amongst the different components (Curry, 2016). Curry (2016, p. 36) agrees that information flow is a "*series of steps needed to generate value and useful insights from data*". The understanding of alignment should be for all stakeholders where value can be realised for each Smart City initiative linked to the dimensions in a Smart City. Then once these components are adhered to, success of a Smart City project can be achieved.

4.8 Summary

The objectives of this chapter were achieved by identifying the theories that relate to stakeholders (RO_3) and stakeholder value in smart cities. The first part of $RO_{5.1}$ was achieved in this chapter by identifying the phases that should be applied in a Smart City to identify the criteria for value and that the nature of the benefits experienced by stakeholders can be measured as value. These phases were therefore incorporated in this study and can be considered for benefit realisation and for identifying the value for stakeholders in a Smart City ($RO_{5.1}$). Furthermore, it was confirmed that value can be created through collaboration amongst stakeholders from different Smart City initiatives and by aligning the value to all stakeholders of the initiatives ($RO_{5.2)}$. The theories were used to confirm the concepts of the theoretical framework from Chapter 2and to design the components of the VASCS Concept Model (Figure 4.6).

In the following chapter, Smart City initiatives will be discussed from an international and a national view.

Chapter 5 - Internet Search for Smart City Initiatives

5.1 Introduction

Research has been done on smart cities; however, few studies have analysed Smart City initiatives. This study views a Smart City initiative as one that forms part of any of the nine Smart City dimensions listed in Table 2.5.

In Chapter 1 to Chapter 3, the broad contexts of this study were described. In this chapter the more specific contexts (as per FraIM) of Smart City initiatives are investigated in terms of their data and IoT initiatives and projects implemented internationally and nationally. This chapter reports on Stage 2 of the Research Design that was conducted to meet the following two research objectives:

- RO_4: Analyse and classify existing digital activities for smart cities in a developing country; and
- $RO_{4.1}$: Identify the data and IoT initiatives.

The Internet Search followed a systematic procedure (Section 5.2). The technologies and initiatives found in the Internet search were analysed and refined (Section 5.3). Preliminary data, open data sources and IoT related initaitves were identified from studies addressed in previous chapters and in this chapter (Section 5.4). Examples of data policies in both the national and international contexts were investigated (Section 5.5). International Smart City initiatives were identified (Section 5.6), as well as Smart City initiatives in South Africa, which is a developing country (Section 5.7). The VASCS model was used to identify stakeholders and Smart City initiatives in the Eastern Cape, since this is the province of the cases being investigated (Section 5.8). Therefore, a selection of active initiatives or initiatives that are being implemented formed part of the final list of locations where technologies were used. Summaries are provided about the findings of this chapter (Section 5.9). The Chapter 5 structure is presented in Figure 5.1.

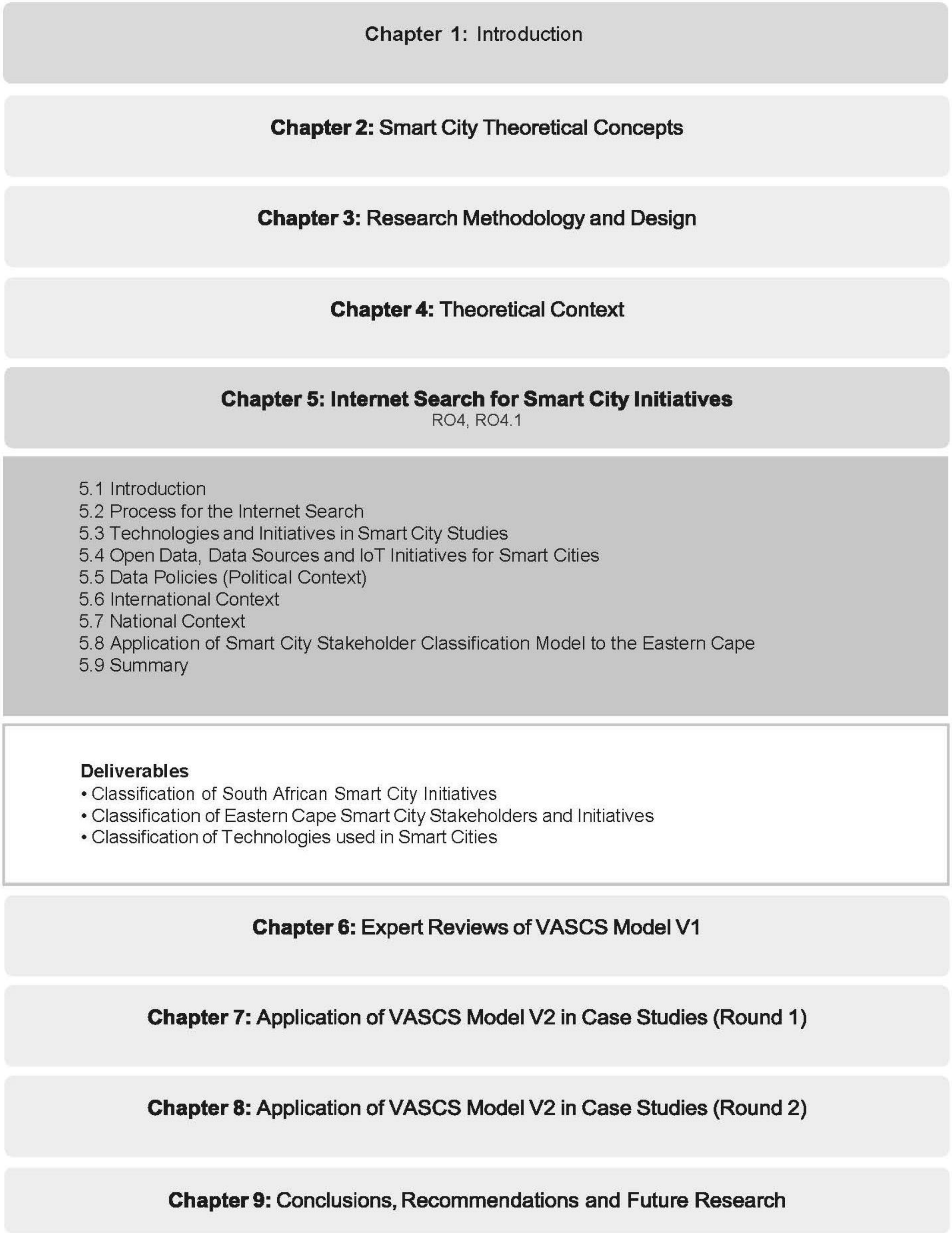

Figure 5.1: Chapter 5 Structure

5.2 Process for the Internet Search

The first step of the Internet Searches started with a search of technologies in a Smart City by using the Web of Science (WoS) database. The second step was to select the date range, which was for journal articles from the last decade (2009 to 2019). The third step was to refine the list to the final selected publications.

The search resulted in the return of 51 documents where the minimum record count was set to ten (Figure 5.2). The 51 documents consisted of articles, reviews and editorials from the research areas relevant to the Smart City topic and field, which included Computer Science, Engineering and Telecommunications. The list was refined to return only the journal articles, and because of this refinement, 21 journal articles were shown. Each of the 21 articles was analysed to identify IoT and data initiatives in the Smart City context.


Sort by **Record count** | Show **100** | Minimum record count 10 | Update | How are these totals calculated?

Select records to view, or exclude. Choose "View records" to view the selected records only or "Exclude records" to view the unselected records only.

Select	Field: Research Areas	Record Count	% of 51	Bar Chart
	COMPUTER SCIENCE	31	60.784 %	
	ENGINEERING	25	49.020 %	
	TELECOMMUNICATIONS	23	45.098 %	

Figure 5.2: Search term "*Technologies for Smart Cities*" Results (Web of Science, 2019) [6]

Figure 5.3 represents the refined list of 21 publications that were identified from this search by using the search term: "*technologies for smart cities*", for journal articles published between 2014 to 2019.

[6] The record count in each column is the total number of articles published in the selected year. The count includes Early Access articles that are fully peer-reviewed, citable, and published but have not been assigned a volume/issue/page/page number (Web of Science, 2019).

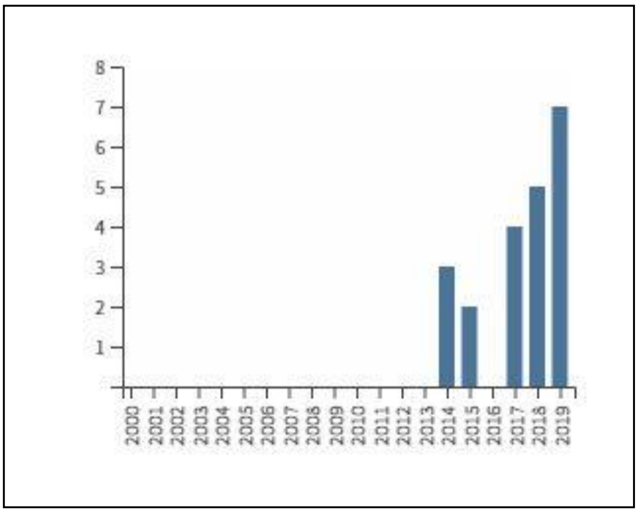

Figure 5.3: Total Publication by Year (Web of Science, 2019)

5.3 Technologies and Initiatives in Smart City Studies

This section reports on the findings of the Internet Search to determine the different initiatives and technologies implemented in the Smart City studies identified. It is important to note what technologies are being used internationally and what purpose these technologies serve for Smart City initiatives. Further, it is also important to identify which of these solutions have been practically implemented.

The 21 studies were from different contexts, approaches and countries. Nine were proposed theoretical examples, three were conducted simulations, one was a systematic analysis of smart city cases, one was based on a fictitious city, and two were scenario-based case studies. The remaining five of the 21 studies were the only ones that were either practical solutions, surveys or case studies of implemented solutions (D'Aquin et al., 2015; Hu et al., 2019; Kamolov & Korneyeva, 2018; Santana et al., 2018; Yaqoob et al., 2017). These five are therefore highlighted in grey in Appendix L and summarised in Table 5.1.

Table 5.1 summarises the technologies used in the five studies from the WoS Internet Search that were practically applied in the smart cities identified. Four of the five focused on IoT technologies; thus, it is one of the most common Smart City technologies that have been used across cities to achieve their initiatives. These technologies are project specific and can therefore be used as a guide to know which technologies could work in similar projects and initiatives. Only one of the studies was conducted in a developing country, namely that of Brazil (United Nations, 2020).

Table 5.1: Technologies used – International Smart City Initiatives

Author and City/Country/Continent	Technologies	Types	Purpose
D'Aquin et al. (2015) ***Milton Keynes*** ***United Nations***	IoT Semantic Web Technologies	Sensors	Data Hubs (Data Management and Data Usage)
Yaqoob et al. (2017) ***Barcelona*** ***Stratford*** ***Singapore*** ***Porto***	Fibre optical 3G 4G WiFi WAN Ultra-high-speed 1Gb/s nationwide broadband access Wireless broadband infrastructure NetRider Multi-networks On-board units Fibre	Networking	Communication and Networking
Kamolov & Korneyeva (2018) ***Rio De Janeiro (in a developing country-Brazil)*** ***Santander***	IoT	Sensors	Enhancement and Associated Risks
Santana et al. (2018) ***European Smart Cities***	IoT		Open Platforms for Creation of Services
Hu et al. (2019) ***China (Peking University-Beijing and Xidian universities, University- Xi'an)***	IoT-based Ground sensing IoT-based Arial sensing		Air Quality Data Monitoring System

Due to space constraints, the list of 21 articles is not included in the body of the thesis, but is included in Appendix L where they are summarised and listed in chronological order (between 2014 to 2019). The first study in Appendix L was a model proposed by Orłowski (2014), which consisted of integration technologies that can be used to build Smart City systems. However, at the same time, they can be used to learn from the input and output data to improve the process of selecting technologies to create improved Smart City systems. Takebayashi et al. (2014) reports that smart technologies, such as demand response (DR) and automated DR (ADR) should be used in smart cities to control the electricity demand and supply while preserving the environment and reducing social costs for electricity use.

Wenge et al. (2014) proposed a data architecture for smart cities, consisting of six layers, namely: events, domain services, support, storage and vitalisation, data transportation and data acquisition. They proposed the architecture from a data perspective, which highlights the importance of data in smart cities. For each of the layers, certain technologies are required, which include tags, virtual tags, sensors connected to the Internet, as well as location-based or geographic information services (GIS) and systems.

The technologies that are required to transmit the data include wide bandwidth and cloud computing. Then, once the technologies and data are in place, other smart devices and systems can make use of Smart City services.

D'Aquin et al. (2015) indicated the importance of semantic web technologies and examples of this potential were highlighted through Milton Keynes (MK)-Smart and Hypercat data hubs. The study showed that once a data hub of any sort is set up properly and key role players are involved in contributing and using such hubs, cities have the potential to create and use Smart City services.

Khorov et al. (2015) refer to the wireless local area network (WLAN) standard, IEEE 802.11ah, which is a standard created to support IoT requirements. They proposed supporting descriptive algorithms to indicate how this standard can be applied, especially in wireless sensor technologies. They used Smart City use cases that focus on sensor applications such as smart meters, smart grids, environmental and agricultural monitoring, automation of industrial process, indoor healthcare and fitness systems, and an elderly care system.

He et al. (2017) reported that information security, privacy and anonymity of residents and citizen data has become sought after in smart cities and they proposed the use of a generic identity-based broadcast encryption (IBBE) scheme. The benefits of using this scheme for Smart City systems are to obtain both confidentiality and anonymity against chosen-ciphertext attacks.

Tucker et al. (2017) reported on ideas for innovative Smart City infrastructures to transform the fictitious OFCity, based on the geographical area of Vilnius in Lithuania, into a Smart City. The winning ideas addressed the low-uptake of broadband challenges and proposed:

- The gigabit city (where the entire city should have fibre rollout to all premises, free WiFi in public spaces);
- A community engagement program (examples: OFCity Portal, innovation hubs, heated city swimming pool);
- A network plan (public-private partnerships, open access to promote competition amongst retailers); and
- A budget model (encouraging upgrades at future decreased prices).

Another set of winning ideas addressed the challenge of making the city the most livable and attractive city and proposed:

- Applications and services (that citizens would require to live in a Smart City and thus use affordable network cloud infrastructure to enable innovative services such as on demand transportation, e-health, e-government applications);
- Architecture and technology (focus on open and standard-based infrastructure to ensure multi-solution creation through dynamic sharing of resources); and
- A business plan (using fibre and intelligent technologies can save up to 50% of a budget. A budget should also include funds allocated to invite businesses and citizens to create smart services for the city).

Yaqoob et al. (2017) proposed a taxonomy of technologies and networks that can be used to enable a Smart City (Figure 5.4). They identified four practical solutions as the case studies addressed and shows the communication and networking technologies used in these. The taxonomy can be used to identify which technologies and networks are required for a Smart City project, based on the objective of the project and the required wireless standard for the project.

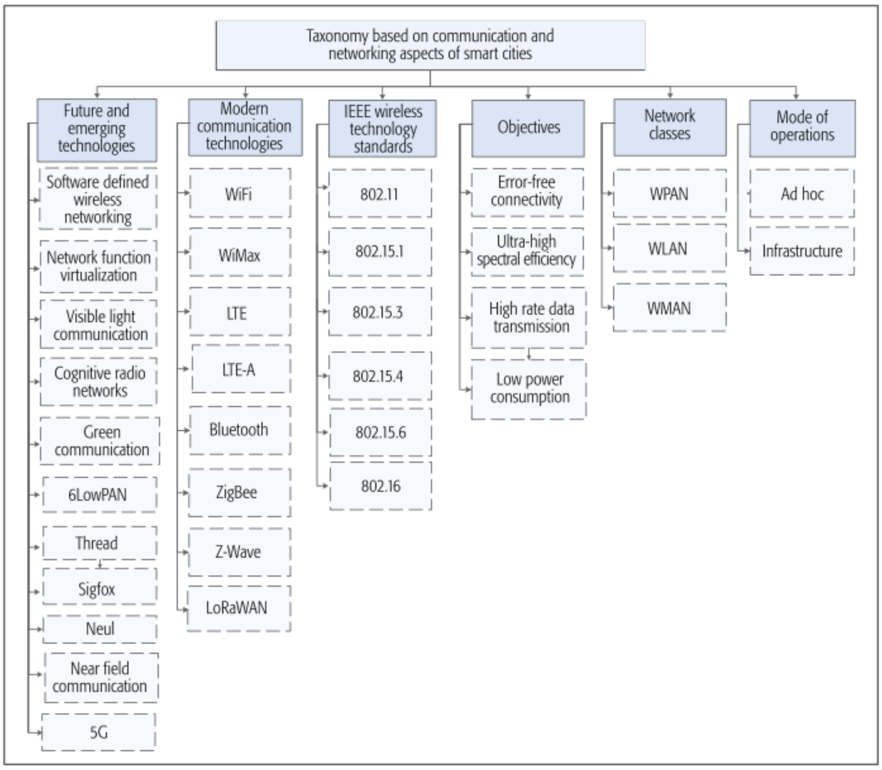

Figure 5.4: Taxonomy of Enabling Communication and Networking Technologies for Smart Cities (Yaqoob et al., 2017)

Yaqoob et al. (2017) also indicate the advantages and disadvantages (Figure 5.5) of using the modern communication technologies identified in Figure 5.4. The eight modern communication technologies are as follows:

- WiFi;
- WiMax;
- LTE;
- LTE-A;
- Bluetooth;
- ZigBee;
- Z-Wave; and
- LoRaWAN.

The advantages can be summed up as either having power saving, low cost, high-speed Internet, or broader coverage of an area. Their study recommends that future Smart City technologies should address the challenge of overcoming limited devices being connected using communication technologies and that such connections should be error-proof. It can be deduced therefore, that when a city does consider technologies for a Smart City, they should take into account different aspects such as existing infrastructure and what could work in addition to that.

Modern communication technologies	Advantages	Disadvantages
WiFi	(a) Lack of wires (b) User can move, no need to be stuck at one place	(a) High signal attenuation (b) Limited service radius (c) Less stable compared to wired connections (WiMAX)
WiMAX	(a) High-speed wireless Internet (b) Broad coverage area	(a) Expensive to install
LTE	(a) Backward compatibility and future-proofing (b) High spectrum efficiency (c) Reduce the problem of lagging in Internet connection	(a) Higher cost due to the usage of additional antennas at network base stations for data transmission
LTE-A	(a) High data rates (b) Particularly elevated voice excellence	(a) High cost (b) Accessible in convinced cities only
Bluetooth	(a) Cheap (b) Easy to install	(a) Short-range communication (b) Secure flaws
ZigBee	(a) Power saving (b) Collision avoidance (c) Low cost	(a) A bit slower
Z-Wave	(a) A lot simpler than ZigBee	(a) Mobility management is very difficult (b) Security flaws
LoRaWAN	(a) Low power consumption (b) Secure bidirectional communication (c) Low cost	(a) Short-range communication

Figure 5.5: Advantages and Disadvantages of Modern Communication Technologies (Yaqoob et al., 2017)

Hui et al. (2017) identified technologies and requirements for building a smart home in a Smart City based on IoT. The technologies are:

- Wired/Wireless sensor networks;
- Mesh networking;
- Indoor localisation;
- Web of Things (WoT);
- SOA;
- Cloud computing;
- Reactive programming;
- Human Computing Interaction (HCI);
- Activity recognition;
- Identity Management (IdM);
- AI;
- Recommendation methods; and
- Semantics.

Billhardt et al. (2018) used the Agreement Technologies (AT) sandbox approach in their study to depict the interdependence of each technology level in the tower or sandbox which is representative of systems or software agents. The technology levels provide functionality to the next level. The lowest level is the semantics level, the second the norms level, the third the organisations level, the fourth the argumentation and negotiation level and the top level is the trust level. These levels depict the information flow of each of the technologies used at specific systems in a Smart City and the information flow feedback can be used from the top-level (trust) as input to the lower levels (semantics).

The AT sandbox approach is proposed to be used to get large scale open systems to achieve their Smart City visions. Examples of this included economic incentives where information is offered. For closed systems, or domains, the benefits of using AT were the simulated interactions, which led to new functionalities and services.

Ferraro et al. (2018) proposed a twofold use of distributed ledger technologies (DLT). Firstly, to implement social contracts for software/system agents to access shared resources and secondly, for digital currency deposits to access a network of shared resources.

The idea is to use DLT as a social compliance aspect to train models and systems to become more stable in Smart City environments and to influence human behaviour through such enforced digital aspects for example, restricting parking times at specific public spaces.

Kamolov and Korneyeva (2018) highlighted the importance of IoT technologies to enhance smart cities. They indicate the main disadvantages of having many IoT devices connected in a Smart City is the data, information and security risks.

Santana et al. (2018) reported that Europe is addressing the challenge of smart cities through becoming the leaders in this field of research by producing novel solutions such as open platform initiatives. The main challenge addressed for these initiatives in Europe is to overcome the vertical silos in single cities and amongst other cities. Therefore, projects focused on architectures to address this are proposed, namely, the FESTIVAL project, the OrganiCity project and the FIESTA-IoT project. A brief explanation of each project is given below (Santana et al., 2018):

- FESTIVAL project: focuses on the heterogeneity issues in smart cities and focuses on using aggregators to bridge the integration gap between different platforms, while adhering to security protocols;
- OrganiCity project: focuses on decision making in smart cities as well as focusing on citizen and community involvement. Therefore, the project uses urban data and co-creation tools in their experiment tier; and
- FIESTA-IoT project: focuses on using IoT experiments as a service paradigm and focuses on using taxonomies and ontologies to handle data from various sources.

Usman et al. (2018) presented a classification of Localisation and Proximity (LP) technologies that can be used to enable Location-based services (LBS) in smart cities. Examples of the LP technologies include Global Navigation Satellite System (GNSS), Assisted-GNSS, WiFi-based Positioning System (WPS), Cellular Network-based Positioning, and Bluetooth. However, these technologies still have issues in achieving the required accuracy and security in LBS. Therefore, emerging technologies such as Multiple-Input and Multiple-Output (MIMO), LTE-M (Long Term Evolution-machine type communication), NB-IoT (narrowband), and 5G should be addressed to overcome security issues by incorporating security features in their technology standards.

Caputo et al. (2019) illustrated the use of Big Data in the Smart City domain by showing the interrelated data process between smart technologies such as sensors, data collector systems, the applications and the customer. The customer in their scenario has an emphasis, as the customer is seen as the user of the data but must be encouraged to contribute data back into the process to create improved services.

Duan et al. (2019) showed the importance of AI and deep learning technologies in video management for smart cities and that it can operate as the visual brain of the city and in turn, contribute to the future development of AI technologies. For video management, the challenge that was highlighted was to standardise bitstream syntax to achieve the required compressed features for surveillance and retrieving videos at optimal quality.

Habbal et al. (2019) proposed a conceptual model for Context-aware Radio Access Technology (CRAT) selection. They completed many simulations of their model based on two scenarios of which the user will have real-world experiences namely, a shopping mall and an urban city. The results proved to be beneficial based on their 5G mobile network, where Smart City applications were used. The model showed improvements of the throughput, packet delivery ratio, number of handovers and average network delay, compared to other similar models.

Hu et al. (2019) reported the implementation of an air quality data monitoring system in China at two universities, that was prompted by the air pollution health risk issues that have become a world-wide concern. They proposed a system architecture that consists of four layers, namely: sensing layer, transmission layer, processing layer and presentation layer. The sensing layer includes the ground sensing device and the unmanned aerial vehicle (UAV). The transmission layer is where the base station is located, which sends push notifications from the processing layer (database server, web server, WeChat server) to the sensing layer and uploads data from the sensing layer to the processing layer. The processing layer is in the cloud with all the servers required to send data to the presentation layer, where users can access and interact with information on the air quality maps website and the WeChat Official Account.

Lu et al. (2019) created a technology roadmap to identify technologies and applications required to build a Smart City by using different benchmark cases around the world. They identified the two technology development trends, namely Biometric Sensor integrated circuit and Water, Power and Energy Monitoring, for world-wide case studies.

Malik et al. (2019), in their literature review study, proposed that the integration of Cloud, IoT and Internet of Everything (IoE) technologies should be integrated to achieve Smart City services. They further highlight that not only should these technologies be used to create Smart City services, but that these technologies should also be used to improve the platform for smart cities.

Yu et al. (2019) reported that auditing in Smart City environments, related to big data auditing schemes, is seen as an important aspect especially because of the reliance on Third Party Auditors (TPAs). In their study they propose the use of blockchain technologies and capabilities to decentralise the big data auditing scheme for Smart City environments.

The 21 studies identified in the WoS Internet Search had different types of technologies, which the researcher grouped into six broad categories. Each category was mapped to the purpose of use identified in the related articles and the frequency for each of the six types was calculated. All 21 studies related to data and IoT Smart City initiatives. The frequencies for each category of technology were as follows:

- Network and Communication (*f*=13) - consisted of 13 types of technologies and had the highest frequency count;
- Sensors (*f*=10);
- Integration technologies (*f*=4);
- Location Based (*f*=3);
- Semantics (*f*=2); and
- Machine Learning (*f*=1).

The results of the mapping from Atlas.ti are visualised in Figure 5.6. The technology category blocks in the visualisation are all shaded in grey. For example, Decision Making Algorithms on the left of the figure are a purpose of use that are linked to the categories of Integration and Network and Communication technologies. For example, User Experience in Smart Environments is a sub-purpose to Network and Communication technologies.

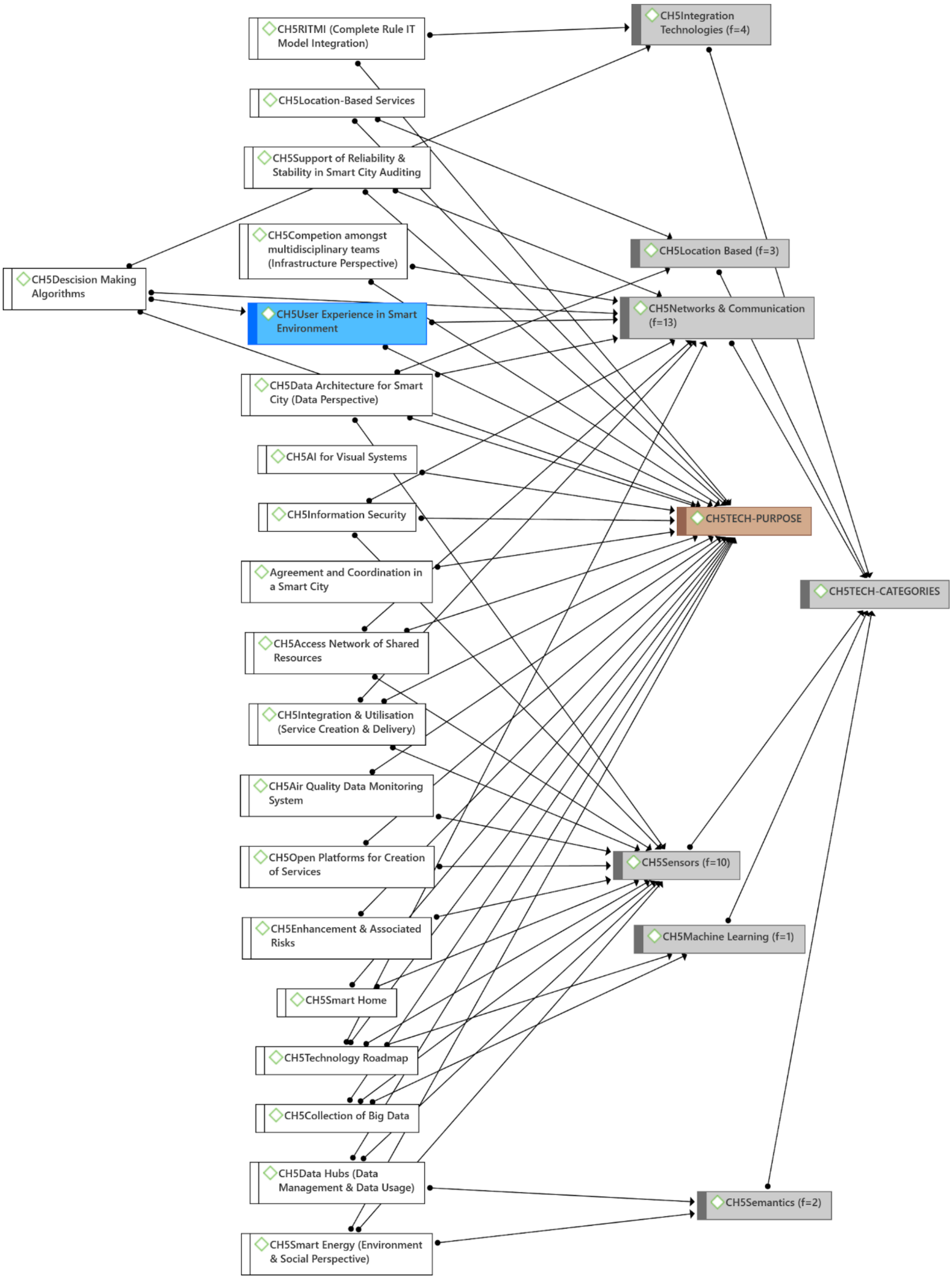

Figure 5.6: Technologies and Purpose of Use from WoS Internet Search (Author's own construct)

5.4 Open Data, Data Sources and IoT Initiatives for Smart Cities

The Smart City definition (Section 1.1) illustrates the importance of information exchange within a Smart City. It is evident from the review of existing literature undertaken (Section 1.1 and Section 2.7), that the results and recommendations from different studies identify the importance of open data.

Some of the opportunities for smart cities are that the data are in a digital format through IoT, AI and machine learning technologies, making real-time collection, processing and sharing easier and therefore, decision making and solution development is becoming faster and more advanced (Allam & Dhunny, 2019). The previous section highlighted the technologies found in 21 studies of smart cities that were proposed, and future technologies that could be integrated with current technologies to improve the data and information architectures of smart cities. Aspects in the previous sections also highlighted the many data and information security challenges that exist in smart cities. In this section, the data value chain initiatives and activities of smart cities are reviewed.

Open data is a term that was introduced by the Committee on Geophysical and Environmental Data who formed part of the National Research Council in Washington, DC (National Research Council, 1995). This was prompted to exchange and disclose complete scientific data on geophysical and environmental data between countries. Important reasons were highlighted by the National Research Council (1995, p. 2) for the global, open and full exchange of scientific data. One of the main statements were: "*The Earth's atmosphere, ocean, and biosphere form an integrated system that transcends national boundaries*", and that in order to understand the elements of such an integrated system and to address issues at a global level, it necessitates the collection and analysis of environmental data of the world. One of the highlighted benefits of this open data exchange at a global level, is that it would be cost-effective and efficient to share data and information, rather than doing the individual tasks of gathering data independently.

Kassen (2017, p. 238) explains that open data is a *phenomenon,* and in his study, refers to open data "*as a combination of various formats and types of government datasets, that are publicly available in special depositories as a raw material for further formatting and processing in various third-party open data-driven applications, computer programs or hybrid mobile and online platforms without any copyright restrictions on its reuse and further processing*".
This study by Kassen (2017) focused on presenting a policy review of the open data movement in the Nordic state in Sweden. The result achieved, in his research was that the policy review process could help other countries in evaluating and improving their operations of various open data-driven projects.

Open data is described by Ojo et al. (2015) as a concept that is a Smart City initiative, as it has become a key part of defining a Smart City. They developed a Smart City Initiative Development (SCID) framework to support a formal evidence base for open data Smart City initiatives. Their SCID framework tries to simplify the linking of Smart City initiatives to a city policy and the impact on stakeholders and city transformation outcomes, which is influenced by enablers, critical success factors and challenges that the city might experience.

To use information in a Smart City, data needs to be collected from different sources within the city (Section 2.8). Several studies (Lea & Blackstock, 2014; Scriney et al., 2017; Yadav et al., 2017) explore data sources and how they can be used to provide services in a city. However, before quality services can be considered, the quality of the data used is important. Therefore, Smart City studies are trending on data formats and data sources for analysis purposes (Scriney et al., 2017; Yadav et al., 2017). Limited studies focus on data quality to attract investors and other stakeholders or, whether the data is accurate or valuable enough for investors and other stakeholders to make informed decisions.

Lea and Blackstock (2014) state the importance of access to Smart City data streams from different types of systems, which will allow for the next generation of Smart City applications. A more recent study by Allam and Dhunny (2019) confirms this argument, where it is encouraging that in using AI adoption as a source of big data analysis, it can help cities with the integration of cognitive computing to produce improved urban design, planning related processes and governance. Some other key data sources identified by Lea and Blackstock (2014) were: open data, IoT objects, city sub-systems, and static and real-time data sources (e.g., traffic). They also proposed the use of a Smart City portal as a central point of data access in emerging smart cities. The portal is based on the IoT hub (Figure 5.7) concept, as it is seen as more promising when used as an architectural framework for smart cities (Lea & Blackstock, 2014). The hub uses an IoT architecture and has two offerings, namely:

- A consistent and easy-to-use interface for emerging IoT infrastructure of the city that can be used by systems integrators and application developers; and
- A point of interoperability where common hub APIs allows developers access to other city hubs and each of these hubs can represent a subset of the Smart City infrastructure.

The core idea for identifying open data sources found in smart cities is promoted by the research of Lea and Blackstock (2014), who stated that if IoT in a city can be combined with open data then, "*developers can begin to find the links between disparate data sources, build the next generation of Smart City applications, and identify opportunities to optimize city services*" (Lea and Blackstock, 2014, p. 2).

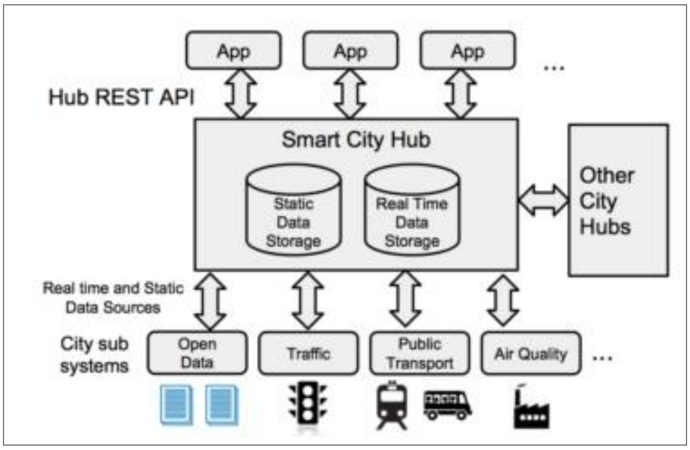

Figure 5.7: IoT Hub as a Smart City Portal (Lea & Blackstock, 2014)

Scriney et al. (2017) agree that Smart City data is primarily sourced from web streams producing Extensible Markup Language (XML) and JavaScript Object Notation (JSON) data, which is transformed by using algorithms to produce readily available data cubes. Their study further states that it is important to collect data from different providers to add value to the services required by citizens.

Open data portals are seen as a primary data source for the way forward to create sustainable Smart City solutions (Yadav et al., 2017). They refer to the evolution of open data as being fundamental to a citizen's right to public information. The study shows that different types of open data have many benefits such as innovation, collaboration, decision making, and service delivery, as well as insight into critical questions from policymakers.

One of the leading open-source data portal platforms in the world is CKAN (Comprehensive Knowledge Archive Network). The CKAN organisation published that "*CKAN is a powerful data management system that makes data accessible by providing tools to streamline publishing, sharing, finding and using data*" (CKAN, 2017). The CKAN system and concept is adopted by most developed countries and cities (Yadav et al., 2017). It is, therefore, necessary to identify which processes can offer value using open data sources that will help cities in developing countries such as Africa, use their sources of data to deliver services or meet the needs in the city (Section 4.6).

Hwang et al. (2016) propose a value configuration framework for IoT diffusion based on empirical studies where RFID, sensors, wireless sensor networks (WSNs), real-time locating systems (RTLS) and near-field communication (NFC) were used. They identified the IoT attributes which add value in a specific business context. The framework consists of three levels, namely: the value chain activities level, the service level and the market level. Their study proposed nine value chain activities at the activity and organisational level that can be used to identify and classify the clusters, where IoT technologies are used. The framework was based on the findings from 762 IoT business cases from different empirical studies. The resultant analysis of the framework was to assist businesses, which are early adopters of IoT to understand how IoT technologies could be used to add value within their business processes. The next section identifies the related data policies for smart cities.

5.5 Data Policies (Political Context)

The Political context is addressed in this section for both the National and International contexts as part of the FraIM methodology. In the previous chapter, the Theoretical context was addressed for the different Smart City domains. Policies relevant to a Smart City are of particular importance, since Smart Policy is one of the nine dimensions of a Smart City. This dimension includes political components as well as "*the form of a city government, mayor-*

council and council-manager type, and the relationships among key players such as mayor or city manager, council, and related agencies) and institutional components (law, regulation, code, and intergovernmental agreement"(Alawadhi et al., 2012, p.43): This description of policy in the Smart City context provides a comprehensive idea about the political components that should be considered within a Smart City.

Curry (2016) states that to achieve an effective big data ecosystem amongst European countries, societal and environmental challenges such as "*Reducing fragmentation of languages, intellectual property rights, laws, and policy practices between EU countries*" (p. 35) need to be overcome.

Tshiani and Tanner (2018) addressed the data privacy concerns of citizen in Cape Town, a Smart City in the Western Cape of South Africa. They indicated that policy makers and practitioners should take the onus of protecting citizen data collected through Smart City initiatives. The City of Cape Town is the first city in South Africa that launched an open data portal and a related open data policy (City of Cape Town, 2016).

When personal data and information are shared, it is required to address policies outlining the legislation of what is allowed to be shared publicly or kept anonymous. Therefore, the Protection of Personal Information Act (POPIA) should be described. POPIA is a South African act established to protect the information and privacy of people and was agreed upon in 2013. However, the commencement date, as indicated by the president of South Africa, is said to be 1 July 2020 (POPIA, 2020). The goal of POPIA is:

> *To promote the protection of personal information processed by public and private bodies; to introduce certain conditions so as to establish minimum requirements for the processing of personal information; to provide for the establishment of an Information Regulator to exercise certain powers and to perform certain duties and functions in terms of this Act and the Promotion of Access to Information Act, 2000; to provide for the issuing of codes of conduct; to provide for the rights of persons regarding unsolicited electronic communications and automated decision making; to regulate the flow of personal information across the borders of the Republic; and to provide for matters connected therewith.*

A study addressing the impact of cloud computing on South African regulation frameworks such as the POPIA, was conducted (Mohlameane & Ruxwana, 2020). Although their study included expert interviews and questionnaires, their findings highlighted challenges of the understanding and implementation of the POPIA.

Their findings were that 56% of the participants disagreed that "*existing ICT policies and regulations in South Africa address issues of cloud computing*" and that 39% of the participants indicated that they did not know about such policies. However, they indicated the POPIA to be the best legislation to enable cloud computing and to ensure protection and privacy of personal information in South Africa.

The General Data Protection Regulation (GDPR) is the European regulation and is similar in its intention to the POPIA for South Africa. The GDPR articles are shown for 2016 but their latest applicable version is from 25 May 2018. The main objectives of the GDPR are as follows (GDPR, 2018):

- *This Regulation lays down rules relating to the protection of natural persons with regard to the processing of personal data and rules relating to the free movement of personal data*;
- *This Regulation protects fundamental rights and freedoms of natural persons and in particular their right to the protection of personal data*; and
- *The free movement of personal data within the Union shall be neither restricted nor prohibited for reasons connected with the protection of natural persons with regard to the processing of personal data*.

Privacy of personal data and information is causing concern to many. Therefore, acts and regulations such the POPIA and the GDPR, to name a few are important in the context of a Smart City, which depends on vast amounts of data to be collected, analysed, shared and used for various purposes. The following sections investigate the different Smart City initiatives on an international and a national level i.e., South African.

5.6 International Context [7]

Some examples of Smart City initiatives have been reported on around world-wide. The studies discussed in this section had the following themes in common:

- Citizen and people centric (three studies);
- Organisation based (one study);
- Governmental and economy (three studies); and
- Infrastructure-driven (four studies).

The three Smart City initiatives found in cities from Australia, Greece and the United Kingdom, had more of a citizen and people centric approach. The first initiative was from Townsville City in Australia. In this city, citizens can have their say on new Smart City strategies (Townsville City Council, 2018). The Townsville City Council believes that this will help the community to be involved in the future of the city. The Townsville city strives toward using council data in a smarter way; for people to make use of city parking data, and to make real-time decisions about where and how to access services. The issues reported concerning Townville city's council data are classified as an "underused resource". Townville City's Projects as part of their strategy are:

- Technology to detect water leaks;
- Online dashboards for the community to monitor Council's performance;
- Transacting more Council services online;
- Making Townsville a more attractive place to relocate, study and build a business using a data driven campaign to highlight the benefits; and
- Reinvigorate the Central Business District (CBD) by using innovative technologies, including special event lighting.

The second initiative was from communities in Greece. Marinakiset al. (2018) found that in these initiatives, the potential of ICT and IT to create smart and innovative platforms and systems can contribute to better empowerment and behaviour of people (Marinakis et al., 2018). Examples include how incentives and ownership contribute to changing the behaviour of citizens toward energy use, which contributes to sustaining smart cities.

[7] Some of the results in this section have been reported on and published in a Springer book chapter (refer to Appendix E)

The third initiative was Milton Keynes (MK) founded in 1967, which is classified as a Smart City and is one of the fastest growing cities in the United Kingdom. It has received many smart awards between the years 2014 and 2017 (Motta, 2017). The MK Smart City vision includes initiatives on transport, energy, water, an MK data hub, enterprise, citizens and education. One example shown on the MK-Smart website is that input provided by an elderly citizen, led to the creation of a navigation system in their shopping mall for visually impaired citizens (Motta, 2017).

The organisation-based study was from Denmark, where public organisations were mandated to go paperless; this was possible and achieved by all organisations due to the well-developed digital infrastructure of the country (Snow et al., 2016), thereby, making Denmark a place where Smart City testing and implementations happen. One of London’s well known Smart City initiatives is the *Transport for London Open Data and Big Data* (Van Den Bergh et al., 2018). Small business solution developers can use the open data that was fed into the initiative from larger businesses to develop innovative city solutions, allowing for low, or no cost data, being made available for advantageous opportunities.

The Governmental and economy-based initiatives were from India, Russia and Burkina Faso in Africa. The Indian initiative, reported by Patil et al. (2017), found that surveillance systems with affordable IoT and web service have become part of key Smart City initiatives, especially in countries with very large populations (Patil et al., 2017). In their study, they propose Google drive as a cloud storage service for accessing and storing data timeously. The use of surveillance systems for crime monitoring in cities was also proposed by Lu et al. (2019) and Mehmood et al. (2017).

In Russia, the need to create an improved digital economy was shown where it was implemented as a National Technological Initiative (Vorobieva et al., 2019). Russia has a technology-based entrepreneurial community and the government made efforts toward benefitting the community by establishing this initiative and the government has already predicted the growth of the digital economy over the next 15 years to be worth $100 billion US dollars.

Burkina Faso, a country in the West of Africa, depends largely on their fishing agriculture to survive (Zougmore et al., 2018). The fishing agriculture is a large contributor to the country's economic well-being. A sensor-based network solution was deployed at the country's Nazi Boni University, the Aquaculture and Aquatic Biodiversity research unit. The solution was used to help with the monitoring and managing of activities at the fish farms and the soil moisture of their fields. The research unit is part of the Smart City data initiative to collect the agriculture data and then to supply this data to farmers to aid their decision-making activities. The research unit used a cloud platform and a 3G modem to achieve their objectives.

Infrastructure driven Smart City initiatives were identified by Yaqoob et al. (2017), who reported four case studies where communication and networking technologies were used to enable smart cities. These case studies are described below and are from Barcelona, Stratford, Singapore, and Porto:

- Barcelona, Spain, is seen as a city that transformed itself into a Smart City. Barcelona focused on using ICT to get different sectors in the city on board with the automation of processes and their identities. The three core structures of their Smart City are around digital transformation, digital innovation and digital empowerment. Barcelona focused on enabling their Smart City initiatives with various smart technologies (*3G and 4G technologies, WiFi mesh network, sensor network, public WiFi network, mobility plan, heating and cooling systems, energy networks, underground galleries*);
- Stratford, Canada, presented their Smart City initiatives with a focus on smart metering initiatives and economic growth. Technologies that were used for the smart metering project included: *Motorola's 802.11n mesh wide area network (MWAN), Motorola AP 7181 802.11n* (outdoor access point) and *GPON AXS1800 system* (*encrypted smart meter data*). These meters were installed into 200 homes with 40 access points. Electricity usage was monitored and accessed remotely by companies that were part of the stakeholders involved in the project;
- Singapore focused on sustainable urban development for smarter cities. The Smart City drivers stemmed from a need for an intelligent transportation system and a lack of natural resources. Sensors were implemented to establish their intelligent transportation system through using their existing technologies, such as their *ultra-high speed 1 Gb/s nation-wide broadband* and their wireless broadband infrastructure. The taxicabs had *GPS devices and network sensors* installed. The benefits that were achieved were

improved traffic monitoring, predictions and route planning. Another benefit was the use of RFID cards for disabled individuals as part of their intelligent transportation system, where extended crossing times were allowed when the card was tapped at the traffic light. They are also known as a leading Smart City, globally; and

- Porto in Portugal converted its transportation and mobility challenges into Smart City solutions. They used their existing infrastructures such as their fibre and WiFi to build a connected city by connecting their public transportation system to a network. Therefore, it is reported that they have one of the largest *WiFi-in-motion networks*.

5.7 National Context

Table 5.2 shows the results of Step 2 of the Internet Search (Section 3.5.2) to identify active or implemented Smart City initiatives that were reported on in the provinces of South Africa. Initiatives were identified in five of the nine South African provinces. These provinces are the Eastern Cape, Gauteng, KwaZulu Natal, Free State and Western Cape.

Efforts of Smart City initiatives in South Africa, which have been highlighted by the 2015 SALGA report, included providing free WiFi in the major cities at viable locations (SALGA, 2015). This has been confirmed in major cities in the Eastern Cape, Western Cape, Gauteng and Free State and indicates that the government is committed to delivering services and to add to "*a robust information society and knowledge economy that is both inclusive and prosperous*" (ITWeb, 2016).

The South African National Roads Agency Limited (SANRAL) focused on providing their Intelligent Traffic (i-Traffic) Management Systems in Gauteng, the Western Cape and KwaZulu-Natal (SANRAL, 2012). i-Traffic is a type of LBS which provides motorists web access to real-time traffic information such as road conditions, incidents, roadworks and weather forecasts (Usman et al., 2018).

Table 5.2: South African Smart City Initiatives

Province/City	Initiative and Technologies	Reference
Eastern Cape		
• NMB	• The Re-Trade Project • NMBM Application • Nelson Mandela University Solar Farm • Free WiFi Project • KaziBantu • Joe Slovo West township school	• ReTrade Project (2020) • NMBM App (2020) • Rogers (2019) • ITWeb (2016) • Steinmann (2017) • Beamon (2020)
• Buffalo City	• SmartWire Application • Buffalo City Citizen Engagement Application • BCMM Tourism Application • Designer Lighting Application	• BCMM (2019b) • BCMM (2019a) • Groove IS (2020)
Gauteng		
• i-Traffic		• SANRAL (2012)
• Melrose Arch	• New Smart City in South Africa–11 years old	• Melrose Arch (2020)
• Tshwane	• Namola Application • Free WiFi Project	• Namola (2017) • ITWeb (2016)
• Pretoria	• Gautrain Application	• Gautrain (2020)
• Johannesburg	• Pelebox	• Mzekandaba (2019)
	• Johannesburg Roads Agency's (JRA) Find & Fix Application	• Newsroom (2014)
• Ekurhuleni	• Free WiFi Project	• ITWeb (2016)
KwaZulu-Natal		
• i-Traffic		• SANRAL (2012)
Free State		
• Free WiFi Project		• ITWeb (2016)
Western Cape		
• i-Traffic		• SANRAL (2012)
• Cape Town	• Open data portal • MyCiti Application • Gunshot detection system • Strategic Surveillance Unit • Parkfind • Free WiFi Project	• City of Cape Town (2018) • MyCiti (2020) • City of Cape Town (2018a) • Parkfind (2017) • ITWeb (2016)
• Stellenbosch	• Namola Application	• Namola (2017)

The NMB broader Smart City initiative was planned and based on a partnership approach to address the economic challenges in the city (Regional Innovation Forum, 2018).

The reported initiatives established in the NMB are as follows:

- The Re-Trade Project – "is a community-based recycling and social empowerment project" and was established to help the local communities who need the basics for food and essentials, while educating those members about sustainability and environmental responsibility (ReTrade Project, 2020);
- NMBM Application – was launched to assist residents with services such as pre-paid electricity purchases, utility statement requests, utility bill payments, incident reporting and meter readings (NMBM App, 2020);

- Nelson Mandela University Solar Farm – launched in 2019, it is said to generate sustainable electricity by using sun energy and is estimated to help the South Campus at the university reduce their electricity peak demand by 40% (Rogers, 2019);
- KaziBantu – also translated as active people, is a project that was a continuation of the Disease, Activity and Schoolchildren's Health (DASH) project (Steinmann, 2017). The DASH project was established during 2014 and was organised to use an intervention toolkit to help school children from disadvantaged communities around Port Elizabeth, which is part of the NMB, to improve their health. The goal for the KaziBantu project is to reach more schools in South Africa and to help pupils and their teachers through literacy about living healthier and being active; and
- Joe Slovo West township school – this project was initiated by a young architect from Nairobi who built a school in the Joe Slovo West township, situated in Port Elizabeth in NMB, from only recyclable materials. These types of projects are needed to alleviate the urbanisation stresses in cities (Beamon, 2020). This project is an example of the Smart Living and Smart People dimension since smarter ways were used to erect a school that can now be used to reach many children to be educated. The project was also used as a tool to educate citizens of Joe Slovo West township on usable materials that can be collected to build something. Stakeholder involvement was necessary to promote, fund and achieve the completion of this project.

Ettmayr (2018) reported on initiatives that are needed in order for Buffalo City to be a Smart City and highlighted the need that, for this to happen, existing ICT solutions should be integrated into the city's operations.

The reported initiatives founded in Buffalo City are as follows:

- SmartWire Application – this was created based on the smart meters that were installed around the city for consumers to gain access to accurate billing records and monitoring of electricity use (BCMM, 2019b);
- Buffalo City Application – this was originally on their website, but more recently a notice appeared on the city website to say that the "Citizen Engagement Mobile App is currently not working till further notice" (BCMM, 2019a);
- BCMM Tourism Application – the tourism application is also listed on the city website for download from Apple Store and Google Play store, but the links are not working (BCMM, 2019a); and

- Designer Lighting Application – this is an application that was designed for the citizens to report faults for street, traffic and unmapped lights (Groove IS, 2020). Users can track the status of the reported faults and receive notification of the statuses.

The reported initiatives founded in the Gauteng province are as follows:

- Melrose Arch – is 11 years old, is a new Smart City and boasts safety and innovation with 24-hour closed-circuit television (CCTV) surveillance, fibre optic network, green star-rated buildings, onsite power backup facilities and mobile-enabled payment parking app (Melrose Arch, 2020);
- Namola Application – is a smart policing initiative in South Africa. This was also implemented in some of the major cities such as Stellenbosch and the city of Tshwane (Namola, 2017). The application is designed to send out an alert from a crime scene, or in an endangered situation. The closest police response receives the alert;
- Gautrain Application – is an e-commerce service for the commuter rail integrated transport system in Gauteng (Gautrain, 2020). The route connects locations between Johannesburg, Pretoria, Ekurhuleni and OR Tambo International Airport. The web-based application provides access to all the trip planner information, fares, schedules, payment options as well as the integration of the Gautrain and the Gautrain-bus services. A mobile application is also available for the Gautrain;
- Pelebox – is a smart locker system for chronic medication distribution for disadvantaged communities with few healthcare service facilities (Mzekandaba, 2019). This initiative was founded by an engineer who established the first pilot in 2017 in one of the townships in Johannesburg. The system is unlocked with a pin which is received via short message service (SMS); and
- JRA Find and Fix Application – was created for residents in Johannesburg to report road issues (Newsroom, 2014). However, the data shown on the Google Play Store indicates a total of only 360 downloads, a 1.1 user rating with the reviews reporting that the application does not work and the last updates made to the application shows July 2017.

The reported initiatives founded in the Western Cape province are as follows:

- Open data portal initiative – launched by the City of Cape Town, is a first in South Africa (City of Cape Town, 2018b). The initiative was for stakeholders and citizens to participate in local government as well as to increase transparency. The data provided on the data portal has been approved by the city based on the city's Open Data Policy (City of Cape Town, 2016). Some of the popular datasets reported are: tender awards, water consumption, aerial photography, parking zoning and the town survey marks.
- MyCiti Web-based service – is an integrated bus rapid transit (BRT) system for the public in the city of Cape Town (MyCiti, 2020). The integrated network public transport system was created to encourage social and spatial equality while using Smart City capabilities such as CCTV cameras, lighting at the enclosed bus stations, to promote a safer city. This, all while using the web-based application to plan trips and load money on the Myconnect card, to tap and pay inside the bus.
- Gunshot detection system – also known as ShotSpotter technology, is another intelligent technology used in the city of Cape Town in the Hanover and Manenberg suburbs (Parkfind, 2017). This ShotSpotter system also incorporates CCTV capabilities to identify the shooters. It also allows the tracking of the number of shooters, the shots fired and the map location of where the incidents took place (City of Cape Town, 2018a).
- Strategic Surveillance Unit – includes over 560 cameras in Cape Town city which are being monitored 24 hours a day (Parkfind, 2017).
- Parkfind – is a mobile application to assist motorists to find parking in the CBD area of Cape Town city and to make parking payments (Parkfind, 2017). This application is another first in South Africa.

The initiatives listed inTable 5.2 confirm what the SALGA (2015) report stated that applications have been developed and adopted in cities by residents for checking municipal accounts, or entering meter readings and some to report problems. The report also indicated that Smart City solutions in South Africa are still done in isolation, where the focus is on city performance and not on dealing with real city problems (SALGA, 2015).

5.8 Application of Smart City Stakeholder Classification Model to the Eastern Cape

The Smart City Stakeholder Classification Model (Figure 2.10) was used, together with the TOE theory definitions (Section 4.5), to classify the Smart City dimensions and the mapping is shown in Figure 5.8. The dimension D9 was classified as part of the Technology category. The dimensions D3 and D8 were classified according to the Organisation category and D1, D2, D4, D5, D6 and D7 were classified as part of the Environment category.

Stakeholder Role	Dimension	TOE Category
Enabler	D9-Smart Technology & ICT Infrastructure	Technology
Provider	D3 Smart Economy	Organisation
	D8 Smart Organisation	
Utiliser	D1-Smart People	Environment
	D2-Smart Governance	
User	D4-Smart Environment	
	D5-Smart Mobility	
	D6-Smart Living	
	D7-Smart Policy	

Figure 5.8: TOE Classification of Stakeholders and Dimensions (Author's own construct)

The classification was extended by using the Smart City Stakeholder Classification Model (Figure 2.10) to identify specific stakeholder types in the Eastern Cape per stakeholder role. Table 5.3 presents the results of the Step 2 in the Internet Search (Section 3.5.2). The stakeholders were classified according to the stakeholder roles and types in smart cities (Section 2.5.1). For each of the four stakeholder roles, namely, enabler, provider, user and utiliser, a broad range of Smart City stakeholder types were identified in the Internet Search and were therefore classified accordingly.

The next step of the Internet Search was to broadly identify and classify the Smart City initiatives, which are the cases of the Eastern Cape in this study. The five broad cases identified in the Eastern Cape were based on the main industries in the province and the TOE classification of Stakeholders and Dimensions (Figure 5.8). These are as follows:

- **Initiative 1: Smart Communities** – Considers all activities that involve smart communities that relate to the goal of improving services and ICT in such communities. Incubators form an important part of such smart communities, contributing to delivering smart solutions in the city through their different programs;
- **Initiative 2: Smart Manufacturing and Engineering** – Considers all activities that illustrate innovation and technology in smart automotive manufacturing and

engineering industries. IoT sensors are examples of technologies that can be used to collect data digitally for decision making purposes and to create innovative solutions through using this data;

- **Initiative 3: Smart Parks and IDZs** – Represents the smart parks and smart IDZs. These parks and IDZs focus on aligning with the Industry Revolution 4.0 (IR4.0) agenda;
- **Initiative 4: ICT Infrastructure** – Considers initiatives in the ICT industry in the Eastern Cape and includes the concepts of using data in smarter ways with an extended focus on ICT infrastructure solutions; and
- **Initiative 5: Research and Education** – Includes educational and research institutions, particularly those related to a 'smart campus' and all the related projects and initiatives happening at a campus or university level.

Table 5.3 presents the classification of the broad range of Smart City stakeholders and cases in the Eastern Cape. Citizens and Workers in the Eastern Cape were classified across all five cases.

Table 5.3: Classification of Stakeholders and Initiatives in the Eastern Cape[8]

Stakeholder Types Per Initiative				
Case/Initiative 1 -Smart Communities	**Case/Initiative 2 -Smart Manufacturing and Engineering**	**Case/Initiative 3 -Smart Parks and IDZs**	**Case/Initiative 4 -ICT Industries**	**Case/Initiative 5 -Research and Education**
• Citizens • Workers				
• Uber/Smart Mobility • Project NMB (Safe City; Clean City; Smart City iGEMS; Connected City) • Green waste and others • Incubator • Eastern Cape Schools • Council for Scientific and Industrial Research (CSIR) • NMB Mayor and Nelson Mandela Bay Municipality (NMBM) Council • NMBM • Eastern Cape Tourism	• Large organisations: • Automotive/Engineering Industry (Eastern Cape) • Other (Pharmaceuticals)	• Employees in Smart Parks (ELIDZ) • Smart Parks (ELIDZ Renewable Energy & ICT Sector Manager) • Coega Development Corporation (CDC) • Investors in Smart Parks	• Newspapers and media of NMB and BCMM • NMBM/BCMM (Departments and Employees)	• Nelson Mandela University; Rhodes University; Walter Sisulu University, Fort Hare University • Electric Vehicles and Smart Mobility

[8]The results on this table have been reported on and published in the ICTAS conference proceedings (refer to Appendix B)

5.9 Summary

This chapter applied the VASCS Model to investigate and classify Smart City initiatives that reflect data and IoT initiatives on a national (South African) and an international level. The investigation also included indentifying and classifying the stakeholders for the South African Initiatives in the Eastern Cape (Table 5.3). In South Africa active initiatives were found in five of the nine provinces. It was found that most of the reported initiatives made use of applications, either, mobile or web based, as a way of addressing their Smart City challenges. On an international level, most of the studies addressing Smart City related reported initiatives, made use of IoT technologies and most of the cities are based in developed countries and continents. In previous sections (Section 2.8 and Section 5.3), IoT relates to things and objects that are connected to the Internet. These things can include sensors and can be placed everywhere in smart cities.

Therefore, they are creating opportunities to collect data everywhere, creating big data and thus contributing to benefits addressed through initiatives in smart cities. One study reported the importance of collecting data from different providers to add value to the services required by citizens, and another study argued that open data is fundamental to a citizen's right to public information. Open data sources that are used on an international level for Smart City initiatives are implemented and managed and the outcomes indicate that those stakeholders who are using such sources are benefiting. Some of these benefits are related to transparent communication from the government to citizens and are a better solution development, because of involving citizens and the users of products and services. Milton Keynes was found to be leading globally regarding using open data sources. Locally, Cape Town in the Western Cape province, is the only city which has an open data portal that is useable and accessible to the public and government.

Two data policies are found that can have a direct impact on Smart City initiatives. In South Africa, it is the POPIA, and in Europe it is the GDPR. Both policies were created to promote and/ or regulate the protection of personal information and data. SALGA (2015) reported that one of the challenges faced by smart cities in South Africa is that governmental departments focus on competitiveness. Therefore, information silos are created and the resulting isolation negates the impact of value creation of the entire city, or an entire process.

e-Madina (2016) also states that African countries have limited digital resources, limited reliable real-time high-data rates and limited access to digital services. These challenges are still prevalent and the situation is evident from the findings of this study, based on some of the limited Smart City solutions of every province in South Africa.

It is therefore necessary to identify which processes can offer value when open data sources are used, and whether these can help cities in developing countries such as in Africa, to use their sources of data to deliver services or meet the needs in the city. The findings from the results of this chapter indicated that Smart City initiatives in South Africa were only for five provinces (Table 5.2). Official, reported, smart cities and its related initiatves in South Africa are, Melrose Arch, a fairly new city of 11 years and Cape Town's Open Data portal, providing citizens with city related information and encouraging transparency and open communication between the government and the citizens.

In the Eastern Cape, these initiatives are mostly related to recycling, citizen services (through municipality applications), solar farms and health education at schools. In Buffalo City, three of the applications identified were reportedly not working, leaving citizens and residents frustrated, based on the mobile applications review pages.

In summary, it is evident that the following research objectives were achieved in this chapter:

- **RO_4**: Analyse and classify digital activities, benefits and challenges for smart cities in a developing country. The first part of this research objective was addressed in this chapter since activities and technologies were identified and mapped according to smart cities on an international and national level (Section 5.3).
- **$RO_{4.1}$**: was achieved since open data and IoT related initiatives and digital activities were identified.

The next chapter reports on the findings from an expert review where VASCS Model V1 was presented to a panel of eight experts and was subject to an expert review. The feedback from this review was used to make some minor changes to the model and resulted in VASCS Model V2.

Chapter 6 - Expert Reviews of the VASCS Model V1

6.1 Introduction

The previous chapter investigated and reported on international and national Smart City initiatives. This chapter reports on an expert review that used interviews to evaluate and validate the proposed model of this study. Expert reviews are interviews with experts from a particular field. The model is proposed to indicate the important components in a Smart City that can lead to achieving a successful Smart City project or initiatives through stakeholder value alignment.

In this chapter, the main research question RQ_m, *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?* is addressed. The structure of this chapter is presented in Figure 6.1.

The procedure of the expert review adhered to the four criteria for the selection of experts for an expert review (Section 6.2). The participants were experts in Information Systems research (Section 6.3). They were approached to give input into the status of Smart City research (Section 6.4). The interview responses were thematically analysed using the QCA method to confirm or refute the model components (Section 6.5). Recommendations of changes to the overall model were provided (Section 6.6) and several key findings were made (Section 6.7). Reviewers at conferences are also considered as experts and therefore these reviews were also considered as part of the expert review (Section 6.8). Several conclusions from the expert reviews and summaries were made (Section 6.9).

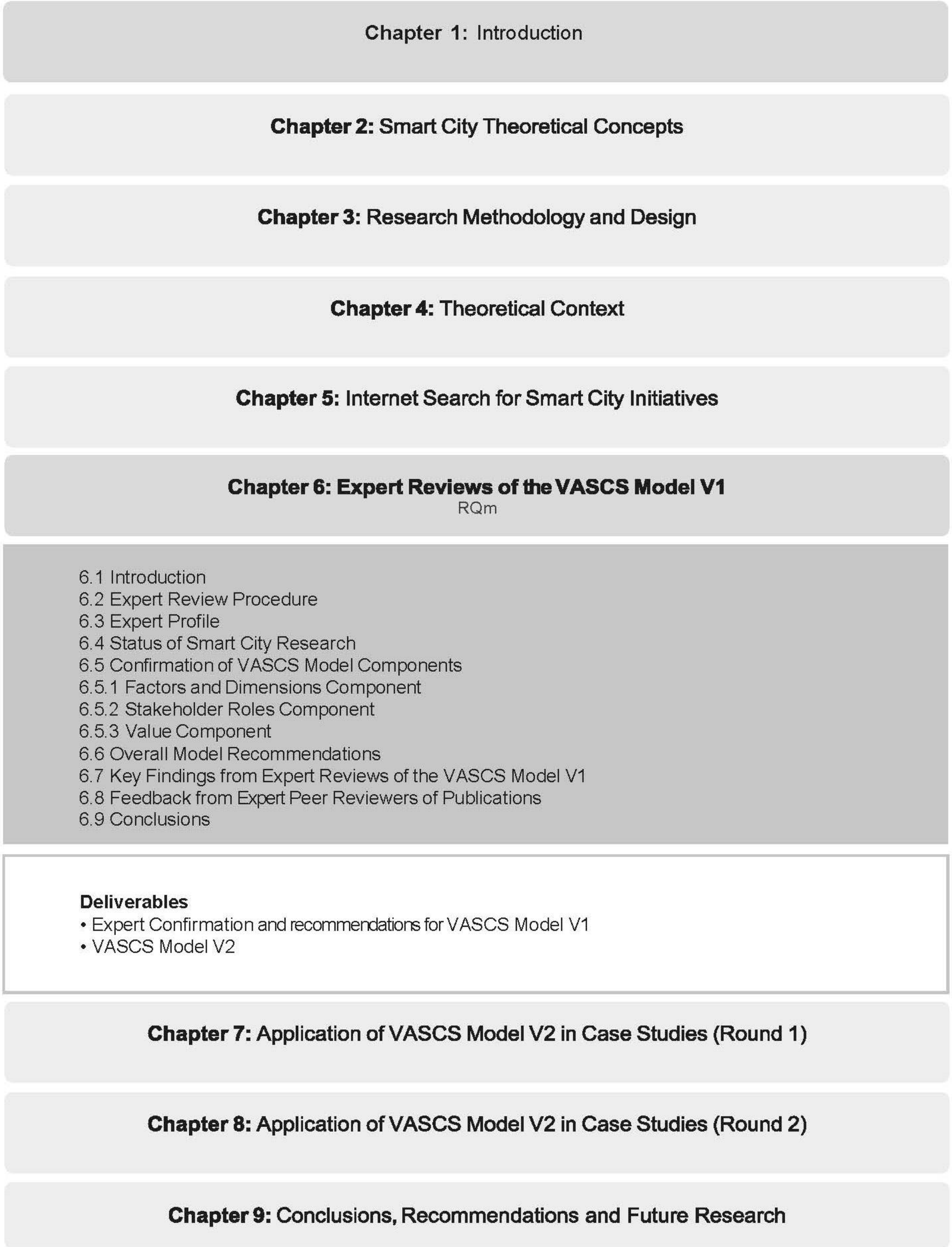

Figure 6.1: Chapter 6 Structure

6.2 Expert Review Procedure

An expert review is a process of interviews that are used as an efficient and concentrated method to collect narrative data, while shortening the time of accessing key practical knowledge in a particular field (Bogner et al., 2018). For example, an expert review was conducted in Malaysia to validate a software improvement model (Almomani et al., 2020). The expert review in their study was regarded important in order to gain independent feedback from experts related to important components of their proposed model. Similarly, the expert review in this study is important in order to understand what the experts in the field of IS indicate and validate as key components of the proposed VASCS Model V1 (Figure 6.2).

The four criteria for the selection of experts and procedure were used (Section 3.5.3). Experts in the research fields of ICT for Development (ICT4D), innovative solutions, IS, data analytics, digital transformation and related Smart City education were selected to review the VASCS Model V1. The researcher approached delegates at the AMCIS at selected sessions between the 14^{th} to 17^{th} August 2019, in order to elicit experts for the review.

The sessions were selected based on topic relevance. At the sessions, the chair of the session was approached, and requested to share information regarding the study. The chair and other delegates were asked to participate and to select a suitable date and time for conducting the review. The requests were made at the following sessions of the conference:

- The Panel discussion for the ACM/AIS IS2020 Taskforce: Updating the Model Curriculum;
- The Panel discussion for “The 4th Industrial Revolution Powered by the Integration of 5G, AI, and Blockchain”;
- The Session for IS in Business and IS Business Value;
- The Session for Organisational Transformation through Digitalisation and Digital Transformation;
- The Welcome reception; and
- The Social event.

An email (Appendix G4) was sent to 14 prospective experts who indicated that they were interested in the research project and would participate in the study. The email information included was:

- Statement of request for participation in an expert review;
- Requirements of each expert reviewer's profile (four criteria of the process); and
- A follow-up email was with background information (Appendix G4) and a copy of the proposed VASCS Model V1 (Figure 6.2).

The VASCS Model V1 (Figure 6.2) was based on the theoretical VASCS Concept Model (Figure 4.6). The changes that were made from the VASCS Concept Model to the VASCS Model V1 are:

- The Dimensions label was removed to check whether or not the dimensions are identifiable;
- The stakeholder border was removed to see if the presentation made about stakeholders that should be considered across the Smart City initiatives could be confirmed without a border;
- The phases label was removed since the five phases included the word phase for each one;
- The stakeholder value alignment arrow was moved inside the main border of the model, to indicate that alignment is for stakeholders across the dimensions;
- The words Digital Value Chain was replaced with Smart Data Value Chain, to check whether describing the data value chain as smart versus digital had any significance; and
- Aesthetic changes were made to the model to improve the visual quality and present it in a more aesthetically pleasing format instead of a purely theoretical format.

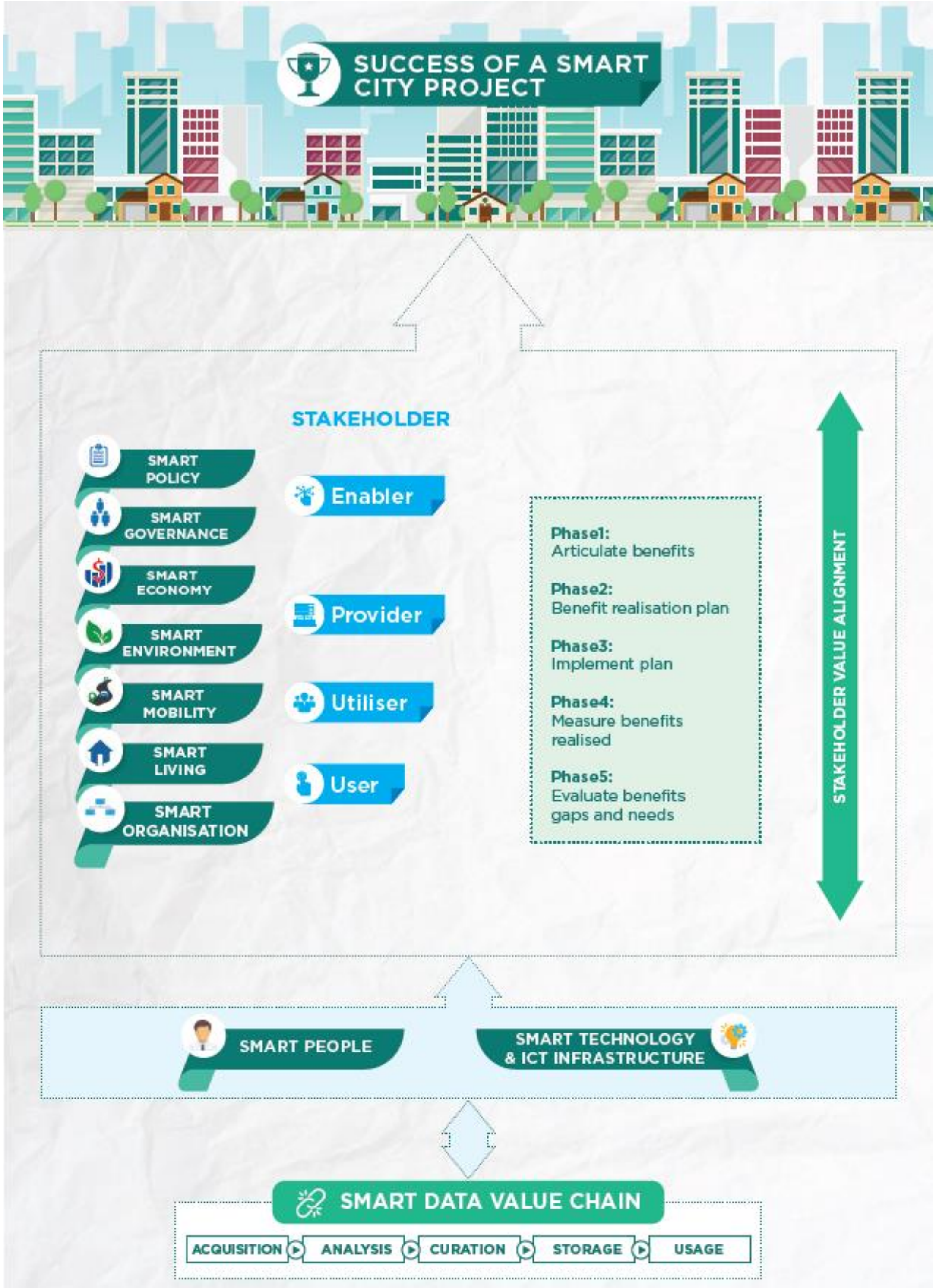

Figure 6.2: VASCS Model V1

The Expert Review Form (Appendix G1) included questions of the different sections focusing on the different components of the proposed model. The sections in the review form were:

- Biographical information;
- Expert experience (including the status of their research fields and Smart City research);

- Dimensions and Factors – the experts had to consider the 39 factors (F1 to F39) linked to each dimension (D1 to D9) that were provided to them in a table (Table 2.5);
- Stakeholder roles and types (Table 2.3);
- Stakeholder Value Alignment;
- Value co-creation Phases from Section 4.4; and
- General model feedback.

6.3 Expert Profile

This section indicates the background information of the experts that was part of the review process of the VASCS Model V1. Based on time and availability to conduct the interview, eight of the 14 experts approached indicated that they were able to complete the review. All eight experts (ER1 to ER8) stated that their highest qualification was a PhD, they all worked at respected universities in their cities and that their roles ranged from being Professors in their fields of study, to Heads of Departments, Directors and Deans of Departments (Table 6.1).

Table 6.1: Expert Biographical Information

Expert Reviewer (ER)	Title	Qualification and Department	Gender	Country	City	Institution
ER1	Professor	PhD (Head of Department - Informatics)	Female	South Africa	Pretoria	University of Pretoria
ER2	Professor	PhD (Management Information Systems)	Male	United States of America	Dallas	Texas Woman's University
ER3	Professor	PhD (Master of Science in Data Analytics Program Director)	Male	United States of America	Chattanooga, Tennessee	University of Tennessee Chattanooga
ER4	Professor	PhD (Department Chair, Integrated Information Technology)	Female	United States of America	Columbia, South Carolina	University of South Carolina
ER5	Dr	PhD (Director of Innovation and Technology Development)	Male	Mexico	Mexico City	Universidad Nacional Autónoma de México (UNAM)
ER6	Professor	PhD (Deputy Dean – School of IS)	Male	Singapore	Singapore	Singapore Management University
ER7	Professor	PhD (Faculty of IT)	Female	United States of America	Worcester	Worcester Polytechnic Institute (WPI)
ER8	Professor	PhD (School of Public and Business Administration)	Male	Brazil	Rio De Janeiro	Getulio Vargas Foundation

All eight experts indicated that they were experts in the IS fields and that they have more than five years' research experience in the IS and Smart City related fields. Seven of the experts had also done research in the Smart City field and one expert (ER4) had worked on city planning projects. All the experts had backgrounds that were related to the aspects of a Smart City, including research fields such as Digitalisation, Transformation, Innovation, Strategies, Management and ICT.

Three of the experts (ER5, ER7 and ER8), indicated that they had published in the field of Smart City research. Their publications were related to addressing factors that would impact young people's decisions to move to a Smart City, and research about smart health and IS in developing countries. The other five experts (ER1, ER2, ER3, ER4, ER6) did not have publications specific to smart cities at the time of the review. However, three (ER2, ER4, ER6) of the five experts indicated their research involvement in other Smart City related fields. The involvement related to Smart City work, such as hosting seminars and training sessions about Smart City implementation (ER2), programmes about Smart City management and technologies on how cities adapt to the new trends (ER6), as well as town council work related to managing and planning of smart cities (ER4).

All eight experts indicated the Smart City dimensions in which they had expertise. These included Smart Technology andICT-Infrastructure (ER1, ER3, ER4, ER6), Smart Living (ER2, ER7), Smart Governance (ER2, ER4), Smart Economy related to Digital Transformation (ER5, ER8) and Smart Policy (ER4).

The responses for the expert involvement in Smart City projects were analysed using the QCA process (Table 3.3). Five themes were identified related to the types of involvement. The involvement related to ten different countries with only one from South Africa.

The interview questions are discussed in the following sections. Some sample quotes were included verbatim for each question to present some of the data evidence findings from the raw interview data. The data evidence provided supports the themes in Table 6.2.

Table 6.2: Expert Involvement in Smart City Projects

Theme	Data Evidence	Data Evidence/Sample quotes	Country/City
Idea Conception	ER1	*"Thinking of a project for **traffic flow** at University"*	Pretoria
	ER3	*"a lot of them were health related…transport related in the "Smart City. Mostly at the idea stage conception stage, the projects have not even started."*	Chattanooga
	ER5	*"That was in Sau Palo…what I had to do was to find out exactly what were the features that made living in a "Smart City" attractive for the young people"*	Sao Paulo
Attended presentations on smart cities	ER4	*"So, one example where I have heard presentations in Columbia is in the department of transportation. How they're using smart technologies in terms of all that transportation for servicing, for emergency services, managing threats of hurricanes and other threats, traffic monitoring where they use a lot of cameras, to monitor traffic …"*	Columbia
Early stages	ER6	*"At the moment (in Singapore) but also in India, they are launching a lot of smart cities…they are still in the early stages…the other place I am associated with is London I feel London is also more smart, in terms of bicycle usage, in terms of travel "*	Singapore India London
Consultant	ER2	*"Malaysia which was the Kuala Lumpur and their technology sector. My role was consultant in the arm of the government called telecommunications, it's called **multi-media, telecommunications**, the idea was… to cut back on the **travel, on the commute**. If people could communicate using technology for business and personal use and again, being so close to Singapore was their neighbour, some of them were influenced by their neighbour, which is a good thing"*	Kuala Lumpur
	ER7	*"we did get involved in Worcester and they were trying to do more, better tracking of opioid use and opioid spread and how to address opioid immediate crisis, how to keep track of overdoses and so on…but mainly on a specific condition in a specific city."*	Worcester
Academic	ER8	*"… just as an academic"*	Brazil

The Smart City project types the experts (ER1, ER3, ER5) had been involved in and the related activities and the roles they had, were those mostly at the Idea Conception stage. Two experts indicated that they had a Consultant role for Smart City projects; one in Kuala Lumpur (ER2) and one was in Worcester (ER7). One expert was involved as an academic in Smart City projects in Brazil (ER8) and another expert was involved in projects from three different countries, indicated that they are introducing Smart City projects in India and London (ER6), due to their expertise in the Smart City project in Singapore. One expert (ER4) stated that they attended Smart City presentations to learn how Columbia was handling their transportation, threats and emergency services. Five of the experts (ER1, ER2, ER3, ER4, ER6) were involved in projects related to transportation and mobility solutions, two (ER4 and ER7) concerning health crisis management and one related to making a city attractive for young people to live and move there (ER5).

6.4 Status of Smart City Research

The experts were asked to give their views regarding the status and importance of Smart City research (Table 6.3). The six main themes that were identified from the responses were as follows:

- **Early stage of the research**: The views of three experts (ER2, ER3, ER6) confirmed the findings of this research in Chapter 2 and Chapter 5, since in Chapter 2 limited empirical frameworks were highlighted and in Chapter 5 limited empirical practical examples were identified;
- **Value to citizens**: ER1 indicated that Smart City research "*is very important to uplift our cities especially in South Africa and give more value to citizens*". Albino et al. (2015) reported in their definition of a Smart City, that using intelligent information flow can translate into services for citizens. Hamzah et al. (2016) emphasised the importance of including citizen requirements in order to achieve Smart City goals. Wendt and Dübner (2017) agreed that citizen and stakeholder engagement can form stronger networks and provide better solutions between different cities;
- **Drivers of efficiency and cost**: ER4 said that "*efficiency and cost being a big driver*" of Smart City research confirming studies by Albino et al. (2015) and Kassen (2017). Proposals of city upgrades should include decreased pricing opportunities, and funds should be allocated to invite businesses and citizens to create Smart City services (Tucker et al., 2017);
- **Hyper-connectivity of people through technology**: Technology enables connectivity and people to be connected in Smart Cities and is stated by ER5 "…*Allows us to be connected and active everywhere and the other characteristic that is very important is the massive use of IT.*". This confirms many studies reporting technologies (Section 5.3); and
- **Complexity** and **Multi-faceted with diverse contexts and definitions**: ER7 indicated that smart cities should be context based and ER8 indicated that smart cities are diverse and it is difficult even to define single 'facets' of a Smart City and that it is a 'buzz word' and that it is important to define a Smart City is important. This statement confirms what is being addressed in literature where no comprehensive Smart City definition exists because of the complexities found (Albino et al., 2015; Khatoun & Zeadally, 2016).

Table 6.3: Expert Views of Smart City research

Theme	Data Evidence	Data Evidence/Sample quotes
Value to citizens	ER1	*"I think it is very important to uplift our cities especially in South Africa and give more **value to citizens**"*
Early stage	ER2	*"some of the cities such as Singapore, comes to mind, and the other would be, I think some in **China are headed in that direction** with their fast trains, their eco-friendly nature solar, wind energy in leu of fossil fuels…and the design of the city based on population and the needs of the residents of that city. **So, in terms of research that's not my, I have not seen the current literature in that area, so I can't comment on that,** that's not been an active area of interest in the recent, by recent I mean in the last twelve months"*
	ER3	*"I think it's at **a very early stage**, I don't think there is much going on"*
	ER6	*"I feel **not much is being done** at least I haven't come across a lot of publications. There used to be this E-government conference in Europe, and I think they are more doing some of that into the Smart City area."*
Drivers of efficiency and cost	ER4	*"I think there's a lot of interest in the US in doing that, I mean, I think there is a big push and I think there are a lot of reasons you know, just **efficiency and cost being a big driver**…"*
Hyper-connectivity of people through technology	ER5	*"So, there would be research in **e-government**…Or citizen participation through electronic means...It would be like taking the different elements in an isolated way, rather than just saying; all of this together is making a Smart City…The difference is **hyper-connectivity** which is also one of the main components of a Smart City. **Allows us to be connected** and active everywhere and the other characteristic that is very important is the **massive use of IT**."*
Complexity	ER7	*"So, with that perspective why I feel smart cities is an extremely interesting research area but at the same time **extremely challenging hence we don't necessarily know how to study it.** And at least in the United States we have a specific call for research proposals from the National Science Foundation for smart cities, called smart and connected health and smart and connected health is linked to the smart cities, not a separate one and it is recognised as a whole separate area of research that needs to be addressed."*
		*"**So, I think "smart cities" is a very complex field** it has a lot of sub-components to it that are interrelated so I like the idea of studying it as a whole but at the same time each sub-unit has its own issues that needs to be resolved and in some cases in conjunction with the others. So, a case study, a field study is the most appropriate way of approaching it. And for example, our city, I am at the WPI and we live in Worcester and Worcester is trying to become a Smart City*
Multi-faceted with diverse contexts and definitions	ER7	*"…so that is why it is very, as much as it seems it is one big thing it's many little different things, unfortunately**. Context matters**"*
	ER8	*"So, **it's so diverse**, its so difficult to define in a single construct that **you need to focus in a specific facet of Smart City** and for instance; Rio de Janeiro is ranked as one of the highest, one of the "smartest" city in South America and I live there and it's impossible, but why? Because we host the Olympic games in 2016 and that's a lot of facilities were built because of the Olympic games and in the ranking, we ranked in the world because of this, but there is a lot of problems because in Rio. A lot of propellers, a lack of security and so forth. So, how is it possible we is a "Smart City"? Another thing is Vienna. Vienna is ranked number one (1) in "Smart City", I have been in Vienna almost one (1) year ago, and I was subtly disappointed, not because of Vienna, Vienna is a marvellous city but it's not a city to be considered the "smartest" city in the world. The airport of, Vienna is a joke there are no signs in other languages other than German, okay. It's quite difficult to take the metro, the underground and how is it possible to say that Vienna is so "smart"? So, **we are dealing with a buzz word**, so we must be careful about that, **you must define precisely what is "Smart City**"*

The experts identified 20 cities world-wide that they believed to be smart cities. None of these cities were from Africa. Table 6.4 provide sample evidence of why they regard these cities as smart cities. Their reasons were identified as new themes from the raw interview data. The analysis of the data revealed that some of the countries and cities identified in Table 6.4 by the experts as those with Smart Cities are similar to the findings from literature that were identified in Chapter 2 (Table 2.1) and Chapter 5 (Table 5.1).

The analysis is visualised in Figure 6.3. Suffixes are used to distinguish the countries/cities/continents by the chapter reported on (either CH2, CH5 or CH6). Austria was identified in CH2 and Vienna, the capital of Austria, was specifically mentioned as a smart city by expert, ER8. The smart cities identified in Asia were cities in China (CH5, CH6); the city of Singapore (CH5, CH6) and Malaysia (CH2), specifically the city of Kuala Lumpur (CH6). Other cities were those in Canada (CH2, CH5), Mexico (CH2) and Mexico City (CH6) as well as cities in Latin America (CH2), specifically Brazil (CH5), Columbia (CH6), and Rio de Janeiro (CH6).

Four of the experts (ER2, ER3, ER6 and ER8) regarded Singapore as a Smart City because of its transportation systems, airport and technology and eco-friendly state. Other cities that were regarded as smart cities are from Europe, North and South America, Australia and Asia. More cities were mentioned from Europe than from any of the other continents.

One expert (ER2) referred to New Zealand as making progress toward smart cities. The main reasons listed why these cities are smart cities, are due to their transport systems, available applications for citizens and tourists, smaller populations, digital education, smart health systems, surveillance systems, security and free WiFi on a city-wide scale.

Table 6.4: Expert Classification of World-Wide Smart Cities

City/Country	Theme	Data	Data Evidence/Sample quotes
Amsterdam	Transport	ER1	*"Amsterdam – use of* ***App*** *for tourists,* ***transport systems****"*
Kualar Lumpur	Early stage	ER2	*"… so Kuala Lumpur I think is again headed in that direction, but they are not quite there. There are a few features that I would say qualify "*
Singapore	Technology Eco-friendly	ER2	*"Singapore's Changi* ***airport*** *recently I was at would certainly qualify, I mean it's really a nature park of an airport and I don't see any other airport that has achieved that. Now that's just a part of the city but overall,* ***technologically, eco-friendly****, in terms of meeting the needs of the residents"*
		ER3	*"I heard about Singapore, I haven't seen much, what came there… but other than that I don't know that there is really any which is truly "Smart City".*
	Transport	ER6	*"… definitely Singapore as one of the … Why? Because they do a lot of different things in how to make life more liveable in the city through "****smart transportation****", for example, many years we have a card and that card I can use for bus, train, anything "*
	Services Stakeholder value Technology and Infrastructure Digital maturity	ER8	*"Singapore of course, but Singapore is so tiny, a tiny country so … And these are other cities that say they are "smart". Why they are "smart"? Because they offer* ***service*** *because why is the preconditions, the precedent for the city to be "smart"? Is to offer* ***public value of the citizens****. So, the cities are the stakeholders, they need to understand, the services, the applications, the mobile apps and so forth is so complicated because you need an infrastructure of course, a* ***technological infrastructure****, you need* ***apps****, mobile apps in some cases of course, but you need a digital maturity,* ***digital education****. People must understand that it is good to use the mobile that is there, we need awareness okay."*
New Zealand Cities		ER2	*"and also New Zealand is working on some of these same initiatives"*
Mexico City	Eco-friendly		*"Mexico, the new president here …has Some* ***eco-friendly initiatives*** *to cut back on pollution, he is putting in a* ***train*** *in to go across the entire country and connect it to the beach resorts, as well as to the Mayan ruins, all the things the tourist want to see but now they see it on a train. "*
Chattanooga		ER3	*"We claim that Chattanooga is a "Smart City"*
Columbia		ER4	*"So, I would put Columbia, South Carolina in that category…"*
Cities in China	Surveillance Well-being of the people not met	ER5	*"… there is some elements of intelligence that not necessarily relate to the final user, like in China, … I mean* ***surveillance*** *in China is incredible, facial recognition, everything on the camera's, they have everything classified, they have a point of system that's just the points and stuff like that but that avails to the objective of the government, and not necessarily to the well-being of the people…"*
Cities in Sweden	Facial recognition Transport Automation of processes Diversity		*"And it's not going to be the same in China that it's going to be in Sweden … And You have to count on technologies to make it happen, those are the same…* ***Facial recognition*** *and* ***automatic vehicles*** *and* ***sensors*** *and* ***automation of processes*** *and stuff like that but, the objectives are different. And the infra…The idiosyncrasy, of the group you are serving makes the difference in the way you provide it."*
Gothenburg Stockholm		ER8	*"Sweden, Gothenburg, Stockholm are "smart" but on the other hand they have problems."*
Cities in Japan	Long term objectives and integrated view	ER5	*"There are probably some cities in Japan, I mean, right, it's sort of like the Asian cultures seem to be really good at having* ***long term objectives*** *and an* ***integrated view****. So, I think those are better…"*

City/Country	Theme	Data	Data Evidence/Sample quotes
Boston	Transport	ER7	*"Boston there were some trials that might have led that would show from a **transportation perspective**, trying to encourage people to bike by putting in their kind of carbon prints and how much it reduces if you use a bike and so "*
Brooklyn	Connected Free WiFi	ER7	*"… in Brooklyn, another city in the Boston area they are extremely **connected**, there is WiFi across the whole city, but **free WiFi for everybody**… You can have access to. So certain aspects of each or of "smart cities" is addressed…"*
Copenhagen	Healthcare Technology Context	ER7	*"Denmark is one of the examples that we give from a **healthcare and technology**, better healthcare perspective that Denmark usually stands out because of their ability to nation-wide, it's a small country, it's nation-wide access supported by **technology** so that kind of is our case study involves successful from a healthcare perspective, Denmark as a country is much more successful than others but again can you replicate something that happens in Denmark in, even in the UK? Like, talking about US or Africa, even in the UK or Germany**, systems are so different**."*
	Security	ER8	*"Copenhagen, the others study, associate "Smart City" with **security** and so forth."*
London	Transport		*"London is a "Smart City", yeah, because of the **transport system**, Europe because of the **security**. So, but all of these cities, they have problems."*
Vienna			*" Vienna is a Smart City"*
South Korea			*"South Korea is a "Smart City"*
Rio de Janeiro			*"Rio in Brazil, there is a very Smart City"*
Curitiba			*"Curitiba is a very good city, South of Brazil"*

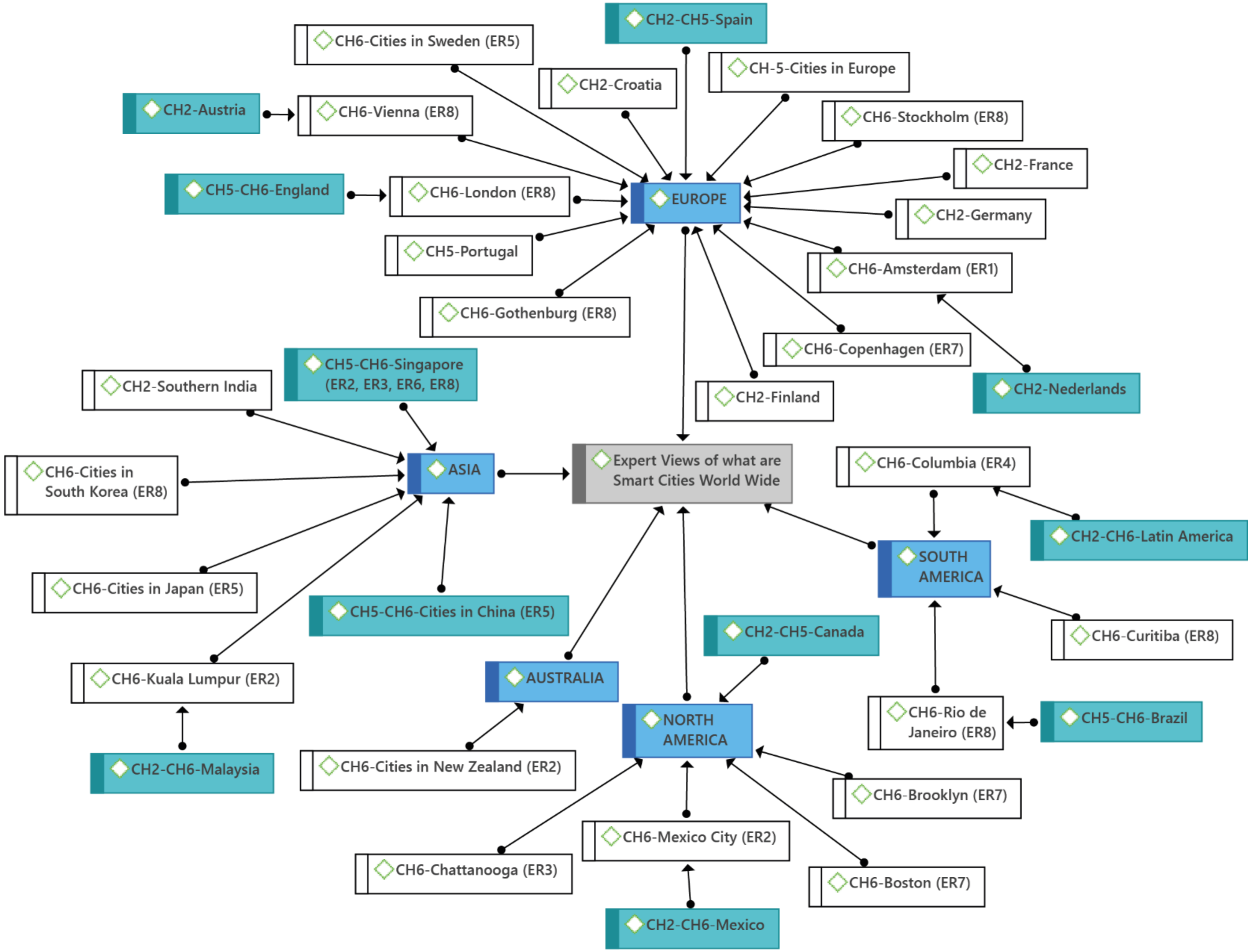

Figure 6.3: Expert Views of What are Smart Cities World-Wide (Author's own construct)

6.5 Confirmation of VASCS Model Components

The following sub-sections are structured according to the components of the VASCS Model V1 (Figure 6.2). These components of a Smart City included the factors with dimensions, the stakeholder roles and types and the value in terms of benefits realised.

6.5.1 Factors and Dimensions Component

The experts were asked if they thought any factors should be added, changed, or removed and if so which ones. The feedback is summarised in Table 6.5. All eight experts agreed that the dimension model component (with nine dimensions as labelled D1 to D9, see Table 2.6) is clear, identifiable and complete and that the dimensions are interrelated. This confirms the importance to have alignment between all dimensions. The expert (ER7) indicated that Smart People are also stakeholders, which confirmed the decision to highlight the importance of stakeholders as a component of the model and the decision to place people in the support dimension. Some suggestions regarding clarity of the context of the components in the model was provided. One expert (ER3) indicated that an explanation should be given to what makes a dimension "smart". The explanations of the dimensions are given in the context of this study and from the SLRs completed in Chapter 2. Expert (ER7) indicated that it was not clear what under what heading the stakeholder heading belonged to and what the phases are used for.

Some of the experts suggested the addition or ordering of dimensions namely:

- Citizen and Smart services (ER1, ER4);
- Smart health (ER5, ER7); and
- Security (ER8).

The recommendations regarding ordering of the dimensions were made by ER4. These included that smart services can be at the top of the model "…*I mean I would put them right up on top. you've got have policy and the governance but I… it's the smart services that I would put… at least up here if not at the very top*" to indicate that "*smart cities is all about smart services*". ER8 indicated that the first dimension should be Smart Policy, then Smart Governance then the rest of the dimensions could follow as the other dimensions were consequences of the first two. This confirms is how the dimensions are structured on the model. The suggestions about adding dimensions were indicated by ER1 that Citizen Services could be added "*Under Smart Governance, I assume that all services provided to citizens are included*".

ER2 indicated that "*the environment* dimension *would include the socio-economic, technological environment so, that's all encompassing*". From the above suggestions the following conclusions for the respective dimensions and factors depending on the context of the city were made (Table 2.5):

- The health factor can be grouped under the D6-Smart Living dimension (see F27-Health conditions);
- The security factor could form part of the following:
    - D6-Smart Living (see F28-Individual safety);
    - D9-Smart Technology and-ICT-Infrastructure (see F38-Smart data i.e. data protection); and
    - D8-Smart Policy (see F34-Policy integration - data protection policies).

Other suggestions about removing dimensions were provided by the following experts:

- ER7: "*I think ... technology is just like transportation ...so it should be moved back? because of course, anything "smart" is enabled by technology but it is an infrastructure just like mobility*". The suggestion to move dimension, D9-Smart Technology and-ICT-Infrastructure to the list of the other dimensions in the model, was not applied. The reason was that it is clear from this research that the order of the dimensions should be to indicate D9 as a support dimension as indicated in Section 2.6;
- ER8 said that Smart Organisation as a dimension could be removed, "*Smart organisation for me I would take that out…*"; and
- ER1, ER3 and ER6 said there was no need to remove dimensions, and ER6 said "*it is comprehensive in my opinion, I think it covers all that and there is some overlap, but I understand why you need to keep it separate*".

The experts were asked to indicate whether they agreed with the decision not to show the detail of all the 39 factors (F1 to F39) for each dimension on the model as it would make the model too cluttered, and to rather to include them as a supplementary component. All the experts agreed with this decision, however two experts said, "*it would be too busy*" (ER2) and "*it would not be clear*" (ER5). ER3 was the only expert who did not make any recommendations to add, change or remove any of the factors. The Smart Living (D6) dimension had the highest number of factors (f=9) that were recommended by the experts to be added, such as health conditions, individual safety, housing quality, touristic attractiveness, affordability and entertainment and leisure.

Table 6.5: Dimensions and Factors - Expert Review Feedback

Theme	Expert	Data Evidence/Sample quotes
Smart Data -data analytics	ER1	*"Does F38 include data analytics?*
Smart People - training and experience	ER2	*"What about training and experience? Because they can pick some of that up either or... It could be training and or experience. But that is important because you know"*
Social cohesion - can be further sub-divided		*"Social cohesion? Okay, I could see how that fits in there. But what if you don't have social cohesion but you have other factors? Cause in some cities you may not have…"*
Smart leadership - should belong to both organisation and people category		*"So, wouldn't "Smart People" also need the leadership? "Smart leadership"? So that's why I think it would belong in both categories. Organisation and people. "*
Emergency preparedness - as a factor should be added	ER4	*"You know one that I don't see on here is "emergency preparedness". Because that's a really … a really critical one, "emergency preparedness". Especially in a city. You know, like flooding or hurricanes or … that's a big … fires, all that and the healthcare facilities, you know. You know, cities now will do these mock trials of, you know, on a city wide basis, do mock trials to see, you know, at the … the coordination of all of their services, emergency services, you know, so, they are not trying to figure out while the hurricane is striking how they are going approach it so And they have rehearsed so I've read, you know…yeah so, "emergency preparedness" would be the one "*
Plurality - should be made a personal feature (diversity)	ER5	*"On the individual level of analysis, however plurality, social and ethnic plurality is not an individual feature unless you say, you are social and ethnic conscious. Which in that case is a competence and is an individual feature, otherwise it is an external environmental factor, right? It is a condition; it exists or doesn't exist. Then you are mixing individuals with society and then you don't know. Right? So, I would try, if I am saying a person is smart because …. Then make this a personal feature."*
Smart Living - health conditions		*"So, it is health conditions, individual safety, housing quality, educational facilities, touristic attractiveness and social cohesion … with touristic attractions, I would think of leisure, right?"*
Smart Living - individual safety		
Smart Living - housing quality		
Smart Living - educational facilities		
Smart Living - touristic attractiveness & leisure		
Smart Living - social cohesion		
Smart Living - Entertainment and leisure		*"And is entertainment and leisure, is like having a place for recreation. Even if you are not a tourist, right. But having a recreational facility something that is going to be a healthy way of spending time, quality time together."*
Smart Organisation - organisational intelligence		*" With "Smart Organisations" definitely you have to look here into organisational intelligence"*
Smart Technology &ICT Infrastructure - technology development		*"Technology development should be there. Maybe part of "smart technologies" right? The developmental cycle"*

Theme	Expert	Data Evidence/Sample quotes
Smart Living - recreational facilities (leisure - culture)		*" Actually, cultural facilities would be part of recreational … Yes, absolutely"*
	ER1	*D6: what about shopping, retail, etc. and recreational spaces?"*
Smart Living - affordability	ER6	*"And the other thing is also you need to included affordability."*
Smart Policy - collaborative policy development		*"Collaborative policy development"*
Smart Technology &ICT Infrastructure		*"Okay and "smart technology" and ICT infrastructure I think, One of the things is when you say "smart data" right, I assume you are also including security and all those aspects of the data "*
Smart Data - data security		
Smart health – health care: access, quality, cost, education	ER7	*"So, access is going to be one, right? Access to care is going to be something we always talk about. Then quality of care is going to be another one when it comes to health. Cost of care, like these are the three dimensions, every time that you talk about health, cost, access and quality are three dimensions of health, right. Because normally what you do, trying to do, quality care can be extremely costly and you may not be able to have access to quality care across the board, right. At the same time maybe, low-cost care is more accessible but then the quality might be low at the same time. This is where we are trying to involve health care, cost, quality care and access that always becomes a challenge. So, anything beyond that, education, definitely."*
Smart Economy - security	ER8	*"Security must be a factor. Also, you can link it to "Smart Economy"*

6.5.2 Stakeholder Roles Component

All the experts agreed that the model considered the major stakeholder roles for a Smart City. However, ER2 said sponsor as a stakeholder type can be added, "*because they really initiate a project*". ER4 indicated that "*leadership and service providers*" as types should be added and "*different service departments in a city*", such as the "*police department*". ER6 stated that utilisers should be changed to "*implementers*" as the role represents implementers. ER7 also indicated that the roles should be clearly defined, "*I had a hard time distinguishing between the utiliser and the user*".

The experts were asked to indicate if they believed there were any stakeholder roles or types that should be removed. ER1 indicated that the User role and User types (Table 2.3) should be changed from users to visitors. ER6 recommended that providers and enablers could be combined. ER4 and E7 indicated that providers and utilisers are more closely related. ER2 and ER3 recommended that users and utilisers should be merged. ER8 recommended that utilisers should be changed to implementers.

Based on the inputs from the experts, the recommendation is that the utilisers and users as roles could be combined and the providers and enablers could be combined as roles in a Smart City. The recommendations about specific stakeholder types that should be added would be noted for future research and for the practitioners classifying stakeholders for their Smart City projects. The experts also agreed that there should not be an explicit one-to-one mapping between dimensions and stakeholders. These are interrelated and that there could be a many-to-many relationship between stakeholders and dimensions.

6.5.3 Value Component

The experts were provided with a definition for stakeholder value alignment by Freeman (2018) as follows:

> "*The 21st Century is one of "Managing for Stakeholders. The task of executives is to create as much value as possible for stakeholders without resorting to tradeoffs. Great companies endure because they manage to get stakeholder interests aligned in the same direction*".

The experts were asked whether they regarded stakeholder value alignment as an important component of a Smart City. Overall, value alignment was regarded as an important component by all eight experts. ER1 said "*Yes, you need buy-in from stakeholders"* and ER2, said "*I think yes, it is important because you have to look at what is important to them. In order for measuring success*". ER5 indicated that alignment should form part of Smart Policy and that "*Smart Policy should guarantee this"*. ER6 said that *"Well, I think that is the most important component, if you don't align the value government can invest to do something but nobody will use it"*.

The experts agreed that the phases for value and benefit realisation (or co-creation) should be part of the model and ultimately agreed that it would influence alignment and value co-creation for project success. They also agreed with where the five phases (of benefit realisation) is placed in the model. ER2, said that the scope would be smaller for the Smart City to address, if they added phases of value and benefit realisation. ER5 also indicated that in the first inception or iteration of the Smart City project, the phases should be part of the model and thus by going forward they would build on what is already there through iterations or cycles of the project. ER8 recommended that Phase 0 should be added to the list of phases and that Phase 0 should represent "understand the context" of the Smart City project such as the social and ecological status of the city.

6.6 Overall Model Recommendations

The experts were given an opportunity to make general recommendations about the model and to comment on any part of the model that they thought was not accurate in terms of a scientific concept viewpoint. The experts were given a printed version of the model to draw their changes and make recommendations. Figure 6.4 illustrates an example of one of these, where ER1 had drawn on their printed version of the model. In this example ER1 indicated that the alignment arrow should be placed in between the dimensions and stakeholders going from dimensions and the other arrow going to the stakeholders. Then the phases should then be shown towards the alignment arrow indicating value or benefit realisation. The inputrs of the other reviewers' printed versions where the experts had drawn are included in Appendix G3.

One expert (ER2) said he thought that the model was fairly well researched. Another (ER8) reiterated that the definition of success should be added and recommended adding the definition of a Smart City and success of a Smart City project. The recommendation made was because the definitions are context based and should be adapted for each Smart City and Smart City project. The success factors regarding the dimensions of each Smart City and Smart City project should be an indication of what is relevant and applicable.

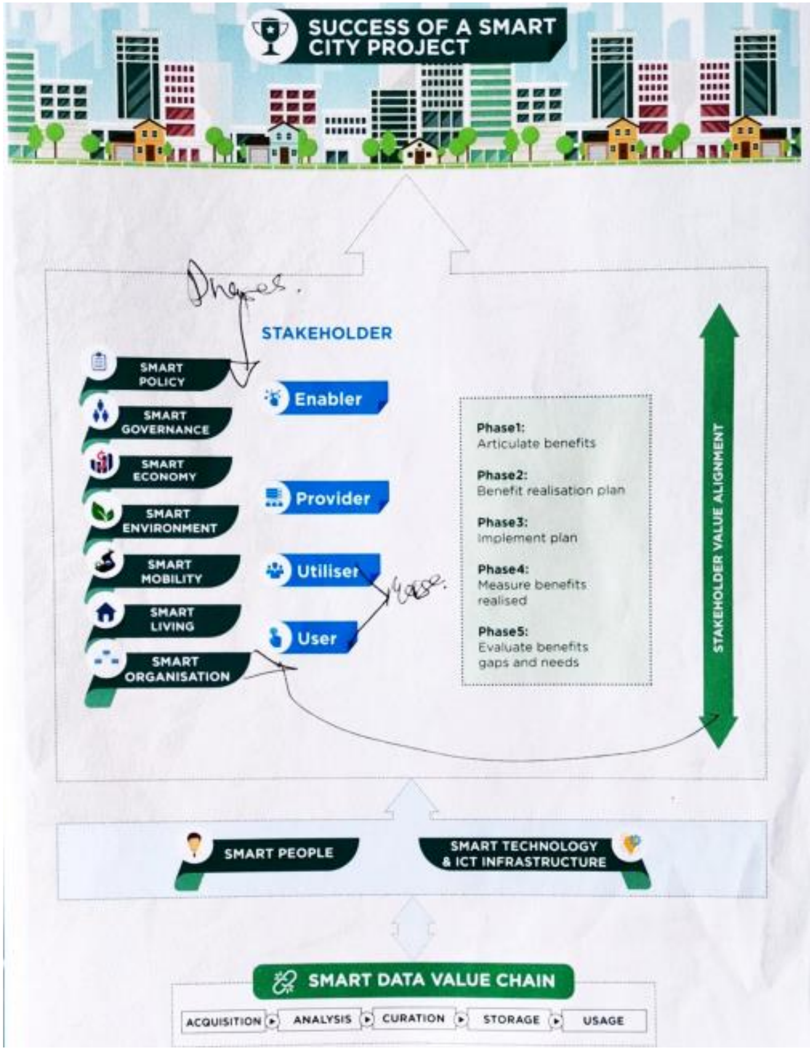

Figure 6.4: Expert Reviewer 1 Example of Direct Inputs on the Model

The key recommendations from the experts about the VASCS Model V1 components were an indication of the iterative or cyclical processes. These were related to the phases of value realisation as well as to the technology and data value chain components.

Four experts (ER4, ER5, ER6 and ER8) recommended the inclusion of cyclical or an iterative process as an indication for the phases and two recommended some iterative or cycling indication for the data value chain (ER2) and the technology dimension (ER5) on the model. ER1, ER7 and ER6 recommended that the alignment arrow and the phases component should be moved between the dimensions' and the stakeholders' components on the model. ER6 and ER7 suggested the addition of the labels for dimensions and stakeholder roles.

6.7 Key Findings from Expert Reviews of the VASCS Model V1

Based on the recommendations, updates were considered and these included several changes made to the VASCS Model V2 (Figure 6.5). The changes that were made were:

- The Dimensions and Phases labels were added;
- A border was added around the Stakeholder roles (as per original concept model);
- Double pointed arrows between the support dimensions (Smart People and Smart Technology-and-ICT Infrastructure) and the rest of the dimensions to indicate the flow of support;
- Double pointed arrows between the Dimensions' and Stakeholders' components, to indicate that that alignment should be across all dimensions and between all the relevant stakeholders;
- The alignment arrow was moved outside the border which was around the Dimensions, Stakeholder and Phases components on the VASCS Model V1 (Figure 6.2). The arrow was moved outside this border to indicate that when all the components are aligned, then success of a Smart City project can be achieved;
- An arrow was added from Stakeholders to Phases to indicate that value should be realised for all stakeholders in a Smart City and that the stakeholder involvement is key to each phase; and
- The Smart Data Value Chain component was changed back to the original term of Digital Value Chain as motivated in Section 4.7, using the definition by Rouse and Chala (2016), stating that "*smart data is digital information*" and therefore it is confirmed that smart data is digital data and because the expert indicated no changes regarding the wording or context of this component on the model.

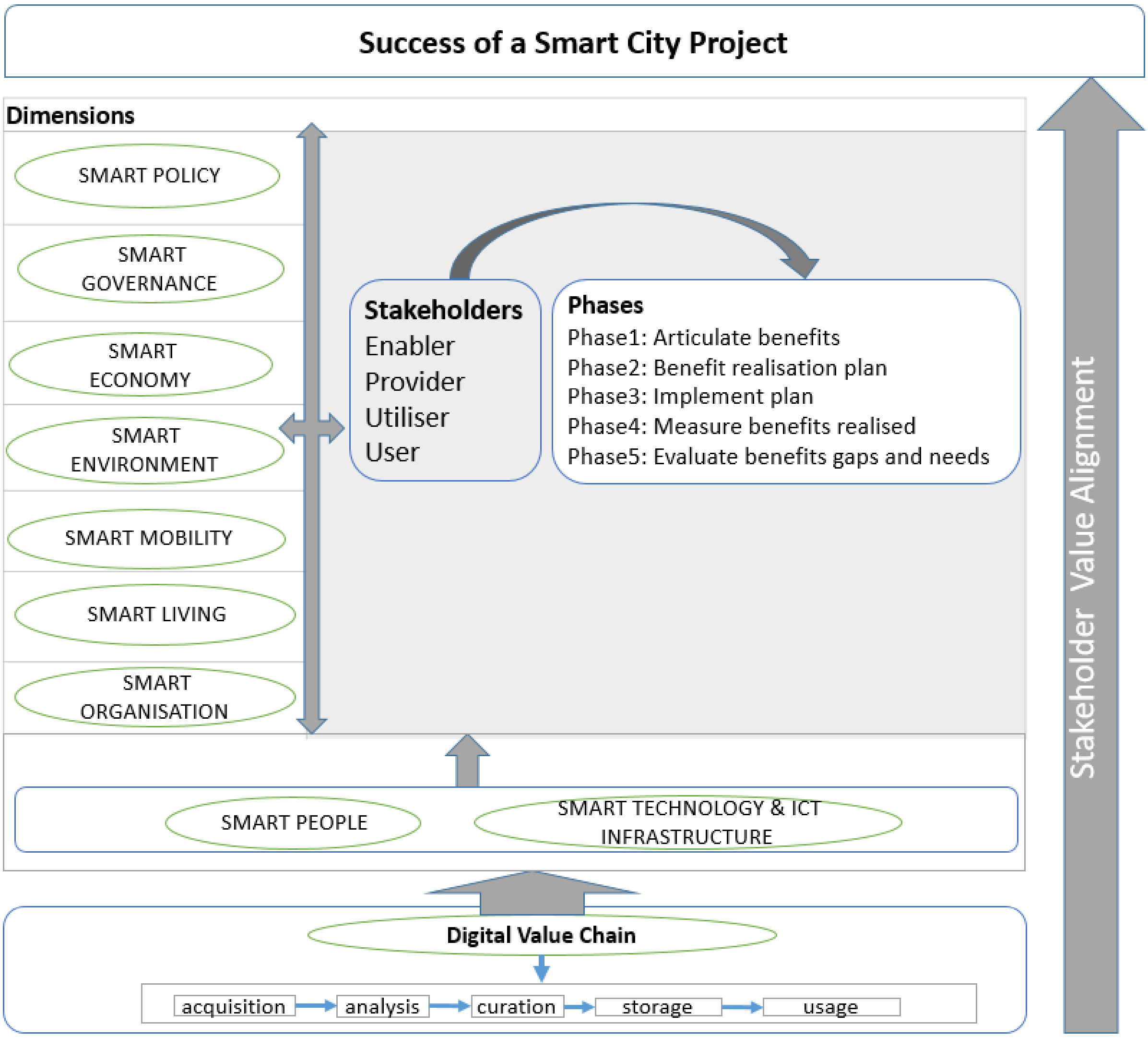

Figure 6.5: VASCS Model V2

6.8 Feedback from Expert Peer Reviewers of Publications

This section highlights the feedback on the results in this study reported on in peer reviewed publications, such as book chapters, journals and conferences. It is believed that this feedback can be considered as additional expert reviews by peers, thus contributing towards warrantable research.

The first publication (Appendix B) based on the findings in this study was a conference paper presented at the 2019 Conference on Information Communications Technology and Society (ICTAS). This publication included the findings from an SLR to classify stakeholders in a Smart City. The paper was accepted for publication and the key reviews given from the two reviewers were as follows:

- Reviewer 1: "The result is a model of stakeholders that can be applied to new projects to analyse how to maximise engagement with the project"; and
- Reviewer 2: "*Outlines a model of classification for shared aspects of smart cities along with their stakeholders and accompanying roles. Provides, through systematic literature review and subsequent modelling, an important contribution to Smart Cities*".

The second publication (Appendix C) was a journal paper published at the 19th IFIP Conference on e-Business, e-Services and e-Society (I3E2020) in *Lecture Notes in Computer Science* in a book on Responsible Design, Implementation and Use of ICT. This publication was based on the SLR findings (Chapter 2) and review of relevant theories (Chapter 4) that can be used to design or inform models such as a value alignment model (VASCS Model V2) for Smart City initiatives. The reviewers gave the following remarks:

- Reviewer 1: "*The paper uses a systematic literature review to identify dimensions, factors and potential stakeholders of Smart City initiatives and develop a value alignment model to support the success of Smart City initiatives. Smart City initiatives are highly topical, and as the authors point out, more research in this area is required. The authors should be complimented on a readable and well written paper*"; and
- Reviewer 2: "*The method is sound and convincing, and the identification and use of the results are adequate. The topic is certainly relevant. Given the theory-basis for the proposed model, the development of the model is well argued and convincing and constitutes an acceptable contribution. The research is certainly on an interesting and relevant topic; smart cities will be part of our future. The incorporation of value provides a model context given current Smart City research. The development of the model uses current literature through an extensive SLR and incorporates theory. The research is therefore sound and interesting.*"

The third paper (Appendix D) was presented at the 19th Global Information Technology Management Association (GITMA) World Conference 2020 (Virtual) where it received the Best Paper Award on the Drivers, Benefits and Challenges to Improve Access to Smart City Data in Developing Countries. This publication was based on some of the findings from interviews with some stakeholders at the two case studies (Section 7.4.2). Three reviewers gave feedback on the paper as follows:

- Reviewer 1: "*The paper addresses an interesting and relevant topic for developing countries*";
- Reviewer 2: "*This communication provides a comprehensive framework that can cover various aspects related to health*"; and
- Reviewer 3: "T*his paper identified the lack of research relating to the benefits and value obtained from Smart City initiatives, particularly with regard to those that attempt to provide cities with access to data.*"

The fourth publication (Appendix E) was accepted as a chapter in a Springerbook. This publication was based on some of the findings from interviews (Section 7.5.2, Section 7.5.4) and addresses the need to investigate this through innovative digitalisation initiatives for smart communities and smart cities in a developing country. The reviewers suggested the following:

- Reviewer 1: "*Those infrastructures and the technologies could be used by the SMEs in order to create new innovative digital solutions that support initiatives to promote smart communities. Possible contributions of the Smart-City framework in the Community based on the TOE-Theory*"; and
- Reviewer 2: "*This paper presents interesting and relevant first-hand testimonies from Smart City initiatives in South Africa.*"

The fifth publication (Appendix F) was accepted as a chapter in a Springer book. This publication was based on an extensive analysis of Initiative 1, Round 1 interview with P1 (Chapter 7) and addresses this through identifying stakeholder value in Smart City implementation in the Nelson Mandela Bay Municipality (NMBM). The reviewer suggested the following:

- Reviewer 1: "*… specify what you want to do and why (collect and evaluate information/ knowledge on Smart City activities in a selected South African area … in order to, e.g., underline the value of Smart Cities (for [Southern] Africa), show exemplary initiatives that can be used as role model activities/ learn from best practices or carve out difficulties and how to deals with them/ state the potential for further development/ innovations). What kind of Smart City activities do we have in the NMBM and how do they contribute to SDGs in general and to specific stakeholders' value? What about suggesting concrete ideas, such as a stronger connection of the entrepreneurial power that NMBM has with all the incubators you mention and the technical expertise in fields* *as energy, mobility etc.? What can practice learn from your work (how can, e.g., municipalities adapt SC concepts or create value based on single SC activities/ ideas if not able or willing to build up an entire SC (directly) (may be also interesting for a step-by-step-transformation of existing areas into smarter. Drawing implications from your work and adapting Smart City solutions to other environments (in Africa) as for example different environmental, social and economic conditions have to be taken into account.*"

6.9 Conclusions

In this chapter, the main RQ_m: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?* was partially answered since the expert review conducted established that the theoretical model proposed in this study (VASCS Model V2) was deemed usable in the context of smart cities by the eight experts, with some minor recommendations for improvement made.

The eight experts who participated in the expert review were seven Professors and the eigth one had a PhD (Section 6.3). The experts were from different universities across the world, four from the United States of America, one from South Africa, one from Mexico, one from Singapore, and one from Brazil. The experts provided their views about the status and importance of Smart City Research (Section 6.4). Three participants stated that they believed that Smart City research is mostly still in the early stages. One participant stated that value to citizens as an important element that can uplift cities in South Africa and create value to citizens.

The experts indicated which cities they regarded as Smart Cities (Figure 6.3). None of the cities reported were from Africa or South Africa. Europe and North and South America had the most cities reported as smart cities by the experts.

The findings show that the proposed model consists of important components that are required in a Smart City. Some suggestions regarding context clarity of the model components were given; for example, "*what makes a dimension smart*".

The findings also indicated what the experts said about smart dimensions and factors that were specific to their research areas (Section 6.5.1); these were mostly related to innovative, digitalised and technological solutions that can aid a city in service delivery while making a city livable. These could therefore be seen as factors of what makes a dimension in a city smart.

The experts recommended that the users and utilisers stakeholder roles should be grouped together and the same for enablers and providers. Some of the specific stakeholder types that were recommended to be added (Section 6.5.2) should be considered as a practice for a specific Smart City context and adapted accordingly. Another suggestion was to clearly indicate the stakeholder heading label and what the phases were used for (phases label). This was updated in the VASCS Model V2 (Figure 6.5).

Overall, value alignment was regarded as a key component and one expert said that *"Well, I think that is the most important component, if you don't align the value government can invest to do something but nobody will use it"*, confirming the argument made in this research study.

The phases of value realisation were also confirmed as important when a Smart City project was initiated (Section 6.5.3). One expert indicated that these phases could assist Smart City projects with scope management. Only one expert suggested an additional phase, that of a Phase 0, which should encapsulate the understanding of the context of a city. The recommendation was to include cyclical or iterative process indication for the phases (ER4, ER5, ER6 and ER8) and data value chain (ER2, ER5) on the model. The feedback from peer reviews of results published, based on this work, was considered and it provided validation and early recommendations. These Conclusions (eighth component in FraIM) were reached by using the claims (sixth component in FraIM) in this chapter. These claims are based on the evidence (seventh component in FraIM) from the expert review.

In the next chapter, the concepts addressed thus far are explored in the cases of smart cities in the Eastern Cape province, South Africa. Interviews were used where the VASCS Model V2 (Figure 6.5) was applied in different contexts of Smart City cases. The application of the VASCS Model V2 was administered across five cases in the Eastern Cape, whereby six providers and enablers were part of Round 1 interviews and sixteen users, utilisers and citizens took part in Round 2 interviews.

Chapter 7 - Application of VASCS Model V2 in Case Studies (Round 1)

7.1 Introduction

In the previous chapter, expert reviews of the VASCS Model V1 were reported. This chapter will address the following seven research objectives:

- Identify the success factors of a Smart City (RO_1);
- Identify the stakeholders for smart cities (RO_3);
- Analyse and classify digital activities, benefits and challenges for smart cities in a developing country (RO_4);
    - Determine what makes data smart ($RO_{4.2}$);
- Determine the influence of the initiatives on the creation and alignment of value to a Smart City in a developing country (RO_5);
    - Identify the criteria for value creation in a Smart City in a developing country ($RO_{5.1}$); and
    - Determine the alignment of data and IoT initiatives on the value creation for stakeholders in the city ($RO_{5.2}$).

To address these objectives, interviews were held. This chapter reports on the interview results for Round 1 interviews conducted with stakeholders of the two Eastern Cape case studies, namely NMB and Buffalo City that are the focus of this research (Section 1.1). The participants of these interviews were from different sectors on Smart Communities, Smart Manufacturing and Engineering, Smart Parks and IDZs, ICT Industry and Research and Education in the Eastern Cape (Section 7.2). An interview schedule, including the interview questions, were used during the interview with identified providers and enablers. Each of the interview questions were derived from literature and the research objectives and followed the interview procedure (Section 7.3). The interview findings were categorised according to the TOE theory using these as the primary themes. Sub-themes were identified for the Organisation category (Section 7.4), the Technology category (Section 7.5) and the Environment category (Section 7.6). The benefits of the initiatives for were identified (Section 7.7) which is Phase 1 in the benefits realisation phases on the VASCS Model V2. The participants assessed which Smart City success factors were applicable to their cases (Section 7.8). A discussion includes some of the key findings (Section 7.9), and conclusions are made about the cases (Section 7.10). The chapter structure is presented in Figure 7.1.

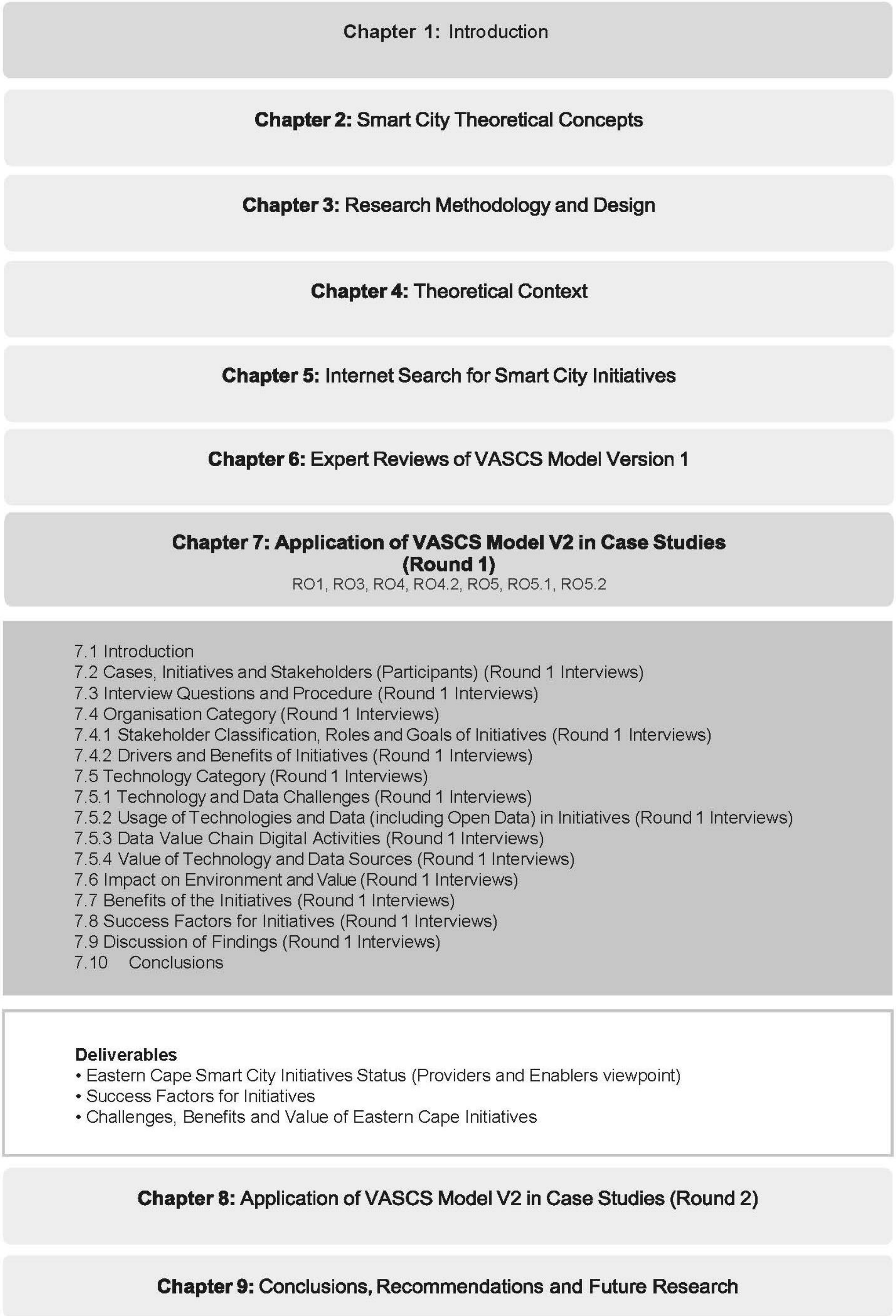

Figure 7.1: Chapter 7 Structure

7.2 Cases, Initiatives and Stakeholders (Participants) (Round 1 Interviews)

The case study strategy (Section 3.4.2) was used in this study with the FraIM methodology to explore the analytical findings from a rich data perspective. The cases identified are the five Smart City initiatives (Table 5.3) in the NMB and Buffalo City cities. The potential participants were stakeholders who were approached as part of Stage 4 in this study, as the gatekeepers (Section 3.5.4), their involvement in one or more of the five initiatives had to be in the role of either providers or enablers of smart city initiatives in the Eastern Cape or both.

Existing contacts were used from networks available to the principal investigator and co-promotor of this study and this trail was followed to reach the potential participants of this study. One gatekeeper who was contacted was the ICT Sector Manager at the ELIDZ who represented Initiative 3 and who also identified two other contacts for Initiative 2 and Initiative 4 in the Buffalo City area. The other two contacts were from NMB for Initiative 1 and Initiative 5. An introduction was made by sharing the oral information via a prepared email which is and attached in Appendix H1.

The profiles of the six participants (P1 to P6) that took part in Round 1 interviews are summarised in Table 7.1. The first participant was from NMB and represented projects related to the first case, Initiative 1. This participant described his role as a custodian and promotor of Smart City initiatives in the NMB who had worked closely with stakeholders in the city through the NMBM.

Table 7.1: Profile of Round 1 Interview Participants

Participant Job Description	Initiative	Stakeholder Role	City
Deputy Director: Enterprise Programmes-Municipal Information Systems – P1	Initiative 1	Provider/Enabler	NMB
Projects and Innovation-Information Technology-Data Science – P2	Initiative 2	Provider/Enabler	Buffalo City
Projects and Innovation-Information Technology-Quality Assurance – P3		Provider/Enabler	Buffalo City
Renewable Energy & ICT Sector Manager – P4	Initiative 3	Provider/Enabler	Buffalo City
Managing Director – P5	Initiative 4	Provider	Buffalo City
Director – Research and Design – P6	Initiative 5	Provider	NMB

The second interview was conducted as a dual interview whereby two participants took part and represented Initiative 2. Both participants were from the projects and innovation IT automotive manufacturing organisation; one represented data science projects and the other represented quality assurance projects.

The third interview was linked to Initiative 3 and the participant was from the Renewable Energy and ICT Sector representing projects of smart IDZs and smart parks. The fourth interview participant was a Data Science Director and represented Initiative 4 projects related to data and ICT infrastructure for smart solutions. The sixth participant was a director with a research and design background and represented projects from the smart campus initiatives.

7.3 Interview Questions and Procedure (Round 1 Interviews)

The Round 1 interview questions were designed based on the research question and objectives, the literature review and the TOE theory (Table 7.2).

Table 7.2: Round 1 Interview Questions

TOE category	Interview questions	References
Organisation	O1. How did the initiative start?	Alawadhi et al. (2012)
	O2. What are the main goals of the initiative? (is it a for profit, or social entrepreneurship or non-profit; education etc.)	
	O3. What were the expected benefits/value of the initiative?	From RQ_m context (Section 3.4.1)
	Stakeholder role and responsibilities: (internal stakeholders form part of an Organisation, external ones are part of the environment)	
	• S1. Is your organisation a provider/enabler?	Mayangsari and Novani (2015)
	• S2. What are your roles and responsibilities in the initiative?	
Technology	Dimension 9: Smart Technology and Built infrastructure:	
	• D1. What technologies are being used in the initiative, how and to what extent? – e.g. IoT, artificial intelligence; cloud computing.	Alawadhi et al. (2012)
	• D1.1 What is the value of using the above-mentioned technologies?	
	• D1.2 What are the barriers and challenges to using technologies for the initiative?	
	D2. Data (digital) Value Chain:	
	• D2.1 Which digital activities do you use for your smart city initiatives?	From RQ_m context (Section 3.4.1) Curry (2016)
	• D2.2 What phases of the data value chain are relevant to your initiative?	Curry (2016)
	• D2.3 Which data/open data sources are you using?	Kassen (2017)
	• D2.4 For which purpose was the above-mentioned data/ open data sources used?	Yadav et al. (2017)
	• D2.5 What is the value of using the above-mentioned data/ open data sources? (i.e. do you have any problems with getting the data or the quality of the data)?	Curry (2016)
	• D2.6 In your view what would make the data ‘smart’?	General question linked to this study and $RO_{4.2}$.
	• D2.7 What are the challenges of using the above-mentioned data/ open data sources?	Kassen (2017)
Environment	Relates to, e.g. policy etc. external environment	
	E1. How are other external stakeholders involved in the initiative?	Mayangsari and Novani (2015)

TOE category	Interview questions	References
	E2. Benefits/impact/value	
	• E2.1 How does the initiative relate or impact the city's economy?	Alawadhi et al. (2012) Flak et al. (2015)
	• E2.2 How does the initiative relate to or impact the city's natural environment?	
	• E2.3 How does the initiative impact the daily lives of citizens i.e. the social lives?	
	• E2.4 What do you believe is the impact or benefit to the users/utilisers of your initiative?	
	• E2.5 Do you think the benefits are as you/the provider expected?	Flak et al. (2015)
	• E2.6 Is there a gap between expected and actual benefits? Did you consider this?	

The *Organisation* category entailed five questions, three related to the specific Smart City initiative that participant was involved in and two questions related to the stakeholders' role and responsibilities in the initiative. In the *Technology* category, three questions were related to the Smart Technology and-ICT-Infrastructure (D9), and seven questions were related to data or digital value chain aspects. The *Environment* category consisted of one question that related to the environmental aspects such as the policy and external environment and six questions that were constructed to determine the benefits, impact and value of the participants' initiatives. These constructs were then used as the foundations of the coding frame for the data analysis.

Three documents were emailed upon indication of the participant's interest in the interview. The email information documents provided were:

- A short overview of the aim of the study (Appendix I1);
- The formal letter providing the research information including the ethical clearance reference and some ethical information (Appendix H1); and
- The Interview Question Guide (Appendix I2) including the VASCS Model V2, was provided to get an overview of the types of questions that would be asked and clarify any uncertainties beforehand.

Once the interview was completed, based on the participant's time and availability, they could choose to complete the Success Factors Template (Appendix I3) on a hard copy or via email. The following section presents the interview findings and examples of some sample quotes. The data evidence sample quotes are available on request (Appendix M).

7.4 Organisation Category (Round 1 Interviews)

The TOE theory was used to classify the interview data into the first level of primary themes. The second level of themes were the interview questions. Therefore, both these levels were *a priori* themes, since Braun and Clarke (2006) show that when existing themes are used from theory, they are considered *a priori* ("from before") or pre-existing. The third level themes were newly derived sub-themes identified from the QCA of the raw interview data.

7.4.1 Stakeholder Classification, Roles and Goals of Initiatives (Round 1 Interviews)

The interview questions for this section that were structured according to the Organisation primary themes were:

- O2. What are the main goals of the initiative? (is it a for profit, or social entrepreneurship or non-profit; education etc.);
- S1. Is your organisation a provider/enabler?; and
- S2. What are your roles and responsibilities in the initiative?.

The interview questions are discussed in the following sections. Some sample quotes were included verbatim for each question to present some of the data evidence findings from the raw interview data.

The stakeholders confirmed their roles and responsibilities as providers or enablers, whilst some stakeholders said they take on both roles. Participants P1 to P4 confirmed that they take on both roles as providers and enablers of their initiatives' services. Participants P5 and P6 confirmed being providers of the services for their initiatives and that they are directors of the business services they provide.

Participant, P1 indicated that their responsibilities included promoting the concept of a 'Smart City' to their departments and other stakeholders around the city by presenting the benefits of investing in the concept and related technologies. Participant, P2 represented the data science responsibility in their organisation and said that "*...we had to find ways of simplifying the process of streaming the data, storing the data, using the data and giving the data back to the business*". Participant, P3 also indicated his responsibility over the quality assurance responsibility in their organisation where he had to focus on camera inspections of the products created.

Participant, P4 had the responsibility of business development and said that "*we try and get investment into the zone, we definitely focus on the creation of jobs and the also the transfer of skills and skilling-up of people to work in these facilities*". Participant, P5 said "*we assessed a number of international software packages and tools and techniques*" and participant, P6 indicated different responsibilities, "*I was the system architect and then became director and doing recently some research on market and how does it work in the market*".

The question about the goals (O2) was stated as: *What are the main goals of the initiative? (is it a for profit, or social entrepreneurship or non-profit; education etc.).* Therefore, the questions related to this objective were categorised under the Organisation context of the TOE theory, since they related to the strategies and goals of the organisation/initiative. The seven goals identified were:

- Cost Reduction (P1, P2);
- Accessibility/Infrastructure (P1);
- Proximity (P1);
- Innovation (P3);
- Industry 4.0 (P4);
- Accurate and Complete Data (P5); and
- Data Discovery (P6).

The participants provided examples of the goals that they were trying to reach. Participant, P1 indicated that their goals were about Accessibility and Infrastructure and Cost Reduction, where buildings were connected to networks and where people away from the city could access services through mobile and web-based applications. P2 also said that Cost Reduction in the manufacture of vehicles was a goal. P3 stated Innovation as a goal to provide space and enable employees with innovative solution development. P4 said that Industry 4.0 trends were important to them at the IDZ. P5 explained that it was the main goal for their project to represent the digital data accurately and completely. P6 indicated that they discovered data that became a new project goal while trying to solve one problem.

7.4.2 Drivers and Benefits of Initiatives (Round 1 Interviews)[9]

The next set of questions related to the drivers (O1) and benefits (O3) of the initiatives. These were stated as follows:

- O1. How did the initiative start? (Drivers of initiatives)
- O3. What were the expected benefits/value of the initiative?

These sub-themes were categorised according to the TOE theory and a legend is used to indicate the corresponding context per sub-theme. Figure 7.2 is a network diagram and represents the sub-themes for both questions O1 (drivers) and O3 (benefits) identified by the QCA process (Table 3.3) and created in Atlas.ti for Smart City drivers and benefits in the Eastern Cape. The Technology context was further classified into data-related and non-data related sub-themes.

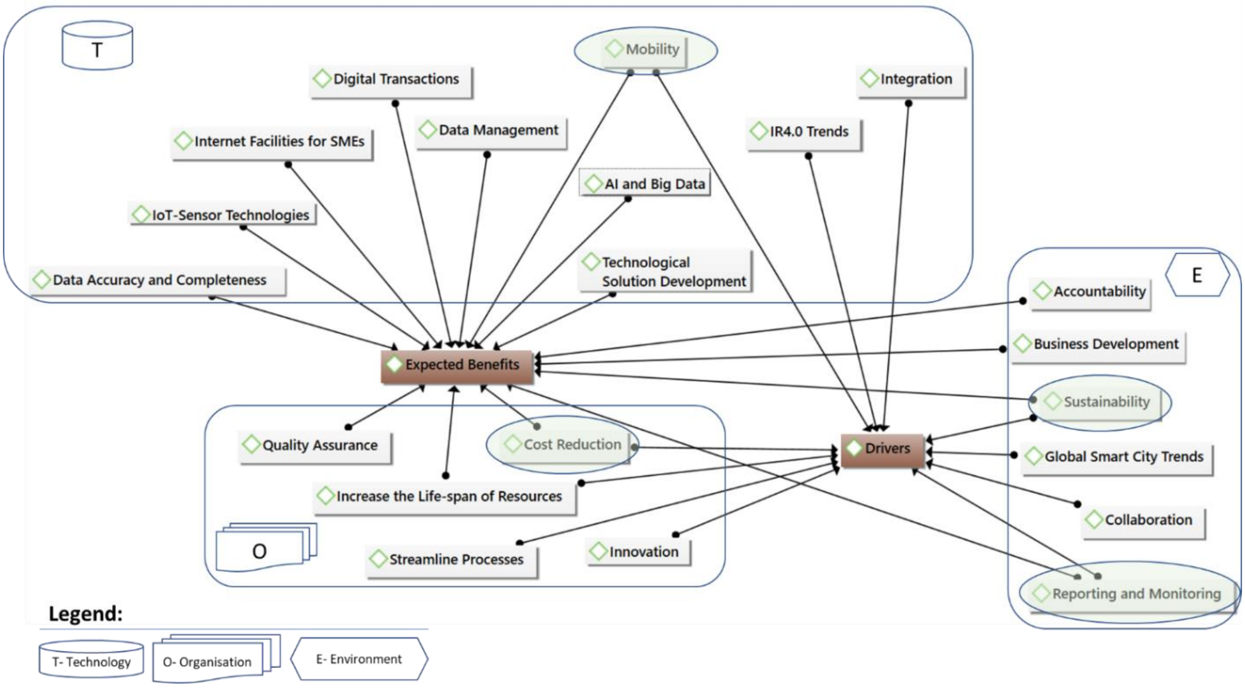

Figure 7.2: Drivers and Benefits of Smart City Initiatives in the Eastern Cape-Round 1 (Author's own construct)

With regard to the drivers of Smart City initiatives, the following 11 unique sub-themes were identified and sorted from highest to lowest frequencies:

- Organisation drivers (*f=8*)
    - Cost Reduction (P1, P2, P4, P5, P6);

[9]The results in this section have been reported on and published in the GITMA conference proceedings (refer to Appendix D)

  - Increase the Life-span of Resources (P4);
  - Innovation (P2); and
  - Streamline Processes (P2).
- Technology drivers (non-data) (*f=4*)
  - Integration (P1, P4);
  - IR4.0 Trends (P4); and
  - Mobility (of people and vehicles) (P6).
- Environment drivers (*f=4*)
  - Global Smart City Trends (P4);
  - Collaboration (P1);
  - Sustainability (P4); and
  - Reporting and Monitoring (P4).

The sub-themes that are similar for both the drivers and benefits are shown in Figure 7.2 and are shaded with a circle shape in the diagram. These are: Mobility (sub-theme of Technology), Cost Reduction (sub-theme of Organisation) and Sustainability and Reporting and Monitoring (sub-theme of Environment).

Participants, P1 and P4 stated that Integration was a driver for their initiatives. P4 said that "*We've got a lot of the tier 2 and 3 suppliers that are based here in the IDZ and they supply components to (...). So, it's very important that we link up and integrate quite well with…*". One of the experts from the expert review (ER5) confirmed this when describing smart cities should have an integrated view (Table 6.4).

All the Technology related drivers were non-data related. Participant, P4 mentioned that one of their main drivers for a smart IDZ was the IR4.0 Trends and that "*...on everything moving towards "Industry 4.0", like we saw (...), they are already operating on a "Industry 4.0" platform with a paperless production flow and so more and more companies are moving toward that space… Not to mention that our then minister of Science and Technology, (...) was sitting with (...), who is the previous DTI minister and they said "ah "Industry 4.0", all the IDZ's must get into this "Industry 4.0" and they must be ready for the impact and the disruption expected by the 4th Industrial Revolution*".

Mobility as a Smart City driver was a common one stated by five of the experts; their projects were focused on mobility issues (Section 6.3). Mobility of people and vehicles was a driver mentioned by participant, P6 *"...navigating people through the buildings and also show paths that were related for these separate people and search a solution. ... So we came up with a solution…to solve this problem and we contacted Google, still we are in the queue, after four years/five years so we tried to develop a solution for them and right now we are going into indoor navigation, through the building and then navigating vehicles and smart vehicles, and this is becoming a serious story*". This confirms the study of Yaqoob et al. (2017) showing how the city of Porto in Portugal addressed mobility challenges as a Smart City solution.

Cost Reduction was mentioned by five participants (P1, P2, P4, P5, P6) as drivers of their Smart City initiatives. Cost Reduction as a driver was also confirmed by experts and other empirical studies (Section 6.4). The data evidence sample quotes for the participants are as follows:

- Participant, P1: "*I think the first thing, from a city's point of view why, is that we saw that there was a huge (...) cost that we every month had to pay. That was a driving factor we had to bring down that cost by building a network of, so, we would cut that cost down. That would reduce our voice calls so, right now currently all our offices are running on our own network. So, we have, every building is connected…So, all those buildings there, whatever phone calls that they make is a free phone call.*"; and
- One participant (P4) stated that: "*...we certainly see a lot of opportunity in leap-frogging and getting into the city space or the "smart city" or the "smart industrial park" space and what we would first would do is the benefits to us would be immediate cost savings so, next week we are installing a "smart street-light" system, a pilot project, where the innovators claim that you could save 30% of your electricity costs, so we need to write a business case and say you would certainly, definitely save 30%*".

Increase the Life-span of Resources was one of the Organisation drivers identified by participant, P4 who said "*...and then also you get "smart cities" they utilise infrastructure and technology to actually extend the life-span of their equipment and assets.*" This statement confirms that city resources is a global driver for many cities addressing initiatives of smart cities. One such example was provided by Tucker et al. (2017), who reported a competition where a team presented dynamic resource sharing using architecture and technology infrastructure.

P2 stated that Innovation and Streamlining their Processes were Organisation drivers behind their initiative to develop innovative solutions by collecting data from IoT sensors within their manufacturing plant. Some studies confirmed this, that innovative technological solutions used IoT sensors to collect data (Lu et al., 2019; Vermesan et al., 2014).

P1 indicated Collaboration as a Environment driver and said "*And then we can also share all our applications so that we can have a fully integrated approach when we go out to the business"*. Participant, P4 indicated that *"…now these sensors also measure air quality and they start reporting on that so if we want to report on our sustainability and our impact on the environment and our carbon emissions, we can start integrating this technology into our park*".

With regard to the benefits of the Smart City initiatives in the Eastern Cape, fourteen themes were identified. Four of the themes were already identified as part of the drivers, these are indicated with a circle shape around the themes in Figure 7.2 and were: Mobility, Cost Reduction, Sustainability and Reporting and Monitoring. Ten new sub-themes were identified and classified according to Technology (data or non-data), Organisation or Environment benefits.

The Technology (data) benefits were (*f=4*)

- AI and Big Data (P4);
- Data Accuracy and Completeness (P5);
- Data Management (P5); and
- Digital Transactions (P1).

The Technology (non-data) benefits were (*f=3*)

- Technological Solution Development (P1);
- Internet Facilities for SMEs (P1); and
- IoT- Sensor Technologies (P4).

The Organisation benefits were (*f=2*)

- Quality Assurance (P2, P3).

The Environment benefits were (*f=2*)

- Accountability (P5); and
- Business Development (P1).

Technology (data) had the highest frequency of themes ($f = 4$). The study by Zhou et al. (2017) described that intelligent systems are needed for information management in IDZs and smart parks. This is confirmed by the expected benefit listed for the initiative represented by P4 of AI and Big Data.

Participant, P1's identified the Digital Transactions and Technological Solution Development themes as part of the approach to create a departmental smart community within the organisation to assist communities within the city. He said "..*And that was one of the good stories that from a community point of view, they didn't have to walk around with cash because we all know about the crime and the surveillance so, they could actually buy the pre-paid electricity from their home. And using the connectivity to these buildings that we provided…"*. Pellicano et al. (2019) describe a similar approach where administrators can leverage from smart cities to create better communities while Santana et al. (2018) propose that scientific communities can use open data to create new citizen services.

7.5 Technology Category (Round 1 Interviews)

Ten interview questions were structured according to the Technology theme and were related to data and non-data related technologies. The relevant questions are discussed in the sections that follow.

7.5.1 Technology and Data Challenges (Round 1 Interviews)

Since data is a key element of technological systems, it can be considered a Technological driver; therefore, all the sub-themes were classified within the Technological context.
The question (D1.2) stated was *"What are the barriers and challenges to using technologies for the initiative?"* The eight barriers/challenges identified were:

- Culture (P2, P5)
- Skills Development (P2, P4);
- Budget (P5);
- Political Change (P1);
- Ethics and Data Privacy (P6);
- Lack of Infrastructure (P5);
- Licensing and Permissions (P4); and
- Learning (P3).

The two challenges mentioned by more than one participant were Culture and Skills Development. For the theme Culture, participant P5 reported it as a challenge and stated that "*there were multiple languages and multiple cultures*". Participant, P2 said "*It's come as sort of a culture change to the organisation itself, internally*". With regard to Skills Development, participant P4 said, "*the transfer of skills and skilling-up of people to work in these facilities*" and participant and P2 said "*I think mostly because it's cutting edge, it's still new stuff so for me, what I've identified is the skills, getting the people with the right set of skills to actually grasp these concepts*".

Regarding budget, participant, P5 indicated that "*budget is a massive challenge"*. Participant P1 highlighted Political Change as a challenge and stated that *"You have politicians and politician changes, and their mindsets change, and their agendas are different. So, that is one of your main challenges around… especially when you work in a public sector*".

The question D2.7 related to the challenges of using data/open data sources. The analysis is presented in Figure 7.3. The seven sub-themes identified are:

- Data Management (P2, P5);
- Lack of Audit Procedures (P4, P5);
- Reliable Data Sources (P1, P4);
- Unstructured Data (P2, P5);
- Data Privacy (P6);
- Data Silos (P5); and
- Skewed Data (P1).

With regard to the Data Management challenge, Participant, P5 indicated that "*...managing data is massive. It's a challenge. And putting structure around data and putting processes around that data management, we deal with this almost daily so it's really complicated.*". Having Reliable Data Sources to get the required data for trends and decision-making was a challenge reported by P1 and P4.

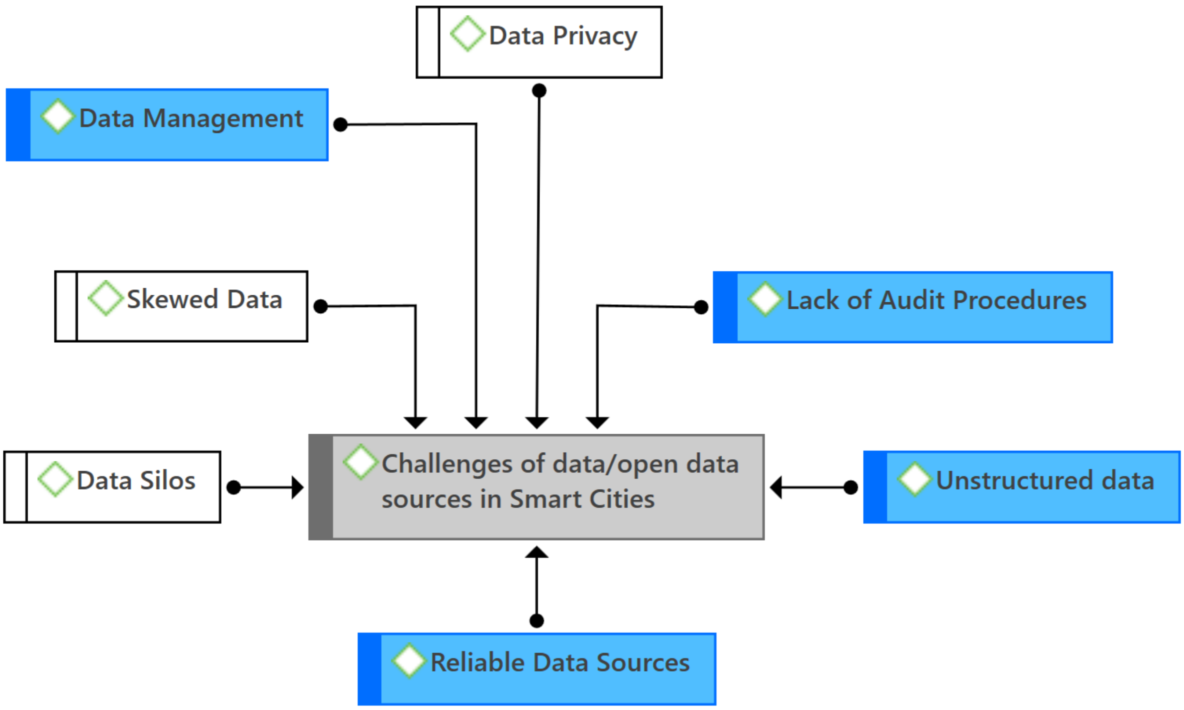

Figure 7.3: Challenges of Data/Open Data Sources in Smart Cities in the Eastern Cape-Round 1 (Author's own construct) [10]

One participant (P6) raised the challenge of Data Privacy issues, confirming the study done by Tshiani and Tanner (2018) in Cape Town. Their study reported that residents' data were collected through Smart City initiatives without measures to protect their identities. The Data Privacy challenge was identified by P6, who represented the location-based solutions at a university. An example of this was reported by Usman et al. (2018), who highlighted the problem that users' identity might be revealed through location-based services.

7.5.2 Usage of Technologies and Data (including Open Data) in Initiatives (Round 1 Interviews)

Questions D1, D2.3 and D2.4 are addressed in this section. The question (D1) asked "*What technologies are being used in the initiative, how and to what extent? – e.g. IoT, artificial intelligence; cloud computing*", and D2.3 "*Which data/open data sources are you using?*". Figure 7.4 presents an analysis of the responses to both these questions and the relationships between them, the six technology types, the three data/open data sources and the purposes of using these data/open data sources (D2.4). Each of the sources is linked to the purpose of use and to the relevant technology type indicated by the different participants.

[10]The results in this figure have been reported on and published in the GITMA conference proceedings (refer to Appendix D)

The following relationships were identified during the QCA:

- Internal data sources are linked to technologies such as AI and Big Data, Open Source Technology, Cloud Solutions and Data loggers/Data recorders and the purposes indicated of using these data sources are for Quality Inspection, to Train Models, for Predictive Analytics, for Reporting and Monitoring, and for Accuracy and Completeness;
- Public sources are linked to technologies such as Fibre Optic Internet and the purposes of using these sources are for the Health Sector, Traffic Information and Citizen Engagement; and
- The University portal is linked to technologies such as AI, Big Data and IoT-Sensor Technologies and the purposes of using these sources are to Train Models.

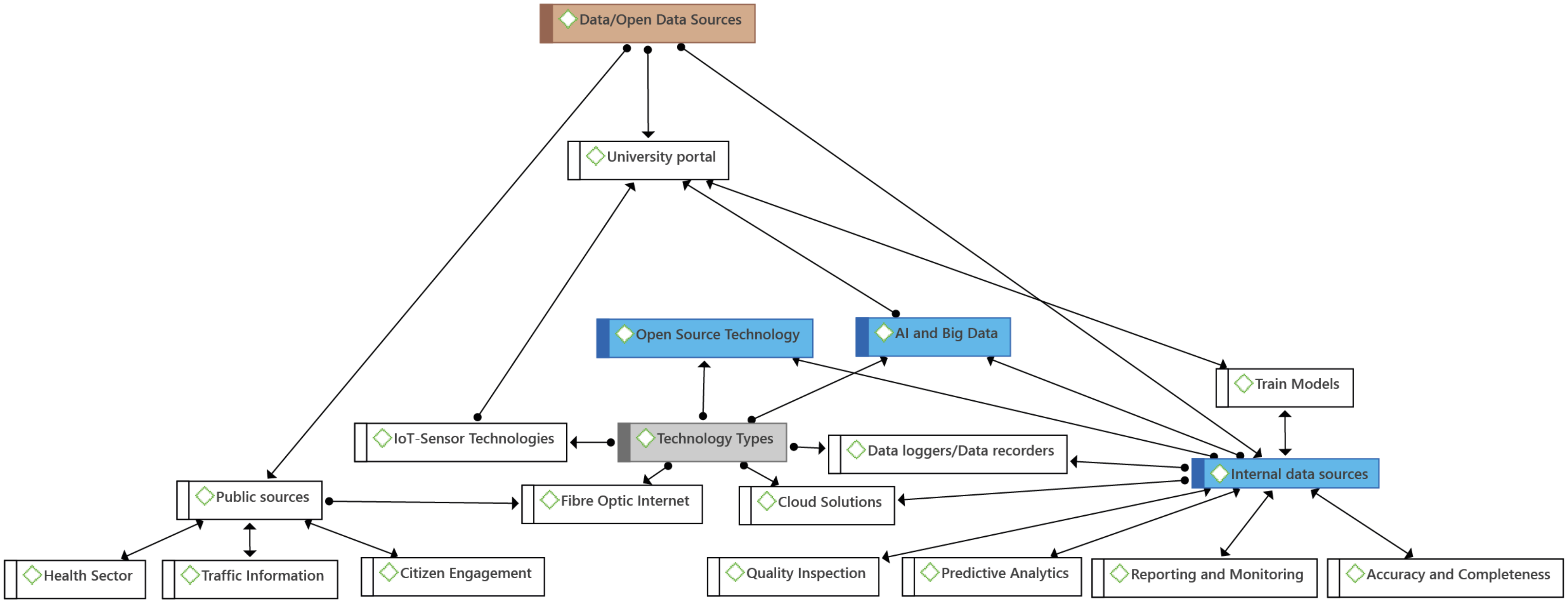

Figure 7.4: Technology Types and Data/Open Data Sources in Eastern Cape Smart City Initiatives-Round 1 (Author's own construct)

The participants identified the technology types (question D1) used in their initiatives as follows:

- AI and Big Data (P2, P6);
- Open Source Technology (P3, P5);
- Fibre Optic Internet (P1);
- Cloud Solutions (P2);
- IoT-Sensor Technologies (P6); and
- Data loggers/Data recorders (P4).

Two participants (P2, P6) reported the use and need for AI and Big Data. P2 stated that - "*... using artificial intelligence of course. We leverage in this new field of IA and big data to try and improve quality on the production line*". With regard to Fibre Optic Internet participant, P1 stated that "*…you have to go across the city and that cuts across all different communities. So, we use the wireless to expand on the connectivity side, and we use fibre as a medium to provide the high-end applications and the demands from the communities*".

With regard to the question *"Which data/open data sources are you using?"* (D2.3), the following sources were identified:

- Internal data sources (P2, P4, P5);
- Public sources: (P1); and
- University portal (P6).

With regard to the purposes of the data/open data sources (Question D2.4), the following were identified:

- Health Sector (P1);
- Traffic Information: (P1);
- Quality Inspection: (P2);
- Train Models (P2);
- Predictive Analytics (P2);
- Citizen Engagement (P1);
- Reporting and Monitoring (P4) – including environmental monitoring; and
- Accuracy and Completeness (P5).

Reporting and Monitoring included environmental monitoring participant, P4 stated that "*For now it's simple reporting, and billing, so consumption of utilities and things like that. Some monitoring so we do environmental monitoring*".

7.5.3 Data Value Chain Digital Activities (Round 1 Interviews)

The question related to digital activities identified six main themes (Question D2.1) as follows:

- Scoot System (traffic signals) (P1);
- Surveillance System (state/city) (P1);
- Building a Secure, Standardised Data Pipeline (P2);
- Eliminate Data Silos (P4);
- Data Analyses (identify missing information) (P5); and
- Digitalisation (human activity recognition) (P6).

With regard to missing information participant, P5 said, "*So we had to process reams of data because when we got in there we were given data to say this is what everything looks like. Now we had to take this 40 000 row spreadsheet basically and analyse it to say well not quite because we put this through the machine and the machine told us that 80% of the data is missing information so you have a much bigger problem than you think you have*".

With regard to human activity recognition through Digitalisation participant, P6 stated, "*we've digitised everything and our maps. Digitalisation would be like connecting the (...), we can track people with the movement. We can't track people inside the buildings so our solution is that we use the human activity recognition to see are they going upstairs, are they going downstairs and we use their activity to detect them but it is still experimental at this stage, it is not fully implemented*".

With regard to the question D2.2 *What phases of the data value chain are relevant to your initiative?*, the following phases were identified:

- Data Deployment/Usage: (P1; P2; P4; P5);
- Data Analysis: (P1; P2; P5; P6);
- Data Collection/Acquisition: (P1; P2; P5);
- Data Validation/Curation: (P1; P2; P5); and
- Data Storage: (P1; P2; P5).

Participant, P5 said that: "*So we did the whole value channel, it sort of comes with the territory*".

From the responses to question D2.6 "*In your view, what would make the data 'smart'?*", the following themes were identified:

- Value/Use (P1, P4);
- Clean Data (P1);
- Data Context (P2);
- Problem-Solving Skills (P3);
- Data Queries (P5); and
- Availability (P6).

Participant, P1 said that smart data is "*…about clean, yes clean data".* participant, P2 said that *"For me it's context, definitely… Data on its own means nothing if you don't know where it's coming from, what produced it and what the problems are that you are actually wanting to solve*".

7.5.4 Value of Technology and Data Sources (Round 1 Interviews)

The question regarding the value of technologies used (D1.1) and value of data/open data sources (D2.5) revealed 11 sub-themes categorised as part of the Technology theme. The sub-themes are presented in Figure 7.5.

The technology value sub-themes identified were:

- Efficiency/Improvements (P1, P2);
- Integration/Open Standards (P1);
- Access to Data (location-based data) (P6);
- Cost Reduction (P3);
- Security and Trust (P3);
- Sustainability and Automated Reporting (Consumer Awareness) (P4);
- Attract Investors (P4);
- Business Development (P1); and
- Improved Human Behaviour (P5).

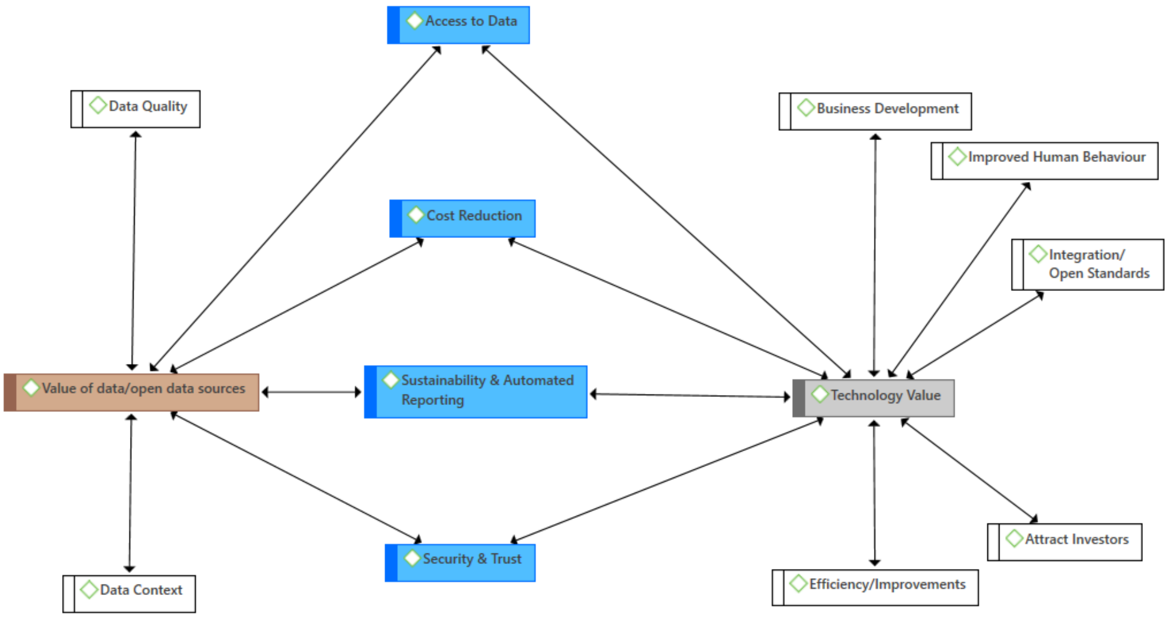

Figure 7.5: Technology and Data Value in the Eastern Cape-Round 1[11]

The sub-themes identified for the value of using data/open data sources were:

- Data Context (P2, P5);
- Data Quality (P1);
- Sustainability and Automated Reporting (Billing) (P4);
- Access to Data (Location-Based Data) (P6);
- Cost Reduction (P3); and
- Security and Trust (P3).

For the theme Data Context, participant P2 indicated that "*I mean initially the data you get is just a massive dump of meaningless numbers so you've got to have the insight and context to actually get value from them*" and participant P5 said, "*Yes absolutely because again, in this particular context, if you know what your data set looks like you can sort of understand what your risk exposure is. So, for example, in this department they wanted to know how many vehicles did they have that were over a certain age*".

[11]Some of the results in this figure have been reported on and published in a Springer book chapter (refer to Appendix E)

Participant, P6 indicated Access to Data (Location-Based Data) as a theme and said that "*Actually, there's a lot of value of this data. I always use to use it, either in the places we work so if I go to a new city, I learn that new city easily but if we all use Google map then that map tries to put us in the city to go with every day*".

Security and Trust was discussed by participant P3 as the value of open source technology; he/she said that: "…*You can use it and with open source technology you get an added layer of security because there are thousands of eyes looking at the code all the time and you are using code that is trusted by thousands and millions of people as well...*". Sustainability and Automated Reporting was also regarded as value obtained from their technologies by participant, P4 who stated that: "*...Also with very environmentally sensitive consumers that want to know that they are driving a vehicle made from renewable energy, so that's something we have to always respond to*".

The four sub-themes that are common amongst the responses for both technology and the data/ open data sources are: Access to Data, Cost Reduction, Sustainability and Automated Reporting and Security and Trust. These are shaded blue in Figure 7.5 by shading them with the colour blue. The other themes are unique to either value of technology (f=5) and value of data/ open data sources (f=2).

7.6 Impact on Environment and Value (Round 1 Interviews)[12]

Seven interview questions were structured according to the Environment themes and the impact or value of the Smart City initiatives in the Eastern Cape to three aspects of the environment (economic, environmental and social impact). Each of the interview questions is discussed in the following relevant section.

The external stakeholder sub-themes were identified from the responses to the question (E1) *"How are other external stakeholders involved in the initiative"?*

The five main types of stakeholders identified were:

- Universities;
- Foreign Investors;

[12] The results in this section have been reported on and published in a Springer book chapter (refer to Appendix E)

- All governmental departments (including non-IT-role players, auditors, asset managers);
- Industrial park, IDZ, City, Government, Policy makers; and
- Multi-vendor.

The question "*How does the initiative relate or impact the city's economy?*" (E2.1) revealed the following five sub-themes:

- Attract Foreign Investors (P1, P3);
- Employment and Skills Development (P2, P4);
- Reduced Costs (Connectivity) (P1);
- Transparency for Citizens (P5); and
- Navigation and Mobility (P6).

The two themes mentioned by more than one participant was Attract Foreign Investors; and Employment and Skills Development. With regard to foreign investment participant, P1 said that "*At IDZ and it's mainly you have a lot of the car manufacturing, you have a lot more of the Asian countries that is investing in there, you have a lot of different business sectors that's coming in. And why? Because of the Telco costs that has come down now."* Participant, P3 said that *"Currently we are sitting on 4.6 and with the new investors that are coming into the automotive industry we are expecting to get to about 7000 / 7.2 in terms of jobs created and not just any jobs but people with qualifications…*".

The question *"How does the initiative relate to or impact the city's natural environment?"* (E2.2) revealed four sub-themes, which were classified under the Environment theme, namely:

- Providing Job Creation and Increasing Employment (P2);
- Reporting and Monitoring (environmental monitoring i.e. water quality and dam levels) (P1);
- Introduction of Renewable Energy Projects (P4); and
- Navigation and Mobility (traffic reduction, reduce carbon dioxide) (P6).

Each of the participants indicated how their initiatives impact citizens' daily lives (social or at work) in their respective cities (E2.3). Specific mention was made of how they improved mobility, increased ICT skills and data awareness and improved processes and efficiencies in businesses.

The following are the sub-themes:

- Navigation and Mobility (proximity improved mobility) (P1);
- ICT Education (P4);
- Improved Processes Internally (P5);
- Data Awareness (P2); and
- Optimisation (space and time management) (P6).

With regard to Navigation and Mobility, participant, P1 said that "… *what we've done is try to minimise the people, the communities…travelling into the cities, by us providing these type of services out there which are now becoming digital… that had an impact on their pocket, where previously they had to take buses and taxis, now they can, in their own communities get the same type of services as previously they would look up to coming into the cities…*".

Participant, P5 said for Improved Processes Internally that "…*it was much easier for them with new technology and less paperwork and less manual approaches, it's a lot easier for them to do their jobs and therein roles the value down to the citizen level but also just simple things, like for example, the fleet manager could instantly see which vehicles needed to be serviced soonest so that made the operating model a lot easier*…".

7.7 Benefits of the Initiatives (Round 1 Interviews)

The question E2.4 was *"What do you believe is the impact or benefit to the users/utilisers of your initiative?"*. The four sub-themes of this question are:

- Job Efficiency (P4, P5, P6);
- Cost Reduction (P1);
- Quality Assurance (P2); and
- Transparency and Investment (P4).

Job Efficiency was mentioned as a benefit by the highest number of participants. Participant, P5 said for Job Efficiency that "*individuals who are tasked with managing the data, obviously they had a massive impact because now it was much easier for them with new technology and less paperwork and less manual approaches, it's a lot easier for them to do their jobs and therein roles".*

With regard to Transparency and Investment, participant P4 stated that *"I think if we get it right it's going to be more transparency so my investor can sit there and look and see what the electricity bill is sitting on at any point in time...*".

Another question (E2.5) was "*Do you think the benefits are as you/the provider expected?*" The following evidence indicates the participants' views on the expected benefits:

- People Buy-In (P2);
- Advanced Technologies (P2);
- People AI Expectations (P3);
- Delayed Achievement (P4);
- Stock Verification (P5); and
- Location-Based Tracking (P6).

Participant, P1 indicated that they think that the benefits were as expected. Participant, P2 said that "*…but in terms of leveraging the benefits fully, you need to get your people out to buy and I think we are not there yet. I mean it's a culture change, it's definitely a different way of thinking...*". Participant, P5 said that "*…So the expected benefits were certainly achieved in cleaning up that (…), which is what the primary objective… our scanning teams walked in and it was piled floor to roof…We were expecting to walk in with a simple neat exercise but the guys had to spend a whole day unpacking a room and then trying to make sense of what was in the room and repack...*".

The last question (E2.6) was "*Is there a gap between expected and actual benefits? Did you consider this?*".

All the participants except P3 stated that there were expectation gaps. Two participants specifically explained that there was an Expectations and Reality Gap (P2, P5). Participant, P2 indicated that "*…There is a bit of a gap between expectations and reality but we obviously work to educate people about that…*". Participant, P5 said "*…So there were a number of gaps but most of it was just the physical interaction or implementation of technology in that environment because the environment was simply not expecting that to happen…*".

The themes of the types of gaps were related to:

- People Buy-In (P1, P2);
- Availability of Resources (P1);
- Customer Satisfaction (P4);
- Difficulties with Physical Environment (P5); and
- Introduction to New Technologies (P6).

7.8 Success Factors for Initiatives (Round 1 Interviews)

The question related to the Smart City initiatives' success factors was provided to the participants in a questionnaire template format, the Success Factors Template (Appendix I3). The template included the 39 success factors across the nine Smart City dimensions. However, the factors template relates to the following question:

> *Select the dimensions that are relevant for your initiative in the below table, from D1 to D9. Then please rate each of the listed factors in those dimensions according to the following statement*: *I believe that our initiative supports or provides value to our users/utilisers with regard to the factors in the table below (Strongly Disagree to Strongly Agree). Use an "x" to indicate your selection.*

The responses of the success factors template were grouped as Not Applicable (N/A), Agree and Disagree. Therefore, if all six participants selected Agree to all 39 factors, there should be 234 instances. The summary of responses is provided in Table 7.3.

Overall, 79% (184/234) of the success factors were selected as Agree. Thus only 8% (19/234) Disagreed that the success factors apply to their initiatives. Therefore, 13% (31/234) indicated N/A for these success factors.

Table 7.3: Eastern Cape Smart City Success Factors (Author's own construct)

	Dimension(n)Factor(n)	N/A	Agree	Disagree
SMART PEOPLE	D1F1 - Level of qualification	0	6	0
	D1F2 -Affinity to life-long learning	0	6	0
	D1F3 - Social and ethnic plurality	0	6	0
	D1F4 - Flexibility	0	6	0
	D1F5 - Creativity	0	6	0
	D1F6 - Cosmopolitanism/Open-mindedness	1	5	0
	D1F7 - Participation in public life and smart city initiatives	0	6	0
	D1F8 - Synergies through partnerships and collaborations	0	6	0
SMART GOVERNANCE	D2F9 - Participation in decision-making	0	6	0
	D2F10 - Public and social services	1	4	1
	D2F11 - Transparent governance	0	6	0
SMART ECONOMY	D3F12 - Innovative spirit	0	6	0
	D3F13 - Entrepreneurship	0	6	0
	D3F14 - Economic image & trademarks	0	6	0
	D3F15 - Productivity	0	6	0
	D3F16 - Flexibility of labour market	1	3	2
	D3F17 - International embeddedness	0	5	1
SMART ENVIRONMENT	D4F18 - Attractiveness of natural conditions	2	4	0
	D4F19 - Pollution	2	3	1
	D4F20 - Environmental protection	2	2	2
	D4F21 - Sustainable resource management	1	5	0
	D4F22 - Future proof	1	5	0
SMART MOBILITY	D5F23 - Local accessibility	1	5	0
	D5F24 - (Inter-)national accessibility	1	5	0
	D5F25 - Sustainable, innovative and safe transport systems	0	5	1
SMART LIVING	D6F26 - Cultural facilities	2	2	2
	D6F27 - Health conditions	2	3	1
	D6F28 - Individual safety	2	3	1
	D6F29 - Housing quality	2	1	3
	D6F30 - Education facilities	1	4	1
	D6F31 - Touristic attractiveness (smart tourism)	1	3	2
	D6F32 - Social cohesion	2	3	1
SMART POLICY	D7F33 - Relationship between the smart city initiative and the city's policy	2	4	0
	D7F34 - Policy integration	2	4	0
SMART ORGANISATION	D8F35 - Organisational culture	1	5	0
	D8F36 - Innovative leadership and management	1	5	0
SMART TECHNOLOGY & ICT INFRASTRUCTURE	D9F37 - Smart technologies	0	6	0
	D9F38 - Smart data	0	6	0
	D9F39 - Availability infrastructure (including Built & ICT)	0	6	0
	Total	**31**	**184**	**19**

The Smart People dimension had no Disagree selections. The dimensions and related factors which had no Disagree selections were Smart People, Smart Policy, Smart Organisation and Smart Technology and-ICT-Infrastructure. The dimension and related factors with the highest frequency (*f*=11) of Disagree selections were Smart Living. One possible reason could be because many of the participants were industry-based and did not necessarily focus on factors such as Cultural facilities (D6F26), Housing quality (D6F29) and Touristic attractiveness (smart tourism) (D6F31).

7.9 Discussion of Findings (Round 1 Interviews)

Section 3.7 highlighted the four criteria for trustworthy QDA, and these were applied to the interviews as follows:

- Internal validity: the participants responded according to their understanding of each question during the interviews and the researcher coded their answers using themes and sub-themes;
- External validity: the findings can be regarded in other similar Smart City contexts such as the Eastern Cape contexts as compared with other cities in developing countries;
- Reliability: direct sample quotes as data evidence were used as part of the analysis and presentation of the findings; and
- Objectivity: the findings (selected quotes) were selected to represent the participants' views and represent the themes; these were selected by two other independent data coders to reduce subjectivity.

For external validity, the interview findings related to benefits experienced were compared with those in Section 2.8, where studies of smart cities in developed and developing countries from an ICT Infrastructure perspective were reported. The benefits reported from a developing country's viewpoint, were as follows:

- Attract foreign investment in order to promote local advantage and to improve cultural, economic and social development;
- Enable service delivery and economic development;
- Enable the transition to a knowledge economy; and
- Focus on ICT access in rural and periphery urban areas.

The Round 1 interview findings related to the drivers (Figure 7.2Figure 7.2), impact (Section 7.6) and gaps (Section 7.6) of smart cities in the Eastern Cape cases were compared with the benefits of other developing countries reported in Section 2.8. The interview themes per dimension are as follows:

- People (D1): ICT Education; People Buy-In; Introduction to new technologies;
- Governance (D2): Integration; Improved Processes Internally;
- Economy (D3): Reduce Costs (Connectivity); Employment and Skills Development;

- Environment (D4): Sustainability; Global Smart City Trends; Reporting and Monitoring (environmental monitoring i.e. water quality and dam levels); Availability of Resources;
- Mobility (D5): Navigation and Mobility (of people and vehicles); and
- Living (D6): Customer Satisfaction, Difficulties with Physical Environment.

From this comparison it can be deduced that the benefits envisioned and experienced by the Eastern Cape cases are similar to other developing countries (as reported in Section 2.8). The similarities are mainly concerned with mobility, availability of resources, education, employment and skills development. It was mentioned by one participant that the economic impact of their initiative related to attracting foreign investors. It was also reported by one participant that employment and skills development was part of their economic impact; which links to a knowledge economy. The focus on ICT access in rural areas was also evident as one participant highlighted the benefits of the Internet facilities provided to SMEs and citizens in communities without access ("*under-privileged*"). This is also linked to the concept and importance of service delivery. Technological solution development and IoT-sensor technologies were also benefits cited from initiatives. Where one of the participants indicated that technological solutions can add to becoming a Smart City and safe city, that he could see how cameras around the city benefitted other departments such as the traffic and police departments in the NMB area.

Related to the benefits of initiatives, is the positive impact thereof. Some participants stated that the impact of the intiatives came from the introduction of new technology concepts which allowed stakeholders to become more data aware; while it was also mentioned that ICT Education had a positive impact on citizen's social lives.

Findings from empirical studies in Section 2.8 indicated the challenges of smart cities. These are classified by according to the dimensions, D1 to D6 as follows:

- People (D1): urban poverty and inequality, shortage in access to technology, specific problems of urban youth, threats to cultural identity, and low educational level;
- Governance (D2): low urban institutional capacities, instability in governance, the gap between government and governed, unbalanced geographical development, and a deficit of social services;

- Economy (D3): high infrastructure deficit, shortage in access to technology, economy weaknesses and lack of competitiveness, specific problems of urban youth, and limited urban-based industries, and unbalanced geographical development;
- Environment (D4): a scarcity of resources, water scarcity, climate change effects, pollution and rapid growth and urban sprawl;
- Mobility (D5): lack of public transport, high infrastructure deficit, pollution and rapid growth; and
- Living (D6): slum proliferation, urban violence and insecurity, rapid growth, deficit of social services, threats to urban identity and urban poverty and inequality.

The interview findings highlighted that the main challenges in the cases were related to People (D1) and specifically culture; skills development and access to data (in terms of data management; a lack of audit procedures and unstructured data). The challenges related to all three aspects of Environment i.e. natural environment, social and economy were confirmed.

The main themes for technology and data related challenges (Section 7.5.1) in the cases were Budget, Political parties changing, Ethics and Data Privacy, Lack of Infrastructure, Culture and Skills development related to using technology for the initiatives. Some of the Data challenges included Data Management, Data Silos and Unstructured Data. The participants provided their views on what they thought makes data smart ($RO_{4.2}$), and these were Data that is Clean, Data Context, Usable and Available.

The five phases of benefits realisation were followed through the application of the VASCS model in the cases of the Eastern Cape. These were followed by identifying the benefits (Phase 1), identifying the drivers and goals of the Smart City initiatives (Phase 2), confirming the actual initiatives that were active (Phase 3), identifying the actual versus expected benefits and how they related to the users and utilisers of such initiatives (Phase 4) and the co-realisation benefits process where benefits, gaps and needs can be evaluated (Phase 5). Therefore, the application of the VASCS model included identifying these in the cases/initiatives in the Eastern Cape. The theory of Value Co-Creation (Section 4.4) also served to support the premise that the benefits not realised and the gaps identified will negatively influence the value obtained. Therefore, it can be deduced that these gaps can be used to indicate the criteria for value creation of smart city initiatives and thereby partially address $RO_{5.1}$.

The outcome determination of the alignment of data and IoT initiatives ($RO_{5.2}$) can also be linked to the value and purpose identified for data and open data sources (Section 7.5.2) and the value of technologies (Section 7.5.4). Some of the themes related to the purpose of data/open data sources were Quality Inspection of Products, Citizen Engagement. The four common themes related to the value of using technology and data (Figure 7.5) were Access to Data; Cost Reduction; Sustainability and Automated Reporting; and Security and Trust.

Since the interviews in Round 1 were exploratory only, the value criteria objective and others will be investigated in more detail in the Round 2 interviews.

7.10 Conclusions

The VASCS Model V2 was applied to the five initiatives/cases (Table 5.2) in the Eastern Cape province in two case studies, NMB and Buffalo City. These five initiatives are the cases considered for data source management. It must be emphasised that the Round 1 interviews were exploratory interviews only in order to obtain background information on the intiatives and these conducted with providers and enablers of Smart City initiatives in the Eastern Cape.

RO1 was achieved though confirming the success factors of smart cities relevant to the five cases in the Eastern Cape province of South Africa. The 39 factors were provided to the six participants who agreed with 79% of them (Section 7.8).

RO_3 was achieved as the stakeholders involved in Smart City cases in the Eastern Cape were identified by first addressing the first two stakeholder roles of Providers and Enablers. The main stakeholder types (Section 7.4.1) were identified for these cases and were universities, foreign investors, departments (non-IT-role players, auditors, asset managers) in organisations, IDZs, government, municipalities, policy makers and multi-vendors.

RO_4 was partially achieved as some digital activities, benefits and challenges were identified and analysed for the initiatives in the Eastern Cape. The digital activities (Section 7.6.2) linked to the cases primarily involved traffic and surveillance systems and data management activities.

RO_5 (Section 7.6) was achieved as the impact of the Smart City Eastern Cape cases was identified. These were related to the economic, environmental and social impact as well as the gaps identified. Some of the economic impacts that the participants identified involved attracting foreign investors, employment and skills development, and citizens' transparency.

The environmental impacts addressed factors such as providing job creation and increasing employment and environmental monitoring. The social impacts affecting citizens' lives were improved mobility, ICT education, and job efficiency. However, some gaps were identified relating to the availability of resources; people buy-in; expectations and reality gap; and introduction to new technologies.

The next chapter presents the results of the Round 2 interviews, which focused on gathering the participants' views regarding the impacts of the cases identified in the Eastern Cape.

Chapter 8 - Application of VASCS Model V2 in Case Studies (Round 2)

8.1 Introduction

In the previous chapter, the application of the VASCS Model V2 and the Round 1 interview results were reported. This chapter will further address the following research objectives that were partially addressed in previous chapters:

- Analyse and classify digital activities, benefits and challenges for smart cities in a developing country (RO_4);
- Determine the influence of the initiatives on the creation and alignment of value to a Smart City in a developing country (RO_5);
  - Identify the criteria for value creation in a Smart City in a developing country ($RO_{5.1}$); and
  - Determine the alignment of the data and IoT initiatives on the value creation for stakeholders in the city ($RO_{5.2}$).

The interview procedure included email communication and an interview schedule (Section 8.2) for the stakeholders. The stakeholders were the participants of Round 2 interviews, were from different NMB and Buffalo City sectors and had various stakeholder roles (Section 8.3). The interview findings were categorised according to the Technology (Section 8.4) and Environment (Section 8.5) contexts of the TOE theory by using these as the primary themes.

Connections of the relationships between the themes identified for economic, environmental and social impacts were made (Section 8.6). The benefits of the initiatives (Section 8.7) and the gaps between the actual versus the expected benefits were identified (Section 8.8). The findings for the technologies were triangulated with those of the Internet search in Chapter 5 and Round 2 interviews (Section 8.9), and several summaries and conclusions were made (Section 8.10). The chapter structure is presented in Figure 8.1.

Chapter 1: Introduction

Chapter 2: Smart City Theoretical Concepts

Chapter 3: Research Methodology and Design

Chapter 4: Theoretical Context

Chapter 5: Internet Search for Smart City Initiatives

Chapter 6: Expert Reviews of VASCS Model Version 1

Chapter 7: Application of VASCS Model V2 in Case Studies (Round 1)

Chapter 8: Application of VASCS Model V2 in Case Studies (Round 2)
RO4, RO5, RO5.1, RO5.2

8.1 Introduction
8.2 Data Collection Round 2: Interview Questions and Procedure
8.3 Stakeholders (Participant Profile) Round 2 Interviews
8.4 Technology Category (Round 2 Interviews)
8.4.1 Technology Challenges (Round 2 Interviews)
8.4.2 Data Challenges (Round 2 Interviews)
8.4.3 Technologies in Initiatives (Round 2 Interviews)
8.4.4 Data Value Chain Digital Activities (Round 2 Interviews)
8.4.5 Data (including Open Data) in Initiatives (Round 2 Interviews)
8.5 Impact on Environmental and Value (Round 2 Interviews)
8.5.1 Value of Technology and Data Sources (Round 2 Interviews)
8.5.2 Economic Impact of Initiatives (Round 2 Interviews)
8.5.3 Environmental Impact of Initiatives (Round 2 Interviews)
8.5.4 Social and Work Life Impact of Initiatives (Round 2 Interviews)
8.6 The Relationships between the Economic, the Social and the Environmental Impacts
8.7 Benefits of the Initiatives (Round 2 Interviews)
8.8 The Gaps: Expected versus Actual Benefits (Round 2 Interviews)
8.9 Discussion of Findings (Round 2 Interviews)
8.10 Conclusions

Deliverables
- Eastern Cape Smart City Initiatives
- Impact of Eastern Cape Smart City Initiatives from a User's and Utiliser's Viewpoint
- Digital Activities in the Eastern Cape
- Data Sources and Purpose of Use in the Eastern Cape
- Technology and Data Challenges in the Eastern Cape
- Criteria for Value Creation in the Eastern Cape
- Value of Technology and Data in Eastern Cape Initiatives

Chapter 9: Conclusions, Recommendations and Future Research

Figure 8.1: Chapter 8 Structure

8.2 Data Collection Round 2: Interview Questions and Procedure

It is evident that the findings from the Round 1 interviews regarding the Smart City success factors, that the participants focused on initiatives which included the two support dimensions, namely Smart People and Smart Technology and-ICT-Infrastructure. The other dimensions where there was a key focus were Smart Economy, Smart Mobility, Smart Policy, and Smart Organisation.

The interview questions that were addressed in this chapter are similar to Round 1 interview questions (Table 7.2), but no Organisation context questions were addressed in Round 2 interviews, since this context was not relevant for users, utilisers and citizens. Therefore, only the Technology and Environment questions are addressed in the sections to follow.

Twenty-one participants were approached based on the trail provided by Round 1 participants. The Chief Operating Officer at the NMBM was contacted to represent Initiative 1 in the second round of interviews and advised the researcher to contact citizens (who were users or utilisers of services in the city) via social media. Therefore, a social media notice (Appendix K) was created to invite Eastern Cape citizens to participate. A possible participant was contacted directly to represent Initiative 1, as their project related to smart health and education in the Eastern Cape but he/she did not have availability to partake in the interviews at the time.

For Buffalo City, one citizen declined to partake in the interview, after accepting the invitation and stated that he/she did not know enough about Smart City initiatives or services in their city. Another citizen who confirmed the date and time for their interview did not show up and did not respond to the request for another possible date and time. Contact was made with a Smart City service provider for Initiative 3, but he/she could not find available and willing users or utilisers to participate. Where there were more than two contacts from a specific initiative or trail, the participants would collectively decide who would participate in the interview based on their knowledge about the initiative that they needed to represent and based on their availability.

Four documents were emailed upon indication of the participant’s interest in the interview. The email information and documents provided were:

- The Interview Questions Guide (Appendix J1) which provided an overview of the types of questions that would be asked;

- A short overview of the aim of the study (Appendix J2);
- The classification of stakeholder roles for a Smart City (Figure 2.10); and
- A formal letter, with the research information, including the ethical clearance reference and some ethical information (Appendix H1).

The QCA process (Table 3.3) was followed to identify the different level themes and sub-themes for Round 2 interviews. Coders other than the author were part of the QCA process, to ensure that the process of analysis had a higher consistency and reliability of identifying the themes from the different participant responses for this study. The *a priori* themes are the first level themes which are the three TOE contexts. The second level themes are the interview questions, the third level themes were those identified from the raw interview data and the fourth level themes (shown in brackets) are related to the sub-themes of the third level. The frequencies (*f*) are indicated as the number of themes for each level. The following section presents the interview findings and examples of some sample quotes. The data evidence sample quotes are available on request (Appendix M).

8.3 Stakeholders (Participant Profile) Round 2 Interviews

Six participants (P1 to P6) were interviewed in Round 1 and 16 participants (P7 to P22) were interviewed in Round 2 (Table 8.1). The same five cases for the Smart City initiatives (Table 5.3) in the NMB and Buffalo City cities were used in Round 2. The stakeholders for Round 2 interviews were identified based on the trail followed and provided by the gatekeepers of Round 1. These gatekeepers were contacted to identify possible utilisers and users of their initiatives for Round 2 interviews. A notice (Appendix K) was also added to the Nelson Mandela University Computing Sciences Department social media platforms and to the Buffalo City Border-Kei Chamber of Business social media platforms, to invite Eastern Cape citizens to participate in the Round 2 interviews as part of the users of such initiatives.

In Round 2, four participants represented the citizen stakeholder type in the Eastern Cape under Initiative 1 for Smart Communities (P12, P13, P15, P16). One (P16) of these citizens was a business coach and trainer for professionals working in the pharmaceutical industry. The second citizen (P13) formed part of the Wi-Fi For All Forum in NMB and was a fibre network installer. The third citizen (P15) was a senior student at the Nelson Mandela University and the fourth citizen participant (P12) was an administrative employee and entrepreneur of the same university.

The other twelve participants represented the stakeholder roles varying from users to providers or both. The participants had different job descriptions based on their stakeholder roles. One of these was a manager (P10) at an NMB incubator and was part of the participants who represented Initiative 1. Two other participants represented Initiative 1; these were P17 and P19. P17 was the Head of the Connected City project in NMB, and a General Manager (P19) for Electricity and Energy Services at Buffalo City.

Table 8.1: Profile of Round 2 Interview Participants

P#	Participant Job Description	Initiative/Case	Stakeholder Role	City
P10	Enterprise Engineering Manager (incubator)	Initiative 1 (Smart Communities)	Provider	NMB
P17	Head of Connected City			
P19	General Manager for Electricity and Energy Services		User/Provider	Buffalo City
P8	ICT IoT Cyber-Security Maintenance Department: Automotive Manufacturing	Initiative 2 (Smart Manufacturing and Engineering)	User	Buffalo City
P9	Entrepreneur – Engineering software solutions		Provider	NMB
P18	IT Manager: Software applications and Business processes	Initiative 3 (Smart Parks and IDZs)		
P20	Technology-related technical services		User/Provider	Buffalo City
P21	Technical Advisor for Smart City initiatives		Provider	
P22	ICT Manager	Initiative 4 (ICT Industries)	User/Provider	
P7	Programme Manager - Innovation through Engineering	Initiative 5 (Research and Education)	User/Provider	NMB
P11	Sustainability Manager - Infrastructure Service & Space Operations			
P14	HoD - at a department			
P12	Administrator and Entrepreneur	Initiative 1 (Smart Communities) - Citizens	User	NMB
P13	Fibre Installer and WiFi Forum Custodian		User/Provider	
P15	Student		User	
P16	Pharmaceutical Business coach and professional trainer		User/Provider	

Two participants represented Initiative 2; one (P8) was from the ICT IoT Cyber-Security section for Maintenance at an automotive manufacturing company, and one (P9) was an entrepreneur from an engineering software background. Three participants represented Initiative 3. The first one (P18) was an IT Manager specialising in Software applications and Business processes at the NMB IDZ.

Another participant (P20) was responsible for the Technology-related technical services division at the Buffalo City IDZ and the third one (P21) was a Smart City Technical Advisor to Buffalo City. The ICT Manager (P22) at the BCMM participated in Initiative 4.

Three participants represented projects related to Initiative 5 at the Nelson Mandela University; one (P7) was from a Smart Mobility perspective on campus, another (P11) from the Infrastructure Service and Space Operations department on campus and the third (P14) was Head of Department (HoD) of a department at the university.

8.4 Technology Category (Round 2 Interviews)

The interview questions addressed in this section are specifically related to the Technology context. The interview questions are discussed in the following sections. Some sample quotes were included verbatim for each question to present some of the data evidence findings from the raw interview data. Only sample quotes are included.

8.4.1 Technology Challenges (Round 2 Interviews)

Question D1.2 was used to discover *"What are the barriers and challenges to using technologies for the initiative?"*.

Themes from Round 1 for the same question are indicated as bold text in the list to show which of the themes identified are similar from both rounds. The main challenges are grouped as Budget-Costs; Connectivity; Access to Resources; Awareness and Usage; Sustainability; and Safety and Security. Each of these themes has several sub-themes as follows:

- **Budget - Costs** (*f=9*)
  - Research and Design-Costly (P19, P20, P21);
  - High Initial Investment (P7, P14);
  - Increased Budget (P9);
  - Lack of Funding (P10, P11); and
  - High Internet Costs (P13).
- Connectivity (*f=9*)
  - Internet (P13, P16, P17);
  - **Data**, IT and Cyber-**Security** (P8, P13);
  - Service Delivery (P12);
  - Digital Divide (P13);
  - In-Person Meetings (Facial Interpretation) (P16); and
  - Data Access (P17).
- Access to Resources (*f=8*)
  - Lack of Technical and Innovation Skills (P10, P20, P21);

  - Lack of OPC (Open Platform Communications) (P9);
  - **Lack of Infrastructure** (P13);
  - Access to Smart Devices (P17);
  - Access to Investments (P22); and
  - Access to Government and Business (Collaboration to share resources) (P22).
- Awareness and Usage (*f=4*)
  - Education and **Skills Development** (P14);
  - **Culture and Change Management** (P14, P18); and
  - Government and Business (Alignment of Goals) (P22).
- Sustainability (*f=1*)
  - Self-sustaining Incubator (P10).
- Safety and Security (*f=1*)
  - Public Transport (Gender Based Violence) (P15).

Figure 8.2 presents the network diagram derived from Atlas.ti related to technology challenges (D2.1). The suffix R2 indicates the Round 2 interview themes. The challenges linked to Budget-Costs (*f=9*), Connectivity (*f=9)* and Access to Resources (*f=8*) had the highest frequencies. The sub-themes with the highest frequencies are Lack of Technical and Innovation Skills (*f=3*), Research and Design-Costly (*f=3*), and Internet (*f=3*).

Public Transport was classified as a Safety and Security challenge and was related to Gender Based Violence and was mentioned by a female participant, P15. She uses public transport in NMB that she does not feel safe especially if she is the only female in the vehicle with other men and the driver.

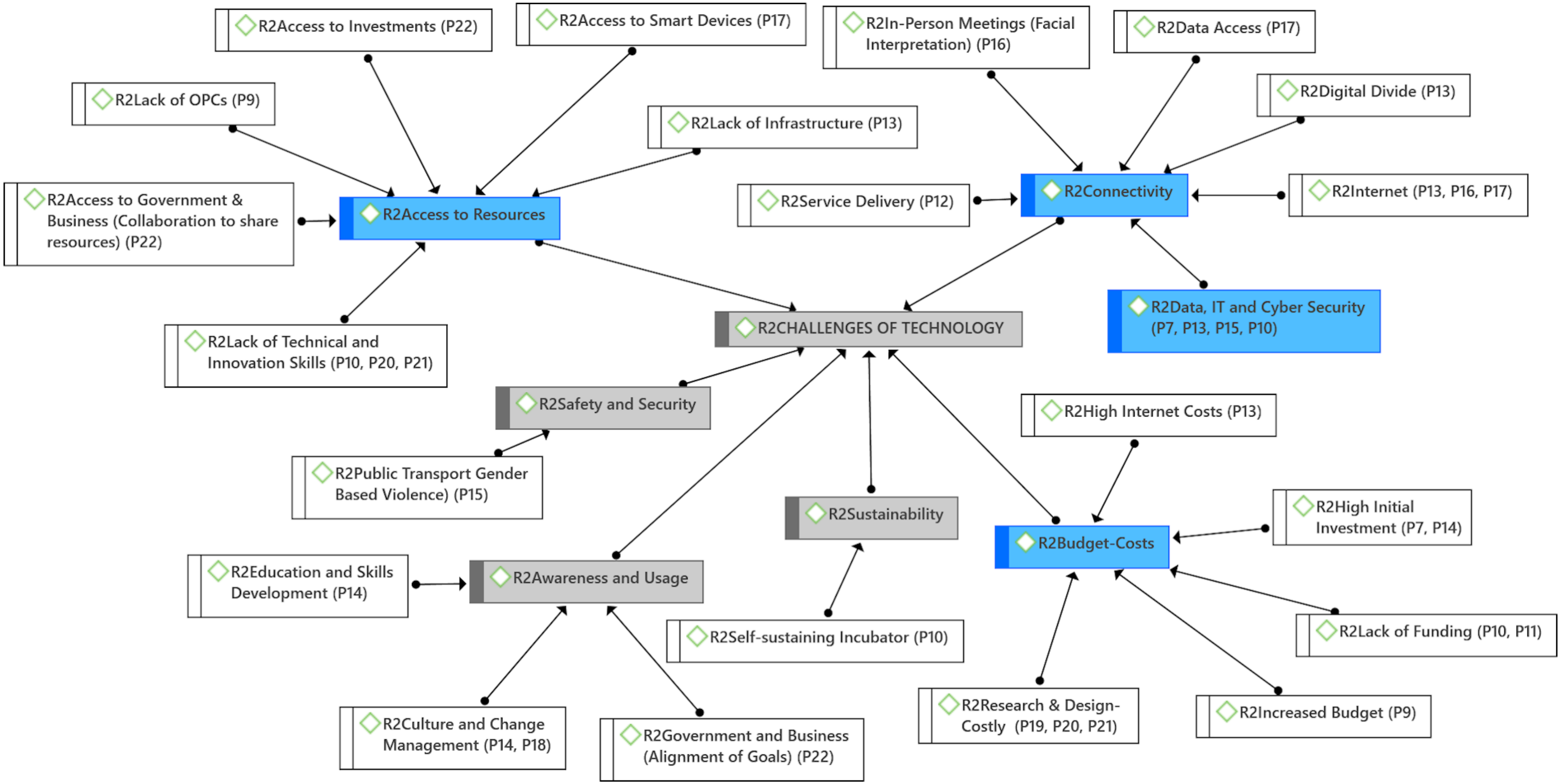

Figure 8.2: Technology Challenges in the Eastern Cape Smart Cities (Author's own construct)

With regard to the Budget – Costs theme, P14 said "*…I think cost would be a big barrier. Implementing all that's necessary…to make these initiatives work. A second would be if I think of the* ***diverse background of users*** *and having…them at the…****right skill level*** *to be able to take advantage of all of these…and cost as well in terms of not just the implementing having the infrastructure in place, but also maybe the complementary or supplementary devices and things that I needed to make use of these technologies that so the…****cost on the user having the technologies in place*** *in the cost on the person providing more, or* ***setting up the various technologies****. And another barrier would be also* ***education****…not everyone is aware or would be able to see the benefit or knows of these benefits and maybe sees it as this overcoming the barrier of change…suddenly you're trying to change the way things are done…there's always issues around* ***change management*** *when it comes to new technologies…*".

With regard to the Connectivity theme, P13 said "***Internet connectivity*** *that is the biggest barrier that we are facing at this point in time. Without Internet connectivity we* ***cannot access anything*** *else, so we can have the best initiative put in place in terms of the smart city and the concept of a smart city and connecting the city but the* ***structure of having of a superior fiber*** *line running through every Township through* ***every community that connects the East, the West*** *that connects the poor to the rich that connects the domestic worker to a boss...*".

With regard to the Access to Resources theme, P10 said "*…access* ***to some technical skilled resources****…where there doesn't exist, what we then do is make use of our own internal ecosystem…try and provide them with an income…when it comes to incubation…one must* ***make an incubator self-sustaining****…it's damn difficult…because based on the very…simple scenario is the people the resources that you are developing are not actually in a position to pay…****access to funding*** *for us still remains a challenge to offset some of the overhead, costs, etc…So investing in some of our own technology initiatives and then looking at industry and saying to industry. Can you find a use for this?...we wanting to derive an income and whether that's on the SAAS based model or IaaS based model infrastructure as a service…*".

8.4.2 Data Challenges (Round 2 Interviews)

Question D2.7 was used to identify the challenges of using data and open data sources. Themes from Round 1 for the same question are indicated as bold text in the list to show which of the themes identified are similar from both rounds. The themes that are indicated as *Italics* in the list are similar to those from the previous question (D1.2).

The three main themes related to data/open data challenges were Connectivity, Access to Resources and Safety and Security.

These themes and sub-themes are as follows:

- *Connectivity*-Data (*f=18*)
  - **Data and System Integration** (P11, P18, P20, P21, P22);
  - **Data, IT and Cyber-Security** (P7, P13, P15, P10);
  - Service Provider Lock-In (P11, P18);
  - **Making Sense of Big Data** (P14, P16);
  - IoT Readiness (P8);
  - Manual Tasks and Human Error (P8);
  - Data Access (Live and Real-time) (P8);
  - Global Central Database (P16);
  - Data Integrity (P21);
- *Access to Resources*-Data (*f=18*)
  - *Costs* (Process and Money) (P9, P13, P14, P17);
    - ❖ Increased Process Complexity (P9);
    - ❖ Increased License Costs (P9);
    - ❖ Subscriptions (P13, P14);
    - ❖ Sustainability (Funds for Free WiFi) (P17);
  - Access Controlled (P12, P20);
  - Hardware Compatibility (P8);
  - Investments (P8);
  - Lack of Technical Skills (P18);
  - Lack of Collaboration (P21);
  - Procurement Bottlenecks (Prevents Acquiring Resources) (P21);
  - Competition of Governments (Prevents Collaboration & Sharing Resources) (P21);
  - **Lack of People Buy-In** (Prevents Collaboration & Sharing Resource) (P22); and
- Safety and Security (*f=1*)
  - Public Transport (Gender Based Violence) (P15).

Figure 8.3 presents a network diagram created by using Atlas.ti that illustrates the themes related to the challenges that the participants are faced with, related to using data and open data sources. It is evident that the Connectivity theme had the highest frequency count (*f=18*). Data and System Integration as a challenge faced by the participants had the highest frequency (*f=5*) in the Connectivity theme. Access to Resources also had the highest frequencies related to challenges (*f=18*) and a further four (*f=4*) sub-themes related to Costs (Process and Money).

The Safety and Security comment by participant P15 was related to physical and personal data security risks, where the data could be used to track and identify the gender of a person and thus can result in some cases to Gender Based Violence.

With regard to the Global Central Database theme under the Connectivity theme, P16 indicated, "*…the biggest thing is obviously there's no proactive change control on versions…you've got 15 sites that you scanning and one of them updates a version. You have to know that. So otherwise you may be working off one back and so* ***there isn't a global central database*** *which gives you what the latest versions on. You got to have your own intelligence tools to know who's updating what, there's various newsletters, user groups for that, that I dial into, and that are part of my radar…*".

One quote related to Data Security under the Connectivity theme was indicated by P10 "*…when it comes to data now and the POPI Act…people have to give consent over and above that is also, the information, the data etc that you pass over so the POPI Act itself I think is becoming a little bit of a constraint. People need to take cognisance of it. I am not highly familiar as to the extreme restrictions other than I am aware of it. Also POPI will have an impact on data and how we use data in the future…* ".

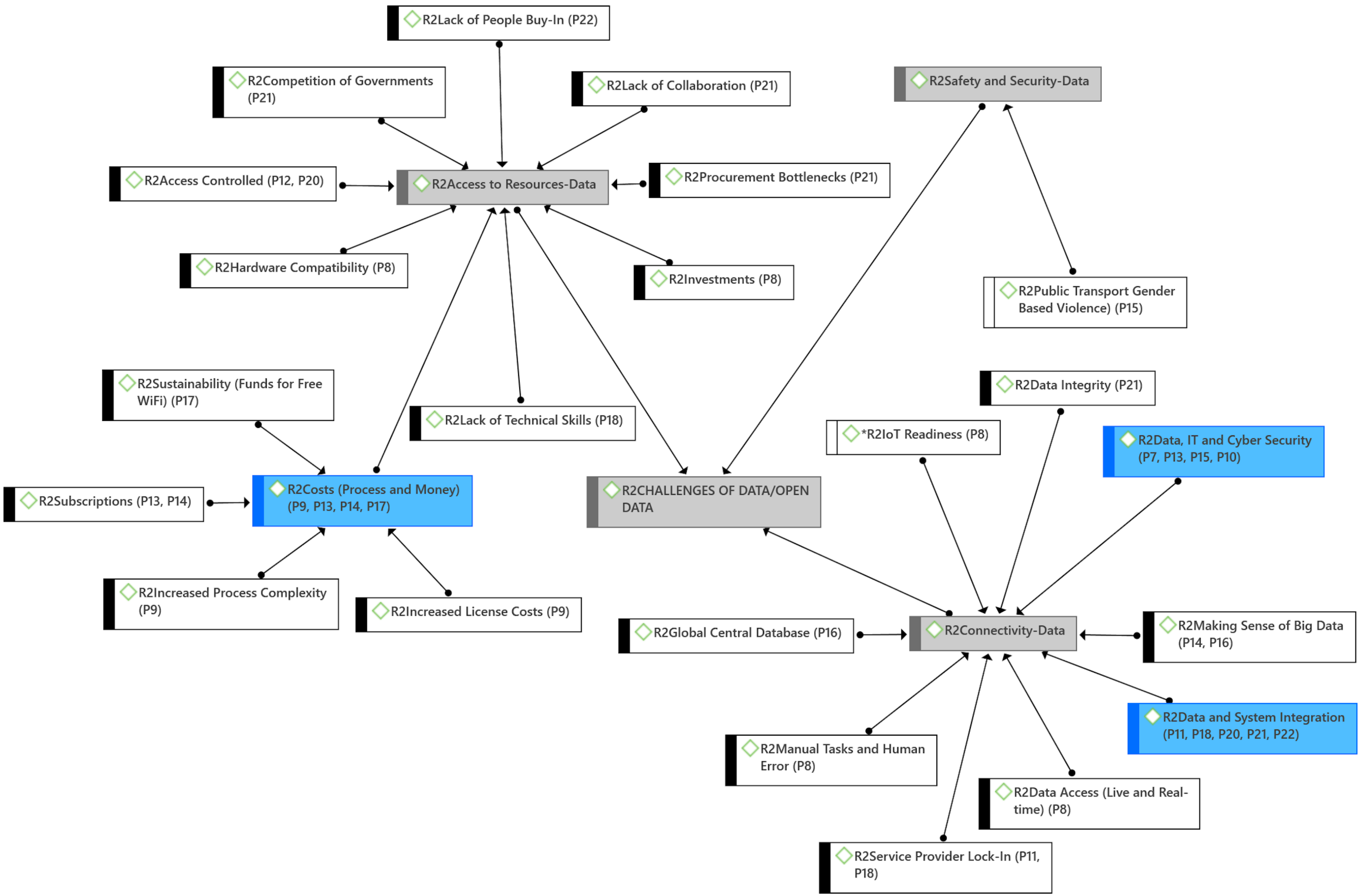

Figure 8.3: Challenges for Data and Open Data Sources in the Eastern Cape Smart Cities (Author's own construct)

8.4.3 Technologies in Initiatives (Round 2 Interviews)

The participants were asked in question D1. *What technologies are being used in the initiative, how and to what extent?* – e.g. *IoT, artificial intelligence; cloud computing.*

Question D1 findings were split into the types of technologies and the purpose of technologies. The themes identified were compared with those from Round 1 for the same question. Figure 8.4 presents an Atlas.ti network diagram of the themes related to the technology types and the purpose of using these technologies as indicated by the participants. In the list below of sub-themes for the types of technologies for Round 2, the common themes with Round 1 are shown in bold. The list of themes is:

- Mobile and Web Applications (E-Learning and Employment Platform) (P12, P15, P16, P17, P18);
- **IoT** and IoT-Hub (P7, P10, P18, P20);
- **Cloud Computing** (P7, P10, P18, P20);
- WiFi-Hotspots and Internet (P13; P14, P16, P22);
- CCTV and Smart Cameras (P13, P21, P22);
- Devices and Smartphones (P12, P14);
- **AI** (Machine Learning, Chatbot, Blockchain, Fibre Security) (P18, P20);
- **Smart Meters and Sensors** (P20, P22);
- EV Batteries and Micro-Grid Charging Stations (P7);
- Robotics (Spot & Stud Welding, Gluing, Mechanical Joining) (P8);
- PLC (Programmable Logical Controller) and OPC Server (P9);
- 3D Printers, Scanners & Laser Cutters (P10);
- Electronic Shields/Stacks (P10);
- Building Management Systems (BMS) (P11);
- Referencing Database (P16);
- Power Inverter (P16);
- Undersea Fibre Optic Cable (P18);
- SCADA System (Electric Power Grid Product) (P19);
- Enterprise Resource Planning (ERP) System (P21); and
- Geographic Information System (GIS) (P21).

Data Access (*f=7*) and Data Streaming (Dashboards, Decision Making) (*f=4*) had the highest frequency counts for the purpose of using technologies for Smart City initiatives. The Electronic Shields that P10 is referring to is a printed circuit board, which can be used for prototyping Engineering solutions.

Participant, P16 mentioned using a Referencing Database for all the Pharmaceutical industry related standards and documents. The Supervisory Control and Data Acquisition (SCADA) System was indicated by P19 as a system that is being used for their initiative with an electric power grid product to monitor and manage their power supply to the citizens and businesses. The five themes with the highest frequencies were Mobile and Web Applications such as E-Learning and Employment platforms (*f=5*); IoT and IoT-Hub (*f=4*); Cloud Computing (*f=4*); and WiFi-Hotspots and Internet (*f=4*).

Themes from Round 1 for the same question related to the purpose of using technologies for Smart City initiatives are indicated as bold text in the list to show which of the themes identified are similar from both rounds. The themes for the purpose of using technologies were identified as follows:

- **Data Access** (P7, P8, P9, P12, P16, P17, P20);
- Data Streaming (Dashboards, Decision Making) (P8, P17, P18, P20);
- Data Collection (P18, P20, P22);
- Remote Access and Working (P7, P16, P18);
- **Navigation and Mobility** (Traffic and People Flow Management; Access to Buildings) (P14, P21, P22);
- Smart Home (P13, P16);
- Online Meetings, Presentations and Scheduling (P16, P18);
- Load-shedding (P16, P19);
- Prototyping (P10);
- **Monitoring** (Controlling Building Components) (P11);
- Monitoring (Network Performance) (P19);
- Waste Management (P15);
- Uber (P15);
- Procurement (P18);
- **Connectivity** (P18);

- Attracting Foreign Investors (P18);
- **Online Customer Service** (P22); and
- Integration (Finance and Asset Management System) (P21).

With regard to the purpose of technologies, P7 said *"Internet of Things, the charging stations that I spoke about in our micro-grid piloting facility…are linked to a server so to help us…gather data continuously so the intelligence of the charger is…linked…to IoT. Because the charger communicates with a server, you can actually do remote work on the charging station, so you do not have to be physically at the charging station to work on the charger. And then we also use Internet of Things to gather data from any of the storage systems, like the batteries for example. IoT related and then also cloud computing as well yeah…because then…it's where…it helps us get access to data and it is. Also, a cheaper way…of saving the data instead of creating a whole. A database management system. So we use things like Windows Azure, your Google Cloud…".*

Participant P20 indicated the purpose of technologies and said *"…from an IoT perspective. I mean, we planning to implement sensors...Meters and…IoT devices will definitely be implemented, Cloud computing is kind of a natural thing, whether it just be virtual computing in a data center somewhere by us or on some type of cloud platform...some security products with artificial intelligence… from a…fibre security perspective, so yes, artificial intelligence definitely plays a part in assisting with…data and then presenting it in a meaningful way on dashboards…".*

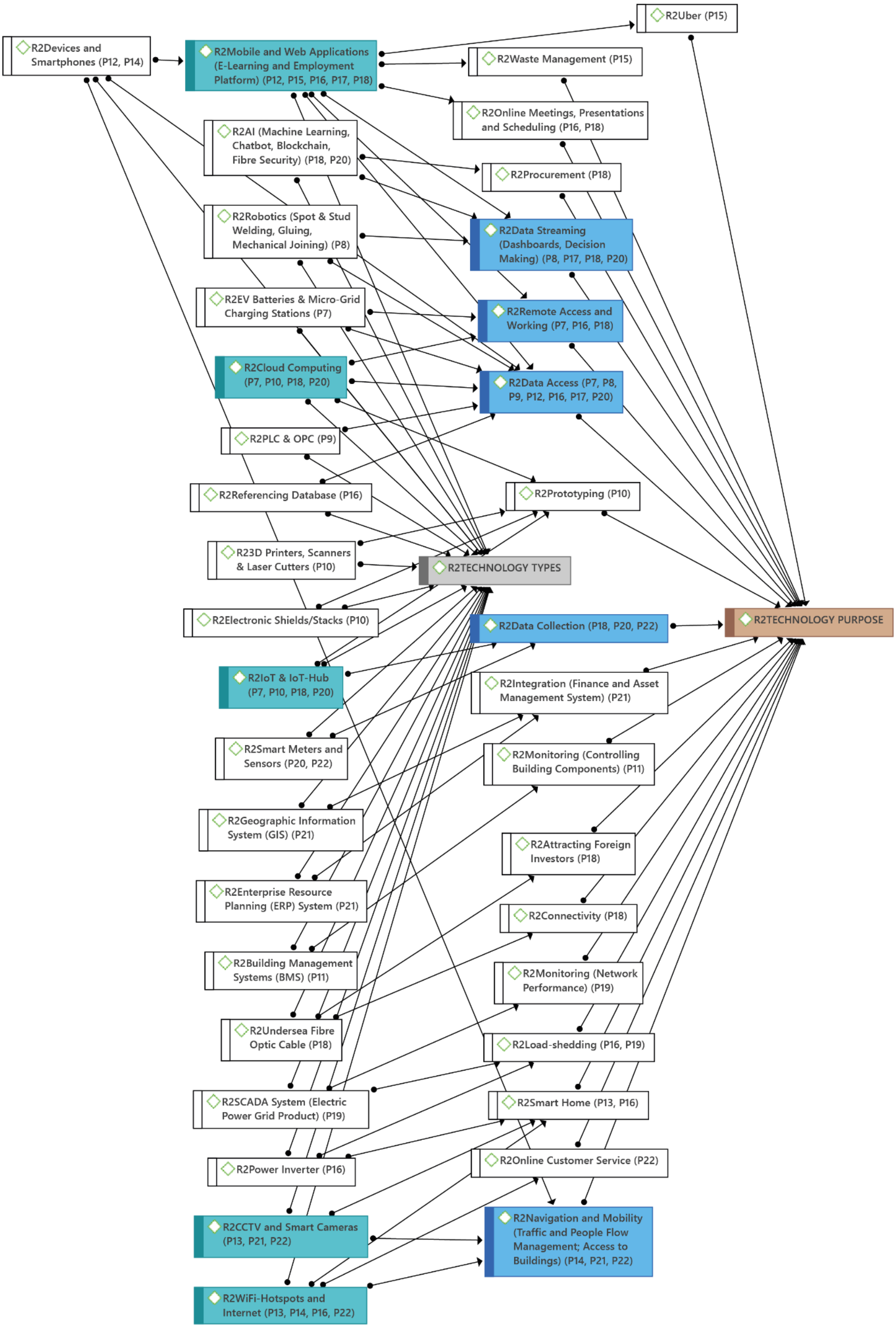

Figure 8.4: Technologies and purpose of use in the Eastern Cape Smart Cities (Author's own construct)

8.4.4 Data Value Chain Digital Activities (Round 2 Interviews)

The digital activities and the data value chain phases were explored using questions, D2.1 "*Which digital activities do you use for your smart city initiatives?*" And D2.2 "*What phases of the data value chain are relevant to your initiative?*".

Five Data Value Chain Phases namely, Data Acquisition, Data Analysis, Data Curation, Data Storage and Data Usage were identified. Themes from Round 1 for the same question are indicated as bold text in the list to show which of the themes identified are similar from both rounds. The following sub-themes for the digital activities were mapped to the relevant data value chain phase.

For **Data Acquisition** the following themes were identified (*f=22*):

- Trackers/Sensors/Meters (P7, P10, P11, P22);
- **Digital Portals/Databases** (P8, P14, P22);
- Online Search Engines (P12, P13, P15);
- Sustainability (Resource and Energy Management System) (P7, P18);
- Sustainability (Mobile and Web Applications – Utilities and Waste Management) (P11, P12);
- Digital/Adobe Signature (P16, P18);
- Usage Patterns (P7);
- OPC Server (P9);
- Communication Portals (P10);
- Excel Spreadsheet (P11);
- eMail (P16); and
- **CCTV** (P22).

For **Data Usage** the following main themes were identified (*f=20*):

- Data Streaming (Dashboards, Decision Making) (P7, P8, P10, P11, P18, P22);
- Online Shopping/Services/Streaming (P12, P13, P14, P15);
- Social/Online Media (P13, P17);
    - Online Marketing (P17);
    - Research (P13);

- Online Teaching and Learning (P14, P16);
- Online Banking (P12, P13);
- Maintenance (Schedule for EVs) (P7);
- Maintenance from Condition to Predictive (P8);
- Manipulate Data into Human Readable Data (P9); and
- Google Maps (P12).

For **Data Analysis** the following themes were identified (*f=7*):

- Run Analytics to make Inferences (P8, P10);
- Algorithms to predict the source of energy (P7);
- Website Usage Traffic Monitoring (P17);
- Social Media (P13);
- Online Research (P14); and
- Database Master Files (P22).

For **Data Storage** the following themes were identified (*f=7*):

- Cloud Computing (P9, P13, P14, P16, P18);
- EV Batteries (P7); and
- Access Controlled Database (P22).

For **Data Curation** the following themes were identified (*f=4*):

- Actuation of Sensor Data (P10);
- Social/Online Media (P13);
- Online Research (P14); and
- Database Master Files (P22).

P20 and P21 indicated that it is Early Stages for their initiatives and therefore did not contribute to any comments relevant for this question. Figure 8.5 presents the analysis of the themes for each of these phases the participants indicated the related digital activities. Data Acquisition main theme had the highest frequency count, twelve (*f=12*) digital activities. Data Streaming sub-theme related to Data Usage had the highest frequency count, six (*f=6*) participants. Cloud Computing also had one of the highest frequency counts, five (*f=5*) as a digital activity related to Data Storage.

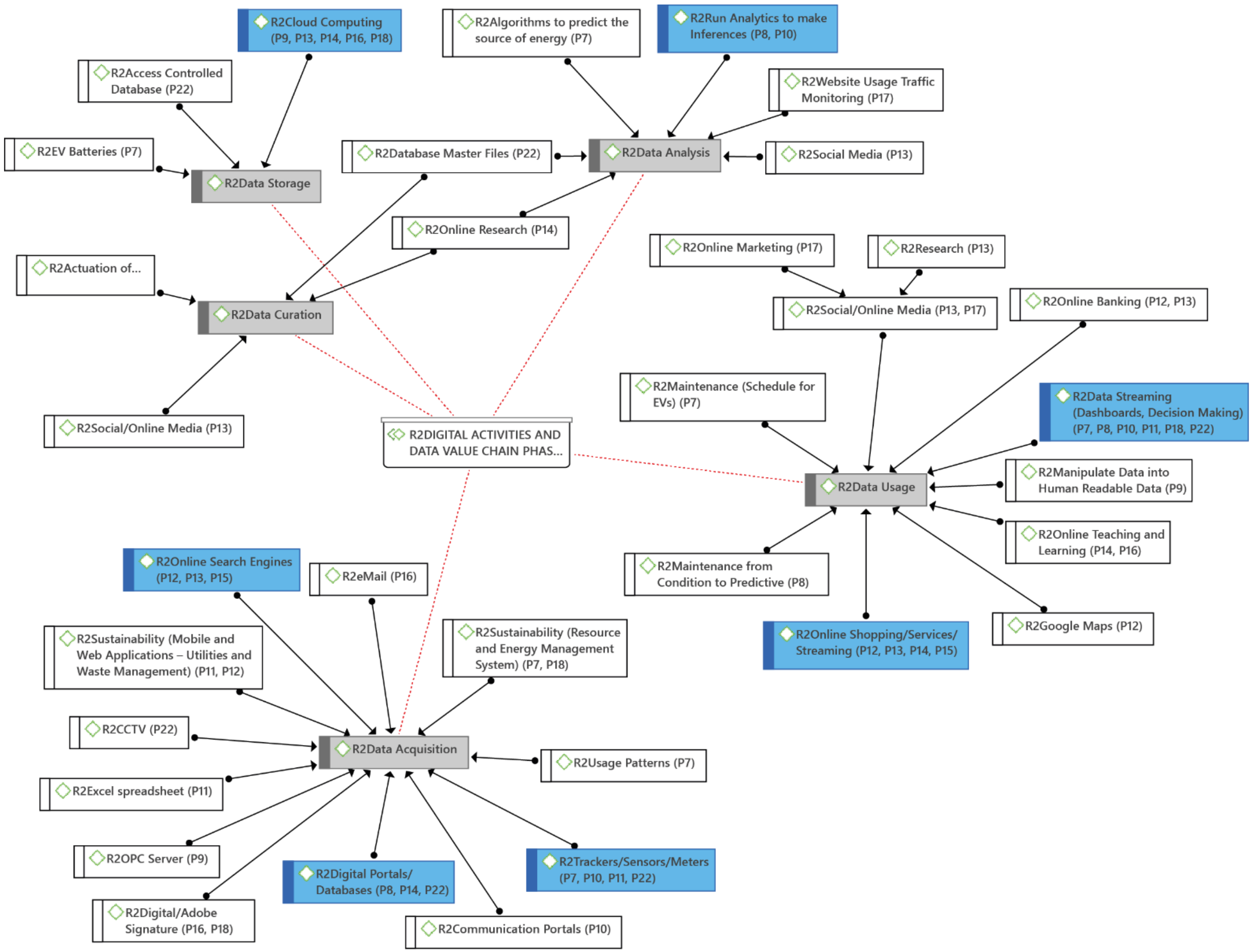

Figure 8.5: Data Value Chain Phases and the related Digital Activities in the Eastern Cape Smart Cities (Author's own construct)

With regard to the digital activities and the relevant data value chain phases, P7 said *"…the main activities relate to the gathering of data. So for example, with our micro-grid facility on (…) Campus…we gather data…to help with the energy management system...the data that we use uses an algorithm to help us predict what source of energy we use at a specific point in time… for the E-bikes. We've got a tracker on all the E-bikes so that tracker helps us understand usage patterns…it also helps us schedule maintenance for the Vehicles…"*.

P22 said, *"…all of them are relevant to us to have…clean data because as a Metro also we discovered we've got a water electric section, we've got electricity section we've got Road section. We've got…different departments and we found that all of them have got headed databases of consumers and we found that they're all running on…duplicate database system or data sets…"*.

8.4.5 Data (including Open Data) in Initiatives (Round 2 Interviews)

With regard to the data/open data sources, the participants responded to question D2.3 "*Which data/open data sources are you using?"*.

Three main themes were identified for the data sources namely Internal Data Sources, Open Data Sources, and Access Controlled Open Data Sources. Each of these data sources had related data sources which were identified as the sub-themes. P8 did not identify any types of open data sources for this question, but indicated the purpose of data sources in D2.4 and therefore a data type was identified accordingly. P21 indicated that it is still Early Stages for them and therefore did not contribute any relevant comment for this question.

For **Access Controlled Open Data Sources** the following nine sub-themes were identified (*f=10*):

- Structured Query Language (SQL) server (P9, P20);
- Open Charge Point Protocol (P7);
- OPC server (P9);
- PLC server (P8);
- Higher Education Facilities Management Association (HEFMA) (P11);
- Pharmaceutical Industry Standard Website (P16);
- Enterprise Architecture iServer (P18);

- Buffalo City Electricity App (P19); and
- Municipal Websites (P22).

For **Open Data Sources** the following eight sub-themes were identified (*f=8*):

- Search Engines (P13);
- Photo Editing Software (P13);
- Statistics SA (P14);
- World Bank (P14);
- Open Access Textbooks (P14);
- Recycling Websites (P15);
- E-Learning Platform (P17); and
- Employment Platform (17).

For **Internal Data Sources** the following seven sub-themes were identified (*f=7*):

- Communication Protocol (IEC 61850) (P7);
- Enterprise Architect (P7);
- WAN-LoRa Sigfox for IoT-Hub (P10);
- BMS (P11);
- University Portal (P12);
- Cloud Solutions (P18); and
- Open Platform Communications (OPC) SCADA (P19).

The themes indicated as bold text in the list are those that were also identified in Round 1 in a related question; therefore, showing the themes identified that are similar in both rounds.

With regard to the Internal Data Sources that are being used, P7 said *"…for our Chargers we using a protocol called Open Charge Point Protocol which helps us access data easily from the charger and then for our micro-grid to help us connect easily to the municipal utility grid. We use a* ***communication protocol*** *called IEC 61850 so those online tools that we use really assist us for gathering and processing data, and then we use another one called Enterprise Architect which helps us visualise data and try and develop business cases…".*

With regard to the Open Data Sources that are being used, P14 indicated the use of Open Access Textbooks for access by the university. With regard to Access Controlled Open Data Sources, P16 indicated the use of the Pharmaceutical Industry Standard Website theme and said *"…There is a vast variety of about 15 or 20 pharmaceutical sites…all the industry standard site. So if you want the European approach you go to the EMEA site and then from there if you want a small scientific thing you go to the International Conference for Harmonization. You want the American, you go to the US PD…That's part of what I have to teach people. Probably about 25 or 50 cool places where you acquire this information…".*

Question D2.4 was used to gather sub-themes "*For which purpose was the above-mentioned data/ open data sources used?*".

Figure 8.6 presents the network diagram of all the relationships between the data and open data sources used by the participants and their purposes in using these data sources. The theme of Access Controlled Open Data Sources had the most sources and therefore had the highest frequency count of nine (*f=9*).

The themes identified were compared with those from Round 1. Common themes in both rounds for the same question are indicated as bold text in the list below to show which of the themes identified are similar from both rounds. The following 18 themes were identified:

- Access to Resources for Research (Online Information) (P13, P14);
- Data Storage (P9, P20);
- **Data Access** (P12, P21);
- **Reporting and Monitoring** (P11, P20);
- Develop a Visualisation Model (P7);
- Remote Access to Data (P7);
- Integration of Power-Grids (P7);
- Adapt and Modify Maintenance Process (P8);
- Project Management (P10);
- Photography (P13);
- Online Services (P15);
- Referencing (P16);
- Online Marketing (P17);

- Website Usage Traffic Monitoring (P17);
- Providing Free Access to Resources (P17);
- Integration (Data and Processes) (P18);
- **Analysis** (Calculations for Performance Indicators) (P19); and
- Online Publishing of Municipal Information (P22).

With regard to the purpose of the data and open data sources, P7 indicated three reasons for using these sources as highlighted here, and said *"…The Enterprise architect was used to **Develop a visualisation model** for our micro grids and with that we were able to develop a business case for utilizing a grid which has access to different types of. Renewable energy sources…and then for the Open Charge Point protocol that was used to help us have **remotely access our data** from the charging stations. And the IEC61850 protocol we used to assist us with **integrating our micro-grid** into the municipal electrical grid…"*.

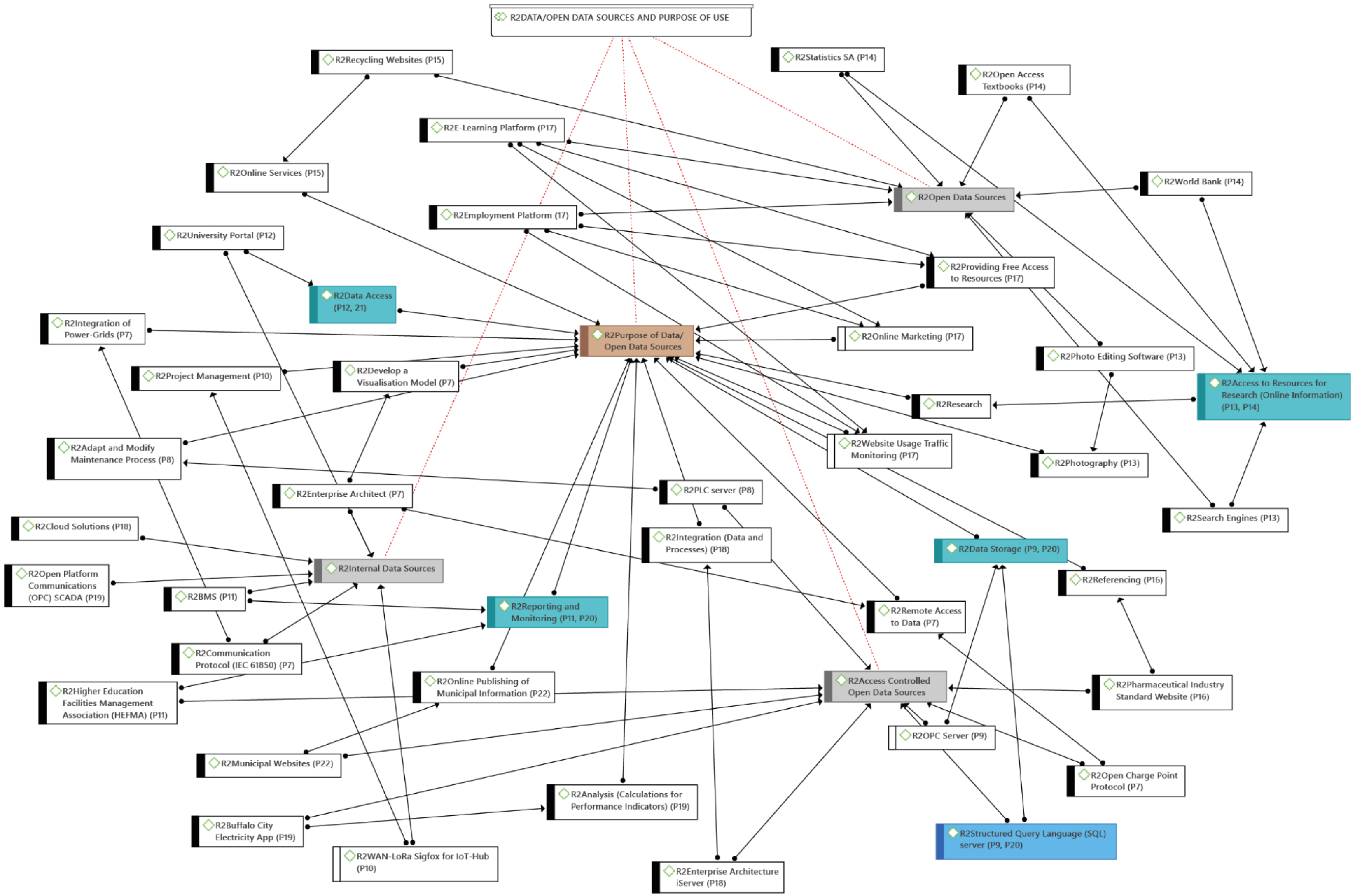

Figure 8.6: Purpose of using Data and Open Data Sources in the Eastern Cape Smart Cities (Author's own construct)

8.5 Impact on Environment and Value (Round 2 Interviews)

The Environment related interview questions are addressed in this section, where the findings and relevant data evidence and sample quotes of these interview questions are presented.

8.5.1 Value of Technologies and Data Sources (Round 2 Interviews)

The participants indicated their value of using technologies by answering question D1.1 "*What is the value of using the above-mentioned technologies?"*.

Figure 8.7 presents a network diagram of the themes for the value of using technology for Smart City initiatives. The themes were compared to those of Round 1 for the same question and are shown as bold text in the list of themes. An asterisk (*) indicates where the response was negative. The list of themes and sub-themes for value of using technology from Round 2 are:

- Connectivity (*f=10*)
  - Remote Access and Working (P7, P13, P14, P16, P18);
  - Access to Resources (Online Information) (P12, P13, P14, P15, P17);
- Living Conditions (*f=8*)
  - Safety and Security (P13; P19, P21)
  - Convenience (P13, P14, P16);
  - Education and Literacy (P13, P15);
- Opportunities (*f=3*)
  - Entrepreneurship (P12);
  - Efficient City (P21);
  - Mentoring (10);
- **Budget-Costs** (*f=2*)
  - Cost Reduction (P18);
  - Return on Investment (P18);
- **Data Access** (P7, P9);
- Sustainability (Resource Management) (P8, P11);
- **Monitoring** (Condition and Quality) (P8);
- Data Streaming (Dashboards, Decision Making) (P8);
- Maintenance (Moved to Condition and Cycle-based) (P8);
- Easy to Use and Understand (P9);

- Time Saving (Marketing) (P10);
- Business Development (Accelerated Products) (P10);
- Paying Customers (Quicker turnaround time) (P10);
- Online Customer Service (P19);
- Customer and Citizen Participation (P19);
- Contribution to Smart Policy (P19);
- *Corruption and Procurement (P21); and
- *Fake Qualifications and Skills (P21).

From the 22 sub-themes, Connectivy had the highest frequency (f=10). Living Conditions had the second highest (f = 8). The two sub-themes with the highest frequency counts (f=5) were those linked to Connectivity and were Remote Access and Working and Access to Resources (Online Information).

Corruption and Procurement and Fake Qualifications and Skills were two sub-themes reported that were a negative value of technologies; both of these were from participant P21, who was a citizen of the Eastern Cape.

With regard to the value of technology, P10 said "*…obviously time because a…lot of this is all about time to market. You want it to get to a market this quickly as possible even with our still state and our process is 3 years. But the fact of the matter is that if you have the appropriate technology and the know-how and we also of course bring in business savvy people around the mentoring so there's the whole human aspect around this as well. It obviously accelerated the whole process and that is really, really what you wanted to do, and it's accelerated product development. It's accelerated business development…it's about us getting to that paying customers as quickly as possible...*".

P18 said, "*…The main reason what we're trying to do is IT; we are aiming for this of return on investment. So, the amount that we spent on this new technology with AI artificial intelligence with AI and IoT what we're doing is we I have to reduce the cost like we're going to going to review our bring your own device policy. So, then people is responsible for it and we can cut down on the cost…and…work more smartly…*".

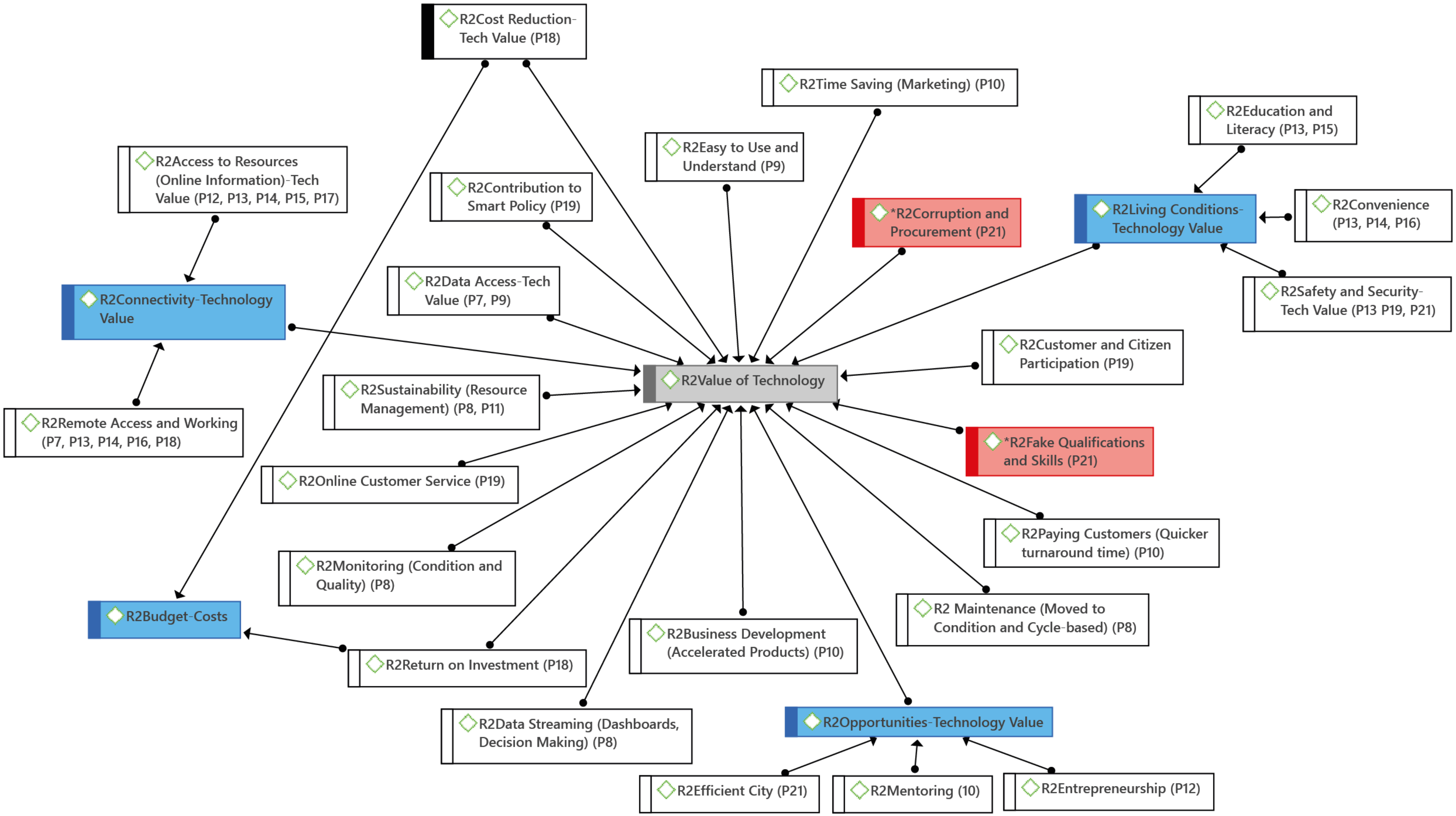

Figure 8.7: Value of using Technologies in the Eastern Cape Smart Cities (Author's own construct)

The value of data/open data sources was investigated by using the question, D2.5 "*What is the value of using the above-mentioned data/ open data sources? (i.e. do you have any problems with getting the data or the quality of the data)?"*.

Figure 8.8 presents the value of using data and open data sources for Smart City initiatives. Themes that are similar to Round 1 for the same question are shown in the list below as bold text and negative themes are indicated with an asterisk. The following themes and sub-themes were identified:

- Connectivity (*f=12*)
    - **Access** to Resources (Online Information) (P12, P14, P16, P18);
        - Centralisation of Information (P12, P16);
        - Standards and Compliance Information (P16, P18);
    - Internet Research (Monitoring, Managing and Analysing Data) (P13, P14, P20); and
        - Decision Making for better Solution Development (P14).
- Digitalisation (*f=3*)
    - Feedback to Council (P19);
    - Performance Indicators (P19); and
    - Planning Capital and Maintenance (P19).
- Data Gathering (P11, P13);
- Sustainability (Resource Management, Awareness) (P11, P20);
- Stakeholder Management (Digital Hub-Working Group) (P21);
- Living Conditions (Better Customer/Citizen Service) (P22);
- Affordability (P7);
- Data Storage (P9);
- Data Usage/Manipulation (P9);
- Big Data Analytics (P10);
- Competitiveness (P10);
- **Data Integrity** (P11);
- Knowledge (Acquisition, Awareness) (P15);
- Free Access to Mobile and Web Applications (E-Learning platform, Employment platform) (P17);
- **Cost Reduction** (P20);

- Business Development (Enable SMMEs) (P22); and
- *IoT Readiness (P8).

The Connectivity theme as value of using data sources had the highest frequency (*f* = 12). The two Connectivity sub-themes are Access to Resources (Online Information) (*f*=4) and Internet Research (Monitoring, Managing and Analysing) (*f* = 3). Only one negative response was made and this related to a lack of IoT Readiness. This theme is shaded in red in the network diagram to show that P8 regarded this as negative since he stated that their readiness of IoT capacity is not where it is supposed to be.

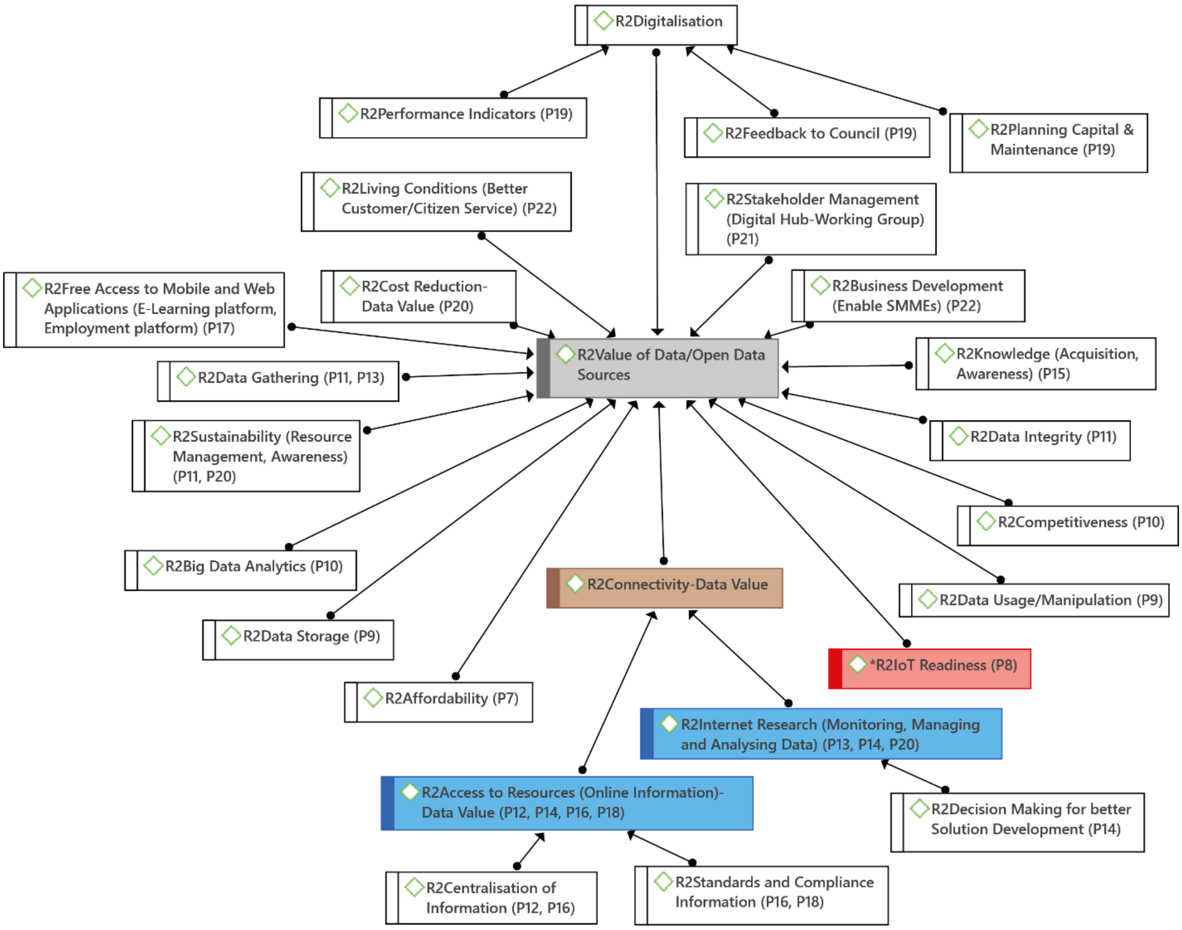

Figure 8.8: Value of Data and Open Data Sources in the East London Smart Cities (Author's own construct)

With regard to value of data/open data sources, P14 said "*…The value of using these data sources…the one…benefit of having access to all of these data sources that you have information that is up to date and relevant, and then that enables you as well to be able to make correct analysis and…come up with appropriate solutions and conclusions and recommendations to whatever problems you're trying to solve…it enables us to make better decisions and formulate better solutions to the real world issues…*".

Participant, P18 said "*…the open data sources all the data sources that will be available will be a standard to an ISO…requirement or compliance requirement for examples because we are a parastatal we have (...) …audits especially for IT. So even we use open source where those software…is available. They have been structured to those requirements…So that's the biggest benefit if you use an open source is because we don't have to customise…you just need to use application as it comes…it is aligned to those compliances that is required for each standard…that needs to be audited…*".

8.5.2 Economic Impact of Initiatives (Round 2 Interviews)

The participants responded to the question regarding "*Smart City initiatives' impact on the city's economy"* (E2.1).

Several themes that were identified were similar to those found in Round 1 interviews for the same question. These are shown as bold text in the list below. The responses from the participants were either positive, negative or mixed. The negative themes are indicated with an asterisk (*). The sub-themes are:

- **Employment and Skills Development** (P8, P10, P14, P16, P17, P18, P20);
- **Attract Investors** and New Markets (P13, P20, P21, P22);
- Digitalisation (IoT Readiness) (P8, P13, P18, P21);
- **Reduction of Costs** (P8, P9, P11, P22);
- Improved Living Conditions (P19, P22);
- Sustainability (Resource Management) (P7);
- Sustainability (Awareness of Benefits of EVs) (P7);
- Sustainability (Economy) (P11);
- Digitalisation (Connectivity) (P14);
- Increased Revenue Streams (P14);
- **Navigation and Mobility** (P15); and

- Service Delivery (Reduced Business Downtime) (P19);
- *Service Delivery (Navigation and Mobility) (P12); and
- *Service Delivery (Data Integrity) (P21).

Employment and Skills Development had the highest frequency (*f=7*). Attract Investors and New Markets; Digitalisation (IoT Readiness); and Reduction of Costs all had the second highest counts with *f=4*. Both Employment and Skills Development related to Smart City initiatives were also identified as themes in Round 1 that had an impact on the economy.

With regard to Employment and Skills Development, P17 said "*...qualifications and the other aspect, and that's just from the E learning side… It is more of an upliftment that they are in a position to be able to contribute above the basic employment sort of level, but a level of people with qualifications the other side from the employment system that we rolled out. That would then directly impact on the economy because it's reducing unemployment...*"; and P20 said *"...So it's kind of got a bit of a snowball effect whereby…you start creating more high tech jobs... Its higher-paid individuals…*".

The Attract Investors theme was also identified in Round 1. With regard to Attracting Investors and new Markets, P20 said "*...if we build this high tech environment, you know you start attracting other high tech companies…"* and P21 said *"…obviously deepen the impact in the value chain…greatly improved competitiveness… East London's a bit far away from markets and hasn't really got great logistics infrastructure…There's a lot of advantages that are going to come with the development of ICT and bringing all the kind of big digital players in…*".

8.5.3 Environmental Impact of Initiatives (Round 2 Interviews)

The participants indicated how their Smart City initiatives impact or relate to the natural environment (E2.2). The themes that are similar to those *a priori* Round 1 themes for the same question are shown as bold text. All the themes for this interview question related to Sustainability. P8 said that the environment question is not applicable in their company's scenario and P9 indicated that their software and system could allow for environmental monitoring. The four sub-themes identified were:

- Sustainability (Resource Management) (P7, P10, P11, P14, P18, P19, P20, P21, P22);
- **Sustainability** (**Navigation and Mobility** (Traffic Reduction)) (P11, P12, P13, P14, P17);

- **Sustainability** (Economy (P15); Service Delivery(P15)); and
- **Sustainability** (Awareness) (P16).

With regard to Sustainability (Resource Management), P7 said *"…when you use electric vehicles they are zero-emission vehicles, so they will contribute towards reducing the carbon footprint; and another aspect that some people also forget about is the uptake of electric vehicles also assist the overall health of the city in terms of reducing air pollution and air pollution also contributes to diseases such as like your asthma for example… noise reduction as well. Electric vehicles are much quieter"*.

Regarding Sustainability (Navigation and Mobility (Traffic Reduction)) and Sustainability (Resource Management), P14 said *"…moving away from your paper based systems is good for the environment when you've got connectivity and access…not needing to move around so much, that's also going to reduce the carbon footprint from that perspective traveling, you can access services from wherever you are, as long as you've have connectivity…the new residences have been built now are green buildings so they have been built with the environment in mind and connectivity in mind and safety, security, etc. So that's good for the environment for sure..."*.

8.5.4 Social and Work Life Impact of Initiatives (Round 2 Interviews)

The interview questions that are addressed in this section focus on the impact of the initiatives on the lives of the citizens in the Eastern Cape (E2.3). The findings indicate the benefits of the initiatives, whether the users or utilisers think they are as expected and/or whether there are gaps.

All sixteen participants indicated the impact of Smart City initiatives on citizens daily lives (social and at work). Fourteen main level themes were identified. The themes similar to Round 1 for the same question are shown as bold text and those themes that are related to a negative impact are shown with an asterisk (*).

The following are the themes and sub-themes identified:

- Living Conditions (*f=6*)
    - Reduce Stress (P7);
    - Smart Homes (P11);

- Smart Work Life (P13);
- Income and Sustainability (P15);
- Fault Reporting (P19); and
- Data Access for Service Delivery (P20).

- Infrastructure (ICT & Built) (*f* = 3)
  - *Vandalism (P19);
  - Other (P18, P21).
- **Process Improvement** (P8, P14, P9);
- Digitalisation (Access to Free WiFi) (P19, P22);
- *Smart Service Delivery (Lack of; Increased Costs) (P12, P21);
- **Sustainability (Awareness)** (P7, P11);
- Condition Based (P8);
- Digitalisation (IR4.0) (P8);
- Knowledge Sharing (Preventative Maintenance) (P9);
- Collaboration (Social Networking) (P13);
- Sustainability (Recycling) (P10);
- Early Warning Systems (P10);
- **Education and Training** (P17); and
- Uplift Communities (Learner Education) (P17).

The theme with the highest frequency count was Living Conditions (*f* = 6). The common themes from Round 1 were Process Improvement; Sustainability; and Education and Training. In Round 1 the Process Improvement theme was indicated by one participant, saying that with the new technology it improved the process of his/her client and that paperwork and manual approaches were reduced making people's jobs easier. In Round 2, three participants indicated the Process Improvement theme; for example, P14 stated that less admin and improved workflow through automation made tasks easier.

Smart Service Delivery relates to those service related to some digital activity or using smart technologies to deliver or access a service. Two participants highlighted negative impacts regarding Smart Service delivery, one regarding the Lack thereof (P12) and the other regarding the impact a Lack of Smart Services have which increases costs to citizens who receive inflated utility bills.

With regard to Living Conditions and Reducing Stress, P7 said *"...It makes life easier, like I would say, for example, drive driving an electric vehicle. It's much easier to than driving a petrol vehicle because you don't have to think about filling petrol everyday. You just charge the vehicle and also in terms of riding, an electric bike is actually less stressful. Terms of peddling..."*.

With regard to Sustainability, Recycling and Early Warning Systems, P10 said *"...Biodigester project now we did. Actually, be looking at giving selling gas in almost foil bags… we almost looking at the 10 cent 50 Cent market as well where we could provide that kind of a gas at a very low cost, but it's very clean. Burning methane is. Yeah, you know it's a bio-gas. Yes, very environmentally friendly, but using waste, you know within the environment so you're cleaning up the environment in the townships, but you also providing very very clean fuel…*".

With regard to Education and Training, P17 said *"…aren't actually very many places currently in. The Nelson Mandela Bay area for Second Chance learners…hey don't facilitate your training…we've got (...) ...so that people can go in there. They can work on their CVs. Can upload it online, they can email it out. They can do whatever research they need to on the laptop, so we've got all the tablets there with the E-learning…with them having the WiFi around town and at these various places it's just sort of uplifting everyone across the board…"*.

P17 also indicated that they try through their initiatives to Uplift Communities through Learner Education, and said *"…We're uplifting, the scholars, the pupils that them coming home with good marks increases the desire for their parents to assist him and for him to realize how, how important they schooling is…"*.

8.6 The Relationships Between the Economic, the Social and the Environmental Impacts

Figure 8.9 presents the network diagram of all the category of the three Environment-related sub-themes (Economic, Social and Environmental). The negative impacts are shaded in red on the diagram and those with the highest frequencies are shaded as blue.

Overall, four of the main themes were negative, three of which related to service delivery. Two of the these were in the 14 high level Economic related sub-themes were indicated as negative by P12 and P21, both are related to Service Delivery; one to Navigation and Mobility (P12) and the Data Integrity (P21). The other two negative themes related to Social and Work Life.

One of these was Smart Service Delivery (P12, P21) which indicated a Lack of service and Increased Costs related to Smart City initiatives. The second one was Vandalism (P19) of Infrastructure (ICT & Built) such as the Fibre Optic Internet installations being dug up and stolen in Buffalo City.

The Sustainability sub-theme had the highest frequency count (*f=9*) of all the Environment Category sub-themes related to Resource Management. Navigation and Mobility related to Traffic Reduction had the second highest frequency (*f=5*) for its impact of reducing carbon footprint in the Environment.

Employment and Skills Development was regarded as important and had the highest frequency (*f=7*) for the Economic Category in the Eastern Cape. The Economic Smart City related sub-themes that were regarded as important on a city's economy with a frequency count of four was Attract Investors and New Markets (*f=4*); Reduction of Costs (*f=4*) and Digitalisation (IoT Readiness) (*f=4*).

Living Conditions has six (*f=6*) related sub-themes and is one of the sub-themes for Social and Work Life. These themes were identified as important impacts on the lives of citizens, users and utilisers of Smart City initiatives in the Eastern Cape.

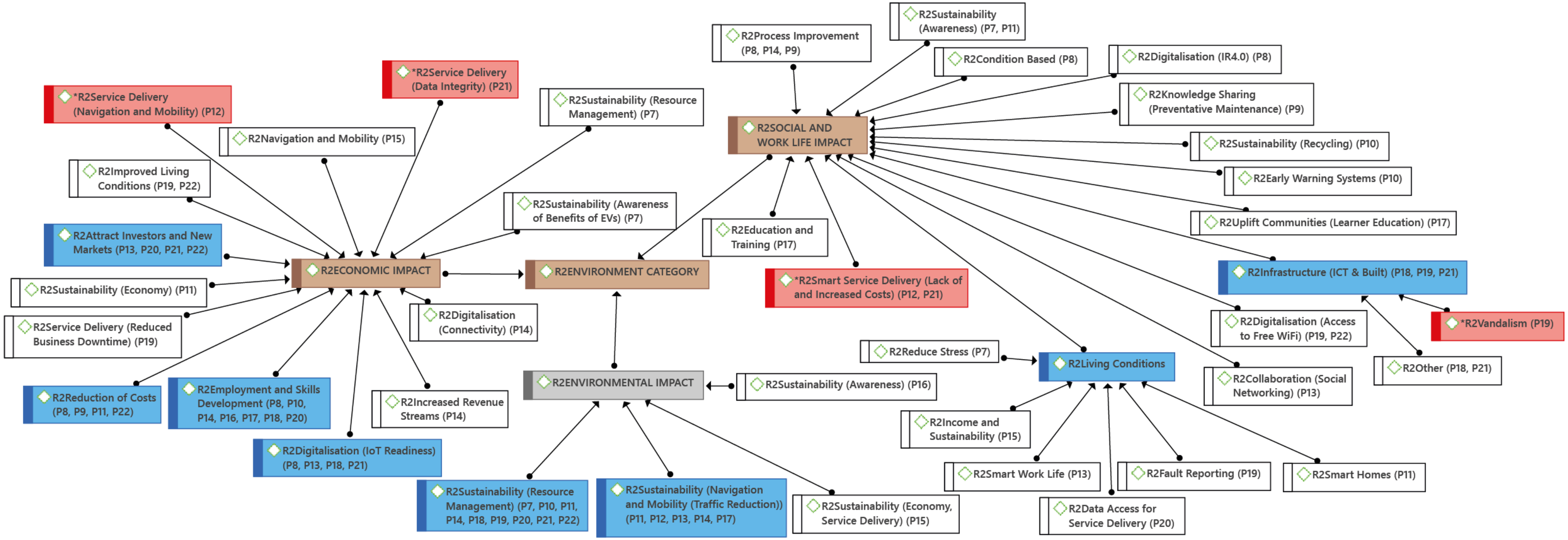

Figure 8.9: Economic, Social and Environmental Impact of Smart City Initiatives in the Eastern Cape (Author's own construct)

8.7 Benefits of the Initiatives (Round 2 Interviews)

The participants indicated what they believed were the benefits of their initiatives to the users or utilisers (E2.4). Some participants also indicated the possible beneficiaries of their initiatives and their impact, whether positive or negative. The themes that are similar to those from Round 1 interviews for the same question are shown in the list in as bold text and negative themes are indicated with an asterisk. A total of 22 actual benefits (*f=22*) were identified and were:

- Connectivity (*f=9*)
    - Social Networking (P13);
    - Digitalisation (P14, P21);
    - Networking (P15);
    - Access to Resources (Online Information) (P12, P13, P20, P22);
        - Bridging the Digital Divide (P22); and
- Education and Training (*f=7*)
    - Uplift Communities (P15, P17);
    - Knowledge (Acquisition, Sharing, Awareness) (P15, P16);
    - Training Center (Eco-Friendly) (P18);
    - Lifelong Learning (P16): and
    - Confidence in Knowledge & Skills (P16).
- **Cost Reduction** (P7, P8, P9, P19, P20);
- Sustainability (Resource Management) (P10, P14, P15);
- Living Conditions (P14, P22);
- Time-Based to Condition-Based (P8);
- Predictive (P8);
- **Job Creation** (P10);
- **Return on Investment** (P11);
- Competitiveness (Foreign Investors) (P21);
- Productivity (P21); and
- *Smart Service Delivery (Lack of, Inefficient) (P21).

The theme with the highest frequency was Connectivity (*f=9*) and second highest was Education and Training (*f=7*). The theme regarding Knowledge under Education and Traning includes Awareness and participant, P15 indicated that streets are dirty in townships (locations) and people are not willing to clean up. The participant continued to explain that this related to not being as educated and aware of the benefits of being sustainable and earning an income using waste as a resource of recycling. Participant, P16 explained the related impacts of their initiatives and their links to employee confidence and lifelong learning. Participant, P21 said that productivity in the backward Buffalo City is declining and that service delivery is inefficient and participant, P22 indicated that their Smart City initiatives could help level the playing field by ensuring everybody gets the same service and access to information.

Cost Reduction had the third highest frequency (*f*=5) and was also mentioned in Round 1, With regard to this theme P9 said "*...your plant manager and your manufacturing manager. We think that using our software you can actually reduce entire plant floor factory costs. You can save a lot of your time and then also you can just improve your overall plant efficiency...*".

The Time-Based to Condition-Based theme was identified as a benefit by P8, who said "…*But actually that device doesn't need to be maintained so often you know. So in doing so, you driving up costs with driving up labour. Yeah, personnel that you need now when you move to condition-based, you reduce that cost significantly...*".

The participants were asked if they thought the benefits were as they expected (E2.5). The themes similar to Round 1 for the same question are shown as bold text and the negative views are indicated with an asterisk and *Italics* (*). The identified themes were as follows:

- *Early Stages and Slow Progress (P8, *P13*, P14, *P20*, *P21*);
- **Expectations are Met** (P17, P18, P19, P22);
- **Awareness and Usage** (of Technology and Services) (P7, P10, P11, P16);
- Saving (Cost and Time) (P8, P9, P18); and
- *Reducing Digital and Physical Divide (P13, P15, P22).

Early Stages and Slow Progress theme had the highest frequency (*f*=5). Three of these were negative (P numbers italicised) from participants who did not think that benefits were quite as expected since the benefits were limited to due to most of the initiatives having slow progress and being in the early stages of their Smart City initiatives. For example, P21, and said "…*there are some efforts underway in the city in Buffalo City in the Metro and that they not being integrated in a kind of smart city strategy…they are still very silo based… one department, will put up cameras from a public safety perspective, but they not necessarily linked to, you know South African Police, private security, and so there's a lot of issues around lack of integration…data integration…you really need a smart city strategy that that can provide that level of integration…it's all about integration, data sharing, open platforms and things, and I think that's what we have to shift the city towards…*".

Four comments related to the general Expectations are Met theme. For example, P17 said "*To be honest, I think when we initially started, we didn't think we would be able to achieve as much as we have..*.". Awareness and Usage (of technologies and services) was cited by four participants to support the argument that benefits were as expected.

One participant, P16, had a mixed response and indicated "*No*" from a short-term viewpoint based the perspective of the employer of his customers who are the employees, but "*Yes"* from the perspective of the employee gaining immediate benefits.

The participants were asked to identify gaps between their initiatives' expected and actual benefits (E2.6). Participants P13, P14 and P15 did not indicate gaps. The gaps reported by the others are as follows:

- **Expectations and Reality Gap** (P11, P16, P19);
- Early Stages (P20, P21);
- **Awareness and Usage** (of Technology and Services) (P7);
- **Learning Curve and Time Expense** (P9);
- **Sustainability** (Resource Management) (P17);
- Time-Based to Condition-Based (P8);
- Slow Process (P10);
- Smart Service Delivery (Non-Delivery) (P12); and
- Infrastructure (Connectivity Internet) (P18).

The themes similar to Round 1 for the same question are shown as bold text. With regard to Sustainability (Resource Management) theme, P17 said "*...the problem now that we face is we got a decent amount of funding and it was able to take us to this particular level…it was a positive gap in terms of what we're expecting and what we did deliver in terms of an impact…But now our contract for the WiFi will end…so it now becomes difficult problem. The problem we're facing now is how do we get the next round of funding?…How do we make the Wi-Fi sustainable?...from a consistent Wi-Fi usage, it's not sustainable…"*.

With regard to the Smart Service Delivery theme, P12 indicated Non-Delivery who said "*…Yeah there is a gap. A huge gap, you know, the stuff that they promised. They don't deliver. Yeah so. And I mean I can appreciate their attempt, but I mean they are the city that they are the I'll say the government. So you know I can't expect less from them. I must expect more…*".

8.8 The Gaps: Expected versus Actual Benefits (Round 2 Interviews)

Figure 8.10 presents the summary of all the expected benefits, the actual benefits and the gaps between these benefits. From the nine (*f=9*) themes that related to gaps, five of these gaps were identified as overlaps between the expected benefits the actual benefits, there were:

- Awareness and Usage of Technology and Services;
- Projects in Early Stages;
- Maintenance moved from Time-Based to Condition-Based;
- Sustainability related to Resource Management in the cities; and
- *Smart Service Delivery.

The benefits that are indicated with an asterisk (*) and *Italics* highlights negative responses from the participants. The negative responses were about Smart Service Delivery related to Non-Delivery, and a Lack of service and Inefficient service delivery under the actual benefits. Five participants indicated some mixed responses regarding Early Stages and Slow Progress as a theme (*f=5*) of which two participants indicated that even though their Smart City initiatives are in the Early Stages they are reaping some benefits.

Four participants (*f=4*) indicated the Expectations are Met theme reported that the benefits from their initiatives are met. Time-Based to Condition-Based regarding maintenance was regarded as both an actual benefit and as a gap by P8. Three participants (*f=3*) indicated that the Expectations and Reality Gap theme meant that their expectations were not met.

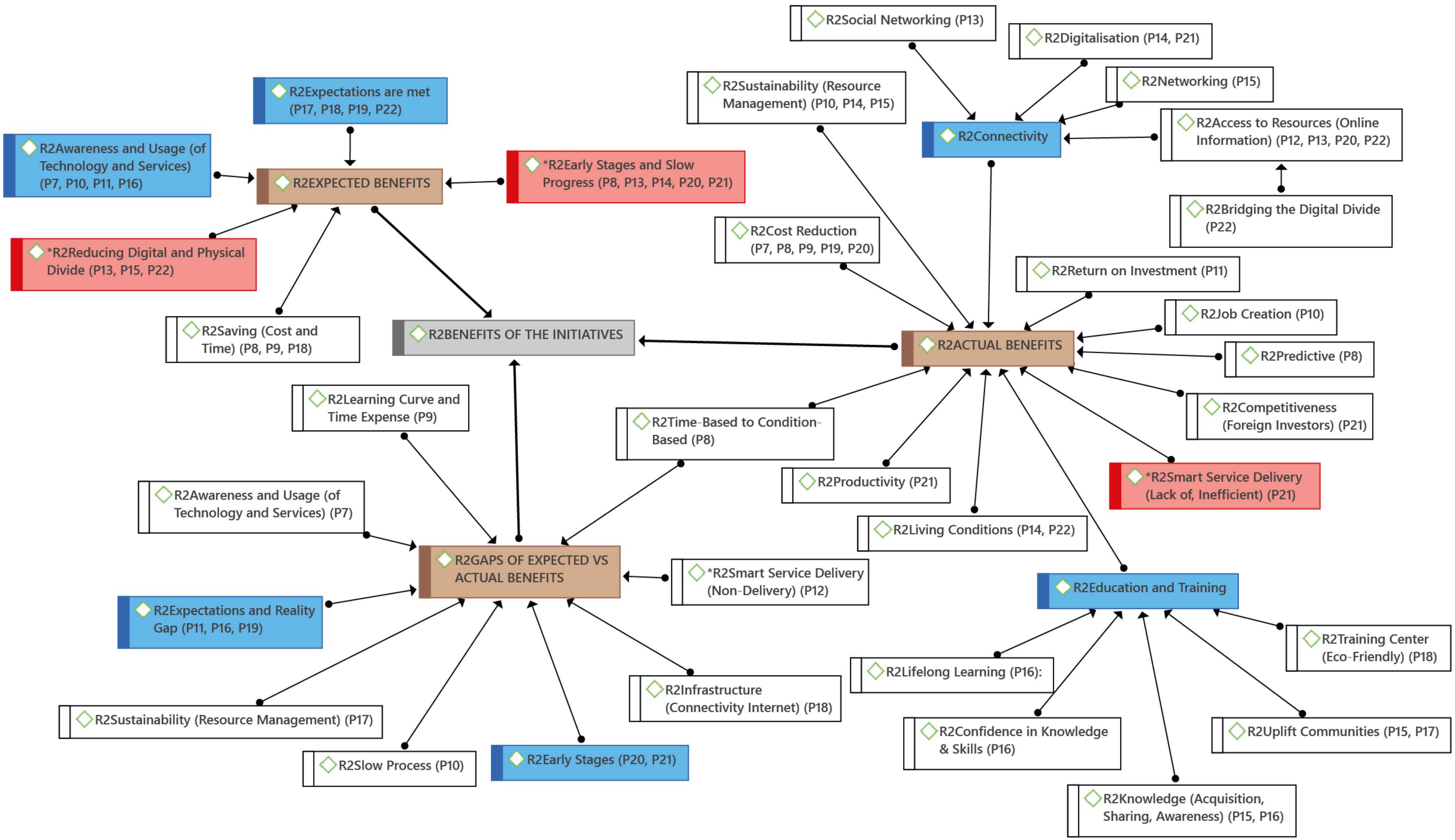

Figure 8.10: Benefits of the Smart City Initiatives in the Eastern Cape (Author's own construct)

8.9 Discussion of Findings (Round 2 Interviews)

Table 8.2 includes all the interview questions that were answered by the participants for both Round 1 and Round 2. In this table only the themes with the highest frequencies for each question are presented. The questions in bold text were excluded from the Round 2 data collection and were the Organisation category questions, the question D2.6 and the question E1. The reason for this was that the Organisation category questions were only applicable to the Round 1 interview participants, who were the providers and enablers of the different projects addressed by the different Smart City initiatives. These questions were therefore not regarded as necessary for Round 2, which focused on gathering data from users and utilisers (including citizens) of related Smart City projects and initiatives in the Eastern Cape identified by Round 1 providers and enablers.

Table 8.2: Round 1 and Round 2 themes based on highest frequencies

Interview questions	**Round 1 – highest themes frequencies for 6 participants**	**Round 2 – highest themes frequencies for 16 participants**
Stakeholder role and responsibilities: (internal stakeholders form part of an Organisation, external ones are part of the environment)		
S1. Is your organisation a provider/enabler?	Provider/Enabler	Provider, User
S2. What are your roles and responsibilities in the initiative?	Unique per participant (Section 7.4.1)	IT, ICT related
Dimension 9: Smart Technology and Built infrastructure:		
D1. What technologies are being used in the initiative, how and to what extent? – e.g. IoT, artificial intelligence; cloud computing.	AI & Big Data, Open Source Technology	Types: Mobile & Web Applications, IoT, WiFi-Hotspots & Internet, Cloud Computing Purpose: Data Access, Data Streaming (Dashboards, Decision Making)
D1.1 What is the value of using the above-mentioned technologies?	Efficiency/Improvements	Connectivity – Remote Access & Working; Living Conditions – Convenience
D1.2 What are the barriers and challenges to using technologies for the initiative?	Skills Development	Budget-Costs (Research & Design-Costly); Access to Resources (Lack of Technical & Innovation Skills); Connectivity (Internet).
D2. Data (digital) Value Chain:		
D2.1 Which digital activities do you use for your smart city initiatives?	Unique per participant (Section 7.5.3)	Data Usage - Data Streaming (Dashboards, Decision Making), Data Acquisition – Trackers/Sensors/Meters
D2.2 What phases of the data value chain are relevant to your initiative?	Data Analysis, Data Deployment/Usage	

Interview questions	**Round 1 – highest themes frequencies for 6 participants**	**Round 2 – highest themes frequencies for 16 participants**
D2.3 Which data/open data sources are you using?	Internal data sources	Accesses Controlled Open Data Sources – SQL server
D2.4 For which purpose was the above-mentioned data/ open data sources used?	Unique per participant (Section 7.5.2)	Access to Resources for Research (Online Information)
D2.5 What is the value of using the above-mentioned data/ open data sources? (i.e. do you have any problems with getting the data or the quality of the data)?	Data Context	Connectivity – Access to Resources (Online Information)
D2.6 In your view what would make the data 'smart'?	Value/Use	N/A
D2.7 What are the challenges of using the above-mentioned data/ open data sources?	Data Management; Lack of Audit Procedures; Reliable Data Sources; Unstructured Data.	Connectivity (Data & System Integration); Access to Resources (Costs – Process & Money).
Relates to, e.g. policy etc. external environment		
E1. How are other external stakeholders involved in the initiative?	Examples included: Universities; Foreign Investors; All governmental departments	N/A
E2. Benefits/impact/value		
E2.1 How does the initiative relate or impact the city's economy?	Employment & Skills Development	Employment & Skills Development
E2.2 How does the initiative relate to or impact the city's natural environment?	Unique per participant (Section 7.6)	Sustainability (Resource Management)
E2.3 How does the initiative impact the daily lives of citizens i.e. the social lives?	Unique per participant (Section 7.6)	Living Conditions
E2.4 What do you believe is the impact or benefit to the users/utilisers of your initiative?	Job Efficiency	Connectivity – Access to Resources (Online Information); Cost Reduction; Education & Training
E2.5 Do you think the benefits are as you/the provider expected?	Unique per participant (Section 7.7)	Early Stages & Slow Progress
E2.6 Is there a gap between expected and actual benefits? Did you consider this?	Yes: Expectations & Reality Gap	Yes: Expectations & Reality Gap

The QCA process followed in this study included the steps of saturation when the coding frame of the different themes was created (Table 3.3). Saturation is described by Schreier (2013) as the point at which no additional or new themes can be found. In this study saturation started becoming evident when the themes from Round 1 and from literature started to become similarly identified for the same questions addressed in Round 2 in the later interviews. During the last few interviews in Round 2, saturation of the themes started to occur between what the participants were saying in different interviews and new themes became less and less.

The Smart City technology themes identified in Round 2 interviews (Section 8.4.3) were compared with those from literature that were summarised in Appendix L. This comparison is illustrated in Figure 8.11 where all the common themes (*f=23*) are shaded in blue. Those found in literature are prefixed with CH5 and those in Round 2 interviews with R2. The themes indentified are as follows:

- Chapter 5 (CH5) - Access Network of Shared Resources; AI for Visual Systems; Collection of Big Data; Data Architecture for Smart City (Data Perspective); Data Hubs (Data Management & Data Usage); Decision Making Algorithms; Integration & Utilisation (Service Creation & Delivery); Location-Based Services; Open Platforms for Creation of Services; Smart Energy (Environment & Social Perspective); Smart Home; and User Experience in Smart Environment.
- Round 2 (R2) - Data Access; Data Collection; Data Streaming (Dashboards, Decision Making); Integration (Finance and Asset Management System); Load-shedding; Monitoring (Controlling Building Components); R2-Navigation and Mobility (Traffic and People Flow Management, Access to Buildings); Online Customer Service; Online Meetings, Presentations and Scheduling; Prototyping; Smart Home; and Waste Management.

The themes found for the purpose of technology from literature (Appendix L) and those identified in Round 2 interviews (Section 8.4.3) are presented in Figure 8.12 where all the common themes found in both (*f=24*) are shaded in blue. The themes are as follows:

- Chapter 5 (CH5) - Access Network of Shared Resources; AI for Visual Systems; Collection of Big Data; Data Architecture for Smart City (Data Perspective); Data Hubs (Data Management & Data Usage); Decision Making Algorithms; Integration & Utilisation (Service Creation & Delivery); Location-Based Services; Open Platforms for Creation of Services; Smart Energy (Environment & Social Perspective); Smart Home; and User Experience in Smart Environment.
- Round 2 (R2) - Data Access; Data Collection; Data Streaming (Dashboards, Decision Making); Integration (Finance and Asset Management System); Load-shedding; Monitoring (Controlling Building Components); Navigation and Mobility (Traffic and People Flow Management, Access to Buildings); Online Customer Service; Online Meetings, Presentations and Scheduling; Prototyping; Smart Home; and Waste Management.

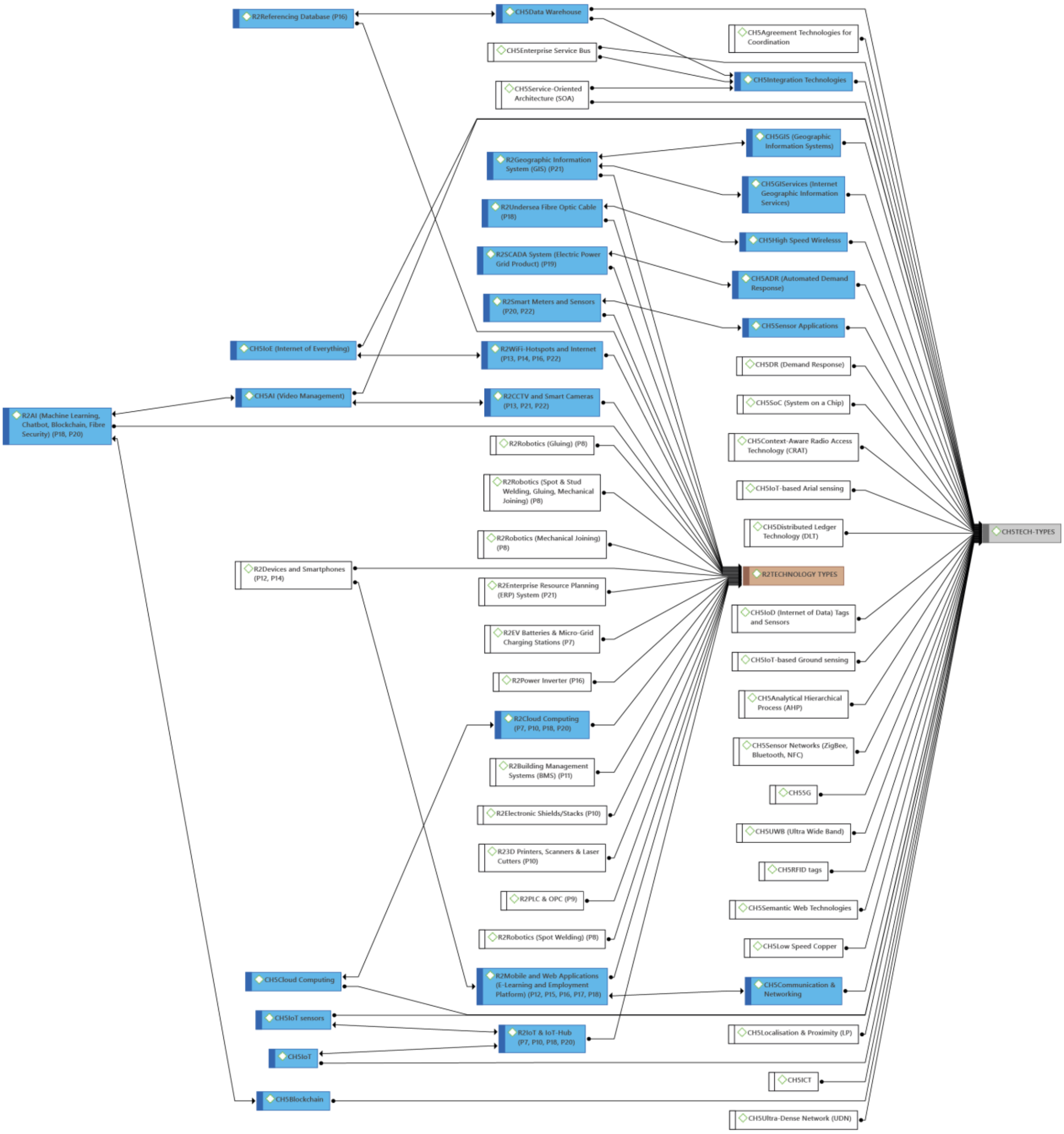

Figure 8.11: Technologies Internationally vs Technologies in the Eastern Cape

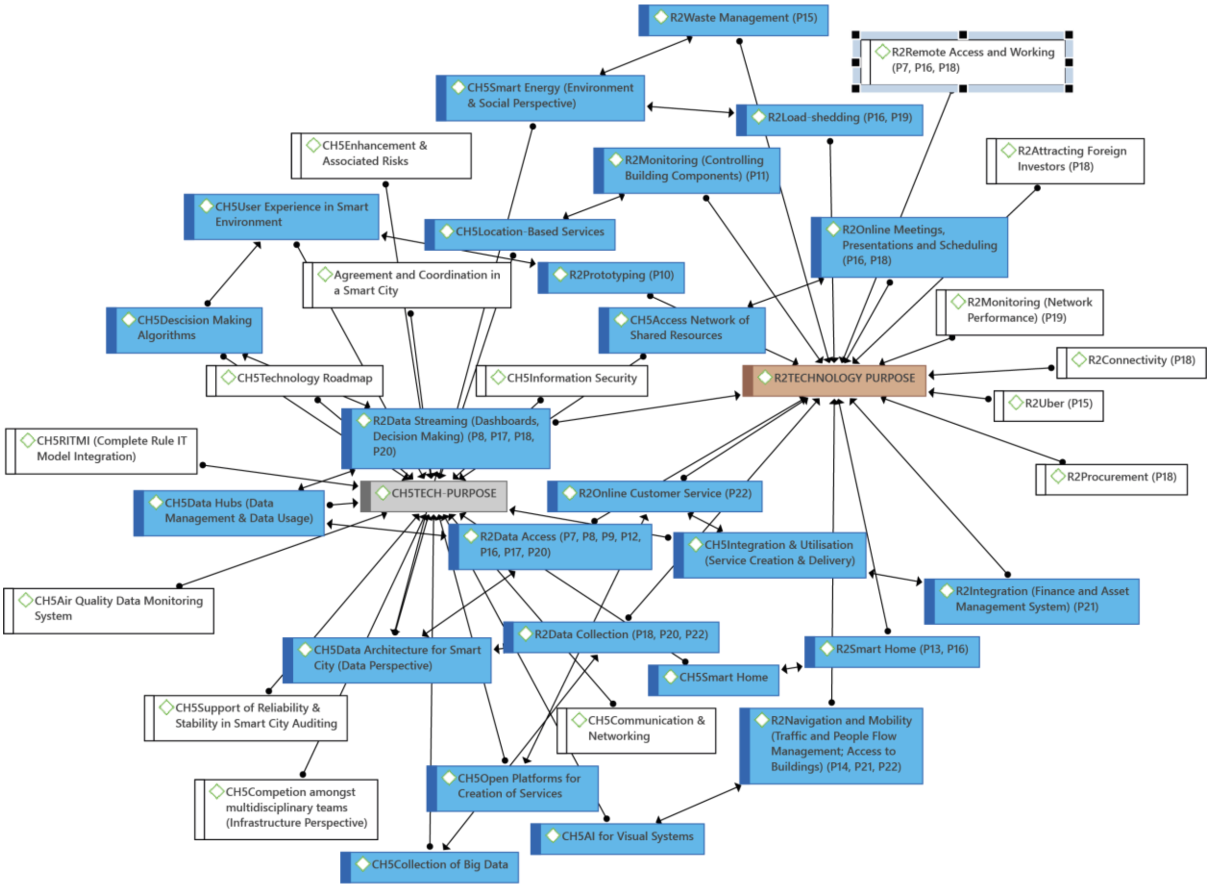

Figure 8.12: Technology Purpose Internationally vs Technology Purpose in the Eastern Cape

The common digital activities in the data value chain identified in both rounds were digital portals, data streaming (dashboards and decision making), online shopping, colud computing, smart manufacturing, solar energy, smart mobility (electric vehicles) and the use of sensors and smart meters. The open data sources available reported in all the cases were extremely limited and virtually non-existent; the only ones identified were the more global sources such as search engines, open access textbooks and the World Bank. Some municipal information was reported as being published but this is still limited. Data sources used were for reporting and monitoring; traffic monitoring and integration of power grids.

A common theme mentioned for the value obtained from the technologies used in the intitiatives were those constructs related to connectivity. Specific examples of connectivity related to providing the ability for remote access to data, online information, services and for supporting remote working. Another construct of the value of technology cited was those related to the living conditions of citizens, specifically related to the physical and cyber safety and security of citizens and other stakeholders as well as convenience. These constructs can therefore be considered as possible criteria for evaluating value in Smart City initiatives. The impact of the poverty in South Africa was evident in the comments related to corruption in the procurement processes in government and fake qualifications and skills.

The main challenges cited related to technology for Smart City initiatives in the Eastern Cape identified from both rounds of interviews were lack of budgets and high costs; problems with connectivity related to the Internet and data security; and lack of access to resources, specifically technical skills and a lack of infrastructure. Public transport was mentioned as a major problem in both cities.

With regard to the challenges of using data or open data, connectivity was again identified by several participants in both rounds. These issues related mostly to data ans sytem integration and data security. Access to resources was again highlighted. Lack of people buy-in was a sub-theme of access to resources and was mentioned in both rounds of interviews. The main common challenges relating to data were connectivity, related to access to online information, data integrity and cost reduction.

Section 2.8 reported on the challenges of developing countries according to Dimensions, D1 to D6. It can be deduced that these challenges are similar with those findings and impacts reported in the cases in the Eastern Cape. The comparisons were made by using some of the sub-themes from the interview findings and mapping them to the dimensions as reported in Section 2.8 as follows:

- People (D1): Government related Corruption and Procurement, Fake Qualifications and Skills;
- Governance (D2): Digital and Physical Divide, Technical Skills;
- Economy (D3): IoT Readiness, Vandalism of Infrastructure (ICT and Built), Smart Service Delivery, Access to Resources (Lack of Infrastructure);
- Environment (D4): Sustainability (Resource Management);
- Mobility (D5): Navigation and Mobility (Traffic Reduction); and
- Living (D6): Public Transport (Gender Based Violence).

The challenges related to internet connectivity and skills reported in the interviews were similar to those reported by Chakravorti and Chaturvedi (2019) in their study of six African countries including South Africa. They reorted challenges of quality Internet access, digital capabilities related to digital payments and digital businesses as well as innovative skills.

The impacts of the initiatives were classified according to the economic, the environmental and the social and work life impacts. The three most frequently cited important and positive economic impacts were identified as being increased employment and skills development; reduced costs; and the attraction of new investors and markets to the province. The potential negative impact on the economy for initiatives that were not successful were related to data integrity and service delivery, specifically a lack of mobility (public transport). Mobility was again mentioned as an impact in the natural environment, specifically traffic reduction were highlighted as a positive common theme. The main sub-themes identified for the social and work life impact related to living conditions such as process improvement, specifically through smart manufacturing, smart homes, smart work life and income and Sustainability. Negative impacts related to the social and worklife related to the lack of service delivery and inflated utility bills.

The most common benefits cited were connectivity; education and training; cost reduction; job creation and return on investment. In all cases, there were some gaps between expectations and reality. Most of the initiatives were still in the early stages and only slow progress had been made. The gaps that were regarded for the cases were mainly to do with the following:

- A lack of awareness and usage of technology and services;
- The steep learning curve for new technologies;
- The time and cost investment required;
- Problems with sustainability, specifically management of resources;
- The lack of infrastructure, specifically connectivity to the Internet; and
- The lack of smart service delivery.

8.10 Conclusions

It is evident from the findings in this chapter that the four objectives stated in Section 8.1 were met. The first part of RO_4 (Analyse and classify digital activities, benefits and challenges for smart cities in a developing country) was achieved as the digital activities were identified in the Eastern Cape Smart City initiatives and were classified according to the Data Value Chain (Figure 8.5). The second part of RO_4 was achieved since the benefits of the Eastern Cape Smart City initiatives were identified and analysed according to the themes of expected and actual benefits (Figure 8.10). Regarding the third part of RO_4, the challenges for smart cities in a developing country related to technology and data were identified.

Research objective $RO_{5.1}$ (Identify the criteria for value creation in a Smart City in a developing country) was achieved. In this study we viewed value and benefits as similar concepts, since we adopted the lens of the Complex Value Typology Theory, where value is the nature of the benefits experienced by stakeholders (Rescher, 1969). In the VASCS Model, the benefits realisation, Phase 5 (Section 4.4), involves identifying the the gaps between expected and actual benefits. The concept of value and the benefits of initiatives, both internationally and nationally, were investigated in previous chapters. In this chapter the benefits (expected and actual) of initiatives in the Eastern Cape were identified as well as the gaps (Section 8.7). These gaps can highlight possible areas of misalignment and improvements that could be made to improve the success of Smart City initiatives. These gaps can therefore be considered as criteria for value creation in a Smart City in a developing country, thus meeting $RO_{5.1}$.

Research objective $RO_{5.2}$ (Determine the alignment of data and IoT initiatives on the value creation for stakeholders in the city) was achieved in various parts. Firstly, by identifying and analysing the purpose of data and open data sources and by mapping these with the related data and IoT data sources (Figure 8.6). Secondly, the data sources and IoT technologies of the initiatives were identified and the value obtained from these. The value obtained thus relate to the “value creation for stakeholders in the city” (Figure 8.7 and Figure 8.8) aspect of the objective. The value of technologies in smart cities was indicated as being related to connectivity and the living conditions of stakeholders regarding convenience such as remote working (Section 8.5.4). The gaps identified can reveal whether or not value is aligned, since if there are no gaps then the value received would be in complete alignment with the value expected. Other areas of misalignment could be between the expectations versus received, which is the difference in benefits or value experienced by different people. Therefore, confirming the Complex Value Typology Theory (Section 4.4).

By achieving both $RO_{5.1}$ and $RO_{5.2}$, RO_5 (Determine the influence of the initiatives on the creation and alignment of value to a Smart City in a developing country) was achieved. The influence (or impact) of the Eastern Cape Smart City initiatives on citizens and other stakeholders was identified in terms of the TOE constructs of Organisational and Environmental (economic, the environmental and the social and work life) impacts (Figure 8.9).

Based on the findings in this chapter it can be concluded that expectations and actual gaps should be articulated at the beginning of the project. In addition, input should be obtained from stakeholders in the early stages regarding the expected benefits, and then these should be monitored against the actual benefits or value experienced by these stakeholders.

The next chapter concludes this research study. The contributions of this study will be further addressed in the next chapter, recommendations will be highlighted based on the findings for future research as well as the limitations of this study.

Chapter 9 - Conclusions, Recommendations and Future Research

9.1 Introduction

Urbanisation, due to an increase in the world population, has placed pressure on resources in countries, cities and communities. Therefore, the concept of a Smart City was created to address real-world issues while developing solutions that are efficient and effective to guide sustainable resource management. Even though no cohesive and standardised Smart City definition exists, the Smart City definition that was adopted in this study emphasises that when information is exchanged by using intelligent means to allow information flow, it can be proposed for use by cities to create citizen services that are resource-efficient and sustainable.

The World Agenda, which focuses on sustainability, is provided by the United Nations using SDGs and in this study, Goal 11 provides information to guide cities as follows: "*To make cities and human settlements inclusive, safe, resilient and sustainable*" (United Nations, 2015, p. 21). This study regards this SDG as part of the National and International Context in which smart cities are placed and how this goal can be used by cities to align the SDG to their national plans. This context and others were guided by the FraIM, which was adopted in this study. Those relevant for Smart City research are the Professional Context, the Organisational Context, the Political Context and the Theoretical Context (Section 3.4.1). These contexts, as adopted in this study, highlighted aspects of a Smart City. Claims made, based on the evidence of the findings from the Professional context, confirm that different professionals, with various skills, are required to contribute to developing a Smart City.

The Organisational context was important as it placed the author of this study in context regarding the background of the author and where the study was conducted in the Eastern Cape where the author is a resident. The Organisational Context highlighted how a Smart City is viewed in this study, as an entity, such as an organisation by using either a top-down or bottom-up approach to developing a Smart City. The Political Context of a Smart City focuses on the policies that can be used to guide smart cities and their solutions. Policies and regulations regarding personal data and information that were identified as being relevant, were the European GDPR and the South African POPIA (Section 5.5).

The National Context of South Africa is set in a background of political and organisational inefficiencies. Old apartheid regimes left the county in a state of challenge, with many problems to address (Section 3.4.1.4). These problems relate to resource shortages, unemployment and poverty. The Theoretical Context allowed existing theories to be used in the Smart City field to confirm the selection of components and concepts of a Smart City (Section 4.7).

The literature review and Internet Search revealed that there is limited research reported, or activities related to Smart City development, or as solutions (initiatives) to problems in cities in Africa and particularly in South Africa. Nine provinces and many cities, exist in South Africa (Section 5.7). However, only five provinces and limited cities across these provinces seem to be addressing Smart City projects and initiatives (Table 5.2). The five contexts of this study were therefore used as backgrounds to guide the study and address the problem statement; "*Cities in developing countries do not have a model to align stakeholder value and analyse and classify Smart City initiatives for all stkeholders"*.

The FraIM methodology (Section 3.4) was used to structure and design this study by using four research stages to collect data (Section 3.5). In the first stage, it was necessary to identify the status of smart cities in South Africa at a national level and compare this with cities internationally. Secondly, a lack of reliable data and information issues, constrains decision making for investors and other stakeholders. Therefore, it was important to investigate the factors, frameworks and models that could be used to improve the success of Smart City projects. The relevant Smart City stakeholders and their roles were investigated. The value of a Smart City was also researched in terms of the benefits experienced and the challenges encountered. The digital constraints were regarded as necessary for the data and IoT initiatives, as they were closely related to information and data required for investors and stakeholders. Therefore, the data value chain phases and the digital activities for smart cities were investigated.

This chapter presents how the research objectives were achieved (Section 9.2). The contributions of this study are theoretical, practical and managerial (Section 9.3). The limitations of the study are noted (Section 9.4) and recommendations and future research opportunities highlighted (Section 9.5).

9.2 Research Objectives and Research Question Achieved-Revisiting the Research Methodology

The main research aim was identified to answer the main research question in this study (Section 1.5), **RQ_m: *What model can be designed, grounded in theories and implemented to determine alignment of value among stakeholders?***

Five research objectives and four sub-research objectives were identified to answer this question and clearly highlight the scope of these objectives. This section addresses how the research objectives and research question were achieved.

The RQ_m of this research was answered through four research stages of the research design process (Section 3.5). In this study, the scope was limited to the Eastern Cape IoT technological and data initiatives and the influence they have on the stakeholders in the city. These initiatives were analysed to identify those that can contribute to the quality of information required to create value within such cities, especially for stakeholders to be informed and make decisions.

Data are the fourth component in FraIM which is related to the fifth component Data analysis. In this study, the interview data were collected and then analysed by using the QCA narrative method and the Atlas.ti frequency counts as the numeric methods. Another numeric method was used by the participants to assess their Smart City Success Factors by using a Likert Scale. Other numeric analyses included the different SLR processes applied in **RO_1** through to **$RO_{4.2}$**.

Research Objective (RO_1): Identify the success factors of a Smart City

Research Stage 1 consisted of a Literature Review and an SLR to address and understand the background to this study (Chapter 1) and identify Smart City success factors (F1 to F39) (Section 2.6). The success factors were identified for each of the Smart City Dimensions (D1 to D9). The findings were then used to create a Success Factor Assessment Template (Appendix I3). This template was successfully used during Round 1 interviews, where the participants assessed which factors were applicable to their initiatives per Smart City dimension (Section 7.9). More than three quarters of the factors (Table 7.3) were verified by the participants who were Smart City stakeholders in the Eastern Cape.

The key success factors for six of the nine dimensions (Table 7.3) were identified as relevant for Smart City dimensions for the cases in the Eastern Cape. These were Smart People (D1); Smart Economy (D3); Smart Mobility (D5); Smart Policy (D7); Smart Organisation (D8); and Smart Technology and-ICT-Infrastructure (D9).

Research Objective (RO_2): Analyse existing frameworks and models for smart cities

An analysis was done in research Stage 1 to evaluate frameworks and models in the field of smart cities (Table 2.1). These were used in an SLR to identify the dimensions regarded as important in smart cities (Table Table 2.4). The findings resulted in identifying nine dimensions (D1 to D9) that were further classified into primary and supporting dimensions (Section 2.6) D1 Smart People and D9 Technology and ICT Infrastructure were regarded as support dimensions to the other seven primary dimensions.

Research Objective (RO_3): Identify the stakeholders for smart cities

RO_3 was addressed in both research Stage 1 and Stage 2. For Stage 1, an SLR was used to identify the relevant stakeholders in a smart city and the related roles and stakeholder types (Section 2.5). Four key stakeholder roles were identified, which were enablers, providers, utilisers and users. Thirty (T1 to T30) relevant stakeholder types were classified according to these roles (Table 2.3). A Smart City Stakeholder Classification Model (Figure 2.10) was developed in Stage 2 and an Internet Search was done to identify the target profile of stakeholders for the interviews (Section 3.5.4). The model was used to identify and classify the stakeholders in Nelson Mandela Bay and Buffalo City for Round 1 interviews (Table 7.1) and Round 2 interviews (Table 8.1). This research objective was guided by the second component in FraIM, the Cases which were referred to as the five broad Smart City initiatives and, by using these as the Data sources from the two case studies. Purposive and convenience sampling strategies were used to identify potential participants in this study.

Research Objective (RO_4): Analyse and classify digital activities, benefits and challenges for smart cities in a developing country

RO_4 was addressed as part of both research Stage 1 and Stage 4. For Stage 1, a literature review was conducted to identify the activities, benefits and challenges from empirical studies and these indicated the potential value and impact of Smart City initiatives on stakeholders (Section 2.8).

In Stage 4, the benefits and challenges from literature were used as *a priori* themes to categorise the themes and codes for the benefits and challenges mentioned by the participants in Round 2 cases that were comparable to those from Round 1 (Section 7.4.2 and Section 7.7) and Round 2 (Section 8.5 and Section 8.7).

The challenges identified from literature regarding developing countries were mostly related to dimensions D1 to D6 (Section 2.8). For People (D1), the challenges related to inequality and access to technology. For Governance (D2), they related to instability in governance and unbalanced geographical development. In the Economy (D3) dimension, challenges were high infrastructure deficit and shortage in access to technology. The Environment (D4) dimension experienced challenges related to a scarcity of resources-water, climate change effects and pollution. Mobility (D5) challenges were mostly related to a lack of public transport, whereas the Living (D6) dimension challenges were related to slum proliferation, urban violence and insecurity, poverty and inequality.

In Round 1 interviews, the challenges and impact of the initiatives were mainly related to:

- Technology and data (lack of infrastructure, skills development, data management, and access to reliable data sources);
- Economic issues (employment and skills development, navigation & mobility);
- Environment issues (traffic reduction, renewable energy, environmental monitoring); and
- Social issues (ICT education, data awareness).

In Round 2, the challenges and impact of the initiatives were mainly related to:

- Technology and data (budget-costs, access to resources such as technology & innovative skills);
- Economic issues (employment & skills development, digitalisation related to connectivity and IoT);
- Environment issues (sustainability resource management, navigation & mobility); and
- Social issues (living conditions related to smart work life, data access for service delivery, process improvement).

The benefits of smart cities in developing countries, identified in literature (Section 2.8), were those related to attracting foreign investors; enabling service delivery and economic development; transitioning to a knowledge economy and access to ICT, particularly in rural urban areas. In the Round 1 interviews, the benefits of the initiatives identified were mainly related to job efficiency and cost reduction. In the Round 2 interviews, cost reduction was mentioned again by several participants as a benefit and so were education/training and connectivity.

Therefore, the Claims (seventh FraIM component) that can be made, based on the Evidence from literature and the interviews, are that many of the challenges and benefits in the Eastern Cape were not dissimilar to those mentioned in other developing countries.

Research objectives $RO_{4.1}$ and **$RO_{4.2}$** were achieved and addressed in Stage 2, which consisted of an Internet Search. Part of this search was to identify the data and IoT Smart City initiatives by using the WoS database. This resulted in 51 empirical studies. The final list of 21 studies was included as part of the analysis of addressing data and IoT related Smart City initiatives (Section 5.3). Digital activities related to data and IoT initiatives were identified (**$RO_{4.1}$)** and classified according to the data value chain phases (Section 5.4). These components were used in Round 1 (Section 7.5.2) and Round 2 (Section 8.4.3) interviews to identify the data value chain phases and the related digital activities per phase. The providers and enablers in the Round 1 interviews also indicated that data is smart if it is context based, is available and can be used to answer queries; and most important, if it is clean (**$RO_{4.2}$**) (Section 7.5.2).

Research Objective (RO_5) Determine the influence of the initiatives on the creation and alignment of value to a Smart City in a developing country

The subsidiary $RO_{5.1}$ and $RO_{5.2}$ objectives were achieved and related to the alignment and value alignment theories (Section 4.4), as well as the data value theoretical concepts (Section 4.6). These theoretical concepts assisted with understanding the interview data and identifying the themes related to the impacts and influence of Smart City initiatives (RO_5) on Round 1 and Round 2 stakeholders. The themes found in literature (Section 2.8) regarding the economic, environmental and social impact were comparable (Section 7.9 and Section 8.9) with the themes identified in the interview data for Round 1 (Section 7.6) and Round 2 (Section 8.5), as described as being part of the challenges and benefits of developing countries in RO_4.

The claims based on the theories of value and alignment and data value in relation to the Round 1 and Round 2 evidence are, that, for the alignment of Smart City initiatives for stakeholder value to exist, that stakeholder participation and identification of stakeholder types and roles for each of these initiatives must be conducted. This should form part of Phase 1 where articulation is done regarding the Smart City project and expected benefits.

Research Objective ($RO_{5.1}$) Identify the criteria for value creation in a Smart City in a developing country

It was deduced from the findings of this study, that the gaps identified between the expected benefits and the actual benefits of Smart City initiatives could be used as the criteria for value creation (Section 7.9 and Section 8.9). The gaps might indicate some of the issues or opportunities that could be addressed to contribute to a successful Smart City project (Section 4.4).

The gaps could also be considered as criteria for value creation. The criteria were related to stakeholder awareness about the technology and services of Smart City initiatives and infrastructure, especially related to Internet connectivity and the availability of other resources, such as technical and innovative skills. Therefore, to reduce or eliminate these gaps (and meet the criteria for value creation), the expected benefits must be matched to the actual benefits in order for stakeholders to receive value from Smart City initiatives and that smart service delivery was related to technology, IoT and data enabled services.

Research Objective ($RO_{5.2}$) Determine the alignment of data and IoT initiatives on the value creation for stakeholders in the city

The technologies and data/open data sources being used in cities in the Eastern Cape were identified in Round 1 (Section 7.5.2) and Round 2 (Section 8.4.3). The value of using these technologies and data sources for the different initiatives were also identified in Round 1 (Section 7.5.4) and Round 2 (Section 8.4.6).

9.3 Research Contributions and Recommendations

The research contributions of this study are grouped under the theoretical, scientific, practical, social and managerial in the following sections.

9.3.1 Theoretical and Scientific Contributions

The main theoretical contribution was the Value Alignment Smart City Stakeholder (VASCS) Model (Figure 9.1). This model can be used to identify and classify digital activities, Smart City projects and initiatives and to determine the value created from the identified activities by using the five phases for benefits realisation.

The design of the model was undergirded by literature and existing theories in a deductive approach. The normative lens was used to identify the standards of smart cities and the problems faced by stakeholders in such cities. Five possible uses for theories in IS research were identified (Section 4.2) and Type II namely, Explanation was adopted in this study. Using Type II allowed existing theories to guide answering the research question and objectives by investigating and answering the "what is", "how", "why", "when" and "where" questions as follows:

- **What**: the explanations of the theories were required to confirm "what" the components of the VASCS Model V2 should be;
- **How**: by using established and existing theories to explain how value is created and aligned;
- **Why**: to guide the research in determining why value is or is not created or aligned and by confirming the validity of the model; and
- **When** and **Where**: to investigate when and where value is created and aligned for stakeholders of smart cities.

The different theoretical concepts were selected from different domains that influenced the selection of the components on the VASCS Model. Three domains that were core to this study are the Smart City, value and alignment domains. For the Smart City domain, concepts were selected from three theories, namely: the Hexagonal Dimension Theory, the Strategic Priority Areas Theory (Kishore & Sodh, 2015), and the Triple Helix Model Theory (Etzkowitz & Leydesdorff, 1995). The Strategic Priority Areas Theory was used to aid in explaining the importance of the additional dimensions added to the VASCS Model V2, and to show that a model can include more than one priority area. The additional areas or dimensions relevant to smart cities that were added were Smart Policy, Smart Organisation and Smart Technology and ICT Infrastructure.

The Triple Helix Model Theory was used to confirm the stakeholder component on the VASCS Model V2 and highlighted the importance of academia, industry and government as key stakeholders in a Smart City. This was confirmed by Round 1 participants, responding to the question that related to external stakeholders who should be involved in a Smart City initiative. Examples of these stakeholders were indicated as being Universities, Industrial parks, IDZs, City, Government, Policy makers and Foreign Investors.

Theoretical concepts for the value domain were selected from the Complex Value Typology Theory (Rescher, 1969) and the Value Chain Analysis Theory (Porter, 1985). The alignment domain included concepts from the Structural Alignment Theory (Rose et al., 2015), and the Strategic Perspective of Alignment theory (Avison et al., 2004). The Theory of Value Co-Creation was used to understand value alignment (Galvagno & Dalli, 2014). The benefits realisation phases were used to identify the value co-creation component of the model (Flak et al., 2015). The TOE theory was embedded in the entire model and was used to structure the interview questions according to the themes and categories for data collection.

The theoretical VASCS Model V2 has the following five main components and is illustrated in Figure 9.1:

- Smart City Success Factors (supplementary template) and Dimensions (Table 9.2);
- Stakeholder Roles and Types (Table 9.1);
- Benefits/Value realisation phases (Section 4.4);
- Digital Value Chain (Section 4.6 and Section 5.4); and
- Stakeholder Value Alignment (Section 4.4).

It also has the following two supplementary components:

- Stakeholder Classification Model (Figure 9.2); and
- Smart City Success Factor Template (Appendix I3).

The model includes all the Smart City components required to achieve the success of a Smart City project. It is proposed that once the Smart City dimensions are known, which represent the initiatives in a Smart City, and the related success factors to be assessed are determined, then the relevant stakeholders can be classified according to each Smart City project. The next steps, based on the proposed VASCS Model, would be to follow the benefits realisation Phases 1 to 5, to establish a clear plan of the different levels of benefits and value to be realised (this label is added for clarity, based on one of the expert reviewer's recommendations).

Therefore, to address this, the Digital Value Chain component should be used to identify the digital activities and technologies required for Smart City projects. Thus, once all these proposed phases in the VASCS Model have been addressed, Stakeholder Value Alignment can be achieved. It is important to note that the components of the model can be adapted and used iteratively to re-assess and improve each phase as the Smart City project progresses.

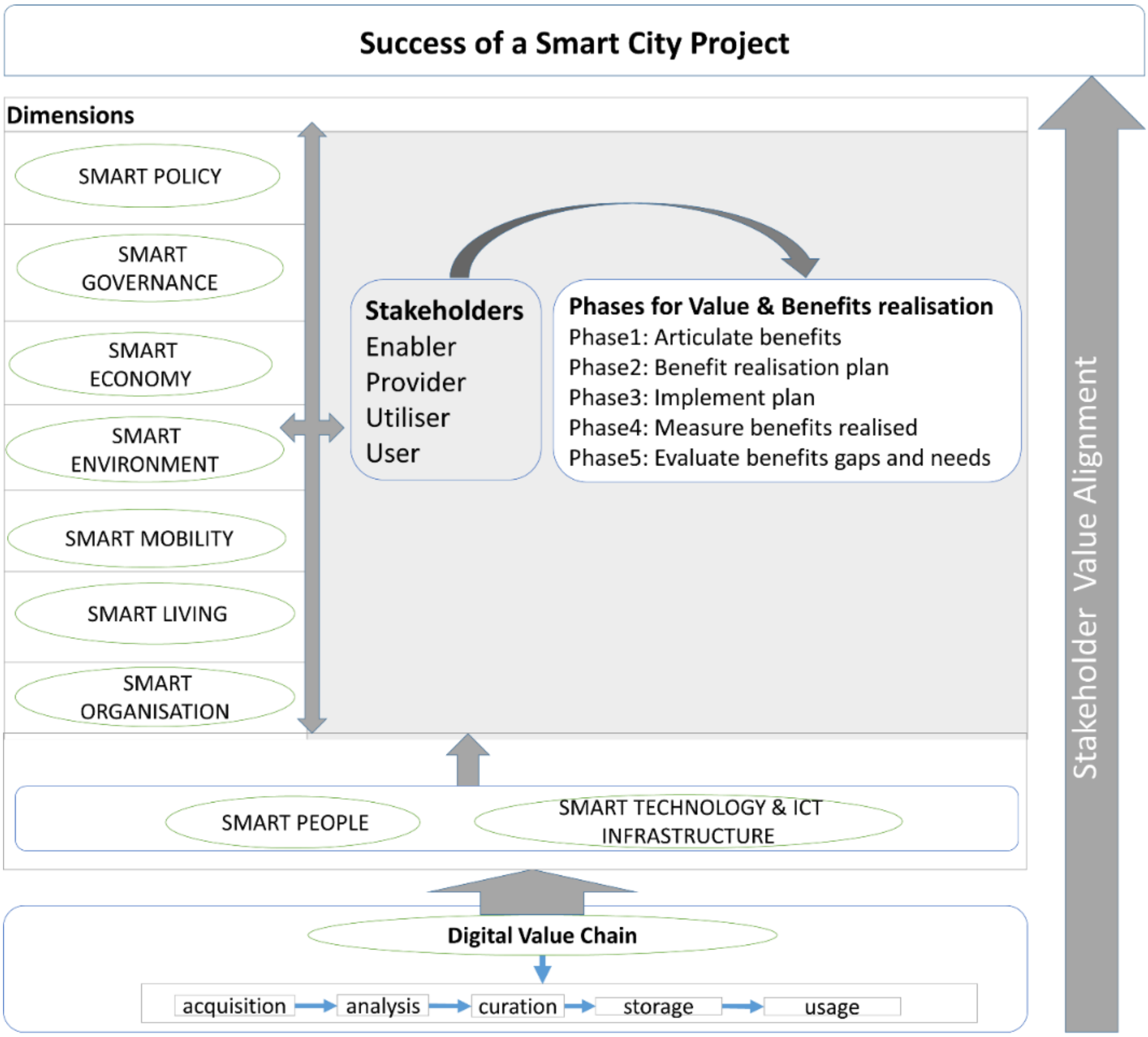

Figure 9.1: VASCS Model (Final)

The VASCS Model V2 was applied by using theoretical research and a case study strategy of several Smart City cases in two cities in a developing country. The model was applied to cases identified in the Eastern Cape. Interviews with 22 participants involved in the cases as Smart City stakeholders, were conducted. Their feedback was analysed to provide real-world scenarios that can be used to guide practitioners, investors, other stakeholders and researchers in the Smart City field to make informed decisions about similar scenarios.

The scientific contribution of this study is the adoption of the VASCS Model to the activities identified in the developing country of South Africa and the specific focus of activities in the Eastern Cape. The in-depth, rich, interview findings provided important analyses and lessons learnt relating to the value and impact of Smart City initiatives for the stakeholders and these add to the body of knowledge of related Smart City fields.

Figure 9.2 presents the Smart City Stakeholder Classification Model, which is one of the contributions from this study. The model, together with the stakeholder roles and type (Table 9.1), can be used to guide researchers and practitioners to identify the dimensions, factors and stakeholders that are required for their respective Smart City initiatives and related projects.

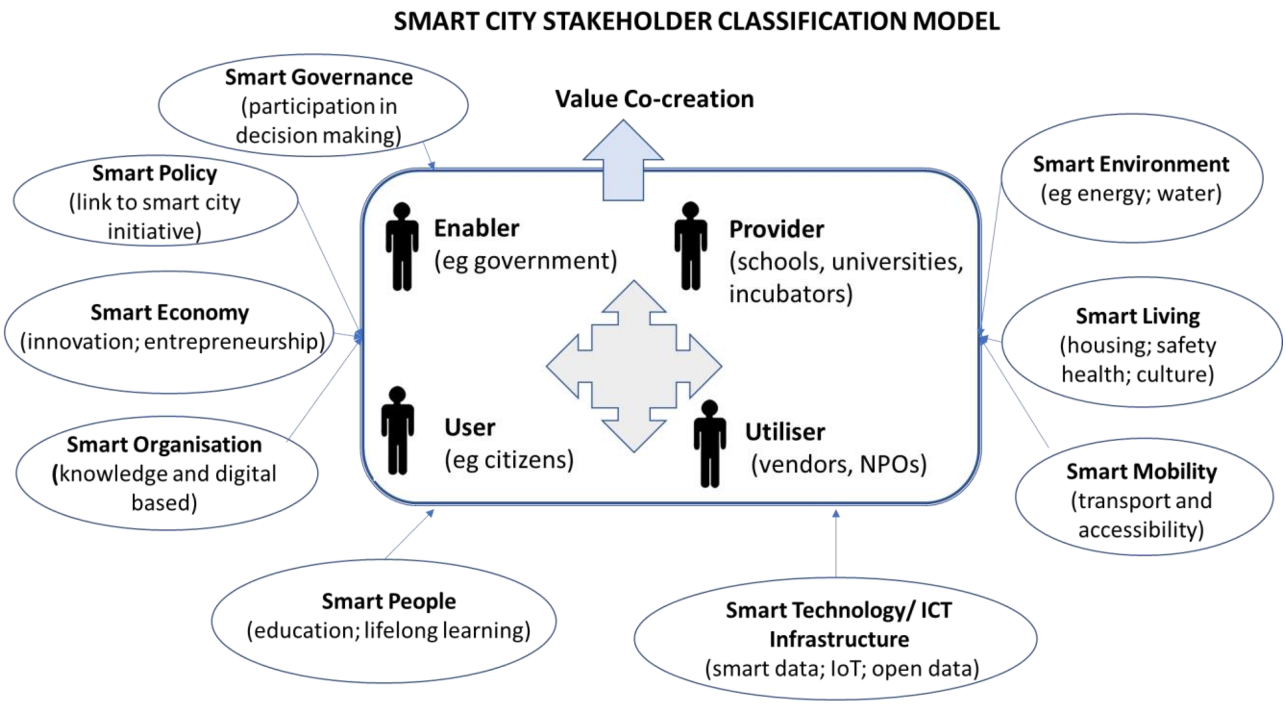

Figure 9.2: Smart City Stakeholder Classification Model

Table 9.1 presents the Smart City Stakeholder Roles and Types. Thirty stakeholder types were identified as T1 to T30. This table can be used in practice and in research, to identify all the relevant stakeholders per Smart City initiative.

Table 9.1: Smart City Stakeholder Roles and Types

Stakeholder Roles	Stakeholder Types
Enabler	Building owners
	Businesses
	City Mayor/Managers
	Government
	Governments in other jurisdictions
	Performance evaluator/Standardisation institutes
	Policy/service domain expert
	Public administration (managers)
	Public government (state owned organisations)
	Public officials
Provider	Data controllers
	Data processors
	Independent developers (Think tanks/Incubators)
	IT experts
	Local experts
	Research/Design and Technology organisations
	Schools
	Third parties
	Universities (Academic communities)
Utiliser	Companies (private-and-public, firms, SMEs)
	Industrial stakeholders
	Non-profit organisations (NPOs)
	Vendors
User	Citizens (local, national, technical savvy)
	Investors (public and private)
	Media communities
	NGOs
	Residents
	Users
	Workers

Table 9.2 presents the Smart City Success Factors identified in this study related to the nine dimensions (D1 to D9) of a Smart City. This table can be used in practice and by other researchers, to identify the Smart City success factors that should be considered and measured for each Smart City initiative.

Table 9.2: Smart City Success Factors for Smart City Dimensions

No	Factors for each Dimension
D1	SMART PEOPLE • Affinity to lifelong learning • Cosmopolitanism/Open-mindedness • Creativity • Flexibility • Level of qualification • Participation in public life and Smart City initiatives • Social and ethnic plurality • Synergies through partnerships and collaborations
D2	SMART GOVERNANCE • Participation in decision-making • Public and social services • Transparent governance
D3	SMART ECONOMY • Economic image & trademarks • Entrepreneurship • Flexibility of labour market • Innovative spirit • International embeddedness • Productivity
D4	SMART ENVIRONMENT • Attractiveness of natural conditions • Environmental protection • Future proof • Pollution • Sustainable resource management
D5	SMART MOBILITY • (Inter-)national accessibility • Local accessibility • Sustainable, innovative and safe transport systems
D6	SMART LIVING • Cultural facilities • Health conditions • Individual safety • Housing quality • Education facilities • Touristic attractiveness (smart tourism) • Social cohesion
D7	SMART POLICY • Policy integration • Relationship between the Smart City initiative and the city's policy
D8	SMART ORGANISATION • Innovative leadership and management • Organisational culture
D9	SMART TECHNOLOGY & ICT INFRASTRUCTURE • Availability of infrastructure (including Built & ICT) • Smart data • Smart technologies

9.3.2 Practical, Social and Managerial Contributions

The practical, social and managerial contributions of this study are the empirical evidence provided from the selected cases and initiatives in two of the cities in the Eastern Cape province. It was determined that the initiatives can influence the creation of value for stakeholders such as citizens in the city and can have a positive and negative impact on the quality of the lives of stakeholders.

The Success Factors Template can be used to assess the applicability of the factors and dimensions for specific smart city projects for both developing and developed countries. The success factors can be used to evaluate the value created by Smart City initiatives and related projects for all the relevant stakeholders. The benefit realisation phases can be used as best practice steps to determine the gaps between expected and actual value. The gaps can be considered as a set of criteria that can be used to improve solution development and create opportunities for value creation amongst the stakeholders. The Stakeholder Classification Model can be used to classify the relevant stakeholders per Smart City project, to ensure all stakeholders are provided with the required communication and opportunities to participate and, therefore, can achieve Stakeholder Value Alignment.

Bibri (2019) indicated the limited efforts regarding building multidisciplinary theories to address changing human conditions in Smart City research. This study contributes to this gap in the research by addressing how the different theories from different domains can be used to identify important components in smart cities to achieve success. This study also investigated theories to address the stakeholders and co-creation of value in the Smart City context, to aid the theoretical understanding of the influence of Smart City factors on the value creation and the success of Smart City initiatives and related projects. The findings from the case studies indicated which success factors were applicable to smart cities in the Eastern Cape and how these Smart City initiatives and projects impact the economy, the environment and the social and work lives of citizens and other stakeholders.

9.4 Warrantable Research

Four types of triangulation were adopted in this study for the data analysis process (Section 3.7). These were as follows:

- Data triangulation: multiple sources of data and information collection were used. Stakeholders were classified into five broad Smart City cases from two smart cities in the Eastern Cape and four different stakeholder roles. The themes identified from literature and from the interviews, were categorised according to the research objectives, interview questions and the TOE theory that were used to collect and analyse the themes and sub-themes;
- Investigator triangulation: The author and two independent researchers were provided with a coding frame to establish the validity of the findings;
- Theory triangulation: theories were used from the Smart City domain, The Value Domain and the Alignment domain. Therefore, validity was established where the same conclusions were drawn regarding confirming the VASCS Model V2 components; and
- Methodological triangulation: included the data collection and analysis methods, both narrative and numeric. The empirical evidence from the literature review, SLRs and the Internet Searches established those common conclusions through the case study and findings from interviews.

In addition to triangulation, reliability and validity were ensured in this study by using the following strategies:

- Coding consistency (independent parallel coding): three coders were involved in coding the raw interview data and therefore, higher levels of agreement were found for the different categories and themes. Elimination of overlapping themes and categories and others were merged;
- Chain of evidence: the coders, reviewers and participants of this study were provided with the opportunity to trace the process of this research from the research questions, interview questions and research objectives. At each of the data collection and analysis processes, the relevant parties were provided with the required information to successfully complete the process required. Peer reviewer feedback was incorporated in this study (Section 6.8);

- External validity: was achieved as the interview findings related to benefits, challenges and technologies regarding the Smart City dimensions in developing countries when compared to literature. Therefore, the findings in this study can be regarded in other similar smart cities.

The case study definition provided by Yin (2014) was met in this study (Section 3.4.2). First, the case study scope was based on empirical inquiry through interviews by using two case studies (NMB and Buffalo City). The initiatives in these two cities are the cases that were part of an in-depth investigation to confirm the real-world context. Second, the phenomena and the context of the case study were situated in the Smart City field to represent the real-world findings. Using the confirmatory case study strategy, allowed for existing frameworks and theories to be used to undergird the analytical categories and the categories used for data collection (Table 3.2). These theoretical concepts (Section 4.2 to Section 4.6) were used from a normative lens, from the Smart City domain, the Value and Alignment domain, the TOE theory context and concepts related to Data Value. It was confirmed through the findings from these case studies that the results provide analytical generalisation rather than a statistical generalisation.

Analytical generalisation, also confirmed by Robson (2002), is where theories can be used and developed, to aid researchers and other practitioners in their understanding of other similar cases and scenarios. The results of this study may apply to the context (that is the Eastern Cape and possibly other South African cities) but could provide insights for the broader Smart City research community. The investigation, using several cases of two cities (Section 7.2 and Section 8.3) and several initiatives in the cities, allowed for understanding the different scenarios and value within a deeper Smart City context.

9.5 Conclusions and Recommendations

Value is defined in this study as the importance and usefulness of the Smart City initiatives for each stakeholder (Section 1.1) and as the nature of the benefits experienced by stakeholders. Value can be linked to monetary worth, as it could be important to some stakeholders such as investors. This was confirmed by the evidence of cost, budget and investors being identified as key themes from the interview responses (Table 8.2).

The findings revealed that some of the initiatives were important and useful, whilst others were still in the early stages and yet others had problems resulting in a negative impact on stakeholders, particularly the citizens.

It was confirmed that the main factors that influence the success of smart cities are related to people (citizen and stakeholder involvement) and technology (related to IoT and data). It was determined how aligning these factors and concepts could add value to stakeholders and achieve success of Smart City projects that are linked to different initiatives. One expert from the expert review suggested that an additional phase should be added to the model, for example, Phase 0, to indicate and aid in the understanding of the context of a city. This also confirms the finding in both rounds of interviews, where participants indicated that their expectations of certain benefits from the Smart City initiatives were not met and, therefore, it created gaps. These expectations should be clarified in the early stages and continuously monitored.

The evidence from the Round 1 interviews indicated that the initiatives used, which were technologies related to IoT sensors, cloud solutions and fibre optic Internet, which are important in smart cities to bridge the digital divide across different communities. They also provide important access to data for the health sector, to improve security for citizens, to improve access to traffic information and to engage with citizens. The evidence further indicated that the value of technology and data related to integration and open standards allowed efficiency and improvements of processes, by accessing quality information about the context for which decisions had to be made to create improved products and services. The value was also indicated in terms of attracting investors (monetary worth) and positive human behaviour in the work environment due to automation of processes related to manual tasks and jobs.

The evidence from the Round 2 interviews revealed that IoT, cloud, mobile and web applications, WiFi-hotspots and Internet are the technologies that are important for smart city initiatives. The importance was indicated in terms of the purpose of these technologies. The stakeholders of these initiatives cited the following purposes: data steaming for dashboards and decision-making; data collection; remote access and working; as well as navigation and mobility.

The data-related Smart City initiatives were indicated in terms of the data sources that were important and the stakeholders identified that open data sources and access controlled open data sources had a higher importance than internal data sources. The experiences of using these open data sources contributed to access to resources for research by using online information to report and monitor different aspects of the initiatives and to develop visualisation models to aid informed decision making.

The stakeholders from Round 2 indicated that the value of technology and data-related initiatives were mainly regarding having a good Internet, which allowed access to centralised information. The related initiatives for technology and data value were monitoring, managing and analysing data through research for decision-making to develop better solutions related to living conditions being improved in terms of convenience, physical and cyber safety and security in cities where issues of violence and poverty are prevalent.

The importance and usefulness of the initiatives were investigated by conducting the SLR and the interviews. According to the literature regarding smart cities in South Africa, the challenges faced are integration of services and the exchange of information amongst city departments. These challenges were confirmed in the interviews and led to preventing value creation for end-users, such as citizens and investors to make informed decisions. Du Plessis and Marnewick (2017) confirmed and reported similar challenges in their study to the interview findings.

Evidence from the interview findings also indicated that stakeholders regard the Eastern Cape as less advanced regarding Smart City initiatives, compared to Cape Town and Gauteng. This was confirmed in the Internet Search, where the Eastern Cape has less active and technologically advanced Smart City initiatives in place. One of the participants even referred to the province as a "backward province". The major challenges referred to were identified in the interviews because of governmental management and political issues. However, it was also indicated in the interviews that if Smart City initiatives were to be managed properly, this management should focus on the allocation of their municipal budget to employment and skills development, improved security related to public transport and consideration of all the relevant stakeholders. This would then allow a province, such as the Eastern Cape, to leapfrog and gain the most benefits compared to other provinces in South Africa.

9.6 Limitations of this Study

The study was conducted in only one province of South Africa, by using a case study strategy with 22 interviews and an expert review of eight interviews. This approach was time-consuming, and gathered rich data from different types of stakeholders. Covid-19 prevented travelling to the different cases and initiatives in the Eastern Cape, and therefore, Round 2 data were collected remotely via the MS Teams platform.

Case study strategies, by using interviews, may be used for analytical generalisability of the results for various contexts and not statistical generalisability. However, in this study the use of *a priori* themes grounded in literature, theories and empirical findings, assisted in guiding the themes for the interview findings. Therefore, the findings from results are presented for both an international and national perspective of Smart Cities. Even though the sample size of this study was limited to 30 interviews (22 interviews and eight expert reviews), saturation of the findings was evident in the last steps of the analysis of the results.

9.7 Future Research

For future research, the vast number of factors that were identified as themes from the interview findings and literature in this study could be used to design and create a Smart City Readiness Index. Such an index could be used to determine and analyse the status of cities in a developing country and provide guidance on how to move to the next level of the Readiness Index.

Future research could be conducted to further verify the VASCS Model components and test the relationships between the constructs by conducting a survey with a large population and analysing the data statistically. This approach of using theories with an experimental study can help to bridge the gap by identifying a comprehensive Smart City definition that is undergirded by theories. The proposed VASCS Model can be adapted and applied in future research to other Smart Cities, which are trying to achieve success in Smart City projects. The Stakeholder Value Alignment component can be investigated further by measuring the perceived stakeholder value against the actual stakeholder value, by using the identified Phases of Benefits and Value Realisation to determine the gaps that exist and thus align the value accordingly.

The data policies identified in this study should be applied and tested in real-world Smart City scenarios. This could help other researchers and practitioners understand further implications regarding collecting and using personal information and data through Smart City initiatives and projects from providers, enablers, users, utilisers, citizens, investors and other stakeholders.

Previous research has indicated that the population in cities will continue to increase. Studies could investigate whether the COVID-19 pandemic is going to have an impact on Smart City migration, specifically, now that people have been working remotely. Especially, since employees that used to work in offices in cities, can now work from locations outside of a city. Future research could include the impact of Covid-19 on city migration and the impact on city stakeholders.

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Appendix A: Ethics Clearance

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Tel: +27 (0)41 504 2347
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Ref: [H18-SCI-CSS-004 / Approval]

16 February 2021

Prof B Scholtz
Faculty: Science

Dear Prof Scholtz

A DIGITAL VALUE CHAIN FOR SMART CITIES: IN THE CONTEXT OF A DEVELOPING COUNTRY

PRP: Prof B Scholtz
PI: Mrs van der Hoogen

Your above-entitled annual progress report (APR) was reviewed by REC-H EXCO for approval. We take pleasure in informing you that the Research Ethics Committee (Human) has approved your report. Please note the following as you continue your study to its completion:

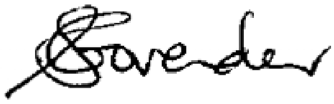
1. In the event of a requirement to extend the period of data collection (i.e. for a period in excess of 1 calendar year from date of original approval of study), completion of an extension request is required (form RECH-005 available on Research Ethics Committee (Human) portal)
2. In the event of any changes made to the study (excluding extension of the study), completion of an amendments form is required (form RECH-006).
3. Immediate submission (and possible discontinuation of the study in the case of serious events) of the relevant report to RECH (form RECH-007) in the event of any unanticipated problems, serious incidents or adverse events observed during the course of the study.
4. Immediate submission of a Study Termination Report to RECH (form RECH-008) upon expected or unexpected closure/termination of study.
5. Immediate submission of a Study Exception Report of RECH (form RECH-009) in the event of any study deviations, violations and/or exceptions.
6. Acknowledgement that the study could be subjected to passive and/or active monitoring without prior notice at the discretion of Research Ethics Committee (Human).

Please inform the REC-H, via your faculty representative, if any changes (particularly in the methodology) occur during this time (forms as above). An annual affirmation to the effect that the protocols in use are still those for which approval was granted, will be required from you.

Please quote the ethics clearance reference number in all correspondence and enquiries related to the study. For speedy processing of email queries (to be directed to Imtiaz.Khan@mandela.ac.za), it is recommended that the ethics clearance reference number together with an indication of the query appear in the subject line of the email.

We wish you well with the continuation of your study.

Yours sincerely



Dr S Govender
Chairperson: Research Ethics Committee (Human)

Cc: The Office of Research Development
Faculty Officer: Science

Appendix B: ICTAS Paper 2019

2019 Conference on Information Communications Technology and Society (ICTAS)

A Smart City Stakeholder Classification Model

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***Abstract*—Cities globally are facing an increasing forecasted citizen growth for the next decade. It has therefore become a necessity for cities to address their initiatives in smarter ways to overcome the challenges of possible extinction of resources. Cities in South Africa are trying to involve stakeholders to help address these challenges. Stakeholders are an important component in any smart city initiatives. The purpose of this paper is to report on a review of existing literature related to smart cities, and to propose a Smart City Stakeholder Classification Model. The common dimensions of smart cities are identified and the roles of the various stakeholders are classified according to these dimensions in the model. Nine common dimensions and related factors were identified through an analysis of existing frameworks for smart cities. The model was then used to identify and classify the stakeholders participating in two smart city projects in the Eastern Cape province of South Africa.**

Keywords—smart city; stakeholders; roles; dimensions; factors; frameworks.

I. Introduction

The population in the world is growing and particularly in urban areas and cities. Over the next 20 years this trend is projected to continue [5]. The United Nations predicts that by 2050 the population in areas such as cities will have increased by 70% [5]. As a result, many questions are being asked around the problems, solutions and opportunities related to managing a city's resources efficiently [22] [27]. Several studies [1] [9] [27] report that the smart city concept has become increasingly popular. Therefore city management, with the help of other stakeholders, are trying to manage their resources smarter [1] [39]. These stakeholders include businesses and companies in the private and public sectors, research and development groups, investors, citizens, city employees and city mayors.

The popularity of smart city research has led to many definitions for smart cities, and these vary in nature since they are tailored per city across the world [2] [9]. A comprehensive definition for a smart city is yet to be developed amongst researchers [2]. Albino et al. [2] conducted a study on smart city definitions and identified the factors of a smart city and the information flow between such factors as the important components of a smart city definition. Their definition [2] will be adopted for the purpose of this study and states that:

"*A smart city is based on intelligent exchanges of information that flow between its many different subsystems. This flow of information is analyzed and translated into citizen and commercial services. The city will act on this information flow to make its wider ecosystem more resource-efficient and sustainable. The information exchange is based on a smart governance operating framework designed to make cities sustainable*".

It can be deduced therefore that the first step in starting a smart city initiative should be to identify what a smart city framework consists of and to identify and classify the important stakeholders. Studies have shown that smart city frameworks consist of dimensions and factors that can drive a smart city initiative [1] [4] [7] [16] [17] [19] [20] [23]. The findings from these studies revealed that the six most widely adopted smart city dimensions amongst many smart city studies were identified by [16] and updated by [17]. These dimensions are: smart economy, smart people, smart governance, smart environment, smart mobility and smart living. Each of the six dimensions have related factors which can be used in a model to classify stakeholders and ultimately information flows and information exchange in a smart city.

Whilst many studies have investigated and proposed dimensions and factors of smart cities, of the studies identified in our literature review, none have provided guidance regarding how to classify the stakeholders according to these dimensions. The purpose of this paper is to address the gap in the research and propose a Smart City Stakeholder Classification Model that outlines the common dimensions of smart cities with their related factors and the roles of the stakeholders in these dimensions.

A case study approach was adopted and the model was applied to two cases in the Eastern Cape (EC) province of South Africa, where two smart city initiatives have been undertaken. In this paper three additional dimensions are added to the six most widely adopted dimensions from [16] and [17] based on [1]. The three dimensions are: 1) smart technologies and ICT infrastructure; 2) smart organisation and 3) smart policy. One of the key factors that is evident across all the empirical studies reviewed is stakeholders. Stakeholders are the most important role players in smart cities and must be considered during a smart city initiative, since they can direct the perceived value of a smart city through co-creation of value for the city.

No recent studies of smart city stakeholder classifications could be found at the time of this review, especially in developing countries such as South Africa. In [9] it was reported that only 2% of African smart city studies have been reported on. Smart cities in South Africa have many challenges regarding integration of services and information flow amongst departments within the cities, thus preventing the creation of value to the end users. The end users are stakeholders such as citizens and investors, who must be considered when making informed decisions. Studies [1] [9] [20] [21] [32] have also

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Appendix C: Lecture Notes in Computer Science 2020

https://rd.springer.com/chapter/10.1007%2F978-3-030-44999-5_5

Using Theories to Design a Value Alignment Model for Smart City Initiatives

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Abstract. Smart city initiatives are widely becoming part of the world agenda to address crises and to identify new initiatives for countries to manage resources while providing better living conditions for all citizens. The purpose of this study was to design a model to support the alignment of value in Smart City initiatives. To address this purpose, a systematic literature review (SLR) was conducted to find what Smart City initiatives have been addressed in empirical studies, and what dimensions and factors are linked to these initiatives. The SLR also identified the stakeholders in a Smart City, and what their roles should be linked to these initiatives. Six theories were identified and used to undergird the researcher's understanding of the domains of Smart Cities, value and alignment. The concepts from these theories were then used with the SLR findings to design a conceptual model for Smart City initiatives. The proposed Value Alignment Smart City Model (VASC) can be used to plan or assess Smart City initiatives. The main contribution is the alignment of value amongst stakeholders to support the success of such initiatives. Further research is required to investigate adopting the model and empirically evaluate it.

Keywords: Dimensions · Factors · Stakeholder roles · Value · Alignment · Theories

1 Introduction

Even though there is no consensus by researchers regarding the definition of a Smart City, many agree on certain aspects that can help with the understanding of what Smart City studies are about [1]. The common component of Smart Cities reported is ICT solutions that address economic, social and environmental issues to contribute to a better quality of life for the citizens [1–3]. It is found that addressing Smart City concepts and trends through initiatives can help to reach a cohesive understanding amongst cities in the world who are trying to overcome similar or different problems [1, 3]. The feasibility of Smart City initiatives is driven from the point of view that it is depending on Big Data and the Internet of Things (IoT) [1, 4]. Smart city initiatives should further incorporate technologies such as sensors where data can be collected and analysed so those who need the information can make informed decisions and manage administrative tasks [5].

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Appendix D: GITMA Paper 2020

http://www.gitma.org/

DRIVERS, BENEFITS AND CHALLENGES TO IMPROVE ACCESS TO SMART CITY DATA IN DEVELOPING COUNTRIES

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Abstract. Smart City research has become increasingly popular. The increase in data volume and provision of on-line data emphasises the importance of access to data for Smart City initiatives. The data-value chain is relevant for providing value to stakeholders or assessing where value is realised. There is, however, a lack of research relating to the benefits and value obtained from Smart City initiatives in developing countries. The purpose of this paper is to investigate Smart City initiatives that influence the data-value chain in a developing country. The paper followed a case study strategy. Selected stakeholders of Smart City initiatives in South Africa were interviewed. The findings of this exploratory study identified specific drivers, benefits and challenges of initiatives that provide access to Smart City data. The findings revealed that having reliable data sources, transparency and audit procedures in place are important and should be considered by other cities planning similar initiatives.

Keywords: Smart Cities, Smart City Data Initiatives, Data Value, Data Challenges.

1. INTRODUCTION

Industries, services and innovation of global cities will contribute to over 60% of economic activities by the year 2030 (Holt, 2018). The Gross Domestic Profit (GDP) of cities in Africa is predicted by the Economist to be the fastest growing in the world and is showing signs of overtaking that of China (Campbell, 2019; Gottschick, 2019). Forecasts also show that the largest increase in city population will occur on the African continent. It is predicted that 50% of people in Africa will live in urban areas by 2030 (SALGA, 2015). Cities will therefore have to find smarter ways of managing their resources (Hämäläinen & Tyrväinen, 2018; Khatoun & Zeadally, 2016). Developing countries are following the recent trends of moving towards Smart Cities. However, many of the core components and characteristics of Smart City initiatives are inherently based on trends in developed countries and therefore may not necessarily be suitable for developing countries (Giffinger, 2011; Manupati, Ramkumar, & Samanta, 2018; Mora, Bolici, & Deakin, 2017). One of the reasons for this is that cities in developing countries have problems that are not always the same as those in developed countries. Examples of these are the higher rates of crime, poverty and unemployment (Cilliers, Flowerday, & Mclean, 2016; Musakwa & Mokoena, 2017; Tshiani & Tanner, 2018).

Smart City initiatives globally have made data accessible and available for analyses to assist cities in planning and in providing the necessary innovative solutions for all stakeholders (Kassen, 2017; SACN, 2016; Yadav, Hasan, Ojo, & Curry, 2017). An understanding of the concepts and factors that characterise smart city initiatives in the developed countries of Canada, Mexico and the United States were reported on by Alawadhi et al. (2012); whilst Albino et al. (2015) reported on the different definitions, dimensions, performances and examples of Smart City initiatives from studies conducted in the developed nations of Germany and the United States. A study in South Africa, which is a developing country, was conducted by Du Plessis and Marnewick (2017) who reported on Smart City services provided to assist Small Medium Enterprises (SMEs) to overcome the challenges from an economic point of view. However, their study only showed the perspective of value for SMEs in South Africa. Another South African study conducted by Tshiani and Tanner (2018) focused on data privacy issues related to data collection from residents in Cape Town. Their findings revealed that Smart City initiatives collected residents' data without measures being in place to protect the identity of the residents.

Other studies in South Africa revealed several attempts that have been made to make its cities smarter (Backhouse, 2015; Du Plessis & Marnewick, 2017; Musakwa & Mokoena, 2017; Tshiani & Tanner, 2018; Van Huyssteen et al., 2015). Cities in South Africa are faced with additional challenges compared to those of developed countries; these challenges include high unemployment, crime and poor quality of basic education (SALGA, 2015).

Appendix E: Springer Book Chapter 1 2021

Innovative Digitalisation Initiatives for Smart Communities and Smart Cities in a Developing Country

Anthea van der Hoogen, Brenda Scholtz, and André P. Calitz

1 Introduction

Digitisation is increasingly becoming part of our lives, especially during a time of the COVID-19 pandemic, lockdown and economic distress. Digitisation is defined by Brennen and Kreiss (2014) as "*the material process of converting individual analogue streams of information into digital bits*". Gartner's (2020) Information Technology Glossary provides a perspective from a research-advisory view on what these terms mean and describes digitisation as "*..the process of changing from analog to digital form, also known as digital enablement. Said another way, digitisation takes an analog process and changes it to a digital form without any different-in-kind changes to the process itself*".

Digitalisation is broader and deeper than digitisation and is defined by Brennen and Kreiss (2014) as "*the way in which many domains of social life are restructured around digital communication and media infrastructures*". The Gartner glossary describes digitalisation as "*the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business*". It is clear from the above that digitisation is taking the physical form of an item and converting it into a digital form. Both views indicate that once something has become digital, the action involves the modification of a process to an improved process.

Digital disruption seems to be a driver for initiatives in Smart Communities and Smart Cities where innovative technologies are used to help solve problems (Ernst & Young, 2017; Mehmood et al., 2017; Silva et al., 2018; Yaqoob et al., 2017).

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J. Halberstadt et al. (eds.), *Resilience, Entrepreneurship and ICT*, CSR, Sustainability, Ethics & Governance,
https://doi.org/10.1007/978-3-030-78941-1_3

Appendix F: Springer Book Chapter 2 2021

Identifying Stakeholder Value in Smart City Implementation in Nelson Mandela Bay Municipality

Ifeoluwapo Fashoro, Brenda Scholtz, and Anthea van der Hoogen

1 Introduction

Cities are centres for cultural and economic development, contributing to about 80% of the world's Gross Domestic Product (Estevez et al., 2016; Meijer & Bolívar, 2016); they are said to be a positive force for economic growth, human development, and poverty reduction (United Nations Department of Economic and Social Affairs, 2018b). Currently, more people live in cities than in rural areas around the world and there is an increase in urban migration from rural areas. This phenomenon of urbanisation began in the 1950s and has since grown at a rapid pace. The world's urban population is expected to grow by 63% between 2014 and 2050 (United Nations Department of Economic and Social Affairs, 2018b). As at 2018, 55% of the world's population lived in cities and this number is expected to increase to 68% by 2050 (United Nations Department of Economic and Social Affairs, 2018a). This population growth has led to increasing demands for energy, water, sanitation, housing, and other public services causing a strain on existing infrastructure. Cities consume 67% of global energy and are responsible for 70% of global greenhouse gas emissions (Estevez et al., 2016; Khatoun & Zeadally, 2016). These issues challenge the sustainability of cities and have led city managers to seek out solutions that will enable them to cater for current demands on public infrastructure as well as prepare for the future of their cities. Governments, researchers, and industry regard Information Communication Technology (ICT) as an enabler and catalyst to providing solutions to these challenges. ICTs are particularly prominent in the functioning of smart cities; enabling cities to address existing challenges through

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Appendix G1: Expert Review Form

Expert Review Form – Smart City Model

Biographical Information

1. Name: Title:
2. Country of work: City:
3. University: Job title/position:
4. Highest level of education:

5. Please rate your level of expertise on Information Systems research on a scale from 1-5 (1-Novice to 5-Expert)					6. Please rate your level of expertise on Smart Cities research on a scale from 1-5 (1-Novice to 5-Expert)				
1	2	3	4	5	1	2	3	4	5

7. What are your top three fields of research?
8. Please elaborate on your knowledge of Smart City research. E.g. have you published in this field, or on any sub-topics in this field?
9. Please specify which specific areas/dimensions are the smart city research you have expertise in.
10. Please elaborate on your views of Smart City research.
11. Which cities in the world would you classify as smart and why?
12. Have you ever been involved in or are you currently involved in any smart city projects?
    a. If yes, in which cities?
    b. What were the projects about and what is (or were) your roles in the projects?

1

Questions based on the Dimensions and Factors. Please refer to the Smart City Model and Table 2.	
13. From the graphical model can you clearly identify the nine dimensions of a Smart City?	YES/NO
14. Do you believe that this part of the model is complete and represents the main aspects of a Smart City?	YES/NO
15. Are there any dimensions that you believe should be added? If so, what are they?	YES/NO
16. Are there any dimensions that you believe should be removed? If so, what are they?	YES/NO
17. Are there any dimensions that should be joined together? If so, clearly explain which dimensions should be joined together.	YES/NO
18. Do you think there should be an 'ordering' to the dimensions? Currently, the dimensions are ordered according to the number of citations of that dimension, so the highest one has the most citations. a. Do you agree with this method of ordering them? b. If no, then please motivate and elaborate.	YES/NO YES/NO
19. Do you agree that the factors for each dimension should not be shown on this model as it will make it too cluttered? YES/NO If no, then please elaborate on how you think the model should be amended.	
20. Consider the 39 factors in Table 2 (F1-F39). Do you believe that there are other factors that should be added? YES/NO a. If yes, then please specify what dimension and what factor. b. Do you believe that there are any factors that should be changed or removed?	

2

Questions based on the Stakeholder Roles. Please refer to Table 4.	
21. Do you believe that the model considers all the major stakeholder roles?	YES/NO
22. Are there any stakeholder roles or types that you believe should be added to the model? If YES then please elaborate.	YES/NO
23. Are there any stakeholder roles or types that you believe should be removed from the model?	YES/NO
24. Are there any stakeholder roles or types that you believe should be changed in the model?	YES/NO
25. Currently, there is no explicit one-to-one or even one-to-many mapping shown between the dimensions and the stakeholder roles. a. Do you agree with this decision/design of the model? b. If NO then please explain your motivation and how you believe it should be designed.	YES/NO
Questions based on Stakeholder Value Alignment	
26. Based on the definition of stakeholder value alignment, do you regard stakeholder value alignment as an important component of a smart city? YES/NO If so, why? If not, why not?	
Questions based on Value co-creation Phases	
27. In your expert opinion, do you believe that the Phases of a smart city project should form part of the model? YES/NO If yes, do you agree that the phases have an influence on value co-creation/alignment and ultimately project success?	
28. Do you agree with where the phases are situated in the model YES/NO If no, where would you place them?	

3

Questions based on the overall model
29. Is there any part of the model that you feel is not accurate in terms of a scientific concepts viewpoint? YES/NO If yes then please elaborate.
30. Is there any part of the model that you feel is not clear or needs improvement in terms of the design or layout? YES/NO If yes then please elaborate
31. Please feel free to provide any other helpful feedback.

I agree that my feedback can be used as an expert review within the thesis of the PhD candidate's (Anthea Van der Hoogen (nee Connolley)).

Sign: …………….…………………………...

Date: …………………….August 2019

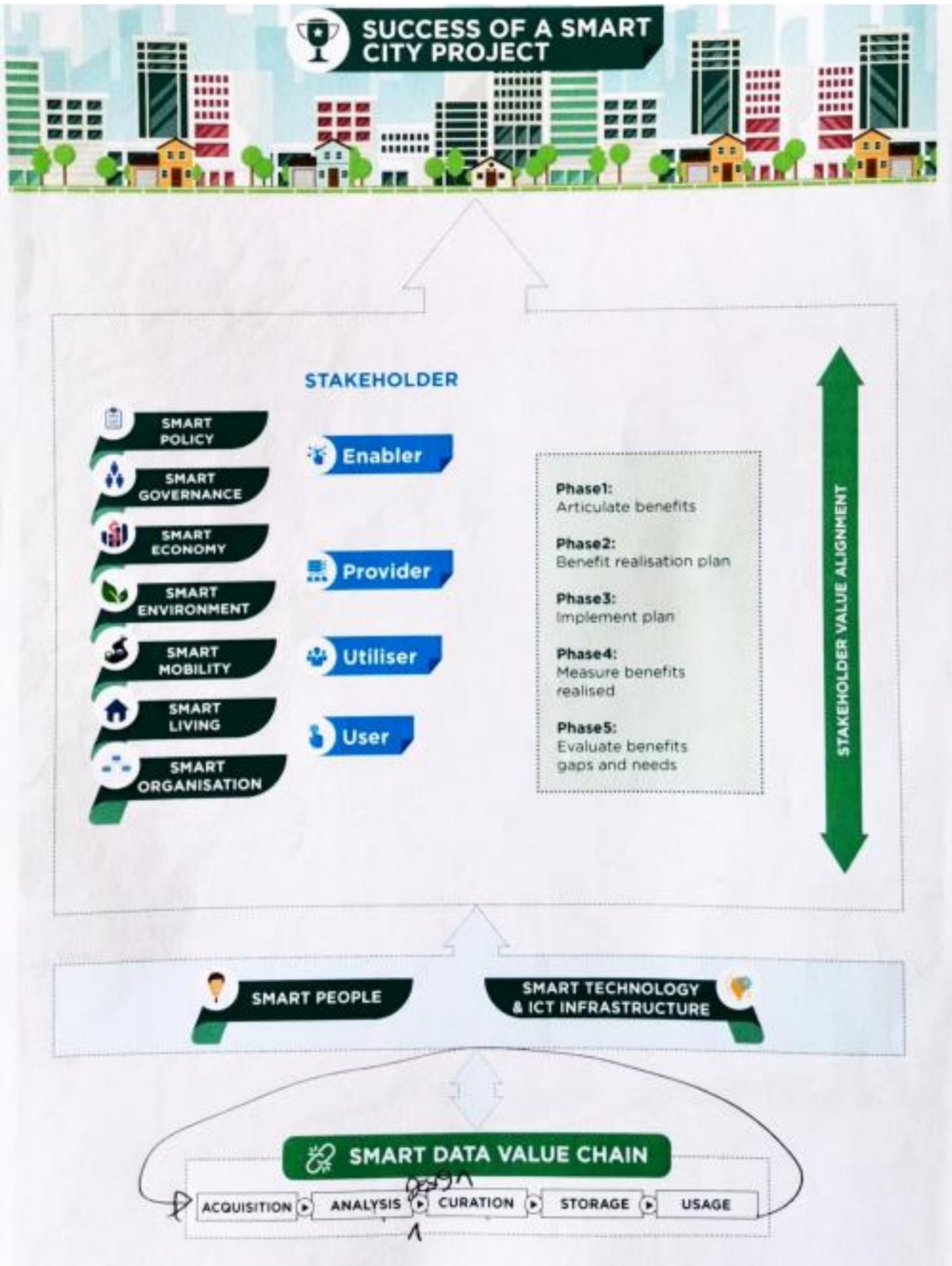
Appendix G2: Expert – Background Information to Model

Due to space constrainst the full document is not included here, the following sections were included in the document that was shared with the experts, pertaining the background information to the model. The sections below are mapped to where the information are now situated in this thesis, as follows:

- Smart City definition adopted in this study (Section 2.2);
- Smart City dimensions and Smart City factors (Section 2.5);
- Smart City stakeholders (Section 2.5); and
- Value co-creation process (five phases for benefits realisation) (Section 4.4).

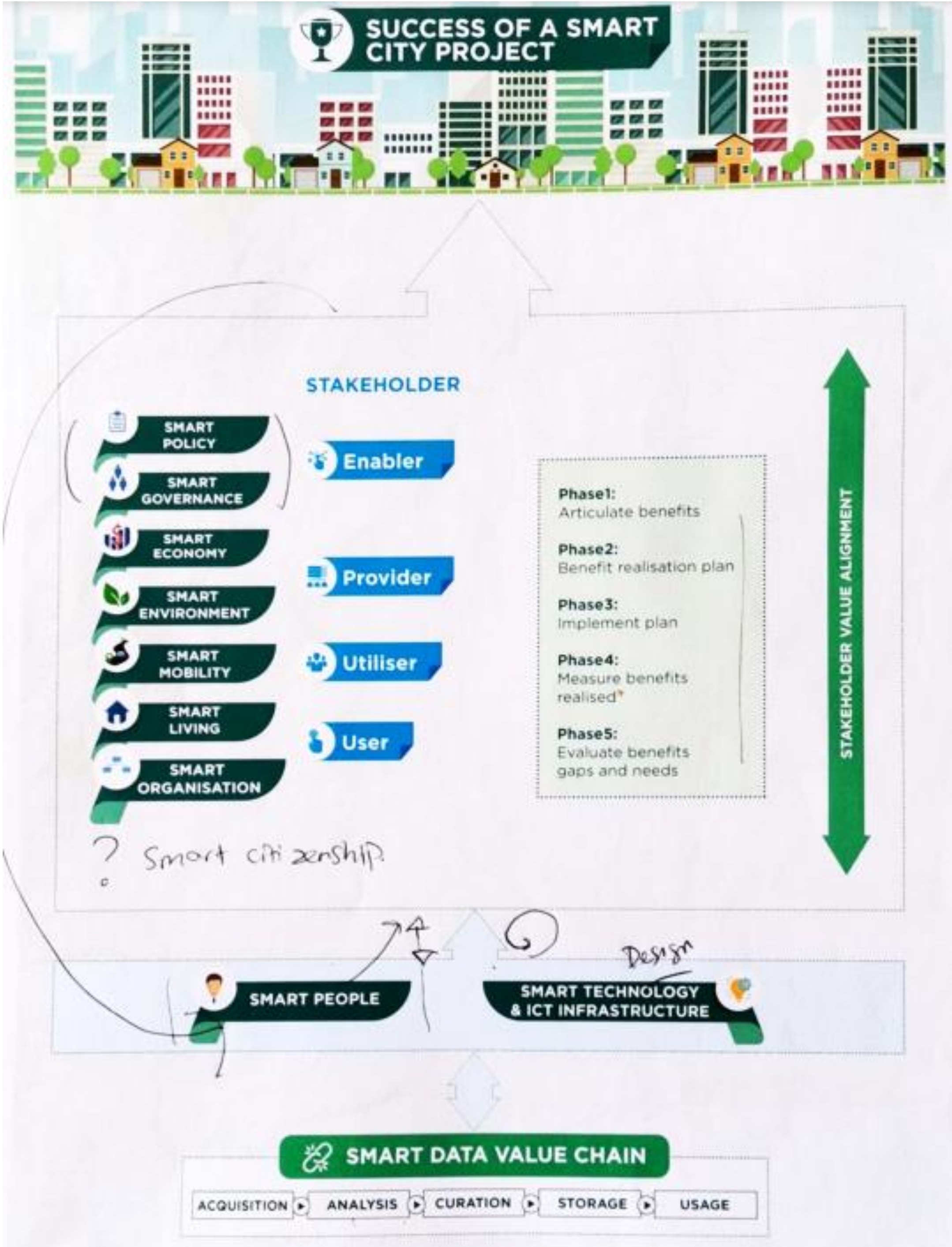
Appendix G3: Expert Written Input on Model

ER2: Direct written input on the model:

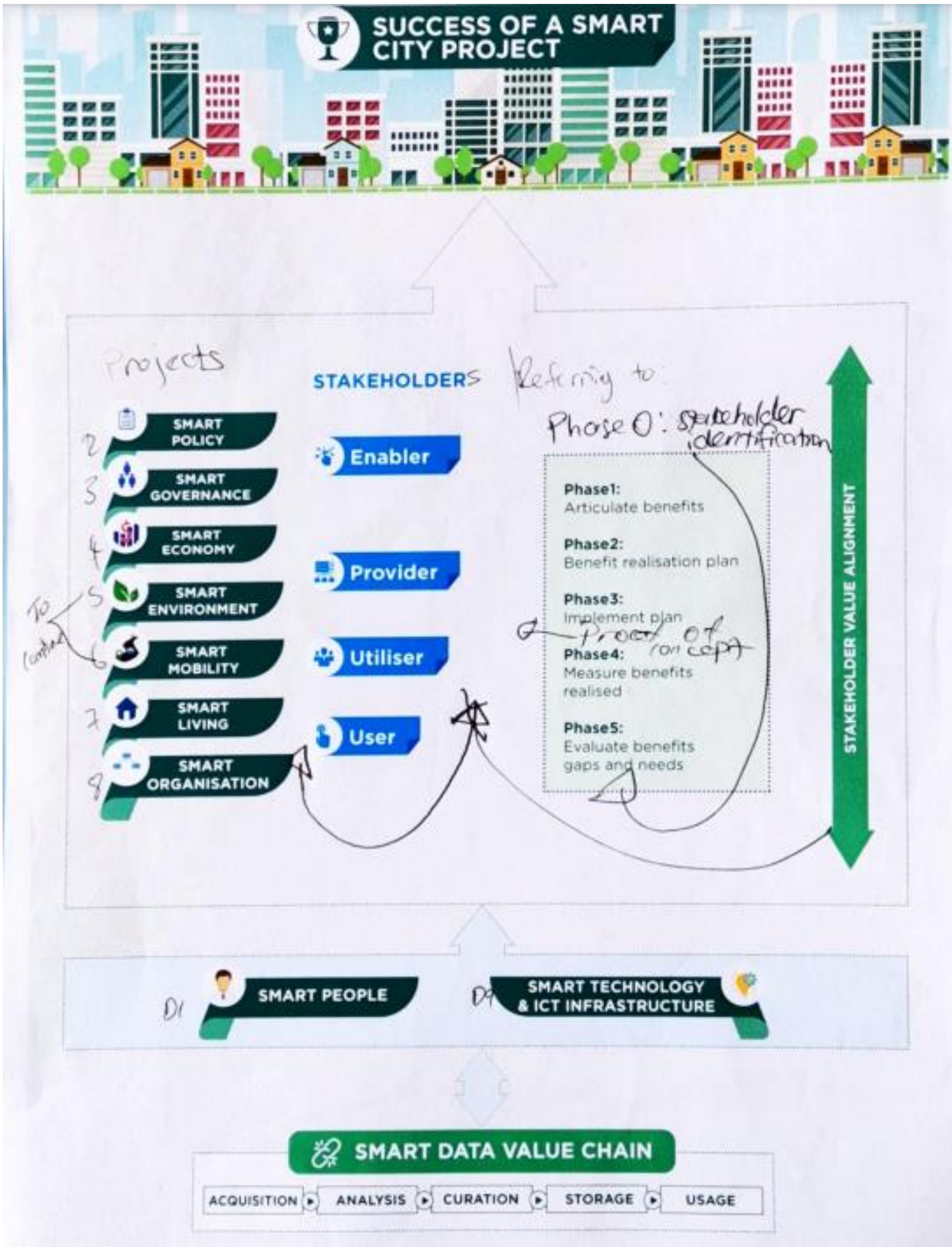


ER4: Direct written input on the model:

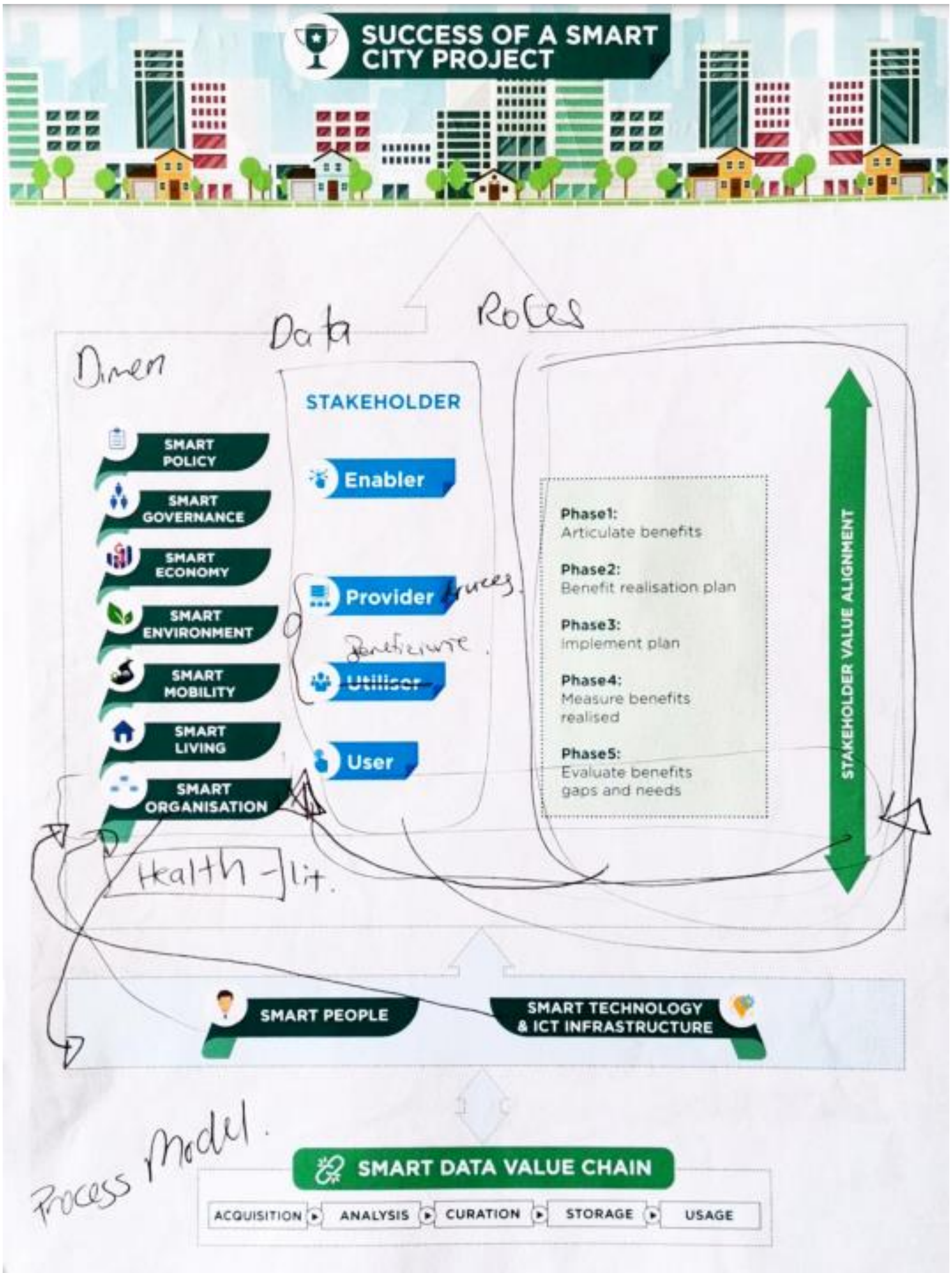
ER5: Direct written input on the model:



ER6: Direct written input on the model:



ER7: Direct written input on the model:



ER8: Direct written input on the model

Appendix G4: Expert-Email to Request Permission

<u>Email text:</u>

I am in the process of collecting data from expert researchers who can assist in reviewing my proposed Smart City Model.

I am interested in receiving feedback from expert researchers who have a PhD, research expertise of 5years minimum, and have published articles before.

Your assistance will be invaluable, and it will provide direction to propose a comprehensive Smart City Model that will be used in case studies in South Africa.

To achieve this objective, a short interview is required.

Please find attached the background information to the Model and the actual Smart City Model. It will be helpful to go through this before our meeting.

Appendix H1: Formal Letter for Case Study Interviews

NELSON MANDELA
UNIVERSITY

WRITTEN INFORMATION FOR PARTICIPANTS

Faculty of Science
Department of Computing Science
Nelson Mandela University
Tel. +27 (0)41 504 2758
Email: Anthea.vanderhoogen@mandela.ac.za
[redacted]

Dear [redacted]

You are being asked to participate in a research study. We will provide you with the necessary information to assist you to understand the study and explain what would be expected of you (the participant). These guidelines would include the risks, benefits, and your rights as a study subject. Please feel free to ask the researcher to clarify anything that is not clear to you. To participate, it will be required of you to provide a written consent that will include your signature, date and initials to verify that you understand and agree to the conditions.

You have the right to query concerns regarding the study at any time. Immediately report any new problems during the study, to the researcher. The telephone number and email address of the researcher are provided. Please feel free to contact the researcher.

Furthermore, it is important that you be aware of the fact that the ethical integrity of the study has been approved by the Research Ethics Committee (Human) (REC-H) of the university. The REC-H consists of a group of independent experts that has the responsibility to ensure that the rights and welfare of participants in research are protected and that studies are conducted ethically. Studies cannot be conducted without REC-H's approval (i.e. approval ref: H18-SCI-CSS-004). Queries about your rights as a research subject can be directed to the REC-H, Department of Research Capacity Development, PO Box 77000, Nelson Mandela University, Port Elizabeth, 6031, South Africa.

If no one could assist you, you may write to the Chairperson of the Research, Technology and Innovation Committee, PO Box 77000, Nelson Mandela University, Port Elizabeth, 6031, South Africa.

Participation in this research is entirely voluntary. You are not obliged to take part in any research. If you do partake, you have the right to withdraw at any given time, during the study without penalty. However, if you do withdraw from the study, you should return for a final discussion or examination to terminate the research in an orderly manner.

Yours sincerely
Anthea Van der Hoogen
EVALUATOR AND RESEARCHER

Change the World PO Box 77000, Nelson Mandela University, Port Elizabeth, 6031, South Africa

Appendix H2: Consent Form for Case Study Interviews

Consent Form for Users and Utilisers

* Required

Email address *

Your email

I hereby confirm that I was invited to participate in the above-mentioned research project that is being undertaken by Anthea van der Hoogen from the Nelson Mandela University *

- [ ] Yes
- [ ] No

The aim of the research has been explained to me *

- [ ] Yes
- [ ] No

I understand that I will partake in an interview and or questionnaire and be asked questions about my involvement within smart city initiatives as well as the leading questions that will build on the aim of this study. *

- [ ] Yes
- [ ] No

I understand that the information I provide may be reused by the researcher for purposes other than the dissertation (e.g. journal papers or conference papers). *

- [ ] Yes
- [ ] No

I understand that I may withdraw from the interview at any time and know that the points raised during discussions are confidential, as is their identity during the study. *

- [ ] Yes
- [ ] No

I understand that my identity will not be revealed in any discussion, description or scientific publications by the investigators. *

- [ ] Yes
- [ ] No

My participation is voluntary *

- [ ] Yes
- [ ] No

I was given the opportunity to ask questions and all these questions were answered satisfactorily. *

- [ ] Yes
- [ ] No

No pressure was exerted on me to consent to participation and I understand that I may withdraw at any stage without penalisation. *

- [ ] Yes
- [ ] No

Participation in this study will not result in any additional cost to myself. *

- [ ] Yes
- [ ] No

I hereby voluntary consent to participate in the above-mentioned project *

- [ ] Yes
- [ ] No

First name and surname *

Your answer

Date *

Date

yyyy/mm/dd

Submit

Page 1 of 1

Appendix I1: Round 1 Interview-Overview

OVERVIEW AND AIM OF THE STUDY

Thank you for agreeing to take part in this research study. Your participation is much appreciated.

This interview is part of a PhD research. The objectives of this study are to identify the co-creation value of digital activities at different components of a smart city within a developing country. Therefore the first step will be to propose a model of smart city components and the specific factors applicable in each component and smart city dimension is required. To achieve the objectives of this study, the following needs to be done:

- Identify the stakeholders involved in smart city initiatives.
- Compare smart city components for developed and developing countries.
- Identify the quality of information sharing between the components.
- Evaluate the impact/value of each initiative for all stakeholders.
- Determine the digital value chain activities.

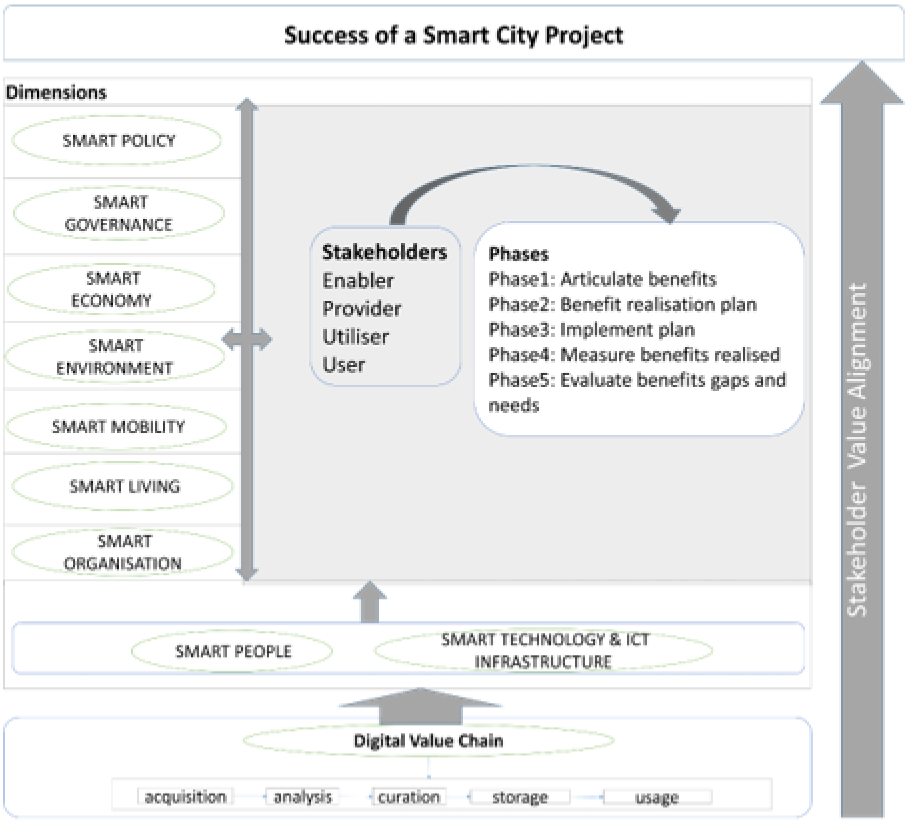
The information given by yourself will be used to evaluate the status of smart cities in South Africa using the proposed model. The second step will be to propose a value chain to show where value exists between or within the smart city components. All stakeholders within a city and or potential investors could use the value chain and model for decision making regarding components within a smart city which interest their investments and smart city projects.

Appendix I2: Round 1 Interview Question Guide

Overview:

Verification of the Model components that should lead to the alignment of stakeholder value to that of the smart city initiatives includes:

- Dimensions
- Factors
- Stakeholder types
- Value chain/value
- Phases – To realise benefits



Objectives of the Interview

1: Identify the factors of a smart city for a developing country;
2: Identify the stakeholders for smart cities in a developing country;
3: Analyse and classify existing digital activities for smart cities in a developing country;
  3.1: Identify the data and technology initiatives;
  3.2: Determine what makes data smart;
4: Determine the value of the initiatives for smart cities in a developing country;
  4.1: Identify the criteria for value creation in a smart city in a developing country;
  4.2: Determine the alignment of the data and IoT initiatives on the value creation for stakeholders in the city.

<u>ORGANISATION</u>

O1. How did the initiative start?

O2. What are the main goals of the initiative? *(is it a for profit, or social entrepreneurship or non-profit; education etc.)*

O3. What were the expected benefits/value of the initiative?

Stakeholder role and responsibilities: (internal stakeholders form part of an Organisation, external ones are part of the environment)

S1. Is your organisation a provider/enabler?

S2. What are your roles and responsibilities in the initiative?

<u>TECHNOLOGY</u>

Dimension 9: Smart Technology and Built infrastructure:

D1. What technologies are being used in the initiative, how and to what extent? – e.g. *IoT, artificial intelligence; cloud computing*

D1.1 What is the value of using the above-mentioned technologies?

D1.2 What are the barriers and challenges to using technologies for the initiative?

D2. Data (digital) Value Chain:

D2.1 Which digital activities do you use for your smart city initiatives?

D2.2 What phases of the data value chain are relevant to your initiative?

D2.3 Which data/open data sources are you using?

D2.4 For which purpose was the above-mentioned data/ open data sources used?

D2.5 What is the value of using the above-mentioned data/ open data sources? (i.e. do you have any problems with getting the data or the quality of the data)?

D2.6 In your view what would make the data 'smart'?

D2.7 What are the challenges of using the above-mentioned data/ open data sources?

<u>ENVIRONMENTAL</u>

Relates to, e.g. policy etc. external environment

E1. How are other external stakeholders involved in the initiative?

E2. Benefits/impact/value

E2.1 How does the initiative relate or impact the city's economy?

E2.2 How does the initiative relate to or impact the city's natural environment?

E2.3 How does the initiative impact the daily lives of citizens i.e. the social lives?

E2.4 What do you believe is the impact or benefit to the users/utilisers of your initiative?

E2.5 Do you think the benefits are as you/the provider expected?

E2.6 Is there a gap between expected and actual benefits? Did you consider this?

Appendix I3: Success Factors Template

Full Name:		
Telephone: Email:		
SECTION A: Demographics		
Please indicate with an "x" your:		
Age		18 – 25
		26 – 30
		31 – 40
		41 – 50
		51 +
Gender		Male
		Female
Population group		Asian
		Black
		Coloured
		Indian
		White
		Other (Please Specify: ________________________)
City/Town (for your involved smart city initiative)		
Residential City/Town		
Employment category		Unemployed
		Employed
		Self-employed
		Pensioner
		Other (Please Specify: ________________________)
Education level		Below Grade 12
		Grade 12
		Diploma
		Degree
		Post-Graduate

Select the dimensions that are relevant for your initiative in the below table, from D1 to D9. Then please rate each of the listed factors in those dimensions according to the following statement:

I believe that our initiative supports or provides value to our users/utilisers with regards to the factors in the table below (Strongly Disagree to Strongly Agree). Use an "x" to indicate your selection.

D1 SMART PEOPLE				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F1	Level of qualification			
F2	Affinity to life-long learning			
F3	Social and ethnic plurality			
F4	Flexibility			
F5	Creativity			
F6	Cosmopolitanism/Open-mindedness			
F7	Participation in public life and smart city initiatives			
F8	Synergies through partnerships and collaborations			
Additional Factors (FA). Please list any additional factors not listed.				
FA.1				
FA.2				
FA.3				
D2 SMART GOVERNANCE				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F9	Participation in decision-making			
F10	Public and social services			
F11	Transparent governance			
Additional Factors (FA). Please list any additional factors not listed.				
FA.4				
FA.5				
FA.6				
D3 SMART ECONOMY				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Stronglry Agree]
F12	Innovative spirit			
F13	Entrepreneurship			
F14	Economic image & trademarks			
F15	Productivity			
F16	Flexibility of labour market			
F17	International embeddedness			
Additional Factors (FA). Please list any additional factors not listed.				
FA.7				
FA.8				
FA.9				

D4 SMART ENVIRONMENT				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F18	Attractiveness of natural conditions			
F19	Pollution			
F20	Environmental protection			
F21	Sustainable resource management			
F22	Future proof			
Additional Factors (FA). Please list any additional factors not listed.				
FA.10				
FA.11				
FA.12				
D5 SMART MOBILITY				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F23	Local accessibility			
F24	(Inter-)national accessibility			
F25	Sustainable, innovative and safe transport systems			
Additional Factors (FA). Please list any additional factors not listed.				
FA.13				
FA.14				
FA.15				
D6 SMART LIVING				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F26	Cultural facilities			
F27	Health conditions			
F28	Individual safety			
F29	Housing quality			
F30	Education facilities			
F31	Touristic attractiveness (smart tourism)			
F32	Social cohesion			
Additional Factors (FA). Please list any additional factors not listed.				
FA.16				
FA.17				
FA.18				
D7 SMART POLICY				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F33	Relationship between the smart city initiative and the city's policy			
F34	Policy integration			
Additional Factors (FA). Please list any additional factors not listed.				
FA.19				
FA.20				
FA.21				

D8 SMART ORGANISATION				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F35	Organisational culture			
F36	Innovative leadership and management			
D9 SMART TECHNOLOGY & ICT INFRASTRUCTURE				
Factor (F)		[1 – Strongly Disagree]	[2-Agree]	[3-Strongly Agree]
F37	Smart technologies			
F38	Smart data			
F39	Availability infrastructure (including Built & ICT)			
Additional Factors (FA). Please list any additional factors not listed.				
FA.22				
FA.23				
FA.24				

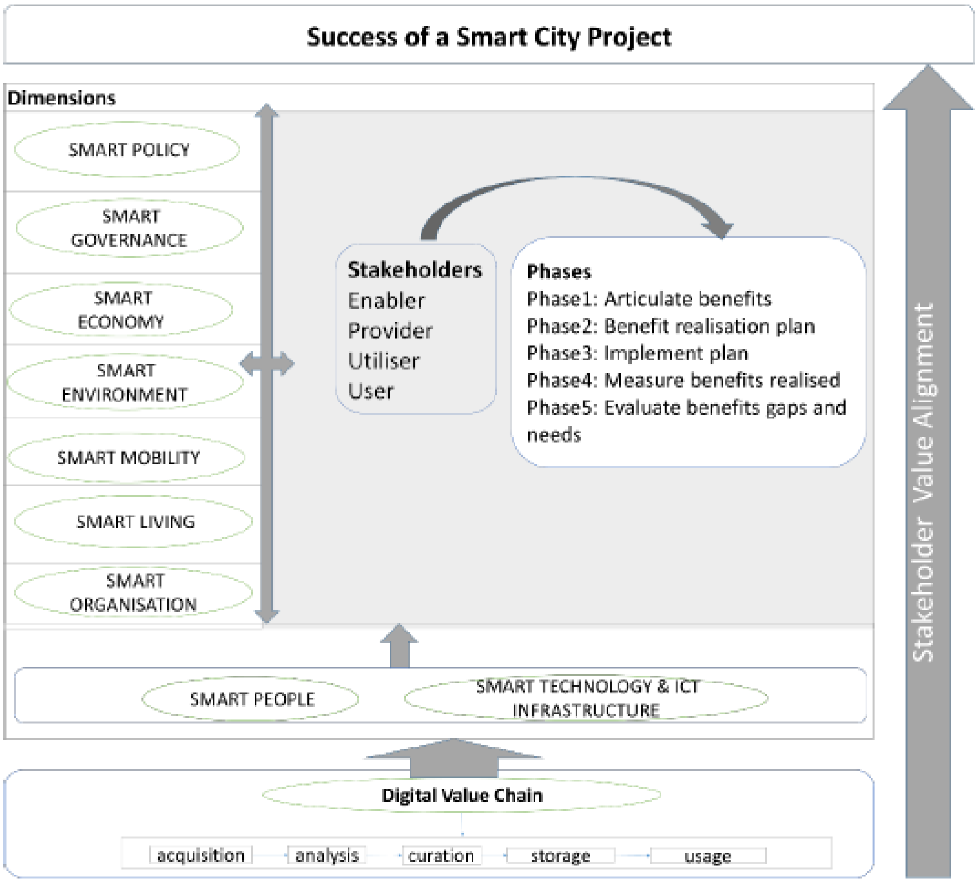
Appendix J1: Round 2 Interview Question Guide

Interview Questions for Users-Utilisers:

Overview:

Verification of the Model components that should lead to the alignment of stakeholder value to that of the smart city initiatives includes:

- Dimensions
- Factors
- Stakeholder types
- Value chain/value
- Phases – To realise benefits



Interview Questions for Users-Utilisers:

Objectives of the Interview

1. Determine the value of the initiatives for smart cities in a developing country;
2. Identify the criteria for value creation in a smart city in a developing country; and
3. Determine the alignment of the data and IoT initiatives on the value creation for stakeholders in the city.

To start the interview, I will make one broad statement about the initiative you are representing today then I will ask an overall question before we get into the final list of questions.

A. On a broader level I am looking at the Smart City initiatives in the Eastern Cape and some of the sub-initiatives that are happening around [redacted].

B. Would you be a provider offering services regarding this initiative or would you be using some of these initiatives? Can you provide examples of the initiatives?

The interview questions are categorised according to the environment and technology related questions for smart city initiatives.

ENVIRONMENT

Relates to, e.g. policy etc. and external environment

E2. Benefits/impact/value

E2.1 How does the initiative relate or impact the city's economy?
E2.2 How does the initiative relate to or impact the city's natural environment (e.g. reducing carbon footprint)?
E2.3 How does the initiative impact your daily life as a citizen i.e. the social lives?
E2.4 What do you believe is the impact or benefit to you as a user/utiliser of the initiative?
E2.5 Do you think the benefits are as you the user/utiliser expected?
E2.6 Is there a gap between said and actual benefits?

TECHNOLOGY

Dimension 9: Smart Technology and Built infrastructure:

D1. What technologies are being used in the initiative, how and to what extent? – e.g. *IoT, artificial intelligence; cloud computing*

D1.1 What is the value of using the above-mentioned technologies?
D1.2 What are the barriers and challenges to using technologies for the initiative?

D2. Data (digital) Value Chain:

D2.1 Which digital activities do you use for your smart city initiatives?
D2.2 What phases of the data value chain are relevant to your initiative?
D2.3 Which data/open data sources are you using?
D2.4 For which purpose was the above-mentioned data/ open data sources used?
D2.5 What is the value of using the above-mentioned data/ open data sources? (i.e. do you have any problems with getting the data or the quality of the data)?
D2.7 What are the challenges of using the above-mentioned data/ open data sources?

Appendix J2: Round 2 Interview Overview of Study

OVERVIEW AND AIM OF THE STUDY

Thank you for agreeing to take part in this research study. Your participation is much appreciated.

This interview is part of a PhD research. The objectives of this study are to identify the co-creation value of digital activities at different components of a smart city within a developing country. Therefore the first step will be to propose a model of smart city components and the specific factors applicable in each component and smart city dimension is required. To achieve the objectives of this study, the following needs to be done:

- Identify the stakeholders involved in smart city initiatives.
- Compare smart city components for developed and developing countries.
- Identify the quality of information sharing between the components.
- Evaluate the impact/value of each initiative for all stakeholders.
- Determine the data/digital value chain activities.

The information given by yourself will be used to evaluate the status of smart cities in South Africa using the proposed model. The second step will be to propose a value chain to show where value exists between or within the smart city components. All stakeholders within a city and or potential investors could use the value chain and model for decision making regarding components within a smart city which interest their investments and smart city projects.

Appendix J3: Round 2 Interview Stakeholder Roles Classification

Descriptions of stakeholder roles in smart cities

Four key roles for stakeholders that focus on serving within a city to achieve their city's shared goals were found and is adopted in this study. The roles were created to incorporate all relevant stakeholders, including governments, business sectors, civil society, academics, technical experts, and citizens. These roles are described as follow:

- **Enabler** – Enablers create a vision, allocate resources, provide strategic leadership, and promote networking;
- **Provider** – Providers engage academics and professionals as innovators, provide innovative research and design (R&D) methods, augment knowledge and manage knowledge distribution systematically;
- **Utiliser** – Utilisers create suitable products and services, set small-scale objectives derived from the vision, learn new practices to produce accessible knowledge and innovate; and
- **User** – Users participate in experiments, empower citizens through co-creation and produce place-based experience.

Table 1 below can be used to identify stakeholder types per stakeholder role for smart city initiatives.

Table 1: Examples of Stakeholder Types the Stakeholder Roles

Stakeholder Roles		Stakeholder Types	
R1	Enabler	T1	City Mayor/Managers
		T2	Government
		T3	Governments in other jurisdictions
		T4	Businesses
		T5	Public administration (managers)
		T6	Public government (state-owned organisations)
		T7	Performance evaluator/Standardisation institutes
		T8	Policy/service domain expert
		T9	Building owners
		T10	Public officials
R2	Provider	T11	Research/Design and Technology organisations
		T12	Schools
		T13	Universities (Academic communities)
		T14	Third parties
		T15	Data processors
		T16	Data controllers
		T17	IT experts
		T18	Local experts
		T19	Independent developers (Think tanks/Incubators)
R3	Utiliser	T20	Non-profit organisations (NPOs)
		T21	Companies (private-and-public, firms, SMEs)
		T22	Vendors
		T23	Industrial stakeholders
R4	User	T24	Citizens (local, national, technical savvy)
		T25	Investors (public and private)
		T26	NGOs
		T27	Users
		T28	Residents
		T29	Workers
		T30	Media communities

Appendix J4: Round 2 Interview Introduction Email

Smart City Initiatives - Buffalo City

van der Hoogen, Anthea (Mrs) (Summerstrand South Campus) <Anthea.vanderHoogen@mandela.ac.za>

[redacted]

4 attachments (1 MB)

Interview Questions for Users-UtilisersNov2020-Jan2021.pdf; Overview and Aim of the Interview for Users-Utilisers.pdf; Stakeholder roles in smart cities.pdf; Letter to the User-Utiliser of Smart City Initiative.pdf;

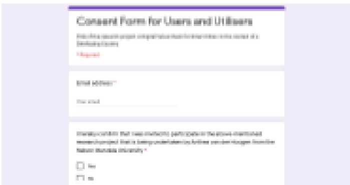
[redacted]

Thank you for indicating your willingness to participate in this study.

Please find attached:

- The interview questions. So, these questions are for users and or utilisers of smart city initiatives in your case it will be the smart city initiative that is the Buffalo City.
- A short overview of the aim of my study.
- The stakeholder roles classified for providers, enablers, users and utilisers in a smart city.
- The formal letter whereby I need to provide you with as a reference and some ethics information.

If you can please complete the online consent form: https://forms.gle/g4nocGgLGyfPCyVz6 to confirm that you will partake in an interview forming part of my study.



Consent Form for Users and Utilisers

Title of the research project: A Digital Value Chain for Smart Cities: In the context of a Developing Country

forms.gle

The interview will be via MS Teams, this will provide me with the option of recording our interview for transcription purposes.

Date and time of the interview confirmed for [redacted] It should not take longer than 30mins. I added 15mins to say hi and for introductions.

I have a telephone number where I can reach you in case of any last-minute changes or quick information sharing. My cell number is below.

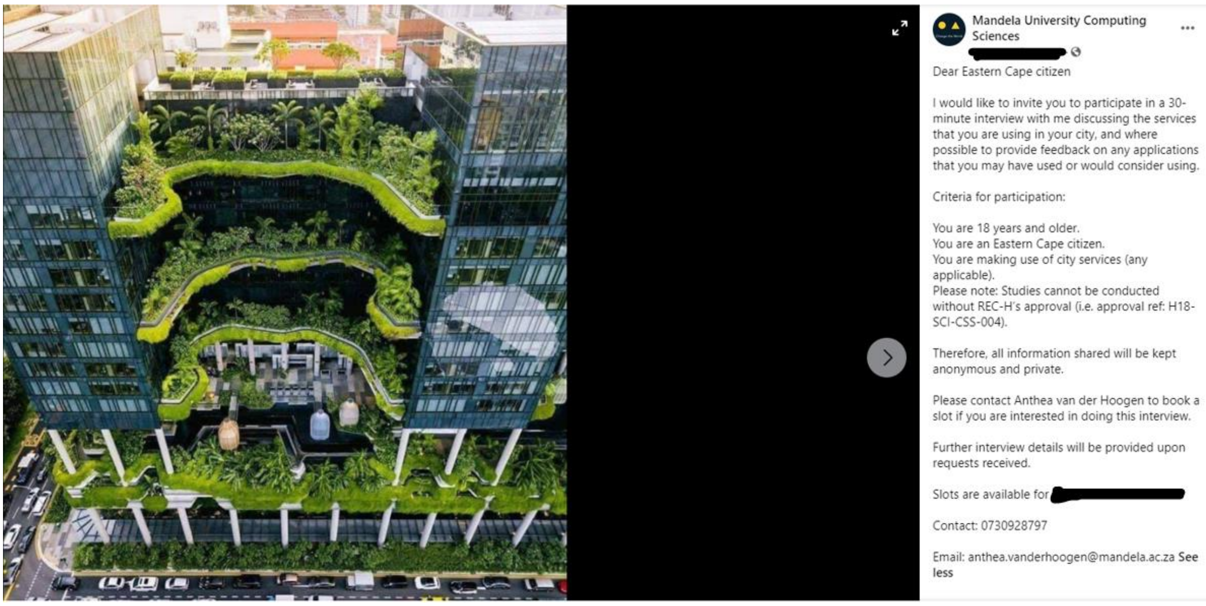
Let me know if you have any further questions for myself or my promoter copied in this email.

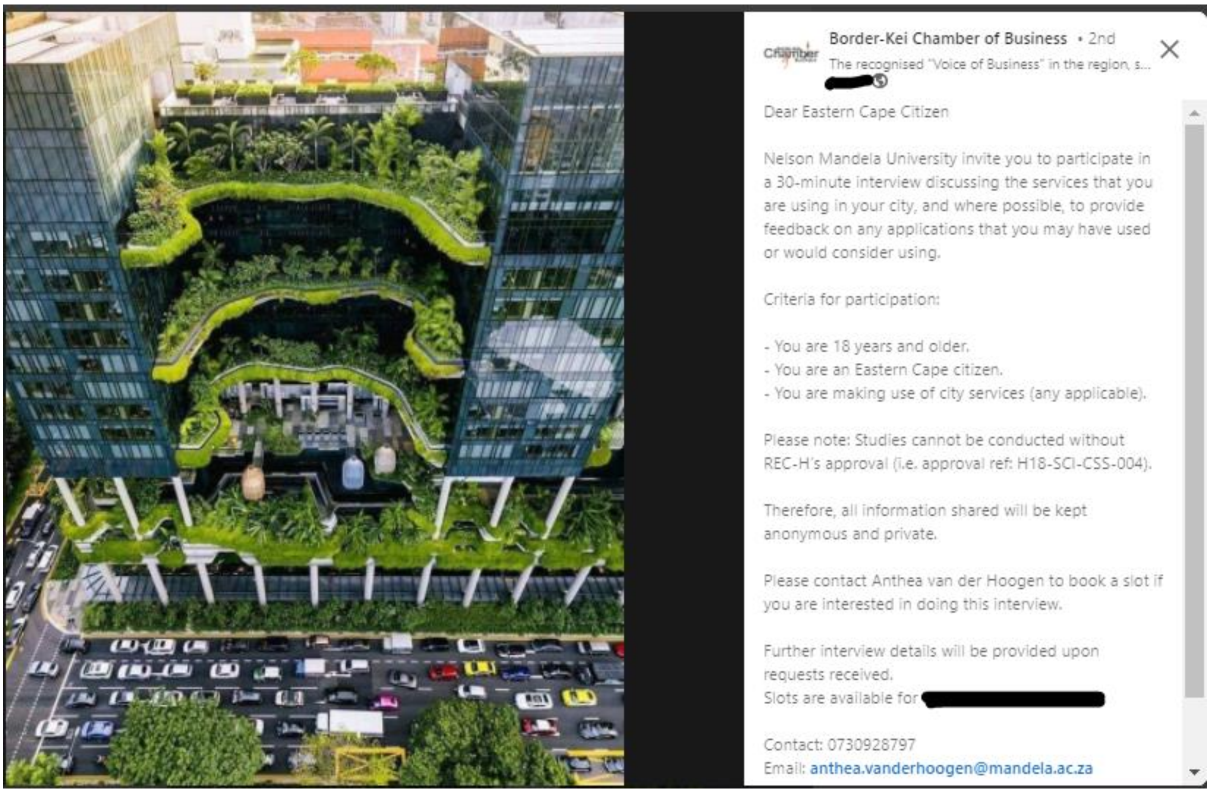
Many thanks.

Regards,

Anthea van der Hoogen
PhD Candidate & Lecturer
Computing Sciences
WFH Contact: 0730928797
Email: anthea.vanderhoogen@mandela.ac.za

Appendix K: Social Media Notice





Appendix L: Table L.1 – Smart City Technologies

Table L.1: Smart City Technologies (for 2014 to 2019)

Author(s)	Context/Approach/Country	Study focus	Technologies	Technology Category (Figure 5.6)	Initiatives/Purpose
Orłowski (2014)	Theoretical example	Rule-based model for selecting integration technologies for Smart City systems	Integration technologies (data warehouse; enterprise service bus; service-oriented architecture (SOA))	Integration technologies	RITMI (complete rule IT model integration).
Takebayashi et al. (2014)	Simulations	Power supply and demand control technologies for smart cities	DR (demand response) ADR (automated demand response)	Sensors	Smart energy – environment and social perspective.
Wenge et al. (2014)	Theoretical example	Smart City architecture: A technology guide for implementation and design challenges	RFID tags IoT sensors SoC (system on a chip) GIServices (Internet Geographic Information Services) GIS (Geographic Information Systems) UWB (ultra wide band) IoD (Internet of Data) tags and sensors Cloud computing	Sensors Location Based Network and Communication	Data architecture for Smart City – data perspective.

Author(s)	Context/Approach/Country	Study focus	Technologies	Technology Category (Figure 5.6)	Initiatives/Purpose
D'Aquin et al. (2015)	Practical *England – Milton Keynes (MK) example* *United Nations – Hypercat example*	Smart Cities' Data: Challenges and Opportunities for Semantic Technologies	IoT Semantic Web Technologies	Sensors Semantics	Examples of initiatives such as MK and Hypercat where data hubs are used to enable Smart City systems, data management and data usage.
Khorov et al. (2015)	Scenario based case studies	A survey on IEEE 802.11ah: An enabling networking technology for smart cities	Sensor networks (ZigBee, Bluetooth, NFC) Sensor applications	Integration Network and Communication	Desribes descision making algorithms and use cases for how the IEEE 802.11ah standard can be applied.
He et al. (2017)	Theoretical example	Anonymous identity-based broadcast encryption technology for Smart City information system	ICT IoT	Network and Communication Sensors	Information security through generic identity-based broadcast encryption (IBBE) scheme.
Tucker et al. (2017) OFCity	Fictitious city	Connected OFCity: Technology Innovations for a Smart City Project [Invited]	Low speed copper High speed wirelesss	Network and Communication	Competion amongst multidisciplinary teams to present ideas and perspectives of infrastructure to make medim-sized city a Smart City.
Yaqoob et al. (2017)	Practical *Case studies: Spain, Canada, Singapore, Portugal*	Enabling communication technologies for smart cities	Communication and network technologies that can be used to enable smart cities.	Network and Communication	Comparison of communication and networking technologies used as practical solutions in case studies
Hui et al. (2017)	Theoretical example	Major requirements for building Smart Homes in Smart Cities based on Internet of Things technologies	Requirements: 1. Heterogeneity 2. Self configurable 3. Extensibility 4. Context Awareness	Sensors	Seven requirements to build a smart home in smart cities using IoT.

Author(s)	Context/Approach/Country	Study focus	Technologies	Technology Category (Figure 5.6)	Initiatives/Purpose
			5. Usability 6. Security and Privacy Protection 7. Intelligence.		
Billhardt et al. (2018)	Scenario based case studies	Agreement Technologies for Coordination in Smart Cities	Semantics Norms Organisations Argumentation & Negotiation Trust	Semantics	Agreement technologies sandbox approach to address coordination in a Smart City.
Ferraro et al. (2018)	Theoretical example	Distributed ledger technology for Smart Cities, the sharing economy, and social compliance	Distributed Ledger Technology (DLT) IoT	Network and Communication Sensors	Use of DLT to access network of shared resources.
Kamolov & Korneyeva (2018)	Practical *Examples included from Brazil and Spain*	Future Technologies for Smart Cities	IoT	Sensors	The use of IoT to enhance smart cities and the associated risks.
Santana et al. (2018)	Practical *Europe Smart City deployments*	On the use of information and infrastructure technologies for the Smart City research in Europe: A survey	IoT	Sensors	Open platforms for creation of novel services based on IoT in a city.
Usman et al. (2018)	Theoretical example	Technologies and Solutions for Location-Based Services in Smart Cities: Past, Present, and Future	Localisation and Proximity (LP) technologies	Location Based	LP technologies are presented to enable Location-based services (LBS) in smart cities.
Caputo et al. (2019)	Theoretical example	Towards a systems thinking based view for the governance of a Smart City's ecosystem: A bridge to link Smart Technologies and Big Data	Sensor technologies	Sensors	Smart City development depends on big data and smart technologies
Duan et al. (2019)	Simulations based on Holiday, Oxford5K and Paris6K data	AI-Oriented Large-Scale Video Management for Smart City: Technologies, Standards, and beyond	AI Video management	Machine Learning	AI-oreintated features are important for a city's visual system

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Habbal, Goudar, & Hassan (2019)	Simulations	A Context-aware Radio Access Technology selection mechanism in 5G mobile network for Smart City applications	5G Ultra-Dense Network (UDN) Context-aware Radio Access Technology (CRAT) Analytical Hierarchical Process (AHP)	Network and Communication	User experience in Smart City environments
Hu et al. (2019)	Practical *China*	UAV Aided Aerial-Ground IoT for Air Quality Sensing in Smart City: Architecture, Technologies, and Implementation	IoT-based Ground sensing IoT-based Arial sensing	Sensors	Air quality data monitoring system
Lu et al. (2019)	Systematic analysis of Smart City cases	Technology roadmap for building a Smart City: An exploring study on methodology	Sensor technologies Integration technologies Intelligent technologies Application technologies	Sensors Integration Machine Learning	Technology roadmap for smart cities
Malik et al. (2019)	Theoretical example	Investigating Technologies in Decision based Internet of Things, Internet of Everythings and Cloud Computing for Smart City	IoT IoE (Internet of Everything) Cloud	Sensors Network and Communication	Integration and utilisation of Cloud, IoT and IoE technologies for Smart City services
Yu et al. (2019)	Theoretical example	Decentralised Big Data Auditing for Smart City Environments Leveraging Blockchain Technology	Blockchain	Network and Communication	Blockchain for support of reliability and stability in auditing for smart cities.

Appendix M: Round 1 and Round 2 Interview Sample Quotes

The interview data evidence sample quotes are available on request. Due to space constrainst the full document pages are not included here as it is approaxamitely 40 pages for all the questions. The sample quotes are one page per interview question for Round 1 inteviews and for Round 2 interviews.