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AN ANALYSIS OF THE EFFECTIVENESS OF THE INFRASTRUCTURE DELIVERY MANAGEMENT SYSTEM IN THE SOUTH AFRICAN GOVERNMENT



Submitted by:

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To:

THE SCHOOL OF CONSTRUCTION ECONOMICS
AND MANAGEMENT (SCEM)

Supervised by:
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A Doctoral Dissertation Submitted in Fulfilment of the Requirements for the Doctor of Philosophy (Ph.D.) in Construction Project Management
To the Faculty of Engineering and the Built Environment,
University of the Witwatersrand

Johannesburg 2024

Declaration

I hereby declare that this research dissertation is my work. It is submitted for the fulfilment of a Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been previously submitted for this purpose or any other degree or examination at any other University.

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_____ Day of _____ (year) _____

Abstract

Governments face inherent obstacles in the provision of infrastructure at a global level. The decline or degradation of societal infrastructure and the limited accessibility to public services for the entire South African population can be ascribed to factors such as inadequate provisioning and upkeep of infrastructure. The adverse implications of construction project failures attributed to a variety of factors, such as delayed provision and increased costs directly impact economic well-being of individuals. South Africa's government is guided by a complicated system of broad and sector-specific policies with distinct objectives. The South African government has implemented various strategies and initiatives to enhance infrastructure delivery, and the effectiveness of developing infrastructure delivery methods for public infrastructure initiatives remains questionable. Despite substantial study on infrastructure delivery difficulties, there remains a paucity of complete evidence about the efficacy of certain infrastructure delivery changes. Previous research identified by academic research has mostly focused on challenges such as public protests, corruption, delays in service delivery, inefficient operations, and inadequate quality management, leaving a knowledge gap about the overall efficacy of various delivery reforms and restricting insights into broader system performance. The South African government has adopted the infrastructure delivery management system (IDMS), a comprehensive approach that integrates planning, implementation ,monitoring and maintenance of infrastructure projects, as its preferred framework for implementation. The system's effectiveness has not been tested. To close this gap the research analyses the effectiveness of IDMS in infrastructure provision. The study's objectives were achieved through a qualitative methods, involving in-depth interviews and thematic and content analysis was employed. A purposive selection process was employed to choose a cohort consisting of senior managers, project managers, and external service providers. This resulted in a total of 100 individuals who were chosen to participate in the study. Interviews were conducted with these individuals. A response rate of 72% was attained, indicating a high level of participant engagement and data reliability. The study posits that various infrastructure delivery methods have been tried by both emerging and developed nations, but with limited success rate. Without a universally diverse and integrated infrastructure delivery, the current state of deterioration will continue. South Africa, as a developing nation, has the potential to reap substantial benefits by placing emphasis on the preservation, expansion, and enhancement of its infrastructure delivery. The findings of the study suggest that there are constraints with the current delivery system on adherence to regulations and implementation of system components. The study reveal a significant prevalence of inconsistencies in the application of the system. Lack of transparency in government policies impedes their implementation, causing a multitude of obstacles that contribute to additional project delays. The project's effectiveness is impeded by its inability to run efficiently due to the impact of the changing political environment on laws and industry reform. The study identified significant relationship between competency and governance, and how each impacts the effectiveness of the delivery management system. Consistently assessing policy

and enhancing the implementation of legislation is vital for properly harnessing industry principles and endeavours. In order to achieve a balanced approach and encourage stakeholder ownership and commitment, collaborative interaction with industry professionals is essential. Improving infrastructure delivery requires implementing an integrated framework with clear goals, enhancing governance structures, a well-defined capacitation strategy to implement the framework, clearly defined roles and responsibilities. and promoting collaboration among government stakeholders for decision making and defined timelines for processing decisions in infrastructure delivery. Additionally, it is essential to streamline processes and cultivate technical expertise within infrastructure departments. The presence of strong governance structures, streamlined processes, and efficient human resource management are strong factors recommended for an integrated delivery framework. This study offers a significant contribution to the current body of literature on public sector infrastructure delivery methods. The research offers study offers valuable insights and contributes to creating efficient and sustainable infrastructure delivery methods and serves as a guiding resource for developing government policies and decision making.

Keywords: Effectiveness, reform, IDMS, infrastructure delivery, public service.

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Glossary

Delivery: the term delivery is used to delineate the spectrum of project delivery methodologies commonly utilised within the construction industry.

Delivery Strategy: describes the implementation of the chosen delivery method and any modifications.

Effectiveness: measure the extent to which the original objectives and policy goals are achieved.

Government: is described as the system or group of people governing an organised community, often a state.

Infrastructure: refers to a station's essential infrastructure facilities and assets needed to operate.

Infrastructure delivery: planning and management associated with the rehabilitation, maintenance, operation, and retirement of infrastructure.

Management: refers to the alignment of activities with the goals. It entails managing operational procedures, and staff through human resource management techniques, and managing relationships with different parties that help organisations accomplish their goals.

Processes: refer to a series of acts that are logically connected and carried out in a certain way, leading to the accomplishment of a significant outcome or the achievement of a milestone.

Project planning: is a discipline that deals with how to accomplish a project in a specific amount of time, typically with specified stages and tools.

The public sector: refers to institutions that are constituted by government elements, publicly funded organisations established in terms of the Acts of Parliament (legislation), all of which are expected to report to organs of state.

Service delivery: the provision of public activities to benefit the people.

Stakeholder: any person or group that can have an impact on or be impacted by an undertaking.

Nomenclature

AsgiSA	Accelerated and Shared Growth Initiative
CIDB	Construction Industry Development Board
CPS	Construction Procurement System
DBSA	Development Bank of Southern Africa
DFID	Department for International Development
FIDPM	Framework for Infrastructure Delivery and Procurement Management
GDP	Gross domestic product
GDID	Gauteng Department of Infrastructure Development
GEAR	Growth, Employment, and Redistribution:
IBRD	International Bank for Reconstruction and Development
ICT	Information and communications technology
IDP	Integrated Development Plan
IDM	Infrastructure Delivery Management
IDMS	Infrastructure Delivery Management System
IGS	Infrastructure Gateway System
IPA	Infrastructure and Projects Authority
IRDB	International Bank for Reconstruction and Development
MTEF	Medium-term expenditure framework
MISA	Municipal Infrastructure Support Agent
NDP	National Development Plan
NIP	National Infrastructure Plan
OECD	Organisation for Economic Co-operation and Development
PFMA	Public Finance Management Act
PICC	Presidential Infrastructure Coordinating Committee
RDP	Reconstruction and Development Programme
RSA	Republic of South Africa
SA	South Africa
SIPDM	Standard for Infrastructure Procurement and Delivery Management
SSA	Sub-Saharan Africa
TOC	Theory of Constraints
WEF	World Economic Forum
UK	United Kingdom

Chapter One: Introduction

1. Introduction

This chapter describes the context of the study and the rationale for the research. The objectives of the investigation are delineated. The study's purpose and research questions are also presented. Furthermore, this section provides the aim and objectives, the scope of the investigation, a brief assessment of the research methods used, limitations, contribution of the research to the body of knowledge, and thesis structure. This chapter encapsulates a thorough overview of the study's goals.

In contemporary times, the importance of infrastructure requirements continues to be as vital as it was prior to the establishment of democratic systems. Infrastructure development plays a vital role in economic growth. Without adequate infrastructure, a country may struggle to achieve its full potential in terms of economic development and social well-being. The National Development Plan (NDP) sets forth ambitious goals for economic development and recognises the importance of infrastructure in achieving a collective vision for South Africa by the year 2030 (NDP, 2030). The built environment and construction sectors are complex and exert a substantial influence on the development of infrastructure for the broader populace (Vosman et al., 2023). After enduring a protracted period characterised by desperate efforts to survive under the apartheid regime, the introduction of democracy in South Africa (SA) brought about a renewed sense of optimism among the population, as they anticipated better living standards and increased access to essential services (Magidimisha et al., 2019). Like many other developing nations, South Africa faces significant challenges in delivering effective and fair public services (Masuku & Jili, 2019).

Numerous countries have encountered challenges in achieving efficient and timely progress in this domain, leading to suboptimal outcomes (Gardoni & Murphy, 2020). Abrahams (2018) asserts that the South African government has used many initiatives with the aim of improving infrastructure delivery. In order to ensure effective implementation of infrastructure projects in the public sector, it is imperative to employ innovative approaches that can ensure service delivery (Tate et al., 2018). The optimal execution of public infrastructure delivery is crucial, owing to its pivotal role in facilitating the progress of a nation. This chapter examines the

implementation of infrastructure projects within the public sector and assesses the effectiveness of the delivery mechanisms in enhancing infrastructure development.

1.1 Background

This section examines the importance of infrastructure and its contribution to the economic advancement of a country, as well as the pivotal role played by the construction industry in the implementation of infrastructure projects throughout many sectors of the economy. The delivery issues associated with the implementation of infrastructure projects within the construction industry, which often translates to non-performance, are also discussed.

1.2 -Characteristics of infrastructure

The presence of infrastructure that is both operational and efficient is of utmost importance for the economic prosperity of all countries. Such infrastructure plays a significant role in adding to a nation's gross domestic product (GDP) and enhancing the effectiveness of service delivery in its primary, secondary, and tertiary sectors (Llena-Nozal, Martin & Murtin, 2019). Infrastructure adequacy, timely execution of projects, effective operation and maintenance (rehabilitation and management), and funding are critical for national economic growth and enhancing competitiveness (Cole et al., 2021; Delmon, 2021). The presence of infrastructure is essential for achieving human well-being as it comprises interrelated systems providing necessary goods and services to support, maintain, or enhance the living circumstances of society (Thacker et al., 2019). A study conducted by the International Bank for Reconstruction and Development (IBRD) observed that infrastructure has played a significant role in driving Africa's recent advancements in development, accounting for over 50% of the progress achieved to date. Furthermore, the study suggests that infrastructure has the potential to make an even greater contribution to Africa's future growth (Kibuuka & Fourie, 2016).

Governments have assumed the responsibility of identifying infrastructure requirements and guaranteeing their provision since the commencement of the twentieth century (Carroli, 2018). The term 'government' refers to the highest governing authority inside a country, encompassing the executive, legislative, and judicial branches and various administrative of governance. Kasper (2015) states that governments are traditionally the primary players in the infrastructure sector, due to their ability to mobilize resources and implement large scale

projects. In South Africa, the government has been and continues to be the primary infrastructure provider (Lemanski, 2020).

The government or public sector assumes the responsibility of enacting policies and legislation pertaining to people's rights and obligations, and delivering government services (Brown & Longman, 2018). Investment in public infrastructure remains shaped and influenced by government management and administrative frameworks (Matji & Reuters, 2015), such as budget allocations, regulatory policies and public-private partnerships. The public sector comprises governmental institutions, government entities, publicly funded agencies, and companies that are established through legislative acts and are accountable to state organs for service delivery (Sithole & Mathonsi, 2015), and hold a significant role in the strategic planning and implementation of infrastructure projects.

Since the introduction of democracy in South Africa, there have been significant improvements in living standards and access to essential services. The government has implemented policies to address infrastructure shortages.SA has worked hard to attain balanced socio-economic development despite limited resources by investing heavily in infrastructure (Akintola, 2017). Clinics, hospitals, and schools provide essential services, railways and roads aid in the transportation and distribution of products and services, and dams conserve water for human, agricultural, and industrial purposes (Municipality, 2018). Efforts have been made to expand access to education and healthcare, ensuring that more people have the opportunity to receive quality services. These improvements reflect the commitment of the government to prioritize the well-being of its citizens and promote equality and social development. Given the presence of public facilities in South Africa, it is essential for the government of the nation to guarantee the proper delivery of infrastructure to ensure that citizens have reliable access to essential services and economic opportunities. Citizens' expectations are driving the public sector to reframe its mission, increase its customer focus, and develop an integrated service delivery model. Public services have not yet reached all South Africans, and inadequate maintenance in some places has resulted in service loss or degradation (Mazele & Amoah, 2022). Poor education, skills shortage and poor infrastructure have long been obstacles in the South African economy (Matji & Reuters, 2015).

The World Economic Forum (WEF) recognises infrastructure as a crucial catalyst for sustained economic development and societal prosperity. Nevertheless, the progress of public

infrastructure development in several countries has been characterised by a lack of speed and inefficiency. Infrastructure development consumes a significant amount of natural and capital resources and has a long-term impact on society's social and cultural aspects. Therefore, it is crucial for infrastructure to exhibit sustainability in terms of delivery and service as highlighted by (Nuramo & Haupt, 2021). The correlation between the availability of infrastructure and economic development is well acknowledged and plays a crucial role in driving the increasing global investment in infrastructure (Awuzie & Monyane, 2020).

Numerous nations are now facing significant deficiencies in infrastructure due to the confluence of rising populations, economic growth, and rapid urbanisation (Huang, Sadiq, & Chien, 2021). The infrastructure delivery units within the public sector are experiencing operational constraints due to the increasing demand for infrastructure. A growing discontentment has been observed regarding the provision of public services in most developing nations (Loayza & Pennings, 2020). However, ensuring that infrastructure is provided effectively and efficiently faces practical difficulties when implementing infrastructure projects to enhance service delivery (Duryan & Smyth, 2019).

Public sector agencies across the world confront similar issues when it comes to infrastructure delivery (Davies, MacAulay & Brady, 2019). Governments around the globe endeavour to effectively address infrastructure needs within the constraints of their budgets and technical restrictions (Khan et al., 2020). Considering the substantial magnitude of the government's investment in infrastructure, it is reasonable for it to seek representation of the demographic distribution of the nation within the building sector (Willar et al., 2021). In many countries, the construction industry considerably impacts national economies (Gamil & Alhagar, 2020). Despite the considerable demands placed upon it, the construction sector has several challenges in the realm of infrastructure delivery (Abioye et al., 2021) such as project delays.

Pisu, Pels, and Bottini (2015) emphasize the importance of a solid policy framework in creating, maintaining and managing a country's infrastructure stock. South Africa's governance is guided by a comprehensive framework of macro and sector-specific policies that outline clear goals. These policies define the intentions of the government ,delineating the requisite measures to ensure that infrastructure delivery contributes effectively to socio-economic growth, development, transformation, and the alleviation of poverty (MISA,2020). Infrastructure sectors worldwide exhibit notable similarities in terms of fundamental principles,

technological advancement, key stakeholders, organisational frameworks, and financing methods. Fuenfschilling and Truffer, (2014) emphasized this similarity. Bolton and Foxon (2014) argue that the provision of infrastructure is accompanied by considerable challenges arising from financial constraints, technological complexities, and institutional settings. Historical events along with political and social dynamics influence the techniques used to implement infrastructure that align with the intended purpose. Goldbeck, Angeloudis and Ochieng (2019), reveal that infrastructure systems are classified according to their potential to provide infrastructure services and meet the anticipated demand for infrastructure services.

The prevalence of inadequate delivery approaches is a widespread phenomenon in several countries, prompting the implementation of various delivery reforms to effectively satisfy infrastructure requirements (Fuenfschilling & Truffer, 2014). Several countries have undergone reforms and implemented various approaches to enhance the efficiency in providing public sector services (De Gennaro, 2019). Recognising the importance of infrastructure, governments have pursued extensive reforms over the last two decades, including restructuring, increasing private participation, and adopting new regulatory methods (Brunette, Klaaren & Nqaba, 2019; Davies, MacAulay & Brady, 2019). Although there have been variations in outcomes across different nations and sectors, it is generally observed that reforms have led to improvements in infrastructure performance (ibid). Africa's institutional, regulatory, and administrative reforms are barely halfway complete, but their impact on operational efficiency has already been demonstrated (Kibuuka & Fourie, 2016). Numerous aspects have had a significant influence on the outcome, including democracy, which is oriented towards the welfare of the populace, individual capabilities and expertise, and the existence of professional organisations (Fuenfschilling & Truffer, 2014).

The built environment and construction sectors play a critical role in infrastructure development. The sectors are responsible for designing, constructing, and maintaining various types of infrastructure. Additionally, they are involved in the planning and implementation of infrastructure projects, ensuring that they meet specific safety standards, comply with environmental regulations, and cater to the needs of the population. Without the expertise and contribution of these sectors, sustainable infrastructure development would be challenging and inefficient. Projects in the construction industry vary in complexity ranging from building physical structures or creating new software or applications to improve corporate processes

(Alshamsi, 2019). Through infrastructure projects, the construction industry provides opportunity to interact with and benefit from infrastructure delivery systems .

The construction industry provides society with delivery techniques and infrastructure solutions for various political, economic, social, and environmental needs, influencing people's societal and physical lifestyle changes (Desta, 2015). In the realm of construction projects, there are multiple players/organisations (Bekdik, 2017). Each construction project has a unique combination of funders, clients, built-environment professionals, site conditions, materials, and technologies, general contractors, specialist contractors, skills, workforces, and client requirements (Watermeyer & Phillips, 2020). Project management has a long history in the construction industry and is commonly applied in projects of varying scales and levels of intricacy. However, meeting mandated performance requirements, budgets and deadlines remains a challenge in projects (Benschop et al., 2020).

Numerous researchers (Desta, 2015; Kwofie, Aigbavboa & Matsane, 2014; Le, Chong & Sullivan, 2020), have highlighted the issue of non-performance within the construction sector in various countries. Desta (2015) attributes the issue of non-performance in the construction industry to its disintegrated nature, disorganised delivery systems, unfavourable supply chain relations, and the reluctance to adopt emergent technologies and obsolete management methods. According to Kwofie, Aigbavboa and Matsane (2014), the construction sector is plagued by project performance challenges stemming from its highly fragmented approach to operations. Organisations are increasingly recognising the need to properly manage projects and leverage new opportunities in the context of infrastructure delivery and maintenance (Liu, 2021). This highlights the importance of utilizing past experiences and lessons learned to avoid repeating errors, ultimately leading improved efficiency and sustainability in infrastructure delivery (ibid). Advancing the construction industry requires a drill in infrastructure delivery mechanism to enhance efficiency and effectiveness of infrastructure delivery, while also advancing long-term national economic and social development objectives.

The successful implementation of infrastructure projects relies heavily on the intricate interplay between the delivery system itself and its surrounding environment, which is subject constant changes. Infrastructure delivery systems are socio-technical systems deeply embedded in society (Borrás & Edler, 2020). Jenkins and Smith (2021) assert that infrastructure systems are

intricate and vital in augmenting the societal, environmental, and economic aspects of countries, necessitating ongoing vigilance. The delivery of infrastructure takes place within various settings of socially created interdependent networks, highlighting the need for comprehending the contextual factors present in delivery systems (Krangsås et al., 2021) to navigate challenges and ensure successful project outcomes. The process of delivering infrastructure as an asset is a multifaceted undertaking that involves intricate structural and social dynamics, where the coordination of various stakeholders and resources harmoniously creates the final masterpiece. These complexities arise from the wide interactions and interdependencies among different stakeholders (ibid).

For South Africa to successfully address poverty, unemployment, and inequality through infrastructure investment, it must have the capacity to develop and provide infrastructure efficiently and effectively (Watermeyer & Phillips ,2020). It is important for policymakers to respond promptly to project developments (Cahen,2016). Improving efficiency in service delivery is essential for reaching project goals and encouraging smart work practises and efficiency integration (Alshamsi, 2020).

Social infrastructure provided by the public sector is vital for social and economic goals. Therefore, improvements in infrastructure delivery systems are necessary to meet these social and economic goals (Awan, 2021). The increasing need for infrastructure demands the exploration of novel and potentially transformative methods to reform, legislation, planning, and governance that take into account the intricacies of organisational dynamics. According to Nwuke (2012), appropriate institutional arrangements and infrastructure delivery systems are required to lower the cost of rural infrastructure investment and ensure seamless operation and maintenance. Re-engineering public sector systems is essential for realizing the benefits and achieving the objective of creating customer-centered service delivery as highlighted by Mwangi, 2021. This requires setting up effective governance and management structures.

According to Hinrichs-Krapels and Grant (2016) research aims to generate new insights and understanding, while also advancing existing knowledge. This process ultimately leads to enhanced comprehension and societal advantages. The vital role of infrastructure in socio-economic development requires a coordinated approach that enhances efficiency and ensures effective infrastructure solutions. These infrastructure solutions explain how policies will be put into action (MISA, 2020).

The infrastructure delivery model specifies and describes the components of infrastructure delivery stages, including coordinated project phases, incentive structures ,risk sharing and interactions among key stakeholders (Hellstrom et al, 2021). A comprehensive examination is crucial for gaining a thorough understanding of the effectiveness of infrastructure delivery systems. The study covers a broad geographical range by exploring infrastructure delivery systems in developed European countries and developing countries in Sub-Saharan Africa. This study examines the effectiveness of infrastructure delivery systems, focusing not only on academic outputs but also on infrastructure outcomes and impact. The research aims to make s significant scholarly contribution to the examination of infrastructure delivery systems. The primary objective of the research is to establish a foundation for further exploration by examining the modifications implemented in other countries to ensure the sustainable delivery of infrastructure projects.

1.3 Identification of the gap

To meet the increasing demand for infrastructure supply requires the implementation of a comprehensive transformational strategy to address infrastructure bottlenecks (Razzaq et al., 2020). Academic studies have highlighted multiple obstacles in public sector infrastructure delivery, including corruption, public protests, delays in service supply, governance factors, poor operations, and inadequate quality management (Mazele & Amoah, 2022, Delta, 2015, Alshamsi,2021, and Amanta, 2020). The presence of multiple challenges in social infrastructure supply can be attributed to the public protests arising from perceived deficiencies in government service provision. Lemanski (2020) suggests that government delivery problems can be analysed through the lenses of ideology, system, or management, each offering unique insights. The Infrastructure Delivery Management System (IDMS) framework has been implemented as an intervention strategy aimed at resolving the challenges associated with the delivery of infrastructure projects in the public sector. Despite extensive research on infrastructure delivery challenges, a lack of comprehensive knowledge persists, regarding the effectiveness of specific infrastructure delivery reforms. Previous studies have primarily focused on case-specific analyses, thereby creating a knowledge gap regarding the overall efficacy of various delivery reforms by limiting insights into broader sytem effectiveness. Further research is imperative to investigate the effectiveness of delivery reforms and ascertain

best practices and strategies for ensuring the successful implementation of infrastructure projects.

1.4 Statement of the research problem

South Africa has been plagued by systemic inefficiency, resulting in a backlog in infrastructure delivery and hindering the achievement of inclusive public development. The introduction of the IDMS was intended to ameliorate this handicap; however, a comprehensive evaluation of its effectiveness has not been conducted. It is crucial to assess if the existing system is effectively fulfilling its intended objectives.

1.5 Research aim

The study aims to enhance comprehension of the infrastructure delivery management system, identify effective and sustainable approaches in infrastructure provision and set benchmarks for enhancing the implementation of infrastructure projects in the South Africa's public sector.

1.6 Research objectives

The objectives of the study are to identify the key challenges and opportunities in infrastructure delivery, assess the effectiveness of current strategies, and propose recommendations for improvement.

The study's objectives are:

- To identify the triggers for IDMS introduction.
- Evaluate the understanding and operation of the IDMS model in the public sector.
- Investigate the constraints experienced in the implementation of IDMS in the country.
- Assay human capacity deficiencies inhibiting effective administration of the IDMS model.
- Concatenate IDMS activities in achieving its intended purpose thus far, facilitating public sector infrastructure service delivery.

1.7 Research questions

This study evaluates the infrastructure delivery management system in the built environment, specifically focusing on infrastructure projects that are implemented by the government. The

research question that will guide the study : How effective is IDMS in infrastructure delivery in the South African Government?

The research sub-questions are:

- What were the triggers for the IDMS introduction?
- How is the IDMS appreciated and implemented in the public sector?
- What are the constraints in the implementation of IDMS?
- What are the institutional arrangements deployed to operationalise the IDMS model?
- How effective has the introduction of the IDMS model been in the provision of public sector infrastructure?

1.8 Scope of the research

Due to the complexity and unpredictability of infrastructure projects, this study assesses the capability of Infrastructure Delivery Management System (IDMS) to address infrastructure delivery challenges. The research is situated within the context of infrastructure delivery strategies. This study examines the existing literature on the impact of reforms in public sector infrastructure delivery. The discussion is around the deficiencies observed in the delivery of infrastructure, particularly in Sub-Saharan Africa and Europe. South Africa has undergone significant political and social changes in recent decades, transitioning from the apartheid era to the post-apartheid period. This transition has had a profound impact on various aspects of society, including infrastructure delivery. This study aims to understand how infrastructure delivery has evolved in South Africa in response to these changes and to identify areas for improvement. Additionally, South Africa's experience can provide valuable insights for other countries facing similar challenges in infrastructure development. The scope of this study is restricted to government controlled organisations and services. The research participants in this study are drawn from the departments responsible for infrastructure provision in the provinces of Gauteng, the Western Cape, Mpumalanga, and KwaZulu-Natal. These provinces were selected as the initial sites for implementing the IDMS framework.

1.9 Research assumptions

The researcher assumes the following:

- The participants possess a comprehensive comprehension of the constraints and potential predisposition inherent in IDMS model, enabling them to engage in a critical assessment of its outcomes.

- The participants have access to precise and current data within IDMS as this is essential for making well informed decisions.
- The records utilised for reporting in IDMS possess credibility which is crucial for maintaining reliability.
- The instruments employed in this study are designed to elicit accurate and consistent responses, ensuring the reliability of the data collected.

1.10 Limitations and constraints

Limitations refer to constraints that are primarily beyond one's control but have the potential to influence the outcomes of a study (Ross & Bibler Zaidi, 2019). The research design is potentially susceptible to some limitations and constraints. The fundamental emphasis of this study revolves around the empirical data that has been gathered and analysed in relation to the delivery management system within infrastructure departments.

Limitations experienced in the study include the following.
Limitations experienced in the study include the following:

- Reaching and engaging with research participants, particularly public sector officials, was challenging due to their demanding schedules and the disruptions posed by the Covid-19 pandemic.
- The utilisation of Microsoft Teams encountered difficulties due to network connectivity issues in certain locations, leading to communication and collaboration obstacles between the researcher and participants.
- Frequent power outages due to loadshedding disrupted virtual meetings and productivity, making it challenging to access necessary documents or resources for the study.
- Participant willingness to openly contribute and disclose information pertaining to the subject matter. The researcher had to ensure confidentially on the subject, allowing participants to share information freely.
- The scarcity of infrastructure delivery management systems literature in South Africa presents challenges for this study. The researcher relied on existing literature in different countries to juxtapose and increase knowledge development in this area.

Constraints included:

- The process of gathering data amidst the Covid-19 outbreak and the implementation of lockdown measures.
- The prevalence of loadshedding interrupted scheduled interview appointments.
- Unanticipated setbacks cut time allotted to complete the research, the constant power outages affected productivity with the research having to find alternative ways to continue with work.
- The total number of participants eligible to take part in the study.
- The lack of studies in infrastructure delivery management system.
- Limited access to organisation data posed a constraint in the research process, due to privacy policies and confidentially agreements.

1.11 Relevant bodies of knowledge

Pisu, Pels, and Bottini (2015) emphasize the importance of a solid policy framework in creating, maintaining and managing a country's infrastructure stock. Numerous countries have encountered challenges in achieving efficient and timely progress in this domain, leading to suboptimal outcomes (Gardoni & Murphy, 2020). The prevalence of inefficient delivery approaches is a widespread phenomenon in several countries, prompting the implementation of various delivery reforms to effectively satisfy infrastructure requirements (Fuenfschilling & Truffer, 2014). South Africa's governance is guided by a comprehensive framework of macro and sector-specific policies that outline clear goals. These policies define the intentions of the government ,delineating the requisite measures to ensure that infrastructure delivery contributes effectively to socio-economic growth, development, transformation, and the alleviation of poverty (MISA,2020). The political landscape consistently garners significant attention, whereas the various elements influencing infrastructure delivery, particularly the pre-existing delivery strategies often remain overlooked. Previous research on infrastructure provision has primarily focused on aspects such as funding mechanisms, corruption, and quality of infrastructure projects overlooking the delivery strategies. However, there is a significant research gap in understanding the effectiveness of infrastructure delivery strategies. This study addresses this gap by offering evidence based insights and recommendations to enhance infrastructure delivery in the public sector. This study aims to significantly contribute to the development of sustainable and effective infrastructure delivery practices, and to inform government decision-making and policy formulation. Moreover the comprehensive evaluation

of the IDMS in this study can guide government agencies in evaluating their current infrastructure delivery processes, identifying strengths and weaknesses and implementing necessary improvements.

1.12 Methodology

The selection of an appropriate research methodology is crucial in order to facilitate the acquisition of precise and reliable responses pertaining to the research inquiry. The research focused on critically reviewing the infrastructure delivery reforms employed in Sub-Saharan Africa and Europe. The literature review examined the historical underpinnings, reforms innovations in infrastructure delivery. The report presents a comprehensive examination of infrastructure departments throughout different regions in South Africa. The examination of case studies provides essential insights into the infrastructure delivery management system. The constructivism paradigm is used in research to understand different perspectives and experiences of individuals in specific situations.

This study aims to interpret the subjective experiences and perspectives of stakeholders in infrastructure delivery systems through a constructivist approach. The paradigm is particularly relevant for understanding the complexities and challenges inherent in implementing infrastructure projects in varying regulatory environments and diverse contexts. The interview method was selected due to its established efficacy in acquiring knowledge about a phenomenon within a particular context. The interview strategy required careful consideration of the complete data gathering and analysis process to guarantee that the research question could be adequately answered at the end of the procedure.

During the interviews, qualitative data was collected through questions that allowed participants to share their experiences and insights on infrastructure delivery systems. Participants for this study were selected using a purposive sampling technique. This individuals have roles in implementing social infrastructure projects within the relevant governmental organisations and were specifically chosen based on their expertise and experience to participate in the study. The purposive sampling technique was used to ensure that the participants had the necessary knowledge and experience to provide valuable insights into the research topic. To ensure the validity and reliability of the findings, the data collected from interviews and documents were triangulated. This iterative process of data triangulation helped to establish a comprehensive and nuanced understanding of the infrastructure delivery

management system. Recommendations were then offered based on the findings. The study provides valuable insights into the delivery of public infrastructure, offering essential information that can guide the development of policies and regulatory frameworks for sustainable infrastructure delivery.

1.13 Ethical considerations

Ethical considerations help to establish a foundation of trust between the researcher and the participants, leading to more reliable and valid results. Without ethical guidelines and protocols, research integrity may be compromised, resulting in potential adverse implications for the researcher's organisation or institution. Ethical considerations in research encompass established standards of conduct that prioritise the safeguarding of individuals under study from potential physical, mental, or psychological harm (Ahmed, 2008). External systems, such as professional codes of conduct and human subjects committees play a crucial role in actively monitoring and regulating ethical behaviour (Figueiredo & Cunha, 2007). According to Creswell (2016), it is imperative for researchers to prioritise the protection of research participants, establish a foundation of trust with them, uphold the principles of research integrity, prevent any form of misconduct or impropriety that may have adverse implications for their respective organisations or institutions, and effectively address novel and challenging circumstances. The integrity and impartiality of the researcher are crucial factors that influence the quality of the study (Saunders, Lewis & Thornhill, 2016).

The researcher followed guidelines that required the provision of detailed information sheets to participants before conducting interviews. These sheets allowed participants to make an informed choice about whether or not to participate in the study. Additionally, consent forms were provided to obtain explicit permission for conducting interviews. The information sheet provided to participants outlined the potential risks and benefits of participating in the study. This allowed participants to weigh the potential benefits of contributing to research against any potential risks or discomfort they may experience. By providing this information, the researcher ensured that participants could make an informed decision about their involvement and that their well-being was prioritized. These specific measures ensure that participants have a clear understanding of the study project and give their voluntary consent to participate.

Confidentiality and anonymity are essential in research to protect the privacy of participants. By securely storing data on an encrypted hard drive and requiring a password for authorized access, the researcher ensures that participant information remains confidential and cannot be accessed by unauthorized individuals. This helps to build trust with participants and encourages their willingness to share honest and accurate information. By prioritizing confidentiality and anonymity, the researcher demonstrates a commitment to respecting the privacy and rights of their participants.

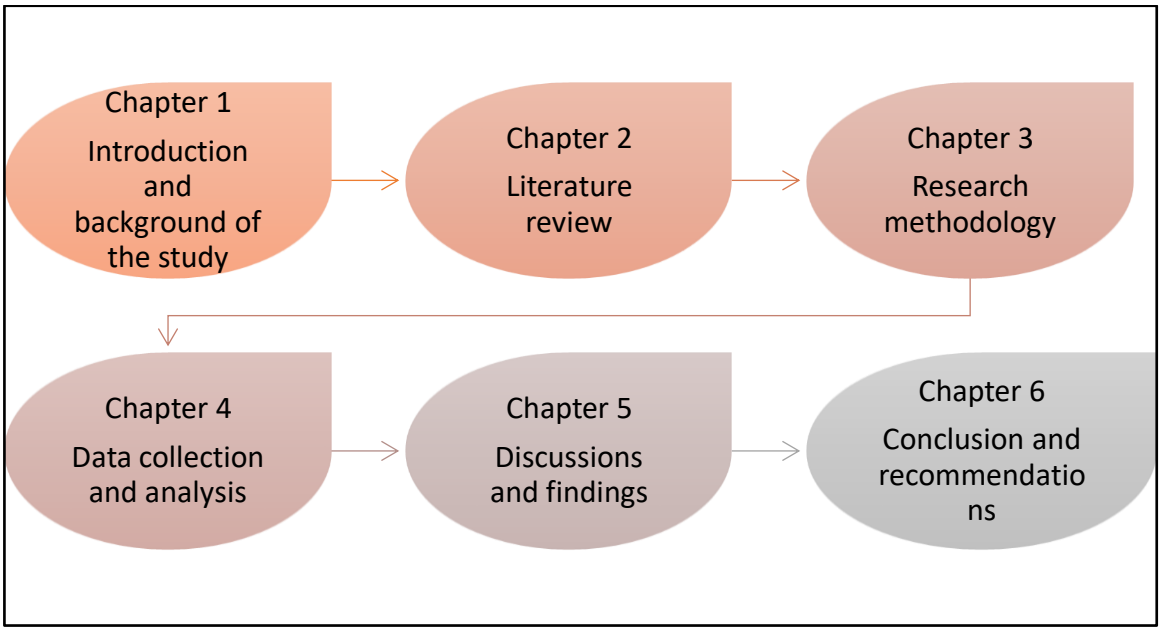
1.14 The rationale for the study

Infrastructure delivery depends on the methods employed in projects that entail the participation of multiple stakeholders (Kaharuddin, Adnan, & Baharuddin, 2020). The IDMS is a comprehensive framework designed to enhance the efficiency, timeliness, and durability of infrastructure construction projects. The framework requires coordination and collaboration among various stakeholders, including government institutions, service providers, and community representatives. The IDMS model incorporates various processes and methodologies to ensure effective project planning, execution, and monitoring. Implementing IDMS can streamline infrastructure projects minimizing delays, cost overruns, and quality issues. The researcher uses systems theory, which studies complex systems and their components, to assess the operation of IDMS. This approach allows for a comprehensive evaluation of the system and enables the identification of potential areas for improvement and optimisation. This study aims to enrich the current knowledge base in the field of infrastructure delivery management by conducting a detailed assessment of the IDMS model, offering insights into its effectiveness and practical application in infrastructure projects. The research seeks to enhance the understanding of theory application in infrastructure delivery management and serve as a point of reference or guideline for evaluating the effectiveness of the infrastructure delivery management system. The study aims to provide valuable insight by highlighting strength, weaknesses and areas of improvement in the IDMS model, which can guides decision-making, regulatory actions, and policy development in infrastructure management.

1.15 Structure of the study

The study is structured into six chapters, each serving a unique objective. This is illustrated in Figure 1.1. Detailed contents of each chapter are also discussed.

Figure 1.1. Outline of chapters.



Source: Researcher's collection

Chapter one reflects on the background of the study. The background of the study is examined to establish the foundation for research. The problem statement, aims of the study, objectives of the study, significance of the study, research methodology, ethical considerations, limitations, and validity of the study are introduced. The contribution of the study is emphasised.

Chapter two explores relevant literature to position the study within the existing theoretical body of knowledge. An examination of literature pertaining to the public sector infrastructure delivery within the context of Sub-Saharan Africa and European countries is also undertaken.

Chapter three focuses on an in-depth examination of the research methodology, whereby the chosen methodologies and processes employed in this study are substantiated and justified.

Chapter four presents and interprets the analysis of data. The conclusions drawn from the analysis technique serve as the basis for the interpretations of the study's findings.

Chapter five summarizes the research findings supported by the existing literature discussed in Chapter two.

Chapter six presents a contextualisation of the results, draws conclusions and provides recommendations for future study, policy development, and practical applications.

1.16 Summary

The South African government is confronted with infrastructure challenges, which are impeding the delivery of services in infrastructure projects. To effectively tackle these challenges through infrastructure provision, the country must have the capability to efficiently construct and provide infrastructure. This necessitates a collective endeavour to improve the delivery of infrastructure projects. This chapter introduces the research problem of infrastructure delivery challenges in the public sector. It also offers a rationale for conducting the study. The research focuses on examining how the infrastructure delivery management system which is a framework used in the public sector for infrastructure provision impacts the delivery of infrastructure projects. The emphasis is placed on the aim, objectives and research questions. The research methodology selected for the study is a qualitative approach. This approach is chosen for its ability to provide a comprehensive understanding of the complex issues of infrastructure delivery, and its significance to expand the existing body of knowledge. The upcoming section will examine the literature review.

Chapter Two: Literature review

2. Introduction

The literature review plays a crucial role in informing the research process by identifying the necessary data that must be obtained. A literature review can be defined as the systematic identification and analysis of published and unpublished documents pertaining to a specific topic. These documents encompass a range of information, ideas, data, and evidence, all of which are presented from a particular perspective in order to achieve specific objectives or convey specific viewpoints regarding the nature of the topic and the manner in which it should be investigated. Furthermore, the literature review involves a critical assessment of these documents in relation to the proposed research. (Daniel, 2017). The review of the literature incorporates observations from research conducted in Sub-Saharan Africa as well as European countries. This chapter explores the common challenges faced by countries in infrastructure development. It also assesses various delivery mechanisms used in the public sector in enhancing infrastructure development. The section also explains concepts of effectiveness, efficacy and efficiency and includes a look at the effect exerted by various infrastructure delivery techniques used throughout history.

2.1 Concepts of effectiveness, efficacy and efficiency

The concept of effectiveness, efficacy and efficiency can be construed differently in research (Chen et al., 2020). Infrastructure delivery encompasses a broad array of elements. Regarding infrastructure delivery systems, the terms ‘effective’ and ‘efficient’ are often used synonymously. Depending on the author’s professional context and research areas of expertise, there are significant differences in how effective and efficient terms are perceived and described (Valizadeh et al., 2022). Singal et al. (2014) mention that understanding the distinction between efficacy and effective research is critical for research and interpreting study findings.

Hinrichs-Krapels and Grant (2016) define effectiveness in research as finding out if research created any outputs, consequences, and societal advantages or influence. Burches and Burches (2020) describe effectiveness as doing the right things, such as setting appropriate aims to attain a larger purpose. Under normal conditions, it is the level to which planned outcomes, aims, or objectives are realised because of an activity, intervention, or initiative aimed at achieving the

desired effect (not controlled circumstances such as in a laboratory) (ibid). Watermeyer (2013) states that 'effectiveness' refers to an activity's ability to produce the desired results. It pertains to how successfully the outputs achieve the desired outcomes . According to Reis (2018), the word effective means: "that which executes or operates, and anything or someone qualified as effective can perform and produce specific tasks, achieving typical results within constraints of normality, being guaranteed the safety, and the utility of what was done".

According to Mihaiu, Opreana, and Christescu (2010), the presence of efficiency is contingent upon the existence of effectiveness, thereby establishing the indispensability of effectiveness in attaining efficiency. There are significant differences in the methodologies used in efficacy and effectiveness research. According to Burches & Burches (2020), efficiency may be defined as the practice of carrying out tasks in a manner that maximises cost-effectiveness. The output ratio of a system to its inputs, sometimes referred to as the input-to-output ratio, is a measure of the effectiveness of the system (ibid). Efficiency refers to the increase in output achieved with a given input or the decrease in input required for a given output, while ensuring the output's quality remains the same. Watermeyer (2013) explains that it is a metric used to assess the efficiency with which various components of a project are converted into tangible outputs and subsequent outcomes. Abdurrezzak (2015) associates efficiency with the performance of a vehicle, a tool or an activity.

Efficacy is defined as the ability to complete tasks, produce a specific amount of a desired effect, or achieve a particular goal (Burches & Burches, 2020). Singal et al. (2014) contend that efficacy refers to the degree of success of an intervention under ideal and controlled conditions, while effectiveness refers to its degree of success in practical and real-life situations. The distinction between efficiency and effectiveness lies in their respective definitions. Efficiency pertains to the level of proficiency with which a task or activity is executed, while effectiveness pertains to the degree of use or value derived from that task or activity. According to Kwofie, Aigbavboa, and Matsane (2014), the concept of efficiency and effectiveness refers to the ability of team members and stakeholders to successfully achieve project objectives in a manner that is highly satisfactory and accepted by all parties involved.

Effectiveness, efficiency, and efficacy have been employed in various settings. Singal et al. (2014) assert that effectiveness studies in the health profession aim to examine the advantages and disadvantages of treatment within a meticulously controlled environment. In contrast,

effectiveness studies examine treatments within contexts that closely resemble real-world settings. In domains outside the health profession, the concept of effectiveness has been used to evaluate the functioning of systems or organisations (Murphy, 2020).

Evidence shows that different constituent groups have different definitions of organisational effectiveness (Garavan et al., 2020) and the effectiveness of specific functions or roles within organisations, such as human resource management (ibid). Georgopoulos and Tannenbaum (1957) define organisational effectiveness as the degree to which, given specified resources and means, a social system achieves its objectives without depleting its resources or putting excessive burdens on its members. Botha (2010) relates effectiveness to a company's ability to meet its objectives.

According to Hinrichs-Krapels and Grant (2016), the concepts of effectiveness, efficiency, and efficacy have been conceptualised and employed in various ways. For instance, the Department for International Development incorporates the terms in its approach to value for money: economy, efficiency, and effectiveness. Economy refers to the examination of programme inputs; efficiency pertains to the assessment of programme outputs; and effectiveness encompasses outputs that contribute to fairness. Additionally, sustainability involves evaluating outputs that contribute to the long-term viability of the programme (ibid). Moreover, similar phrases have been used in the following domains:

- General programme evaluation (Harris et al., 2021)
- Programme evaluation of the quality of healthcare services and evaluating hospital performance (Ferreira & Marques, 2021).
- Health system performance and health promotion (Figueroa et al., 2019)
- Effectiveness, efficiency, and equity (Shad et al., 2019),
- Evaluating proposed climate change projects (Xiang et al., 2021), and
- Attaining value for money in international development (Pritchard, 2022).

Most of these examples are related to evaluating the delivery of a programme or intervention. Watermeyer (2013) states that infrastructure implementation is situated between economy and effectiveness in the results chain framework. Efficient execution is necessary in order to mitigate schedule delays, scope creep and unproductive expenses, while also minimising the

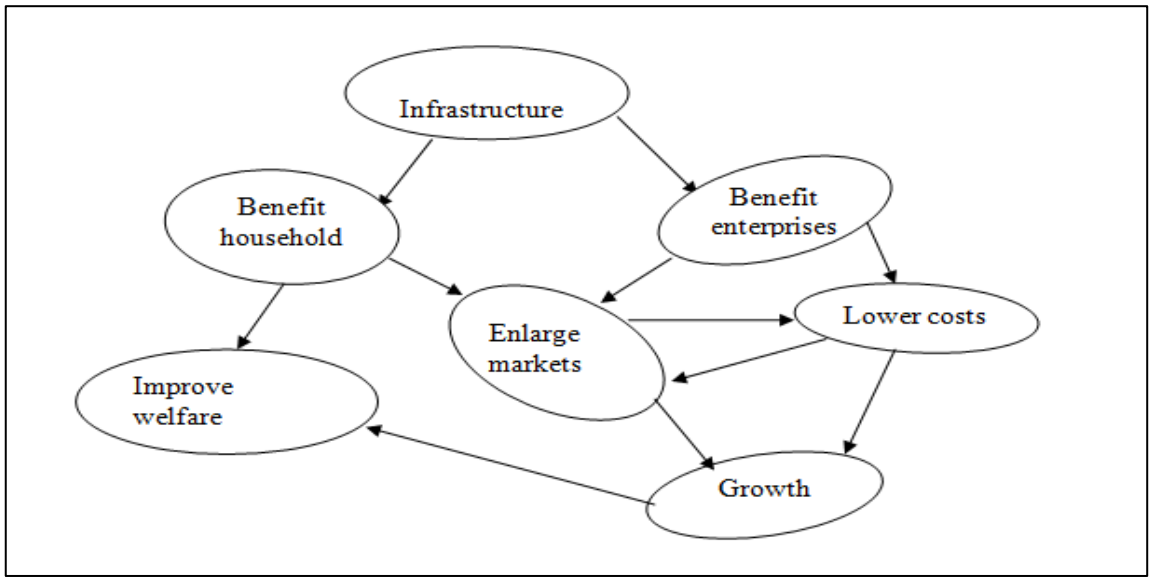
influence of uncertainty on objectives (referred to as risks) to uphold the project's value-for-money proposition (ibid). Infrastructure delivery and service delivery performance are highly interconnected. Thus, performance may be defined as the amalgamation of both the efficiency of a project or activity and the effectiveness in achieving the goals of such activity (Klingebiel et al., 2016). Khan et al. (2019) claim that ineffective project performance has greatly distressed the government, project managers, contractors and professional organisations. Therefore the aforementioned notions shall serve as the basis for the assessment. Infrastructure encompasses more than a mere assemblage of physical features and artifacts (Winter, 2016). It is paramount to a country's functioning and economic development because it enhances people's quality of life. The subsequent section provides a description of infrastructure.

2.2 The context of infrastructure

There is no uniform definition of infrastructure. Infrastructure is often characterised by its attributes, including length, size, inflexibility, and greater investment costs. However, it has been argued that other factors should be included (Colbertaldo et al., 2020). The term 'infrastructure' originates from the French prefix 'infra-', denoting 'below', and the word 'structure', signifying 'building' (Carse, 2016). According to Hall (2020), infrastructure serves as the foundational framework upon which the structure of the economy is established.

Grum and Grum (2020) describe infrastructure as a comprehensive assemblage of physical structures and systems that facilitate the provision of goods and services to the general population. The acceleration of economic product development and distribution contributes to the enhancement of the nation's overall quality of life (ibid). Figure 2.1 below depicts the advantages associated with infrastructure.

Figure 2.1. Benefits of infrastructure



Source: Srinivasu and Rao, 2013

Infrastructure is immovable assets that are acquired, are constructed or result from construction operations, as well as moveable assets that cannot function independently from purpose-built immovable assets (Sol Plaatje Municipality, 2018). The conventional definition of infrastructure encompasses all man-made resources, including human capital, that are necessary for the functioning of social sectors (such as education, healthcare, culture and finance) and economic sectors (such as energy, water and sewage, and transportation) (da Silva & Wheeler, 2017).

The term 'infrastructure' encompasses both 'soft' and 'hard' infrastructure in a larger context (Nuramo & Haupt, 2021). The term 'hard infrastructure' refers to the physical facilities that support essential services, including energy, water supply, sewerage, transportation, trash collection, sanitation, communication, health, and education. In contrast, 'soft infrastructure' pertains to the development of skills and knowledge, as well as ensuring access to appropriate services (ibid). Infrastructure, a term often used to include the many interrelated systems that facilitate the provision of essential goods and services necessary for enhancing, sustaining, or advancing the quality of life within a community, is an indispensable prerequisite for human wellbeing (da Silva & Wheeler, 2017). Infrastructure is a term that is commonly used and often refers to facilities and services required for any country to function (Mabugu, 2016). The Construction Industry Development Board (CIDB) (2016) reports that government values infrastructure as an incitement for escalated growth of the economy and improved social

development. Davies et al. (2019) state that infrastructure incorporates the systems, network utilities, constructs and other physical assets that underpin and enable social and economic development.

The social infrastructure supports people's educational, health, and cultural standards, such as schools, colleges, universities, hospitals, and museums (Kaur & Kaur, 2018). Economic infrastructure includes roads, highways, trains, power, telephones, water supply, and other infrastructure that supports economic activity (ibid). Infrastructure has shifted away from focusing on physical fixed assets such as roads, airports, seaports, telecommunications systems, water distribution systems, and sanitation (what might be called public utilities) in more economically advanced parts of the world (Weijnen & Correljé, 2021). The inclusion of softer infrastructure ideas, such as information systems and knowledge bases, is becoming more prevalent (ibid). According to Saidi et al. (2018), infrastructures play a crucial role in the organisation and management of intricate systems of flow, mobility, and exchange.

Different infrastructure investments help the functioning of a government and stimulate the economy (Hardoy & Satterthwaite, 2019). The selection and prioritisation of infrastructure projects are determined by factors such as market demand, economic considerations, and development needs (Mabugu, 2016). Public infrastructure refers to all the constituents that form a country and can be explained as a country's standard physical or tangible set-up (Wataya & Shaw, 2019). Public infrastructure includes waste infrastructure projects and transportation through roads and aviation, while social infrastructure advances the service provision, for instance, recreation, health, and education (Billones et al., 2021). Public infrastructure aims to increase access to essential services for all citizens by extending or creating new assets and maintaining/or replacing existing infrastructure (Mabugu, 2016).

Development Bank of Southern Africa (DBSA) (2012) describes social infrastructure as household or community-based infrastructure intended for the delivery of basic services that has a direct and/or indirect impact on the quality of life. Social infrastructure such as education, health, and housing are essential to promote better utilisation of physical infrastructure and human resources (Grum & Grum, 2020). The significance of well-developed infrastructure in South Africa cannot be over-emphasised. The Presidential Infrastructure Coordinating Committee (PICC) (2014) mentions that infrastructure is a pivotal promoter of equitable economic development, liberates possible economic breakthroughs, fosters mineral extraction

and processing, pays attention to socio-economic-related requirements, aids employment creation, and assists in merging economic development with human settlements. According to Buhalis, Andreu, and Gnoth (2020), the government creates value for society by designing and establishing social institutions.

The establishment of a functional infrastructure is an essential requirement for any nation, since it plays a pivotal role in various aspects such as the economy, society, and the environment. The study will not include the analysis of soft infrastructure, information and communication technology (ICT), and knowledge base infrastructure. The primary focus of this research is the delivery of public and social infrastructure. The level of trust that the public sector has in its infrastructure needs to be a determining factor in shaping the delivery strategy.

2.3 Undertaking infrastructure delivery

The process of acquiring and delivering infrastructure assets is known to be complex and multifaceted (Awuzie & Monyane, 2020). The complexity of the task is increased by the involvement of several parties and the constraints of time and cost (ibid). According to Cahen (2016), a proficient and well-established organisation is essential for creating a supportive infrastructural environment that facilitates successful project execution. The delivery and planning of infrastructure are executed via a fragmented supply chain that is linked by contractual agreements within a project-specific context characterised by inherent unpredictability. Mabugu (2016) asserts that in a planned economy, the responsibility for planning and constructing projects lies exclusively with government organisations and agencies. Conversely, private entities have the capacity to carry out the role of executing public works projects by means of competitive bidding procedures (ibid).

The provision of infrastructure encompasses a diverse array of operations, culminating in the creation of infrastructure that will be used to provide public services (Thacker et al., 2019). According to Kivilä, Martinsuo and Vuorinen (2017), public infrastructure projects are long-term investments in the public sector directed at developing and advancing infrastructure type. Infrastructure projects are designed with the primary objective of delivering a service that effectively fulfils the requirements of both the owners and users rather than only focusing on the construction of a tangible physical building. Watermeyer (2013) states that infrastructure projects must be attentive to project priorities and achieve planned results, and adhere to the requirements that influence the decision to proceed with the project as closely as possible.

There are several methodologies for effectively strategizing and executing a project, and the selection of a delivery approach significantly influences the infrastructure output. According to Miller et al. (2002), a project delivery technique refers to a structured approach that encompasses the coordination, financing, design, construction, operation, and maintenance activities involved in the delivery of a product or service. The strategic emphasis can be utilised to determine the precise infrastructure delivery requirements. The determination of infrastructure project ownership and delivery modalities is a crucial strategic process that needs careful consideration (Cahen, 2016).

The white paper titled 'Creating an Enabling Environment for Reconstruction, Growth, and Development in the Construction Industry' (Republic of South Africa, 1999), presents a comprehensive blueprint for enhancing the construction industry's capacity to contribute strategically to the socioeconomic advancement of the nation (Emuze, 2011). Nuramo and Haipt (2021) assert that the built environment exerts a substantial, intricate, and enduring influence on the earth, beyond that of any other human undertaking. According to Ezeokoli et al. (2016), the construction industry remains a segment of the economy that turns various resources into an integrated physical, social, and economic infrastructure necessary for socio-economic transformation. Construction as an activity, thus, is not just a translation of inputs to outputs but also a flow of effort and the production of value (Avelar, Meiriño & Tortorella, 2020).

Project delivery systems have distinguishing characteristics. The systems used to implement infrastructure projects inform the infrastructure delivery process, which is operationally complicated. Watermeyer (2020) reports that systems are underpinned by processes (sets of interrelating activities that transform inputs into outputs), procedures (specified ways to carry out an activity or process) and methods (documented, systematically ordered collections of rules or approaches). A system is a set of parts that, when put together, has properties that none of the parts has individually; the pieces communicate with one another and with their external environment (Winter, 2016). Parts of a well-designed system consist of interconnected components that effectively facilitate a desired and esteemed function or result (ibid).

The planning phase involves the identification and determination of the project's infrastructure requirements and activities. Projects are executed by the coordination of activities that are structured into processes. Interdependencies of various kinds manifest within the framework

of infrastructure projects, including its broader societal, environmental, and economic dimensions (Winter, 2016). Gasik (2016) reports that processes refer to a collection of actions that are executed in a predetermined sequence. Consequently, the project process is derived from a deliberate strategic choice that will have a significant influence on the project's ultimate achievements (Mesa, Molenaar & Alarcon, 2016).

All planning, technological, administrative, and managerial activities related to infrastructure development, supply, refurbishment, renovation, improvement, repair, operation, and disposal are included in infrastructure delivery (National Treasury, 2016). An infrastructure delivery system depicts all forms of inter-organisational and multi-layered relationships between various project actors and the inclinations these parties contribute to the project during the delivery of the infrastructure asset (Awuzie & Monyane, 2020). Awuzie & McDermott (2014) explain that infrastructure delivery systems exhibit a high degree of complexity due to a multitude of aspects, including expertise, affiliations, stakeholder connections, government policies, regulatory environment, and dynamic contracting. The intricate process of infrastructure network design, development, operation, maintenance and evaluation necessitates substantial collaboration among all stakeholders, alongside the establishment of institutional structures and regulatory frameworks (Yilema & Gianoli, 2018).

The organisational structure, contractual arrangement, risk allocation, form of compensation and procurement methods are all significant variations between project delivery systems (Mesa, Molenaar and Alarcon, 2016). The project delivery system encompasses the delineation of roles and relationships among participants, the temporal and sequential aspects of events, the implementation of management practices and processes, and the establishment of contractual responsibilities for the purpose of defining, creating and executing a project (ibid). Watermeyer and Phillips (2020) argue that the achievement of successful infrastructure project delivery necessitates the presence of client leadership, client governance that facilitates delivery and accountability, and infrastructure procurement practices that promote rather than impede delivery, and enable effective delivery outcomes.

Bolton and Foxon (2014) describe infrastructure networks as large-scale and complex technological structures that require reciprocal cooperation between large numbers of individual components for their effective operation. According to Awuzie and McDermott (2013), the level of complexity inside a system has a direct impact on the capacity to

comprehend and manipulate information, particularly in the context of project planning and execution. Yilema & Gianoli (2018) mention that the advance of infrastructure systems from chains of isolated structures in the early 20th century to current interrelated systems has increased the complexity and interdependence of infrastructure networks. The authors additionally assert that a thorough understanding of the intricate interplay between government and governance systems is essential for examining the provision of infrastructure.

The execution of infrastructure projects encounters several challenges. The current demand for infrastructure supply is experiencing a notable increase, prompting the need for a transformative approach to address the existing bottlenecks in infrastructure. This calls for a shift from focusing solely on achieving short-term operational efficiency in infrastructure delivery systems to adopting a dynamic delivery model that caters to the needs of the public sector. Kessides (2004) asserts that the optimal design of delivery systems should prioritise the maximisation of value, implementation of rigorous risk management and contracting strategies, and improvement of procurement processes. Additionally, it is crucial to ensure the acquisition of limited resources. Button (2002) asserts that the achievement of sustained economic growth through integration heavily relies on the successful execution of infrastructure plans, regardless of the challenges encountered by less developed countries. Within the realm of historical studies, it holds significant importance to extract specific overarching lessons (ibid). According to Aritua et al. (2011), the effective implementation of whole-of-government strategies requires adherence to established best practises. This entails the commencement of change initiatives and a critical moment for defining the appropriate delivery mechanisms for these strategies.

2.4 Reported infrastructure delivery strategies

In a society characterised by significant social and economic disparities, the attainment of social and economic transformation necessitates the presence of a competent and progressive state, as outlined in the National Development Plan (NDP, 2030). According to Bhuiyan and Amagoh (2011), the public sector is experiencing significant challenges, which is compelling governments to explore innovative strategies for advancing public sector organisations. Alsharari (2022) emphasises that a notable approach involves the dedication to the execution of several changes.

A reform is a deliberate endeavour aimed at effecting constructive change to rectify instances of unfairness or deficiencies within a given system (Amanta, 2020). Public-sector reform is a set of intentional policy measures and administrative activities undertaken by the government with the aim of modifying existing institutional arrangements, including organisational structures, processes, and individuals' behaviour. The ultimate objective of such reform is to enhance the efficiency and effectiveness of the government's administrative apparatus (ibid). Chemouni (2017) posits that the primary aim of public-sector reform is to bolster the institutions or regulatory framework that oversees the operations of the state machinery.

The South African government has been engaged in the strategic planning and execution of infrastructure projects across all tiers of government for several years. Significant progress has been achieved in enhancing the accessibility of general services since 1994, as noted by Barbier and Tengeh (2022). However, there is a noticeable lack of progress in the timely delivery of physical and social infrastructure, resulting in persistent protests over service provision across the nation (Mamokhere, 2020). Throughout history, the government has implemented a variety of governmental endeavours with the objective of addressing structural disparities. These initiatives encompass the Reconstruction and Development Programme (RDP) of 1994,the Growth, Jobs, and Redistribution (GEAR) policy, implemented in 1996, the Accelerated and Shared Growth Initiative (AsgiSA) structure, introduced in 2006 as an extension to GEAR and the National Development Plan (NDP) introduced in 2012 (Maharaj, 2020; DBSA, 2012).

The various reforms had similar goals, but they were different regarding how they were formulated and which regulatory frameworks they employed (Masters, 2019). The National Treasury, cognisant of the necessity to quickly provide favourable conditions for implementing sustainable and development infrastructure, came up with a framework for infrastructure, namely the Infrastructure Delivery Management System (IDMS) (Sirbadhoo & Harinarain, 2022). The IDMS was established in 2010 as a comprehensive framework and body of knowledge aimed at enhancing the management of public sector infrastructure projects. Its primary objectives include improving project capabilities in various areas such as organisational structure, procurement, governance, risk management, systems integration, and asset management (Aiyetan & Das, 2021). To maximise growing expenditures in infrastructure development, the IDMS provides a comprehensive intergovernmental framework and system that is based on established standards. The framework serves to enhance facilitation of planning, management, monitoring, and reporting within infrastructure asset management

(National Treasury, 2016). The IDMS has undergone significant evolution and been subject to several adjustments over the course of several years.

Globally, there are major gaps in the skills and aptitude of public organisations to manage infrastructure projects. Providing efficient and fair public services is a major task for many emerging nations, including those in Africa (Tan & Taeihagh, 2020). Collier and Crust (2015) assert that Africa is now grappling with a severe deficiency in public infrastructure, with several factors contributing to this gap. Africa has a substantial historical record of inadequate investment in and degradation of its existing infrastructure. Additionally, political instability and acts of violence have led to the exploitation and deterioration of public assets (ibid).

African countries have notable disparities in infrastructure when compared to Europe. Every nation has distinct circumstances and rationales for selecting delivery methods that will aid in the attainment of its goals. Furthermore, the selection of a delivery system is influenced by several aspects, including financial, technical, legislative, personnel, cultural, and governance-related considerations (Ajia, 2021). Africa's infrastructure could be more developed and of better quality, as many of the continent's infrastructure achievements come from outside Africa (Ehizuelen, 2021). Despite the fact that some of these nations have higher incomes compared to the majority of African countries, their experiences highlight some of the significant challenges that policymakers in Africa encounter (ibid). These nations persistently encounter challenges in the provision of infrastructure.

2.5 Infrastructure delivery in other countries

Over the past 50 years or more, the way the public sector delivers infrastructure projects has evolved dramatically (Watermeyer & Phillips, 2020). Governments worldwide have embraced various innovations and ways to build and improve infrastructure delivery (Bodolica & Spraggon, 2021). Different strategies and frameworks are being used to implement public-sector infrastructure projects (Danielle & Masilela, 2020; Hwabamungu, Brown & Williams, 2018). Several countries have achieved significant progressive infrastructure delivery improvements by implementing various reforms. Kessides (2004) asserts that the implementation of reforms has expedited the expansion of services across diverse sectors and nations.

According to a research by the World Bank (2018), numerous countries use pragmatic policies that do not effectively contribute to the enhancement of education, healthcare, sanitation, infrastructure management, or crime reduction. The primary cause of this issue can be attributed to inadequacies in the implementation of public-sector initiatives. Therefore, in order to improve the efficiency of the public sector, it is imperative to address and eliminate specific deficits (ibid). The management of a transnational infrastructure programme encounters similar difficulties as those encountered in overseeing any large-scale infrastructure project (Kibuuka & Fourie, 2016).

Africa is confronted with a significant challenge of effectively prioritising, expediting, and expanding the development of high-quality infrastructure (OECD/ACET,2020). It is worth noting that Africa comprises the largest proportion of countries classified as least developed. In terms of infrastructure delivery and quality, African nations, especially those in Sub-Saharan Africa, exhibit a relative lag compared to other areas (Nuramo & Haipt, 2021). The infrastructure expansion in Sub-Saharan Africa has been comparatively slower than that seen in other areas, as stated by the World Bank in 2018. Despite the advancements made in the last 25 years, the majority of nations in the area exhibit subpar performance in their infrastructure sectors and dimensions. This underperformance is evident not just in relation to their level of development but also when compared to global standards (Azolibe & Okonkwo, 2020). When considering infrastructure stock and gaps, it is essential for infrastructure reform to address the contextual factors at the national level and align with the strategic requirements and phases of development of the respective country. Sub-Saharan Africa is exceptionally diverse, with vast disparities in each country's financial resources (Mungai, Ndiritu & Da Silva, 2022).

Throughout the history, the nation of Britain has consistently exhibited a steadfast commitment to fostering and propelling innovation. The United Kingdom has strategically utilised its extensive knowledge and proficiency on a worldwide level. Daniel (2017) states that poor performance is evident in the construction industry, including in the United Kingdom (UK). A paradigm shift from functional activity thinking to system thinking, based on production philosophy, is essential to overcome this anomaly and create construction process improvement. Kasper (2015) highlights that the existing infrastructure in most Organisation for Economic Co-operation and Development (OECD) nations is adequate at the current level. However, expenditures in maintenance and quality upgrades, as well as capacity expansion, are frequently sought. This contrasts with emerging countries, where there is still a high

demand for infrastructure investments in construction, driven by economic and social expectations and demands (ibid).

Developed nations are often seen as exemplifying more streamlined approaches due to their already robust infrastructure systems and involvement in cooperative endeavours prior to pursuing formal integration (iMaciulyte-Sniukiene & Butkus, 2022). According to Danielle and Masilela (2020), the developing nations in Africa are now in the phase of allocating resources towards the development of infrastructure and exploring strategies to enhance the provision of public services. This section provides an overview of the infrastructure delivery approaches utilised in the United Kingdom, a developed country in Europe, as well as Rwanda, Ethiopia, and South Africa, which serve as examples in the context of developing nations.

The United Kingdom is largely acknowledged as a nation that has successfully undertaken substantial reforms, particularly in the domains of emerging technology and infrastructure (Kasper, 2015) It is widely recognised as a leading global innovator in the establishment of novel regulatory frameworks, serving as a model for emulation by other countries. Ethiopia has implemented substantial modifications to its infrastructure, resulting in infrastructure parameters that are comparable to those of low-income countries. According to Chekole and Nuramo (2020), the construction industry in Ethiopia has experienced significant growth during the previous 11 years, along with the emergence of several infrastructure projects.

Rwanda is categorised as a developing country. The occurrence of the genocide in Rwanda in 1994 had profound adverse impacts on the nation's economy and infrastructure (Jacquemin, 2022), nevertheless the has been a commendable growth since then. South Africa has gone through a political turmoil and through its recovery process classified as a developing country. The economic growth of South Africa is influenced by the European enlightenment and its shared status of being a member of the commonwealth. This section presents a comprehensive review of the infrastructure delivery systems that have been adopted in different countries.

2.5.1 United Kingdom

According to Gallent et al. (2020), the UK is geographically partitioned into four distinct administrations, each of which has the responsibility for delivering its own infrastructure. In the context of England, the responsibility for infrastructure delivery lies with many institutions

and organisations, which include government departments and connected agencies (ibid). The UK has played a leading role in the development and implementation of pioneering ways for delivering public infrastructure projects (Davies, MacAulay & Brady, 2019). The implementation of infrastructure enhancements has been widely adopted across several government sectors, owing to the range of accessible solutions (Sharpe, 2007).

Pisu et al. (2015) assert that an examination of British businesses in 2011 revealed many key obstacles to infrastructure investment in the UK. These obstacles include the absence of a well-defined government policy, as well as protracted and costly planning procedures and regulatory limitations. The delivery (planning, design, and operation) of individual infrastructure systems has traditionally been regarded in relative isolation from one another, resulting in a fragmented and reactive approach to infrastructure planning and delivery in the UK (Winter, 2016). Therefore the public sector-initiated research efforts aimed at identifying strategies to improve the implementation of major projects and optimise the use of infrastructure resources. The National Infrastructure Plan (NIP), which was initially published in 2010 and has been updated regularly since then, represents the broad vision of the infrastructure investment needed to support the country's long-term growth (Pisu et al., 2015). The NIP is a comprehensive and informative compilation of both current and future infrastructure initiatives in the UK (ibid). The Gateway Review Process was introduced as a critical strategy for enhancing infrastructure and implemented across the government as a result of the options available (Sharpe, 2007).

The European public sector adopted the Gateway review process to boost efficiency in the delivery of infrastructure and is regarded as a framework for making well-informed decisions to achieve the desired results (Nefs, Zonneveld & Gerretsen, 2022). Regan, Smith, and Love (2014) elucidate that the system was established in the UK in 2001, adopted in 2003 by the Victoria government, and in 2006 by the Government of New Zealand, the Australian government in 2007, and Texas in 2013.

The Gateway Review Process is a project management/development system that seeks to minimise budget/time overruns and scope adjustments in the delivery of initiatives by departments, enhance alignment of initiatives with government policy priorities and departmental corporate strategies, and improve portfolio evaluation across the government (Sharpe, 2007). The system extends to several programmes, including policy development and implementation, organisational reform, acquisition programmes and construction development

(Queensland Treasury and Trade, 2013). According to Sharpe (2007), Gateway is a systematic process that includes policy formation, activity execution and analysis. From concept creation to project benefit evaluation, the Gateway approach is a systematic mechanism for exploring and confirming key decision points (ibid).

Aritua et al. (2011) state that the framework discusses high-risk initiatives and services at critical decision points and offers a forum for objective peer review. The objective of the system is to improve the delivery of infrastructure by implementing a set of checkpoints at the project initiation phase and conducting thorough assessments throughout the duration of the project (ibid). According to Crudgington (2020), the Gateway Review Process enhances project monitoring and governance, aiding organisations in achieving project completion in alignment with their predetermined objectives.

Regar, Smith, and Love (2014) assert that the programme is designed to enhance the procurement process, enable tracking, facilitate monitoring and assessment of authorisations, and strengthen the governance framework for the project development stages. In this respect, the Gateway review mechanism is seen as a structure for informed decision-making to realise expected benefits (Aritua et al., 2011). During implementation, the critical areas of concern are the project's consistency with its business case and the feasibility of planned business results during verification. Gasik (2016), asserts that projects on the Gateway procedure must pass through the following gates and verification:

- Strategic assessment: Verify that the programme is needed and is likely to achieve its objectives.
- Business justification: Verification that business requirements can be satisfied and funded.
- Delivery strategy: Verification of implementation plans or tender documentation.
- Investment decision: Another verification of whether the project is still needed, the funds exist, the implementation plans are appropriate, and the investment decision is appropriate to the current situation.
- Readiness for service: Verification that the organisation is ready to implement project products.
- Operations review and benefits realisation: Verification that the project products are appropriately used, and the business results have been achieved.

According to Winter (2016), opportunities to maximise infrastructure's potential as a system of networks have yet to be exploited in the UK's National Infrastructure Plan. These opportunities occur across the lifecycle of infrastructures, from initial strategic policy decisions to development, infrastructure service management, and eventual renewal or replacement. Introducing a systems approach to infrastructure planning, design, and operation could fix such a deficiency (ibid). In other jurisdictions, demonstrable benefits in terms of project execution have been achieved by: defining the expertise and knowledge necessary to execute effective projects; increasing stakeholder awareness of their position in successful project management and the factors that lead to project goals being met; identifying early in projects where corrective action is needed; and enhancing project management and execution abilities (Sharpe, 2007).

Public programmes are subject to scrutiny throughout their execution. Regar, Smith and Love (2014) confirm that the Australian audit office in 2011 described the Gateway programme as a learning process management system that could improve infrastructure delivery. Meanwhile, the State Services Commission in 2013 asserted that in New Zealand, the Gateway was developing skills and leadership in public service employees and government ministries. Fawcett and Marsh (2012) argue that more evidence is needed to ascertain the efficacy of the Gateway programme.

2.5.2 Ethiopia

Ethiopia, situated in the eastern region of Africa, has a robust economic growth trajectory within the African continent, characterised by substantial investments in the expansion and enhancement of its infrastructure (Yilema & Gianoli, 2018; Nuramo & Haupt, 2021). Ethiopia has paid more consideration to infrastructure growth in recent years, particularly in its major cities (ibid). Foster and Morella (2020) state that Ethiopia has made significant changes to its infrastructure, and that its infrastructure metrics are competitive with those of low-income nations. Ethiopia's infrastructure exhibits a comparatively high level of efficiency when compared to that of other nations (ibid). Despite the notable advancements in infrastructure, Ethiopia continues to encounter challenges associated with its infrastructure delivery. Yilema and Gianoli (2018) assert that the growth of infrastructure and its associated services encounter several coordination issues, including policy and planning, financial and technical, institutional, and governance aspects.

The administration of Ethiopia has been actively engaged in extensive infrastructure development initiatives in several sectors. Nonetheless, the expansion and provision of infrastructure and its associated services encounter the obstacle of coordination across various dimensions, including policy and planning, financial and technological aspects, as well as institutional and governance factors (Yilema & Gianoli, 2018. The Ethiopian government has initiated many public-sector reform initiatives aimed at restructuring the existing public service framework and attaining expeditious economic development.

Tadesse (2019) asserts that reforms were introduced in Ethiopia in the early 1990s to improve the effectiveness of government organisations in providing public services to the population. The government has constructed a multiparty legislative framework, delegated power to regional state and municipal governments, and established norms, policies, and institutional structures to promote and preserve human rights (Amante, 2020). According to Germany (2020), many reform mechanisms, including Business Process Reengineering (BPR), Balanced Scorecard (BSC), Change Army, Citizens Charter, and Deliverology, have been introduced and are used inside the public sector institutions of the nation.

Ethiopia's infrastructure, despite recent improvements, is among the worst in Sub-Saharan Africa (Desta, 2015). The current Ethiopian government has implemented a wide range of economic transformations and is now experiencing a state of civil conflict throughout the northern province of Tigray (Ajia, 2021). Despite reform efforts to remodel and restructure the public sector, an on-and-off phenomenon has emerged to maintain the reforms. In the Ethiopian context, problems with successful reform implementation have been identified in the process, contents, contexts, and outcomes of reform initiatives implemented in the country (Ghrmay, 2020).

The execution of those reforms could have been hindered by many challenges and constraints, hence raising doubts about their actual efficacy (Amanta, 2020). Yilema and Gianoli (2018) report that the Ethiopian administration and policymakers need to pay more attention to coordination in infrastructure development and the interdependencies among infrastructure systems. According to observations made by Adebabay (2011), the reform efforts have shown that they could have met their goals at the level expected. This is also associated with the competitiveness of the construction sector, sustainability, capacity and ability to satisfy the communities (SMEC, 1999). As a result, Ethiopia's infrastructure demands are still enormous.

Desta (2015) posits that the underperformance of projects may be attributed to several rationales, such as the incapacitation and limited ability of local enterprises. Furthermore, the construction sector in Ethiopia has significant underperformance due to difficulties connected to systems and processes (ibid). According to Chekole and Nuramo (2020), there is a significant disparity in construction project management practices across Africa, Europe, and North America. Furthermore, the study highlights that Ethiopia lags far below even the least developed nations in Africa in terms of construction project management performance. The potential reason for this phenomenon may be attributed to the slow adoption of general project management processes, functions, tools, and methods within the field of construction project management (ibid). According to the research conducted by Wubishet (2004), a significant proportion of the surveyed population (about 70% out of a sample size of 79 individuals) demonstrated a lack of familiarity with or misidentification of construction management frameworks, despite the existence of such frameworks, developed by stakeholders within the industry. The aforementioned management style, which lacks a clear rationale, demonstrates the presence of inconsistency across the many stages of the project lifecycle, including planning, implementation, the establishment of monitoring systems for guidance, control, and development (ibid).

Yilema and Gianoli (2018) argue that the lack of a comprehensive policy framework in the Ethiopian public sector leads to insufficient coordination. Insufficient emphasis is placed on the interconnectedness of infrastructure systems, the urban activities they aim to support, and the long-term viability of these assets (ibid). The empirical evidence derived from previous implementations of performance-related programs, such as Business Process Reengineering and Balanced Scorecard, highlights the need of a well-defined and cohesive strategy throughout the implementation process. This strategic approach is crucial in mitigating potential uncertainties and conflicting goals (Nigussa, 2013). According to Tadesse (2019), there exists a deficiency in the execution of rehabilitation programmes in Ethiopia. Heigermoser et al. (2019) argue that the adoption of an integrated process is motivated by the recognition that project delivery efficiency is hindered by the traditionally distinct planning, design, and construction processes.

2.5.3 Rwanda

Rwanda is classified as a developing nation situated in the Sub-Saharan region of Africa. In 1994, the Rwandan Civil War erupted (Lisa et al., 2021). According to Ggombe et al. (2017), the process of rebuilding posed a considerable level of ambition and difficulty, mostly because of the extensive destruction of capital and infrastructure, as well as the depletion of human resources. These circumstances called for the establishment of social cohesion, immediate assistance, and the development and operation of governmental organisations, with a specific emphasis on fiscal capacity (ibid). The government has historically and now assumed a crucial role in facilitating the process of recovery and rebuilding (Ggombe et al., 2017).

The government undertook several measures to revive the economy. In the two decades since a civil war and massive genocide wiped out a significant portion of the country's people, leaving its government and political institutions in shambles and its economy in ruins, Rwanda has seen an incredible metamorphosis (Ggombe et al., 2017). According to the source cited, there has been a consistent average annual growth rate of 8% since 1995. Additionally, there has been a notable reduction in poverty levels, an improvement in the health of mothers and children, and a reconstruction of infrastructure and governmental institutions. Rwanda has reprioritised infrastructure in recent years and made significant achievements. Between 2010 and 2015, the construction, manufacturing, mining, and other industries increased at an annual rate of 9.3% on average, above the broader economy's rate of 7% (Musabyimana, 2021). The building and infrastructure construction sectors accounted for the majority of industry growth, with an average annual growth rate of 12.8% from 2010 to 2015 (ibid*).*

Following the occurrence of the genocide, Rwanda has undertaken many changes aimed at enhancing its project planning framework and fostering a conducive environment for facilitating infrastructure development. Takeuchi (2019) provides an overview of Rwanda's socio-economic performance in the aftermath of the genocide, with a concise summary. The economy has seen rapid development, leading to notable improvements in service delivery within the social sector. According to Musimbyana (2021), the construction sector has considerable importance in the economic and social development of the nation. This is due to its pivotal position as the primary facilitator in generating and ensuring the quality of various economic and social development endeavours inside the country.

Rwanda's government has implemented initiatives aimed at promoting and nurturing the growth of the construction sector, having recognised its significance (Musimbyana, 2021). According to Nkusi et al. (2020), the government has implemented infrastructure reforms in response to the identification of crucial sector policies aimed at revitalising infrastructure and enhancing service provision. Rwanda has adopted many policy measures aimed at attaining expeditious economic expansion, such as Vision 2020, the Poverty Reduction Strategy, the Economic Development and Poverty Reduction Strategy, 2008–2012, and the Economic Development and Poverty Reduction Strategy II, 2013–2018 (Takeuchi, 2019). Considerable advancements have been achieved in the process of national rebuilding.

The government effectively used the aftermath of the genocide as a platform for progress by implementing Vision 2020, a comprehensive national vision that encapsulates the aspirations of Rwandan citizens for the future of their country and society (Nimusima et al., 2019). The adoption of Vision 2020 in Rwanda occurred in 2002, followed by a revision in 2012. Currently, efforts are under way to update and extend this vision to Vision 2050 (Rich et al., 2018). The strategic and visionary documents within the framework of Rwanda's National Vision 2020, an all-encompassing national blueprint, provide guidance for the trajectory of infrastructure development within the nation. The aforementioned frameworks delineate fundamental economic goals, which include the restoration and advancement of infrastructure (World Bank, 2005). In order to tackle challenges related to service delivery, infrastructure development, institutional frameworks, efficient governance, and a competent state are interconnected within the framework (ibid).

One of the key goals outlined in Vision 2020 is the expansion of economic infrastructure, as well as the revitalisation of existing infrastructure and the construction of new infrastructure (Takeuchi, 2019). The framework setting emphasises the significance of effective governance, human resource development and infrastructural development (ibid). The Rwandan government, as outlined in its Vision 2020 document, emphasises the importance of good governance, which necessitates a state that upholds democratic structures and processes, prioritises the rule of law, safeguards human rights, and demonstrates accountability, transparency, and efficiency in resource allocation (Ansoms & Rostagno, 2012). According to Takeuchi (2019), the notion of good governance, as outlined in vision 2020, encompasses the principles of accountability, transparency, and efficiency in the allocation of limited resources. In practical terms, the efficiency of bureaucratic processes has been identified as a significant

element of this overarching concept. The government has repeatedly stated in policy papers that a modest but effective, flexible public sector is needed (ibid).

According to a report by the World Bank (2005), the implementation of Vision 2020 has resulted in the restoration of political security and stability, along with the establishment of robust administrative and organisational procedures. The government has shown progress in the reconstruction of the nation, as seen by the implementation, strategising and acquisition of infrastructure projects. According to Musabyimana (2021), the construction sector in Rwanda is experiencing significant growth, with the government providing subsidies in accordance with the constitution (1995) and the divestiture policy. These measures aim to foster the complete and active involvement of the private sector in the nation's physical infrastructure advancement.

Rwanda has had significant advancements in socio-economic growth subsequent to the conclusion of the civil war and genocide that inflicted severe damage on the economy and social structure throughout the early and mid-1990s (Ggombe et al., 2017). Rwanda's infrastructure, on the other hand, is still constricted. Despite experiencing robust economic development and implementing progressive policies, Rwanda nonetheless faces persistent issues in the delivery of infrastructure. Insufficient institutional competency in government and parastatal organisations may manifest in several ways, such as inadequate project selection, prioritisation and planning (World Bank, 2005). The Rwandan government acknowledged the significant shortage of skilled personnel, particularly in the public sector. It was observed that only 6.5% of the workforce in this sector possessed a university education. Moreover, numerous technical, professional, and managerial positions remained unfilled or were occupied by either expatriates or individuals lacking the necessary qualifications (Rugumamu & Gbla, 2004). Due to a lack of competent institutions and trained persons, governance still needs to be improved, particularly the management of public resources.

Government authorities worldwide face challenges in executing infrastructure initiatives and improving public entity rehabilitation. Despite extensive implementation of public-sector reforms, data shows a lower number of successful outcomes. Insufficient enforcement measures and a lack of a comprehensive strategy have led to ineffective initiatives aimed at rehabilitating public institutions. The lack of a comprehensive strategy may result in less consistent outcomes. The efficacy of management controls may vary across different countries,

with policies that show effectiveness in one nation potentially being ineffective or inefficient in another. The transition of infrastructure between administrations in South Africa is examined in the following section.

2.6 The development of infrastructure that mirrors the transition from apartheid to a democratic South Africa

From 1948 until 1994, the population of South Africa experienced the implementation of apartheid, a legal system characterised by racial discrimination (Brown & Longman, 2018). The policy of apartheid persisted until the early 1990s, resulting South Africa's isolation from the international community and its subsequent designation as a pariah state, subject to widespread global condemnation (ibid). The apartheid regime was characterised by its racially discriminatory policies, which established a white-dominated political system. This racial exclusivity persisted until the early 1990s, as noted by Freund (2020) and Ramutsindela (2001). According to Perkins, Fedderke, and Luiz (2005), apartheid may be characterised as a socio-political framework that is based on the principles of political and racial segregation, leading to the erosion of fundamental human rights, property rights, and freedom. This system resulted in political instability and imposed considerable disadvantages on individuals of black ethnicity.

The legislative framework implemented during the apartheid era in South Africa created a governance structure that systematically discriminated against individuals based on their race. This resulted in the marginalisation and mistreatment of black individuals, characterised by a disregard for their well-being, a perpetuation of a sense of inferiority, and restricted access to vital resources (Mchunu, 2012).The implementation of apartheid in South Africa led to the geographical division of the nation, whereby the government allocated resources and services based on racial criteria. This resulted in notable discrepancies in access between affluent white districts and impoverished black areas (Amusa, 2016). According to Khosa (2000), there was a deliberate division of the economy between the black and white groups.

The infrastructure inadequacies in South Africa can be traced back to the structural disparities that were established during the apartheid era. Under apartheid, resources and infrastructure were disproportionately allocated to white communities, while marginalized communities, primarily black and colored populations, were neglected (Mathe, 2002). This historical injustice has resulted in significant service backlogs, inadequate infrastructure supply, and

racial inequalities that persist to this day. The occurrence of demonstrations related to service delivery can be attributed to difficulties in infrastructure provision, as Natalini, Bravo, and Newman (2020) contend that community protests are linked to deficiencies in government capacity for policy implementation. For example, townships and informal settlements in South Africa continue to lack access to basic services such as clean water, sanitation, and electricity, while affluent neighborhoods tell a different story (Ntliziywana, 2017).Addressing these historical structural disparities is crucial for achieving equitable and inclusive infrastructure provision in South Africa (Mabugu, 2016).

Brown and Longman (2018) argue that the implementation of apartheid resulted in significant economic inequalities between the largely impoverished black population and the historically privileged white population, leaving behind a legacy characterised by brutality. According to Ntliziywana (2017), the apartheid administration in South Africa was unsuccessful in delivering services to its population. Instead, it led to notable distortions in spatial and settlement patterns, economic disparities, a biased urban economic framework, and a substantial accumulation of service and infrastructural deficiencies. According to Brown and Longman (2018), those of Caucasian descent were granted extensive access to a wide array of government services, whereas individuals of African descent were only afforded access to a restricted selection of services. In South Africa, the towns and cities were geographically segregated into areas that were exclusively owned and inhabited by distinct racial groups (Amusa, 2016). According to The Presidency (2015), the apartheid regime primarily allocated resources and implemented infrastructure initiatives that only catered to the interests of the white minority population.

The provision of services to the black people during the apartheid era was complicated in nature. Given the absence of any feasible alternatives, it was inevitable that a dearth in service supply would become prevalent. According to Sithole and Mathonsi (2015), a significant number of black communities had inadequate access to water and sanitation facilities, as well as limited waste disposal and energy infrastructure. The apartheid regime exhibited a disregard for the provision of crucial services, including but not limited to healthcare, housing, education, transportation infrastructure, water supply, and power, inside black communities (Lubinga, 2020).

The existing social infrastructure required improvement in order to effectively adapt to a dynamic economic landscape. Upon assuming power in 1994, the newly established African National Congress (ANC) government inherited a dilapidated infrastructure (Mabugu, 2016). According to the PICC (2014), the economy was hindered, productivity was lower, welfare was jeopardised, and service delivery became challenging due to the absence of habitual integration and increasing population densities in economic and residential domains. The democratically elected government assumed control of a local governance structure that was designed to provide high-quality services to a select group of individuals, while simultaneously marginalising the majority of the population by denying them land ownership in urban regions and restricting their access to vital socio-economic amenities like education and healthcare (Amusa, 2016). Mabugu (2016) posits that South African cities are characterised by a range of challenges, including significant housing and service backlogs, disparities in municipal expenditure, topographical abnormalities linked to the historical apartheid city design, deep-seated conflicts with local government systems, high levels of unemployment, and a substantial number of households living in poverty.

The democratic transition that occurred in South Africa in 1994 signified the demise of the apartheid regime and the commencement of a distinct epoch. The first democratic elections in South Africa saw the participation of a substantial number of voters on April 27, 1994 (Brown & Longman, 2018). The transition of South Africa from apartheid to a truly multiracial democracy is often regarded as one of the most significant political occurrences of the 20th century (Inman & Rubified, 2013). The advent of democracy in South Africa instilled optimism in the majority of its citizens, who had endured immense hardships during the apartheid period, as they anticipated enhanced living conditions and greater provision of public services (Sithole & Mathonsi, 2015). The citizens expressed their desire for enhanced service provision in order to address the lasting and visible consequences of apartheid, with a particular focus on improving social services in rural and underprivileged urban areas (ibid). The changeover not only signified the culmination of a protracted struggle against apartheid but also ushered in a subsequent phase of governmental and societal rehabilitation (Ramutsindela, 2001).

Following the end of apartheid and the subsequent inclusion of formerly excluded populations into the public service, there arose a pressing need for expeditious service delivery in order to address the detrimental consequences inflicted by the apartheid regime (Ntliziywana, 2017). The advent of democracy has presented the administration with a range of prospects and

obstacles. According to Levy et al. (2021), the challenges encompassed the task of regaining political authority over a public service that had been instrumental in enforcing apartheid legislation. Additionally, there was the objective of dismantling segregation within the bureaucracy and reintegrating the quasi-independent bantustans into a new, non-racial semi-federal framework, where responsibilities were aligned across the national, provincial, and local levels. Furthermore, there was the aim of ensuring fair and impartial provision of public services, which had previously been unevenly distributed (ibid).

The process of drafting a permanent constitution began promptly after the nation's transition to democracy (Brown & Longman, 2018). The signing of the Constitution of the Republic of South Africa No. 108 of 1996 was a significant turning point in the historical trajectory of South Africa (ibid). The document serves to define the legal framework of the republic, delineate the rights and obligations of its inhabitants, and outline the organisation of the government. In the context of South Africa, the public sector is organised into government clusters that consist of many ministries (Sithole & Mathonsi, 2015). The Constitution confers both exclusive and concurrent authorities and duties onto each level of government.

The government recognised the need for enhancing the welfare of the country in light of the establishment of a democratic system, and thereafter implemented measures aimed at rectifying the socio-economic disparities via the enhancement of public service provision. In a civilised and democratic society, public services are not a privilege but a fundamental right, according to the White Paper on Transforming Public Service Delivery (1997). The lingering socio-economic disparities in South Africa are a direct consequence of the problems caused by the apartheid period. The endeavour to achieve a balance between economic success and equitable redistribution required a collective social dedication that contradicted South Africa's historical background (Levy et al., 2021). According to Brown and Longman (2018), as South Africans attempted to reconstruct their country, they were confronted with the difficult task of dealing with apartheid's legacies, which included substantial economic imbalances between the predominantly black poor and the historically white elite. The economic consequences of apartheid have been difficult to undo.

Nyikos and Ermasova (2022) believe that the condition of a nation's infrastructure serves as a substantial indicator of its economic well-being. Ntliziywana (2017) asserts that the advancement of developing nations, like South Africa, necessitates the presence of a proficient

and dedicated government that is actively engaged in the formulation and execution of well-defined development strategies and initiatives. These endeavours should be specifically designed to address the issues of poverty and underdevelopment. In order to sustain a functional economy and foster a civilised society, it is essential to establish and maintain dependable transportation networks, provide access to clean water, and implement a secure waste disposal system. Their absence or failure considerably hinders growth and competitiveness (ibid). Ramutsindela (2001) asserts that the state can only be adequately deracialised if policies and programmes addressing the legacy are implemented. The achievement of enhanced infrastructure delivery and sufficient service provision requires internal cooperation across all domains, as well as effective coordination and collaboration. These aspects are elaborated on in the next section.

2.6.1 The Public sector's duty in the delivery of infrastructure in South Africa

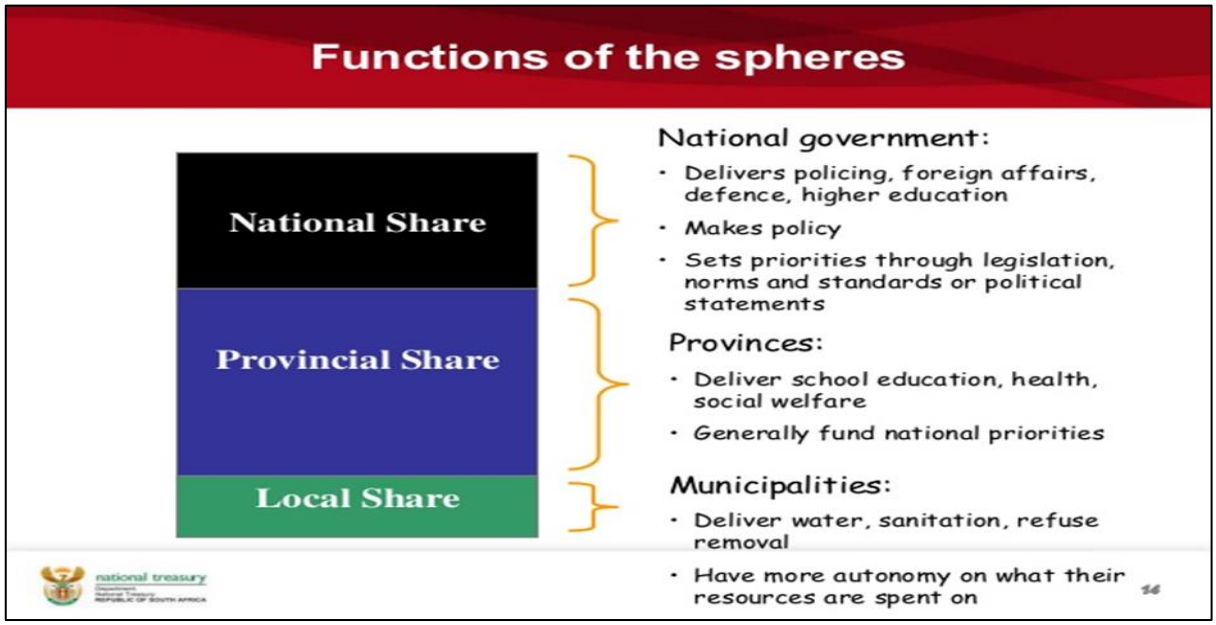
The Constitution of South Africa, Act 108 of 1996, defines the underlying rules for how the government functions. The Constitution furthermore establishes three levels of government: provincial, national, and local. These divisions are correlated yet distinct. Mabugu (2016) asserts that the allocation of functional responsibility for public services, specifically infrastructure, is designated by sections 4 and 5 of the South African Constitution, which pertain to the various spheres. According to Mimba, Van Helden, and Tillema (2007), the public sector has a diverse set of stakeholders, each with its own set of advantages, welfare, or interests, resulting in differing expectations of the public sector. Government institutions may have different accountability, administrative and operational requirements for delivering public sector infrastructure (Amusa, 2016).

The National Treasury (2014) asserts that government spheres have a crucial and mutually reinforcing role in the elimination of poverty and reduction of inequality. The development of infrastructure is an essential element of the government's comprehensive strategic framework. Government agencies face a significant undertaking in the development of effective projects that contribute to the advancement of both the economy and society. Policy development is a fundamental aspect of infrastructure development, as it is derived from the strategic aims and objectives of the government, as well as the investment priorities in various sectors and regions (Mabugu, 2016). The Constitution establishes a framework for intergovernmental relations, assigning specific responsibilities to each branch of government. Within this framework, the

constitution allows for the delegation of important components of public sector infrastructure delivery (ibid).

The organisation of government branches is designed to facilitate the fulfilment of their constitutional responsibilities by including institutions and agencies specifically committed to the legislative process. As per the provisions of the Constitution, local governments constitute municipalities, and provincial and national government comprises government departments and entities created for the entire territory of the Republic (Act 108 of 1996). The diagrams below depict the different spheres of government in South Africa and their respective roles.

Figure 2.2. The Constitutional framework



Source: National Treasury, 2011

The national sphere assumes primary responsibility for tasks that contribute to the efficient operation of the country and are more effectively concentrated at the national level. According to Mabugu (2016), this entity is furthermore accountable for formulating policies that guide the provision of services in the other two spheres, as well as overseeing and assisting in their execution. The primary tasks of the national government include the enactment of laws, the implementation of national mandates, the establishment of national norms and standards for provincial and municipal obligations, as well as the oversight of concurrent activities (National Treasury, 2014). Ajam, Khumalo, and Mabugu (2009) state that the National Department of Public Works offers an inclusionary segment infrastructure system enlightened by much

broader national policies. National departments are in charge of infrastructure-related tasks such as providing state property building structures, bulk water structures, civil services such as courts, police stations, correctional facilities, electrical power supply, and transition to public bodies and agencies (ibid).

The national and provincial governments share a range of objectives. As a result, provincial departments play a vital role in contextualising national imperatives, aligning them with the unique characteristics of each province, and integrating them with the local government realm (Mabugu, 2016). The delivery of social services is primarily the responsibility of the provincial government. Thus, provincial governments develop, budget for, and implement programmes that provide services to people. The responsibility for various social systems, such as health, social development, and education, as well as economic activities like roads and transport and agriculture, lies with provincial departments. Additionally, provincial governance and administration, encompassing the legislature, provincial treasury, local government, and human settlements, are also under their purview (National Treasury, 2014). The provision of health, education, and housing services at the provincial level plays a crucial role in fostering the development of thriving communities and laying the foundation for accelerated economic progress (ibid).

After 1994, there was a notable shift in focus towards emphasising local government within the developmental strategy (FFC, 2023). Municipalities play a pivotal role in augmenting the overall well-being of people via the provision of essential services to local communities. Local government bears the responsibility for the provision of essential services including power, water and sanitation systems and facilities, waste management, stormwater management, municipal roads, transportation, and various other public services such as parks, sports and recreation, municipal roads, and street lighting (National Treasury, 2014). Both provinces and municipalities have direct authority over components of land use planning and regulatory regimes that influence infrastructure deployment and support economic activity (ibid*).*

According to the Constitution, the three spheres of government are discrete, distinct, and interdependent. Despite their autonomy, the three spheres of government coexist in a unified South Africa, which necessitates collaboration on decision-making, budgeting, policies, and operations, particularly for cross-sphere functions (Sol Plaatje Municipality, 2018). They are governed by the cooperative government and intergovernmental relations ideals of the

Constitution. The three levels of government operate within a quasi-federal structure designed to promote cooperation and facilitate the alignment of policy, legislation, and overall service delivery programmes. (Amusa, 2016). Below is an indication of the responsibilities of the spheres.

Figure 2.3. South African Spheres and their functions



Source: Fortuin, 2010

When it comes to managing public investment, various issues confront government sectors and entities (Mabugu, 2016). Investing in new and existing infrastructure is a concurrent function that falls to all the different tiers of government, including state entities (ibid). All spheres are required to invest their infrastructure within the timeframes permitted. Because each level of government has distinct and competing functions, no single level can address the infrastructure gap; thus, the levels of government must collaborate as a multiplicity to overcome the infrastructure gap (Carroli, 2018). The intergovernmental activity designation solicits high levels of planning and solidarity within the sector departments at all stages of the infrastructure

development process (Ajam, Khumalo & Mabugu, 2009). The various domains must collaborate harmoniously to achieve a sustained enhancement and amalgamation in the delivery of infrastructure. Governments with shared ideals are more likely to cooperate and govern effectively.

Infrastructure delivery necessitates the integration of successful development planning activities across all levels of government to improve service delivery. National, provincial, and municipal governments have worked together since 1994 to strengthen and improve the delivery of social infrastructure through reforms in procedures, structures, and financing arrangements (DBSA, 2012). The main aim of infrastructure projects is to present long-term capacity creation of considerable value to the stakeholders (Kivilä, Martinsuo & Vuorinen, 2017. 2017). The interdependencies between infrastructure sectors would necessitate a systems approach to infrastructure planning. Sithole and Mathonsi (2015) mention that the advent of freedom brought hope for better living conditions and more service providers for most South Africans after years of desperation for survival during the apartheid government. South Africa needed to implement a comprehensive economic reform programme (Masters, 2019).

2.6.2 Redress plans addressing the post-apartheid infrastructure imbalances

When the newly democratically elected government took office, several national and provincial infrastructure delivery departments initiated various initiatives and policies to address delivery challenges. Policy and strategy are closely interconnected concepts: policy pertains to the overarching aim and vision for infrastructure delivery, while strategy pertains to the methods and actions required to accomplish and execute infrastructure policies (MISA, 2020). The implementation of novel economic strategies was deemed necessary in order to improve the quality of life for historically marginalised demographic segments. Additionally, it was imperative to devise measures that would rectify the adverse effects of apartheid and tackle the underlying structural challenges within the economy (Masters, 2019). To enhance the operational effectiveness and efficiency of government departments, the new administration undertook the task of de-bureaucratising and restructuring the public service in South Africa. This included dismantling the hierarchical and racially biased oligarchy inside the system (Ntliziywana, 2017).

Following 1994, significant efforts were undertaken to address infrastructure gaps and improve social and domestic infrastructure access by providing housing, education, health care, and electricity and water connections (Mabugu, 2016). The administration began enacting policies to promote proper infrastructure planning and funding. The government launched the Reconstruction and Development Programme (RDP) in 1994, which was succeeded by the Growth, Employment, and Redistribution (GEAR) programme in1996. Subsequently there were the Accelerated and Shared Growth Initiative (ASGISA) framework in 2006 as a continuation to the GEAR programme, and the National Development Plan in 2007 (ibid).

The formation of the RDP was informed by the input of individuals from many backgrounds, who shared their perspectives on the envisioned trajectory of South Africa's reconstruction and development after the end of apartheid (Mathe, 2002).

The following are descriptions of the various reforms:

- Reconstruction and Development Programme (RDP), 1994:

Amusa (2016) states that the RDP was the first substantial economic programme implemented after the 1994 transition. The RDP is described as an integrated, coherent socio-economic policy framework that seeks to mobilise all people and the country's resources toward the final eradication of apartheid's results and the construction of a democratic, non-racial, and non-sexist future in the White Paper on the RDP (1994). It represents a vision for South Africa's fundamental development. Masters (2019) posits that the RDP was a development strategy with a focus on the welfare of the population, aiming to address the socio-economic challenges caused by apartheid. The primary objective of the RDP was to enhance the provision of services to those living in poverty and provide a conducive environment for promoting human development (ibid).

The White Paper on the RDP in 1994 emphasises the importance of an integrated process of change that prioritises the development of robust and enduring democratic institutions and practices. These institutions and practices should be characterised by their ability to effectively reflect the interests of the population and encourage active involvement from all stakeholders. According to Amusa (2016), the RDP urged for the state to assume a prominent and facilitative role in attaining the government's objectives of promoting a fairer allocation of resources and ensuring the supply of fundamental needed services. Additionally, the RDP emphasised the need to prioritise expenditure on social development. According to Ntliziywana (2017), it has

been observed that the RDP outlined the need for transformation within the public sector, including the public service, in order to build delivery systems that are more efficient and effective.

This initiative attempted to redistribute resources to the country's poorest residents by creating infrastructure like housing, water, electricity, schools, and hospitals. The government was able to enhance access to basic infrastructure significantly. However, two years after its implementation, the RDP faced several challenges that spurred new macroeconomic and employment policy disputes (Masters, 2019). The issues identified by the RDP include inefficiencies within the government, the need for appropriate capacity, skilled management, and effective policy coordination and implementation procedures (Ntliziywana, 2017).

Masters (2019) claims that the new implementation team were ineffective because they lacked the requisite training, knowledge, and ability to deliver efficient and effective public services. The RDP approval process for project implementation added to the ambiguity surrounding project approval procedures and who had jurisdiction. As a result, numerous RDP projects failed due to a lack of infrastructure support. The RDP's framework as a collection of initiatives and a goal for social reform has appeared fragile (ibid). Mathe (2002) states that evidence is mounting that South Africa has established sound policies that it is unable to implement due to a lack of capacity and financial resources, which is partly attributable to the government's support of the neoliberal agenda.

Although officials saw the RDP as the best strategy to have implemented in 1994 (Mathe, 2002), the RDP implementation process was beset by difficulties, and it was roundly criticised for its economic policy mistakes (Masters, 2019). The government introduced GEAR to solve these issues, restore confidence, and boost credibility (ibid). Amusa (2016) states that the RDP effort was complemented in 1996 by GEAR. It was introduced as a model for economic growth, rebuilding, and reorganising the economy per the RDP goals (Mathe, 2002).

- Growth, Employment and Redistribution (GEAR), 1996

The GEAR macroeconomic strategy is formally characterised as an encompassing economic strategy aimed at revitalising and reorganising the economy in alignment with the objectives outlined in the RDP. Furthermore, the primary objective was to address the many difficulties associated with fulfilling fundamental requirements, enhancing the capabilities of individuals,

fostering greater involvement in the democratic structures of civil society, and effectively executing the RDP (Mathe, 2002).

The GEAR reforms were designed to enhance economic growth and improve government finances, freeing up budget resources for poverty reduction and social development activities (Mabugu, 2016). GEAR was built on the RDP's goals by committing the government to macroeconomic and social-economic targets (Masters, 2019). The GEAR policy framework proposed a set of initiatives which included the relaxation of exchange rate restrictions, the promotion of trade liberalisation, the implementation of regulatory measures, the reduction of deficits, and the adoption of rigorous monetary and fiscal policies (ibid).

According to Masters (2019), the beginning premise of the RDP was that achieving sustainable economic development required the implementation of a growth strategy that included redistribution. The GEAR policy framework prioritised a more expeditious approach to reducing the fiscal deficit in order to fulfil debt commitments. Additionally, it advocated for budgetary changes that would facilitate redistributive expenditure, as well as measures to manage inflation, enhance investment spending, and implement an exchange rate policy aimed at maintaining competitiveness and ensuring consistency in monetary policy (ibid).

It also aimed to have an impact on the economy by loosening exchange controls, lowering tariffs, increasing tax incentives to encourage investment, establishing a structured collective bargaining system, enforcing a more robust levy system to fund education and training, increasing trade and investment flows in Southern Africa, and committing to the implementation of stable and coordinated policies (Mathe, 2002). Masters (2019) states that these objectives meant that resources for social service delivery and infrastructure programmes should be reprioritised to address the basic requirements of all people, implying a shift to the private sector to facilitate social service delivery.

Despite accomplishing some policy goals, GEAR ran into a number of snags (Masters, 2019). The government recognised the problems and in 2006 passed ASGISA to address and better handle poverty and unemployment, as well as other long-standing impediments to economic development, and to enhance the implementation of relevant policies. ASGISA has supplanted GEAR as the guiding economic paradigm (Masters, 2019).

- Accelerated and Shared Growth Initiative (ASGISA) framework, 2006

The Accelerated and Shared Growth Initiative for South Africa (ASGISA) might be seen as a continuation or expansion of the GEAR strategy. It was built on the RDP's goals of creating a democratic society and an interconnected economy. Masters (2019) asserts that ASGISA was implemented with the objective of mitigating poverty levels by the year 2010, while concurrently striving to decrease the jobless rate to 14% by 2012. The framework highlights several factors that impede economic growth, including the currency's relative volatility, the national logistics system's cost, efficiency, and capacity, shortages of skilled labour, spatial distortions resulting from apartheid that affect low-skilled labour costs, barriers to entry and competition, burdens on small and medium-sized businesses, inadequate government capacity and leadership, and limited opportunities for new investment (ibid).

The ASGISA effort used many strategies, including infrastructure projects, sector investment plans, skills and education initiatives, interventions in the second economy, and the growth of small, medium, and micro businesses in order to effectively tackle and overcome these constraining limitations (The Presidency, 2006). Furthermore, the primary objective of this initiative was to tackle macroeconomic concerns, including the problem of exchange rate volatility, as well as to address public administration issues, with a particular focus on enhancing service delivery (ibid).

- National Development Plan (NDP), 2012

The National Development Plan (NDP) is a comprehensive policy framework aimed at the eradication of poverty and the mitigation of inequality in South Africa by the year 2030. According to Khumalo, Choga, and Monapo (2017), one of the biggest challenges faced by the nation is the inadequate infrastructure that requires improved positioning and maintenance. This insufficiency hinders the ability to nurture extraordinary development. According to Mabugu (2016), the NDP's 2030 objective necessitates significant amounts of infrastructure investment, indicating that there will be a continued focus on infrastructure development in the foreseeable future.

The NDP acknowledges the crucial role of public infrastructure, namely in the domains of electricity, water, and transportation, in facilitating rapid economic growth and enhancing productivity. This is achieved via the promotion of heightened competitiveness, higher exports, and reduced corporate expenses (Watermeyer & Phillips, 2020). Furthermore, the NDP

endeavours to tackle existing spatial patterns that perpetuate social inequities and economic inefficiencies in the realm of development of infrastructure (ibid). According to Mabugu (2016), the primary objective of the extensive infrastructure programme is to enhance and extend the nation's infrastructure network by rectifying deficiencies and inefficiencies in the existing infrastructure. Watermeyer and Phillips (2020) argue that the NDP posits that by the year 2030, South Africa ought to have achieved substantial and demonstrable advancements in the revitalisation of rural regions, as well as the establishment of urban settlements that are functionally interconnected, balanced, and active. The impetus for this infrastructure push stems from the imperatives of economic development and the consideration of greater social challenges.

2.6.3 The identified gaps and difficulties in infrastructure provision

The scope of government responsibilities has expanded, posing increased difficulties in the execution of planned infrastructure delivery services. The phenomenon of increased infrastructure needs has emerged as a consequence of rapid economic development, escalating income levels, and the use of infrastructure originally planned to accommodate a smaller population (DPME, 2014). The nation's economic and social infrastructure is now in a state of disrepair, necessitating substantial government intervention to address the deficiencies via the implementation of public policies (Mabugu, 2016). After an extended period of democratic governance, the present administration is encountering challenges in fulfilling the aspirations of the populace. The public sector is facing challenges in meeting the increasing demand for services.

Service delivery has emerged as a prominent issue in several developed nations, leading to notable instances of public demonstrations in various countries (Masiya et al., 2019). According to Sithole and Mathonsi (2015), people can exercise their rights to articulate their discontent and opinions on service delivery matters. The practice of this liberty was consistently restricted throughout the apartheid era. The prevalence of service delivery-related demonstrations may be attributed to challenges in infrastructure delivery, as Natalini, Bravo, and Newman (2020) argue that community protests are connected to a lack of government capacity in implementing policies.

There are several factors that may be attributed to deficiencies in infrastructure delivery. Ntliziywana (2017) undertook a research study aimed at identifying the issues associated with the delivery of social and economic infrastructures in the Sub-Saharan African area using public-private partnership (PPP) procurement arrangements. The research conducted in South Africa revealed that there is a pressing need for enhanced capacity, policy direction, and clear communication among political leaders and implementing agencies in order to effectively provide social and economic infrastructures via PPP procurement arrangements. The primary factors contributing to project failure or unfavourable project results often stem from deficient governance and ineffective procurement and delivery management practices, both of which fall within the purview of governmental authority (Watermeyer & Phillips, 2020).

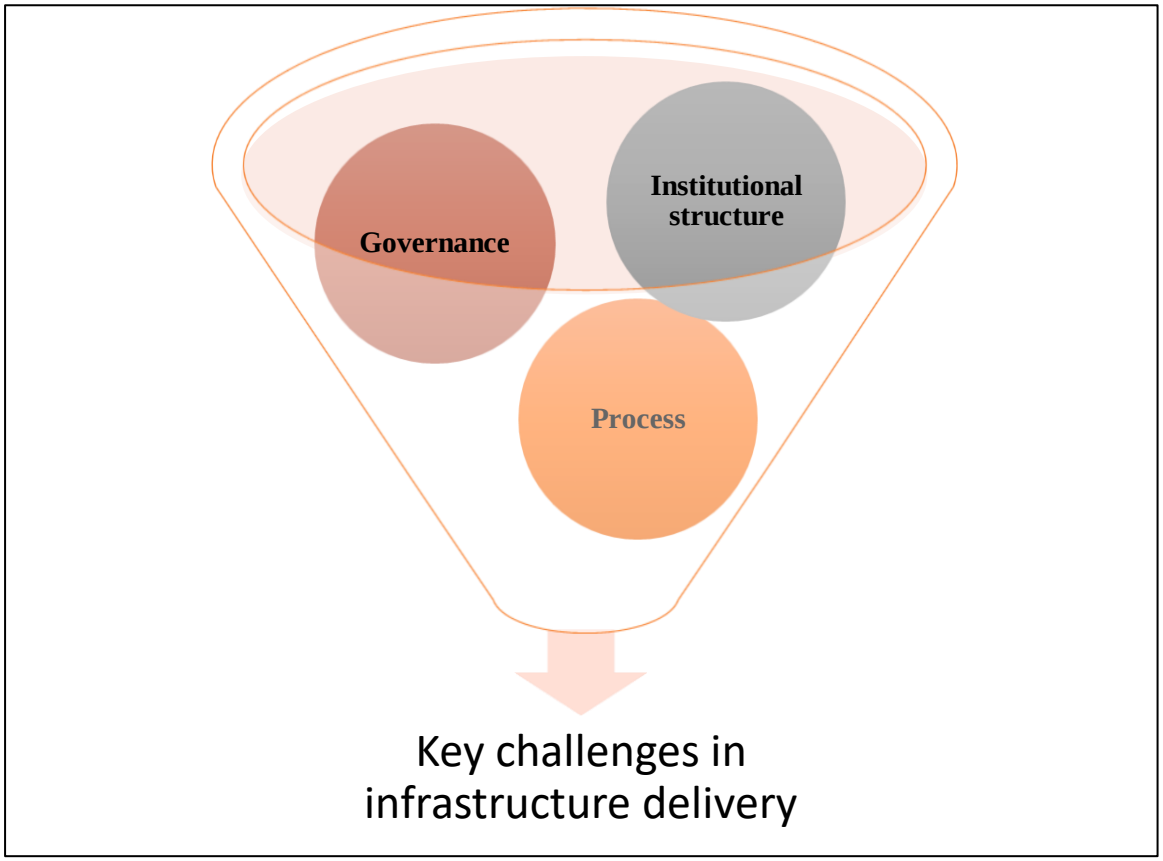
Numerous African nations encounter obstacles in the execution of policies, along with institutional difficulties pertaining to people, resources and expertise, which hinder their ability to accomplish shared objectives and aspirations (Nwuke, 2012). Efficient service delivery is hindered by several challenges, such as capacity limitations, governance issues, and inadequate resources and expertise. The existence of such a discrepancy poses a threat to the cost-effectiveness of a project and may result in unforeseen ramifications, such as social instability and civil upheaval. There has been a lack of progress in establishing the necessary governance mechanisms and developing the management competence to effectively address these concerns. Consequently, the mismanagement of infrastructure assets leads to their deterioration (ibid).

Historically, the evaluation of infrastructure projects has mostly focused on their economic feasibility and viability, neglecting the comprehension of the infrastructure system in question (Ejigu, 2007). Baker and Hincks (2009) argue that coordination and planning have been criticised for their inability to effectively execute policies and plans. According to Watermeyer and Phillips (2020), inadequate procurement practices, which encompass the initiation, creation, and fulfilment of contracts, along with insufficient delivery management, referring to the crucial leadership role of an informed client in efficiently planning, specifying, procuring, and delivering infrastructure projects, are substantial factors that contribute to unsatisfactory outcomes in such projects.

The effective execution of infrastructure projects is subject to many adverse effects, which may be classified into three primary domains: the establishment of governance, a harmonised

approach for the numerous processes involved in the execution of infrastructure projects, and the institutional structure. The infrastructure conundrum revolves around the essential aspects of governance, process, and institutional structure. These are discussed in detail as per the below diagram:

Figure 2.4. Key challenges in infrastructure delivery



Source: Researcher's collection

Governance

Within the realm of literature, a multitude of perspectives exist regarding the conceptualisation and understanding of governance. According to Ojo and Mellouli (2018), the concept of governance has been employed in diverse contexts, but its primary usage pertains to endeavours aimed at enhancing collaboration among interdependent entities to address societal issues. Consequently, the good governance approach emphasises the ideals of a well-managed state and the functioning of government. Winter (2016) asserts that the concept of governance places more emphasis on the procedural aspects of government, facilitating a more comprehensive comprehension of the social structure and interconnectedness of the governing

system. The concept of governance illustrates the intricate nature of decision-making processes within the public sphere, making it difficult to isolate structures and procedures that are expressly linked to a particular model (Yilema & Gianoli, 2018).

Amante (2020) posits that governance is a comprehensive concept including several methodologies aimed at addressing prevalent issues, including those pertaining to organisations, societies, nations, and the international arena. Winter (2016) posits that governance encompasses the establishment of regulations or associations that enable individuals to make choices and operate within fluid and evolving socio-political contexts. Governance is the establishment and maintenance of a cohesive identity and vision that enables synchronised decision-making, including actions, interpretations, and strategic objectives (Katina et al., 2019).

Governance is the comprehensive framework through which governmental entities effectively and efficiently manage public relations and allocate resources. Additionally, it incorporates the procedural aspects of decision-making and subsequent implementation. According to Kenny (2007), the role of governance in infrastructure development is of utmost importance rather than being insignificant. This is because instances of government misconduct, which indicate a deterioration in governance, may have a substantial adverse effect on the anticipated returns from infrastructure investments.

The efficiency of project execution may be considerably influenced by the combination of governance and proper infrastructure systems. Mabugu (2016) asserts that the infrastructure development process requires a substantial degree of control, enforcement, and approval. The performance and success of a project are substantially influenced by the economic, social, legal, physical, and political environment in which it is implemented (Desta, 2015). According to the IPA (2021), the inclusion of whole-life factors in project decision-making and the continuous emphasis on the intended end state are facilitated by effective governance and leadership. According to Mabugu (2016), the effectiveness of public infrastructure projects is significantly impacted by the level of governance quality and institutional design.

Governance involves the administration, organisation, and synchronisation of system control, communication, and integration among different systems and their individual components. As stated by Katina et al. (2019), governance encompasses the imperative to supervise the

progression of a system through the facilitation of resource efficiency, the monitoring of performance, and the investigation of anomalous circumstances. Watermeyer (2012) argues that the inclusion of legislation, governance/management frameworks, and comprehensive documentation is essential for giving adequate support to delivery systems. Nwuke (2012) posits that there is a prevailing view regarding the state of governance in Africa, which is widely acknowledged as a significant hindrance to the advancement of infrastructure development. Consequently, efforts targeted at assisting communities in need are heavily influenced by this aspect.

The interconnectedness of infrastructure sectors poses a significant challenge to the process of infrastructure strategic planning. The adoption of liberalisation, private provision, and competition in infrastructure sectors has led to a more intricate governance framework, including a variety of players in infrastructure planning and decision-making (Hall et al., 2014). The phrase 'transition to a sustainable infrastructure system' refers to a process that aims to achieve a system configuration, including both capacity and demand, which satisfies economic, social, and environmental objectives over a span of many decades (ibid). The fulfilment of public sector needs may be hindered by project delays or disruptions, as well as by substantial demands from stakeholders (Khan et al., 2019). Furthermore, the environmental factors that have been established over the course of many decades are characterized as a shift towards a sustainable infrastructure system (ibid). The fulfilment of public sector needs may be achieved by the implementation of an effective project governance framework that mitigates the potential for project delays, disruptions, and substantial stakeholder pressures (Khan et al., 2019).

The concept of governance encompasses the procedural framework via which choices are made and then executed or disregarded. The government has the capacity to formulate and execute effective policies while upholding human rights and adhering to the principles of the rule of law. According to Ngubane (2005), the state establishes various institutions, regulations, and policies in order to facilitate the efficient provision of services to the general population. Infrastructure initiatives are confronted with substantial and progressively evolving demands from many origins, necessitating a thorough examination of effective governance and institutional procedures. According to Awuzie and Monyane (2020), the primary purpose of a governance framework is to effectively accomplish the strategic goals that served as the foundation for initiating the project. The establishment of an appropriate governance

framework, together with the effective administration of processes, resources, and the system's interaction with its operating environment, are often associated with the governance and management of construction management processes (Desta, 2015).

It is essential to enhance governance at every stage of the infrastructure lifecycle (Cahen, 2016), and several entities are responsible for the oversight of infrastructure policy development and the enhancement of infrastructure performance. The governance structure and project governance policy of a government's commercial affairs department outline the specific responsibilities and duties associated with project development activities (National Treasury, 2014). Good governance refers to the ability of processes and institutions to effectively address the demands of society while making efficient use of the resources at their disposal.

Enhancing the coordination of the project governance structure is a pivotal element in project delivery. It is important for the various branches of government to engage in a cooperative and supportive manner, fostering a sense of mutual cooperation. This approach is necessary to guarantee that their policies, objectives, and provision of services are harmonised, thereby facilitating the effective delivery of services to the populace. An essential aspect of comprehending the governance of infrastructure systems is the provision of guidance, oversight, and accountability. However, there is a need for further improvement in studies pertaining to the mechanisms and processes involved in coordination and integration.

Institutional Structure

Numerous African nations have obstacles in the execution of policies and encounter institutional difficulties, such as limitations in human capital, financial resources, and specialised knowledge, which hinder their ability to effectively accomplish shared objectives and aspirations (Nwuke, 2012). There are several institutional challenges that impede the effective provision of sustainable infrastructure services. These challenges include a range of issues, including inadequate skills and capabilities, as well as insufficient and fragmented delegation and accountability procedures (Mabugu, 2016).

The Constitution of South Africa upholds the notion of professionalism within the realm of public administration. The principles and values that govern public administration are delineated in Section 195(1). These principles encompass the promotion and preservation of a

commendable level of professional ethics, the cultivation of sound human resource management practices, and the facilitation of career development initiatives. The overarching objective of these principles is to optimise human potential, enhance resource utilisation efficiency, foster cost-effectiveness, and establish a system of administration that is accountable and transparent (Ntliziywana, 2017).

The effective management of human resources plays a crucial role in ensuring the successful execution of infrastructure projects. In order to effectively strategise, allocate resources, execute, and oversee initiatives, individuals working in the public sector must possess a combination of technical expertise, public acumen, and project finance proficiency (Kibuuka & Fourie, 2016). According to Desta (2015), in order to effectively fulfil project goals, it is essential for an organisation to establish a structure that connects the activities to be carried out, the technology and layout to be used for performing the job, and the human components involved, via formal and semi-formal procedures. Consequently, an effectively designed organisational structure facilitates the attainment of a synchronised endeavour by delineating responsibilities, establishing hierarchical authority, streamlining workflow, and consolidating resources for the purpose of carrying out work-related duties (ibid).

The construction process encompasses various activities, including conceptualisation, design, management, organisation and coordination of project elements such as time, finances, technology and methodologies. The primary objective is to achieve optimal efficiency in order to successfully complete construction projects within the designated timeframe, budgetary constraints, and in accordance with the quality and performance standards outlined by the project owner or contractor (Mathenge, 2012). The primary issue, as identified by the NDP 2030 pertains to the lack of consistency in resource availability. This inconsistency has resulted in performance disparities across the various levels of government, including the national, provincial, and local levels, therefore impacting infrastructure delivery.

Bhattacharya, Oppenheim, and Stern (2015) argue that the presence of more comprehensive national infrastructure plans and intricate systems exacerbates infrastructure challenges. Consequently, infrastructure projects are susceptible to persistent delays and cost overruns as a result of inadequate institutional capacity and inefficiencies in planning. The study conducted by Asamoah, Osei-Kojo and Yeboah-Assiamah (2013) revealed many flaws in public administration, including poor leadership, a lack of knowledge in key areas, excessive

personnel, instances of misuse and wastage, insufficient internal and external systems, and a proliferation of duplication and fragmentation. Fortuin (2010) further asserts the need for enhanced capacity at the local governmental level, as well as the presence of notable challenges pertaining to coordination, administration, human resources, and information transmission.

According to DBSA (2012), a prominent issue in the existing body of research pertaining to government investment in infrastructure, particularly in developed countries, is regarding the extent to which allotted resources are exhausted during the implementation process. Based on several construction industry publications in South Africa, it has been observed that the industry is now experiencing a deficit in skilled labour, which has had a detrimental impact on both the industry's capacity and public sector customers' ability to effectively execute the government's infrastructure renewal programme (Emuze, 2011). The scarcity of skills in the construction sector in South Africa has created significant challenges for government departments, since these skills are crucial for the effective execution of infrastructure programmes and projects (Nugent, 2020). Koskela (2003) asserts that currently, there is minimum usage of the construction team, necessitating the skills of all personnel to yield value for the stakeholders by consolidating different project processes.

The construction industry delivers its goods and services in a project-specific environment, with different combinations of funding bodies, clients, built-environment professionals, site conditions, materials, and technologies, general contractors, specialist contractors, skills, workforces, client requirements, and stakeholders on each project (Watermeyer & Phillips, 2020). The process of professionalisation is necessary in order to effectively address and mitigate the public health, safety, and financial risks that are inherent in construction activities. The physical environment must be planned, developed, and maintained so that people's lives are not jeopardised, as well as the massive sums of money spent on infrastructure (ibid).

The phenomenon of skills shortage is not limited just to the public sector. According to Nugent (2020), in order to efficiently obtain, contract, involve and oversee the services of professionals and contractors engaged in the implementation of public infrastructure projects, the public sector needs competent internal specialists in the areas of built environment and procurement. The situation described above is often seen within the private sector, hence intensifying the difficulties related to achieving the ideal, skilled, and economically efficient delivery of public

infrastructure. The construction process requires highly skilled individuals and professional teams of clients, designers, suppliers and contractors (Emuze, 2011).

The task of delivering public infrastructure in a manner that is both efficient and cost-effective is further complicated by the existence of a skills deficit, which is often seen in the private sector as well. According to Mathenge (2012), there is a growing trend in the sector towards larger and more complex projects, which in turn requires the recruitment of highly skilled individuals, advanced technological equipment, and enhanced project management systems. Conversely, individuals adept in problem-solving are crucial for the successful execution of creative infrastructure projects, which sometimes need intricate definition and pose significant implementation challenges (Emuze, 2011).

Most African nations, especially those with weak governance and little economic means, have challenges in terms of financial resources and technical and institutional capabilities required to address this disparity (Nwuke, 2012). Mabugu (2016) emphasises the need to incorporate a structure that effectively delivers public services while minimising resource wastage. This requires the implementation of enhanced accountability mechanisms and the cultivation of appropriate expertise and abilities (ibid). Kibuuka and Fourie (2016) state that improving public sector authorities' financial and technical capability is vital to properly managing infrastructure preparation, planning, execution, operations, and maintenance. Mathenge (2012) also supports professional involvement in government planning. Incapacity impediments prevent the successful administration of the economic infrastructure's set plan and agenda; these skills require outsourcing (DPME, 2014).

According to The Presidency (2015), a number of national efforts have been implemented over time to assess and forecast potential shortages in infrastructure-related skills, as well as to formulate strategies for mitigating these shortages. The primary causes of discomfort and obstructions in South African infrastructure may be attributed to the inefficiency of institutional procedures at various levels of government. The aforementioned phenomenon arises from a multifaceted amalgamation of elements, including political-administrative disputes, ambiguity around administrative leadership, deficiencies in skills, less transparency and authority, insufficient organisational structure and design, and diminished employee morale (Watermeyer & Phillips, 2020).

The government encounters a diverse range of challenges that are intricately interconnected with various aspects of its capabilities. The challenges identified by Desta (2015) include inadequate organisation and mishandling of technical skills and expertise, as well as low morale, lack of confidence or team spirit, and interference in political matters. These issues have been found to result in diminished benefits derived from capable employees. According to Nwuke (2012), enhancing the capacity of public organisations responsible for providing public goods and services can yield cost savings and enhance the quality of services rendered.

There are institutional issues related to policy formulation and governance, with organisational obstacles linked to the effective management and accessibility of skilled personnel. The level of performance in the civil service is influenced by the policies and processes governing the workforce (World Bank, 2018). The continent's infrastructure and skills development will offer it a competitive advantage in attracting money and investment (Kibuuka & Fourie, 2016). The primary emphasis of the majority of programmes is mostly centred on the facilitation of service delivery and the execution of projects, rather than effectively addressing the fundamental issues that lead to limitations in capacity and the management process. It is important to acknowledge that throughout the many stages of infrastructure delivery, prioritising the harmonisation of processes and standards is crucial.

Process

Problems with infrastructure provision in many nations are exacerbated by the operational mechanisms of their various delivery systems. Inadequate planning is a significant contributing factor to delays in construction projects, while the process of formulating these plans is time-consuming (Hall et al., 2014; National Treasury, 2014). For any endeavour to succeed in accomplishing its stated goals and objectives, careful forethought, and preparation in the form of planning is an absolute necessity (Daniel, 2017). The act of planning has the potential to fulfil individuals' aspirations, but in its most unfavourable manifestation, it may give rise to discord. According to Daniel (2017), it may be inferred that the benefits derived from various forms of planning may not be uniformly advantageous for all parties involved.

The demand to speed up service delivery and fast-track initiatives often comes at the cost of careful planning (MISA, 2020). The importance of thorough planning cannot be overstated in minimising the need for modifications throughout the implementation stage of a project (ibid). Awuzie and McDermott (2014) state that the capability of systems is wholly dependent on

operation, coordination, control, intelligence, and policy functions, respectively. The ongoing enhancement of infrastructure includes the processes of delivery, maintenance, and overall management. The provision of infrastructure services often follows a sequential process including the phases of design, implementation, and operation, as outlined by Levitt (2009). According to Mesa, Molenaar, and Alarcon (2016), the selection of a project delivery system is considered a crucial choice at the start of a project.

Koops (2017) posits that the achievement of successful project delivery may include supplementary criteria that are contingent on observable performance in meeting the client's requirements. The infrastructure project encompasses a heterogeneous range of individuals, including the operator, the owner, and the numerous consumers (ibid). Consequently, the complexities surrounding the execution of infrastructure projects are many. Planning and delivery include the systematic procedures through which the identification and anticipation of infrastructure requirements occur, as well as the subsequent fulfilment of those needs. Both are backed by corporate funding, regardless of the specific sector. Winter (2016) argues that this calls for the adoption of fundamentally distinct methodologies for dealing with issues related to linear, deterministic procedures and commonly acknowledged, predictable results.

2.6.4 The Infrastructure Delivery Management System

IDMS is a governmental initiative aimed at enhancing socioeconomic progress and advancement via the provision of infrastructure (MISA, 2020). It is developed under the auspices of the National Treasury in collaboration with the national and provincial departments, the Construction Industry Development Board (CIDB) and the Development Bank of Southern Africa (DBSA) (National Treasury, 2016). The establishment of IDMS occurred subsequent to a comprehensive consultation process conducted by the Treasury, which included engaging with many stakeholders from the public sector. The delivery management system is guided by policies, standards, and best practices. The aforementioned phenomenon has significant influence on the hierarchical structure of policy, strategy, and planning, effectively coordinated across the three levels of government (ibid). The primary objective of its creation was to enhance project capabilities by implementing best practices in several areas, including organisational structure, procurement, governance, risk management, systems integration, and asset management.

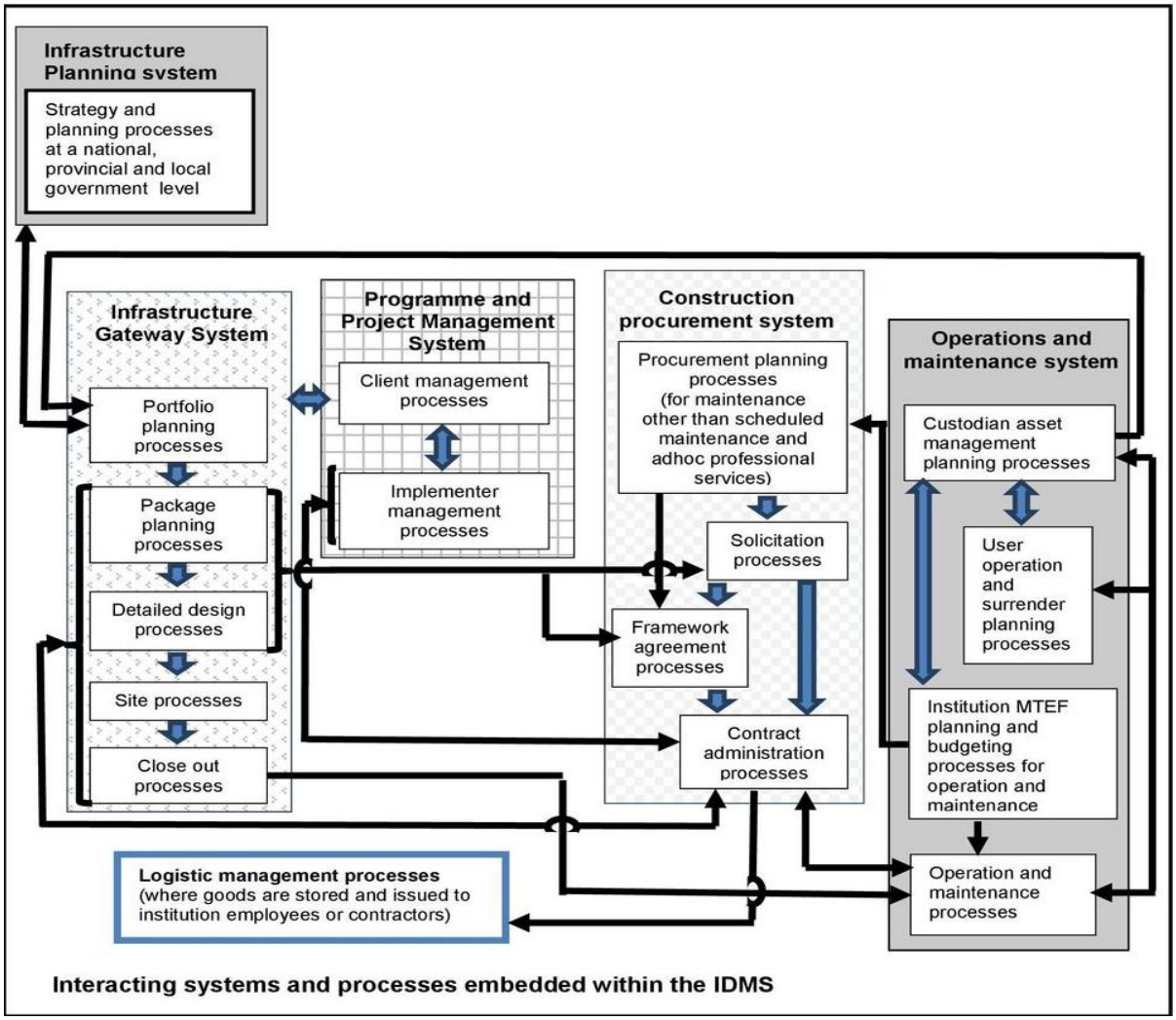
IDMS is an all-encompassing framework and information repository that has been especially developed for the purpose of managing infrastructure delivery within the public sector (National Treasury, 2016). The use of this approach is intended to increase the probability of effectively implementing infrastructure projects and cultivating a mindset that emphasises efficiency in terms of cost. The aim is to improve the cooperation among government agencies and several tiers of government in relation to the delivery of infrastructure. The system was introduced in 2010 to present the guidance requirements and procedures essential for delivering, utilising, maintaining and managing infrastructure. The model offers a documented body of information and procedures that outlines common and established best practices in managing infrastructure project delivery and serves the complex requirements of the construction industry in response to the requirements of South Africa's infrastructure and tactile property provision (Practice Notice 22a, 2010).

IDMS provides for the government, technical support, planning, procurement and management processes (National Treasury, 2016). The system enables the project delivery management team to expedite a uniform motion to the project management and comply with the applicable statutory criteria (CIDB, 2012). IDMS has evolved over several years and developed over time, with numerous updates and the intention to tackle the challenges of inadequate capacity and organisational non-performance arising from the following determinants (ibid):

- Poor infrastructure design and preparation, poor plan consolidation, poor budgeting, and execution.
- Environment bearing shortfalls of necessary support during the delivery processes.
- Lack of sufficient expertise and capacity necessary to prepare and manage the delivery of infrastructure project.
- Inadequate knowledge management and reporting.
- Poor management of projects during implementation (CIDB, 2012).

The delivery system outlines core infrastructure processes and sub-processes inherent in any public infrastructure project. It outlines the critical processes in infrastructure planning, procurement, delivery, operations, and maintenance and provides a systematic framework for the infrastructure project lifecycle (National Treasury, 2016). The figure shown illustrates the interconnection of several operations inside the IDMS.

Figure 2.5. Interacting systems and processes embedded within the IDMS



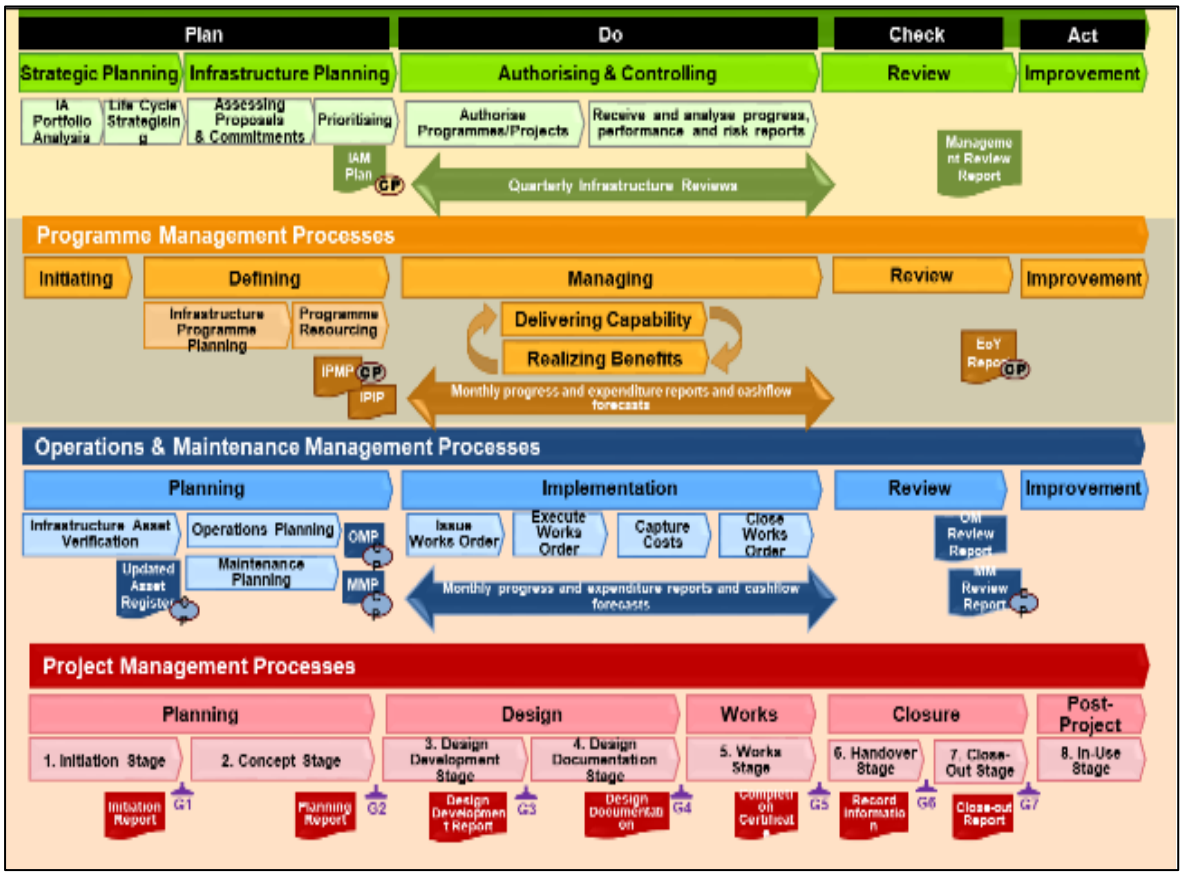
Source: (National Treasury, 2016).

The aforementioned is a comprehensive public-sector management system that encompasses several aspects such as infrastructure planning, budgeting, procurement, delivery, maintenance, operation, and assessment (National Treasury, 2016). The system consists of several linked or interacting components that collaborate to facilitate the transformation of inputs into outputs. The framework comprises several systems, each of which has its own distinct processes. The systems are connected and have elements that interact with one another (ibid).

In the graphic below, the IDM Processes Placemat shows high-level processes that must be followed concerning portfolio, programme, operations and maintenance, and project management. According to MISA (2020), control points and gates serve as the intended outcomes. The Control Stages provide a comprehensive overview and elucidation of the many

phases involved in the lifespan of a project, commencing from its initiation and culminating in its completion (ibid). Watermeyer (2013), posits that it is essential to manage and oversee construction projects in a reasonable, methodical, and auditable manner. The first stage in the development of a delivery management system involves the identification of the specific information that has to be generated and approved by the client at certain milestones throughout the delivery process. These milestones, sometimes referred to as control points or gates, are crucial for the advancement of the project (ibid).

Figure 2.6. IDM Processes



Source: (National Treasury (2016)

Watermeyer (2012) states that IDMS incorporates an Infrastructure Gateway System (IGS) that provides a range of control points (gates) in infrastructure delivery and maintenance projects where a decision is required before moving on to the next level. The determination of specific phases is contingent upon the governance and control requirements of the particular project (MISA, 2020). Such decisions must be based on evidence given and, if properly implemented, assure that a project involving the delivery or maintenance of facilities stays within agreed-

upon mandates, aligns with the intent for which it was designed, and can proceed effectively from one point to the next (Watermeyer, 2012).

The Infrastructure Delivery Management System is categorised into delivery phases: portfolio management, programme and project management, and operations and maintenance processes.

- Portfolio management

  Portfolio management is described as a continuous decision-making process whereby an organisation's list of portfolio components is subject to periodic review for alignment with the organisation's strategy (Watermeyer, 2018). The implementation of infrastructure portfolio management plays a crucial role in facilitating an organisation's service delivery process. It is a set of management strategies applied to infrastructure to plan, implement, monitor and manage prioritised task lists based on long-term objectives, available finances, and the management capabilities of an organisation (CIDB, 2012). The implementation of a well-managed infrastructure portfolio enables government agencies to carry out their assigned functions effectively, efficiently, and consistently. Portfolio management encompasses the establishment and administration of non-asset solutions, which are designed to create an optimal environment that enhances the provision of services by an organisation (ibid).

  The planning of infrastructure portfolio projects in government is influenced by several factors, including strategic considerations, planning processes at different levels of government (local, provincial, and national), as well as asset management plans developed by overseers and infrastructure management professionals. The concept involves the ongoing integration of operations related to infrastructure management, specifically aimed at initiating, executing, monitoring, and controlling organised activities in accordance with predetermined plans, available financial resources, and the organisation's management capacity (CIDB, 2012).

- Program and project management

  The area of program and project management involves the deliberate pursuit of initiatives that have been selected during the planning phase, with the aim of accomplishing infrastructure objectives (National Treasury, 2016). The concept of managing joint programmes in public sector infrastructure management was created to facilitate the coordination of common aims and build synergy across organisations in implementing a similar programmes portfolio (CIDB,

2012). According to Mabugu (2016), infrastructure development necessitates a strong emphasis on project management and infrastructure planning.

Project management involves the application of various skills, knowledge, techniques and tools to effectively carry out a range of project operations in order to meet the specific needs of the project (Alshamsi, 2019). Project management encompasses the systematic coordination and oversight of several project elements, including planning, organisation, monitoring and control. Additionally, it involves the facilitation of stakeholder motivation to effectively accomplish project objectives within the parameters of safety, timeliness and cost-effectiveness (Radujkovic & Sjekavica, 2017).

The management and definition of individual infrastructure projects occur within the broader context of a programme and portfolio, as stated by CIDB (2012). Good project management involves planning, organising, monitoring and controlling all parts of a project and motivating all stakeholders to fulfil the project's triangle of objectives (Zid, Kasim & Soomro, 2020). In order to adhere to budgetary constraints, it is imperative to minimise capital expenditures. Additionally, the design of programmes should prioritise the maximisation of value. Rigorous execution of risk management practices is essential, as is the refinement of contracting strategy and procurement processes. Furthermore, it is crucial to secure precious resources to ensure that budget, quality criteria, and schedule requirements are met (Kibuuka & Fourie, 2016).

The conventional approach to project management is used for the purpose of overseeing the execution of projects (CIDB, 2012). Based on the inherent logic of the project development process, each phase has its own set of goals, commonly expressed as the completion of one or more phase deliverables. The approval of these phase deliverables is usually required before moving on to the project's next phase (ibid). Once the deliverable has been authorised and officially endorsed, it is regarded as having successfully completed the relevant stage gate, hence allowing the project to go forward to the subsequent sequential stage (MISA, 2020).

According to Desta (2015), project management processes are strategically designed to commence, strategise, implement, oversee and regulate, and conclude projects. The Project Management Framework necessitates rigorous adherence to the phase control principle. Before moving on to the subsequent implementation phase, the client must approve the critical

deliverables at the end of each phase to ensure that scope creep and project risks are acknowledged and agreed upon (ibid).

IDMS establishes the framework within which projects are developed, projected and executed. This process is conducted in order to guarantee the following:

1. Purpose and functionally designed infrastructure delivered within the project constraints to yield cost-effectiveness over its lifecycle with safety adherence, reliability and proficiency.
2. Infrastructure maintenance to ensure that standards are sustained.
3. To allineate both contractor and user or client's (stakeholders) interests.

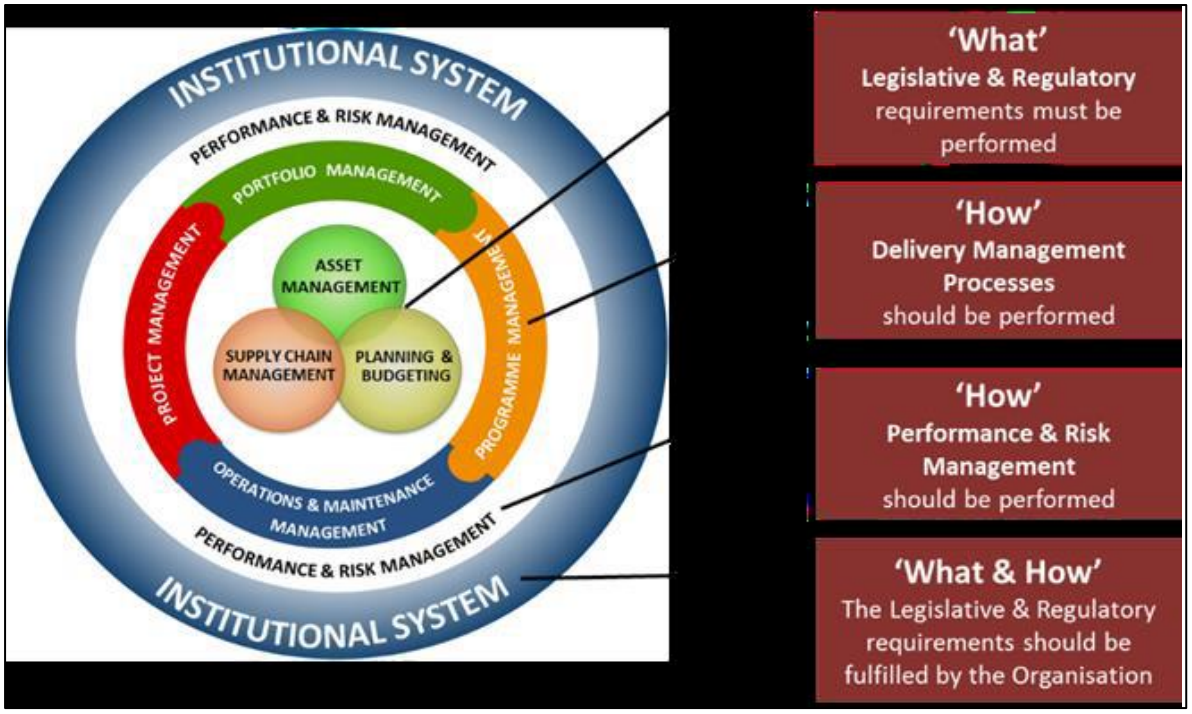
- Operations and maintenance

  Operation and maintenance involve where the infrastructure assets are utilised, managed and retired (National Treasury, 2016). The authors Kibuuka and Fourie (2016) argue that asset maintenance needs to be seen as a strategic investment for the long-term preservation of assets. Infrastructure operations and maintenance is a crucial aspect of infrastructure delivery on the continent; however, it is often undervalued (ibid). Concerns have been expressed by researchers over the substantial quantity of newly constructed infrastructure that has been entrusted to organisations with insufficient ability to effectively run and maintain it (DBSA, 2008).

  The scope of operations and maintenance includes all activities related to the operation of assets, starting from the moment they are recorded in the asset register and transferred to operations from projects, until the assets are eventually disposed of. This encompasses not only the practical and operational tasks, but also the strategic and decision-making processes involved in developing asset strategies, planning the asset portfolio, and implementing physical projects (CIDB, 2012). These components include several aspects such as human and financial resources for operating and maintenance duties, technology, procedures, tools and equipment, and notably, physical infrastructure assets and facilities (ibid). According to the source mentioned, it is important for infrastructure assets to not only be there, but also be situated in the appropriate locations, undergo regular maintenance to ensure optimal functionality, and be enhanced to effectively cater to the distinct requirements of service delivery.

According to the National Treasury (2016), the infrastructure delivery management system plays a crucial role in facilitating advancements in project delivery, construction, rehabilitation, and maintenance. It emphasises that infrastructure-related activities such as acquisition and programme management cannot be carried out independently from this system. Figure 5 illustrates the depiction of the structure and linkages existing among the different parts of the IDMS.

Figure 2.7. IDMS Concept Structure



Source: MISA, 2020

The IDMS Concept diagram illustrates the organisational framework and interconnections among the ideas that facilitate the universal implementation of infrastructure delivery management principles across all governmental entities (Misa, 2020).

IDMS determines how portfolio management, programme management, project management, maintenance, and other related operations are implemented. IDMS's core legislative requirements, namely asset management, planning and budgeting, and supply chain management, are represented by interconnected inner circles (National Treasury, 2019). The integration of performance and risk management is seen within the delivery management procedures. Simultaneously, the outer circle symbolises the institutional framework that offers organisations direction on a standardised method to constructing an institutional Infrastructure

Delivery Management System. The practice of project risk management has been widely used in the realm of capital project development to effectively identify potential risks and evaluate their probability of occurrence. Additionally, it involves assessing the potential repercussions that may arise if these risks materialise and implementing appropriate actions to prevent or minimise their impact (Biesek, 2012).

According to MISA (2020), the use of portfolio, programme, and project management structures may effectively facilitate the management of risk throughout project delivery. Performance management plays a crucial role in guaranteeing the achievement of the government's objectives in terms of infrastructure delivery (CIDB, 2012). The achievement of effective service delivery performance relies on the cohesive integration of several unique components of service delivery (ibid). Performance management is responsible for establishing the criteria used to measure the outputs of IDMS processes. It then assesses the effectiveness and performance of these processes by comparing the outputs against the established criteria. In cases where the processes fail to meet the expected performance standards, performance management devises strategies to enhance their effectiveness (ibid).

The IDMS framework places a strong emphasis on systems thinking, which implies that the individual processes within IDMS cannot operate alone. Instead, they are interconnected, reliant on one another, and work together to strengthen the overall system. The graphic shown above illustrates the integration of these procedures with a performance management system, so constituting the institutional framework for infrastructure delivery. According to Watermeyer and Phillips (2020), the IDMS system serves the purpose of identifying and defining the essential components of the portfolio, programme, operations, and maintenance, project, and procurement processes. It also creates the necessary criteria and designated control points.

Risk may have an influence on the planning and subsequent results of any project. Infrastructure projects encounter several dangers, including but not limited to commercial and legal ties, economic circumstances, human behaviour, environmental occurrences, weather conditions, inherent and unforeseen site conditions, political events and community dissatisfaction (Watermeyer & Phillips, 2020). Various infrastructure systems and techniques entail distinct risks, thereby necessitating the careful assessment of risk for the successful provision of services. Risk refers to the potential occurrence of events or engagement in

activities that may hinder an organisation's ability to accomplish its strategic and operational goals. The sources of risk commonly encountered in projects encompass various factors, including economic and legal relationships, financial standing, political dynamics, human behaviour, natural occurrences, site conditions, community conflicts, technological aspects, and management practices. These risks are effectively managed within a comprehensive framework that prioritises the desired outcome, cost efficiency, functional procurement and delivery management, while also ensuring compliance with relevant legislation (National Treasury, 2016). The use of IDMS risk management within an organisation facilitates the identification of variables that may lead to deviations from anticipated performance in its processes and quality management system. This approach also allows for the integration of proactive controls to mitigate potential unfavourable outcomes and capitalise on opportunities as they arise (MISA, 2020).

The IDMS ensures linkages between people, tasks, information and resources for stakeholders to have a shared understanding of the project's objectives (Pasquire, 2012; Koskela, 2000). According to Koskela and Ballard (2006), the implementation of this approach facilitates a seamless workflow, fosters teamwork and ensures the dedication of all individuals involved in the project. Consequently, this leads to enhanced value for all stakeholders of the project. IDMS supports a basic concept of coordinated organisational structure design, which should be preceded by a thorough understanding of the public organisation's particular mandate and strategy concerning infrastructure. Organisation design refers to aligning the infrastructure unit's structure with the objectives, processes and systems of the public organisation with those of the IDMS. The aim is to enhance the efficiency and effectiveness of the public organisation in delivering infrastructure projects (National Treasury, 2016).

Organisational design involves:

- Understanding the imperative for IDMS-related change.
- Understanding the IDMS processes, workflows, roles and responsibilities, volumes of work, activity analysis and resources.
- Designing new models or systems and putting them to the test.
- Planning and managing the transition from the old structure to the new one aligned with the IDMS.
- Bringing the transition into effect and keeping track of it (Infrastructure Delivery Management Toolkit, 2010).

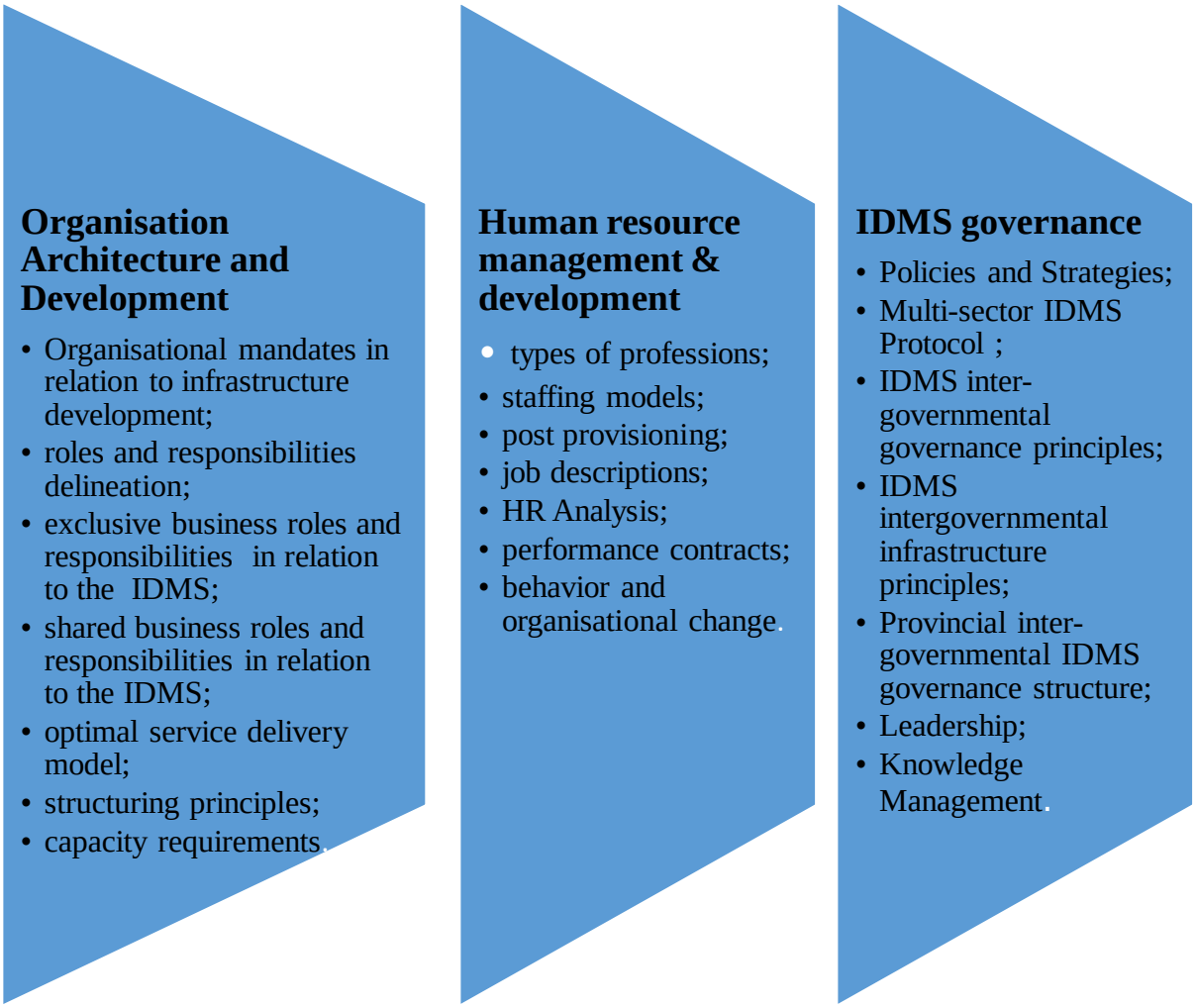
IDMS capacity is the institutions' functional ability to implement and sustain the IDMS. It refers to the availability and access to tangible resources, including human, financial, material, technological, logistical and information. According to Ofori (2012), it is essential for the construction industry to include several aspects, including corporate development, human resource development, technology development, materials development, procedures and documentation development, operational environment, and organisational building. The capacity to implement and sustain the IDMS also includes the intangible requirements of leadership commitment, change management, organisational values and culture, and other intangible attributes needed to translate the IDMS theory into practice.

The IDMS institutional structure is the glue that holds the IDMS systems together and facilitates their integration into the larger governance structure (MISA, 2020). IDMS describes resourcing in programmes as identifying the organisation's current and future resource needs to achieve its infrastructure programme goals (ibid). The IDMS approach instils a quality improvement philosophy in all delivery management processes and promotes maturity evaluations and goals to be included in an institution's planning, execution, and monitoring processes (Chigangacha, Haupt & Awuzie, 2018). Setting up projects for success requires effort spent that is mainly realised during the delivery.

2.6.5 Implementation strategy

Critical drivers of IDMS implementation include public sector governance, organisational design and architecture, and human resource management and development. National Treasury (2016) states that efficient planning, development and implementation of infrastructure programmes requires the evaluation and maintenance of multiple interconnected mechanisms. The IDMS governance structure involves the interactions among the government, the regulated community it serves, and the private sector (Sirbadhoo, 2021). The diagram illustrates the essential component in IDMS implementation including public sector governance, human resource management and organisational architecture and development.

Figure 2.8. Critical drivers of IDMS implementation



Source: Researcher's collection.

The strategic management of project delivery processes and the cultivation of expertise in infrastructure projects are often referred to as strategy. The approach involves adhering to a meticulously structured course of action, using logical decision-making processes about available alternatives and the context of the project in order to get the highest level of performance (Laryea & Leiringer, 2015). The field of project management has made significant progress in its capacity to effectively develop plans, create strategies, and oversee the various tasks associated with projects. According to Alshamsi (2019), a diverse range of duties is encompassed under these projects, necessitating various responsibilities for effective administrastion. According to Daniel (2017), it is crucial to prioritize the human dimension over the technical element to foster collaboration and stakeholder engagement. The aforementioned emphasis holds significant relevance in enhancing the overall quality of the final outcome, which may be achieved by increasing levels of communication and dedication

to the project. This implies that it is imperative for the project manager in the construction industry to establish a conducive atmosphere that encourages the active participation of all stakeholders, particularly during the planning phase. IDMS ensures that the infrastructure value chain is strategically coordinated and managed. During the planning process, the first step in achieving value for money through infrastructure projects is to align them with strategic goals, priorities, budgets, and plans and then to identify objectives and projected results, as well as parameters like timelines, expense and levels of uncertainty (Daniel, 2017). The goal is to prove that the project is "effective" in delivering good value for money (Chigangacha, Haupt & Awuzie, 2018).

The IDMS is complemented by the Standard for Infrastructure Procurement and Delivery Management (SIPDM) and Framework for Infrastructure Delivery and Procurement Management (FIPDM). The National Treasury implemented the SIPDM in 2015, making it applicable to all state organs (Watermeyer & Phillips, 2020). The SIPDM was created with the purpose of aligning procurement, contracting and delivery approaches for infrastructure projects with the goals outlined in the National Development Plan 2030 (Nugent, 2020). The SIPDM governed decision-making, delivery management, procurement processes, methodologies, procedures, and procurement documentation. Infrastructure projects involve interconnected activities with specific deliverables and checkpoints established within the control framework outlined in the SIPDM (National Treasury, 2012). Thorough preparation is necessary in order to minimise the need for modifications during the execution phase of a project. The SIPDM as outlined by the National Treasury in 2016, is founded upon the following principles:

1. To demonstrate engagement centred on trust between stakeholders at all project stages to avoid delays and risks.
2. Strategic administration of governance processes that include supervising elements to evaluate possible valuable factors in the project's lifecycle.
3. Employ meticulous project selection techniques.
4. Distinguish various procurement methods with their associated disadvantages and skillset requirements.
5. Standardise delivery to promote proactive management and clear establishment of roles.

6. Relationship building with the private entity, leaning on understanding and mutual trust.
7. Adapt resourceful data compiling systems for daily and long-term inspections and planning.
8. Establish sound competency within the public sector in planning, delivery, and operations.

The SIPDM mandate, which was implemented under the Public Finance Management Act (PFMA) in 2019, was repealed and replaced with the Framework for Infrastructure Delivery and Procurement Management (FIPDM). This framework aims to set the minimal criteria for the use of the IDMS toolkits, (Watermeyer & Phillips, 2020). The FIDPM is a comprehensive approach that emphasises governance decision-making, alignment and functions aimed at facilitating effective infrastructure delivery and procurement process management (National Treasury, 2019). Its primary objective is to ensure the optimal allocation of public funds and achieve a favourable socio-economic return on investment (Robinson, 2022). FIDPM involves the thorough assessment of stage documents to ascertain that project designs are suitable for their intended purpose and provide optimal value for the South African taxpayer (ibid).

State entities must build systems/frameworks that are solutions and results-driven in order to improve infrastructure service outcomes. Infrastructure deployment must be done in a rational, rigorous, and auditable manner. Effective coordination of stakeholders is paramount as it ensure alignment of project goals (Al Shamsi, 2019). The infrastructure delivery management system was established to allow stakeholders to collaborate in infrastructure delivery and increase efficiency. IDMS requires active participation from the client in project delivery, including decision making on the allocation of design and interface management responsibilities among the contracting parties (Watermeyer & Phillips, 2020). The client delivery management team owns the business case for each project, procuring and paying for the resources needed to complete it, leading the project, managing stakeholder relationships, overseeing delivery elements, and providing client guidance (ibid). Projects that devote adequate time and attention to the early phases are significantly more likely to fulfil their goals and demonstrate world-class delivery standards later on (IPA, 2021). Projects primarily requires early phase attention to maximise risks and achieve project goals.

The system has undergone several modifications and supplemented with SIPDM and FIDM aimed at enhancing project delivery. However the backlogs in infrastructure have also increased, despite the framework in place. The state intervention is primarily for infrastructure departments to enhance efficiency in project delivery. However the desired outcomes have not yet been apparent. This prompts the inquiry as to whether the IDMS is being efficiently executed to achieve desired goals.

2.7 Critiquing the extant literature

A persistent discourse exists over the potential impact of the infrastructure delivery process on the overall condition of infrastructure within nations, as well as its potential to boost the performance of the public sector and improve service delivery. Government authorities worldwide are encountering difficulties in implementing infrastructure projects, while the improvement of public entity rehabilitation still needs to be more efficient and effective. Despite the widespread adoption of public-sector reforms in numerous nations, the available empirical evidence suggests a very limited number of favourable outcomes. The level of difficulties and issues encountered can vary based on factors such as the specific program, the technique employed, and the unique conditions of the participating countries.

According to Amante (2020), an effective government possesses the ability to safeguard its citizens against acts of aggression, while also ensuring the establishment and upkeep of infrastructure that facilitates the exchange of goods and the provision of services. African nations encounter intrinsic difficulties and challenges that significantly impede the progress of their infrastructure development. In order to develop and implement successful policies and effectively navigate the infrastructure delivery environment, it is crucial for the many parties involved to possess a thorough understanding of its complex nature (Aija, 2021). Moreover, it is imperative to acknowledge and differentiate the varying levels of intricacy inherent in the process of infrastructure delivery.

One phenomenon that has been observed in the field of infrastructure delivery is a lack of substantial alterations in the leadership and delivery model. This refers to the tendency of infrastructure model to not effectively adapt to the revolutionary shifts occurring in the environment. According to Chemouni (2017),in a study on core public sector reforms in Rwanda argues that multiple factors contribute to this phenomenon. Research by Crudgington

(2020) argues that there has been a lack of substantial alterations in the leadership and delivery model of infrastructure projects to effectively adapt to the revolutionary shifts occurring in the field. Similarly, Curristine, Lonti, and Joumard (2007) suggest that the driving force behind changes is frequently rooted in ideological factors rather than being primarily driven by efficiency considerations. These arguments highlight the various factors and perspectives that contribute to the phenomenon. This phenomenon is significant because it can impede successful implementation of reform and hinder the achievement of desired outcomes.

masiya,Osei-Kojo and Yeboah-Assiamah (2013) conducted a comprehensive research study that shed light on various deficiencies within the field of public administration. These deficiencies encompassed issues such as inadequate leadership, insufficient knowledge domains, instances of misappropriation and inefficiency, deficient internal and external systems, as well as an abundance of duplication and fragmentation. This examination exposes the intricate challenges and problems that persist in this field. Moreover, Curristine, Lonti, and Joumard contend that changes within the realm of public administration often stem from ideological factors rather than considerations for efficiency. Nonetheless, it is worth noting that efficiency considerations can indeed exert considerable influence when driving changes.

Reforms are frequently implemented with the explicit objective of enhancing operational efficiency to achieve superior outcomes. , while ideological considerations may play a role in certain instances, they should not be regarded as the exclusive determining factor. It is important to note that the strategies employed to address delivery challenges often lack a comprehensive approach towards achieving predetermined targets, which can potentially lead to inconsistent outcomes. The underlying causes behind this issue are linked to insufficient attention given to overall policy development and an assessment of strategy effectiveness in effectively delivering infrastructure projects.

Some critics may argue that the difficulties encountered in infrastructure development are not solely due to existing approaches and management strategies, but are also influenced by other factors such as inadequate funding, political instability, and corruption. While it is true that these factors can contribute to the challenges faced in infrastructure development, it is important to acknowledge that even with adequate funding and political stability, the effectiveness of existing approaches and management strategies can still be questioned.

Yilema and Gianoli (2018) found that in a study of infrastructure delivery methods, there were multiple instances of delays in project implementation due to inadequate coordination between different departments or agencies. They documented cases where different departments were working on similar projects simultaneously, resulting in duplication of efforts and inefficient use of resources. Furthermore, their research indicated a lack of effective communication between stakeholders, leading to misalignment of project goals and objectives. Some scholars (eg Amanta, 2020 ;Adebabay ,2011) argue that the lack of proper infrastructure and resources may hinder effective coordination and management of projects. Additionally, political instability and frequent changes in leadership could also impact the ability to implement coherent policies. The aforementioned challenges give rise to difficulties in the implementation of reforms. This indicates that although coordination may have a role, it showcases the influence of infrastructure delivery reforms and the issues affecting the public sector. This underscores the need to evaluate the comprehensive aspects that comprise delivery systems.

Amanta (2020) found that the lack of accountability and corruption within the Ethiopian public sector led to mismanagement of infrastructure projects. They highlighted specific instances where funds were misused or infrastructure projects were delayed due to improper management. Tadesse (2019) also identified deficiencies in delivery reforms, such as inadequate leadership and delivery models. They provided examples of specific projects that were affected by these deficiencies, showcasing the impact on the overall infrastructure development. Similarly, Desta (2015) discussed revolutionary shifts in infrastructure delivery, including advancements in reforms and changes in project management methodologies. While previous research has primarily focused on identifying deficiencies in urban infrastructure development and the economic consequences of inadequate coordination of delivery reforms, there is a research gap when it comes to understanding the underlying factors that contribute to the effectiveness of delivery systems. This gap leaves a critical knowledge void in the field, as understanding these factors is crucial for improving infrastructure project outcomes.

Winter (2016) conducted a comparative analysis to examine the implementation of delivery changes across various state projects in the United Kingdom. This particular instance serves as an illustration of the variations in management controls across different countries, hence providing support for the assertion put out by Awuzie and McDermott (2014) that the effectiveness of management controls can differ between countries, suggesting that policies that have demonstrated success in one nation may not necessarily be effective or efficient in

another. The significance of the infrastructure disparity between Africa and wealthy economies lies in its consequential effect on economic development. However, it is important to consider that emerging countries may face unique challenges in infrastructure development that differ from those experienced by industrialised nations. Factors such as limited financial resources, political instability, and lack of access to advanced technology and expertise can pose significant barriers to successful infrastructure projects (Watermeyer, 2013). It is crucial to take these factors into account when designing strategies and approaches to improve infrastructure delivery in these contexts. Insufficient infrastructure can impede trade, investment, and general economic development. The aforementioned phenomenon has the capacity to sustain a recurring pattern of impoverishment, hence constraining the prospects of nations to attain enduring progress and development. Hence, it is imperative to prioritize the resolution of this infrastructure deficit in order to foster economic advancement and enhance the overall well-being of the populace within the area.

Previous research has shown that inadequate coordination and improper management in the public sector can have significant economic consequences. A study by Aija (2021) found that delays in project implementation can lead to increased costs and missed deadlines, impacting the overall efficiency and effectiveness of infrastructure projects. Inefficient resource allocation can result in wasted funds and resources, diverting scarce resources away from other pressing needs. These economic consequences can have long-term effects on the country's development and hinder its ability to attract investments.a report by the World Bank (2018) highlighted how poor project management and coordination in a particular country led to cost overruns of 30% and delays of several years in infrastructure projects, ultimately affecting the country's economic growth and stability.

Ntiyakunze (2011) directs their attention on the institutional variables that exert influence on the development of infrastructure in African countries. The authors contend that inadequate governance systems and instances of corruption can impede the effective implementation of infrastructure initiatives. Aija (2021), conversely, investigates the limitations encountered by African governments in terms of financing and executing infrastructure projects. The study conducted by Crudgington(2020) examined the efficacy of infrastructure projects in the public sector across multiple countries. The research revealed that, on average, public sector projects exhibited cost overruns and delays in comparison to those executed by the private sector. Based

on the existing empirical information, it appears that the public sector may have challenges in efficiently delivering infrastructure, necessitating prompt resolution.

Amante (2020) has demonstrated that the implementation of evidence-based decision-making within the government sphere has proven to boost the efficacy and efficiency in achieving strategic outcomes, including infrastructure projects. By basing decisions on empirical evidence and rigorous analysis, policymakers can ensure that infrastructure projects are designed and implemented in a way that maximizes their effectiveness. This can involve conducting thorough cost-benefit analyses, assessing potential risks and uncertainties, and considering the long-term impacts of infrastructure investments. This supports the study Hudson et al,.(2019) indicating there is a growing acknowledgment that the effectiveness of policies is dependent on the implementation process rather than being completely dictated by its intrinsic characteristics. While there are efforts being made to improve infrastructure delivery in South Africa, it is important to consider opposing viewpoints. Some critics argue that the current reforms may not address the fundamental reasons that contribute to capacity limits, and that a more comprehensive economic reform agenda is necessary (Masters, 2019). Additionally, there are concerns that the existing techniques of infrastructure delivery do not adequately reflect the various advances in delivery that have been implemented, and that the relationship between infrastructure services and organisational structure lacks comprehensive understanding (Masters, 2019). These opposing viewpoints highlight the complexity of the issue and the need for a multifaceted approach to infrastructure delivery.

Winter (2016) asserts that the successful resolution of infrastructure difficulties is of utmost importance in order to optimise value throughout the many stages of design, implementation, and maintenance. Furthermore, it is vital for the effective advancement and execution of domestic infrastructure initiatives and strategies. The presence of efficient public administration is necessary for the proper functioning of contemporary states, regardless of their level of development (Ntliziywana, 2017). The utilisation of global observational data may yield additional benefits within this particular situation. The available data indicates that industrialised nations, such as the United Kingdom, have played a significant role in the implementation of infrastructure upgrades. This is visible in the infrastructure expansion. On the other hand, emerging countries as Rwanda, Ethiopia and South Africa, which have been confronted with the challenge of reconstructing and rehabilitating its infrastructure, are actively investigating alternative approaches to improve the delivery of services. Winter (2016) posits

that the existing approaches and management strategies employed in infrastructure development have encountered difficulties in effectively addressing evolving demands. Consequently, this has resulted in a rise in the occurrence of prominent projects that encounter delays, surpass financial constraints, and fall short of achieving public anticipations.

Efforts are currently being made to implement reforms aimed at improving the efficiency, effectiveness, and alignment with national strategic objectives of the national transfers distributed to provinces and local governments. These reforms seek to improve the overall delivery of services and address the infrastructure needs of residents. According to Mathe (2002), there is increasing evidence suggesting that South Africa has formulated good policies; however, their implementation is hindered by limited capacity and financial resources. A study conducted by (Mabugu, 2016) found that instances where policy implementation was hindered due to limited capacity and financial resources and the situation can be partially attributed to the government's endorsement of the neoliberal agenda, which has resulted in resource constraints for public sector reforms.

Aija (2021) asserts that African infrastructure projects exhibit inherent complexity, hence carrying significant consequences for the formulation of policies. The aforementioned complexity pertains to the necessity of comprehending and situating comprehensive requirements and possibilities within a given environment. Winter (2016) argues that effectively addressing evolving demands in infrastructure development has proven challenging, leading to delays, financial constraints, and unmet public expectations in prominent projects. Aija (2021) emphasizes the inherent complexity of African infrastructure projects and highlights the importance of comprehensive understanding and strategic approaches in policy formulation and implementation. The process of strategy involves identifying accountable entities, establishing execution schedules, and estimating corresponding expenses. By recognizing the interconnectedness of policy and strategy, infrastructure delivery can be optimized to achieve desired outcomes and meet societal needs.

The intricate nature of infrastructure provision and the presence of infrastructure inadequacies in South Africa can be ascribed to the structural disparities that were established during the apartheid era, along with service backlogs and significant racial inequalities among the populace. These inadequacies have far-reaching consequences for the population, including limited access to essential services, hindered economic growth, and exacerbation of social

inequalities. For example, a study conducted by Ntliziywana (2017), asserts that there is evidence to suggest that the apartheid regime in South Africa was ineffective in providing essential services to its populace. Understanding the impact of these inadequacies is crucial for developing effective reforms and addressing the needs of the population.

Researchers have raised concerns regarding the significant amount of recently developed infrastructure that has been assigned to organisations lacking the necessary capacity to efficiently operate and sustain it (DBSA, 2008).The topic of service delivery has become a significant concern in numerous industrialized nations, resulting in noteworthy occurrences of public protests in diverse countries (Masiya et al., 2019). The different administrations continually pursue the investigation of various reforms with the objective of attaining universal access and equitable supply of essential services, while also striving to improve service delivery According to Masters (2019), the many reforms shared common objectives, however they exhibited variations in terms of their formulation and the regulatory frameworks they adopted. As the shortcomings of existing systems become increasingly evident, alterations in the policy framework exert a significant impact, hence necessitating a fundamental shift in the operational dynamics of governmental organisations.

Despite extensive investigations, conventional infrastructure delivery strategies fail to adequately incorporate the innovations achieved in delivery processes. Insufficient understanding exists on the influence of organisational structure on service delivery, potentially impeding the enhancement of service delivery outcomes. In addition, prior research has failed to consider important elements such as the regulatory framework, institutional arrangements and processes, and the political economy. These considerations greatly influence the efficacy of infrastructure sectors. The establishment of connections between governance, institutional framework, and procedures across various legislative statutes and regulations is a significant challenge in infrastructure delivery, potentially resulting in a lack of progress and prolonged decision-making processes.

Since 2001, the National Treasury has been assigned the task of commissioning, formulating, and improving policies and strategies designed to tackle the substantial delay in the provision of essential infrastructure. This delay is of utmost importance for the achievement of the developmental goals outlined in the Constitution (Nugent, 2020). A research conducted by the National Treasury revealed numerous difficulties in dealing with infrastructure bottlenecks in

the public sector. These challenges encompass inadequate planning, insufficient technical skills, inconsistent procurement processes, and inadequate reporting and monitoring methods (MISA, 2020). Furthermore, the analysis of specific construction projects in South Africa that have experienced delays or issues due to ineffective delivery systems offers tangible illustrations of the challenges encountered and the potential benefits of enhancing infrastructure delivery (DBSA, 2016).

According to the National Treasury (2016), a proposal was subsequently issued to construct a standardized and comprehensive set of protocols. The objective of these protocols was to effectively oversee and synchronize the execution and administration of public sector infrastructure in South Africa. The present administration is currently enacting a comprehensive infrastructure agenda that integrates rigorous planning and implementation protocols. The current policy and strategy frameworks incorporate the utilisation of IDMS to facilitate the efficient implementation of institutional and capacity building initiatives. A significant portion of the framework is dedicated to addressing the difficulties encountered by organisations responsible for delivering infrastructure. Unforeseen consequences may arise when the management of infrastructure provision is conducted inside a regulatory planning framework.

The data presented does not provide a complete resolution to the methodological obstacles discussed earlier in comprehending development outcomes. However, it does offer an opportunity to conduct a systematic review of the performance of South Africa's public sector infrastructure delivery sector. The provision of infrastructure and the quality of services are determined by multiple variables within the institutional framework, as well as the sequencing and overall composition of reforms, together with other associated issues. This observation ultimately leads to the conclusion that there is a valid inquiry regarding the effectiveness of delivery systems. Without a doubt, it is evident that the challenge within the current body of knowledge does not stem from a dearth of solid information about the relationship between infrastructure delivery methods and infrastructure outcomes. Rather, the issue resides in the constrained applicability of such research when it comes to policy implementation.

The infrastructure industry is constantly evolving, necessitating the assessment of the infrastructure delivery system for effective infrastructure provision This statement implies that there is a significant opportunity to enhance the implementation methodologies used in public

sector infrastructure sector globally. This study seeks to fill the existing research void gap by delving into and unpacking the components of the delivery system, providing insights into how these factors influence the effectiveness of the system in infrastructure project delivery.

2.8 Summary

The literature review on infrastructure delivery within the Sub-Saharan African and European context reveals several key findings. Government authorities worldwide face challenges in executing infrastructure initiatives and improving public entity rehabilitation. Despite wide spread efforts to implement regulatory reforms in the public-sector , data indicates a lower number of successful outcomes in infrastructure delivery. The literature suggests that infrastructure delivery is influenced by various factors, and South Africa is among many countries facing grappling with similar challenges. The research focused on issues identified with implementation of delivery reforms. These studies have emphasized difficulties and identified numerous strategies to enable infrastructure outcomes. Potential barriers to implementing infrastructure projects in developing countries include limited financial resources. Another significant barrier is the lack of technical expertise. Additionally, bureaucratic hurdles pose significant challenges, compounded by prevalent corruption, and ongoing political instability. These barriers can greatly impede the advancement of infrastructure development and necessitate targeted interventions.

Common weaknesses in current infrastructure design, implementation, and delivery approaches include a lack of coordination among government entities, inadequate project management practices, insufficient consideration of long-term sustainability, and limited stakeholder engagement. These vulnerabilities can lead to delays, cost overruns, and suboptimal infrastructure outcomes. These studies have provided valuable insights into the importance of effective governance structures, long-term planning, and stakeholder collaboration in infrastructure delivery. The study seeks to fill the existing research void gap by delving into and unpacking the components of the infrastructure delivery management system, providing insights into how these factors influence the effectiveness of the system in infrastructure project delivery.

The public sector's primary focus is on enhancing social infrastructure, which impacts both the economy and individual well-being. Addressing these challenges and enhancing the

implementation of infrastructure projects is crucial for sustainable development and economic growth. By reviewing and synthesising these previous studies, this research aims to build upon existing knowledge and identify best practices that can be applied in the South African context.. There is an urgent need for a comprehensive infrastructure delivery because current methods have been inadequate in meeting the nation's demand and strategic goals of improving population well-being. The research enhances comprehension and provides valuable insights for policymakers and practitioners by addressing the research gap .The next chapter will delve into the specifics of the research methodology, including data collection methods and analysis techniques.

Chapter Three: Research design and methodology

3. Introduction

The previous chapter reflected the breadth of literature examined in this study. This chapter provides an opportunity for the researcher to elucidate the process through which the investigation project was conceived and developed. The chapter focuses on the research methods employed in the study. This chapter provides a critical analysis of the philosophical underpinnings that underlie the research, as well as the methodological approach and empirical methodologies employed to fulfil the research objectives. Additionally, the rationale for the selection of the preferred paradigm for the study is elucidated. The various data collection and analysis instruments used are outlined and their significance discussed. The report outlines the criteria used for selecting interviewees and provides profiles of the organisations with which they are affiliated. The scope and limitations of the research design are also defined and explained.

Research is defined as a systematic creative effort aimed at expanding knowledge and utilising that knowledge to establish or confirm facts, solve problems, develop new theories, and provide innovative solutions (Basias & Pollalis, 2018). Leedy and Ormond (2010) postulate that research is a systematic method of collecting, analysing, and processing information in order to enhance understanding of a particular research topic. Meanwhile, Merrim (2021) characterises research as a meticulously structured endeavour aimed at collecting factual information in order to address targeted inquiries. The research process involves a structured and organised approach that encompasses various stages, including observing a phenomenon, defining the research problem, making decisions about methodology, collecting and analysing data, interpreting findings, and communicating them through oral and written means, as well as reflections on the project's success by the researcher and various audiences (Alam, 2021).

Saunders, Lewis, and Thornhill (2016) corroborate that research is a process for investigating and increasing knowledge in particular subject areas. Research is a technique for seeking solutions to specific problems by combining tried-and-true methodologies with a logical and systematic approach to the problem at hand. Pandey and Pandey (2015) utter that research is a process of carrying out the scientific method of study in a systematic, formal, and intensive manner and that it entails a more structured inquiry, which usually results in a formal record of

procedures and a summary of findings or conclusions. A comprehensive and systemic perspective is required for research, which entails identifying regulatory or structural forms that generate or amplify the object of analysis (Da Silva, 2017).

There are multiple methods available for the collection of research data. According to Daniel (2017), it is crucial to have a clear grasp of the differentiation between research methodology and research techniques at the outset, as this will facilitate the design of the research process. The selection and implementation of a suitable research methodology and approach need the establishment of a meticulously planned research process. The formulation of research inquiries is of utmost importance as they guide the investigation and may establish the foundation for a broader research program (Atkinson, 2017). In order for the research findings to be deemed trustworthy by the readers of the research report, it is imperative that any methodology employed adequately delineates the research process. Furthermore, the analysis methodologies utilised must possess the capacity to establish the validity of the study. (Johnson, Adkins & Chauvin, 2020).

The term "methodology" is defined as the strategy, plan of action, procedure, or design that underpins the selection and use of specific methods and connects the methods' selection and application to the desired outcomes. Its goal is to describe, assess, and justify the usage of specific methodologies (Moon et al., 2019). Research methodology pertains to procedures of logical thought process that apply to scientific investigations, while research encompasses the specific techniques that are employed and accessible in the process of conducting research (Fellows & Liu, 2003). According to Da Silva (2017), in order for a research endeavour to be considered a study, it must adhere to certain requirements. These criteria include being regulated, rigorous, systematic, and verifiable to the greatest extent possible. Additionally, the study should be characterised by analytical and essential qualities.

The purpose of conducting research is to enhance knowledge and provide ongoing suggestions and enhancements for novel systems and practices (Ntiyakunze, 2011). The selection of a researcher's approach is influenced by both philosophical and practical factors. According to Tumele (2015), it is imperative to establish a clear explanation for linking the data to the propositions and to describe the criteria for evaluating the results. Prior to providing an appropriate formulation of the research question and propositions, it is essential to conduct a

comprehensive examination of the existing theoretical literature and empirical investigations pertaining to the subject matter (ibid).

The selection of a theoretical perspective has a significant impact on the chosen methodology, serving as a foundation for the overall process and establishing its rationale and standards (Kelly & Cordeiro, 2020). Theories serve as conceptual frameworks and foundational ideas that offer guidance for a particular area of research (Desta, 2015). The development of theories can occur through a top-down approach, wherein a theory rooted in scientific principles is implemented in practical settings and serves as a conceptual foundation for the creation of tools and methodologies. The development of theories can also occur in a bottom-up fashion, wherein new procedures and approaches are employed in practice without explicit conceptualisation and theoretical underpinnings. However, it is important to note that scientific clarifications and conceptualisations are finally pursued (ibid). The next section illustrates the pertinent theories and their contributions to the theoretical framework of the investigation.

3.1 Theoretical framework

Adom, Hussei, and Agyem (2018), opine that the theoretical framework holds significant importance in research and is intricately connected to the research problem. Eisenhart (1989) argues that the incorporation of a theoretical framework in research endeavours facilitates the exploration of diverse perspectives that may potentially contradict the researcher's own standpoint, so enhancing the overall strength and validity of the study. This tool facilitates researchers in determining the best appropriate research approach, analytical instruments, and methods for their research enquiries. Akintoye (2015) emphasises the criticality of augmenting the significance and practicality of research outcomes. The utilisation of theoretical frameworks by researchers enables them to build the philosophical, epistemological, methodological, and analytical foundations of their investigations (Grant & Osanloo, 2014). The term "theoretical framework" pertains to a compilation of concepts that are employed in a research undertaking.

This research examines many concepts that have been proposed in the extant scholarly literature, with a particular focus on the theory that is most pertinent to the present analysis. This part centres its attention on three significant theoretical frameworks, namely the theory of constraints, systems theory, and institutional theory. The theories examined in this part

comprise well-established concepts that have been supported by actual study in several academic fields. These theoretical frameworks offer significant insights into the attributes, trends, and variables that are pertinent to systems in the real world. Infrastructure systems can be understood as complex frameworks that provide various difficulties and opportunities, often overlooked by traditional fragmented methods (Winter, 2016). The study focused on a subset of theories that hold significant importance. The theories are elaborated upon and analysed in terms of their role. The identified theories and their application to the analysis are summarised in the table below.

Table 3. 1. Theories applicable to the study

Theory	**Description**	**Applicability**	**Relevance**
Theory of constraints	A technique used to enhance process by identifying factors in systems prohibiting them from reaching their objectives Goldratt (1990)	Theory's focus is on enhancing operations improvement	The theory elucidates factors that attribute to system performance and technical change process The primary aim is to eliminate barriers, or bottlenecks.
Institutional theory	Examine processes that establish the following structures (as determined by authoritative social behaviour guidelines): schemas, rules, norms and routines Also, examines how these elements are spatially formed, transferred, adopted, over time; and also how they are retired (Scott, 2005)	Theory captures structure in the institutions and examines social conditions	The theory explains why practices and structures in institutions are embedded and reasons why change takes place.
Systems theory	A theoretical viewpoint that evaluates an occurrence that is viewed as wholesome instead of as addition of its individual constituents (Mele, Pels & Polese, 2010)	Presents a framework for assessing the quality of a system based on many characteristics, including the examination of its components, structure, interaction, environment, conceptualisation, and holism.	It focuses on the coherence of parts, interactions, relations and takes into consideration the objectives, constraints and resources. The theory addresses the concept of complexity and demonstrates its capacity to effectively navigate and adapt to environmental changes through interactive processes.

Source: Researcher's collection

Institutional theory

The main objective of institutional theory is to provide a comprehensive understanding of how organisations engage with their external environment through an examination of the existing regulations, beliefs, and norms (Lammers, 2017). The theory enables an analysis of the processes implicated in the establishment and structure of an organisation. The scholarly work by David, Tobian, and Boghossian (2019) explores the concept of adopting and disseminating formal organisational structures, such as written regulations, standard processes, and creative organisational forms, through the framework of institutional theory.

Desta (2015) posits that the formation of an organisational structure entails the amalgamation of designated duties, accessible technology, and the impact of environmental and human factors. The attainment of project objectives is facilitated by employing both semi-formal and formal procedures. The author further argues that the successful management of procedures requires the implementation of established protocols that are rigorously enforced, and the allocation of resources is done accordingly. Effective implementation is facilitated by well-designed organisational structures, which align supervision, assign responsibilities, organise work processes, and integrate resources to coordinate diverse activities.

The sceptical viewpoint of institutional theory presents a critique of the rational-actor model of organisation, which asserts that organisations emerge from the choices of individual rational actors. In contrast, the theoretical framework of institutional theory places emphasis on the importance of institutions at a collective level and posits that the establishment and endurance of institutions cannot be comprehensively elucidated solely by individual behaviours (Desta, 2015). The primary focus of the institutional theory lies in addressing issues pertaining to organisations. The application of the theory in this study is limited due to its restricted emphasis on organisations and culture, hence overlooking the potential benefits of incorporating the project delivery system to enhance efficiency.

Theory of constraints

The theory of constraints (TOC) is a management concept proposed by Eliyahu M. Goldratt, which asserts that every system inherently includes at least one constraint. Goldratt (1990) posits that the theory of constraints is a systemic structure aimed at identifying and removing limitations within an organisational process that impede the achievement of goals. The theory of constraints (TOC) is a methodology that seeks to improve process efficiency by giving

special attention to the discovery and management of the 'system constraint' or bottleneck (ibid).

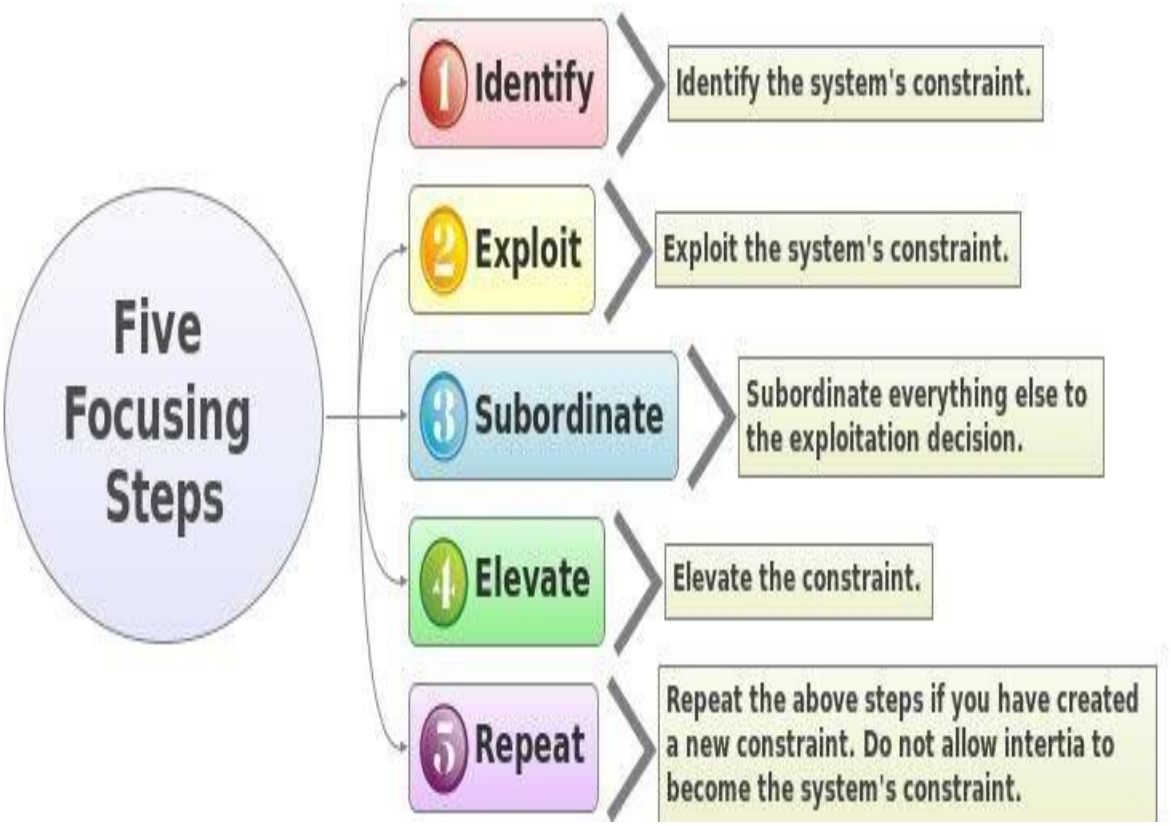
A constraint is defined as a limitation that is imposed on a system, which prevents it from achieving higher levels of performance. This theory explores many constraints inside a system that influence performance and aims to suggest strategies for enhancing performance. Watson, Blackstone, and Gardiner (2002) propose a categorization of limitations into three distinct forms, namely physical, market, and policy constraints. Physical constraints occur when the available resources are inadequate to satisfy the prevailing demand. In contrast, market constraints arise when the level of demand falls below the existing capacity of accessible resources. Finally, policy constraints comprise a range of formal and informal limitations that impose restrictions on the level of efficiency inside the system.

The procedure for putting TOC concepts into practice

The construction of the theoretical framework is based on a technique consisting of five steps. The procedures follow a sequential order, directing individuals to focus their efforts on the system component that has the greatest potential for positive impact on the system. As stated by Watson, Blackstone, and Gardiner (2002), the primary phase of implementation entails the construction of a precise delineation of the system in question and the determination of its intended objective. Once the aim of the system has been established, the final task involves defining measures that align with the aforementioned objective. The following stages presented below comprise the five main key points:

1. Identify the system constraints (The weakest link in a system might be either physical or a policy). The performance of a system is determined by its constraints (Watson, Blackstone & Gardiner, 2002).
2. Decide how to exploit the constraint (The change agent's goal is to get as much capacity out of a restricting component as feasible without undergoing costly adjustments).
3. Subordinate everything else (The system's non-constraint components must be set to a setting that allows the constraint to operate at maximum effectiveness).
4. Elevate the constraint (Taking whatever step is necessary to eliminate the constraint is referred to as 'elevating' this same constraint.
5. Return to step one.

Figure 3.1. Five steps of theory of constraints



Source: Tendon, 2012

According to Goldratt (1990), the theory of constraints (TOC) necessitates the application of cause and effect analysis to comprehend the ramifications of a specific action on different components of the project, as well as the regulation of the project management environment's behaviour. According to Trojanowska and Dostatni (2017), the central emphasis of the Theory of Constraints (TOC) is on the identification of weak links as the initial step in implementing adjustments. This phenomenon can be attributed to the constrained influence that enhancing other system components and optimising local efficiency can exert on the system's overall performance. Therefore, it is essential to maximise the use of the constraint in order to achieve the maximum output from the system (Watson, Blackstone, & Gardiner, 2002). This suggests that various processes, organisations, and systems are susceptible to being disrupted due to the existence of a vulnerable component, which has the ability to cause harm, malfunction, or negative consequences on the overall outcome (Tulasi & Rao, 2012). The primary goal of performance assessments in organisations, as guided by the Theory of Constraints (TOC), is to achieve financial viability in both the present and future (ibid).

The main challenge connected with Theory of Constraints (TOC) is a fundamental adjustment in mindset as compared to traditional practises in operations management. The successful implementation of infrastructure projects is hindered by a diverse array of internal and external limitations. The idea primarily emphasises technical limits, hence overlooking the incorporation of social aspects. The application of the theory in the field of infrastructure studies is significantly limited, making it inappropriate for integration into this specific research undertaking.

Systems theory

According to Skyttner (2008), a system can be defined as a cohesive entity comprised of interconnected units that collaborate to achieve a specific objective. As stated by Walker (2015), a system can be characterised as a cohesive entity comprised of interrelated components, which may encompass both tangible and intangible aspects. As posited by Ntiyakunze (2011), a correlation, whether direct or indirect, can be observed among the various elements. According to Castelle et al. (2015), the interpretation of a system is shaped by its surrounding context, which comprises several elements including situations, components, conditions, values, and patterns. The operational context of a system has a significant impact on its behaviour, interpretation, engineering process, and solution design and deployment (ibid).

Teater (2014) defines systems theory as a theoretical framework that analyses the interrelated and interactive elements inside a system, which collectively contribute to the development of a cohesive entity. Ntiyakunze (2011) posits that the theory provides a conceptual framework for analysing complex processes with the aim of determining, evaluating, and improving the interrelationships among the many components and their influence on the overall effectiveness of the process. The major concern of the theory is around the inquiry into whether perceptible aspects ought to be categorised as constituent components of the system, as well as the identification of which factors should be considered as part of the system's surrounding environment (Ejigu, 2007). The technique outlined above has the ability to assist in the identification and management of complexity and emergent features, leading to cost reduction and the supply of additional benefits, thus boosting the value proposition of infrastructure (Winter, 2016).

According to Ejigu (2007), the concept of systems thinking can be characterised as the act of reducing intricate phenomena, incorporating components from both creative and scientific domains. The primary emphasis is placed on the capacity to observe beyond a state of disorder, skillfully negotiate interconnections, and understand the concept of decision-making (ibid). According to Desta (2015), the utilisation of systems theory enables the analysis of the interconnectedness of many elements of a project, including processes, resources, and management approaches, as well as their interactions with the external environment. The systems approach is a theoretical framework that analyses the interrelationships between technical and social elements within a specific system. The concept of perceiving an organisation as a single entity involves taking into account its fundamental principles, objectives, and governance procedures. This procedure facilitates the recognition of prevalent and rare patterns within a given system, along with the identification of possible actions, risks, costs, and benefits linked to those patterns. Furthermore, it enables the assessment of the system's efficacy and long-term viability.

There is a significant body of academic literature on systems theory that has extensively documented various occasions where the approaches offered by this approach have shown positive outcomes across a wide range of sectors of progress (Ejigu, 2007). In his study, Ejigu (2007) employed a theoretical framework to examine the application of system thinking in practical initiatives and policy-making processes. Additionally, Ejigu explored the conceptual and theoretical usage of system thinking, particularly in scientific studies. The application of systems theory by various theorists (e.g., Winch, 2002; Walker, 2007) offers a conceptual framework for comprehending the interconnected processes involved in project completion, as well as the project's interaction with its environment. Additionally, transaction cost economics is employed to elucidate the formation of entities undertaking the project and the specific structure they adopt (Desta, 2015).

As stated by Ejigu (2007), the strategy exhibits the capacity for implementation across many tiers of infrastructure delivery, encompassing the project level, planning level, and policy making level. The application of a theoretical framework is crucial in the analysis of infrastructure projects, as it undergoes co-evolution and interacts with other systems (ibid). Winter (2016) suggests that comprehension can be improved by utilising the output of the system in regard to component performance and linkages. Moreover, the ongoing and iterative

involvement of stakeholders enables the identification of areas for change, implementation of interventions, and monitoring of progress.

Ntiyakunze (2011) asserts that the degree of collaboration among project participants significantly impacts the efficacy of the construction process. The efficacy of the project is contingent upon the collective understanding of project goals and the acknowledgment that individual accomplishments are interdependent on the efforts of others. The theory indicated above is highly applicable for examining and understanding relational conflicts that occur in the context of building projects. This is because it places significant importance on the collective actions and interconnections of various components within the system.

3.1.1 Relevance of theory to the research

The study focuses on providing a comprehensive and organised analysis of the infrastructure delivery management system. The system approach is seen as an attractive method due to its ability to offer a structured framework for incorporating several schools of thought, while allowing for flexibility and a deeper understanding of the organisational dynamics within and outside of their environment. Theoretical underpinnings of systems theory enhance our understanding of real-world systems and facilitate more accurate interpretation, in addition to serving as the basis for the analysis of complex systems (Castelle et al., 2015). This perspective posits that systems theory incorporates both organisational and process considerations. The use of a systems approach in addressing the challenges associated with managing large infrastructure systems as individual projects has the potential to effectively enhance value creation by reducing both capital and operational costs, as well as improving the realisation of benefits (Winter, 2016). In essence, it is imperative to possess a comprehension of the many interconnections and interdependencies that define infrastructure systems (ibid).

Awuzie and Monyane (2020) suggest that the infrastructure delivery system encompasses two unique modalities of governance, namely a structural perspective and an actor-oriented perspective. The primary focus of the first perspective is the notion that social systems possess self-governing and autonomous characteristics, controlling themselves through cyclical and self-referential processes that contribute to their overall identity (ibid). In contrast, the actor-oriented perspective perceives social systems as an assemblage of inter-actor interactions, wherein the actors function as empirical sub-units. This perspective suggests that governance

involves the operation of self-organising systems and individuals within shared organisational networks.

The study assumes that a comprehensive comprehension of systems theory and its utilisation in the context of infrastructure development serves as the foundational framework for theoretical analysis. The idea offers a conceptual framework that facilitates a broader perspective when addressing intricate global concerns. The use of systems theory highlights challenges associated with integration and the causal relationship. According to Ejigu (2007), the utilisation of the systems approach, along with its wide range of system analytical tools, facilitates the elucidation of policy alternatives. The theory holds significance due to its ability to serve as a framework for applying several flexible and well-known cognitive approaches to comprehending the dynamics within both internal and external aspects of organisations, hence facilitating a comprehensive comprehension of the subject matter. This provides an opportunity to identify and analyse shortcomings, as well as establish guiding principles for addressing these shortcomings within a pertinent framework.

In order to comprehensively assess the effectiveness of the system, it is important to take into account all constituent aspects, including processes, data, tools, relationships, and the organisational structure. Awuzie (2013) posits that the attainment of viability in a system is reliant on the presence of five fundamental functions: operation, coordination, control, intelligence, and policy. The theory's suitability for scholarly inquiry is enhanced by the presence of coherent activities and interrelated relationships within the system's constituents. The achievement of effective infrastructure implementation requires the construction and upkeep of an intricate network of interconnected interactions that have an impact on the ultimate outcome. The successful resolution of inefficiencies in infrastructure delivery relies on the synchronisation of objectives among government agencies. Ntiyakunze (2011) asserts that the effective execution of infrastructure projects is significantly impacted by the dynamic interaction of governance, systems, and human resources.

In order to assure the proper execution of a study, certain procedures were undertaken inside the research process. The initial step in the research process for this study involved doing a preliminary literature review. This review aimed to identify any existing gaps in the literature and to define the specific research question. The appropriate study methodology and design were subsequently selected. The data gathering technique employed in this study was

conducting interviews, followed by an analysis of the collected data. The results derived from the analysed data are reported in Chapter six. This section provides a discussion on the principles that guided the theoretical development of the study, as well as the research methodologies employed. The aim is to enhance comprehension of the analysis and organisation of ideas. The next section highlights the conceptual framework of the study.

3.2 Conceptual Framework

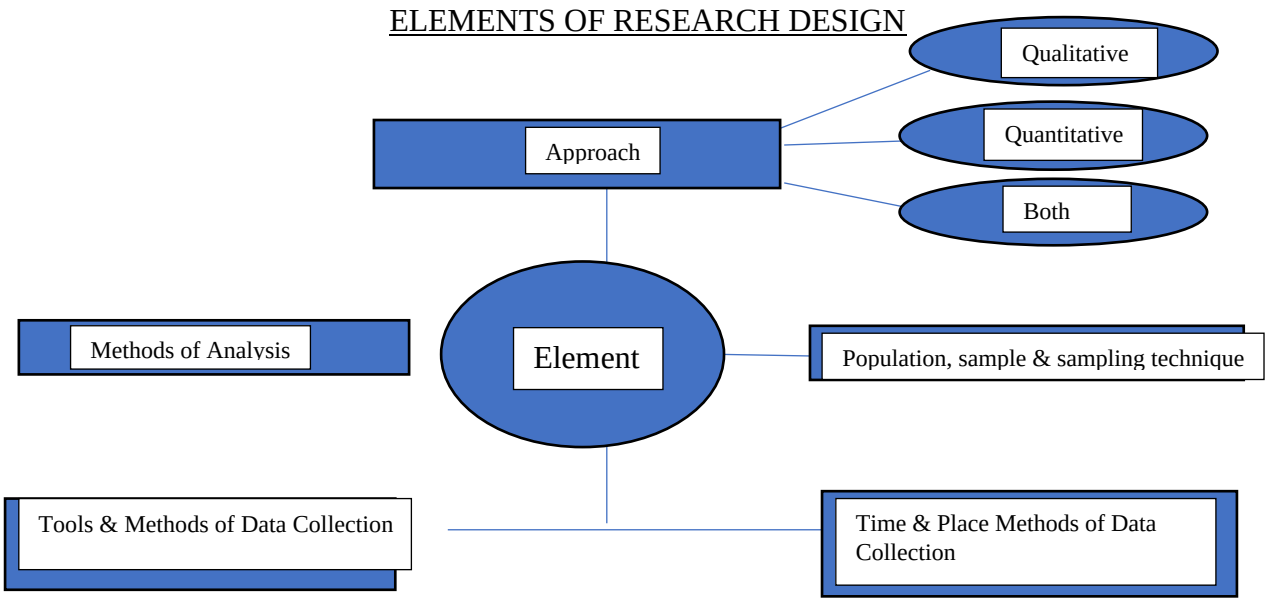
A conceptual framework is a highly effective instrument for establishing the foundational basis upon which subsequent empirical inquiries can be conducted. Miles and Huberman (2018) describe conceptual framework as structured notions, assumptions, expectations, credences and abstracts that promote and inform the research and the relationships among them. According to Ravitch and Riggan (2016), the establishment of a conceptual framework plays a crucial role in shaping and directing a study, providing guidance throughout its growth, and serving as a mechanism for integrating all elements of the research process.

Adom, Hussein and Agyem (2018) stipulate that the framework is a procedure in which the researcher assumes and outlines the subject of interest under study. Chijioke, Ikechukwu, and Aloysius (2021) acknowledge that the topic under investigation is intricately linked to the concepts, empirically supported research, and fundamental theories utilised to facilitate and methodically enhance the researcher's expertise. The concept encompasses a compilation of core principles and regulations that function as a foundational framework for inquiries and scholarly exploration within distinct domains of knowledge. The research process relies on assumptions on the foundational aspects and nature of knowledge (Al Shamsi, 2019).

Ravitch and Riggan (2016) assert that the conceptual framework serves to elucidate the significance of the research issue, the underlying assumptions of the researcher, the scholarly discourse surrounding the topic, and the theoretical rationale behind the researcher's chosen methodology. The framework illustrates a comprehensive methodology for investigating the research problem. Daniel (2017) postulates that the research framework can only be reached or attained with the correct positioning or establishment of the research philosophy. The selection of a research design is influenced by several factors, including the nature of the research problem or topic under investigation, the researchers' own experiences, and the intended audience of the study (Johnson, Adkins & Chauvin, 2020). The diagram presented in Figure 3.1

provides a visual representation of the different components that should be taken into account during the process of constructing a research design.

Figure 3. 2. Elements of Research design



Source: Tendon, 2012.

The design of a research study is shaped by the researcher's conceptions of knowledge and reality, which are frequently shaped by their disciplinary affiliations (Thakur, 2021). The researcher is directed to the components of the conceptual framework that need to be studied.

The research design must be chosen carefully for any investigation to produce accurate results, comparisons, and conclusions (Kumar, 2019). In the realm of research, two distinct forms of reasoning can be identified: deductive and inductive. According to Mahdi (2011), the deductive method involves initiating the research process by establishing an abstract framework that is rooted in a theory or ideas derived from the pertinent literature. The researcher formulates a theoretical framework pertaining to a subject of interest, followed by the development of a specific hypothesis that they intend to empirically investigate (Alshamsi, 2019). The view works from general to specific.

The inductive approach commences with the act of observation and employs a systematic methodology to identify patterns and consistencies (Liu, 2021). This process facilitates the formulation of a hypothesis or research topic that can be subjected to additional investigation, ultimately culminating in the establishment of overarching conclusions or theories. The view is from specific to broader generalisation and theories. These two techniques are poles apart and suggest different foundations when carrying out a research study. By its nature, the inductive method allows more flexibility and the deductive method is more closed by nature and is more oriented at testing or confirming hypotheses (Alshamsi, 2021).

Infrastructure delivery is an essential subject for every country, and the public sector is encountering challenges in infrastructure provision. The study employed a rigorous examination of the literature review through the application of critical analysis. This study entails a comprehensive examination of the existing body of literature on infrastructure delivery methods as a reliable and effective data source for gaining insights into the process of infrastructure delivery. The literature elucidates the widespread adoption of diverse infrastructure delivery systems by public sectors across many countries, with the aim of improving the provision of public sector infrastructure. According to Winter (2016), adopting a perspective that conceptualises infrastructure challenges, assets and resources as interconnected networks with a multitude of unique interactions and viewpoints might enhance comprehension of the processes involved in generating and capturing value.

The delivery of infrastructure is of utmost importance, and it is crucial to improve the level of transparency regarding the effectiveness of the systems utilised by the public sector. According to Atkinson (2017), it is essential to establish a research topic as it serves two important purposes: providing direction for a project and facilitating the development of research tools and methods. The study aimed to fill the existing knowledge gap by adopting a systems theory perspective to investigate the problem, examine the constraints, and analyse the characteristics of IDMS. The study addresses the question: ‘How effective is IDMS in delivering infrastructure to the South African government?’

The formulation of the research question facilitated the determination of the appropriate approaches to employ. The integration of literature with interviews was employed to enhance the robustness of the data sources. The research methodology employed in this study involved the use of a qualitative case approach to establish a connection between infrastructure delivery,

socio-economic impact, and relevant theoretical frameworks. Additionally, the study incorporated reflective analysis to further explore these relationships. Various methodologies exist for collecting qualitative data, including individual interviews, focus group interviews, field notes, and the utilisation of participant-contributed artifacts. Qualitative methodologies, including interviews, focus groups and participant observation, possess the capacity to assume a fundamental position in several academic pursuits, including question formulation, operational definition establishment, and research instrument construction (Atkinson, 2017).

The selection of appropriate data collection methods and procedures is highly dependent on the qualitative research design that has been selected. The case study analysis method was deemed suitable for addressing the research inquiries. The approach facilitated the implementation of a constructive research methodology, which effectively yielded novel and exploratory perspectives on the enhancement of infrastructure delivery systems through the application of an inductive technique. According to Byrne (2021), a researcher employing an inductive approach may seek to develop codes that accurately reflect the substance of the data, without being influenced by prior assumptions. Steele et al. (2020) assert that the objective of researchers is to manifest individuals' perspectives, convictions and perceptions into a tangible manifestation that can be effectively implemented within a specific social context through the utilisation of interviews. Interviewees possess individual perspectives, ideas and impressions that are subjective in nature but hold personal validity (Aldawod & Day, 2017).

Winter (2016) asserts that the implementation of methods aimed at enhancing system efficiency facilitates a deeper comprehension of the intricate and ever-changing operations of the system. Furthermore, the necessity for assessment methodologies that accurately assess the extent to which needs are fulfilled and the application of a systems perspective by stakeholders contributes to the development of a framework for evaluating tangible results and improving infrastructure implementation. This study investigates the interdependence of project components, including processes, resources, and management styles, as well as their interactions with the surrounding environment. According to Desta (2015), the utilisation of systems theory facilitates the identification of crucial elements and their effective alignment towards achieving success in a project.

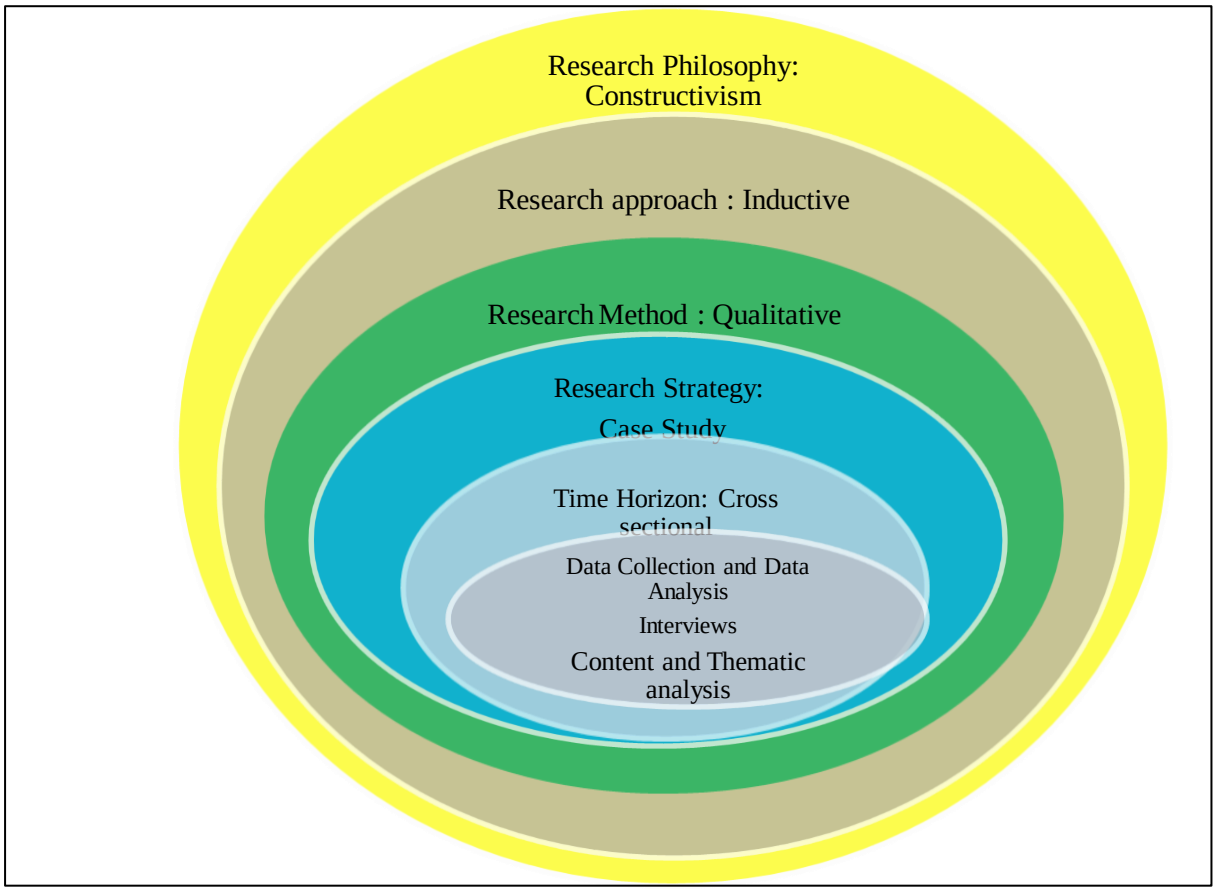
The research employed expert interviews as a cross-sectional study methodology to obtain a full understanding of the subject matter and gain deeper insights into the operational aspects of

public sector infrastructure. The primary objective of this study is to gain a comprehensive understanding of the implementation process of IDMS in order to contribute to the effective delivery of infrastructure projects within the public sector. The characteristics of the IDMS were outlined and evaluated. The research topic was determined to be sufficiently answered via interviews.

The researcher's participation in the study is influenced by ontology, epistemology, methodology and methodologies (Graue, 2015). The study is grounded in the philosophical framework of constructivist epistemology and relativist ontology. The researcher places significant emphasis on the subjective nature of social action and views reality as a construct that is shaped by social processes. According to Cuthbertson et al. (2020), the ontology has an influence on the objectives of the study, the formulation of research inquiries, and the execution of the research methodology. This suggests that although there is an assumption of the existence of an objective reality apart from the researcher, the interpretation and understanding of reality is a subjective construct that requires engagement and interaction between the researcher and the subject of study.

The research process can be elucidated through the use of an onion metaphor (Saunders, Lewis & Thornhill, 2016). According to Al Shamsi (2019), this research framework is widely regarded by scholars as a valuable, captivating, meticulously structured, and appropriate methodology for doing research. The layers of the onion metaphorically symbolise the process of selecting an appropriate research methodology and elucidating the essential methods and procedures necessary for generating accurate data and deriving conclusions from the study (Saunders, Lewis & Thornhill, 2016). The researcher's philosophical convictions need the unveiling of the layers. Prior to accessing the inner core, encompassing data collection and analysis, the researcher must undertake the process of peeling away multiple layers (Mayer, 2015). The diagram presented in Figure 3.2 depicts the several levels of the research onion, which serve as a methodical framework for guiding the research process.

Figure 3. 3. Research onion layers of the study



Source: Researcher's collection

The researcher establishes a strong connection between the study and the research onion model. The subsequent part will detail the research methods and strategies employed in the research, as outlined in the research onion structure.

3.3 Research design

Research designs are plans and procedures covering everything from general assumptions to specific data-gathering and analysis methodologies (Creswell, 2016). Kumar (2019) describes a research design as a set of data collection and analysis conditions that combines relevance to the research goal with the procedural economy. According to Flick (2015), a research design is a structure inclusive of contemplations that steer towards the adoption of a suitable methodology, the respondent's selection manner, and the technique employed in analysing data. It is a rational stage that connects the collected data to the specified research question and the overall conclusion.

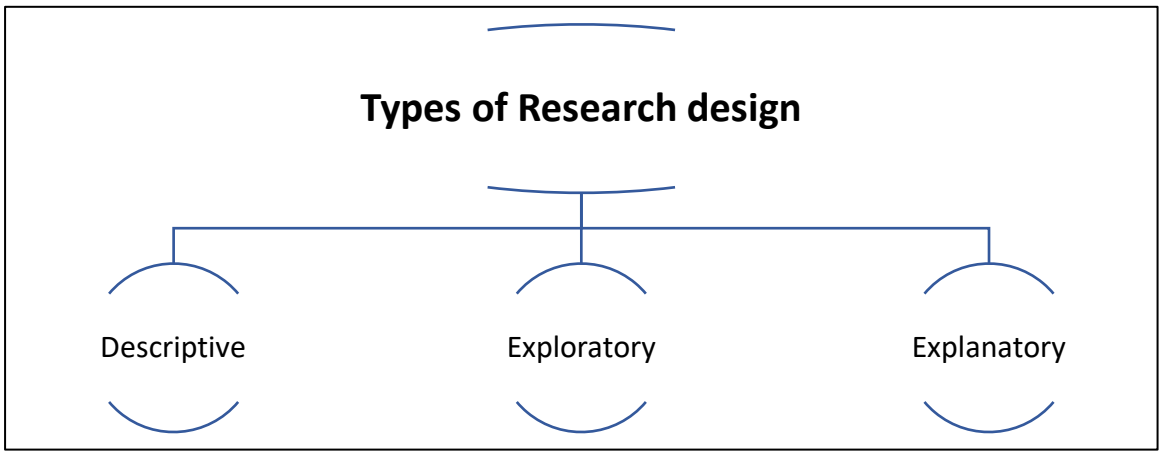
This process involves the examination of applicable research questions, the identification and analysis of relevant data, the formulation and implementation of research procedures, and the collection and evaluation of information in order to arrive at a conclusion (Yin, 2014). Saunders, Lewis, and Thornhill (2016) claim that the research design serves as the structural foundation for data collection and analysis, encompassing many approaches such as cross-sectional and longitudinal designs, among others. A longitudinal study is an investigation conducted over an extended duration, typically involving the collection of data at multiple time points. A cross-sectional study is conducted within a defined timeframe (ibid).

According to Desta (2015), the achievement of valuable research output can be facilitated through the implementation of purposely planned interdependent methods. The primary objective of research design is to facilitate the acquisition of pertinent evidence while minimizing the expenditure of resources, including effort, time, and expenses (Pandey & Pandey, 2015). A research design guarantees that the evidence gathered allows the researcher to successfully and explicitly address the research challenge. A researcher must build the best study design feasible by planning meticulously and thoughtfully based on current circumstances and identifying accessible resources (Bengtsson, 2016). Commencing a research project necessitates the initial step of clearly outlining the researcher's objectives, including the specific knowledge or information sought, the sources from which it will be obtained, and the methodology employed to get it.

3.3.1 Types of Research designs

This section describes the various types of research designs used to guide a study from beginning to end. The classification of research design can be approached from various perspectives. Descriptive, exploratory, and explanatory research represent many study designs. The selection of methods is contingent upon various aspects including the subject matter, field of study, and the specific phenomenon under investigation. Additionally, considerations such as financial implications, research validity, the researcher's personal inclinations, sponsor requirements, and institutional guidelines, among other relevant elements, may also impact the choice of procedures (Sakyi, 2017). Figure 3.3 provides an illustration of the many study designs that can be categorized as descriptive, explanatory, or exploratory.

Figure 3.4. Types of Research design.



Source: Researcher's collection.

- *Descriptive Research design*

The descriptive technique outlines a situation, challenge, and phenomenon strategically, or endeavour methodically and precisely (McCombes, 2020). Nassaji (2015) states that its purpose is to describe a phenomenon and its characteristics. It can respond to inquiries about what, where, when, and how, but not why, in research questions (Mayer, 2015; McCombes, 2020). Descriptive research involves the collection and measurement of a substantial amount of data on variables in order to establish causal relationships (Sakyi, 2017). In research of this nature, data is commonly gathered and subsequently analysed using quantitative methods, such as frequencies, percentages, averages, and other statistical techniques, to ascertain any potential links (Nassaji, 2015). Data is collected through the utilisation of case studies, observational techniques, and survey methodologies.

- *Explanatory/causal research design:*

The research design explores a situation with distinguishing qualities to establish how the variables correlate. Akthar (2016) emphasises that the research design focuses on gaining knowledge in unknown areas. This study design is employed to further explore previously unexplored facets of a subject matter and endeavour to elucidate the unresolved components (Thakur, 2021). The goal of causal or explanatory research is to establish causal linkages between variables to explain their relationship (Mayer, 2015). The views and beliefs of the researcher are further elaborated, examined, and elucidated. The objective is to develop hypotheses and afterwards conduct experiments to evaluate their validity. The data is often

collected quantitatively and necessitates the application of a statistical test. Explanatory research frequently uses deductive reasoning as a methodological approach (Park et al., 2020).

- *Exploratory research design:*

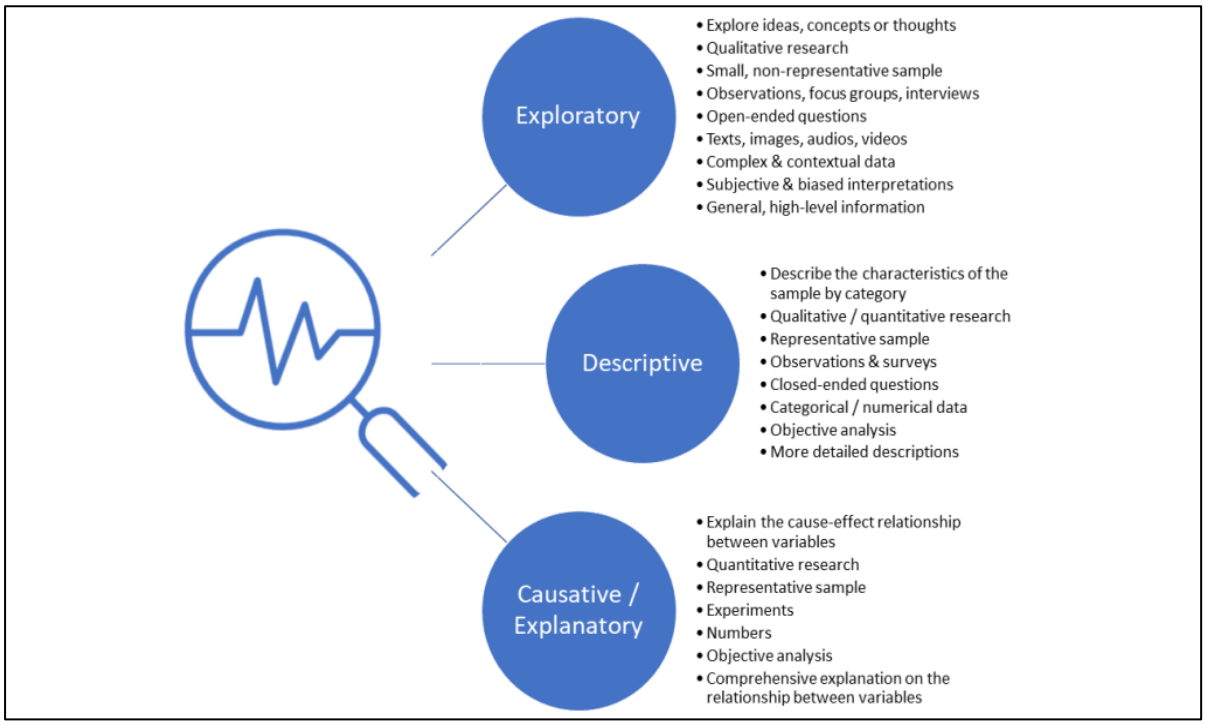
The exploratory research design is employed with the purpose of discovering novel information about phenomena and providing clarification for ambiguous circumstances (Mayer, 2015). The primary aim of this methodology is to explore a relatively under-researched domain and to explore potential avenues for further investigation in a certain field of study. The exploratory study design effectively investigates a topic with a flexible approach to data collection and openness (Stebbins, 2011). Exploratory research is employed as a means to comprehensively comprehend a certain subject matter, particularly in cases when it has not been previously investigated (ibid).

According to Saunders, Lewis and Thornhill (2016), an exploratory study is a valuable methodology for formulating open-ended inquiries in order to gain a comprehensive understanding of a certain field of study. It helps to gain a better understanding of the subject. The explanatory investigation is always accompanied by concepts that direct the researcher's quest for data (Akhtar, 2016). Exploratory research typically involves the utilisation of qualitative data. Data collection is frequently conducted through the utilisation of expert interviews and surveys.

The objective of exploratory design is to uncover ideas and insights, whereas descriptive design aims to define characteristics and functions. Causal design, on the other hand, is employed to establish causal linkages and determine the effects of certain factors (Mahajan, 2021). The distinguishing features of these research approaches are as follows: exploratory research exhibits flexibility and adaptability, descriptive research involves the development of hypotheses, and causal research entails the manipulation of one or more variables.

Below is a basic comparison of basic research design:

Figure 3.5. A comparison of basic research design



Source: Viewposts, 2020

3.3.2 Justification of the research design

Each researcher is guided by their unique methodological approach to conducting research. Research design involves using established methods and standards to guide the process and structure of a research study. Majid (2018) states that a study's design is influenced by various factors such as the research question, aims, phenomena of interest, population and sampling techniques. Tumele (2015) posits that it is imperative to establish a clear explanation for linking the data to the propositions and to describe the criteria for evaluating the results. Prior to accurately defining the study question and propositions, it is essential to do a comprehensive examination of the existing theoretical literature and empirical investigations on the subject matter (ibid).

The significance of research questions lies in their ability to provide guidance for the study's trajectory, establish the groundwork for a more comprehensive research agenda, and facilitate the development of research tools and methodologies (Atkinson, 2017). The inquiry employs an exploratory research approach to gain insight into and analyse the implementation of infrastructure delivery management systems in the public sector. Exploratory research exhibits a high degree of flexibility and versatility, enabling it to effectively highlight and bring focus

to various problems, difficulties or conditions. This study type helps researchers establish a strong foundation for exploring ideas, choosing the suitable research methodology, and finding variables that are truly pertinent to the study (Stebbins, 2011).

The concept of research comprises a wide array of perspectives, methodologies and philosophical underpinnings. Research design is shaped by various components, such as methods, methodology and philosophy (Graue, 2015). Guba and Lincoln (2004) provide comprehensive frameworks in the literature for the classification of philosophical paradigms that encompass several domains of social research. The study elucidates the research paradigm employed in the subsequent section.

3.4 Research paradigm

The concept of research philosophy encompasses a collection of principles and presumptions on the process by which knowledge is generated (Saunders, Lewis & Thornhill, 2016). Paradigms are utilised as both conceptual and practical instruments within the realm of social research, aiding in the resolution of specific research quandaries. In essence, they function as heuristics, as stated by Kaushik and Walsh (2019). According to Kivunja and Kuyini (2017), a research paradigm serves the purpose of elucidating the ideological position of a researcher. Denzin and Lincoln (2000) opine that paradigms can be seen as human constructs that pertain to fundamental principles or ultimate concepts. These paradigms serve to elucidate the researcher's perspective and guide the process of generating meaning from the data. A research paradigm can be conceptualised as a collection of core ideas that serve to represent a certain worldview (Makombe, 2017).

According to Kivunja and Kuyini (2017), the selection of a research paradigm is crucial since it shapes a researcher's perspective and encompasses their fundamental ideas and values, which in turn influence their perception, interpretation, and conduct within the world. The researcher uses a conceptual framework to investigate the methodological aspects of their research endeavour and assess the research methodologies and data to be analysed (ibid). This implies that the research philosophy encompasses substantial assumptions regarding the researcher's worldview. Assumptions play a crucial role in shaping every facet of a research effort. According to Majeed (2019), the paradigm plays a crucial role in determining the philosophical orientation of the researcher.

The selection of a research methodology is influenced by the application of a research paradigm during the research process. Therefore, the act of situating a research proposal within a particular paradigm indicates that the research will adhere to and be driven by the underlying assumptions, perspectives, norms and values associated with the selected paradigm (Kivunja & Kuyini, 2017). According to Mertens (2019), a paradigm comprises three essential components: a belief pertaining to the nature of knowledge, a methodological approach, and standards of validity. The research philosophy and data collection methodologies employed are aligned with the research objectives (Saunders, Lewis & Thornhill, 2016).

Various research paradigms are used in conjunction with additional research philosophical viewpoints. According to Easterby-Smith et al. (2018), a paradigm encompasses four fundamental philosophical assumptions, namely epistemology, ontology, methodology and axiology. Kaushik and Walsh (2019) stipulate that worldviews include the following elements: ontology (assumptions about the nature of reality); epistemology (assumptions about how we know the world, how we gain knowledge, and the relationship between the knower and the known); methodology (a shared understanding of the best means for gaining knowledge about the world); and rhetoric (a shared understanding of the language of research).

Tumele (2015) contends that the philosophical assumptions encompass three key concepts: epistemology, ontology and methodology. Epistemology pertains to the examination and acceptance of the connection between the observer and the observed reality. Ontology, on the other hand, focuses on the exploration and acceptance of the fundamental nature and structure of social reality. Lastly, methodology refers to the various approaches employed to acquire knowledge about social reality. It is vital to articulate the selected paradigm of the investigation and address the research inquiries. Table 3.2 presents the diverse philosophical assumptions, while section 3.4.1 provides a more comprehensive discussion of these assumptions.

Table 3. 2. Philosophical assumptions to research paradigm

Philosophical assumptions	**What is it about?**	**Questions we ask**
Ontology	Philosophical assumptions about the nature of reality	What is reality? What type of beings are there? How is it that different types of beings exist? What is a type?
Epistemology	A general set of assumptions about ways of inquiring into the nature of the world	What is knowledge? How do we know what we know? How is knowledge acquired?
Methodology	A combination of methods used to enquire into a specific situation	What question am I asking, and what kind of conclusion do I hope to come to? How can I best research this question? What data is available?
Methods and techniques	Individual techniques for data collection, analysis.	How can I collect and analyse this data? How does this method or technique help me to answer my research question? Is this method or technique appropriate to the context and research question I am investigating?

Source: Easterby-Smith et al. (2018, p 63).

3.4.1 Philosophical assumptions

This section discusses the various philosophical assumptions according to Table 3.2:

- Ontology

The term 'ontology' pertains to an individual or a group's fundamental convictions regarding the nature of existence (Rehman & Alharthi, 2016). According to Saunders et al. (2016), the concept of ontology refers to the researcher's assumptions and assertions regarding pre-existing knowledge, with particular attention to the manner in which knowledge is structured and its constituent elements. Creswell (2016) posits that ontological assumptions are related to the nature and properties of reality in social science. It is the philosophical examination of the nature of existence, reality, being and becoming, and the basic categories of things that exist and their relations (Kivunja & Kuyini, 2017). When identifying the ontological position of a study, it is crucial to consider the characteristics of the phenomena, entity or social reality being investigated (Al-Abahneh, 2020). The ontological assumptions of a researcher have a significant role in shaping the way a study objective is perceived and comprehended (Saunders, Lewis & Thornhill, 2016). The inquiry of an ontological nature pertains to the extent of knowledge that can be derived from the conducted research.

Aldawod and Day (2017) posit that there is no single interpretation of the social world due to people's perceptions of how things differ from person to person and from context to circumstance. It is imperative for researchers to adopt the assumption that the subject of their study comprises individuals who possess their own unique thoughts, perspectives and interpretations (Ahmed, 2008). Ontology is a question of what is out there; it is a question of idealism or realism, but it can also be a question of nominalism or realism (Sese et al., 2006). Aldawod and Day (2017) posit that social science research is influenced by two ontological orientations: realism and idealism. Realism asserts that the social realm's reality remains unaltered by the actions of social actors. Conversely, idealism contends that reality, in principle, is contingent upon the mind. Idealism is a philosophical stance that posits the notion that the entirety of existence, or at the very least, all that can be comprehended as being, must possess a mental nature to some extent (Sese et al., 2006).

The researcher employs a naturalist approach by applying data obtained from interviews, discourses and historical records. Additionally, the researcher assumes the role of a participant observer. In practical application, the scope of inquiries tends to expand in order to encompass a wider range of topics and become more generalised. This allows participants to collectively

construct the meaning of a given scenario, typically achieved through discussions or interactions with others (Rosner, 2018). This study posits that knowledge construction is an individual process that occurs inside a social-cultural framework, which is influenced by prior information and understanding. The research employs a realistic ontology. The primary focus is on the socially constructed nature of reality. The research setting is intentionally structured to facilitate a close contact between the researcher and the study participants, allowing for the exploration and articulation of their unique individual experiences pertaining to IDMS.

According to Easterby-Smith et al. (2018), the ontological standpoint of realism posits that both the physical and social realities exist autonomously from any observations made regarding them. On the other hand, internal realism is a philosophical stance that asserts the existence of reality independent of the observer while recognising that scientists can only access it through indirect methods. Easterby-Smith et al. (2018) outline four distinct ontological perspectives, which are positioned along a continuum as presented below:

Figure 3. 6. A comparison of four ontological viewpoints

Ontology	Realism	Internal Realism	Relativism	Nominalism
Summary	The world is 'real', and science proceeds by examining and observing it	The world is real, but it is almost impossible to examine it directly	Scientific laws are basically created by people to fit their view of reality	Reality is entirely created by people, and there is no external 'truth'
Truth	There is a single truth	Truth exists, but is obscure	There are many truths	There is no truth
Facts	Facts exist, and can be revealed through experiments	Facts are concrete, but cannot always be revealed	Facts depend on the viewpoint of the observer	Facts are all human creations

Source: Easterby-Smith et al. (2018)

The figure depicted above illustrates the ontological perspectives, which will be expounded in the subsequent discussion:

1. Realism posits that the external world possesses an inherent accuracy and objective existence, independent of subjective perception. The field of science is established on the systematic examination and analysis of natural occurrences, discernible actions and verifiable empirical evidence.
2. Realism on the inside: The external world exists objectively and operates independently of human cognition; however its direct perception is hindered by the fact that our understanding of its organisation, including its various classifications and distinctions, is contingent on mental processes. Once discovered, scientific principles are immutable.
3. Relativism posits that scientific rules are constructed by individuals who are deeply entrenched inside a particular context, thereby giving rise to the notion of a 'beholder'.
4. Nominalism posits that reality is a product of human experience and does not possess an independent existence (Easterby-Smith et al., 2018). We create reality, and thus, it does not exist independently of our perception (Easterby-Smith et al., 2018).

The field of ontology is concerned with propositions regarding the fundamental essence and presence of entities. Ontology in research is the foundation upon which one's epistemological and methodological stance naturally ensue. According to Kivunja and Kuyini (2017), following an explicit or implicit ontological belief system leads to some epistemological conclusions.

- Epistemology

Epistemology is a branch of philosophy that focuses on the theoretical understanding of knowledge, placing special attention on the cognitive processes involved in acquiring knowledge about the social aspects of reality (Daniel, 2017). According to Wagner and Fair (2020), epistemology can be defined as the philosophical discipline that investigates the nature of knowledge. It encompasses various aspects, including the examination of knowledge itself, its connection to belief and truth, the theory of justification, and strategies for addressing both local scepticism (which questions knowledge regarding specific domains, such as the past) and global scepticism (which denies the existence of knowledge altogether). Epistemology, as a discipline within philosophy, is concerned with the examination of the fundamental nature of knowledge and the processes involved in its acquisition and validation (Rehman & Alharthi, 2016). The primary objective is to build a conceptual framework for discerning the conceivable forms of knowledge and devising methods to assure their adequacy and legitimacy (Ahmed, 2008).

Epistemology encompasses the foundational principles behind the investigation of human knowledge, encompassing assumptions regarding knowledge acquisition and the criteria for determining the acceptability, validity, and legitimacy of knowledge. Additionally, it addresses the methods by which information can be effectively communicated to others (Saunders, Lewis & Thornhill, 2016). This pertains to the methodologies employed in the generation of novel knowledge, hence contributing to the existing corpus of knowledge. The inclusion of justifications for the procedures utilised in research endeavours that contribute to the generation of novel information is deemed essential (Aldawod & Day, 2017). The epistemological inquiry explores the nature of knowledge and the methods through which it can be acquired.

Creswell (2016) asserts that the development of new knowledge necessitates a strong foundation in contemporary events and the diverse perspectives of individuals inside the communities being examined. This observation suggests that the process of acquiring new knowledge is greatly facilitated by embracing changes and advancements. Furthermore, the acquisition of new knowledge often necessitates adopting novel perspectives and considering alternate viewpoints, which are subject to evolution over time (Aldawod & Day, 2017). The categorisation of research philosophies can be delineated by the positioning of their beliefs along the objectivism-subjectivism continuum (Saunders, Lewis, & Thornhill, 2016).

Objectivism is an epistemological position that asserts that claiming truth for a statement or theory means asserting its agreement with an underlying 'objective' reality (Schneider, 1995). The term objective refers to the aspect of reality in a given matter that can be understood independently, without being influenced by the actions or perspectives of the subject (ibid). Objectivism encompasses the incorporation of natural scientific principles, positing that the social reality under investigation exists independently of individuals and their surroundings. Conversely, subjectivism asserts that social reality is constructed by individuals' perceptions and subsequent behaviours (Saunders, Lewis & Thornhill, 2016).

Saunders, Lewis, and Thornhill (2016) argue that in order to optimise the acquisition of desired information, it is imperative to carefully evaluate the researcher's ontological and epistemological perspectives while formulating research questions and designing research methodologies. The significance lies in establishing a robust connection between philosophical assumptions, specifically the influence of ontological beliefs on the production of knowledge (epistemology), and the exploration of such knowledge through diverse methodologies

(methodology) (Aldawod & Day, 2017). The methodological process is guided by philosophical ideas concerning the nature of reality, information and values, as well as the theoretical framework that shapes understanding, interpretation, literature choice and research practices in a certain field of study (Saunders, Lewis, & Thornhill, 2016).

- Methodology

Methodology pertains to distinct approaches employed for the purpose of collecting and analysing data. The methodological question asks how we can go about acquiring that information. According to Kivunja and Kuyini (2017), the methodology articulates the logic and flow of the systematic processes followed in conducting a research project to obtain information about a research problem. The strategy, plan of action, process or design inform one's choice of research methods (Rehman & Alharthi, 2016). The nature of a research project and the researcher's analytical mind-set will determine which methods to use.

A research method is an operational framework used by the researcher to conduct the research (Remenyi et al., 1998). Lingayas (2012) further suggests that the research method consistently studies and resolves the research question. Desta (2015) states that a research methodology is a concoction of methods used to inquire into the circumstances under investigation to reach a conclusive interpretation. A researcher should choose a research methodology with inferences that are ideally fulfilled by the circumstances under investigation (Leedy & Ormond., 2010). The research investigates the delivery of infrastructure in the public sector as a means to provide public services. The study provides evidence of convergence and a full understanding of the subject matter. In the realm of research, axiology serves as a means for researchers to comprehend and acknowledge the influence of their values and judgment in the process of data collection and analysis, rather than seeking to eliminate or regulate its impact (Al Shamsi, 2019).

- Axiology

Axiology is a philosophical discipline that focuses on the significance of values and ethics within the context of the research process (Saunders, Lewis & Thornhill, 2016). Sapkota & Paudyal (2021) assert that axiology is the branch of philosophy that studies judgements about values, including ethics and aesthetics. The presumption allows the researcher to understand and acknowledge the impact of their personal views and judgement on the process of gathering

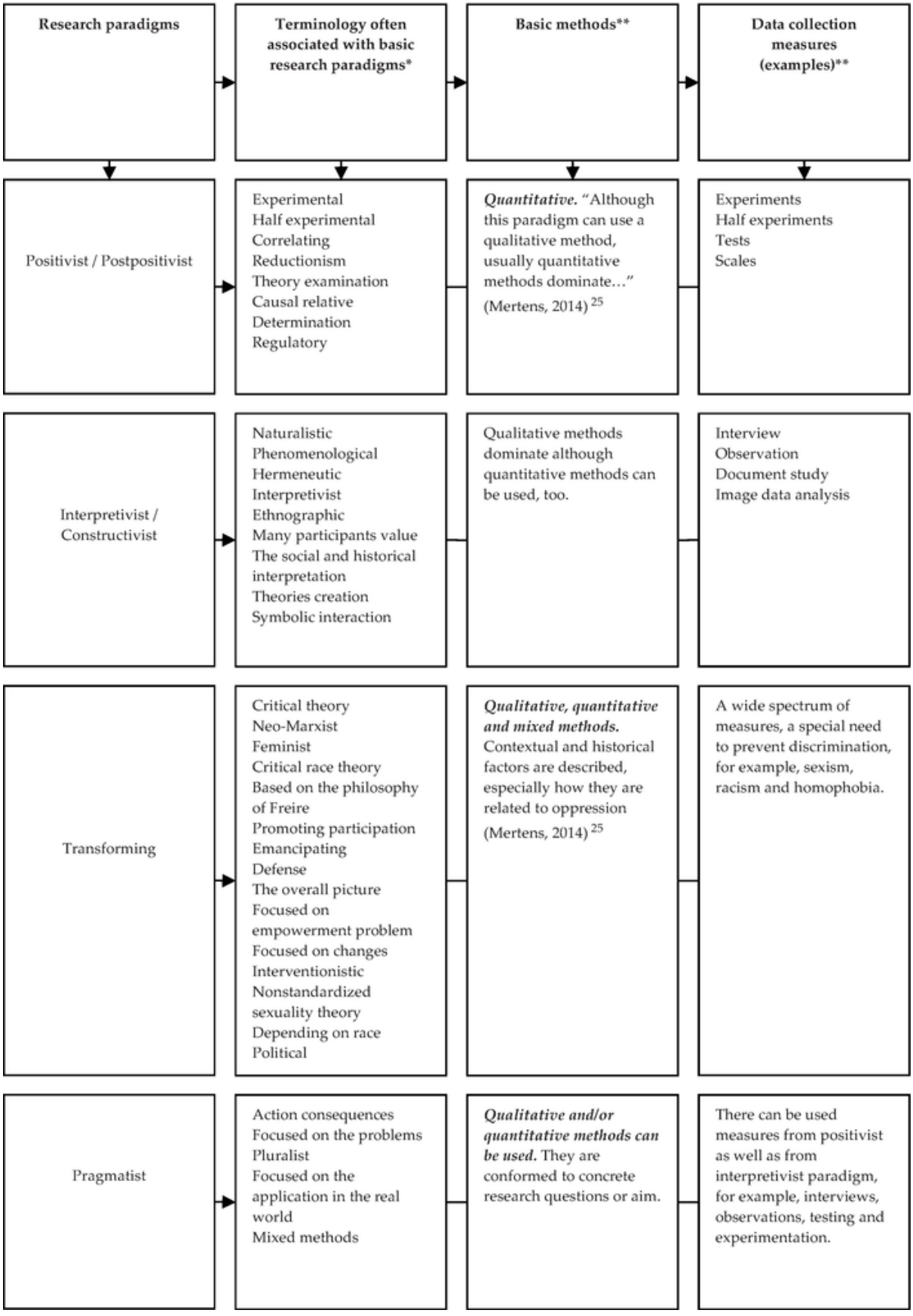
and analysing data, as opposed to attempting to eliminate or regulate its influence (Alshamsi, 2019). One of the ethical considerations that necessitates attention during the preparation of a research project is axiology, as highlighted by Kivunja and Kuyini (2017).

The concept axiology pertains to the integration of values and ethics into the research process, as well as the degree to which the researchers' values exert an effect on their research endeavours (Saunders, Lewis & Thornhill, 2016). The selected philosophy and the data collection techniques reflect the researcher's objectives (ibid). According to Mertens (2019), ethics in research should be considered an intrinsic component of the study planning and implementation process, not an incidental or burdensome consideration. The ethical inquiry, encompassing the field of ethics, pertains to the assessment of the intrinsic worth or value of the knowledge that we generate.

According to Aldawod and Day (2017), a compelling argument can be made regarding the significant association between axiological assumptions and the remaining three philosophical assumptions. By establishing a coherent connection among these assumptions, researchers can effectively conduct high-quality investigations, thereby contributing to the existing body of knowledge. There exist various research paradigms or epistemological branches that warrant consideration, including positivism (and post-positivism), constructivism, interpretivism, transformative, emancipatory, critical, pragmatism, and deconstructivism (Mertens, 2019).

Figure 3.7 provides a visual representation of the application of several paradigms.

Figure 3.7. Paradigms: terminology, methods, and means of data collection



Source: Zukauskas et al., 2018

The subsequent sections will undertake a comprehensive analysis of the diagram, with a specific emphasis on the paradigms it represents.

3.4.2 Research philosophy based on the positivist paradigm

The positivism paradigm is a research perspective constructed from a scientific method of investigation (Kivunja & Kuyini, 2017). Mahdi (2011) posits that positivism is associated with particular assumptions pertaining to the observation and interpretation of human behaviour and ideas. Positivism is grounded in the conviction that objective reality in the physical world must be investigated, touched and known (Guba &Lincoln, 2005). According to Makombe (2017), positivism can be defined as a scientific approach that provides prescriptions on how to conduct scientific inquiry. This paradigm emphasises the importance of problem identification, hypothesis formulation and the use of experiments to test and validate ideas. Rehman and Alharthi (2016) assert that hypotheses on the causal relationship between phenomena are formulated in the form of statements or questions. According to Park et al. (2020), the utilisation of extensive numerical data to validate certain theories and models aligns with the principles of positivism. The process of data collection relies on statistical analysis and a substantial sample size of participants.

Researchers that adopt a positivist perspective assert that information may be acquired through inference, devoid of subjective meaning, and can be applied to various situations (Naidoo, 2018). Positivism posits that the social realm can be understood in an objective manner. According to Zukauskas et al. (2018), the scientist assumes the role of an impartial analyst within the research philosophy, maintaining a detachment from personal values and operating autonomously. Positivists assert that reality is given objectively and quantifiable features exist without the observer's control (Majeed, 2019). The deterministic hypothesis offers a positivist perspective wherein knowledge is delineated as the outcome of exploring the underlying causes of encountered challenges. The conviction in the deterministic hypothesis encompasses the notion of describing a reality that is apart from the subject, as proposed by the realist hypothesis. Additionally, it suggests the potential for providing a singular and enduring explanation for this reality (De Figueiredo & da Cunha, 2007).

According to Park et al. (2020), positivist scholars maintain the viewpoint that matter and reality may be objectively distinguished as distinct realms, hence suggesting that matter possesses inherent objectivity and exists independently. Mertens (2019) affirms that positivism

places significant emphasis on objectivity, experimentation and generalisability as fundamental principles. Researchers in this particular paradigm employ deductive reasoning, the formation of hypotheses, hypothesis testing, organisational concepts, mathematical equations, estimations, extrapolations and expression to reach their conclusions (Kivunja & Kuyini, 2017). Rehman and Alharthi (2016) claim that the deductive approach to data analysis commences by establishing a hypothesis, subsequently subjecting it to scrutiny using statistical analysis in order to ascertain its confirmation or rejection. Within the framework of positivism, deductive reasoning is frequently deemed suitable (Park et al., 2020).

The positivism paradigm provides explanations and predictions based on statistical results. This paradigm responds to the ontological question with the realist hypothesis: whatever reality we may know is independent of us, exists before we try to know it, is potentially knowable, and can be explained by immutable rules, regardless of its complexity (De Figueiredo & da Cunha (2007)). Realism serves as the ontological perspective adopted by positivists, while their epistemological standpoint aligns with objectivism (Rehman & Alharthi, 2016). Positivists employ an experimental technique and uphold beneficence as their axiological principle (Kivunja & Kuyini, 2017).

The selection of quantitative research methodologies is often influenced by the positivist perspective, which posits that objective facts offer the most robust scientific evidence (Saunders, Lewis, & Thornhill, 2016). Positivism is widely regarded as the most pertinent approach in research endeavours aimed at formulating a comprehensive theory or model grounded in verifiable empirical evidence and objective observations (Park et al., 2020). This field is characterised by the utilisation of quantitative methodologies and the use of formal vocabulary that prioritises precision, generalisability, dependability, and replicability.

3.4.3 The constructivism paradigm

Constructivism is a theoretical perspective that posits that the acquisition of knowledge and the perception of reality are dependent on human behaviours. It asserts that knowledge is produced via the dynamic interplay between individuals and their environment, and is shaped and transmitted within a social framework (Ahmed, 2008). Adom, Yeboah and Ankrah (2016) describe the constructivism paradigm as a model that aspires to clarify certain circumstances in a research study from the viewpoint of respondents applying diverse data collection methods.

The basic assumptions of the constructivist paradigm revolve around the notion that knowledge is generated through social interactions among those engaged in the research process. Additionally, proponents of this paradigm argue that researchers should strive to comprehend the intricate nature of lived experiences by adopting the perspectives of those directly involved (Schwandt, 2001). Kivunja and Kuyini (2017) state that the paradigm places significant focus on comprehending the participant and their interpretation of the world around them. According to Kivunja and Kuyini (2017), constructivism places significant importance on the construction of realities, active participation of individuals, and comprehensive depiction of phenomena (Mertens, 2019).

According to the constructivist perspective, the perception and understanding of a particular matter and its corresponding reality are shaped by the diverse interpretations of individuals within various contextual environments (Park et al., 2020). Baxter and Jack (2008), opine that a notable advantage of this approach is the intimate collaboration between the researcher and participant, facilitating the exchange of ideas on reality. Creswell (2016) posits that instead of starting with a theory, a researcher develops a theory that ascribes a meaning. Constructivism allows for development of new theories or models concreted through contextual interpretation (Park et al., 2020).

Constructivism is a relevant research perspective that seeks to establish a more concrete theory or model based on contextual interpretations with subjective views of particular events (Park et al., 2020). Research founded on the constructivism paradigm commonly commences with an open-ended inquiry through specified research questions. There is an assumption that the researcher can construct knowledge socially because of his or her real-life experiences in the natural settings studied (Kivunja & Kuyini, 2017). The ultimate interpretations are then drawn from the research results. According to Park et al. (2020), inductive reasoning is considered to be a more suitable approach for conducting investigations inside the constructivist paradigm.

The phenomenological hypothesis provides the constructivist paradigm's answer to the ontological question: it posits that reality is known by constructing it via interactions with the world in an emergent process that modifies knowledge through interactions (Figueiredo & Cunha, 2007). Constructivist research is based on a relativist ontology that subscribes to the view that there are multiple realities. This is because reality is constructed subjectively in each person's mind depending on context (Guba & Lincoln, 1985).

The principle of value inclusion offers constructivism's perspective on the significance of values in the development of knowledge. It asserts that values play a crucial part in the process of knowledge construction. The concept of intrinsic ethics addresses the inquiry into ethics within the context of constructivist research. It posits that ethical conduct is shaped via the continual pursuit of the collective welfare. This paradigm assumes a subjectivist epistemology, a relativist ontology, a naturalist methodology, and a balanced axiology (Kivunja & Kuyini, 2017).

3.4.3 Summary of positivism versus constructivism

Table 3.3 presents an overview of the philosophical questions addressed by the positivist and constructivist positivist :

Table 3. 3. Positivism and constructivism in light of the four philosophical questions

QUESTIONS	POSITIVISM	CONSTRUCTIVISM
Ontological question **What can be known?**	**Realist hypothesis** we can know reality, which is external to us, independent from us, and driven by immutable laws	**Phenomenological hypothesis** we know the world by interacting with it in an emergent process that changes knowledge as we keep interacting
Epistemological question **What is knowledge?**	**Deterministic hypothesis** knowledge is what we learn by exploring the causes of the problems we face	**Teleological hypothesis** knowledge is what gets us to an intended result
Methodological question **How can knowledge be built?**	**Principle of analytical modelling** to explain reality, we must divide each difficulty into as many parts as possible and necessary to resolve it better	**Principle of complexity** we build knowledge by recognising the world as complex and in constant flux, embodying stability, change, chaos, and order, the whole exceeding the sum of parts and the parts interacting in the shared, emergent and largely unpredictable construction of reality

	Principle of sufficient reason there is no effect without a cause and no change without reason for the change	**Principle of intelligent action** human reason can transform intelligible representations of the dissonances to which it is confronted by creating responses in the form of "intelligent actions" adapted to reduce these dissonances
Ethical question **What is the value of knowledge**	**Principle of value exclusion** values has no role to play in knowledge construction	**Principle of value inclusion** values has an essential role to play in the emergent process of knowledge construction
	Principle of extrinsic ethics ethical behaviour is formally policed by external mechanisms	**Principle of intrinsic ethics** each researcher constructs the principle of intrinsic ethics and ethical behaviour in the persistent search for the collective good

Source: Figueirdo and Cunha (2007).

Theoretical perspectives that emphasise subjectivity, such as social constructionism, inductive reasoning and interpretivism, are commonly associated with the utilisation of qualitative empirical methods. On the other hand, theoretical perspectives that adopt a positivist stance, characterised by deductive reasoning and empiricism, are typically matched with the application of quantitative empirical methods (Kaushik & Walsh, 2019). The following section provides a comprehensive overview of the pragmatist paradigm.

3.4.4 Pragmatist paradigm

Pragmatism is founded upon the principle that researchers ought to employ the philosophical and/or methodological approach that is most effective in addressing the research problem under investigation (Kaushik & Walsh, 2019). Pragmatists do not adhere to a certain philosophy, but rather embrace the freedom to select or combine several ideologies that best serve their study objectives and align with the nature of their research (Kellmereit, 2015). The determination of the research philosophy is contingent upon the research challenge at hand, with pragmatist research philosophy placing emphasis on the examination of factual information (Kaushik & Walsh, 2019). Pragmatism does not have any direct affiliation with a specific philosophical

framework or ontological understanding (ibid). Mixed approaches and numerous methodologies are linked to this phenomenon.

According to Kellmereit (2015), the research technique employed in a multi-method study might be either inductive, deductive or a combination of both. A theoretical argument, for example, may be tested using quantitative or qualitative research, and then a fuller theoretical perspective is produced using additional quantitative or qualitative research (ibid). Pragmatism embraces a plurality of methods.

3.4.5 Comparison of the paradigms

The aforementioned paradigms hold significance in the realm of research and can be implemented according to the researcher's perspective. This study centres its attention on the paradigms of positivism and constructivism, both of which are extensively utilised in academic research. The positivism paradigm in the research process views inquiry as a sequential progression of logically interconnected stages. It asserts that claims of knowledge are derived from objective observations, standardised procedures, deductive reasoning and the ability to exercise control over variables (Kaushik & Walsh, 2019). Therefore, constructivism is commonly associated with qualitative research methods and the utilisation of literary and informal rhetoric. The researcher endeavours to include the viewpoints of the participants to the greatest extent feasible and formulates subjective interpretations of phenomena (ibid).

Positivism and constructivism represent two divergent ends of a paradigm continuum. According to Kaushik and Walsh (2019), constructivism is inclined towards qualitative approaches and inductive reasoning, while positivism leans towards quantitative methods and deductive reasoning. However, pragmatism encompasses both ends of the spectrum and provides a more adaptable and reflective approach to the design of research.

3.4.6 Justification of the research paradigm

Research paradigms drive scholarly advancement by generating new ideas and substantial contributions in academia (Kaushik & Walsh, 2019). Various factors, such as cognitive processes, theoretical preferences, professional and personal experiences, beliefs, contextual dynamics, and political variables, influence the choice of the research topic, analytical approach and interpretation of the findings (ibid). Infrastructure delivery takes place within

multiple contexts of socially constructed interdependent networks, making it imperative to understand the contextual variables in delivery systems (Awuzie & McDermott, 2014). After conducting a thorough analysis of several research paradigms discussed earlier, this study has chosen to utilise the constructivism paradigm. This paradigm allows the researcher to actively engage in the examination and understanding of the topic under investigation. The study addresses the question, how effective is IDMS in delivering infrastructure to the South African government?. Research design provides the framework for data gathering and analysis, while selecting a research paradigm guides the analysis process.

The adoption of appropriate worldviews in research depends on the outcome of the investigation (Park et al.,2020), and is crucial for the success and validity of the research. Constructivism is the epistemological viewpoint taken. The paradigm provides the philosophical principles that form the foundation of the study. The constructivist perspective acknowledges that information serves not only as a means of comprehension, but also as a catalyst for the creation of the seen world. The principle of complexity acknowledges that knowledge acquisition entails perceiving the world as intricate and perpetually changing. It posits that the entirety of a system surpasses the mere aggregation of its constituent elements, with disorder coexisting alongside organisation. Moreover, it emphasises the interplay between these elements as they collectively shape reality, often in an unforeseeable and emergent fashion (Figueiredo & Afonso, 2006). This encompasses a subjective approach to knowledge and a belief in the ontological nature of reality as socially constructed.

The fundamental tenet of positivism revolves around adopting a scientific approach to understanding knowledge and the world. However, due to its reliance on measurable and quantifiable evidence, positivism may not be the most suitable philosophical stance. The positivist paradigm addresses the methodological inquiry by adhering to two fundamental principles: the principle of analytical modelling and the principle of sufficient reason. In order to gain a comprehensive understanding of a given reality, the principle of analytical modelling posits that it is imperative to deconstruct any complexity into its constituent components, hence facilitating a more effective resolution (de Figueiredo & da Cunha, 2007).

According to proponents of the constructivist paradigm, those involved in construction management are primarily responsible for assigning significance to structures and situations that are being investigated (Desta, 2015). Therefore, it is recommended that the rationalist

approach be redirected from the establishment of causal connections and explanations towards attaining a more profound comprehension of meaning and context (ibid). The utilisation of a constructivist model is employed in order to establish the connections between the research inquiries and the data gathered, as it affords the researcher with adaptability in the administration of questions for the study. The qualitative data comprises subjective reflections and individual accounts provided by industry experts on IDMS. The study places a significant emphasis on the participant's impressions of the circumstance, to the greatest extent possible. The pursuit of meaning and comprehension is inherently influenced by individual perspectives, while knowledge is regarded as a product shaped by societal factors.

The researcher has demonstrated a clear focus on investigating the delivery of public-sector infrastructure through the utilisation of different interpretive design methodologies and techniques, including interviews. This approach aims to gain a comprehensive understanding of the application of IDMS in the context of infrastructure project delivery. The suitability of the research paradigm influences the methodology of the research process. Haas and Haas (2018) posit that culture and leadership are perceived differently by individuals, companies, and industries, which is why polling various sources is done to clarify ambiguity. According to Kivunja and Kuyini (2017), the concept of balanced axiology posits that study outcomes should reflect the researcher's principles in order to offer unbiased account of the findings. The research approach is described in the following section. The discussion of the primary distinctions between quantitative, qualitative, and mixed-method research is essential for understanding the methodological approach of the study.

3.5 Research approach

Various research methods can be used in the research process, including qualitative, quantitative, and mixed-method studies. Researchers use quantitative or qualitative research methods to ascertain, gather and assess data with the aim of enhancing our comprehension of a certain issue. The choice between these methods is contingent upon the research's aims, goals, subject matter, and research questions (Basias & Pollalis, 2018). It is imperative for the researcher to provide a clear and concise articulation of their questions at the outset of formulating the study protocols.

There are differences between quantitative and qualitative research in terms of data collection methods, data processing and interpretation procedures, and communication style of results,

despite the fact that the study strategy is the same (Kumar, 2019). According to Creswell (2016), it is important to avoid perceiving quantitative and qualitative tools as rigid, distinct categories or mutually exclusive approaches. However, they do depict distinct terminations of sequential and collective components. The next section provides a comprehensive description of the different research approaches.

3.5.1 Quantitative research

Quantitative research refers to the systematic gathering and quantification of data in a measurable manner (Kellmereit, 2015). According to Mayer (2015), the term 'quantity' in the context of quantitative research refers to the act of counting and measuring, indicating an emphasis on quantification in both data collection and interpretation. Quantitative research aims to identify and analyse correlations between variables, typically necessitating the use of numerical evaluation methods, such as statistical approaches and graphical representations (Saunders, Lewis & Thornhill, 2016).

The approach emphasises the collection of quantitative data through the application of computational, statistical and mathematical techniques in order to obtain outcomes that may be customised for various population groups or used to explain specific situations (ibid). The practice of quantitative research adheres to established procedures, methodologies and forms of analysis in order to enhance objectivity when presenting the outcomes of a study (Mahdi, 2011). Basias and Pollalis (2018) define quantitative analysis as a methodical and empirical examination of phenomena that utilises statistical and mathematical techniques, together with numerical data processing.

Quantitative research often begins with study designs that are guided by a preconceived assumption, which subsequently leads to the development of theoretical frameworks. Quantitative research employs a methodology that involves the use of closed-ended questions that are formulated based on pre-established hypotheses. These queries facilitate the establishment of a clearly defined issue, which will remain consistent throughout the course of the study (Mayer, 2015). Statistics play a crucial role in the quantitative research methodology as they facilitate the examination and manipulation of data. This encompasses several stages such as data collection, evaluation, analysis and the derivation of meaningful findings (Basias & Pollalis, 2018). The estimation of numerical values plays a crucial role in bridging the gap

between empirical observations and the mathematical expression of quantitative connections (Basias & Pollalis, 2018). Below is a summary of quantitative approach.

Table 3.4. Summary of quantitative approach

Research Component	Quantitative
1. Primary purpose	Determine Outcomes
2. Research question	'What' questions
3. Selection of participants	Intervention and comparison groups: groups selected to be equal or randomised (generalisability)
4. Sample size	Determined by a priori by the power calculation
5. Analysis	Statistical, numeric
6. Research quality and rigour	Ensure the quality of the data (validity) and of the data analysis (reliability)

Source: Sargeant (2012).

Ntiyakunze (2011) identifies many key attributes associated with this phenomenon, namely cause-and-effect thinking, formulation of hypotheses and research questions, utilisation of measuring techniques, and a propensity towards deductive reasoning. In essence, this approach aims to examine theoretical frameworks and generate findings that may be applied to broader contexts. According to Mayer (2015), the deductive empirical cycle involves subjecting the theory to subsequent testing. The positivist paradigm is commonly connected with quantitative research. The most common methods of investigation employed by this approach are experiments and surveys (Ntiyakunze, 2011). Quantitative research is not designed to comprehensively capture the complexities of distinctly human and unquantifiable phenomena, such as social construction processes, awareness and emotional experiences (Koche et al., 2014).

3.5.2 Qualitative research

The qualitative research approach successfully enables the exploration of meaning, interpretations and individual experiences. In the realm of investigation aimed at discovering a core phenomenon, qualitative research involves several analyses that together contribute to the ultimate result in order to meet the research question (Ward, Comer & Stone, 2018). Koch et al (2014) highlight that qualitative research facilitates a thorough portrayal and analysis of

social processes, practices and occurrences. Furthermore, it facilitates a nuanced understanding of participants' perceptions and interpretations of these processes, behaviours and phenomena within the framework of their personal experiences and social environments.

The term 'qualitative research' encompasses a range of techniques for collecting and analysing data, with the aim of offering cultural and contextual explanations and interpretations of social phenomena (Vaismorad & Snelgrove, 2019). The primary objective of qualitative research is to conduct observations of a subject within their natural setting, with the intention of capturing data that is unbiased and occurs organically. Mayer (2015) asserts that qualitative methodologies encompass a range of interpretive techniques aimed at elucidating, deciphering, translating, and comprehending the significance, rather than the frequency, of various naturally transpiring phenomena within the social context. This type of study seeks to elucidate the features of the subject through the use of descriptive language as opposed to numerical representations (Mahdi, 2011). Qualitative research spans a wide range of disciplines, fields and themes (Denzin & Lincoln, 2005).

Qualitative research on social phenomena does not aim to establish a straightforward association between identified variables (Feilzer, 2010). Instead, it involves the collection and analysis of descriptive, narrative, numerical, and categorical data from both historical and contemporary sources. The use of this particular empirical study methodology offers the benefit of facilitating a more comprehensive and profound comprehension of the interpretations that individuals attribute to various actions, occurrences and connections (Castleberry & Nolen, 2018). Mahdi (2011) reflects on the advantages of a qualitative approach that it can answer precise questions about specific aspects of organisational life; it can focus on experiences of a specific training or development programme, perhaps as part of a more extensive assessment process, and it can be used to investigate much broader issues. Guba and Lincoln (1985) argue that qualitative research methods possess a greater degree of naturalness due to the inherent requirement for researchers to interpret data and derive conclusions based on their observations.

Qualitative research is primarily focused on achieving a comprehensive grasp of the subject matter (Orr et al., 2021). According to Nassaji (2015), a more thorough approach to research often involves the collection of data from several sources in order to gain a deeper understanding of individual participants, including their views, opinions, and attitudes.

Qualitative study designs are commonly characterised by their flexibility, exploratory nature and emphasis on deductive rather than inductive reasoning. It is imperative to select participants whose data is gathered and analysed through an open-ended inquiry. Common methodologies utilised in qualitative research encompass oral histories, focus groups and case studies, while also capturing respondents' views. Additionally, venues for communal symposiums and academic journal records are often implemented to facilitate the dissemination and discussion of qualitative research findings.

Qualitative research can be undertaken using various methods, including observation, unstructured interviews, group interviews and document gathering. Field notes, interview transcripts, documents, films and other materials are produced as a result of conducting interviews or collecting information (Graue, 2015). In the field of qualitative research, scholars engage in a comprehensive process that involves observing, conducting interviews, summarising, explaining, analysing and interpreting various phenomena within their natural environment (Basias & Pollalis, 2018). The primary objective of this approach is to gain a deeper understanding or interpretation of these phenomena by exploring the subjective meanings that individuals attribute to them (Denzin & Lincoln, 2005). According to Mason (2002), the qualitative approach introduces a broad spectrum of social world possibilities. These are listed as the quality of living conditions, the interpretations, past encounters and thoughts of the respondents, organisations, dialogues, relationships, and the importance of the implications created by the possibilities. Qualitative research proceeds through rigorous and elongated interaction with specific scenery. The below table depicts a summary of a qualitative approach.

Table 3. 5. Summary of a qualitative approach

Research component	Qualitative
1. Primary purpose	Understand phenomenon
2. Research question	'How' and 'why' questions
3. Selection of participants	Purposive to ensure representation of essential elements of the research question
4. Sample size	Determined when data saturation is achieved (through data collection and analysis)
5. Analysis	Interpretive, narrative
6. Research quality and rigour	Ensure the quality of the data (authenticity) and the data analysis (trustworthiness)

Source: Sargeant (2012)

According to Nassaji (2015), the process of analysis in qualitative research typically involves an inductive examination of the data to identify recurring themes, patterns or concepts and then summarising and interpreting those categories. The validation and documentation of qualitative occurrences are achieved by examining views that are not readily measurable or quantifiable. Nevertheless, a strategy that may be used to measure data in the realm of qualitative research involves the utilisation of several data sources and the collection of diverse strands of information (Ward, Comer & Stone, 2018).

Qualitative research focuses on understanding, clarifying, investigating and uncovering scenarios, feelings, views, attitudes, personal inclinations, credence and history of a group of individuals (Saunders, Lewis, and Thornhill, 2007). Amaratung (2002) reveals that qualitative data information originates rational, comprehensive illustrations and definitions of procedures in distinguished local scenarios. Qualitative data possesses the capacity to elucidate intricate processes within particular contexts, exemplified by the ability to compare and analyse data across multiple cases (Park et al., 2020). The distinctive contribution of qualitative research to the body of professional knowledge is in its ability to provide a phenomenological comprehension of the lived experiences of the people involved in the study (Koch et al, 2014).

Denzin and Lincoln (2005) argue that the qualitative approach encompasses a range of terminology, concepts and assumptions. These encompass various traditions such as foundationalism, positivism, post-foundationalism, post-positivism, poststructuralism,

postmodernism and post-humanism. Additionally, there are numerous qualitative research perspectives and methodologies associated with cultural and interpretive studies. The constructivist viewpoint aligns well with qualitative research methodologies.

3.5.3 The mixed-methods research

Da Silva (2017), state that a mixed-method analysis refers to the deliberate combination or integration of quantitative and qualitative methodologies as study components. This may involve combining experimental research with qualitative inquiry or gathering data from diverse sources, such as integrating quantitative test data with qualitative interview data. The primary objective of employing mixed-method research is to determine if the findings derived from these distinct approaches align and converge (Nassaji, 2015). The utilisation of this analytical approach enables researchers to adopt a detached and objective perspective towards their research without compromising the essential scientific impartiality (Da Silva, 2017). The mixed-methods technique is widely utilised when the study's goal is to comprehend various phenomena simultaneously, necessitating both quantitative and contextual interpretation (Park et al., 2020).

The mixed-methods approach to research is considered to be a supplementary way to quantitative and qualitative research methodologies rather than a substitute for them (Mitchell, 2018). According to Park et al. (2020), researchers employ both quantitative and qualitative data in an objective-driven methodology, either alone or in combination, based on the significance of these two data kinds and their intended role in addressing research problems or attaining research objectives. Scholars employing a mixed-methods approach in their study endeavour to capitalise on the advantages and limitations inherent in a conventional single strategy (Mitchell, 2018).

3.5.4 Notable distinctions between the research approaches

Instead of being considered as opposites or dichotomies, qualitative and quantitative approaches should be considered as different ends of a continuum (Creswell, 2016; Newman & Benz, 1998); by contrast, mixed-methods research sits in the middle of this continuum because it combines components of both qualitative and quantitative methodologies. The significant distinction between the two methodologies lies in the fact that quantitative research entails the systematic examination and analysis of phenomena through the utilisation of statistical and mathematical techniques. On the other hand, qualitative research entails the

examination of experiences, behaviours, and relationships without employing statistical or mathematical techniques (Basias & Pollalis, 2018).

Casteel & Bridier (2021) posit that in qualitative designs, the data are collected to explore the unit of analysis, which may be a phenomenon, lived experience, case, individual, or group, depending on the nature of the research design and the research problem. Qualitative studies possess an exploratory and observational nature, with the objective of acquiring knowledge and observing the occurrences within a given context. On the other hand, quantitative studies adopt an experimental approach, seeking to ascertain the effects of a particular intervention and relying on either inductive or deductive reasoning. The utilisation of qualitative data is prevalent in the majority of exploratory research, as noted by Stebbins (2011). Table 3.6 succinctly delineates the disparities between quantitative and qualitative methodologies.

Table 3. 6. Summary of differences between quantitative and qualitative approaches

Features	Quantitative strategy	Qualitative strategy
Aim and objectives	Measurement of views and opinions The goal is to establish cause and effect Focus on data quantification and generalisation of findings	To gain complete insight into the research problem Focus on describing the problem and process Focus on understanding the research problem and the motivations
Hypothesis/research question	Stated before the commencement of the study Investigation is based on theory, and it uses a deductive approach	No defined hypothesis before the study
Study variable	The independent variable is usually controlled and manipulated	Theory is usually developed inductively after the investigation
Data collection method	Fixed an objective approach. Uses closed and structured questionnaires, experimental methods	Flexible approach. Uses open-ended, semi-structured and unstructured interviews, case studies, observations, focus group
Research design	Fixed research design, usually developed before the study	No predetermined research design: it keeps developing as the study progresses
Method of data analysis	Descriptive statistics with a focus on numerical values, percentages, and mean.	Content analysis and coding of themes

Validity and reliability	Uses statistical analysis and data to ascertain and validate data	The use of multiple approaches, known as triangulation, helps in the validation of information
Study sample	The selected sample should represent the population for the study	Purposive sampling is usually used for the study; sample size is not the focus
External validity	Uses statistical data (size of population) and inference to validate results and generalise findings Focus is on the research design and the data collection The research problem is investigated in a simplified and objective manner	The focus here is not to generalise findings, but multiple sources are used in validating and enriching findings
Strength	Findings can be easily generalised The selected variables can be easily measured Data is obtained from a large sample, which supports finding generalisations.	Participants' opinions and views about the phenomenon can be readily obtained.
Weakness	The approach is rigid, which could limit the development of theories	Findings cannot be easily generalised due to the small sample size. Knowledge generated may not be readily applicable in other settings.

Source Daniel (2017)

The initiation of the research design process in qualitative research involves the identification of the philosophical assumptions made by researchers when choosing to undertake a qualitative study (Creswell, 2007).The goal of quantitative research is to discover causal links that may be expressed using observation statements, verification and prediction. Qualitative research, on the other hand, examines human behaviour and the search for knowledge via people's behaviours (Khatleli, 2009). Meanwhile, the most popular methods for gathering data in qualitative research include observation, document review, and one-on-one or small-group interviews (including focus groups) (Sargeant, 2012).

3.5.5 Justification for the research approach

According to Khatleli (2009), qualitative research does not disregard or diminish the utilisation of quantitative methods and statistical techniques. Instead, it advocates for their incorporation, as the comprehensive nature of qualitative research is more suited to investigating particular phenomena related to everyday experiences compared to a solely quantitative approach. The

utilisation of qualitative research as a research approach is deemed suitable for fulfilling the objectives of the study and addressing the research questions, as it enables a comprehensive understanding of the nature and intricacies of the phenomenon being investigated. Qualitative research enables the comprehensive depiction and examination of social processes, practices and phenomena. It also allows for a nuanced comprehension of participants' perspectives on these processes, practices and phenomena within the framework of their personal lives and social surroundings (Koch et al, 2014).

The primary focus of this study is to investigate and analyse the implementation of an infrastructure delivery management system. Additionally, the study aims to identify the connections between delivery challenges in public sector infrastructure projects and explore potential strategies for mitigating these challenges in order to enhance infrastructure delivery. Given the complexity of infrastructure delivery management systems, a qualitative research technique is essential to delve into this topic. The complexity of methodological framework and the need to assess it in a real-world context using qualitative features are key influencing the decision to opt for qualitative research. The researcher concluded that employing qualitative methods is suitable for this study. These procedures enable a more comprehensive exploration of the individuals and settings involved, allowing for the generation of a subjective understanding that would have been overlooked if quantitative or experimental approaches had been utilised. Qualitative research methods are often used to interpret and evaluate in-depth research in their natural environment to understand the problem better. Qualitative research, as advocated by Cresswell (2016), emphasizes the significance of embracing multiple realities to gain a comprehensive understanding of phenomena.

Basias and Pollalis (2018) assert that qualitative research offers greater flexibility compared to quantitative research due to the researcher's ability to adapt and adjust their technique. The researcher determines the development of the research approach in detail and flexibility to the participants (face-to-face problem-solving in the interview, open questions to provide detailed information). In contrast, quantitative research is typically more rigid (ibid). Park et al. (2020), highlight the benefits of using qualitative research with inductive reasoning and a constructivist framework, which are advantageous for developing theories and models. This approach involves cognitively reconstructing phenomena to derive novel insights and achieve a comprehensive understanding of the underlying facts. Quantitative research, known for its emphasis on logical thinking and positivism, excels in validating and generalising hypotheses

and models. This is achieved by the examination of numerical data pertaining to phenomena (ibid).

3.6 Research Strategy

A research strategy refers to the approach that a researcher intends to employ in order to carry out research work, utilising several methods that are available (Saunders, Lewis, and Thornhill, 2007). The critical components of a research project, including the subject area and scope of the research, the theoretical framework, the research methodology, and the research design, are all delineated within a research strategy. Strategies play a crucial role in guiding the procedures within a research design, aiding the researcher in identifying the specific data to be collected, determining the analytical tools to be employed for source analysis, and outlining the approach for reporting the acquired data (Al Shamsi, 2019).

Majeed (2019) posits that several research strategies, including inductive, deductive, abductive, and reproductive approaches, can be employed to address research inquiries. The deductive approach commences by formulating a preliminary hypothesis or set of assumptions that formulates a theoretical framework capable of offering a potential solution or explanation for a particular scenario. Subsequently, observations are employed to systematically assess the validity of these hypotheses (Malhotra, 2017). Deductive reasoning begins with the assertion of a general rule and leads to a specific conclusion that is assured (Mitchell, 2018).

According to Mitchell (2018), the process of inductive reasoning commences with the formulation of a hypothesis or general rule, which is subsequently subjected to empirical testing using evidence. If the hypothesis is confirmed to be accurate, this process culminates in the derivation of a specific conclusion. The initial stage involves the presentation of discrete or isolated statements, which subsequently transitions into broader or more general assertions (Malhotra, 2017). The Inductive Research Strategy seeks to establish limited generalisations concerning the distribution of observable or measured attributes of individuals and social events, as well as the patterns of association between them (ibid).

Abductive reasoning typically commences with a collection of partial observations and proceeds towards the most plausible and viable explanation. This research technique involves the formulation of hypotheses through analysing the language, meanings and narratives of individuals within the framework of their daily activities (Malhorta, 2017). The initial step of

this study involves establishing clear definitions for the identified behaviours and their respective interpretations. Subsequently, categories and concepts are derived from these behaviours that may then be employed to gain a comprehensive understanding of the given circumstance. Table 3.7 outlines the various research strategies:

Table 3.7. Peirce's ordering of the logic of scientific inquiry

Inference	Process	Relationship to theory	Examples based on this approach
Abduction	Creates tentative explanations to make sense of observations for which there is no appropriate explanation or rule in the existing store of knowledge	Does not start with explanations but instead links things together to generate an order that fits the surprising facts - the beginning of theory-building	Lean start up, grounded theory, ethnomethodology, machine learning, hypothesis-free a-b testing, design thinking, constructive design research, prototyping, cultural probes
Having developed a guess, explore the consequences via deduction			
Deduction	Taking a general rule and seeing what follows in particular cases	Top down: Explores the necessary consequences of a rule	Randomised control trials, experiments in the natural and physical sciences
Now make observations to see if the rule and the consequences hold via induction			
Induction	Looking across cases and data to produce a rule or pattern	Ground up: Has a theory in mind and seeks confirmation across cases	Surveys, cases, interviews

Source: Hanse (2008)

According to Byrne (2021), researchers employing a deductive or theory-driven approach may opt to generate codes within a pre-existing conceptual framework or codebook. In this scenario, the analysis process is typically directed by the analyst and relies on the researcher's interpretation, which is guided by relevant theoretical perspectives. A researcher employing an inductive or data-driven approach may seek to generate codes that accurately represent the substance of the data, without being influenced by pre-existing ideas or conceptual frameworks. The various research methodologies are interconnected with philosophical underpinnings. Researchers have the option to employ diverse qualitative analytical approaches, such as narrative research, phenomenology, ethnography, case study and grounded theory, among others.

- Narrative research

The technique is investigative, wherein the researcher examines the lives of persons and solicits narratives from one or more participants regarding their life experiences (Ntiyakunze, 2011). The researcher often retold or reconstructed the information into a narrative chronology (Creswell, 2016).

- Phenomenology

The term 'phenomenon' originates from the Greek term *phaenesthai*, which denotes the act of something appearing or manifesting itself (Liamputtong, 2018). Phenomenology is a research approach that centres on elucidating the shared aspects of a lived experience among a specific collective in order to characterise the essence of the phenomena (Creswell, 2016). According to Mahdi (2011), phenomenology posits that the construction of reality and its interpretation is a social process, wherein individuals assign significance to their experiences rather than relying on an objective determination. Liamputtong (2018) asserts that phenomenology is a research approach that investigates the lived experiences of individuals or groups in relation to a specific concept or phenomenon. The objective of this methodology is to gain a comprehensive understanding of an individual's distinct lived experience by exploring the significance of a particular event (Petty et al., 2012). In order to get a deeper understanding of the phenomenon, researchers engage in a procedure called bracketing, when they temporarily suspend their own viewpoints on the subject matter (ibid). According to Mahdi (2011), a significant limitation of this approach is the challenge of generalising the findings due to the specific setting in which the researcher conducted the observations.

- Ethnography

Ethnography is a study methodology that involves the comprehensive examination of a cultural community within its natural environment over an extended duration. This is achieved by the collection of observational and interview data by the researcher (Creswell, 2016). The research process is predicated on the notion that researchers can gain a comprehensive understanding of how individuals manifest their values, beliefs, and behaviours within a cultural context by immersing themselves in prolonged and extensive engagement with these individuals (ibid). The main aim of the ethnographic approach is to document the perspective, sense, motivations, intentions and expectations that the actors assign to their social behaviours, individual or group endeavours, and the cultural context in which they live (Al Shamsi, 2019). This prolonged

interaction will provide researchers with anecdotes, living patterns and cultural themes from which they can create an ethnographic report (Liamputtong, 2018). Researchers in ethnography use in-depth interviews, focus groups, life histories and unobtrusive methodologies (ibid). Therefore, the practice of juxtaposing and expanding upon concepts of intermediate or broader scope enhances the anthropological perspective on the interplay between nature and society. On the other hand, a case study is a research methodology characterised by the necessity of conducting a systematic investigation and analysis of one or multiple cases (Al Shamsi, 2019).

- Case study

A case study refers to an empirical inquiry conducted within the actual context of a contemporary phenomenon, serving as a comprehensive examination of specific conditions in their authentic setting (Yin, 2014). Ahmed (2008) defines a case study as an in-depth exploration of a unique situation, providing a detailed view of real people in real situations to enhance researcher's understanding of their experiences. According to Yin (2014), a case study enables the examination and preservation of the comprehensive and significant elements of real-world occurrences. Yin (2014) postulates that a case study permits an investigation to preserve the holistic and significant aspects of real-world events and is particularly beneficial when the contextual factors of the events under investigation are essential. The level of control exerted by the researcher on the outcome is limited.

Creswell (2016) emphasizes that case studies are a valuable research method for examining real-life, contemporary bounded systems or numerous bounded systems over a period of time. This approach entails a meticulous data collection process that comprehensively integrates information from various sources. The phenomenon observed inside the constrained environment of the particular instance is commonly referred to as the case in the realm of case study research (Baxter & Jack, 2008). Case studies aim to explore the attributes of a particular phenomenon from the viewpoint of those involved. This is achieved by carefully reviewing and analysing a multitude of data sources. Yin (2014) asserts that the utilisation of a case study technique is appropriate for addressing research inquiries pertaining to the 'why' and 'how' aspects of investigating a certain occurrence.

A case study is a methodological approach that evaluates and justifies a singular item in order to ascertain its fundamental attributes (Bryman, 2012). Case study research can be employed in several contexts, including exploratory, explanatory or descriptive scenarios (Stake, 1995).

Furthermore, based on the phenomenon being examined, case studies can be classified as single, holistic or multiple case studies. Case studies can be conducted as either single examples, which aim to question or confirm a theory, or several cases, which follow a replication logic (Yin, 2014). According to Stake (1995), determining the number of cases to be done does not adhere to a fixed or predetermined quantity. The research question and goal determine the exact quantity (Gog, 2015). The examination of various entities such as individuals, groups, processes, events, decisions, programmes and other phenomena that possess temporal and spatial boundaries, can be conducted through the utilisation of case studies (Casteel & Bridier, 2021; Yin, 2014).

A single case study is formulated with the purpose of applying, examining or constructing a theory. In contrast, employing a numerous case study approach allows for the examination of both commonalities and distinctions among various situations (Yin, 2014). Case studies facilitate the examination of cultural systems of action from multiple perspectives, enabling a comprehensive knowledge and providing insights into exploratory inquiries (Basias & Pollalis, 2018). The case study methodology preserves the comprehensive and meaningful elements of real-life events. Case studies are sometimes referred to as evaluations that incorporate numerous perspectives, including the examination of voice expressions, observations of individual actors and groups of actors, as well as their relationships (Yin, 2014). The table shown below presents the many classifications of case studies.

Table 3.8. Single or multiple case study designs

Case study	**Type definition**
Explanatory	This type of case study would be used if a researcher were seeking to answer a question that sought to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. In evaluation language, the explanations link programme implementation with programme effects (Yin, 2003).
Descriptive	This type of case study describes an intervention or phenomenon and the real-life context in which it occurred (Yin, 2003).
Multiple-case studies	A multiple case study approach enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases. Because comparisons will be drawn, the cases must be chosen carefully so that the researcher can predict similar results across cases or predict contrasting results based on a theory (Yin, 2003).
Intrinsic	Stake (1995) uses the term intrinsic and suggests that researchers who have a genuine interest in the case should use this approach when the intent is to understand the case better. It is not undertaken primarily because the case represents other cases or illustrates a particular trait or problem but because, in all its particularity and ordinariness, the case itself is of interest. The purpose is not to understand some abstract construct or generic phenomenon. The purpose is not to build theory (although that is an option; Stake, 1995).
Instrumental	It is used to accomplish something other than understanding a particular situation. It provides insight into an issue or helps to refine a theory. The case is of secondary interest; it plays a supportive role, facilitating our understanding of something else. The case is often looked at in-depth, its contexts scrutinised, its ordinary activities detailed, and because it helps the researcher pursue the external interest. The case may or may not be typical of other cases (Stake, 1995).
Collective	Collective case studies are similar in nature and description to multiple case studies (Yin, 2003).

Source: (Baxter & Jack, 2008)

The structure and design of a case study provide the logical connection between the collected data and the derived findings, aligning them with the research objectives that underpin the study (Aczel, 2015). This can be considered a logical model and a plan that guides a researcher through gathering, analysing and interpreting data. The inclusion of a case study in research also serves to demonstrate the theoretical constructions and assumptions that underpin the

study (ibid). Case research facilitates the generation of unique viewpoints from different individuals inside an organisation pertaining to a specific research subject. In contrast, surveys are often limited to soliciting responses from a single subject, while an intensive case study programme may involve conducting many interviews with a diverse cohort of individuals (Mahdi, 2011).

The utilisation of the case study approach enables researchers to examine inquiries related to the how and why of a certain phenomenon, while also taking into account the influence of the contextual factors in which it takes place (Baxter & Jack, 2008). According to Yin (2003), case studies are utilised for the purpose of analytical generalisations wherein the researcher seeks to connect a specific set of data to wider theoretical assumptions. Gog (2015) asserts it is used in order to obtain insights that can be applied to a broader context. In order to mitigate the scope of the study and ensure a feasible research endeavour, the case limits serve to delineate the parameters for data collection and the context within which the data will be analysed (Casteel & Bridier, 2014).

3.6.1 Researcher's chosen strategy

A case study is a beautiful opportunity for a novice researcher to get valuable insights into a particular topic matter. Simultaneously, this methodology enables the researcher to gather data from several sources and integrate it in order to emphasise the particular instance (Baxter & Jack, 2008). The goal of the case study is to determine the exact variables and causes that explain the entire behavioural patterns of the unit as well as the unit's position in its social environment. The case study technique investigates the subject matter qualitatively, includes all elements of a single entity, and provides enough knowledge about a person, a group, or a unit (Akthar, 2016).

Given the exploratory and evolving nature of the qualitative research question, the research study will be able to preserve its qualitative character. The research question serves as a guiding principle for the collection of data throughout the research process. Qualitative research typically involves the collection of descriptive data, including historical and present information as well as narrative material. On the other hand, quantitative research focuses on the extracting categorical or numerical data. The utilisation of narrative research,

phenomenology and ethnography may not be appropriate for this study due to the requirement for these methodologies to effectively address the research problems at hand.

The main benefit of employing several case studies is that it allows the researcher to obtain a more profound knowledge of little-known problems or occurrences in a specific context by triangulating data from different sources (Yin, 2014). The research methodology employed in this study is the utilisation of a multiple-case technique to examine the phenomenon under investigation. Case studies typically concentrate on limited samples and aim to examine real-life events rather than making statistical inferences about the broader population (Yin, 2003). Yin (2014) highlights that the case study technique enables the creation of detailed and comprehensive descriptions of the phenomena under investigation. This methodology enables the researcher to gain insight into the intricacies of transformation and the existence of various interpretations, aspects that would not be captured using quantitative or experimental methodologies (ibid).

The main goal of conducting a case study research is to get a more profound comprehension of the implementation of IDMS in public sector departments across diverse geographical regions. This methodology facilitates the researcher in gathering and synthesising data from multiple sources in order to shed light on a specific case scenario. The case study additionally offers additional information regarding current practises and the various forms of support that will be offered to ensure the successful execution of the plan. To increase the chances of obtaining an accurate assessment of facts it is imperative to take into account several key factors. These factors encompass the utilisation of diverse data sources, employing various gathering strategies, consulting current literature, and conducting a comprehensive examination of prior research endeavours. The necessity for a substantial amount of empirical evidence indicates that employing a case study approach would be suitable, as it enables a thorough investigation of the implementation of infrastructure delivery systems. The data collection and analysis process involved incorporating theoretical assumptions, which ultimately helped achieve the desired outcome. The researchers chose the case study approach for its ability to capture the participants viewpoints, feelings, experiences, and internal thought processes (Baxter & Jack, 2008). A case study provides a thorough perspective on the procedures involved and a deeper understanding of the research problem.

The instances outlined are part of the multiple unit analysis structure. To identify the case organisation, the researcher used a specific set of criteria: the researcher approached the organisations responsible for overseeing infrastructure delivery through IDMS within South Africa. The organisations execute a wide range of infrastructure projects. The selected departments were those that had widely utilised the system and were identified as potential advocates for the implementation of the system. The units under consideration in this context pertain to the processes, governance, and organisational structure of the several departments. The table presented below provides profiling of the multiple cases.

Table 3. 9. Multiple case overview:

Case description	**Province**	**Country**	**Category of Projects**	**Project delivery system**
Department of Infrastructure Development	Gauteng	RSA	Infrastructure	IDMS
Department of Public Works, roads and transport	Mpumalanga	RSA	Infrastructure	IDMS
Department of Public Works, roads and transport	Western Cape	RSA	Infrastructure	IDMS
Department of Public Works, roads and transport	KwaZulu- Natal	RSA	Infrastructure	IDMS

Source: Researcher's collection

The case studies being studied are from four departments allocated the responsibility to provide infrastructure . The cases are categorised as follows:

The department of public works is responsible for public infrastructure as well as providing accommodation and property management to other government institutions. There are mandates that guide the department, one of which is infrastructure development. The public works department has branches across the nine provinces in the country. The department implements public infrastructure projects through IDMS. The selected departments in the study are from the provinces of Gauteng, Kwa-Zulu Natal, Mpumalanga and Western Cape as they were the early adopters of the project implementation model.

The department of Infrastructure Development is responsible for implementing social and building projects in the province, located in Gauteng. The organisation focuses on improving how public infrastructure is built and manage. The department's client profile consists of education, health, sports, arts, and culture departments. Built environment professionals in various roles supervise infrastructure projects. The department oversees projects in the province from planning to completion, including the operation and maintenance of infrastructure. The projects are carried out through the IDMS model.

The Kwa-Zulu Natal Department of Public Works is responsible for providing public infrastructure in the province. The department implements infrastructure projects on behalf of departments of education, health and social development. The department plays a critical role in infrastructure projects. The organisation comprises of built environment professionals in varying positions who are entrusted with the responsibility of overseeing projects under infrastructure units. The department oversees projects for the province from planning to completion as well as operation and maintenance of the infrastructure projects. The projects are implemented through IDMS.

The department public works Western Cape includes the mandate to construct and maintain roads, educational and health facilities and general buildings. The department has responsibility to provide public infrastructure in the province. The organisation comprises of built environment professionals in varying positions who are entrusted with the responsibility of overseeing projects under infrastructure units. The department oversees projects for the province from planning to completion as well as operation and maintenance of the infrastructure projects. The projects are implemented through IDMS.

The department public works Mpumalanga rolls out social and public infrastructure in the province. The department's mission is to provide integrated, reliable and cost effective infrastructure. The department oversees projects on behalf of education, health, social development and sports, culture and recreation. The organisation comprises of built environment professionals in varying positions who are entrusted with the responsibility of overseeing projects under infrastructure units. The department oversees projects for the province from planning to completion as well as operation and maintenance of the infrastructure projects. The projects are implemented through IDMS.

The cases exhibit significant variability in terms of geographical location and socio-demographic background. The department of public works closely collaborates with implementing agents to carry out social and public infrastructure projects. Some of their initiatives are executed internally, with the aid of professional service suppliers. The Department of Infrastructure Development acts as an implementing agency for government departments in the province. The department oversees the implementation of a range of social and public infrastructure projects.

3.7 Target population

The term 'population' carries a distinct connotation within the realm of study. The population, as defined by Bhandari (2020), encompasses the entirety of the group that a researcher aims to draw conclusions about. A population can refer to a collection of items from the phenomena under study, such as items, events, organisations, countries, species or organisms. Casteel and Bridier (2021) identify the target population as a conceptually bounded group of possible participants to whom the researcher may have access and who represent the population of interest. The construction of the sampling frame is derived from the target population (ibid). The term population in the context of sampling refers to the specific units that are the focus of analysis. Individuals, legal instances and empirical evidence can all be regarded as entities.

To effectively define and specify the group of participants chosen for the study, it is crucial to apply additional limitations to the target population, considering both temporal and spatial aspects (Casteel & Bridier, 2021). In order to enhance the generalisability of conclusions and minimise the influence of extraneous variables, it is imperative to standardise methods and employ random participant selection in quantitative research. On the other hand, the process of

participant selection for qualitative research is guided by a distinct purpose, which is to identify individuals who have the capacity to offer valuable insights into the phenomenon being studied and effectively address the research questions at hand (Sargeant, 2012).

Qualitative research often focuses on a small number of respondents who have been purposely chosen to participate because the researcher believes they have extensive expertise in a topic (Lund Research Ltd, 2012). The determination of the selection criteria is based on the research questions, theoretical perspectives, and supporting evidence for the study (Sargeant, 2012). The process of selecting individuals to be interviewed holds significant importance, as the level of expertise possessed by these individuals can greatly impact the quality and accuracy of the information collected (Johnson & Christen, 2008). As a result, the process of case selection requires the application of judgemental, purposeful, strategic, or information-centred sampling strategies (ibid).

The target population is a defined, conceptually bounded group of possible participants to whom the researcher may have access and who represent the population of interest (Casteel & Bridier, 2021). Al Shamsi (2019) asserts that the target population, parameters of interest, sampling frame, acceptable sampling method and required sample size should all be considered when creating the sample. The target population of the study refers to the individuals who will be the focus of investigation. The study population includes the major infrastructure departments in South Africa, and the study's sampling frame covered all essential players in infrastructure project implementation.
The researcher employs purposeful participant selection, with a specific focus on persons who possess specialised expertise in the subject issue under investigation (Ward, Comer & Stone, 2018). The selection of subjects for sampling should encompass individuals who possess the capacity to provide valuable insights into crucial characteristics and perspectives related to the topic being studied (Sargeant, 2012).

The objective of this thesis is to enhance understanding regarding the implementation of IDMS in the context of infrastructure delivery within public sector organisations in South Africa. A comprehensive analysis of the key contextual factors, both at a broader and more localised level, is necessary to understand the impact of implementation processes inside public sector departments and the subsequent changes that occur as a result of these procedures. The adoption of constructivism epistemology ensued from this approach, with the objective of

uncovering truth by analysing occurrences within their natural context. The deployment of the study in four provincial departments in the Western Cape, Gauteng, KwaZulu-Natal and Mpumalanga, is thus delineated using a case study approach. These cases were identified by identifying the organisations that have been utilising the system since its inception, as well as the access and knowledge of the participants.

- Demographics of participants

The study's population and sample size are primarily in the public sector. Officials from the public sector and service providers are part of the sample size. One hundred people were identified, and 72 participants participated in the study. The sample included specialists in project management, programme management, senior managers, and external service providers comprised of various built environment professionals. The interviewees have a thorough understanding of the topic of this research. The respondents work in various capacities within their organisations, with most directly involved in deploying IDMS on infrastructure projects and in charge of project delivery. Table 3.10 represents the demographics of the study across the government department studied.

Table 3.10. Demographics of the study

Eligibility	Description
Selection of participants	The deliberate identification of departments for review for the preparation of the reference tool was made through the application of the following filters: • Departments that have taken the lead in IDMS implementation; • Departments are responsible for the delivery of social infrastructure in order to provide adequate coverage across the country.
Participants	• The interviewees were project stakeholders involved in social infrastructure projects. • Participants include representatives from infrastructure departments: implementing agents, sponsors, clients, and service providers. This group comprises project managers, programme managers, senior managers and professional service providers. • Participants were chosen from the executive and operational levels to reveal different viewpoints and perspectives.

Source: Researcher's collection

Table 3.11 below depicts the distribution of respondents among public sector departments in the four provinces examined in the study. Thus, the outcomes of this study should generally mirror the current application of IDMS in South African government public sector infrastructure projects.

Table 3.11. Distribution of respondents in each case study

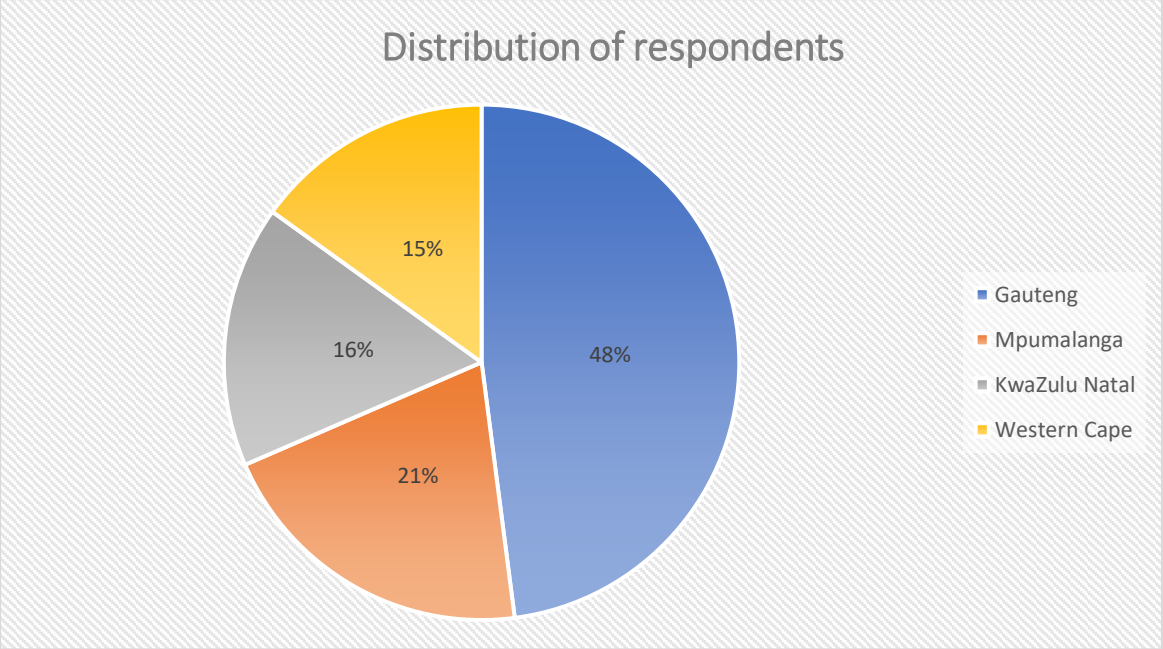
Meetings with the Mpumalanga Department of Public Works were conducted digitally using Microsoft Teams.	Fifteen semi-structured interviews were conducted with project participants involved in the project delivery chain. The participants comprised of : 5 Senior managers 7 Project managers 3 External Service Providers
Meetings with the Western Cape Department of Public Works were conducted digitally using Microsoft Teams.	Eleven semi-structured interviews were conducted with project participants involved in the project delivery chain. The participants comprised of 4 Senior managers 5 Project managers 2 External Service Providers
Meetings with the Gauteng Department of Infrastructure delivery were conducted digitally using Microsoft Teams.	Thirty-five semi-structured interviews were conducted with project participants involved in the project delivery chain. The participants comprised of 8 Senior managers 19 Project managers 8 External Service Providers
Meetings with the KwaZulu-Natal Department of Public Works were conducted digitally using Microsoft Teams.	Eleven semi-structured interviews were conducted with project participants involved in the project delivery chain. The participants comprised of: 3 Senior managers 6 Project managers 2 External Service Providers

Source: Researcher's collection

The research involved respondents from various organisations, spanning from strategic to operational, who played a significant role in planning and executing infrastructure projects. Their extensive experience in public sector projects, coupled with their knowledge of implementing IDMS, ensure the reliability of the data collected. This high level of expertise in

the building industry contributes to the high quality and depth of the data, enhancing its accuracy and comprehensiveness. Below figure present the distribution of respondents.

Figure 3.8. Distribution of respondents



Source: Researcher's collection

The four government agencies presented varied perspectives stakeholders including construction professionals, senior managers and external professional service provider institutions who collaborate on IDMS initiatives. They contribute expertise in the built environment and project execution experience in the public sector. The decision to stop collecting data is based on the researcher having fully developed the themes with which he or she may adequately answer the study problem in the environment offered (Casteel & Bridier, 2021). The researcher deemed the 72 replies, which represents a 72% response rate, adequate to support the findings discussed in the next section.

The target population for the study is the public-sector entities implementing infrastructure projects through IDMS. The study population includes public sector officials and service providers with exposure to IDMS. For this study, informants are selected from a pool of experts who hold authoritative positions overseeing the processes. The subject matter experts use their experience and knowledge of IDMS applications to facilitate the implementation of infrastructure projects. To address the research question and reduce sample bias, careful

consideration is given to the sampling procedure and participant selection (Sargeant, 2012). The sample selection for the study depends on the attributes of the population. The following section discusses the sampling techniques for the study.

3.8 Sampling methods

A sample refers to a subset of a population chosen for observation and analysis (Pandey & Pandey, 2015). The sampling frame is an operationalised representation of the target population that will be asked to participate in the research (Casteel & Bridier, 2021). According to Kumar (2019), sampling refers to the process of systematically choosing a subset of individuals from a larger population to serve as a representative sample for the purpose of collecting information about the entire population. The sampling frame is a crucial component in the process of sample recruitment, as it serves as the operational structure. Consequently, the characteristics of the sampling frame are closely linked to the chosen sampling method (Casteel & Bridier, 2021).

One crucial aspect of data collection is ensuring that the data gathered are sufficient to appropriately depict the phenomenon under investigation (Vaismorad & Snelgrove, 2019). Sampling is a method employed to ascertain the specific geographic and demographic characteristics of individuals eligible to participate in a research investigation. The sampling methodology refers to the systematic approach employed to choose individuals or elements that constitute the sample (Casteel & Bridier, 2021). Probability and non-probability sampling are common types of sampling strategies. The selection process for determining which units are included in the sample is thoroughly outlined for both non-probability and probability sampling strategies (Lund Research Ltd, 2012).

3.8.1 Probability sampling

Probability sampling, sometimes referred to as random sampling, is a method that guarantees an equal likelihood for every element in the population to be selected as part of the sample (Etikan & Bala, 2017). Probability sampling is employed for a multitude of theoretical and practical purposes. These include, but are not limited to, the following: a) facilitating the derivation of statistical inferences; and b) ensuring the acquisition of a sample that accurately represents the larger population (Creswell, 2015).

Different forms of probability sampling techniques exist. Probability sampling approaches encompass several methods such as simple random sampling, systematic random sampling,

stratified random sampling and cluster sampling (Lund Research Ltd, 2012). Random sampling methods are frequently employed in quantitative research sampling (Creswell, 2015). Probability sampling is often considered the most suitable approach for research that is directed by a positivist or post-positivist research paradigm, employs a quantitative research design, and utilises quantitative research methods (Lund Research Ltd, 2012). When probability sampling is applied to select units from the population to be included in the sample to generalise from the sample to the population, the sample is called statistical inference rather than generalisations (ibid). Some of the most common probability sampling strategies used are listed.

i. Simple random sample

The method of simple random sampling can be likened to a process of randomly selecting individuals from a population, similar to drawing names from a hat. This method can be further classified into two categories: sampling with replacement and sampling without replacement (Casteel & Bridier, 2021). Sampling with replacement is a method by which units are selected from a pool, their attributes of interest are recorded, and then the units are returned to the pool. This allows for the possibility of picking the same unit many times in subsequent selections, with each unit having an equal likelihood of being selected during the entire process (ibid).

ii. Stratified random sampling

The determination of proportions is accomplished through the utilisation of stratified sampling, followed by the implementation of simple random sampling within each stratum until the desired sub-sample size that is proportionate is achieved (Casteel & Bridier, 2021).

iii. Cluster sampling

Cluster sampling is a sample technique employed when a sampling frame is partitioned into natural clusters, often characterised by geographical boundaries (Casteel & Bridier, 2021). This method is frequently employed to acquire substantial quantities of data.

iv. Non-probability sampling

Etikan and Bala (2017) describe non-probability sampling as a sampling method that does not provide a basis for any estimate of the likelihood that components from the universe will be included in the study sample. While it is not necessary for a sample of participants or cases to

be representative or randomly selected, there should be a valid rationale for including some situations or individuals over others (Taherdoost, 2019). Non-probability sampling encompasses a collection of methodologies that allow researchers the capacity to choose units from a population of interest for the purpose of investigation. Lund Research Ltd (2012) opines that non-probability sampling methods are characterised by the researcher's subjective judgement in selecting samples rather than relying on random selection.

Non-probability sampling is a valuable set of techniques that can be applied in qualitative, mixed-methods, and even quantitative research. Non-probability sampling, as opposed to utilising statistical techniques for sample formation, necessitates researchers to make subjective judgements grounded in theory and the evolutionary nature of the study process (Lund Research, 2012). The utilisation of sampling methods proves to be particularly advantageous in exploratory research, as it enables researchers to rapidly and effectively ascertain the presence of a problem or issue (ibid). Non-probability sampling is commonly associated with qualitative research and case study research design (Taherdoost, 2019).

According to Lund Research (2012), non-probability sampling processes involve the researcher's subjective judgement when selecting units from the population to be included in the sample. There are different sampling methods when it comes to non-random designs. Etikan and Bala (2017) identified several non-probability sampling approaches, including quota sampling, purposive sampling, convenience sampling, snowball sampling and self-selection sampling. Qualitative researchers frequently employ a variety of ways to identify the participants in their studies. Two of the most notable strategies in qualitative investigations are snowball sampling and purposive sampling, which will be examined in detail.

- Snowball sampling

Snowball sampling is a non-random sampling strategy that leverages a few cases to urge others to participate in the study, resulting in a larger sample size (Taherdoost, 2019). The approach involves soliciting input from those who possess extensive expertise in the specific domain (Casteel & Bridier, 2021). The process of selection is conducted inside a collective or organisational setting whereby the necessary information is gathered. The selection of the study sample will yield advantages in terms of communication, decision-making and knowledge transmission to individuals (Etikan & Bala, 2017). The technique works best when the target group under investigation exhibits characteristics of being concealed or challenging to access,

primarily due to their closed nature (Taherdoost, 2019). The outcomes obtained using snowball sampling, similar to other non-probability sampling methods, are not generalisable to the target population due to concerns with external validity (Casteel & Bridier, 2021).

- Purposive sampling

Purposive sampling, also known as judgemental, refers to sampling procedures that rely on the researcher's judgement when selecting the units to be investigated (Taherdoost, 2019). The selection criteria for participants may encompass various factors, such as the exploration of a particular story, the presence of a shared experience with a phenomenon, affiliation with a specific culture, or the potential to contribute to theory development (Creswell, 2013). The sample process is limited to individuals who possess the necessary information and fulfil particular criteria outlined by the researcher (Al Shamsi, 2019).

The sampling method provides a practical means of enabling the data collection and processing components of research to be carried out while ensuring that the sample accurately reflects the characteristics of the larger population (Fellows & Liu, 2003). Lund Research (2012) states that there are multiple applications for purposive sampling methodologies. For instance, in academic research, samples are frequently chosen in a deliberate manner to serve as representative subsets of a larger population, with the intention of capturing specific features depending on the information that is accessible. Purposive sampling is frequently employed in qualitative research designs as a result of its inherent sampling technique (Patton, 2015).

Purposive sampling approaches encompass various methods, including maximum variation sampling, homogeneous sampling, typical case sampling, extreme (or deviant) case sampling, entire population sampling, and expert sampling (Lund Research Ltd, 2012).

- Maximum variation sampling

Maximum variety sampling, also known as heterogeneous sampling, is a purposive sampling approach utilised to encompass a diverse array of perspectives pertaining to the subject of study (Lund Research, 2012). The approach involves gaining a comprehensive understanding of a topic by examining it from multiple perspectives. This technique can be employed by researchers to effectively enlist individuals across a wide range of age groups, genders, ethnic

backgrounds, socioeconomic strata, geographical regions, health conditions, countries and other pertinent attributes (Liamputtong, 2018).

- Homogeneous sampling

Homogeneous sampling is a purposive sampling approach that aims to generate a sample characterised by a high degree of homogeneity, wherein the components possess substantially similar features or attributes (Lund Research, 2012). A homogeneous sample is often selected when the research question pertains specifically to the characteristics of a particular interest group.

- Critical case sampling

Critical case sampling is a type of purposive sampling approach that is particularly advantageous in the context of exploratory qualitative research, studies with limited resources, and investigations where a singular occurrence holds significant explanatory power for the topic under investigation (Lund Research, 2012). Although it is not advisable to draw statistical generalisations from individual critical situations, it is possible to derive logical generalisations from them (ibid).

- Expert sampling

Expert sampling is a method of purposive sampling that is employed when research necessitates the collection of information from individuals with a specific area of expertise. The focus is placed only on those possessing specialised knowledge and skills (Lund Research, 2012). The researcher obtains consent from specialists or renowned authorities in the relevant field of study before proceeding to collect data directly from individuals or groups of respondents (Etikan & Bala, 2017). Expert sampling plays a vital role within the expert elicitation study approach. According to Etikan and Bala (2017), the utilisation of expert sampling serves the objective of effectively capturing the viewpoints and insights of experts within a certain domain.

Non-probability sampling strategies, such as purposive sampling, can provide researchers with reasonable theoretical grounds to select units for inclusion in their sample based on theoretical justifications within the context of qualitative study design (Lund Research, 2012). Various

sampling designs, such as purposive, judgemental, expert, accidental and snowball sampling, can be employed in qualitative research, with the exception of quantitative research. In quantitative research, the selection of a random sample is guided by the researcher's intention, whereas in qualitative research, the selection is driven by the researcher's judgement regarding individuals who are most likely to offer the most valuable information (Kumar, 2019). In the context of qualitative research, the emphasis on sample size is placed on its flexibility and depth, prioritising the quality of data rather than the quantity (Liamputtong, 2018). Purposive sampling is distinguished from stratified random sampling by the deliberate selection of units to be included in each group's sample, as opposed to a random sampling approach. The fundamental objective of purposive sampling is to focus on specific features of the population that are relevant to the study objectives. Table 3.12 presents a comprehensive overview of several sampling strategies.

Table 3. 12. Strategies for the selection of samples and cases

Type of Selection	**Purpose**
A. Random selection	To avoid systematic biases in the sample. The sample size is decisive for generalisation.
1. Random sample	To achieve a representative sample that allows for generalisation for the entire population
2. Stratified sample	To generalise for specially selected subgroups within the population
B. Information-oriented selection	To maximise the utility of information from small samples and single cases. Cases are selected based on expectations about their information content.
1. Extreme/deviant cases	To obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense
2. Maximum variation cases	To obtain information about the significance of various circumstances for cases process and outcome (e.g. three to four cases that are very different on one dimension, size, a form of organisation, location, budget).
3. Critical cases	To achieve information that permits logical deductions of the type. If this is (not) valid for this case, then it applies to all (no) cases.
4. Paradigmatic cases	To develop a metaphor or establish a school for the domain the case concerns.

Source: Khatleli (2009)

A crucial qualitative characteristic is that research topics are usually narrow, focusing on a single central phenomenon in a specific environment. The primary objective of the researcher is to elucidate, articulate, and analyse the phenomenon in question (Maxwell, 2017) rather than making broad inferences from a subset of data to a larger population. Therefore, the focus in

sampling pertains to the extent of information richness rather than the inclusion of representative opinions.

3.8.2 Justification of the research sampling methods

Sargeant (2012) opines that in quantitative research, the sample size must be calculated statistically in advance to ensure sufficient power to verify that the outcome is, in fact, attributable to the intervention. Nevertheless, the sample size in qualitative research is generally adaptable, and the quantity of participants is contingent upon the extent required to comprehensively comprehend all noteworthy facets of the investigated subject (ibid). The process of selecting participants for qualitative case study research is purposeful and intentional, as emphasised by Kusel (1992). Furthermore, the selection of participants is strongly influenced by theoretical considerations, as highlighted by Miles and Huberman (1994). In addition, it is worth noting that qualitative study samples have the potential to undergo partial predetermination, modification and evolution throughout the course of the research.

Purposeful sampling is a widely utilised method in qualitative research for the identification and selection of relevant information pertaining to the subject of inquiry. Rather than engaging in statistical comparisons or employing a representative sample, a crucial element of qualitative research involves the deliberate and meticulous selection of research participants (Liamputtong, 2018). The sample size must be appropriate for the study's aims, and representative of the population that will benefit from it (Mertens, 2019). The determination of the sample size is contingent upon the characteristics of the study and the necessity to accommodate new themes. In qualitative research, it is essential for the researcher to continue data collection until the research topic is adequately addressed (Casteel & Bridier, 2021).

Purposive sampling is a viable and efficient approach for constructing the sample in the context of the research being examined. The study utilised a purposive sampling strategy, which involved the collection and analysis of IDMS data pertaining to the implementation of infrastructure projects. Purposeful sampling is a method employed primarily to pick participants who possess a high level of competence in the subject matter and may make valuable contributions to the study. The selection of participants in this method is based on their expertise, affiliations, and proficiencies in the research area (Al Shamsi (2019).

Before initiating the inquiry, researchers determine the requisite sample size, which remains consistent for the entirety of the study (Lund Research, 2012). Insufficient or excessive sample sizes can significantly the validity and reliability of study results or findings. Both inadequate and excessively sample sizes have the potential to result in inaccurate findings (ibid). Brink (1993) posits that the selection of a sample in qualitative research is contingent upon the subject's ability to provide data that is relevant to the research inquiry. If a sufficient amount of comprehensive data has been obtained, and subsequent coding does not yield novel codes or additional themes, it is appropriate to conclude data collection process (Casteel & Bridier, 2021).

Prior communication with the individuals responsible for overseeing infrastructure projects enabled the chance to interact with department officials and service providers associated with the research endeavour. The study's participants were selected from a diverse pool of persons, encompassing both authorities with previous experience in deploying IDMS on infrastructure projects and service providers tasked with executing similar projects. The study sample comprised individuals with professional roles as project managers, senior managers, and service providers in the field of public infrastructure services. These participants have relevant knowledge and expertise in IDMS. Data collection involved conducting a series of 72 interviews ,which constituted the sample.

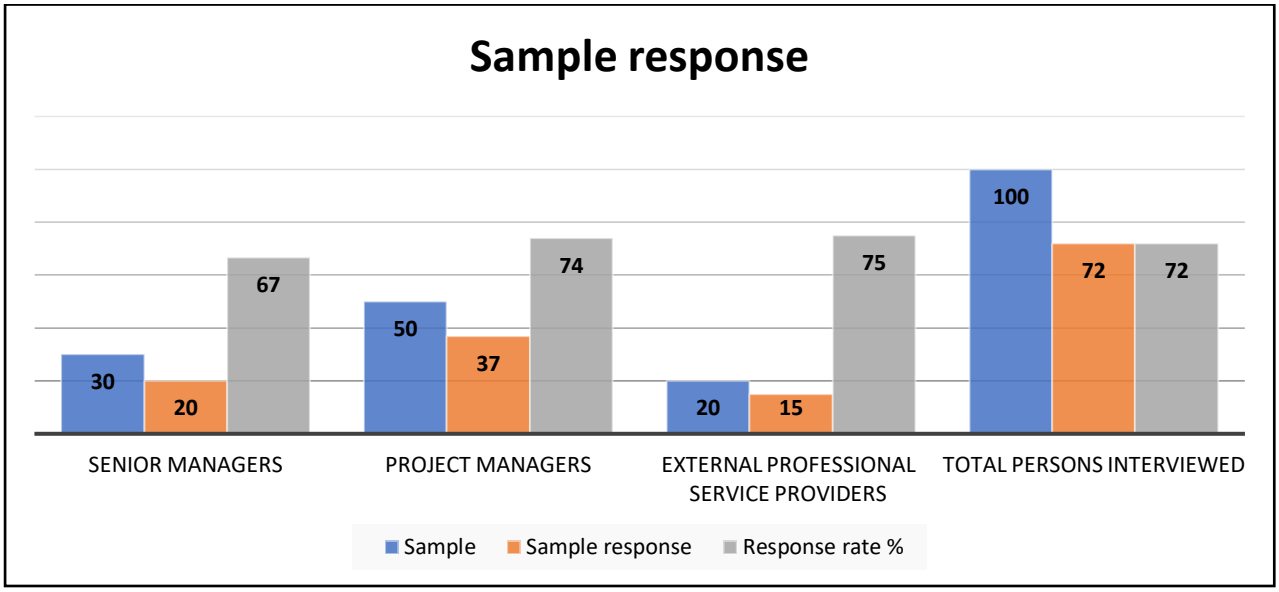
Below table and figure illustrates the interviewee sample.

Table 3. 13. Interviewee descriptions across departments

Designation	Sample	Sample response	Response rate %
Senior managers	30	20	67
Project managers	50	37	74
External professional service providers	20	15	75
Total persons interviewed	100	72	72

Source: Researcher's collection

Figure 3.9. Sample of persons interviewed



Source: Researcher's collection

The interviews underwent a process of formatting and coding in order to ensure the removal of any identifying information, such as names or references to specific individuals or organisations, in adherence to ethical considerations. The interviews were formatted and coded to ensure the anonymity of individuals and organisations for ethical reasons. Below section presents the interviewee codes:

Table 3. 14. Interviewee codes across departments

Respondents	Codes	Grouping	Departments	Codes
Senior managers	SM	01	All	SM01
Project managers	PM	02	All	PM02
External professional service providers	EPS	03	All	EPS 03

Source: Researcher's collection

According to the interview responses, 51% are from project managers, 28% are from senior managers, and 21% are from external service providers. It is worth noting that responders have been involved in delivering social and public infrastructure. The findings indicate that the respondents have been exposed to IDMS and have used it in social infrastructure projects. It is fair to infer that the respondents have worked in the public-sector infrastructure industry in

South Africa. Thus, their perspectives on the problems and potential solutions that apply to the sector and the construction industry might be considered beneficial.

In order to address time limitations, a total of 100 participants were selected and included in the study using the purposive sampling method to provide a representative and valid sample for the subsequent analysis. The validity of the results is contingent mostly upon the adequacy of the sampling technique employed. Because of the Covid-19 epidemic, interviews were conducted remotely, utilising digital platforms for recording and afterwards transcribing the conversations. The objective is to provide an explanation, description and interpretation of the subject matter, rather than making generalisations from a specific sample to a larger population.

3.9 Data collection methods

Methods are commonly known as the techniques or protocols employed to acquire and compile data that are pertinent to a research query or hypothesis (Ahmed, 2008). According to Casteel and Bridier (2021), the key factors to be taken into account when establishing guidelines for sample recruitment in qualitative research are the research design and the data source. Pandey and Pandey (2015) opine that researchers will need a range of data collection instruments and methodologies. A multitude of data collection strategies are available for use in research that can be employed either alone or in conjunction with one another. According to Pandey and Pandey (2015), there can be variations in the complexity, comprehension, design and administration. The selection of a particular approach is contingent upon the study purpose, available resources and level of skill. The utilisation of primary and secondary data sources can facilitate the accomplishment of this task.

According to Bowen (2009), it is anticipated that the qualitative researcher will employ several sources of evidence in order to achieve convergence and confirmation. This is accomplished through the integration of diverse data sources and methods. Kumar (2019) refers to primary sources as information that is directly obtained from participants. Pandey and Pandey (2015) posit that various sources of data gathering encompass a range of methods such as surveys, interviews, schedules, observation techniques and rating scales, among others. Baxter & Jack (2008) assert that primary data sources may include, but are not limited to, interviews, observations, focus groups and designed questionnaires. This section provides an overview of several methodologies employed in the collection of primary data.

3.9.1 Primary data collection methods

- Interviews

Interviewing is a popular approach for the collection of information, employing various channels such as face-to-face interactions, telephone conversations, email correspondence, online platforms, computer-assisted interviews or documented dialogues between people (Daniel, 2017). According to Gottfert (2015), an interview can be defined as a bilateral conversation between the researcher and the participant, involving direct interaction between the two individuals. The procedure involves the researcher presenting inquiries to the participants and thereafter affording them the opportunity to provide their responses (Atkinson, 2017).

The process entails posing questions and recording the responses given. Pandey and Pandey (2015) highlight that the interview process encompasses the establishment of formality, which then allows for the exploration of the interviewee's intellectual, emotional and subconscious responses. The primary objective of an interview is to acquire a deeper understanding of the interviewee's emotions, motivations and perspectives (Gottfert, 2015). As stated by Mahdi (2011), interviews offer valuable insights into the narrative behind a participant's experiences, allowing the interviewer to delve more into the research topic at hand. In contrast to questionnaire surveys, which impose severe constraints on respondents due to the fixed nature of the questions, the interview method offers greater flexibility (Daniel, 2017).

The interviewer will elicit information about unrelated causes, assess behaviours and determine the crux of the problem (Pandey & Pandey, 2015). Qualitative interviews offer a wealth of valuable and insightful data that enhances our comprehension of individuals' lived experiences (Peters & Halcomb, 2015). Kumar (2019) indicates that researchers possess the autonomy to structure the format, sequence and content of questions when conducting interviews with respondents. Additionally, researchers have the discretion to determine the phrasing of questions and the manner in which they are presented to the respondents. The interview process entails a psychological dynamic wherein both participants engage in reciprocal interaction, despite the fact that the interview's social science objective necessitates diverse replies from the individuals engaged (Pandey & Pandey, 2015).

Interviews can be conducted in a variety of ways. According to Gottfert (2015), interviews can be classified into three distinct categories: standardised, semi-structured and unstructured interviews. Researchers must choose their points along the continuum between structured and unstructured interviews (Westbrook, 1994). Structured interviews are mostly dependent on a predetermined set of questions that are posed to participants throughout their interactions with the researcher (Atkinson, 2017). The implementation of a standardised approach allows for relatively minimal variation in the presentation of questions to the participants and guarantees that the data gathered from the interviews is well organised and ready for analysis (ibid). The standardised interview comprises a series of systematically arranged, standardised, open-ended questions. On the other hand, semi-structured interviews offer greater flexibility in terms of question sequencing and standardisation, enabling researchers to conduct more comprehensive investigations or examinations when deemed suitable for the research objectives (Gottfert, 2015). The following section outlines the advantages and disadvantages of utilising interviews as a research methodology.

Table 3. 15. Strengths and weaknesses of interviews

Strength of interviews	Some weaknesses of interviews
• Can be used for thematic and issue analysis	• Can serve as foundation for extending the study
• Useful for small samples	• Training of interviewers and the need for interpersonal skills
• Allows subjects to speak for themselves	• Usually needs to be transcribed
• Allows teasing out of underlying issues	• Potential lack of precision
• Enabling gathering of rich and deep knowledge	• Potential lack of precision
• Can serve as the foundation for extending the study	• Need for rigorous thematic analysis
• Formally tests the emergence of patterns and relationships.	

Source: Daniel (2017)

The act of conducting interviews can be considered a form of experimental study design, wherein the data collected is derived via verbal or narrative communication (Gottfert, 2015). According to Atkinson (2017), researchers who adopt ontological orientations centred on social construction and meaning negotiation commonly utilise interviews and focus groups as a qualitative approach.

- Observation

Observation is a deliberate, systematic and discerning approach to witnessing and listening to an encounter or event (Kumar, 2019). This methodology entails the collection of empirical data by means of sensory perception, enabling the researcher to observe and analyse people within an authentic environment.

- Questionnaires

A questionnaire is a structured instrument consisting of carefully crafted inquiries intended to elicit specific information from respondents, which is subsequently recorded for analysis and documentation. As stated by Kumar (2019), the participants involved in the study actively participate in the cognitive process of perusing the inquiries, comprehending the intended connotations, and subsequently documenting their answers. There are three possible methods for administering questionnaires: mailing them to the intended recipients, who are then responsible for completing and returning them; conducting them via telephone; or conducting them in person (Singh, 2014).

- Focus groups

A focus group can be defined as a carefully structured and facilitated discussion that seeks to collect insights and perspectives on a certain subject of interest within a permissive and non-intimidating setting. The purpose of such a gathering is to capture any unexpected findings that may arise from the participative nature of the group (Kellmereit, 2015). The projected duration of the meeting is approximately two hours, which corresponds to the customary length of a focus group interview. When selecting individuals, it is imperative to ascertain that they possess sufficient expertise and familiarity with the topic at hand (ibid).

Liamputtong (2018) asserts that the utilisation of focus groups enables researchers to investigate individuals' perspectives and thought processes about significant matters, without imposing any pressure on them to arrive at definitive findings. Open-ended inquiries are

employed to obtain this information, and the acquisition of data can be accomplished more expeditiously and at a reduced expense compared to conducting individual interviews with each member of the group (Kellmereit, 2015).

3.9.2 Secondary Research Methods

A secondary source refers to a narrative or record of a historical event or circumstance that is removed by one or more degrees from the primary source (Kumar, 2019). Bowen (2009) states that documents of various kinds can aid the researcher in deciphering meaning, gaining insight, and discovering new information pertinent to the research subject. Documents offer supplementary study and insights that contribute to a knowledge base.

Bowen (2009) asserts that documents serve multiple functions within the context of a research project :

- to provide information on the environment in which research participants work,
- to give background information as well as a historical perspective by bearing witness to past occurrences,
- to provide insight into some of the questions that should be answered and events that should be observed as part of the research,
- to provide additional research information,
- to provide a means of tracking change and development and
- to confirm conclusions or corroborate facts obtained from a different source.

The inclusion of such data and expertise can greatly contribute to the existing knowledge base and aid researchers in gaining a deeper understanding of the phenomena being studied (Bowen, 2009). Certain secondary sources can be categorized as easily accessible information acquired from external sources, including government publications, pre-existing records, and previous research studies. These sources will now be delineated and discussed.

- Government publications

Numerous governmental entities collect data on a regular basis across various domains and subsequently disseminate it to both the general public and specific interest groups (Kumar, 2019).

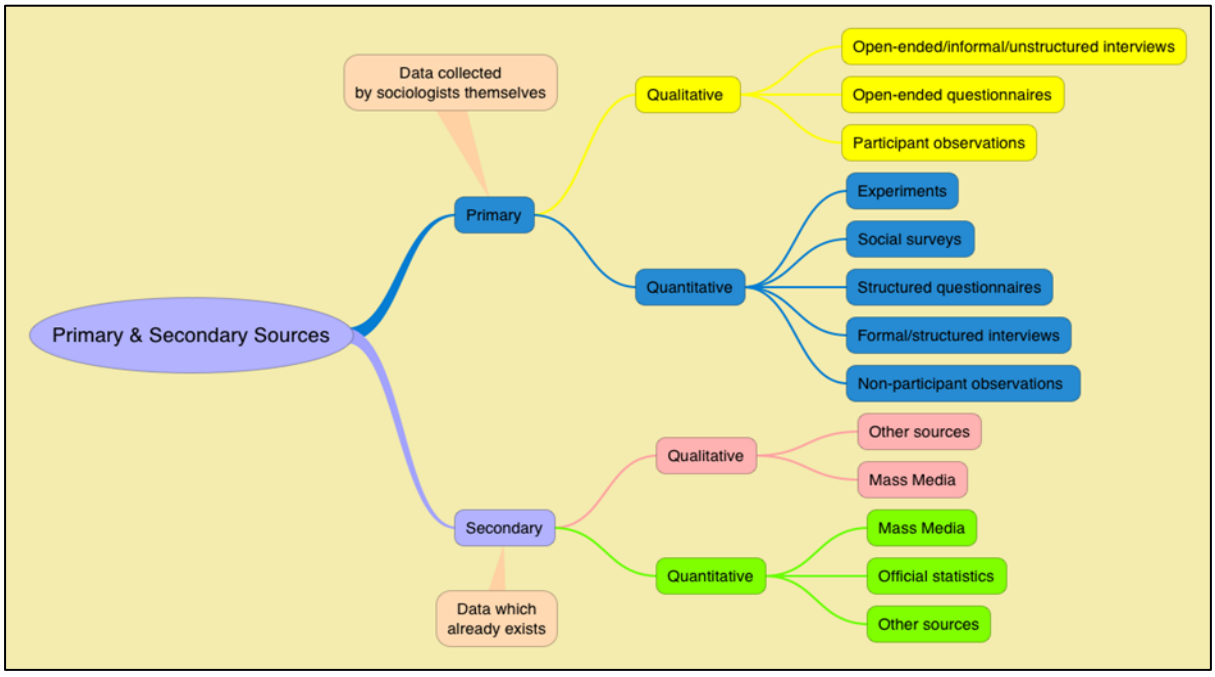
- Existing records

Kumar (2019) mentions that for certain subjects, an immense amount of research studies conducted by others will provide you with the knowledge you need.

- Past research studies

The historical method can be defined as a systematic approach through which contemporary events are examined in relation to past occurrences (Pandey & Pandey, 2015). Historical studies have the potential to uncover significant insights into the repercussions of previous actions and can even provide recommendations for future courses of action. Documents provide a means of monitoring the progress and evolution of a certain phenomenon. The utilisation of document analysis might serve to validate findings or bolster evidence derived from alternative sources (Bowen, 2009). The utilisation of primary and secondary data is depicted in Figure 3.10.

Figure 3.10. Primary & Secondary Sources.



Source: Thompson, 2012.

A range of data-gathering processes exists, which exhibit variation based on the level of interaction between the researcher and the phenomenon being studied. According to Creswell (2007), qualitative researchers play a crucial role as key instruments in the data collection process, employing methods such as document analysis, observation, and interviews.

Researchers are responsible for the collection of data, however they may employ various instruments to facilitate this process. The case study research paradigm encompasses a range of data sources, including documentation, historical logbooks, interviews, and observations (Yin, 2014). Below table indicates strength and weakness of instruments used in the study.

Table 3. 16. Strengths and Weaknesses of sources of evidence in Case studies

Source of evidence	Strength	Weakness
• Documentation	• Stable – can be reviewed repeatedly • Unobtrusive – not constructed as a result of the case study • Exact- contain exacts names, reference and details of events	• Retrievability -can be difficult to find • Biased selectivity • Access- may be deliberately withheld
• Interviews	• Target – focuses on the case study • Insightful -provides perceived causal inferences and explanation	• Bias due to articulated questions • Response bias • Inaccuracy due to bias • Reflexivity -interviewee gives what the interviewer wants to hear

Source: Daniel (2017)

Casteel and Bridier (2021) emphasise the advantages of conducting interviews as a data collection method compared to written replies or other survey data sources. Interviews offer the researcher the opportunity to ask specific questions, guide the conversation and facilitate real-time exploration of participant responses. Consequently, interview data tends to exhibit a higher level of quality. The study employed qualitative interviews as a means of investigating the essential practices for infrastructure delivery within a project setting. The interviews were conducted with participants who had primary responsibility for overseeing the delivery of

infrastructure. Each interview had a duration of 60 to 90 minutes. The selection of respondents was based on their pertinence to the conceptual inquiries and their familiarity with the subject matter of the study project, as well as their level of expertise in IDMS.

The research adopted the interview approach, which necessitated meticulous deliberation of the comprehensive data collection and analysis process to ensure the satisfactory resolution of the research questions at completion of the procedure. To effectively tackle the intricacies of infrastructure delivery and the analysed context, the case study methodology entails the collection of a substantial volume of comprehensive qualitative data from many sources. The most prevalent sources of secondary data in this study are government publications, technical documents, and literature. The acquisition of secondary material from many sources played a pivotal role in the preparation for the interviews. Secondary data can be found within the existing body of literature, which offers comprehensive information regarding countries that have undertaken initiatives to enhance their public sector infrastructure. These countries have also implemented several strategies to improve the efficiency of infrastructure delivery. The analysis relies heavily on documents and archives as key sources of data. The indicated gaps are bridged and the collected data is triangulated through the review of documents, which is reinforced by information obtained in interviews.

The data collection process took place between September 2020 and October 2021, with the public-sector departments implementing IDMS. The organisations that supported IDMS programmes were identified using the document reviews. Four infrastructure departments were approached, and all consented to participate in the study. The invitation letter explained the research, the ethical elements of conducting interviews, and the benefits of participating in the organisations. This would allow the researcher to ensure that qualitative data was gathered and analysed in a way that honoured and conveyed the subjectivity of the participants, acknowledging and embracing one's interpretations as the researcher. Key players from the infrastructure departments were invited to participate in the research to understand the system's complexity and context. The sample included senior managers, project managers, built environment professionals, and external service providers responsible for public sector social infrastructure project implementation using IDMS. All the interviewees have expertise in the construction industry, and they have worked on public-sector infrastructure projects.

The process involved conducting interviews with participants through the Microsoft Teams platform. Qualitative interviews can develop new ideas and thoughts and increase knowledge (Mahdi, 2011). The participants were questioned individually; this was achieved to encourage open and honest discussions. An interview guide, which served as a data collection tool, was developed before conducting the study and attached to the ethical clearance application. Participants were given an overview of the procedure and were emailed an interview guide. Interview appointments were scheduled, and this was communicated to participants beforehand to enable them to know what to anticipate and when they needed to participate. During the interview, participants were requested to confirm their organisation, role and involvement with the implementation of IDMS. They were assured that the interview outcomes would not be directly ascribed to them. This is crucial in order to create a comfortable and trustworthy interview environment.

The adoption of open-ended questions, as opposed to closed-ended questions, was implemented in order to facilitate a more comprehensive and in-depth engagement with the individuals being interviewed. The interview questions were prepared with improved precision in order to gain a deeper understanding of the deployment of IDMS within project delivery. This study was conducted in order to gain a deeper understanding of the impact of wider factors, such as the political, environmental, and social context, on the execution of infrastructure projects. The interviews conducted were deemed appropriate for this research as they provided valuable insights into the participants' experiences in deploying IDMS for infrastructure delivery projects.

All of the interviews were carried out in the English language. The primary participants in this study consisted of officials from the departments of public works, infrastructure development, and property management in the provinces of Mpumalanga, KwaZulu-Natal, Western Cape, and Gauteng. Additionally, the study involved 15 external service providers who were contracted by these departments. The methodology involved the utilisation of Microsoft Teams as a platform for conducting interviews with the participants. The interviews were transcribed and recorded via Microsoft Teams and script notes, which facilitated the data analysis phase of the project. The interviews were subjected to coding in order to enhance comprehension of the prevalence of the ideas expressed and to obtain additional information. The obstacles encountered encompassed the cancellation of scheduled interviews and the unavailability of potential participants. The utilisation of Microsoft Teams encountered difficulties arising from

network connectivity issues in certain locations. Consequently, the researcher was compelled to ascertain the presence of a dependable and logical internet infrastructure, while also considering the obstacle of loadshedding prevalent in the country.

The utilisation of various source types enables researchers to integrate data from many sources, hence facilitating a more comprehensive comprehension of the phenomenon under investigation (Onwuegbuzie et al., 2012). This, in turn, enables the development of an integrated infrastructure delivery framework that can be applied on a worldwide scale. Ensuring the integrity and validity of the data, as well as the reliability and credibility of the analysis, are two fundamental strategies in qualitative research that enhance the rigour and quality of the study (Sargeant, 2012). The subsequent section examines strategies pertaining to the concepts of reliability and reliability.

3.10 Validity and reliability

The concept of validity pertains to the degree to which a research instrument effectively and accurately evaluates the underlying construct it is intended to measure (Blumberg, Cooper, & Schindler, 2005). Validity, as defined by Leung (2015), pertains to the suitability of the methodologies, data, and protocols utilised in a research investigation. In a similar vein, Kumar (2019) argues that validity is crucial in research as it ensures the implementation of suitable methodologies to address specific research questions and obtain accurate findings. The notion of validity is centred on the assessment of the accuracy of research findings as evaluated by the researcher, participants, and readers (Creswell, 2016).

In a more expansive structure, the notion of validity relates to the ability of a research instrument to accurately and effectively measure the intended information, whilst reliability pertains to the consistency of its findings when utilised again (Kumar, 2019). Singh (2014) has provided evidence that qualitative research can be improved in terms of clarity and the minimisation of potential study bias by establishing validity and reliability. The achievement of this purpose is facilitated by the systematic recording of all the procedures and methodologies utilised in obtaining the outcomes of the study (Khatleli, 2009).

Qualitative literature extensively discusses topics such as trustworthiness, authenticity, and credibility (Creswell, 2016). The concept of 'data authenticity' refers to the integrity of the data

and the procedures utilised in its acquisition (ibid). Kumar (2019) identifies four key indicators that serve as markers of the reliability of a qualitative study: credibility, transferability, dependability, and confirmability. These indicators are indicative of the validity and reliability of qualitative research. Validity is a concept that pertains to the extent to which the instruments utilised in a research study are considered appropriate and fitting for the intended objective.

Numerous approaches have been developed to evaluate the soundness of a study, encompassing construct validity, internal validity, and external validity. To ensure the robustness of case study research, it is crucial to evaluate the study's accomplishments in terms of construct validity, internal validity, external validity, and reliability (Tumele, 2015). The next section provides an explanation of the several techniques used to assess validity.

- Construct validity refers to the degree to which a measurement instrument accurately assesses a theoretical concept or characteristic that it is intended to measure (Emuze, 2011). It is a crucial aspect of research that aims to establish accurate and useful measures for the concepts being studied. Its primary objective is to uncover and minimise any potential bias or subjectivity on the part of the researcher (Tumele, 2015). The identification of appropriate metrics for the concept being investigated is beneficial. The concept of construct validity pertains to the assertion that the measurement used in a research study effectively captures the intended construct as first defined (Khatleli, 2009).
- External validity is a concept that pertains to the extent to which the results of a study may be generalised and applied to different individuals, time periods and contexts (Emuze, 2011). The concept of external validity pertains to the extent to which the findings of a study can be extended beyond the specific context in which the research was conducted. The researcher employed a strategy of external validity by incorporating various cases in order to enhance the potential for generalisability of the acquired data with respect to infrastructure delivery.
- Internal validity relates to the extent to which the participants of a study can have confidence in and trust the findings. It pertains to the extent to which a test appears to accurately assess the intended construct (Jahja, 2017). The primary focus of internal validity lies in the capacity of the research design as a whole to identify causal relationships, if they indeed exist (Khatleli, 2009). The researcher made deliberate choices about the selection of research equipment and measurements that were deemed

suitable for the study in order to enhance the validity of the findings. The assessment of internal validity was employed to ascertain the plausibility and impartiality of the obtained results, hence establishing their validity. asserts the necessity of internal validity is limited to explanatory and causal case studies. Reliability pertains to the ability of a study's procedures to be replicated, yielding consistent outcomes (Tumele,2019).

According to Kumar (2019), reliability refers to the degree of accuracy offered by a research instrument during the evaluation process. This pertains to the concept of replication or maintaining consistency. The consistency of measurements delivered by an instrument is of utmost importance in research. The concept of external consistency techniques, as outlined by Kumar (2019), involves the comparison of findings obtained from two separate data collection methods in order to validate the reliability of a measurement. On the other hand, internal consistency pertains to the notion that if objects or questions assessing the same phenomenon are valid indicators, they should yield consistent results irrespective of their quantity within an instrument.

The utilisation of diverse approaches enhances the reliability of the knowledge acquired by the researcher. Various procedures, including triangulation, member verification, peer review and prolonged involvement, are employed to assess the reliability of the findings.

- Creswell (2016) refer to member checking as a technique utilised in qualitative research to validate the correctness of findings. This involves sharing the final report or specific descriptions and themes with participants and soliciting their feedback on the perceived truthfulness of the information. This was not necessary for this research
- Prolonged engagement is defined as the practice of dedicating a substantial duration of time to actively observe and interact with individuals within their authentic surroundings (Creswell, 2016). This was not applicable to the study due to the time required to engage and conclude the study.
- Credibility pertains to the extent to which the findings align with established principles, procedures, standards and empirical evidence (Guba & Lincoln, 1985). The presence of credibility serves as evidence that the analysis process employed is both dependable

and impartial. According to Naidoo (2018), the credibility of a study is contingent upon the researcher's competence and diligence.

- Triangulation is a research methodology employed to ensure and establish the credibility of studies by examining a research question from many vantage points (Guion et al., 2011). Triangulation is a research method that involves the use of many strategies to investigate a research subject, with the aim of increasing confidence in the resulting conclusions (Bryman, 2012). The primary objective of triangulation is to enhance and validate the credibility of research findings (Mayer, 2015).

  The utilisation of the triangulation method has been acknowledged as a viable approach for enhancing the methodological soundness of case study research, as stated by Yin (2014). The methodology can also be employed to generate a new hypothesis, validate an established theory, or modify it as necessary in accordance with the outcomes of the investigation (Daniel, 2017). The adoption of triangulation serves as a valuable tool for researchers in mitigating the potential criticism that the conclusions drawn from a study may be attributed solely to a singular method, a solitary source, or the personal bias of a lone investigator (Bowen, 2009). The research employed a triangulation approach to optimise data collection by utilising document analysis and conducting interviews. Triangulation was employed in qualitative research as a means to enhance the reliability and validity of the findings.

A range of reliability tests is employed to ascertain the degree of consistency:

- The test-retest reliability assesses the degree of consistency in the obtained results when the same test is administered to the same individuals on multiple occasions.
- Parallel-forms reliability refers to the assessment of the consistency of findings obtained from two separate tests that measure the same concept.
- Internal consistency reliability refers to a statistical measure used to assess the consistency of data obtained from different items inside a test or measurement instrument.
- Inter-observer reliability refers to the assessment of the consistency of results obtained when multiple observers are involved in the data collection process.

- Generalisability refers to the capacity to extend research findings derived from a specific sample to the broader population, as well as the ability to transfer these findings from one study to another within a comparable environment (Leung, 2015). In order to achieve complete generalisability, it is imperative to investigate the research problem by encompassing the entire population (ibid). According to Yin (2014), it is advisable to analyse many instances whenever feasible, as conducting a multiple-case research can strengthen the conclusions drawn and avoids mere replication.

Qualitative research can be evaluated based on several relevant criteria, including the utilisation of systematic sampling, triangulation and constant comparison, as well as the implementation of appropriate audit and documentation practices and the incorporation of multidimensional theory (Leung, 2015).A comprehensive review of existing literature and desk study was undertaken to enhance understanding of global infrastructure delivery changes and identify areas of improvement. The data collection involved examining frameworks from both established and developing nations in the Sub-Saharan Africa region. The results were incorporated within the literature review section. The study utilised a multi-case study approach to strengthen the obtained conclusions, and included in-depth interview questions to ensure uniform assessment of replies. The interviews allowed study participants the opportunity to express themselves freely without being constrained by a predetermined set of response options.

The interview questions were designed with a structure that ensured the absence of leading questions, so maintaining objectivity in the data collection process. Additionally, the study's objective was clearly communicated to the participants, establishing transparency and clarity regarding the purpose of the research. The questions were meticulously crafted to serve as a comprehensive data repository and were organised in accordance with the existing body of literature. The questions were strategically formulated to align with the aims and objectives of the research endeavour while concurrently affording the researcher the opportunity to amass data within a predetermined temporal framework. To ensure the accuracy of data interpretation, the researchers utilised both an audio recorder and written notes. The researcher's findings are reinforced by the availability of both written transcripts and audio recordings.

3.11 Research ethics

Ethics is a field of study that assesses the moral conduct, personal qualities and intentional choices of individuals and their appropriateness (Singh & Nath, 2008). According to Ahmed (2008), ethics can be defined as the pursuit of norms of behaviour that allow us to engage in educational research in a justifiable manner within political environments. Ethical considerations in research encompass established standards of conduct that prioritise the safeguarding of individuals under study from potential physical, mental or psychological harm (ibid). External systems, such as professional codes of conduct and human subjects committees, play a crucial role in actively monitoring and regulating ethical behaviour (Figueiredo & Cunha, 2007). According to Creswell (2016), it is imperative for researchers to prioritise the protection of research participants, establish a foundation of trust with them, uphold the principles of research integrity, prevent any form of misconduct or impropriety that may have adverse implications for their respective organisations or institutions, and effectively address novel and challenging circumstances. The integrity and impartiality of the researcher are crucial factors that influence the quality of study (Saunders, Lewis & Thornhill, 2016).

According to Guba and Lincoln (1985), they put out a theoretical framework for ethical qualitative research, whereby they include trustworthiness and authenticity as key criteria for ensuring rigour. They further elaborate on these criteria by discussing the importance of balance or fairness, ontological authenticity, educational authenticity and catalytic authenticity. Ethical concerns encompass various aspects within the realm of academic research. These include personal disclosure, which pertains to the extent to which individuals reveal personal information about themselves. Additionally, the authenticity and trustworthiness of study reports are crucial considerations, as they determine the reliability and credibility of research findings. In cross-cultural contexts, researchers play a significant role, and their actions and decisions can have ethical implications. Lastly, the collection of internet data raises concerns regarding personal privacy, highlighting the need for ethical considerations in this domain (Creswell, 2016).

The foundation of knowledge derived through research is contingent upon the commitment of both individuals and groups to fundamental principles such as objectivity, honesty, transparency, impartiality, responsibility and guardianship (National Academies of Science, 2017). The presence of bias in a researcher's work is considered to be ethically unacceptable. According to Kumar (2019), bias can be defined as a deliberate effort to either conceal or

emphasise certain aspects within a study in a manner that is disproportionate to their actual presence. Creswell (2016) asserts that it is imperative for writers to anticipate and address potential ethical concerns that may arise over the course of their research.

Saunders, Lewis and Thornhill (2016) assert that researchers must possess a comprehensive understanding of the numerous ethical considerations that arise throughout the acquisition and presentation of study data. Given the nature of the topic under investigation, the interview strategy encompassed a comprehensive evaluation of the entire process of data collection and processing to ensure the research question could be appropriately addressed. The researcher reviewed the study's aims and objectives in order to develop the interview questions. From within and outside the institution, the researcher obtained and sought the proper support for undertaking the research. The researcher conformed to the institutional structures and protocols of the institution. In order to ensure adherence to the ethical norms set forth by the institution, the research proposal underwent a thorough evaluation and received approval from the ethics committee of the university. Before commencing the study, an interview guide was developed and associated with the ethical clearance application, serving as a means of data collecting.

Prior to the commencement of the interviews, the participants were provided with a comprehensive information sheet pertaining to the study. This was done to afford them the opportunity to make an informed decision regarding their participation in the study. Consent forms were presented to participants in order to guarantee that proper authorisation for conducting interviews was obtained. The concept of informed consent entails ensuring that participants have received sufficient information regarding the nature of the data sought, the purpose of its collection, the manner in which it will be utilised, the extent of their involvement in the study, and the potential direct or indirect impact it may have on them (Kumar, 2019).

The interviews were done using a non-leading approach. The data was collected by a combination of technological means and handwritten notes during interviews, in order to capture and analyse the thoughts and experiences of the participants on the procedure. In order to ensure the preservation and protection of the participants' privacy, all data submitted by them was handled with strict adherence to principles of confidentiality and anonymity. The collected data was securely stored for a certain duration. The study data was stored on the researcher's own computer as well as within the repositories of university libraries. In order to obtain a comprehensive understanding of the IDMS, a series of interviews was conducted with

public sector stakeholders that possess expertise in IDMS. These interviews aimed to gather valuable insights and perspectives on the practical application of IDMS within the public sector. This measure was implemented to guarantee that participants possess adequate knowledge on the subject matter and are capable of providing suitable responses to the inquiries, hence generating reliable outcomes. Additionally, it aims to establish a representative sample and mitigate any potential biases in the sample.

3.12 Quality of research

Bryman (2012) asserts that research ethics encompass several criteria pertaining to the conduct of daily work, the protection of individuals' dignity, and the dissemination of research findings. It was imperative to execute this research in a professional manner in order to guarantee the provision of respectful treatment to the individuals who willingly offered to participate in the study while also upholding their rights, dignity, and overall well-being. When doing data collection, it is imperative to assure the reliability, validity, and quality of the data.

The researcher submitted an online application to the Ethics committee at Wits University in order to obtain ethical approval. Subsequently, the researcher was granted an ethical clearance certificate, which authorised the use of the proposed data-gathering methods. The researcher was required to acknowledge and adhere to the necessary ethical principles in order to enhance the reliability and validity of the undertaking. Thus, the researcher completed the requisite ethical documentation provided by the academic institution. Moreover, the collected data was not subjected to any form of modification. The study incorporated authentic replies from several infrastructure departments across multiple provinces in order to enhance the generalisability of the findings.

The researcher performed all interviews to ensure consistency. All collected data underwent a rigorous process of double-checking and verification to ensure its accuracy. The interview included the participation of all key stakeholders, with a deliberate effort made to mitigate potential bias in the conclusions and promote objectivity. The interviews were structured and subjected to a coding process in order to uphold ethical standards, ensuring the removal of any identifying information or explicit allusions to particular individuals or organisations. Themes for in-depth analysis were then manually constructed. Daniel (2017) delineated the requirements for conducting a good interview as:

- The researcher's familiarity with the subject matter of the research,
- Making the purpose of the interview clear to the respondents,
- Displaying receptiveness and adaptability towards the interview subjects,
- Relating the questions to what the interviewee has previously said,
- Be patient with the interviewee,
- Be ready to challenge what the interviewee has said,
- Employing strategic questioning techniques and utilising prompts can effectively guide the interview process, and
- Respond to what is essential to the interviewee.

The aforementioned criteria by Daniel(2017) were strictly followed during the entire interview process. Throughout the analysis, considerable efforts were made to verify that data reliability and validity were established. The reduction of threats to validity was achieved by employing multiple data sources, namely interviews and document analysis. Standard interview data-gathering procedures were followed to ensure the study's reliability. The interviews were conducted with experienced professionals to improve the research's validity and dependability. The researcher utilised conventional methodologies for data collection and analysis, while maintaining an impartial stance to uphold consistency.

Throughout the interviews, there was a deliberate avoidance of leading questions, and the primary objective of the study was effectively communicated and explained. The interviews afforded study participants the opportunity to freely articulate their thoughts and opinions, as opposed to being constrained by a predetermined set of response options. The time allocated for the interviews was sufficient to gather enough data. The interviews were audio-recorded and transcribed, and notes were taken to help with the transcription. The data analysis approaches is explained in the next section.

3.13 Data analysing technique

DaSilva (2017) posits that data analysis encompasses the systematic acquisition, examination, and interpretation of data in order to address inquiries. To be considered valid research, this process must adhere to certain criteria, such as regulation, rigour, methodological precision, and reproducibility. Emuze (2011) argues that data analysis is characterised as an ongoing process that informs and shapes the research design before the researcher concludes their work in the field. According to Pandey and Pandey (2015), data analysis involves examining

organised information from multiple perspectives to uncover new insights. In data analysis ,the process entails the interpretation of information derived from many sources to determine its relevance to the research at hand. This process includes the organisation of data, segmentation into manageable parts, synthesis, pattern identification, discernment of significance and knowledge acquisition, as well as the determination of information to be communicated to others (Westbrook, 1994).

The significance of data analysis in qualitative research is of utmost relevance (Maguire & Delahunt, 2017). Qualitative analysis involves the examination of textual information derived from interview transcripts to derive insights and meanings (Bowen, 2009). Data analysis in qualitative research significantly shapes the outcomes of studies and plays a crucial role in deriving meaningful conclusions (Flick, 2015). Yin (2014) asserts that various methodologies exist for the analysis of data, including pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis. According to Bowen (2009), qualitative analysis necessitates adopting a participant-in-context mind-set, maintaining an ethically conscious perspective, and employing a range of analytical techniques. Data analysis necessitates the utilisation of categories, the implementation of those categories to unprocessed data via coding, tabulation, and statistical inference (Pandey & Pandey, 2015).

Document analysis is a methodical approach utilised to assess and appraise various forms of written and digital materials, as described by Bowen (2009). This process involves the examination of documents through techniques such as skimming, reading and interpreting. According to Bengtsson (2016), irrespective of the methodology employed, the process of analysis aims to streamline data by reducing the volume, organising it into categories, and enhancing comprehension for meaningful insights.

Qualitative data analysis refers to the systematic procedure of describing, classifying and establishing connections between phenomena and the conceptual framework employed by the researcher (Graue, 2015). To acquire a comprehensive understanding of the data, it is imperative to thoroughly peruse the entire dataset multiple times. The acquisition of relevant data pertaining to the research question necessitates adherence to this requirement (Byrne, 2021). Qualitative data analysis methods encompass grounded theory analysis, content analysis and thematic analysis.

- Content analysis

Content analysis is a methodical investigation of the substance of a text, involving the analysis of several elements such as the speaker, the message, the intended audience, the purpose, and the impact. This examination can be conducted using either quantitative or qualitative approaches (Bowen, 2009). Content analysis is a research approach that focuses on the investigator's active involvement in interpreting and constructing the significance of textual materials (Graue, 2015). According to Stemler (2000), content analysis is a methodical approach used to condense textual information into distinct categories. Bengtsson (2016) refers to content analysis as a research methodology that enables researchers to draw accurate conclusions from verbal, visual or written material in order to systematically and objectively identify and evaluate certain phenomena. The researcher engages in a process of carefully examining each text and identifying significant components that align with established categories or have the potential to generate new categories (Atkinson, 2017). The significance of recognising and deriving categories from data, as well as their role in understanding the contextual significance of an object under analysis (including the categories derived from it), is highlighted (Graue, 2015).

The investigation examined the IDMS records. The adoption of document analysis is justified by several factors, including the significance of documents in case study research, their role in methodological triangulation, and their efficacy as an independent tool for specific forms of qualitative research. The process of content analysis entails a thorough examination of data in order to extract significance, leading to the acquisition of insight and the generation of empirical knowledge (Bowen, 2009). According to Stemler (2000), the utilisation of this technique allows researchers to efficiently navigate through extensive amounts of data by employing well-defined coding standards. The procedure entails the systematic arrangement of data into distinct categories that are directly related to the core objectives of the research (Bowen, 2009). The process of categorising or coding data involves the systematic organisation and preparation of data in order to facilitate its analysis (Graue, 2015).

According to Atkinson (2017), qualitative content analysis is commonly conducted using one of two methods: either by a meticulous examination of pertinent resources by the researcher or by employing coders. The act of reading has the potential to yield a prompt and effective qualitative content analysis (ibid). The analytical process encompasses several key components, including the identification, selection, evaluation, and integration of data derived

from various publications (Bowen, 2009). Excerpts, quotations, or entire paragraphs derived from documents acquired by document analysis are afterwards categorised into meaningful topics, categories, and case illustrations, employing content analysis as a specialised method (ibid). Conclusions can be drawn by the researcher based on the analysis of the coded data, which can then be elucidated in the findings section. According to Graue (2015), the researcher possesses the ability to modify the study question and categories in the event that new concepts and patterns arise, which were not previously taken into account.

- Thematic analysis

Maguire and Delahunt (2017) opine that thematic analysis is a method employed to discern prevalent themes or patterns within collected data. A theme refers to a recurring pattern that encompasses a significant or captivating aspect of the data and/or study inquiry (ibid). According to Byrne (2021), codes serve as fundamental components that lay the foundation for the subsequent development of themes. These codes are utilised to succinctly and concisely assign descriptive or interpretive labels to informational pieces that hold relevance to the research matter. Vaismorad and Snelgrove (2019) asserts that the establishment of a theme can be achieved by the integration of codes that have common points of reference, possess a high degree of transferability, and have the capacity to unify concepts throughout the research phenomena. The primary objective of thematic analysis is to identify overarching patterns of significance within the collected material (Atkinson, 2019).

The selected data is subjected to a thorough examination by the reviewer, who then proceeds to apply coding and category construction techniques depending on the unique qualities of the data. The objective of this process is to identify themes that are pertinent to a certain occurrence, as outlined by Bowen (2009). Researchers are able to offer an elaborate account of the significance and structures of significance within data (Atkinson, 2019). According to Vaismorad and Snelgrove (2019), it is essential for researchers to thoroughly document all analytical processes, ranging from the selection of data units to the development of themes, in order to ensure the reliability and validity of the findings. This practice promotes transparency in the process of theme development. The ultimate results of thematic data analysis are commonly referred to as themes or patterns.

- Grounded theory analysis:

Grounded theory is a research methodology that involves the systematic collection, analysis, and categorisation of data to develop a theory that defines or explains a certain phenomenon or situation (Flick, 2015). The objective of grounded theory is to elucidate or construct theory by utilising systematically collected evidence and doing comparative analysis (Bryman, 2012). Atkinson (2017) states that grounded theory is a research methodology that emphasises the use of data as the basis for theory development. This approach involves a systematic process of data collection, analysis and refinement, whereby each stage is intricately interconnected.

The concept of grounded theory pertains to the inductive approach of identifying analytical categories as they emerge from data, rather than predefining them beforehand. This method involves establishing hypotheses from the specific study area or context, allowing for a bottom-up approach in the research process (Pope et al., 2000). According to Graue (2015), an important aspect of grounded theory is its focus on the development of theory based on empirical evidence. Additionally, the technique employed in grounded theory is characterised by an iterative or recursive process, wherein data collection and analysis occur simultaneously and continuously inform one another.

The grounded theory approach is employed by researchers in order to elucidate the structure and processes of a phenomena, with the aim of establishing or enhancing a conceptual framework, or alternatively, constructing a conceptual framework from the ground up (Atkinson, 2017). Grounded theory serves as the foundation for various stages of the research process, including initial data coding and categorisation, concurrent data generation or collection and analysis, memo writing, theoretical sampling, constant comparative analysis using inductive and abductive logic, theoretical sensitivity, intermediate coding, core category selection, theoretical saturation, and theoretical sensitivity (Graue, 2015).

Atkinson (2017) emphasises that the three steps of grounded theory data analysis, namely open coding, axial coding, and selective coding, are conducted concurrently.

- Axial coding involves the identification of interrelationships among different categories, typically achieved by establishing dimensions for the categories that have been established through open coding.

- Selective coding is a method used to identify and establish the fundamental concepts that have been uncovered through the processes of open and axial coding, along with their interconnectedness (ibid).

According to Ntiyakunze (2011), grounded theory is characterised by rigorous methods of data collection, coding and theory development. The perpetual comparative technique, as described by Atkinson (2017), involves an ongoing engagement between researchers and data. This strategy entails comparing multiple sets of data, beginning with data collection and extending throughout the process of constructing the final theory. Grounded theory analysis is employed as a methodological approach to systematically identify and analyse recurring themes within a dataset. This process involves a detailed evaluation of the data, followed by the coding of emergent themes using relevant keywords and phrases. The subsequent step is organising these codes into hierarchical conceptual frameworks. Finally, the ideas are categorised by identifying relationships among them (Bryman, 2012). The methodology places significant emphasis on the utilisation of method triangulation as a data collection strategy, with the primary objective of gradually constructing a theoretical framework pertaining to the subject matter (Ntiyakunze, 2011). In order to verify the validity of the analysis, it is recommended to code a significant portion of the data (Graue, 2015).

3.13.1 Justification of the research analysis method

The objective of qualitative analysis is to interpret the data and the corresponding themes in order to enhance the comprehensibility of the phenomenon being studied. This interpretive process can lead to a more profound understanding of the research findings (Sargeant, 2012). There exist various approaches to presenting findings in qualitative analysis. These include constructing a narrative to depict a particular situation, episode, case, or instance; elucidating and discussing the primary themes that arise from field notes or in-depth interview transcriptions, employing extensive verbatim quotations; and quantifying the main themes to ascertain their prevalence and consequential importance (Kumar, 2019). According to Sargent (2012), essential components of the analysis process are as follows:

Table 3. 17. Summary of key elements in the analysis process:

Activity	Key Elements
Selection of participants	• Be clear on research question • Select participants who can best and most broadly inform the questions • Recruit participant purposefully until saturation is achieved
Data analysis	-Includes 3 phases • Deconstruction • Interpretation • Reconstruction
Quality and rigour	Includes ensuring • Authenticity or quality of the data and collection • Trustworthiness or quality of the data analysis

Source: Sargeant (2012)

The adoption of document analysis as a research approach in qualitative case studies has been deemed highly advantageous (Bowen, 2009). In order to comprehend the outcomes, it is imperative to critically examine the data methodologies employed. According to Vaismorad and Snelgrove (2019), themes are utilised to direct attention towards the implicit and significant elements of data, whereas categories primarily emphasise the explicit and observable components of data analysis. The effective organisation of codes and data points plays a vital role in conveying meaningful information that contributes to the resolution of the research inquiry (Byrne, 2021). According to Blair (2015), the information derived from the data is not always readily apparent, necessitating the utilisation of certain techniques to uncover these solutions.

Pandey and Pandey (2015) assert that it is essential for the data analysis to be sufficient in order to reveal its significance, and the methods employed for analysis should be deemed appropriate. Qualitative data, which encompasses information gathered through interviews, open-ended questions, and images, is mostly expressed in words. Consequently, researchers are unable to

utilise statistical analysis to derive meaning from the data. As a result, the adoption of content analysis is necessary to draw conclusions from the qualitative data (Bengtsson, 2016). In the process of topic production in both content and thematic analysis, researchers rely on analytical examination of narratives of social phenomena. This involves dividing transcriptions into smaller segments and conducting data analysis (Vaismorad & Snelgrove, 2019).

The entity being studied, known as the unit of analysis, is subject to evaluation throughout the research process in order to produce a conclusion that elucidates the results and addresses the research question (Casteel & Bridier, 2021). The primary focus of analysis pertains to the public sector, specifically government entities that bear the responsibility of infrastructure provision. Various departments are depicted as case studies. Casteel and Bridier (2021) argue that the selection of case studies as the unit of analysis is supported by their operational definition, which asserts that the unit of analysis corresponds to the content of the data. The significance of the department of selection may be attributed to two key factors: its role in the implementation process and its facilitation of IDMS rollout. These criteria are crucial for doing the research.

Data collection in this study involved the utilisation of interviews, with subsequent analysis of the resulting transcripts and written notes. The purpose of this analysis was to discover recurring themes, which were then categorised and compared across similar occurrences. According to Bryman (2012), the act of recording and transcribing an interview serves as a means to address inherent limits in our memory and mitigate the potential for forgetting the statements made by the interviewee. Vaismorad and Snelgrove (2019), asserts that a comprehensive approach to data analysis involves transcribing and reviewing various types of data materials numerous times. This iterative process aims to gain a holistic understanding of the data, uncover the underlying core meaning, and identify latent issues by tracing interconnected thoughts.

The existing body of research has extensively examined various strategies for infrastructure delivery and has derived valuable insights from a thorough review of infrastructure delivery methods, governance structures and implementation processes. The study incorporates a variety of data sources, encompassing primary documents and interviews. Content analysis is a research methodology that involves the systematic examination of documented or recorded material, wherein the material is deconstructed into distinct components for study. The main

aim of content analysis is to methodically classify and evaluate the gathered material in order to derive logical and well-founded conclusions (Bengtsson, 2016). In contrast, thematic analysis allows the researcher to delve further into the selected data and utilise coding and categorisation methods that are informed by the unique attributes of the data, with the aim of identifying themes that are pertinent to a certain occurrence (Bowen, 2009). This enables a thorough examination of the importance of the data and its observable patterns (Atkinson, 2019). The research adopted both content and thematic analysis.

The researcher examined and analysed the data obtained from the interviews in order to accurately describe the aims and conclusions of the study. The interviews conducted with the participants were transcribed using Microsoft Teams and field notes. The amalgamation of data from multiple sources enhances the dependability of the findings (Bowen, 2009). Table 3.18 presents a comprehensive overview of the complete research methodology procedure, followed by a summary of the research approach.

Table 3. 18. Research methodology summary

Research aim	To evaluate the effectiveness of the Infrastructure Delivery Management System (IDMS) in the provision of public sector infrastructure in South Africa	
Research approach	Research paradigm	Constructivism
Research methodology	Research method	Qualitative
	Research type	Exploratory
Qualitative research design	Data collection	Literature review and interviews
	Sampling	Purposive
	Data analysis	Thematic and content analysis

Source: Researcher's collection

Table 3. 19. Methodological approach for the study

Research question	**Research objective**	**Method and data collection**
1. What were the triggers for the IDMS introduction?	To identify the triggers for Infrastructure Delivery Management System introduction	Qualitative documents/archives
2. How is the IDMS appreciated and implemented in the public sector?	To evaluate the understanding and operation of the IDMS model in the public-sector infrastructure projects	Qualitative documents/archives interviews
3. What are the constraints in the implementation of IDMS?	To investigate the constraints experienced in the implementation of IDMS in the country	Qualitative Interviews
4. What are the institutional arrangements deployed to operationalise the IDMS model?	To assay human capacity deficiencies inhabiting effective administration of the IDMS model	Qualitative documents/archives interviews
5. How effective has the introduction of the IDMS model been in provision of public sector infrastructure?	Concatenate IDMS activities in achieving its intended purpose thus far, in facilitation of infrastructure.	Qualitative interviews

Source: Researcher's collection

The selected methodology and instruments are considered to be capable of addressing the study topic and facilitating precise data gathering.

3.14 Summary

The theoretical framework connects the conceptual examination of the research component to infrastructure delivery systems, while the systems theory approach understands the characteristics and arrangement of connections between constituent pieces and external context, contributing to the overall objectives and effectiveness of the system. This study uses the constructivism paradigm, which involves diverse settings and occurrences through the lens of individuals perceptions and interpretations. It employs the triangulation technique to optimize data acquisition through document analysis and interviews. The research is exploratory, using appropriate instruments for comprehensive data collection. The case study methodology provides a deeper understanding of a phenomenon, allowing researchers to formulate unbiased queries. The study has an ethical obligation to protect participants from potential harm. Methodically addressing uncertainties is vital for improving service quality and establishing an efficient public infrastructure delivery system.

Data collection involves systematic acquisition and evaluation of information related to variables of interest, enabling researchers to address research questions, test hypotheses, and assess outcomes (Kabir, 2016). The data was collected from a combination of secondary and primary sources. Primary data sources for each case study included key individuals with significant knowledge and insights. A literature review is essential for gathering data by selecting relevant published and unpublished documents that contain valuable information and evidence (Daniel, 2017). Government publications, technical documents, and literature are common secondary data sources. Both primary and secondary data collection methods are essential for evaluating the proposed research.

Secondary data from various sources was used to prepare for interviews, providing insights into countries improving public sector infrastructure and enhancing efficiency. This study used document analysis and interviews to examine responses to research-related inquiries. The case study technique involved gathering detailed qualitative data from diverse sources, and connecting gaps through analysing documents. Documents were used to contextualize data acquired during interviews, while the interview method was chosen for its efficacy in acquiring knowledge about a phenomenon within a specific context. The interview strategy required careful consideration of the entire data gathering and analysis process to ensure adequate answers to the research question. The next chapter discusses the data analysis process.

Chapter four: Data analysis

4. Introduction

The previous chapter provides a comprehensive explanation of the methodology and methods utilised in acquiring data to address the research question. This chapter elucidates the process analysing qualitative data, and provides a comprehensive description of the tools and methodologies employed for the analysis of the interviewees' data. Casteel and Bridier (2021) posit that data analysis serves as a mechanism for understanding and comprehending the phenomenon under investigation. This process involves reducing the volume of raw data, distinguishing between significant and insignificant information, identifying noteworthy patterns, and constructing a framework based on the insights derived from the data. The chapter provides empirical evidence regarding the current comprehension and execution of IDMS in the context of infrastructure project delivery within South Africa.

The data obtained from the organisations that were included in the study is presented. The approach for analysing the interviews and the information gained from the interviews are presented. The study sought insight into the transcribed interviews while conceptualising them with what was already known in the literature. The section presents the interview results regarding the current understanding and application of IDMS in the public sector on construction projects.

4.1 Data processing and analysis overview

In order to foster economic growth and enhance competitiveness, it is imperative to have infrastructure that is both efficient and productive (Matji & Reuters, 2015). The approach employed by the public sector in the execution of infrastructure projects has undergone a transformation. The development of infrastructure holds comparable importance and the primary actors involved in the process of infrastructure delivery consist of the client delivery management team, the delivery team, and the stakeholders (Watermeyer & Phillips, 2020). The purpose of IDMS is to facilitate the strategic planning, efficient implementation, effective management, and comprehensive support of infrastructure projects within government departments. IDMS is regarded as a facilitator of infrastructure delivery due to its ability to address significant backlogs in infrastructure and services. IDMS is implemented to assist the

governance and service delivery structure and to enable departments to establish their structure, strategies, and infrastructure deployment.

The implementation of IDMS was intended to optimise the efficiency, effectiveness, and cost-efficiency of service provision. The initial stage of the inquiry involved conducting a comprehensive examination of the pertinent scholarly works. This study employs a comprehensive examination of existing scholarly works to systematically identify and assess the key components of IDMS operation, with the aim of facilitating infrastructure development and implementation. The aforementioned documents were the principal data reservoir for the inquiry of the efficacy of infrastructure delivery systems in foreign countries. To investigate the infrastructure delivery management system implemented by the South African public sector, interviews were conducted with key persons who hold responsibility for infrastructure delivery in this sector. The analysis and discussion are organised according to the following categories: institutional structure, process, and governance.

The researcher gathered both primary and secondary data then applied the research components to the object of interest. The objectives and initial design of the study were created in accordance with the research questions, literature review, transcriptions of interviews, and emergent discoveries. This evaluation necessitates a thorough examination of infrastructure processes and organisations, the identification of prevailing deficiencies, and the exploration of alternative approaches that are currently not included in the conventional toolkit. This has the potential to advance research boundaries and bridge deficiencies in the delivery of public sector infrastructure. The procedures for data analysis are described below.

4.1.1 The data processing approach

A thorough examination was undertaken utilising scholarly sources to analyse infrastructure delivery systems and assess the current best practices. The evaluation involved an examination of the available literature and information about infrastructure delivery approaches. The objective was to obtain a deeper understanding of the present condition of infrastructure delivery systems and to identify any flaws that may currently exist. The literature presented a thorough examination of infrastructure delivery in various nations. The studies exhibit variability across different countries and encompass a range of strategies aimed at enhancing the efficiency and effectiveness of infrastructure delivery. The research conducted involved an analysis of several strategies for infrastructure provision, facilitating policy changes in both

European countries, with a focus on the United Kingdom, and developing nations in Sub-Saharan Africa, particularly Rwanda, Ethiopia, and South Africa. The study examined the diverse processes, overall solutions, and existing deficiencies in infrastructure delivery on a worldwide scale.

The existing body of research has extensively examined various strategies for infrastructure delivery and has derived valuable insights from a thorough review of infrastructure delivery methods, governance structures and implementation processes. The study incorporates a variety of data sources, encompassing primary documents and interviews. Content analysis is a research methodology that involves the systematic examination of documented or recorded material, wherein the material is deconstructed into distinct components for study. The main aim of content analysis is to methodically classify and evaluate the gathered material in order to derive logical and well-founded conclusions (Bengtsson, 2016). In contrast, thematic analysis allows the researcher to delve further into the selected data and utilise coding and categorisation methods that are informed by the unique attributes of the data, with the aim of identifying themes that are pertinent to a certain occurrence (Bowen, 2009). This enables a thorough examination of the importance of the data and its observable patterns (Atkinson, 2019). The research adopted both content and thematic analysis.

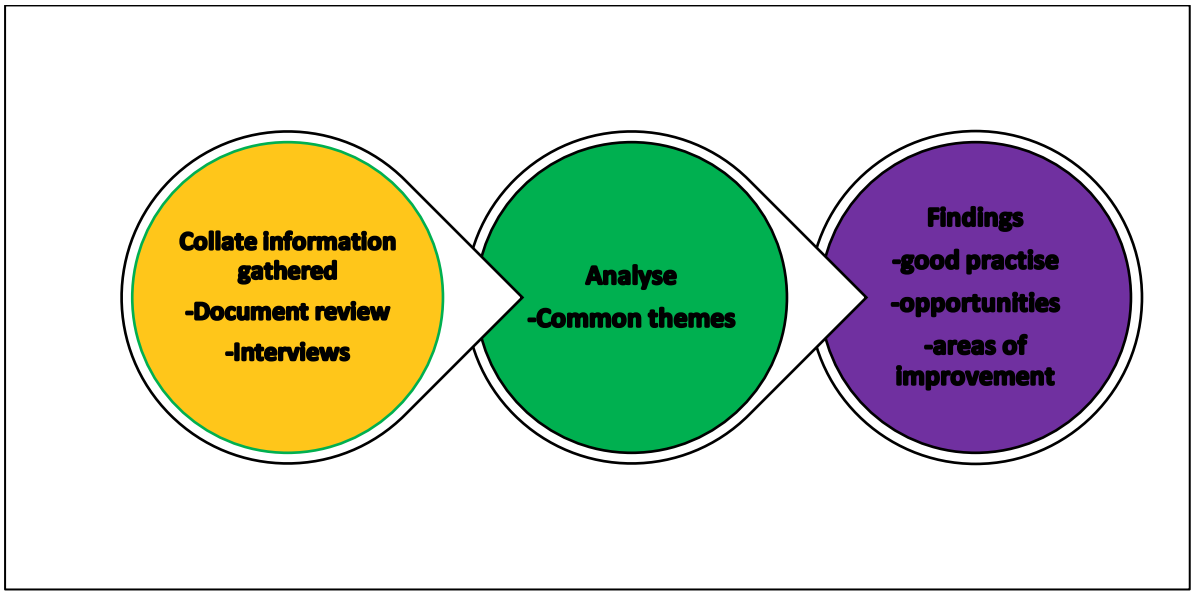
The examination and evaluation of the progression of delivery methods employed in infrastructure delivery across various nations is acknowledged and scrutinised via the utilisation of document analysis and interviews. The IDMS establishment and practices found from the document analysis were further augmented by interviews, participation for confirmation, and in-depth examination of their practice. The study relied on documentation and previous studies as its main sources of information in order to understand the delivery methods employed in infrastructure delivery. This served as a foundation for assessing their performance. The important factors influencing the delivery of project infrastructure were categorised based on governance, organisational structure, and processes.

The study is conducted using a methodical process, which encompasses the subsequent procedural stages: thorough examination of infrastructure delivery reforms, conducting interviews with key stakeholders involved in infrastructure delivery, filtering the findings for inclusion in the study, coding the data collected for analysis, and integrating and analysing the data gathered.

4.1.2 Analysing the data

According to Daniel (2017), qualitative data analysis is characterised by a distinct and structured approach that differs from quantitative data analysis. In this approach, the nature of the data and the researcher's creativity often assume greater importance. Content analysis and theme coding are commonly used techniques for analysing qualitative data (Bryman, 2012). These methods involve transcribing interviews and establishing connections with relevant academic literature. The researcher assumed an active role in the organisation and interpretation of the data. The diagram presented below illustrates the process of data analysis.

Figure 4.1. The data analysis process



Source: Researcher's collection

The researcher familiarised themselves with the data by engaging in the process of actively listening to and transcribing each recorded interview. Before commencing the transcription process, the researcher employed active listening techniques in order to gain a deeper comprehension of the main subjects spoken in each interview. This process enabled the extraction of non-verbal cues and behaviours that might not have been recorded in the interview transcripts. The audio interviews were transcribed exactly as said and then converted into written format using word-processing software. The act of recording and transcribing an interview serves as a means to mitigate the inherent limitations of human memory and the potential for forgetting the information conveyed by the interviewee (Daniel, 2017).

The researchers adopted thematic analysis as a method to analyse the transcripts and written notes. The utilisation of the constructivist research paradigm offers significant benefits in the context of performing thematic analysis. This is primarily attributed to its emphasis on the construction of meaning, which holds a pivotal position in the process of generating and interpreting codes and themes (Byrne, 2021). The procedure involved the scrutiny of data and the study of prevailing themes. The coding and theme creation procedures are known for their intrinsic flexibility and organic nature, often undergoing frequent revisions during the analysis of data (Byrne, 2021).

The study applied the technique of open coding to discern and classify units of meaning found within the transcribed materials. The meaning units in question covered a variety of linguistic features, such as individual words, phrases, complete sentences, and entire paragraphs. As stated by Byrne (2021), it is imperative for the researcher to systematically analyse the entire dataset, giving equal consideration to each data point and recording any notable attributes that could aid in the discovery of themes. The act of progressing through the analytical process often leads to an improvement in the clarity of the data, which can potentially aid in the discovery and understanding of novel patterns. The observed patterns were identified and methodically classified into thematic categories. The themes were subjected to detailed analysis and careful consideration in order to attain a more comprehensive comprehension of the facts.

This study centres its attention on the constituent elements encompassing the governance, processes, and institutional structure of several departments that bear the responsibility for infrastructure. A critical analysis approach was employed in order to carry out the literature review. The constructive aspects of epistemology and ontology were addressed by providing due consideration to the meaning generated and conveyed by the participant, as well as the interpretations made by the researcher, which were influenced by the theoretical assumptions behind the analysis. The next part outlines the procedures undertaken to ensure the integrity of the research.

4.2 Interviews analysis

The literature suggests that similar issues in infrastructure delivery are recognised in other emerging nations undergoing growth and expansion, similar to those faced by South Africa.

Developing nations have made significant progress in their efforts to address the issue of public infrastructure delivery. However, it is crucial to acknowledge that not all applied strategies have resulted in successful outcomes. Infrastructure delivery systems were better addressed in research in affluent nations. An alternative perspective is that throughout history, nations with strong economic prosperity have tended to offer more favourable social conditions. Conversely, research undertaken in less developed countries has indicated a prevalent dependence on a trial-and-error methodology. This study evaluates the infrastructure delivery management system in the context of government implementation processes. The study questions for this interview were derived following an extensive review of pertinent scholarly literature. The research seeks answers to the question, how effective is IDMS in infrastructure delivery in the South African Government?

The interviews focused on the following research sub-questions aligned with the objectives:

- What were the triggers for the IDMS introduction? To identify the triggers for IDMS introduction.
- How is the IDMS appreciated and implemented in the public sector? To evaluate the understanding and operation of the IDMS model in the public sector.
- What are the constraints in the implementation of IDMS? To investigate the constraints experienced in implementing IDMS in the country.
- What are the institutional arrangements deployed to operationalise the IDMS model? To assay human capacity deficiencies inhibiting effective administration of the IDMS model.
- How effective has the IDMS model's introduction been in providing public sector infrastructure? To concatenate IDMS activities in facilitating infrastructure in achieving its intended purpose thus far.

During this phase, the objective was to generate a thematic map or table that emphasises the essential attributes of the data pertaining to the research question. As stated by Patton (1990), it is imperative that each theme offers a cohesive and internally congruent interpretation of the evidence, which is discernibly different from the explanations put out by the other themes. According to Byrne (2021), it is essential for all themes to converge in order to construct a coherent narrative that is consistent with the dataset's content and provides valuable insights related to the study issue. To ascertain themes, it is important to undertake a thorough examination of the foundational data components. At this juncture, the researcher must make a determination regarding the choice of data points to be employed as excerpts for synthesising the findings of the investigation. The section below highlights the participant responses and identified themes from the collected data.

4.2.1 Awareness and understanding of IDMS

Officials and service providers have indicated that they had a proficient understanding of IDMS. The adoption of IDMS is mandated in public sector construction projects as a result of established policies. The development of IDMS was driven by the imperative to address the need for innovation and improve delivery processes. The provided data extracts were used for the purpose of analysing the perspectives of the participants regarding the given topic. The analysis offers a comprehensive elucidation of the data and demonstrates its congruence with the research questions. The persons who have employed IDMS since its start have divulged the subsequent facts.

Below are some of the quotes from the participants in the study:

"Yes. We fully implement the IDMS in our component (DTPW Education Infrastructure) as per the various iterations of the frameworks provided by the National Treasury and Provincial Treasury." (PM02)

"My organisation has adopted FIDPM as an administrative process that prescribes requirements for effective governance of IDMS. This process comprises the following processes:

1. *Portfolio processes*
2. *Programme processes*
3. *Operation and maintenance processes*
4. *Project processes.*

Previously, we used SIDPM, but it imposed operational challenges." (SM01)

"*I am fully aware of the Infrastructure Delivery Management System (IDMS).*
The IDMS is a public-sector infrastructure delivery model that seeks to improve the seamless rollout of public infrastructure. It adopts a holistic approach which seeks to align infrastructure planning, design development, procurement, construction, maintenance, and disposal. Further to the above, the public infrastructure delivery cycle revolves around the client and implementing departments with specific and unique mandates. The IDMS seeks to synchronise the various activities to improve the effectiveness and efficiencies in service delivery whilst adopting international best practices. (PM02)

"In bolstering the above, the IDMS provides toolkits, guidelines, templates, and best practices to guide and support implementation managers." (SM01)

"Yes: The government has adopted this business governance process to establish a framework that enables departments to effectively plan, budget, procure, deliver, maintain, operate, monitor and evaluate the infrastructure. This system/ process seeks to provide business oversight over the government's dealings concerning infrastructure delivery. Its sole aim is to administer order and effective flow of all the associated administrative process linkages." (SM01)

"The process has limitations when it comes to other infrastructure needs. Other infrastructure needs can be actualised effectively and efficiently provided that a clearly defined official process from the IDMS framework addresses emergencies and fast-tracks other project-related activities that do not have mutual dependencies on other project activities." (EPS03)

"From a governance point of view, the IDMS meets its objectives of regulating and providing a governance framework necessary for infrastructure delivery in the public sector. However, the system's perceived complexity or misunderstanding of its application in practice becomes a barrier to effective infrastructure delivery. The latter point is often a source of frustration for suppliers and contractors who have to wait for the relevant approvals to be given by various stakeholders."(PM02)

"The reality is that it is difficult to implement consistently and sustainably a systematic way of infrastructure in an environment with a significant infrastructure backlog. The demand is very high with constrained budgetary resources. This will always pose a challenge in meeting the objectives of the IDMS." (EPS03

Byrne (2021) emphasises the significance of establishing coherent and meaningful linkages between topics to develop a persuasive narrative grounded on the evidence. The participants

demonstrated a high level of proficiency in articulating their comprehension of IDMS. The themes that have been deduced from the gathered data are delineated below and expounded upon in Figure 4.2.

Figure 4.2. Themes identified



Source: Researcher's collection

The table presented below offers a comprehensive elucidation of the identified themes.

Table 4.1. Themes and participants' views

Themes description	**Participants' views**
1. Awareness	The participants demonstrated knowledge regarding the presence of IDMS and exhibited familiarity with the new system used in the implementation of infrastructure projects.
2. Framework	IDMS permits implementing agents and client departments to implement construction projects and share information via project delivery with client approval protocols, with the end product being social infrastructure. The endeavour is to build a new, industry-wide common standard to assist the implementation of social infrastructure at the heart of government.

	Specific requirements for use in the planning, execution, and operational phases, as well as information handover and maintenance, are outlined in these standards.
3. Implementation	In delivery management, there are stage gates, and various template stage-gate models are used. The collaborative use of information challenges the model's stages since it necessitates more attention to information generation earlier in the process. In project phases 1 and 6, the procedure necessitates a consultative process, information exchanges, and approvals. Participants engage with efforts in public sector systems to comprehend the direction and set of transitions associated with ongoing change and to learn, adapt, and implement in the face of exponential rates of change. Client communication: To clarify the exchange of information between the delivery team and the customer, a set of data was articulated, indicating how information is created as documentation and then supplied to the client for approval at specific stage gates.
4. Training	Participants put forth significant effort to adjust the rapid rate of innovation in infrastructure delivery while receiving insufficient training on the new system. According to the participants, consultants are sometimes held responsible for poorly implemented projects due to a lack of training on the system. Service providers should be well-trained and skilled to ensure a seamless process implementation.
5. Governance	Many interviewees felt that administrative procedures could be more convenient due to the management system and necessitate coordination amongst essential parties. According to the participants, IDMS administrative processes are repetitive; most projects have experienced delays in execution, citing a lack of collaboration among stakeholders as the culprit. The operation of infrastructure systems requires the interplay of multiple interconnected systems. Certain participants argue that the absence of specific timeframes for the submission of deliverables during stage approvals is the underlying factor contributing to delays in project planning. Therefore, the process of project planning can span a duration ranging from one to five years. Appropriate planning is critical to the success of any endeavour. The framework is used in a selective manner, without a cohesive flow, there seems to be a lack of thorough review to ensure consistency.
6. Performance	The study reveals a growing convergence among the four infrastructure departments analysed in terms of encountering comparable challenges related to IDMS, process implementation, communications, and project approval time frames. The participants emphasised the absence of performance measurements to review the system and advocated for regular reviews to enhance its efficiency.
7. Efficiency	The interviewees see uniformity as the primary motivator of IDMS in the public sector. According to the participants, given the assurance of quality

	and deliverability, an IDMS solution appeals primarily to policymakers. However, it needs to consider industry standards or alignment with professional bodies at the project implementation stage. Significant efforts have been made to develop and standardise IDMS, leading to a state of ambiguity regarding the most up-to-date version to employ and its compliance with the mandates of built environment professional entities. The collaboration between industry and government entities has fostered the advancement of project delivery methodologies, leading to the development of innovative practices. According to most participants, a lack of adequate planning has harmed the success of many infrastructure projects. Planning should be completed in the period allotted, with no approval delays. Before beginning any project, appropriate planning for each stage should be completed, as these plans will be used to meet the project's goals. Due to delays in stage approvals, the delivery management system has impacted the number of projects delivered each year. The majority of interviewees expressed that the management system continues to exhibit deficiencies and shortcomings, which have had an adverse effect on infrastructure projects as a result of misconceptions and a lack of comprehension. The need to accelerate infrastructure delivery is a shared objective among officials in all the department, prompting a growing worry on the problem of future planning.

Source: Researcher's collection

Although the participants were knowledgeable about IDMS, further discourse revealed their desire for a comprehensive understanding of the process. This caused concern because some of the people involved are considered active stakeholders. An overwhelming majority of the participants perceive limitations in infrastructure delivery to inflexibility in dealing with alternate procurement modes, training and development, and capacity constraints within the organisation to be a significant problem with IDMS implementation. They also mention the discrepancy in the interpretation of IDMS by different stakeholders. The participants spell out how, from their experience, mainly in projects, both the implementing agent and the client should be driven by the service delivery will. However, they observe that this is not always the case, which has implications for the project delivery chain.

4.2.3 IDMS implementation

The analysis demonstrates that the participants were primarily responsible for the development, execution, operation, and maintenance of infrastructure projects across various infrastructure units. Based on the conducted interviews, the participants indicated that the delivery process is

still affected by implementation challenges. The participants have identified a range of implementation challenges, including insufficient training, capacity limitations within the delivery chain, and a limited understanding of the process. As per the respondents, a notable obstacle to the effective execution of projects is the requirement for enhanced expertise and comprehension of the system. Prior to implementing IDMS on any project, it is imperative to acknowledge the necessity for enhancing training. The following quote is derived from the statements made by the participants:

"Training and development of external service providers and contractors is an ongoing concern due to their need to provide various inputs into the procurement and delivery process to meet the requirements of the IDMS. This is often seen as a drain on internal resources, regularly called to reiterate how the system works and explain the subtleties or nuances of the processes or deliverables required to meet the stage gate objectives. What is left is an internal team incentivised to 'do the work themselves', which passes risk back onto the public-sector institution and further delays implementation." (PM02)

"The process has limitations when it comes to other infrastructure needs. Additional infrastructural needs could be effectively met if there was a clearly defined official process from the IDMS framework to address emergencies. Also ensuring fast-tracking of other project-related activities that do not have mutual dependencies on other project activities with a systematic and clearly defined IDMS framework." (PM02)

The participant admits to the premise of the IDMS system, which aims to standardise the process of procuring and delivering infrastructure by government entities. This is done to effectively manage governance and ensure that state moneys are used ethically. Nevertheless, despite the emergence of the IDMS in the last ten years, its implementation continues to be an ongoing task. The IDMS iterations have introduced a certain level of complexity. The implementation of the SIPDM in 2015, which was subsequently replaced by the FIDPM in 2019, was executed with limited advance warning in order to provide the necessary adjustments to align the delivery process with the updated framework.

From the perspective of the participants, it can be argued that the drawbacks of IDMS not only outweigh its positives but also have adverse consequences, like prolonged project delivery lead times and interface complications. As per the respondents, it was observed that IDMS does not establish a specific time limit for the completion of deadlines. This deficiency is noteworthy,

as it can impede project progress by not accounting for the duration required to obtain essential permissions prior to advancing to further stages. Obtaining the client's approval within a certain timeframe can often be the most arduous aspect, leading to delays in project completion. Consequently, the duration of a stage review might vary significantly, ranging from a minimum of two weeks to an extended period of several months.

"The gate stage system would become far more effective if stakeholders tried to have decision timelines. Due to the need for various stakeholders to oversee and provide input comment on submissions, approvals to move to the next stage often experience delays." (SM02)

Timely approval is a crucial criterion for the progression of a project. The realisation of time savings is contingent upon the provision of a suitable description of the process, which must be agreed upon beforehand and meticulously coordinated by all relevant parties. Furthermore, the inclusion of such elements contributes to the increased intricacy, ambiguity, and rigidity of the construction procedure (Bekdik, 2017). The findings from the study indicate that the adoption of IDMS within the sector remains incomplete. The duration of the project planning phase is sometimes extended because of the presence of unclear interpretations and the inability to reach decisive conclusions. Consequently, the frequent deferral of decisions leads to an extended duration of planning and a protracted process. The question of whether the system has enhanced service delivery has generated a diverse array of perspectives. According to a number of participants, it was asserted that the procedure has resulted in enhanced service provision. However, the individuals were unable to furnish concrete instances of service improvement, apart from assuring a certain level of consistency.

The majority of participants observed that the IDMS is not effectively attaining its intended goals and necessitates enhancements. The respondents place further emphasis on the fact that issues in service delivery by infrastructure departments are mostly caused by a lack of integration and resource constraints. The changes implemented by the government, as disclosed by department officials, have significant implications for infrastructure and can potentially affect the delivery of services. The participants concur that there is a lack of consensus regarding the implementation or utilisation of IDMS.

EPS 03 indicated a gap in the planning and different interpretations by different stakeholders, which impacts the implementation of projects through IDMS.

"Long-term planning at portfolio and program level is not given sufficient credence and support in the IDMS. This is especially apparent in the current context of a constrained fiscal environment where government departments are reticent to commit funding to large multi-year projects which may be cancelled in the near future or divert resources from more politically favourable objectives. This lack of an enabling framework that facilitates and balances long-term strategic public sector infrastructure delivery objectives leads stakeholders to prefer short-term objectives which are not sustainable in the long run." (SM01)

"Also, derailment from long-term plans is a common scenario as there are political pressures emanating from service delivery protest by communities which results to shoving the plans and principles of the IDMS." (PM02).

The success of any project is contingent upon effective planning (Mahdi, 2011). According to the Project Management Body of Knowledge (PMBOK), project planning is characterised as a structured collection of approved documents that provide guidance for both project execution and project control. The temporal and cognitive resources required for project planning utilising IDMS are contingent upon the specific attributes of the project:

- The volume of project information that needs to be prepared and examined.
- The extent of stakeholder involvement.
- The finalisation and consolidation of documents for approval.

The capacity to use discernment is vital for the success of any enterprise. The lack of decision-making skills or the postponement of decision-making processes undermines the achievement of infrastructure project objectives. According to the respondents, the implementation of the IDMS procedure in construction projects necessitates the attainment of gateway approval for each stage, resulting in significant time delays. According to the participants' responses, the duration required to finalise a project, spanning from initial design stages to its ultimate completion, remains unquantified and can extend over several years. Moreover, the occurrence of a time delay can be attributed to a range of causes, such as legal impediments, municipal authorisations, and alterations in priorities resulting from financial limitations and portfolio requirements. The consensus among all participants is that IDMS does not incorporate specific timelines for the completion of stage deliverables, since it fails to account for the duration required to plan and execute a project, as well as the budgeting procedures.

4.2.3 Governance

The participants revealed that the present administration is not effectively implementing IDMS across all governmental departments. In certain circumstances, there exists a tendency for individuals to exhibit resistance towards change. It is argued that the government should continue its efforts to ensure conformity across all departments, hence leading to varying levels of implementation. This matter is of relevance due to the crucial role that enforcement plays in the implementation of regulations and norms.

The participants disclosed variations in the interpretation and execution of the system. From the standpoint of the participants, the drawbacks of IDMS not only outweigh the advantages but also result in adverse consequences, such as increased project delivery lead times and interface complications. Based on interviews conducted with officials, it is imperative to establish synchronisation across the various infrastructure agencies in order to ensure efficient processes. Officials from multiple departments engaged in the sharing of information, which brought to light a discernible discrepancy in the implementation of their IDMS across the different departments and units. The individuals involved in the study are cited as follows:

"Another challenge is change resistance. Most Implementation Managers, i.e., technical personnel such as Quantity Surveyors, Engineers, and Architects working in the public space, need to fully understand their role in the public sector. They focus solely on the project management deliverables and neglect the programme and portfolio management elements, which are crucial for the existence of the IDMS.

"Also, systematic way of infrastructure planning and delivery are still not grasped by the political heads who usually influence the infrastructure delivery programme." (EPS03).

The IDMS procedure and its implementation may have been deemed less suitable by multiple service providers. When prompted to provide further clarification on this perspective, the individual stated that the necessary documentation exists, but differing interpretations arise due to a deficiency in comprehension and training. The participants expressed that the lack of understanding of IDMS among various stakeholders presented a substantial obstacle in attaining successful project implementation. There were individuals who did not necessarily associate it with wider planning protocols and the provision of services. PM02 cited the following:

"The reality is that it is difficult to implement consistently and sustainably a systematic way of infrastructure in an environment with a significant infrastructure backlog. The demand is very

high with constrained budgetary resources. This will always pose a challenge in meeting the objectives of the IDMS."
"From my experience, the submitted documentation still needs to fulfil its intended purpose: long-term and infrastructure life-cycle planning. As the situation is currently, the documents are submitted for compliance and still do not give a sense of the infrastructure direction."

It is imperative for all parties involved in a project to establish and maintain robust working relationships. A participant emphasised the importance of clearly defining the exact nature of the relationship between project implementers and their engagement with other pertinent stakeholders in order to mitigate potential challenges. Based on the perspectives of certain parties, it is evident that there is a need for enhancement in this connection, resulting in the occurrence of project delays. It is imperative to establish a coherent and well-defined relationship among all project implementers in order to facilitate the smooth execution of projects, hence minimising any potential complications or challenges that may arise during the process. The efficacy of a procedure is heavily contingent upon its enforcement. Notwithstanding this, the interviews have shown that the government's program has facilitated the enhancement of standardization in departmental projects. A majority of the participants, including over 60% of the respondents, said that they are now adapting to the implementation of IDMS. However, it is worth noting that there remains potential for further enhancements in this regard.

The majority of participants have reached a consensus that there is a need for improvement in the delivery management system. Effective management practices and a comprehensive comprehension of responsibilities and objectives are necessary. This has the potential to enhance the efficacy of infrastructural development. The inadequate training and limited comprehension of the respondent regarding the IDM process, along with subpar documentation and knowledge transfer, impede the country's ability to achieve successful project delivery in the construction sector and infrastructure development.

4.2.4 Institutional arrangement

According to the Project Management Body of Knowledge (PMBOK), project organisation refers to the human infrastructure of a project, encompassing the project organisation chart and the duties and interactions of the project team. The concept of 'organisational structure' pertains to the arrangement and configuration of an organisation. The participants in the study

identified capacity as a significant obstacle in achieving a smooth integration of IDMS. They also highlighted those delays in decision-making capabilities contributed to project delays within the public sector. The following quotations are extracted from the participants' responses:

"There is still a gap between the capacity used to implement the process and the actual desired outcomes that the process seeks to achieve." (PM02).

"Capability – do the people deployed along the value chain able to do what they are supposed to do? IDMS is about institutionalising certain functions at particular stations of the process." (SM01).

"Differentiation/ acceptance of Responsibilities and Turf wars – the institutionalisation is a Change Management process, some of the historical assignments change, and the role-players need to adjust to this." (SM01).

"This largely depends on the change management process at the beginning. Everyone (All stakeholders) has to be on board from the beginning, and proper process onboarding has to be done to ensure that every stakeholder understands their role and can effectively carry out their duties." (PM02).

The participants identified many key factors that contribute to project delivery delays in the South African building industry. These factors include delays in obtaining planning approval, inadequate capacity building, resource duplication and changes, bureaucratic processes, sluggish response to information requests, and challenges in implementing project processes. The implementation of IDMS inside infrastructure departments is facilitated by the involvement of treasury departments. The review emphasises that the resolution of capacity constraints would enable the departments to sustain the implementation of IDMS. In light of the constraints imposed by limited resources in the public sector and the need for alignment in recruitment practices, it is imperative to enhance the capabilities of departments in order to facilitate integration. The process of integration poses a considerable challenge. The imperative to implement systems integration methods increases proportionally with the complexity and unpredictability of projects.

4.3 Summary of interview findings

To be able to achieve a successful implementation of IDMS in project settings, project participants have emphasised the importance of acquiring knowledge pertaining to IDMS processes, workflow, and important variables. The framework is there to enhance user participation and improve communication between client departments and implementing agents during the various stages of project delivery. This is achieved through the use of stage gate approvals, which serve to mitigate risks associated with the project.

The majority of participants have expressed viewpoints indicating that a lack of adequate coherence within the project delivery chain gives birth to certain challenges. The generation of information by the project team and subsequent permissions granted by the client give rise to a cyclical process, as the absence of assigned timescales within the delivery chain perpetuates this loop. The primary objective of IDMS is to streamline the transmission of information and develop linkages across various processes. However, addressing the existing infrastructure obstacles is crucial to fully realizing the potential of IDMS. Therefore necessitating the development of strategies to increase the delivery of public facilities and the stage approval timeframes.

Based on the conducted interviews, it is evident that there remains a requirement for enhanced comprehension of processes and the provision of training. Comprehensive knowledge of government principles and regulations within the system is crucial to the successful execution of projects. This involves the efficient utilisation of IDMS for the ongoing monitoring of infrastructure planning and operation, pre-emptive intervention prior to the emergence of issues, and the development of improved solutions for future endeavours. A comprehensive policy that effectively addresses the issue of consistency is vital for the achievement of success inside any organisation.

Raising public awareness regarding the limitations and advantages of IDMS throughout the life-cycle of construction projects is of utmost importance. Achieving this goal involves emphasizing the procedural aspects, well-defined roles, and responsibilities of the diverse stakeholders engaged in the nation's infrastructure planning, design, construction, operation, and maintenance. Consequently, this enables the streamlining of IDMS procedures.

To effectively address the challenges associated with infrastructure project delivery, the IDMS requires a precise articulation of objectives, seamless coordination with multiple stakeholders, and the formation of highly skilled and competitive teams.

The following are the benefits that respondents expect to accrue as a result of IDMS adoption:

1. Enhancement in the quality of work and an increase in productivity
2. Improved delivery of infrastructure services
3. Uniformity
4. Fast-tracking the planning process
5. Infrastructure delivery and project management efficiency
6. Optimal resource utilisation, and
7. Better relationships with stakeholders.

The researcher posits that there is a need for further attention to be given to the deployment of infrastructure delivery methods to enhance their effectiveness.

4.4 Summary

This chapter presents an overview of the methods employed for the collecting and analysis of qualitative data, specifically focusing on the interviews conducted as a component of the study project. The disclosure of the selection criteria for both the organisations and interviewees is accompanied by the provision of information pertaining to the interviewees' professional background and present employment status. The chapter also encompasses the tools and methodologies employed in data analysis. This suggests that the veracity of the facts supplied and examined in the subsequent chapters can be relied upon. The chapter also presented a thorough examination of the methods required to improve the quality of research findings in relation to both validity and reliability. The primary emphasis of the chapter was on doing an analysis of interviews in order to identify, evaluate, and characterise the various factors that influence the implementation of IDMS.

There are numerous factors that exert influence on the effective implementation of infrastructure projects. The primary factors contributing to delays in infrastructure delivery were identified as cumbersome administrative procedures, governance issues, institutional structure, inadequate system training, and planning delays. The successful implementation of IDMS requires a systematic and organised approach, as well as the active involvement and dedication of all individuals and groups involved in the project. In the context of project delivery, it is important to note that there is no universally applicable solution that can be used to all situations. Based on the conducted interviews, the implementation of IDMS is carried out despite encountering various challenges. The subsequent chapter will expand on the literature

study and interview analysis to facilitate additional conversations and develop a comprehensive framework for integrated infrastructure delivery. The findings from the interviews are presented and discussed in the next chapter.

Chapter Five: Findings and Discussion

5. Introduction

This section provides a full overview of the findings, the underlying rationales, and the methods and approaches deployed for integrating IDMS into public infrastructure projects. The development of the built environment infrastructure in South Africa is currently underway, accompanied by notable maintenance and infrastructure backlogs that necessitate the use of integrated delivery systems. Infrastructure policies are frequently exclusive to certain countries, and various practices exist within a single country. Gaining a comprehensive understanding of these regulations and practises is crucial in order to effectively evaluate the potential opportunities and problems associated with integrating IDMS into public infrastructure projects. Various challenges such as delayed project delivery are commonly during encountered the implementation of infrastructure initiatives. It is essential to emphasise that the South African case serves as model for understanding challenges and opportunities that are prevalent in developing countries.

A qualitative research methodology employing interviews was devised to provide a comprehensive understanding of the current infrastructure delivery management system. The present study incorporates a review that accompanies a synthesised form of data, aiming to elucidate the strengths and shortcomings of the specific domain under investigation. The conclusions are derived from the perspectives of the individuals who were interviewed and took part in this research. All interviewees employ IDMS in infrastructure projects in their organisations. The research question and study goals are addressed in this chapter. The results are also triangulated with documents to corroborate the findings and spot emerging problems.

The study utilised systems theory to clarify the components and connections inside the delivery system among various units functioning in the project setting. Furthermore, it facilitated the examination of the interdependencies among many elements within the framework, including processes, structure, governance, and the connections between the IDMS and the infrastructural environment. The application of systems theory has played a crucial role in the recognition and direction of fundamental elements necessary for the operation of a delivery system. Hence, the application of systems theory concepts and principles has facilitated the progress of a methodical methodology employed in the examination of infrastructure delivery

systems. This theory is of great significance due to its provision of a conceptual framework for the use of several adaptable and widely embraced cognitive approaches in understanding the dynamics within both the internal and external components of organisations. As a result, this approach led to a comprehensive comprehension of the topic at hand.

The main focus of this study is to analyse the relationship between the IDMS chain, which serves as a fundamental basis for project implementation. The IDMS chain ensures that projects are executed efficiently, with clear objectives and well-defined roles and responsibilities for stakeholders promoting coordination. The primary emphasis lies in the examination of the interaction among the IDMS chain, serving as a foundation for the execution of projects. By analysing the interaction among the different components of the IDMS chain, this study aims to provide insights into how projects are successfully implemented and managed. The departments elucidate the manner in which IDMS is operationalised inside projects, the dynamics of engagement among many stakeholders, and the overarching framework within which the projects are executed. The study acknowledge the importance of considering the interconnections among all factors inside the system components. The elements under consideration encompass governance, organisational structures, and processes. The research findings are substantiated with relevant literature in the next section.

5.1 Research output

The execution of infrastructure projects is a multifaceted endeavour that necessitates the cooperation and participation of various stakeholders, rather than being solely reliant on the efforts of an individual. The researcher initiated the study by gathering relevant material pertaining to infrastructure delivery reforms and the execution of such reforms in Sub-Saharan nations and Europe, and then the public sector departments in various regions in SA offered the cases for analysis. The study presents a knowledge foundation of accessible methods and applications for qualitatively promoting the systemic analysis of IDMS. The methodologies employed encompass literature reviews, case studies, interviews conducted with key players, The study seeks to achieve a thorough comprehension of the obstacles, prospects, and approaches pertaining to infrastructure delivery reforms in Sub-Saharan countries and Europe through the utilisation of these tools.

This study's main objective was to evaluate how well IDMS delivers infrastructure projects in South Africa. The purpose of the research was to determine whether the adoption of IDMS yielded the expected outcome of enhancing infrastructure performance. This study gives five key questions and objectives to address IDMS's effectiveness in delivering infrastructure to the South African government.

The research sub-questions are:

1. What were the triggers for the IDMS introduction?
2. How is the IDMS appreciated and implemented in the public sector?
3. What are the constraints in the implementation of IDMS?
4. What are the institutional arrangements deployed to operationalise the IDMS model?
5. How effective has the IDMS model's introduction been in providing public sector infrastructure?

The research questions are tied to the objectives below:

The study's objectives:

1. Identify the triggers for IDMS introduction
2. Evaluate the understanding and operation of the IDMS model in the public sector
3. Investigate the constraints experienced in the implementation of IDMS in the country
4. Assay human capacity deficiencies inhabiting effective administration of the IDMS model
5. Concatenate IDMS activities in achieving its intended purpose thus far in facilitating infrastructure.

The subsequent section presents the discourse about the study.

5.2 What were the triggers for the IDMS introduction?

During interviews with participants from various departments, it was found that they all acknowledged the historical background and implementation of IDMS as a significant step towards improving infrastructure delivery. The existing infrastructure delivery process in South Africa was characterised by delays, cost overruns, and a lack of standardisation in infrastructure projects. Projects were often delayed due to bureaucratic red tape and inefficiencies in procurement and project management. This led to a backlog of infrastructure projects and a lack of timely delivery of services to the public. The shortcomings of the existing process necessitated the implementation of IDMS to address these issues and improve the

overall delivery of infrastructure projects. Following a sequence of advancements in infrastructure delivery, the South African public sector implemented the Infrastructure Delivery Management System (IDMS) with the aim of assisting departments in effectively managing infrastructure delivery.

Governments have undertaken significant reforms in the past to acknowledge the significance of infrastructure. These reforms encompass restructuring, augmenting private involvement, and embracing novel regulatory approaches (Brunette, Klaaren & Nqaba, 2019; Davies, MacAulay & Brady, 2019). Although there have been disparities in outcomes among different nations and sectors, it is generally acknowledged that reforms have resulted in improvements in infrastructure performance (ibid).According to the research undertaken by Aritua et al. (2011), nations that have implemented infrastructure changes, such as the United Kingdom, have observed notable enhancements in their key performance metrics. The empirical data presented in this study underscore the favourable effects of infrastructure changes on performance. The implementation of these changes has led to a rise in investments, enhanced service quality, and widened the availability of services for the general populace. Aritua et al. (2011) argue that the successful execution of whole-of-government plans necessitates strict adherence to established best practises.

By implementing IDMS, the South African government aims to mitigate the backlog of infrastructure projects and ensure the timely delivery of services to the public. This system facilitates the adoption of a standardised approach and offers the necessary procedures for constructing, operating, and maintaining infrastructure. The system encompasses various aspects such as infrastructure planning, execution, governance, procedure, operations and maintenance, and capacity building. The purpose of implementing IDMS is to mitigate backlogs and improve the delivery of infrastructure services within government departments.

The framework delineates the procedures that have been identified as expediting the resolution of infrastructure backlog and providing tangible benefits to the populace. The system encompasses project management principles that are considered to be the most effective, as well as procurement management and infrastructure operation and management. The standardised procedures and streamlined processes provided by IDMS is anticipated to reduce delays and cost overruns, leading to more efficient infrastructure delivery. This means that essential infrastructure projects can be delivered in a timely manner, improving the quality of

life for the public. Additionally, IDMS promotes transparency and accountability in infrastructure projects, ensuring that public funds are used efficiently. The purpose of IDMS is to effectively oversee the whole life cycle of the portfolio of infrastructure initiatives and projects. The framework provides support to public bodies and organisations in their efforts to enhance their capabilities, while also outlining transparent procedures for infrastructure projects.

The existing body of literature suggests that numerous countries and public sector organisations have been required to reconfigure their approaches to infrastructure delivery in order to achieve their respective national objectives. The manner in which infrastructure is implemented has an impact on projects within the public sector. Various systems and reforms often arise as a result of a transition in political leadership aimed at enhancing service delivery or due to the shortcomings of an existing process. The use of streamlined procedures and the integration of systems facilitate the efficient delivery of infrastructure projects to the broader populace. Typically, procedural measures are implemented to correspond with overarching national objectives. Frequently, prior to assessing the effectiveness of a given system, a new transformational process is established. Consequently, it is widely acknowledged that infrastructure delivery systems must prioritise meeting delivery objectives prior to undergoing evaluation. These factors pose a greater level of difficulty in implementing a strategic shift towards integrating infrastructure delivery within the public sector.

5.3 How is the IDMS appreciated and implemented in the public sector?

According to Awuzie and Monyane (2020) the process of acquiring and delivering infrastructure assets often involves navigating complex regulatory frameworks, coordinating with multiple stakeholders with different priorities and interests, managing large budgets and financial resources, and dealing with unexpected technical and logistical issues that can arise during construction. These complexities can lead to delays, cost overruns, and conflicts among the parties involved, making successful project execution more challenging. However, it is important to note that some researchers namely Watemeyer and Phillips (2020) argue that successful infrastructure project delivery also depends on factors such as technological innovation, effective risk management strategies, and the availability of skilled labor. While client leadership, client governance, and infrastructure procurement practices are important,

these factors should not be considered in isolation and must be examined in conjunction with other critical elements of project management.

The respondents gave precise responses on this question. There are different stakeholders involved in the delivery chain. Internal stakeholders in the project life cycle may include client departments, project management units, and implementing agents. These stakeholders are responsible for initiating and overseeing the project, making decisions, and providing approvals at various stages. External stakeholders may include community members, regulatory agencies, and other organisations that are affected by or have an interest in the project. These stakeholders may provide input, feedback, and approvals, and may also be involved in monitoring and evaluating the project's impact on the community and environment.

Infrastructure planning and execution are overseen by several governmental entities throughout different stages, including planning, implementation, and operation. Every participant in the delivery process bears a distinct set of obligations. The responsibilities of the implementing agents within the delivery management chain encompass several tasks such as project planning, cost estimation, procurement, project execution, and operation and maintenance. The client departments engage in the formulation of a business case, commencement of feasibility studies and finance procedures, and authorisation of the project brief and deliverables for an infrastructure project. Client departments initiate project requests to project management units or implementing agents for project execution. Upon receipt of a request, service providers are contracted to assist in the implementation of the project. The role implementing agents involves the management and strategic planning of initiatives, which are subject to approval from client departments before progressing further. The project life cycle necessitates the engagement of both teams with both internal and external stakeholders at different stages.

The application of IDMS involves conventional measures to improve the public sector infrastructure department’s governance, process, and institutional strategies. This includes include the establishment of clear project planning and execution processes, the implementation of effective cost estimation methods, the development of procurement strategies that promote transparency and fairness, and the establishment of protocols for project operation and maintenance. These measures aim to ensure that infrastructure projects are managed efficiently, resources are allocated effectively, and decision-making processes are transparent and accountable.

Infrastructure projects are often executed in a phased manner. In the context of IDMS, it is imperative for infrastructure projects to undergo gate controls during the progression of their delivery operations. In order to progress to the subsequent stage and fulfil all necessary criteria, a project must undergo multiple phases and obtain gate approval. Gate controls in the progression of infrastructure projects serve as checkpoints that ensure that projects meet certain criteria before proceeding to the next stage. At each gate, the project team seeks approval from relevant stakeholders, who assess the project's progress, adherence to budget and timeline, and alignment with project objectives. The criteria for gate approval may include the completion of specific deliverables, the resolution of identified risks or issues, the availability of required resources, and the demonstration of stakeholder support. Gate controls help to mitigate risks, ensure accountability, and maintain project alignment with organisational goals and objectives.

Gate review approvals are undertaken throughout the whole project lifecycle, from the planning phase through conclusion. During these reviews, the project team seeks approval from relevant stakeholders that are involved in the project. The deliverables associated with each gate are incrementally moved to the subsequent gate as each stage is successfully completed. Throughout the project management process, a multitude of decisions must be made. Planning decisions play a crucial role in the project management process, as they have a substantial impact on enhancing service delivery. An indepth understanding of system operations and process management is essential for effective management of infrastructure projects. Cahen (2016) established in his study the importance of a proficient and well-established organisation for creating a supportive infrastructural environment.

The participants emphasise the significance of neglecting a function within the chain, as it has a direct impact on the overall success of the project. Neglecting a function within the delivery chain, such as project planning, cost estimation, procurement, or operation and maintenance, can have significant consequences for project success. For example, inadequate project planning may result in unclear objectives, unrealistic timelines, and inadequate resource allocation, leading to delays, budget overruns, and reduced project quality. Similarly, poor cost estimation can result in underestimation of project costs, leading to funding shortages and potential project abandonment. Neglecting procurement processes may result in unfair practices, corruption, and lack of transparency, undermining stakeholder trust and project credibility. Lastly, inadequate operation and maintenance can lead to infrastructure deterioration, decreased service quality, and increased long-term costs. Therefore, each

function within the delivery chain plays a crucial role in ensuring the success and sustainability of infrastructure projects.

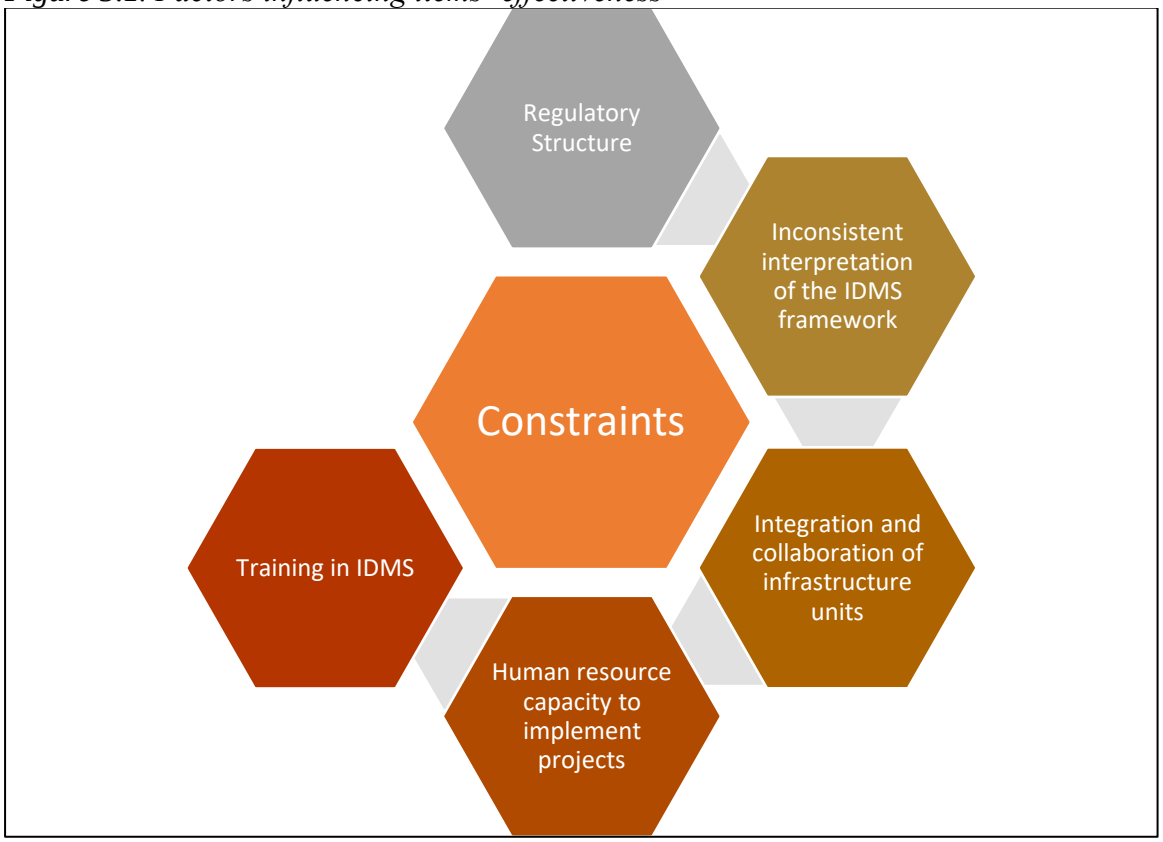
5.4 What are the constraints in the implementation of IDMS?

The government's infrastructure service performance has been disappointing since the introduction of IDMS, interviewees show. These include the need for timelier finished infrastructure projects. According to the data analysis, the cause emanates from:

- The lack of improvement in internal technical and management resources
- The general lack of capacity within the project units
- Differences in understanding and interpretation of IDMS infrastructure
- The inadequacy of consultation and cooperation among key stakeholders in the delivery of infrastructure initiatives
- The need for more training
- Inadequate governance structure.

An examination into this reveals the factors influencing IDMS' effectiveness, summarised as below:

Figure 5.1. Factors influencing items' effectiveness



Source: Researcher's collection

The above factors are deliberated in detail below.

5.4.1 Regulatory structure

Despite the system being introduced some time ago and undergoing several updates, users still require clarification regarding procedures and operational methods. The frequent changes have introduced some instability in project delivery and necessitated greater alignment with construction industry regulations and the requirements of the built environment council. Based on the feedback provided by the participants, it is imperative to evaluate the regulatory system's adequacy in relation to its intended purpose. From a practical standpoint, the implementation of such measures could be perceived as constraining and onerous, resulting in project elongation and heightened reliance on external factors.

The study conducted by Asamoah, Osei-Kojo and Yeboah-Assiamah (2013) revealed many flaws in public administration. These include instances of poor leadership, such as a lack of vision and ineffective decision-making. Additionally, the study found a lack of knowledge in key areas, such as policy formulation and implementation. There were also instances of excessive personnel, leading to inefficiency and increased costs. The study also highlighted instances of misuse and wastage of resources, such as funds being allocated to projects that did not yield significant results. Insufficient internal and external systems, such as poor communication and coordination between departments, were also identified as flaws. Finally, the study found a proliferation of duplication and fragmentation, with multiple agencies or departments performing similar functions without proper coordination.

These flaws in public administration can have significant consequences. Poor leadership can result in a lack of direction and decision-making paralysis, leading to delays in policy implementation and ineffective governance. A lack of knowledge in key areas can lead to poor policy formulation and implementation, resulting in policies that do not address the needs of the population. Excessive personnel can strain limited resources and hinder efficiency. Instances of misuse and wastage can lead to financial losses and undermine public trust in the government. Insufficient internal and external systems can result in poor coordination and communication, hindering effective service delivery. Finally, the proliferation of duplication and fragmentation can lead to inefficiencies, redundancies, and a lack of accountability.

The study revealed that the inclusion of built environment professionals or officials from the infrastructure department is necessary throughout the policy-making phase, in order to enhance the initial system development and delivery procedures. This implies that the individuals responsible for executing the tasks were not actively engaged in the creation of the system, hence posing challenges in its implementation. Built environment professionals bring valuable expertise to the regulatory system and infrastructure projects. Their knowledge and skills in areas such as design, construction, and sustainable development can contribute to the overall quality and effectiveness of projects.. By actively involving professionals in the built environment field in the policy-making phase and throughout project execution, the regulatory system can benefit from their creativity, adaptability, and ability to find innovative solutions to challenges.

The system's capability and value for money may be compromised when citizens become impatient while waiting for infrastructure delivery. The system's inability to adjust to changing circumstances over a prolonged offtake time and the protracted approval deadline is compromised. The mandatory framework challenges the public officials assigned to implementation roles, as they are required to ensure timely delivery of programmes and projects while adhering to the established system. Considering the central objective of the infrastructure department to ensure the successful and efficient implementation of infrastructure projects, it is imperative to consider the capacity of the public service to engage in collaborative efforts with professionals in the built environment field and align the overall framework accordingly. Such alignment is essential for the effective execution of infrastructure projects. Through the process of collaboration, a system has the potential to derive advantages from the specialised knowledge and skills possessed by individuals engaged in the activity. Furthermore, effective management and execution of the collaborative effort are essential components for achieving desired outcomes. The involvement of professionals in the built environment is crucial for promoting creativity, adaptability, proactivity, transparency, and creative solutions to the challenges related to service provision.

5.4.2 Human resource capacity

The framework has been in place for some time, with inadequate capacity in departments to implement projects through IDMS. The interviews have highlighted that resourcing, as per the framework, was a challenge for their organisations. All the case departments indicated that they have internal struggles to full comply with IDMS due to a lack of resources. Based on the

findings from the interviews, it is evident that the various departments are in need of additional human resources in order to effectively align themselves with the appropriate delivery framework. Similarly, the service providers also lack the necessary personnel to meet these requirements.

According to a study by Nugent (2020), competent internal specialists in the areas of built environment are essential for the public sector to effectively manage and implement public infrastructure projects. These specialists have the knowledge and expertise to navigate complex procurement processes, ensuring that the right professionals services providers and contractors are recruited for projects. They are also skilled in overseeing the execution of projects, ensuring that they are completed on time and within budget. Without these specialists, the public sector may face challenges in obtaining high-quality services, managing financial and technical capabilities, and ensuring the successful execution and maintenance of infrastructure projects.

Delays in completing infrastructure projects due to a lack of human resources can have significant consequences. The question of money for capacitation continues to be a concern. The insufficiency of human resources within the infrastructure departments, in accordance with the established framework, presents considerable obstacles and delays in the completion of infrastructure projects. The existing personnel are facing an excessive burden of duties. Some may argue that investing in technical staff capabilities is a costly endeavor for the government. However, the long-term benefits of having skilled personnel far outweigh the initial investment. Skilled staff can contribute to more efficient project execution, reduced costs through effective planning and risk management, and improved overall project outcomes. Therefore, the government should view the development of technical staff capabilities as an investment rather than an expense.

Potential solution to address the issue of inadequate human resource capacity is to allocate additional funding for hiring and training new personnel. This could be done through budget reallocation or seeking additional funding from government sources. The organisational structure illustrates the interconnection between the human resources of the organisation and the empowerment of infrastructure delivery units, with the aim of improving operational effectiveness. This highlights the importance of a strong and adequately resourced workforce in the effective delivery of infrastructure projects. By ensuring that there are sufficient human

resources within each department and infrastructure delivery unit, organisations can improve operational effectiveness and overcome obstacles and delays in project completion.

5.4.3 Inconsistent interpretation of the IDMS framework

Research suggests that the effective administration of infrastructure projects is contingent upon financial and technical capability in public sector authorities. For instance, a research study by Kibuuka and Fourie (2016) demonstrated that public sector organisations with elevated higher financial and technical proficiency achieved higher success rate in completing infrastructure projects on time and within budget. These organisations exhibited proficiency in project planning, execution, resource allocation, and adeptly managing unforeseen circumstances. In contrast, organisations with restricted financial and technical proficiency frequently encountered project delays, cost overruns, and quality issues in their infrastructure projects.

Misunderstandings and obstacles to collaboration and integration are frequently the result of diverse interpretations within organisations. Divergent interpretations of the IDMS framework, might result in misinterpretations, since many stakeholders may possess distinct understandings on how to employ the framework and its components. Due to hazy and unclear understandings, stakeholders have assigned different meanings to work items and interpreted the IDMS framework differently. When stakeholders have different interpretations of the IDMS framework, it can lead to miscommunication, delays, and errors in project documentation and processes such as conflicting instructions and inaccuracies. This can ultimately impair service delivery resulting in project delays, cost overruns, and reduced quality of deliverables, consequently affecting overall service delivery.

During the project management process, planning decisions significantly influence the overall project outcomes. Effective management of infrastructure projects necessitates understanding process management methodologies and system processes intricately. For example, if work items are not clearly defined and understood by all stakeholders, it can result in misaligned expectations and ineffective coordination, leading to delays in project milestones and ultimately affecting service delivery to the end-users. Lack of in-depth knowledge in implementing IDMS directly impacts service delivery outcomes. It is crucial for personnel of state organs who oversee infrastructure projects to possess the requisite training and expertise. Ensuring the presence of appropriate competencies is imperative for the successful completion of a project.

5.4.4 Integration and collaboration of infrastructure units

The findings from the interviews indicated that a lack of sufficient knowledge and understanding of the IDMS played a significant role in the failure of the project. Nonetheless, the absence of sufficient knowledge about the system among client departments and supporting units led to a state of role ambiguity, ineffective communication, and ultimately, the failure to successfully implement infrastructure projects. The attribution of responsibility was placed on the factors of role confusion, inadequate familiarity with the IDMS methodology, and deficient internal control. Client departments and supporting units possessed extensive authority, which they employed to the detriment of the successful execution of infrastructure projects.

The challenges identified by Desta (2015) have significant implications for the management of public infrastructure projects. Inadequate organisation and mishandling of technical skills and expertise can lead to poor project planning, execution, and quality control. This can result in delays, cost overruns, and subpar infrastructure. Low morale, lack of confidence, and lack of team spirit can affect the productivity and collaboration among project teams, hindering effective communication and coordination. Interference in political matters can introduce biases and prioritise political agendas over project objectives, leading to inefficient resource allocation and decision-making. Addressing these challenges is crucial for ensuring the successful implementation and maintenance of public infrastructure projects.

Insufficient project governance, procurement, and delivery management procedures are frequently identified as the underlying factors contributing to project failure or unsatisfactory results. These aspects of project management are typically the responsibility of the client (Watermeyer & Phillips, 2020). However, it is important to consider that factors beyond role confusion, familiarity with the IDMS methodology, and internal control may also contribute to project failure. For instance, external factors such as changes in government policies, budget constraints, or unforeseen environmental challenges may significantly impact the successful execution of infrastructure projects. While these factors may not absolve client departments and supporting units from responsibility, they should be taken into account when evaluating project outcomes.

Based on the findings from the interviews, it can be observed that the gateway approach of project delivery has a discernible impact on project performance, as it introduces delays in the

processes of integration, coordination, and delivery. Delays are often experienced during the decision-making process, which can be attributed to the client's failure to satisfy their requirement of making timely decisions. The discrete phases of planning, design, and execution are separate from the system itself, thereby requiring the development of a comprehensive project management approach to enable seamless integration. The system is required to deliver a comprehensive and cohesive public infrastructure solution that effectively addresses the demands and expectations of stakeholders. However, implementing enhanced coordination and clearly defined roles may face challenges such as resistance to change, bureaucratic hurdles, and conflicting priorities among different government agencies. It is important to address these challenges through effective communication, stakeholder engagement, and a phased approach to implementation. The effective management of infrastructure projects throughout their life-cycle delivery necessitates the utilisation of continual discussions, structured involvement, and prioritised service delivery. Achieving a balanced coordination among all players engaged is crucial.

5.4.5 Training in IDMS

A study conducted by Watermeyer and Phillips (2020) found that interventions introduced without thorough piloting, training, and capacitating implementers significantly impact the portfolio, programme, and project management practices. According to those who participated in the interviews, using systems without proper training makes managing construction projects challenging, as it affects the entire business processes chain. The lack of training has resulted in inconsistent interpretations and approaches to projects. Organisations that did not invest in proper training for IDMS implementation had a significantly higher rate of project delays compared to those that received minimal training. This highlights the direct correlation between the lack of training in IDMS and the nation's inability to achieve its infrastructure objectives.

Organisations without proper training in IDMS, may struggle to effectively track and manage project timelines, budgets, and resources. This could result in delays, cost overruns, and inefficient use of resources, ultimately impacting the success and profitability of the projects. Additionally, the lack of training may lead to inconsistent data entry and interpretation, making it difficult to generate accurate reports and make informed decisions. Additionally, interviews with industry experts and stakeholders can provide firsthand accounts of how the lack of

training hindered project management practices and impacted the overall success of infrastructure projects.

5.5 What are the institutional arrangements deployed to operationalise the IDMS model?

The role of project coordination in operationalising the IDMS model involves ensuring effective communication between different departments, coordinating the allocation of resources, monitoring project progress, identifying and resolving any issues or conflicts that arise, and facilitating collaboration between internal and external support units. Research studies like Alshamsi (2018) and Desta (2017) have shown that effective project management in the construction sector is crucial for achieving project objectives within the constraints of available resources. Additionally, studies have found that deficiencies in knowledge, aptitude, experience, and competence can lead to inefficiencies and errors in project execution.

Project management in the construction sector involves the establishment of specific objectives that can be achieved through the execution of various activities, taking into account the constraints imposed by available resources. The efficacy of the project chain hinges upon the individuals engaged in its execution possessing a comprehensive understanding of the procedural aspects. The individuals employed within the various departments possess a high level of proficiency and competence in the field of built environment. This diverse skill set enables them to effectively execute IDMS. Nonetheless, the system’s performance is hindered by the many interpretations within the departments and a deficiency in knowledge, aptitude, experience, and competence. The deficiency in knowledge, aptitude, experience, and competence within the departments can lead to miscommunication, errors in data entry or analysis, delays in project timelines, and overall inefficiencies in the execution of the IDMS system. It can also result in a lack of understanding of the system's capabilities and limitations, leading to suboptimal decision-making and implementation.

The responsibility of project coordination is often delegated to the divisions specialising in project management, which involves facilitating communication with both internal and external support units. The departments are required to realign their organisational procedures and consistently enhance their ability to adapt to the changes resulting from the evolution of IDMS. Examples of changes resulting from the evolution of IDMS that departments may need

to adapt to include new developments, the integration of new modules or functionalities into the system, and shifts in industry standards or regulations related to IDMS. Some examples of institutional arrangements that may be deployed to operationalise the IDMS model include the establishment of cross-functional teams, the implementation of regular communication channels between departments, the development of standardized processes and procedures, and the provision of training and development opportunities for employees to enhance their knowledge and skills in IDMS.

5.6 How effective has the IDMS model been at providing public sector infrastructure?

The framework for infrastructure delivery includes key components such as streamlined project management processes, standardised procurement procedures, and effective stakeholder engagement strategies. These components are key in improving the efficiency of infrastructure delivery, reducing project delays, and attracting infrastructure investment. The participants argue that the IDMS model may be overly rigid and bureaucratic, leading to delays and inefficiencies in the delivery of infrastructure projects. The participants indicated that project decisions are often delayed, leading to prolonged planning periods impacting delivery timeframes. They point to cases where the strict adherence to compliance procedures has hindered the timely completion of projects, resulting in cost overruns and public dissatisfaction. Information shared by participants from the infrastructure departments showed that infrastructure projects implemented using the IDMS model had a lower rate of completion and a higher rate of cost overruns compared to projects using traditional delivery methods. This was evidenced in the delivery of projects implemented between 2015 to 2021. Furthermore, there concerns about the ability of the IDMS model to adapt to rapidly changing technological advancements and emerging trends in the infrastructure sector. These potential limitations needs thorough consideration and addressing to ensure the effectiveness of the IDMS model.

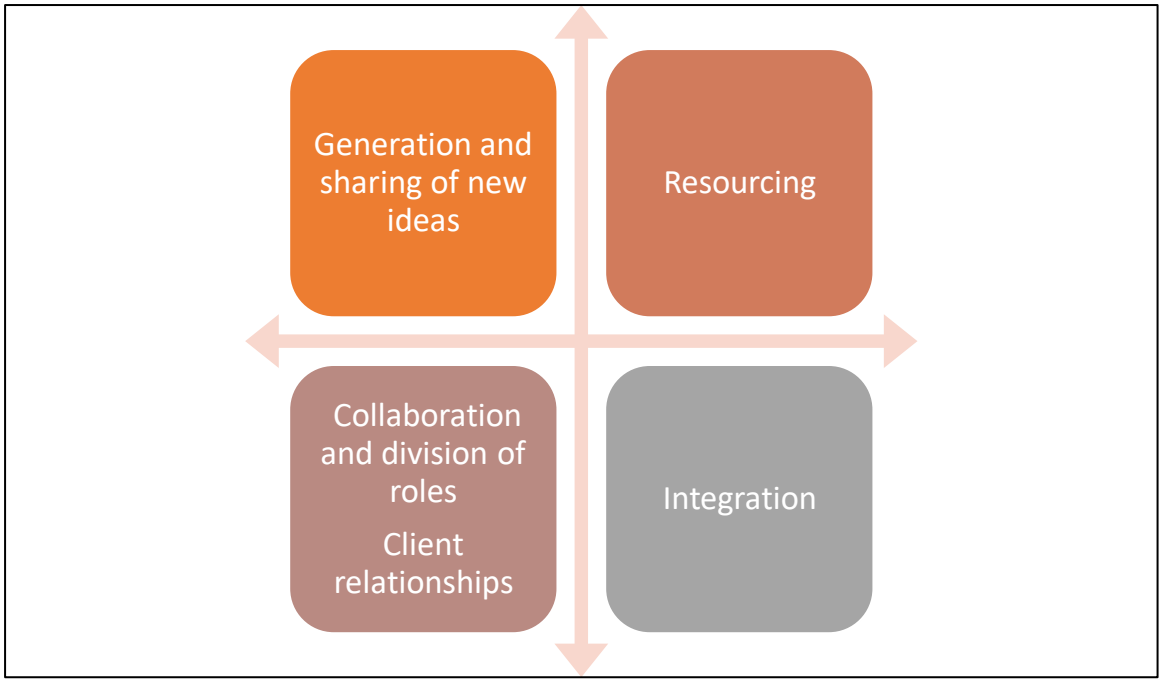
The aforementioned findings unequivocally illustrate the impact of the delivery system on infrastructure projects. Rapid service delivery and increased demand for public infrastructure have remained the same even since the introduction of the framework. The difficulty in infrastructure delivery is the ability to adapt and implement innovative reforms in complex organisational environments. According to the interviews, participants perceive compliance and execution as hindrances rather enablers ,even with an existing infrastructure delivery framework. Kessides (2004) asserts that the optimal design of delivery systems should

prioritise the maximisation of value, implementation of rigorous risk management and contracting strategies, and improvement of procurement processes. While the existing system requires further enhancement, it is important to consider the interdependencies among all stakeholders. A significant majority of the participants, expressed the view that conducting an IDMS review and engaging in the recruitment of built environment professionals for infrastructure departments were of utmost importance for enhancing operational effectiveness.

5.7 Theoretical contextualisation

This section presents findings pertaining to theoretical frameworks utilised in the study of systems. The discussion explores the hierarchical structure of systems and interdependence among various components within. The identification and analysis of themes pertaining to the implementation of the IDMS were derived from the examination of the collected data and its subsequent application within the realms of governance, processes, and institutional structure.

Figure 5.2.Key consideration for the delivery framework



Source: Researcher's collection

The system theory emphasises the interconnection of the value chain in the implementation of IDMS. The project team consists of many stakeholders and sub-systems referred to as project participants within the system. In order to facilitate the progress of infrastructure efforts, it is

imperative to establish linkages and take into account the interests and perspectives of both internal and external players. The management of project risks is a collective obligation shared by all stakeholders, including clients, implementing personnel, and service providers. Contrary to the intended purpose of using IDMS to establish a standardised and optimal operational framework, the outcomes have proven to be different.

Improving policy formation can be attained by promoting the exchange of ideas and fostering collaboration with experts from the industry which leads to comprehensive and well-informed policies. The assignment of suitable skills to various departments is a crucial necessity for enhancing operational effectiveness. The expeditiousness of the decision-making process is significantly influenced by the efficacy of teamwork and the formation of unambiguous role delineation. Including all relevant parties would significantly enhance performance by leveraging diverse expertise and perspectives. Considering essential factors is imperative while making modifications to the framework to ensure alignment with strategic goals and operational requirements.

5.8 Factors affecting governance

Reforms and policies are put into action to improve services, buy they can have both beneficial and detrimental effects on infrastructure projects. Infrastructure governance encompasses the range of approaches, instruments, and concepts used by governing organisations and their counterparts to deliver infrastructure services to the general public and the government. It involves coordinating different tiers of government, the establishment of regulatory structures, and the capacity to uphold the long-term sustainability of infrastructure assets. Awuzie and Monyane (2020) state that the primary purpose of a governance framework is to effectively accomplish the strategic goals that served as the foundation for initiating the project.

The extent to which the government exercises control over the nation's infrastructure significantly influences policy matters. Alshamsi's (2019) research reveals that the stability of the government emerges as a critical factor influencing project performance and outcomes in various sectors, including the construction industry. It is the essential for policymakers to have a comprehensive understanding of the difficulties faced by various departments such as infrastructure development and public works, in order to formulate effective solutions.

Nevertheless, it is crucial to recognise that while government stability significantly impacts the execution of infrastructure projects, it is not the exclusive factor that determines their success. Project performance can be impacted by various factors, including regulatory frameworks and the organisation capability. Moreover, it is worth noting that government stability might vary across different countries and areas of economic differences. Therefore, the presence of a stable administration should be taken into account in conjunction with other variables when assessing the overall efficacy of infrastructure initiatives.

The extant literature examines the difficulties encountered in implementing delivery reforms and the relationship between service delivery and infrastructure provision. Watermeyer and Phillips (2020), emphasize that inadequate governance, ineffective procurement and delivery management practises, both of which are under the jurisdiction of the government, are primary factors that contribute to project failure or unfavourable project outcomes. The contention put up by the Ntiyakunze (2011) in examining governance found that insufficient governance structures and occurrences of corruption have the potential to hinder the successful execution of infrastructure projects. Research on infrastructure governance indicates that this field is still in its nascent phase of advancement. Yilema and Gianoli (2018) argue that there has been a shift in the development of infrastructure systems, moving from isolated structures to interconnected systems. This change has resulted in greater complexity and interaction within infrastructure networks. Additionally, the concept of governance is supported by a significant growth in institutions and a greater flexibility in organisational frameworks. Consequently, there is a continuous reassessment of the relationships between governmental and non-governmental entities (ibid). The authors conclude that many sectors engage in independent planning and heavily depend on bureaucratic protocols, hindering collaborative planning and execution.

Governance in the IDMS chain pertains to the set of policies, procedures, and decision-making processes that provide guidance for project implementation. Infrastructure governance requires numerous essential components, such as a well-defined institutional and regulatory framework, effective coordination across the different levels of government, and the ability to maintain sustainable performance for the entire lifespan of an asset. The interviews from the study indicate a notable presence of discrepancies in system implementation. Insufficient clarity in government policies hampers their execution, leading to various challenges that result in further delays to projects. The project's performance is hindered by its inability to operate

effectively as a result of the influence of the shifting political environment on regulations and industry reform. It is imperative to acquire a comprehensive understanding and conduct a thorough evaluation of the system during the initial stages of the development process.

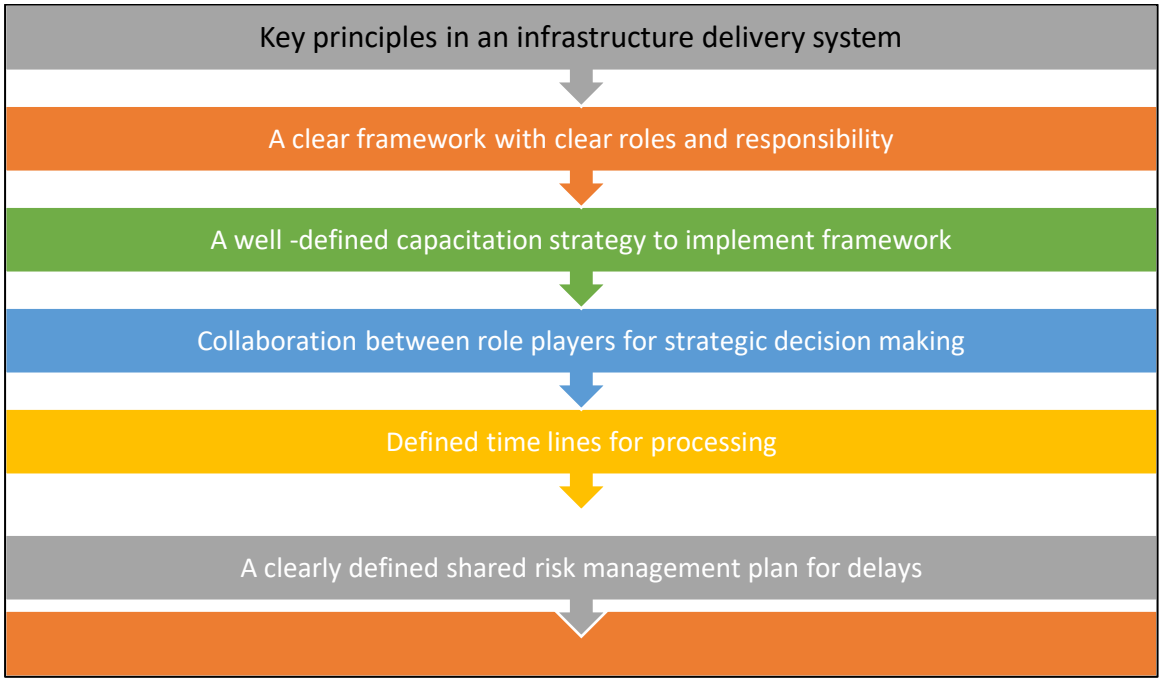
The analysis of the collected data sets revealed unveiled a substantial correlation between governance and competency, and their influence on the efficiency of the delivery management system. This remark further supports the need for public sector department responsible for overseeing projects in the IDMS frameworks to engage in self-assessment of their level of organisational dedication and proficiency. The influence of the political atmosphere on project performance necessitates the establishment of clear governing regulations and defined regulatory duties. Having robust governance structures, efficient processes, and effective human resource management is vital in this context. The principle should be extended to encompass all sectors of delivery that possess infrastructure. Regularly evaluating policy and improving legislation execution is crucial for leveraging industry principles and endeavours effectively.

Effective infrastructure governance includes the establishing transparent procedures for project planning, procurement, and implementation to ensure the timely completion of infrastructure projects. Furthermore, infrastructure governance frameworks frequently incorporate systems for public engagement and accountability, so guaranteeing that the demands and apprehensions of the public are duly acknowledged and addressed throughout the decision-making process. The establishment of robust infrastructure governance is necessary to guarantee the successful execution of infrastructure initiatives and the optimal allocation of resources, ensuring efficient project management and resource utilization. The implementation of this approach facilitates enhanced lucidity, uniformity, and responsibility within decision-making procedures, hence mitigating potential delays and optimising the achievements of project objectives.

The presence of numerous obstacles encountered during the project can potentially result in delays in the implementation of infrastructure development, particularly in cases where a clarification of government guidelines is required. Hence, one could posit that the establishment of a stable government is vital in fostering a conducive milieu for economic advancement and development. A considerable proportion of respondents indicated that the projects are impacted by various issues, including legislation and the efficacy of governance. Based on the perspectives shared by the interviewees, it is evident that government policy plays

a significant role as a political factor. The significant importance lies in the interdependencies across different components, resources, and processes within the infrastructure delivery chain. The study has determined that the existence of a clearly defined framework is essential for efficient implementing projects. There is a significant and pressing need for increased efficiency within the public sector. The existing system should be enhanced to adequately handle and satisfy the demands of infrastructure processes. The system should consider the proposed requirements outlined in Figure 5.3.

Figure 5.3. Key principles for an effective delivery system



Source: Researcher's collection

In summary, the governmental influence on infrastructure bears substantial implications for political matters. The successful execution of infrastructure projects and the efficient allocation of resources necessitate the presence of a stable administration and good infrastructure governance. By acknowledging the significance of governmental stability and establishing well-defined regulating regulations, the public sector has the potential to augment the efficiency and efficacy of infrastructure procedures. Policymakers need to possess thorough comprehension of the issues encountered by various departments and devise efficacious solutions to foster economic growth and advancement.

5.9 Factors affecting the process

Process optimisation is accomplished by implementing standards that streamline operations and by considering the interconnections within the system. This fosters a comprehensive understanding of how diverse inputs and outputs interact synergistically. The implementation of IDMS by the institution holds significant relevance. An organisation that is well prepared for implementation will exhibit a proactive stance and demonstrate the capacity to efficiently oversee and uphold its operations and maintenance protocols. Moreover, it will demonstrate expertise in portfolio management, programme management, and project management. Proficiency in all three domains holds significance as it facilitates the assurance of effective portfolio management, which entails the appropriate selection and alignment of projects with organisational objectives. Additionally, programme management plays a crucial role in coordinating and integrating projects to maximise their benefits. Lastly, project management ensures the successful execution of individual projects within the program.

Organisations that dedicate a significant amount of time and resources to improving their project management procedures and developing their project management capabilities are more likely to accomplish effective project implementation as highlighted by a study conducted by Alshamsi (2019). The achievement was ascribed to the organisation's allocation of resources towards staff training, implementation of standardised project management procedures, and enhancement of interdepartmental collaboration. The effective implementation of an appropriate and efficient process is undeniably indicative of an organisation's success. The findings of this study have highlighted the imperative of fostering increased interdepartmental collaboration. Enhanced interdepartmental collaboration can boost the efficiency of IDMS implementation through the facilitation of improved communication, resource sharing, and coordination of activities.

Collaboration among players in the public sector, such as government agencies, regulatory organisations, and infrastructure providers, has the potential to yield numerous advantages in the realm of infrastructure delivery. Primarily, pooling resources and skills fosters a unified and comprehensive approach to decision-making, leading to improved project outcomes. Moreover, collaboration facilitates the dissemination of optimal strategies and valuable insights, allowing stakeholders to gain knowledge from both successful and unsuccessful experiences. Ultimately, the act of collaborating has the potential to optimise the decision-making procedure and mitigate bureaucratic hurdles, so enhancing the efficiency and

punctuality of infrastructure delivery. Continuous process evolution is vital as it hinges on the critical role for effective process enhancement.

The successful implementation of process enhancement relies heavily on the importance of effective communication. Prior to commencing project implementation, meticulous consideration of proficient communication strategy is essential. Achieving this goal is possible through the utilisation of interdepartmental communication channels for effective information exchange. By effectively using suitable communication channels, stakeholders can grasp the nuances of system modifications and adaptations, understanding the reasons behind utilizing various system iterations in different departments. This practise guarantees that all parties involved share a common understanding and are able to actively engage in the procedure, resulting in enhanced cooperation, effectiveness, and eventually, superior project results. The aforementioned aspect exerts a substantial impact on the delivery network.

The system considers interactions among its users. The project and its stakeholders are considered a sub-system. The interconnections among the stakeholders form a system and this system, in turn, is part of a supra-system. Implementing suitable controls throughout the delivery chain reduces the frequency of delivery delays. The ramifications of delivery delays might be substantial in the context of infrastructure projects. These factors can lead to higher expenses, failure to meet project timelines, and reduced satisfaction among stakeholders. Moreover, delays have the potential to disrupt the overall workflow and coordination across various infrastructure units, leading to increased errors, communication breakdowns and resource misallocation. The implementation of appropriate controls at every stage of the delivery chain is necessary in order to ensure efficient distribution and approval procedures, hence reducing the likelihood of delays and mitigating their adverse consequences. Developing a comprehensive tracking plan that encompasses the entirety of the project is of utmost importance for ensuring transparency, accountability, and prompt detection of any deviations or difficulties.

Effective leadership plays a crucial role in monitoring the workflow within infrastructure units. By employing effective leadership, management can proactively identify and address risks in advance, preventing any detrimental effects on the project. This entails vigilant monitoring of progress for each stage, ensuring optimal task execution, and promptly resolving any bottlenecks or issues that may impede the project's timeline. Maintaining a strong oversight

and offering proactive guidance to the project team directly increases the likelihood of project success, ensuring timely completion. Implementing control management is critical for ensuring the timely and satisfactory fulfillment of approvals by optimizing processes, reducing errors, and adhering to regulatory standards. Efficient leadership can facilitate The monitoring of workflow in infrastructure units. As a result , the probability of project success increases significantly, as senior management possess the ability to mitigate risks prior to their potential negative impact.

Masters (2019) found that inadequate training, competence, and capability within public sector teams impede the ineffectiveness in implementing reforms and providing public services. For project team members to effectively utilise the delivery management system for infrastructure projects, acquiring sufficient training is essential. The inclusion of training in the strategic development plan is recommended, along with the suggestion that departments construct dedicated training facilities for service providers and officials involved in infrastructure delivery. The training procedure can be improved by collaborating with built environment councils. This could lead to enhanced expertise among the project team members, leading to better utilisation of the delivery management system and ultimately, more streamlined project delivery process.

5.10 Factors affecting the institutional structure

The capacity of an entity is shaped by the broader institutional structure and the availability of resources. The institutional structure is connected to governance systems, organisational policies, decision-making processes, and resource allocation mechanisms. These aspects of the institutional structure can influence the availability of resources, the level of support for technical skills development, and the overall capacity of an entity. In a study by Ntliziywana. (2017) on the issues of infrastructure provision, it was found that there is a substantial requirement for enhanced capacity. Nugget (2020),asserts that the shortage of skills in the construction industry in South Africa poses considerable difficulties for government departments as these skills are essential for the efficient implementation of infrastructure initiatives and projects. Conversely, an organisation with a decentralised decision-making process may have greater flexibility in allocating resources to develop technical skills, while an organisation with a rigid hierarchical structure may face challenges in adapting to changing needs and acquiring new knowledge. Kibuuka and Fourie (2016) propose that African

governments should regularly assess skills needs to proficiently address human resource capacity demands and facilitate the smooth implementation of projects at all stages. These skills assessments are crucial because they help identify any gaps in the existing workforce and determine the specific skills and expertise required for successful infrastructure project implementation. By conducting these assessments, governments can then take proactive measures to recruit and train the necessary personnel, ensuring effective and efficient project implementation. Implementing this approach can help avoid delays, minimize errors, and enhance the overall quality of infrastructure projects.

Assessing and organisation's technical skills capacity is critical to guarantee the successful implementation of infrastructure projects. Efficiently achieving targeted goals requires users to possess a profound comprehension of intricate systems. Organisations face challenges in developing technical skills capacity due to various factors. Having a strong foundation in technical skills and a comprehensive understanding of the many processes involved are essential factors. Successful IDMS implementation is contingent upon the availability of competent personnel possessing the requisite skills and knowledge. The ability to comprehend and assess information and processes is of paramount significance. Establishing precise criteria that can function as a reference point for selecting service providers in projects who possess expertise and proficiency in IDMS implementation ensures the quality and efficiency of project outcomes. This enhancement will not only improve the selection of the best service suppliers but also address process related issues through their understanding of the systems.

When establishing precise criteria for selecting service providers, it is important to consider factors such as their experience in implementing similar projects, their track record of delivering high-quality results, their ability to collaborate effectively with other stakeholders, and their capacity to adapt to changing project requirements. Criteria for technical skills and knowledge may encompass specific certifications or qualifications in relevant areas, demonstrated expertise in specific tools or technologies, and a strong understanding of the departmental systems and processes. By defining these criteria and including them in the selection process, organisations can ensure that they choose service providers who are best equipped to address any process-related issues and contribute to the successful implementation of IDMS.

5.11 Summary

Although the infrastructure delivery management system framework has been in place for a while and has been revised multiple times, users still require guidance on procedures and operational methods. The study indicates the departments do not have enough capacity to effectively carry out projects using IDMS. The allocation of resources, in accordance with the established framework, posed a difficulty for the respective organisations . All the departments in the case have acknowledged that they are facing internal challenges in fully adhering to IDMS due to insufficient resources. Delays frequently occur during the decision-making process, primarily because stakeholders struggle to make timely decisions. The lack of sufficient training in using the framework makes it difficult to manage construction projects, as it has a negative impact on the entire chain of business activities. The absence of proper training has resulted in varying interpretations and methods towards projects.

The study emphasizes the importance of improving service delivery , particularly in relation to the provision of infrastructure. The complexity of infrastructure presents challenges, which require heightened governmental interventions to guarantee that organisations possess the requisite resources for effective implementation. Government involvement in project creation and enforcement is of considerable importance, requiring the implementation of resilient and adaptable processes. The study revealed that lofty targets in delivering infrastructure are often set without the comprehensive pilot testing, training and evaluation of new advancement. The report highlights the government's responsibility to ensure organisations have the requisite resources to efficiently deploy infrastructure delivery systems. Coordinating stakeholders, increasing institutional capacity, and establishing rigorous governance mechanism can improve complex infrastructure systems.

Chapter 6: Conclusions and recommendations

6.1 Introduction

This section represents the concluding portion of the thesis. This chapter presents an outline of the conclusions derived from the investigation on infrastructure delivery management system. The validation process has confirmed the originality and contribution of the research. The subsequent section outlines the limitations of the study. The chapter additionally present prospective directions for future research on enhancing infrastructure delivery efficiency.

At present, numerous infrastructure delivery systems in the public sector are plagued by inefficiencies, delays, and cost overruns. This phenomenon not only impedes the prompt delivery of crucial services to the general population but also imposes substantial financial strains on governmental entities. Moreover, the presence of disparities and the absence of uniformity in infrastructure policies and practises throughout various jurisdictions pose challenges in extracting valuable insights from effective strategies and impede the recognition of optimal methodologies. Uniform provision of infrastructure is essential regardless of the underlying delivery system. The effectiveness of the infrastructure delivery system is crucial in enhancing public sector performance.

The study investigated the effectiveness of a delivery management system aimed at enhancing efficiency within the public sector infrastructure. The infrastructure delivery management system utilised by the public sector infrastructure departments is the focus of the empirical data acquired for the study. The system plays a vital role in supporting infrastructure departments by streamlining project planning, resource allocation and stakeholder coordination for successful project execution. Through a comprehensive analysis of the system's strengths and shortcomings, it becomes possible to discern specific areas that require development. This knowledge empowers the public sector to make educated choices aimed at optimising infrastructure delivery in subsequent endeavours.

The study conducted a comprehensive review of available academic literature on infrastructure provision and identified a notable gap in research pertaining to the effectiveness of infrastructure delivery strategies. In light of this gap, the study aimed to determine the key principles that contribute to the successful implementation of infrastructure delivery systems.

This research employed systems theory to elucidate the elements and interrelationships within the delivery system among different units operating in the project environment. The theory also assisted to explore the interconnectivity of multiple components within the framework, including processes, institutional structure, governance, and the interactions of IDMS with the infrastructural environment. The application of systems theory has been instrumental in the identifying essential components such as efficient communication channels, streamlined decision making processes and clear accountability structures needed for the operation of a delivery system. Therefore, the concepts and principles related to system theory have enabled the advancement of a systematic approach utilised for the analysis of infrastructure delivery systems. The theory holds significant importance as it has provided a conceptual framework for the application of several flexible and widely accepted cognitive approaches in comprehending the dynamics within both the internal and external components of organisations. As a result, it facilitated a comprehensive understanding of the subject matter.

The research examined case studies of different departments involved in infrastructure delivery. The qualitative data collection process involved conducting in-depth interviews with key stakeholders and experts in the field of infrastructure delivery management systems. These interviews were designed to gather rich and nuanced information on the topic, allowing for a deeper understanding of the factors that contribute to the success or failure of delivery systems. The interviews were semi-structured, allowing for flexibility in exploring relevant topics while still ensuring consistency across participants. The purpose of these interviews was to acquire information pertaining to the subject matter of IDMS, as supported by the extant body literature. The data obtained from the interviews was subsequently subjected to analysis in order to detect recurring patterns that shed light on the various aspects that impact the effectiveness of infrastructure delivery systems. This comprehensive approach facilitated a deeper understanding of the topic and provided valuable insights for future research and policy development in the field of infrastructure delivery.

6.2 Main conclusion

Infrastructure projects can exhibit varying structural characteristics, that enable the successful management of social and economic requirements and considerations. Furthermore, by providing targeted support and resources, infrastructure projects can empower marginalized sectors economically. The findings indicate a correlation and interdependence among various

components in infrastructure system, and addressing these aspects would enhance the system. The study's findings suggest that robust governance structures and transparent regulatory frameworks are vital for improving the efficiency and effectiveness of infrastructure delivery systems. Research indicates that alignment between governance, institutional structure and process, as well as the utilisation of precise and timely data, leads to project outcomes and stakeholder satisfaction.

The study's main objectives have been met, which were :

- To identify the triggers for IDMS introduction.
- Evaluate the understanding and operation of the IDMS model in the public sector.
- Investigate the constraints experienced in the implementation of IDMS in the country.
- Assay human capacity deficiencies inhibiting effective administration of the IDMS model.
- Concatenate IDMS activities in achieving its intended purpose thus far, facilitating public sector infrastructure service delivery.

1. The first objective sought to establish the triggers of the infrastructure delivery management system. In South Africa, the implementation of public sector infrastructure projects was characterized by delays, excessive costs , and a lack of uniformity. Throughout history, the government has implemented several reforms to aimed at enhancing infrastructure development. The persisting delays and backlogs in infrastructure necessitated a reform change. The introduction of infrastructure delivery management system aimed to tackle various difficulties in infrastructure delivery including inefficient project management, inadequate capacity, organisational non-performance and inconsistent implementation processes. The deficiencies required the use of IDMS to tackle these problems and enhance the overall execution of infrastructure projects. The identification of these triggers is based through an analysis of infrastructure delivery systems and interviews.

2. The second objective aimed to understand how the model operates and its connection to the environment. Infrastructure implementation exerts a substantial impact on public sector efforts. The infrastructure delivery chain involves a diverse range of

stakeholders, such as government agencies, contractors, professional service providers and regulatory bodies both internal and external entities. Internal stakeholders are accountable for initiating and overseeing the project, making decisions, and providing permissions at various stages. External stakeholders provide input, feedback, and approvals, and may also be involved in monitoring and analysing the project's impact on the community and environment. Every participant in the delivery process possesses a distinct array of duties. The implementing agents in the delivery management chain are responsible for tasks such as project planning, cost estimation, procurement, project execution, and operation and maintenance. It is essential for them to ensure timely execution of all project components. Projects implemented within the framework of IDMS, undergo gate controls throughout the course of their delivery activities. Gate controls serve as crucial checkpoints to verify project compliance with predefines before proceeding to next stage. Observations were conducted to comprehend the entire value chain of operationalising IDMS. During the observations, it was found that the model's operation is influenced by factors such as environmental regulations, institutional structure and delivery process. Failure to address any aspect of the delivery chain, such as project planning, cost estimating, procurement, or operation and maintenance, can have substantial repercussions on the success of the project. Finally, insufficient operation and maintenance can result in the deterioration of infrastructure, a drop in service quality, and a rise in long-term expenditures. Thus, every function inside the delivery chain has a vital part in guaranteeing the triumph and durability of infrastructure projects.

3. The third objective was to identify constraints in the current implementation of infrastructure delivery management. Despite the system's introduction and subsequent modifications, users still demand clarity on procedures and operational approaches. The frequent changes have caused instability in the delivery of the project environment. The study revealed specific constraints including inadequate training, prolonged decision making for infrastructure projects, delays in obtaining necessary permits and approvals, and scarcity of skilled labour, all of which significantly impeded the effective delivery of infrastructure projects. Interviewees have highlighted specific instances where the government's performance in providing infrastructure services was deemed unsatisfactory since the implementation of IDMS. This includes the urgency for

infrastructure projects to be completed more promptly, due to the increasing demand for timely delivery.

4. The fourth objective was to assess the human capacity deficiencies that affect the effectiveness of the delivery system. Project coordination in operationalising the IDMS model involves ensuring effective communication between departments, coordinating resource allocation, monitoring project progress, resolving issues, and facilitating collaboration with support units. The responsibility of project coordination is often delegated to the divisions specialising in project management, which involves facilitating communication with both internal and external support units. The departments are required to realign their organisational procedures and consistently enhance their ability to adapt to the changes resulting from the evolution of IDMS. The study revealed deficiencies in the infrastructure value chain, such as inadequacies in policy development, planning, execution of infrastructure projects, and the required resources. These deficiencies further hampered delivery system's effectiveness. All the case departments indicated that they have internal struggles to full comply with IDMS due to a lack of resources. Similarly, the service providers also lack the necessary personnel to meet these requirements. Based on the findings from the interviews, it is evident that the various departments are in need of additional human resources in order to effectively align themselves with the appropriate delivery framework.

5. The fifth objective was to concatenate the IDMS activities that lead to infrastructure provision. These activities encompass various stages such as project initiation, feasibility studies, portfolio management, site selection, land acquisition, design, engineering, procurement of materials and equipment, construction, installation, commissioning, handover, programme and project management, and operation and maintenance. Each of these activities includes specific tasks and processes that are essential for successful provision of infrastructure. Analysing the collected data revealed a strong correlation between governance, competency, and their influence on the effectiveness of the delivery management system. Managing the impact of the political environment on project performance requires the implementation of explicit governing regulations and well-defined regulatory responsibilities. It is crucial to have strong governance structures, streamlined processes, and efficient human resource management in this particular situation. The interconnectedness of various elements,

resources, and procedures within the infrastructure delivery sequence is of utmost significance. Process optimization is achieved by the implementation of standards that simplify processes and by taking into account the interconnections within the system. This promotes a thorough comprehension of how various inputs and outputs interact in a synergistic manner. An organisation that is adequately prepared for implementation will show a proactive attitude and display the ability to effectively supervise and maintain its operations and maintenance routines. Furthermore, it will showcase proficiency in portfolio management, programme management, and project management. Having proficiency in all three domains is important because it ensures the proper management of a portfolio. This involves selecting and aligning projects with the objectives of the organisation. Furthermore, programme management is essential in the coordination and integration of initiatives to optimize their advantages. Finally, project management guarantees the effective implementation of specific projects within the program.

Improvement efforts in the public sector seeks various ways to improve efficiency in the delivery of services. To enhance infrastructure delivery, governments should undertake measures beyond mere streamlining of processes and focus on identifying a suitable implementation strategy that aligns with the governance and institutional structure. To realise the maximum potential of infrastructure service improvements, governments must also reform the enabling legal, regulatory, legislative, and organisational structure. Enhanced strategies for delivering essential infrastructure services must adapt with changing environments to ensure project success. Government programs that are not effective ultimately exacerbate the conditions and circumstances experienced by the population. Unless a better infrastructure delivery model is developed, the status quo will persist and conditions may worsen. Reliable, comparable data on the performance of programs drives a feedback loop that allows for ongoing improvement. The dissemination of these insights and the identification of areas that require further attention might facilitate policymakers in making more informed and effective decisions.

The following conclusions were reached:

- The findings indicate the necessity of reviewing and modifying the framework in accordance with the fundamental principle presented to improve implementation.

- The alignment of the framework with professional bodies in the built environment is essential, and effective coordination among stakeholders is of utmost importance.
- Governments ought to establish collaborative platforms that engage both users and construction industry professionals/experts to assess the existing system, foster the sharing of knowledge, and develop strategies to address challenges leading to more informed decision making and effective solutions.
- Integrating review committees into the system is recommended to improve the process of decision-making by ensuring diverse perspectives are considered, leading to more thorough and well informed decisions.
- Transparency and accountability must be prioritized in the governance of infrastructure delivery to build trust, ensure responsible use of resources, and enhance public confidence in project outcomes.
- To effectively apply the framework, it is imperative to ensure strict adherence and compliance to the established governance structures, ensuring consistency, accountability and effective decision making processes.
- Addressing the matter of insufficient institutional structures requires careful consideration and remediation to enhance coordination, efficiency and quality in infrastructure projects.
- Governments should develop institutions that possess the requisite skills to effectively execute and implement infrastructure plans.
- Government departments should be provided with the necessary resources in order to effectively implement system modifications.
- The modifications presented are anticipated to enhance the effectiveness of the system, and improve delivery of infrastructure projects. Improving governance efficiency, augmenting the capacity of the state, streamlining processes, and prioritising service delivery are essential for a stronger foundation in integrated delivery of infrastructure.

6.3 Recommendations

The project management process is distinguished by its dynamic nature and the effective utilization of appropriate resources within the departments. Enhancing value throughout the project lifecycle can be achieved by implementing key modifications in the delivery system. The steps involved in this process encompass:

- completing a comprehensive examination of the system

- making revisions to the current framework,
- developing the required capacity and competence,
- and adopting processes that align with established compliance standards.

Improving the accessibility of services and infrastructure can lead to tangible benefits for society and promote economic advancement. The limited capacity of government agencies to efficiently deliver infrastructure and related services can be attributed, in part, to the hurdles such as those that impede the successful deployment of IDMS.

The focus area in advancing the framework are:

- Governance

The complexity of governance in infrastructure projects is increasing, with politicians and regulators facing various challenges. Policymakers play a crucial role in promoting system installation and usage, constructing a leadership hierarchy to advocate for necessary modifications and enforce system adherence. Efficient governance is essential for improving governmental practices and achieving national objectives, as system deployment effectiveness relies on effective policy measures and shared responsibility frameworks.

Transparency is necessary for the successful adoption of upgrades that involve technological improvements to basic operational protocols. The establishment of a comprehensive governance structure plays a pivotal role in fostering transparency and accountability among various stakeholders. The delivery model facilitates comprehension of the many stages of infrastructure projects, with the goal of achieving a harmonious balance between task execution, industry stakeholders, and professional service providers. Utilizing this framework is vital for efficiently executing and achieving desired outcomes.

Collaborative involvement with industry professionals is crucial for a balanced approach, fostering stakeholder ownership and commitment. The framework will be subject to further adjustment in order to enhance the efficiency of the delivery plan. Prioritizing collaboration among government entities promotes coordination and aligns policies with industry norms. The active engagement of professionals from the construction sector contributes to improved decision-making processes, hence facilitating the successful implementation of infrastructure projects.

The optimisation of a resilient delivery system requires a balance between technical proficiency and political factors, enhancing collaborative decision-making. Collaboration among multiple sectors and infrastructure groups is crucial for system development and implementation. Despite passing evaluations without user feedback, the system has not yet demonstrated effectiveness. A condition of equilibrium considering stakeholder interests is essential for renewal and transformation, fostering a culture that encourages risk-taking and transformation while maintaining high quality standards.

Establishing a review committee at the national level be established, comprising experts from the building sector and infrastructure officials, is essential for thorough analysis and effective policy formulation. The primary objective of this group would be to conduct frequent analyses of gaps, monitor challenges, and formulate policies accordingly. The inclusion of stakeholders in the decision-making process has the potential to enhance the performance and efficacy of a system. Effective collaboration and communication play a pivotal role in ensuring the successful implementation of infrastructure delivery alternatives. The result will be a comprehensive framework for effectively implementing and executing a delivery strategy.

- Process

The delivery of infrastructure services encompasses all levels of government and stakeholders, yet, an isolated delivery method can impede effectiveness. To effectively address service demands, organisations must establish and equip themselves to supply crucial services with increased frequency. The efficient coordination of governmental activities is of paramount importance in contexts characterised by fragmentation. Clear delineation of roles between clients and implementing agents is of utmost importance, as it ensures effective execution of tasks. Additionally, it is imperative to frequently engage in decision-making processes to maintain efficiency and productivity. Furthermore, it is imperative that the implementation of decision-making procedures takes place at consistent time intervals.

In order to achieve success, it is imperative that project decisions are substantiated by robust evidence. Enhancing the effectiveness of the delivery system can be achieved through enhancing cooperation and establishing clearer delineation of duties. Government agencies are required to engage in the coordination and synchronisation of their activities across different levels, encompassing strategic policy coordination as well as operational cooperation.

Enhancing coordination and clarifying role delineation are key factors that can enhance the effectiveness of the delivery system. The attainment of national objectives is contingent upon the successful implementation of defined institutional protocols at several levels of governance, encompassing local, regional, and federal spheres. The establishment and maintenance of connections between internal and external entities is crucial for enhancing institutional performance. This approach guarantees the effective functioning of the distribution system.

The systems theory approach highlights the significance of linkages in determining the success of a system. The effective coordination of government activities is hindered when there is a fragmentation of the organisational structure. The successful implementation of an infrastructure protocol necessitates the establishment of coherent process links and well-defined timelines. Strategic decision-making encompasses the process of conducting stakeholder review sessions to aim for consensus. The successful implementation of infrastructure projects relies heavily on the efficient reorganisation and optimisation of activities by institutions. This technique facilitates the resolution of difficulties pertaining to the coordination of government activities and the attainment of consensus.

- Institutional structure

The implementation of IDMS signifies a necessity for the government to enhance its capability in effectively delivering public services. The implementation of a comprehensive resource allocation strategy is of utmost importance, given the specific demands of the delivery system. Securing sufficient financial resources for a clearly defined organisational structure is crucial for developing institutional capacity and attaining targeted goals. The prioritisation of technical staff competencies and the deployment of resources in an appropriate manner are of utmost importance in order to attain national objectives and enhance organisational effectiveness.

The presence of a proficient management team is crucial for the efficient oversight of infrastructure projects. The acquisition of highly skilled personnel within the public sector is essential for effectively executing diverse tasks throughout the duration of infrastructure projects. It is imperative for governments to acquire technical competence in order to efficiently execute and advance infrastructure projects. One potential strategy for improving service provider capacities is the implementation of an iterative approach. This method involves a cyclical process of continuous improvement, where feedback and lessons learned

are used to refine and enhance service delivery. Additionally, training sessions can be developed to particularly target the utilisation of the toolkit, ensuring that service providers are equipped with the necessary skills and knowledge to effectively utilise the resources provided.

6.4 Contribution to the body of knowledge

One of the most significant obstacles encountered by the public sector pertains to the provision of services and infrastructure. The political landscape consistently garners significant attention, whereas the various elements influencing infrastructure delivery, particularly the pre-existing delivery systems often remain overlooked. Previous research on infrastructure provision has primarily focused on aspects such as funding mechanisms, project management, and stakeholder engagement. However, there is a significant research gap in understanding the effectiveness of infrastructure delivery strategies. This study addresses this gap by offering valuable insights and recommendations to enhance infrastructure delivery in the public sector.

- The concepts and principles of system theory have facilitated the principle of a systematic approach used to analyse infrastructure delivery systems. The theory is significant as it provides a conceptual framework for the utilizing adaptable cognitive approaches, widely acknowledged for understanding the intricacies within the internal and external elements of organisations. This theory contributes to the accumulation of knowledge by bridging gaps between other theories and prompting the re-evaluation of existing theories from an entirely new viewpoint.
- The research findings aim to influence policy decisions on the performance and improvement of infrastructure delivery systems, the publication of new research, and prompting the re-evaluation and implementation of changes to vital aspects of the infrastructure delivery management system.
- The research broadens extant perspectives on infrastructure delivery methods and advances knowledge of operationally significant topics in the public sector infrastructure delivery context. The evaluation prompts careful attention to identifying flaws and anticipating approaches not yet been incorporated into the framework. Importantly its future use has the potential to significantly advance research frontiers and effectively address infrastructure shortages.

Specific knowledge advancement made by the research:

- Acknowledging limitations pertaining to the adoption of IDMS
- The research critically provides examines the comprehension of IDMS concepts
- A detailed analysis of many components and processes involved in IDMS
- The evaluation of IDMS's efficiency in delivering infrastructure
- Identifying necessary adjustments for policy development and enhancing delivery techniques

6.5 Limitations of the research

Limitations experienced in the study include the following:

- Reaching and engaging with research participants, particularly public sector officials, was challenging due to their demanding schedules and the disruptions posed by the Covid-19 pandemic. Due to remote working and pandemic restrictions interviews had to be conducted online. The limitation was addressed by conducting online interviews instead of physical interviews.
- The utilisation of Microsoft Teams encountered difficulties due to network connectivity issues in certain locations, leading to communication and collaboration obstacles between the researcher and participants. This resulted in delays in data collection and analysis. The researcher had to find locations with strong network to ensure the interviews take place.
- Frequent power outages due to loadshedding disrupted virtual meetings and productivity, making it challenging to access necessary documents or resources for the study. The researcher had to check and adjust to loadshedding schedules to ensure continuity of the research.
- Participant willingness to openly contribute and disclose information pertaining to the subject matter. The researcher had to ensure confidentially on the subject, allowing participants to share information freely.
- The scarcity of infrastructure delivery management systems literature in South Africa presents challenges for this study. The researcher relied on existing literature in different countries to juxtapose and increase knowledge development in this area.

Constraints included:

- The process of gathering data amidst the Covid-19 outbreak and the implementation of lockdown measures. The researcher followed covid 19 regulations and minimised in-person contact.
- The prevalence of loadshedding interrupted scheduled interview appointments. The scheduling of interviews was aligned with the loadshedding schedule.
- Unanticipated setbacks cut time allotted to complete the research. The constant power outages affected productivity, leading the researcher to find alternative ways to continue with work.
- The study had identified 100 participants for inclusion, allowing for a diverse sample. Only 72 participants managed to participate in the research.
- There was a lack of studies in infrastructure delivery management system within the researcher's field as the model was just piloted.
- Limited access to organisational data posed a constraint in the research process, due to privacy policies and confidentially agreements.

6.6 Future research recommendation

The findings of this investigation offer several avenues for expanding this field of study.

- Policymakers are underrepresented in the literature; it is crucial to take their perspectives into account. Future research should thus take their opinions into account to provide a more complete grasp on infrastructure delivery framework. Incorporating their perspectives in future research, can enhance the understanding of how their input influenced the design, implementation, and success of infrastructure delivery frameworks.
- The evolving nature of infrastructure delivery techniques could be explored in more detail, particularly concerning developing countries. Additional research could examine the effects of constantly changing infrastructure delivery management systems and how much that impacts service delivery. Understanding the effects of these changes on local communities and economies is crucial, as it can help identify strategies to alleviate negative impacts and foster sustainable development.

- Examining the sustainability of infrastructure delivery management systems is vital for several reasons. Understanding the factors that contribute to the sustainability of these systems enables policymakers and practitioners to make more informed decisions regarding infrastructure investments and ensure efficient resource allocation. Furthermore, research on the sustainability of infrastructure delivery management systems can help identify best practices and inform policy recommendations to promote sustainable development and address the challenges of climate change and urbanization.
- Conducting an investigation into how service providers influence the infrastructure project delivery outcomes. Service providers play a critical role in infrastructure project delivery, and studying their impact on outcomes is crucial for several reasons. Moreover, comprehending the factors that contribute to effective service delivery is crucial for identifying strategies to enhance project outcomes, stakeholder satisfaction, and the long-term sustainability of infrastructure systems. Furthermore, exploring the relationship between service providers and project delivery outcomes can lead to the development of best practices and inform policy recommendations to optimize the performance of service providers and improve the overall effectiveness of infrastructure projects.

6.7 Summary

Efficient and effective infrastructure delivery is crucial for economic growth, as it enables the movement of goods and people, supports businesses, and attracts investment. Infrastructure delivery also plays a key role in providing essential public services. By improving infrastructure delivery systems, governments can enhance the overall quality of life for their citizens. This creates a conducive environment for economic development. The study aimed to address a gap in understanding related to infrastructure delivery challenges. The primary objective is to improve infrastructure delivery by implementing a robust infrastructure delivery management system, aiming to streamline processes and improve efficiency. The study identified deficiencies in the framework implementation and proposes recommendations for organisations utilizing IDMS. The shortcomings requiring attention for successful governance include improving the governance approach, providing assistance to policy makers, enhancing capacity and training in public sector institutions, and developing efficient processes. The study illustrates the connections and interdependencies among these components as crucial for achieving efficacy in infrastructure delivery. The research explored the delivery reforms implemented in different nations. It highlighted the global issues encountered in the existing literature. Interviews played a vital role in the research. This research enhances understanding of infrastructure development. It identifies limitations in current practices, examines the effectiveness of delivery methods, and proposes necessary adjustments in policy and techniques. By addressing these challenges and implementing the recommended enhancements, governments organisations can enhance the delivery of infrastructure projects.

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Appendix A - Ethical clearance certificate

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Malete

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H20/07/20**
PROJECT TITLE	An analysis of the effectiveness of Infrastructure Delivery Management System (IDMS) in the South African Government
INVESTIGATOR(S)	Miss R Malete
SCHOOL/DEPARTMENT	Construction Economics and Management/
DATE CONSIDERED	24 July 2020
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	18 October 2023

DATE 19 October 2020 **CHAIRPERSON** _____
(Professor J Knight)

cc: Supervisor : Dr N Khatleli

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

_____ Date 19 / 10 / 2020
Signature

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix B - Data collection instrument (Interview questions)

An analysis of the effectiveness of Infrastructure Delivery Management System in South African Government

Introduction

Public entities around the world are battling with effective service delivery and have adopted different approaches to enhance and improve infrastructure delivery. In 2010 the government introduced Infrastructure Delivery Management System (IDMS) to facilitate effective, timely and sustained infrastructure development, and tackle the challenges in public sector infrastructure delivery to enhance service delivery. The study seeks to evaluate the effectiveness of IDMS through a qualitative approach and usage of documents and archives in infrastructure delivery in the public sector. The study aims to provide a useful basis for government institutions on effective and efficient infrastructure management delivery system, to achieve better public sector performance.

Interview questions (The interview will be audio recorded)

1. Are you aware of IDMS and what is your understanding of the system?
2. Tell me about the administrative process of implementing IDMS which your organisation uses to deliver infrastructure?
3. Describe the stakeholders involved through the infrastructure delivery chain and their roles?
4. As a person who have experienced IDMS what are the constraints encountered with the use of the system?
5. Does the IDMS meet all the stakeholder's infrastructure needs in your environment?
6. Is the IDMS process easy to implement and maintain.
7. Are there IDMS performance measurements in place?
8. Is IDMS meeting its objectives in infrastructure delivery?
9. What steps should be taken to improve infrastructure provision?

In closing the researcher will thank the participant.

Appendix C – Participant information sheet

An analysis of the effectiveness of Infrastructure Delivery Management System in South African Government

Dear Sir/Madam

My name is Refiloe Malete, I am a student at the University of Witwatersrand, School of construction economics and management. I am undertaking a research project to meet the Doctor of Philosophy degree requirements. The research will be carried out under the supervision of Dr. Khatleli Nthatisi.

The research project aims to evaluate the effectiveness of the Infrastructure Delivery Management System (IDMS) in the provision of public sector infrastructure in South Africa. Considering the importance of infrastructure in socio-economic growth, the purpose of this study is to gain better understanding on IDMS in order to improve service provision of public sector infrastructure and to provide an effective infrastructure solution.

You have been invited to take part in this study given your expertise in public sector infrastructure projects. Participation in the study involves sharing knowledge on the implementation of Infrastructure Delivery Management System in government. Your participation is entirely voluntary and involves an audio recorded 20 minute interview session. Please note that consent to participate is implied by you giving permission to proceed with the recording of the interview. You can withdraw at any time or refuse to answer any question without any consequences of any kind. The research is self-funded and the participant does not bear any cost.

All information provided for this study will be treated with confidentiality. The data collected will go through an analysis process and interpreted by the researcher and the recordings will be destroyed in 5years on publication of the dissertation .The data related to the research will be stored in the researcher personal computer and university libraries and the names of the participant will not be identified anywhere. The results of the research will be used for the purpose of Ph.D. degree in and might be additionally disseminated at conferences or published in peer reviewed publications. If you are interested in receiving a copy of the final report, or have any questions about the research at any point I can be contacted on details provided below.

You are entitled to expect the highest level of integrity from the researcher during the course of the study. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non - Medical ;), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely

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Refiloe Malete Date

Email: 0305268n@students.wits.ac.za

Supervisor Dr Nthatisi Khatleli, Email: Nthatisi. Khatleli @wits.ac.za

Appendix D - Permission letter

GAUTENG PROVINCE
INFRASTRUCTURE DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

University of Witwatersrand
School of Construction Economics and Management
01 Jan Smuts Avenue
Braamfontein
2000

Dear Sir/Madam

LETTER OF AUTHORISATION TO CONDUCT RESEARCH AT THE GAUTENG DEPARTMENT OF INFRASTRUCTURE DEVELOPMENT AND PROPERTY MANAGEMENT.

This letter serves as an authorisation for PhD candidate Refiloe Malete to conduct interviews at the department in line with her PhD studies in infrastructure delivery. All interviews to be done in respect of government policy, with integrity and confidentiality.

Yours sincerely

[redacted]

Act Head of Department
Gauteng Province Department of Infrastructure Delivery and Property Management
Date: 2020/6/01

Appendix E - Consent form (draft)

An analysis of the effectiveness of Infrastructure Delivery Management System in South African Government

Researcher: Refiloe Malete

Consent to take part in research

I..... voluntarily agree to participate in this research study

I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

I understand that I can withdraw permission to use data from my interview at any time, in which case the material will be deleted.

I have had the purpose and nature of the study explained to me and I have had the opportunity to ask questions about the study.

I understand that participation involves sharing knowledge on the implementation process of Infrastructure Delivery Management System I understand that I will not benefit directly from participating in this research.

I agree to my interview being audio-recorded.

I understand that all information I provide for this study will be treated confidentially.

I understand that in any report on the results of this research my identity will remain anonymous.

I understand that disguised extracts from my interview may be quoted in dissertation, conference presentation, published papers.

I understand that signed consent forms and original audio recordings will be retained by the researcher and destroyed in 5years on publication of the dissertation.

I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage by the researcher.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Signature of research participant

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Signature of participant Date

Signature of researcher

I believe the participant is giving informed consent to participate in this study

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Signature of researcher Date