Development Bank of Southern Africa Working Paper Series | **Aug 2023**

Improving Infrastructure Delivery Models

Masedi Sesele

Authorised for distribution by Zeph Nhleko

WP/2023/01

Table of Contents

List of acronyms

AfDB	African Development Bank
CIDB	Construction Industry Development Board
CoE	City of Ekurhuleni
COVID-19	Corona Virus
DBSA	Development Bank of Southern Africa
FIDPM	Framework for Infrastructure Delivery and Procurement Management
GTLM	Greater Tzaneen Local Municipality
IDD	Infrastructure Delivery Division
IDMS	Infrastructure Delivery Management System
IPIP	Infrastructure Project Implementation Plan
KfW	Kreditanstalt fur Wiederaufbau
KM	Kilometer
MoA	Memorandum of Agreement
MTREF	Medium Term Revenue and Expenditure Framework
NDP	National Development Plan
NERSA	National Energy Regulator of South Africa
OECD	Organisation for Economic Co-operation and Development
PRASA	Passenger Rail Agency of South Africa
SDGs	Sustainable Development Goals

Abstract

The two objectives of this research were to investigate challenges and improvements for infrastructure delivery models and assess the DBSA infrastructure delivery model against their key features. The study has identified the key features of infrastructure delivery models as capability and capacity, cooperation, efficiency, finance, risk, and sustainability. The findings from the assessment of the DBSA infrastructure delivery model and selected case studies have shown that through the Infrastructure Delivery Division (IDD), the DBSA delivery model has sufficient capacity and capability to efficiently deliver infrastructure that is sustainable and has positive impacts on the environment. The different stages of the DBSA delivery model adequately account for project level risks and have sufficient risk mitigation measures in place. The delivery model also allows for effective co-operation that does not only include stakeholders such as contractors and professional service providers but also the community members who have a voice in the development of the infrastructure that will ultimately serve their needs.

1. Introduction

Infrastructure is a key driver of economic growth and prosperity. It is important for the development, functioning and prosperity of a country and provides the underlying foundation for countries to thrive (Arimah, 2016). Adequate infrastructure such as proper water and sanitation, reliable and sufficient power supply, efficient transport networks and cutting-edge information and communication technology contributes to the sustainable and economic growth of countries while also promoting the competitiveness of local businesses, improving the productivity of workers, enhancing investment and mobility within the country (Arimah, 2016). Basic economic growth theory identifies different channels through which infrastructure can positively impact economic growth (Kumo, 2012) and these include infrastructure as a factor of production as well as a complement to other factors of production, infrastructure as a stimulus to aggregate demand as well as a stimulus to factor accumulation and infrastructure as a tool of industrial policy (Kumo, 2012).

However, it remains common knowledge that delivering public infrastructure is a challenging undertaking as investment in public infrastructure in South Africa has been consistently lower than the National Development Plan (NDP) target of 10 percent of gross domestic product. The NDP has also stated that gross fixed capital formation needs to reach about 30 percent of GDP by 2030 to realize a sustained impact on growth and household services. However, gross fixed capital formation in South Africa remains lower than the intended target at around 14 percent (StatsSA, 2023).

Many of the challenges regarding public infrastructure delivery can be traced back to the infrastructure delivery model chosen. Key features of the delivery model can be scrutinized against capability and capacity, cooperation, efficiency, finance, risk, and sustainability. The two objectives of this paper were to document challenges and improvements facing infrastructure delivery models using the six criteria listed above and utilise a case study approach to track the Development Bank of Southern Africa's (DBSA)

project implementation process against these criteria. The study seeks to document learnings with a view to proposing generic working processes.

2. Background

An infrastructure delivery model is about the overall process and decisions to deliver operating infrastructure. The delivery model is designed and developed during the front-end planning phase when the procuring authority defines the overall strategic objectives, shapes the governance structure, scopes the project, decides the funding options, secures the financing, and prepares the contracting, procurement, and packaging strategy (Vautibault, 2022). G20 governments and industries have shown improvements to the infrastructure delivery process by developing a delivery challenges and improvements framework. It is comprised of six themes that sum up global improvements made by governments to improve infrastructure delivery models (Global Infrastructure Hub, 2022). Some of the themes have been mentioned before in work done by the World Bank and the OECD (World Bank, 2019; OECD, 2021), however, the Global Infrastructure Hub was the first initiative to consolidate all the themes into one framework.

The first theme is capability and capacity, which focuses on improving organizational ability to adequately plan, deliver, operate, and maintain quality infrastructure. The second theme is cooperation which involves partnering with other connected parties to achieve improved shared outcomes. The third theme is efficiency, which results in optimizing delivery to maximize infrastructure outcomes. The fourth theme is finance, which entails identifying and securing funding and financing of infrastructure. The fifth theme is risk, whereby the risk in delivery is adequately planned, managed, and allocated appropriately. The final theme is sustainability, which considers the environmental sustainability impact that infrastructure can provide (Global Infrastructure Hub, 2022).

In the DBSA, the Infrastructure Delivery Division (IDD) exists to enhance the capacity of the state to plan, design, construct, maintain and manage social and economic

infrastructure. The Division is an implementing agent of excellence that augments the capacity of clients to deliver infrastructure by providing efficient and effective planning and procurement to enable accelerated project initiation and execution. The Division also provides client centric infrastructure delivery solutions through a multi-disciplinary team of professionals and technical specialists. The Division also exercises effective project controls, monitoring, and reporting in line with applicable norms and standards. The infrastructure delivery model of IDD is shown in Table 1.

Table 1 Infrastructure Delivery Division Infrastructure Delivery Model

1	2	3	4	5	6	7
Inception	**Concept & Viability**	**Design**	**Procurement**	**Execution**	**Hand-over**	**Close-out**
Project brief	Procurement of consultants	Detailed Design & Documentation	Procurement of contractors	Construction schedule	Works completion certificates	Archiving record information
Initial Visual Assessments	Signed Consultants' Agreements	Indicative construction programme	Recommendation for approval by client of tender recommendations	Progress milestone payment certificates	Certificate of final completion	Payment of final amounts
Infrastructure implementation programme plan	Recommendation for approval by client to proceed to stage 3	Procurement documentation for construction programme	Signed contractor agreements	Monthly progress reports	Final handover of facilities to the end user	Submission and approval of project close-out reports
Procurement Plan		Recommendation for approval by client to proceed to stage 4		Certificates of practical completion	Preparation of as-built drawings	
Programme Plan					Project close-out	

Source: DBSA (2022)

3. Methodology

To address the scope, the methodology followed in this study utilised two approaches. Firstly, a systematic review of existing literature with regard to infrastructure delivery models, their challenges and improvements as well as international and local examples of such improvements. Secondly, case studies have been conducted to track the DBSA infrastructure delivery process and scrutinize it against capability and capacity, cooperation, efficiency, finance, risk, and sustainability. The selected case studies are the Greater Tzaneen Medium Term Revenue and Expenditure Framework Electricity Programme, Delville Extension 9 Social Housing Project, and the Tembisa Pedestrian

Cycle Rail Underpass Bridges. These case studies were selected based on availability of data.

4. Literature review

This literature review is divided into two sections which formed the scope of this research. The first section is a documentation of different infrastructure delivery models, their definition and characteristics. The second section provides an analysis of the challenges and improvements of infrastructure delivery models. The challenges and improvements are divided into the six themes (capability and capacity, cooperation, efficiency, finance, risk, and sustainability) and the themes do not apply to one specific infrastructure delivery model, but rather to all models in some respect.

4.1 Infrastructure Delivery Models

Below are some infrastructure delivery models categorized by the functions the models deliver. These functions cover the main activities to deliver an infrastructure project, namely design, construction, operations and maintenance.

Table 2 Infrastructure Contractual Model

Infrastructure Contractual Model	Characteristics
1. Build or construct only The project owner contracts the design and construction efforts separately in a linear manner. Plans are fully developed and complete and the project is advertised for bidding by contractors bidding on the project precisely as designed.	• Traditional, well-known delivery method with a simple procurement process • Design professional protects the interests of the owner • Able to select designer and contractor independently • Linear process means a longer schedule • Design and construction teams have competing interests
2. Design and Build A single entity provides for the design and construction of the project. The owner contracts both a designer and contractor as a single team. This normally requires a design criteria package to be prepared by a separate design consultant to communicate project intent.	• Single point of responsibility for design and construction • Allows fast-track delivery with construction beginning before design is complete • Project cost determined early in the process • Design-build firm in charge of contingency
3. Public-Private Partnerships There are different types of PPP projects, of which this study will analyse three. The first one is *Design-Build-Operate-Maintain*, where the private entity finances, designs, builds and maintains the infrastructure asset. The second is *Design-Build-Finance-Maintain*, where the private entity designs, builds, finances, operates and maintains the infrastructure asset for a set term and then transfers it back to the public entity at the end of the term. The third is *Design-Build-Finance-Operate-Maintain*, where the private entity operates and maintains existing infrastructure and may be granted a concession to charge for the services provided.	• Long-term contracts • Integrated design, construction and operations and maintenance to consider a whole life approach to achieve 'value for money' • Whole life approach motivates innovation and focus on outcomes • Private finance and equity discipline to ensure correct due diligence around the possible risks and mitigations • Allows risk transfer for construction and operations and maintenance • Considerable procurement costs • Funding primarily sourced from payments from the public sector, user charges, or a mixture of both • Substantial budgetary certainty for public sector
4.Privatization The private sector acquires the public sector infrastructure asset either via a long-term lease or an outright partial or full acquisition. The private sector then undertakes all activities as an owner including expansion, upgrades, operations, and maintenance, while charging for the services provided.	• Leases over long terms, such as for 99 years • Payment made by private sector to the public sector for the lease or purchase • Risk is fully assumed by the private sector • Creates motivation for growing revenue and meeting market demand

Source: Global Infrastructure Hub (2022)

4.2 Infrastructure Delivery Models Challenges and Improvements

This study makes use of the six overarching themes below to document the challenges and improvements of infrastructure delivery models. The themes have been determined by a G20 governments initiative created to help infrastructure practitioners, policymakers and decisionmakers identify improvements for adoption prior to commencing the planning, design, and procurement of infrastructure projects. The themes do not apply to one specific infrastructure delivery model, but rather to all models in some respect. Therefore, the themes are not applied specifically to the contractual models in Table 2, but rather offer general challenges and improvements that can present themselves in all models.

4.2.1 Capability and Capacity

4.2.1.1 Challenges

A challenge facing delivery models regarding their capacity to deliver infrastructure is the limited delivery capability of some government agencies, due to a lack of engineering and project management skills which affects the planning and delivery of infrastructure (Chigangacha, et al., 2021). The limited amount of personnel with vast experience in the implementation of complex projects has a negative effect on the capacity to deliver the infrastructure. This has been evident in South Africa as there are low percentages of major construction occupations in the sector that are filled. There are only 10 percent of managers and 8 percent of professionals, and in a developing country like South Africa, there should be a larger number of these categories of professionals for better performance of the construction sector (Oke, et al., 2018).

There is also limited workforce diversity in infrastructure as the industry is unable to fully capitalise on its pool of potential resources such as women and youth participating in order to increase industry capacity (Madikizela & Michell, 2022). Without a diverse leadership and workforce, innovation in the South African construction sector is hindered

and slowed, resulting in a weakened ability to respond to a fast paced and technologically driven market (Madikizela & Michell, 2022). The inconsistent approaches to project appraisal, procurement selections, financing strategies and contracting does pose a challenge to infrastructure delivery as it can create an unstructured decision-making framework and process which will undermine public sector capacity and capability in infrastructure projects (Taliercio & Estrada, 2020).

4.2.1.2 Improvements

Improvements on the above challenges include the establishment of dedicated delivery authorities with specialized project delivery skills (AfDB, 2015). The authority will be able to recruit highly competent individuals with the necessary skills to carry out the delivery such as the Water and Sanitation Corporation Authority in Rwanda, which was responsible for the Kigali Bulk Water Supply project (AfDB, 2015). There is also project leadership training implemented to build critical infrastructure delivery skills such as the Major Projects Leadership Academy by the Infrastructure and Projects Authority and Oxford Business School in the United Kingdom. This involved the development of leadership skills and expertise for infrastructure projects in the United Kingdom (University Of Oxford, 2015).

Improvements also include the use of project preparation facilities, which provide financial and technical support to developing economies (Taliercio & Estrada, 2020). This allows them to obtain support in their early-stage project preparation. There have also been efforts to increase capacity through the use of delivery models which involve the private sector for its management expertise, either as an implementing agent for the client or a delivery partner. This was evident in the Maputo Port project which involved private sector participation in the design, construction and maintenance of the port (Farlam, 2005).

In terms of diversity, the development of procurement guidelines with specific mandates to meet the targets of women, youth and people with disabilities participation in government infrastructure projects have improved diversity in infrastructure. This was evident in the Mi Teleferico Cable Car Project in Bolivia which established a program to

train the youth by having the participation of 886 graduates between 2014 to 2018. The project also had a workforce which included people with disabilities, women and low-income groups (Global Infrastructure Hub, 2012). In South Africa, the National Home Builders Registration Council (NHBRC) developed a women empowerment programme to enhance leadership potential and boost business skills for women in the construction sector (Matshediso, 2023).

Regarding inconsistent project appraisal and procurement selections, an improvement has been through the establishment of a well-functioning infrastructure investment decision framework which features a multi-stage process that progressively moves to more detailed assessments of options and models. This was evident in the United Kingdom which developed the Infrastructure and Projects Authority Gateway Process. It made use of independent experts to analyse the scope, benefits, cost, risk, procurement, contracting and financing of projects to ensure better success (UK Government, 2021).

4.2.2 Cooperation

4.2.2.1 Challenges

A challenge facing delivery models, in terms of their cooperative abilities towards infrastructure delivery is the poor early planning and consultation. One consequence is an inadequately scoped project and the possibility of choosing the wrong delivery model that is unable to deal with the scope, schedule, and budget risks (Lunay, 2023). Another challenge associated with delivery models is the lack of cohesion and co-operation between clients and contractors, which can lead to issues associated with the scope, cost, and schedules.

4.2.2.2 Improvements

To address the above challenges, an improvement would be to perform early consultation with potential contractors, consultants, and suppliers to inform the scope of the intended work. This will properly shape the procurement approach to account for capacity,

capability, and risk profile (Laudy, 2021). The Sydney Metro Northwest – operations, trains, and systems public-private partnership in Australia, is an example, as part of the early planning involved market engagement, which included industry briefings and obtained market feedback. This allowed the project to be properly configured as industry recommendations were incorporated resulting in a better-informed procurement process (Pacific Partnerships, 2014).

In South Africa, the Department of Tourism in collaboration with the Limpopo Economic Development, Environment and Tourism Department hosted community engagements to discuss the progress related to the infrastructure projects being built to drive tourism to the Kruger National Park's Shangoni Gate and the surrounding communities (Department of Tourism, 2023). Such engagements allow for proper scoping of infrastructure projects by identifying the needs of the communities that will make use of the infrastructure asset.

Another approach to improving infrastructure delivery models with regards to cooperation is the implementation of a co-design methodology to infrastructure design. This type of approach allows for the local communities to develop design solutions that meet their expectations through a participatory design process with the project design team. This was evident in the Our Tampines Hub project in Singapore, which was a community-based development project that made use of participatory designs which involved residents and public sector stakeholders to create an inclusive community and lifestyle hub serving more than 250,000 residents (People's Association, 2022).

The construction of the Mapungubwe Interpretation Center in South Africa showed evidence of community participation in the design of the center. The construction of the center was initiated when local communities requested the return of the remains and artefacts removed from Mapungubwe Hill in the 1930s. The South African National Parks then launched a competition for the design of the center by inviting four architectural practices to present designs as part of the competition. The competition brief required that the design should be for a building that must be constructed using methods that will

maximise the use of manual labour and allow for job creation and skills development. The competition was won by architect Peter Rich (Vosloo, 2021).

An improvement to this challenge is the use of progressive design-build and integrated project delivery approaches. These approaches involve both the client and the contractor working together in the early stages of the project, so the design meets the client's expectations and can be costed by the contractor to ensure it is within budget. This was evident in the Tin Shui Wai Hospital project in China, which is a 12-storey hospital for up to 300 patients. The project made use of a collaborative framework which enabled the contractors to efficiently deal with design changes from stakeholders through good communication and timely action (Hospital Authority, 2013).

4.2.3 Efficiency

4.2.3.1 Challenges

A challenge with the efficiencies of infrastructure delivery models is the underspending and lack of attention to detail given during the early planning studies particularly during economic, commercial, technical and design feasibility studies. This results in inefficient procurement processes that will later result in re-works and re-designs that will add to client and contractor costs (Watermeyer & Phillips, 2020). Another cause of inefficiencies in delivery models is when the model primarily focuses on the construction stage rather than have a balanced assessment of the whole project life cycle (risks, performance, etc.).

Inefficiencies can also be caused by the inflexible selection and choice of contractual models (see 4.1) and the overreliance on contractual models to solve delivery and construction issues. Infrastructure budgets tend to be based on early cost estimates which are often understated and can also present a challenge to the efficiency of the delivery model, as the actual project costs tend to be substantially more (Awosina, et al., 2018). Another challenge to the efficiency of infrastructure delivery models is the high cost of bidding which discourages contractors and consultants from tendering for projects,

resulting in a lack of contractor competition. This has been evident in South Africa where the new public private partnership transactions have been decreasing over time due to their high costs of bidding (National Treasury, 2021).

4.2.3.2 Improvements

An improvement on the abovementioned challenge entails the development of a sufficiently detailed level of feasibility and design at the early stages to allow for reasonable and well-informed budget estimates (Global Infrastructure Hub, 2022). This will also allow for accurate appraising and selection of a procurement model based on a full and balanced understanding of the project cycle. This will include the construction costs, operations, maintenance costs, risks, and performance. This was evident in the Sydney Metro Northwest – operations, trains, and systems public private partnership which structured and deliberated operations and maintenance involvement in the design stage to ensure a whole life cycle approach was considered. This approach allowed the project to identify the use of shorter length trains as a way of increasing service frequency, which allowed fewer trains to be acquired and subsequently reduced capital expenditure and maintenance costs (Pacific Partnerships, 2014).

An improvement to rigid contractual models is through the use of agnostic approaches to delivery strategies which include hybrid contractual models that make use of features from several existing models. It is also important not to underestimate the importance of the procurement and packaging decisions while overestimating contractual models. Selected procurement procedures play a vital role in the design and development of the overall delivery strategy by connecting front-end development with the delivery stage. Understated infrastructure budgets have been improved through using an envelope approach with enough flexibility when determining the initial budget. This allows early estimated cost to always be provided as an upper and lower range which can be re-assessed and adjusted periodically during the project cycle. This was evident in the United Kingdom where government published the cost estimating guidance, which provided a best practice approach to the development of cost estimates for infrastructure (UK Government, 2021).

The issue of high bidding costs has been addressed through a reimbursement of a portion of bidder costs for projects over a certain value. This was evident in Australia, where the New South Wales Government Bid Cost Contribution Policy outlined conditions where reimbursement of up to 50 percent of unsuccessful bidder costs on projects over AUD 100 million may apply in the State. The policy attracted sufficient contractors, therefore increasing competition and new entrants (NSW Treasury, 2018). Digitalization has also been seen to increase efficiencies as digital planning, design, build, and operations technology offered institutions in the infrastructure delivery space the opportunity to achieve greater efficiency, speed and optimize infrastructure performance (such as 4D building information models to optimize energy usage). This has been developed by the WBHO construction company in South Africa, which made use of cutting-edge technology in their construction of an office park and gym at Waterkloof Ridge in Pretoria (WBHO, 2021).

4.2.4 Finance

4.2.4.1 Challenges

The COVID-19 pandemic has negatively affected the fiscal capacity of governments to fund infrastructure, which has in turn adversely impacted infrastructure delivery models. The pandemic resulted in reduced taxes, duties, and patronage revenue which are regular government funding streams (OECD, 2020). Private sector investment in infrastructure has also been declining due to the large amount of un-bankable projects. Private financing has also been discouraged due to demand and usage uncertainty of infrastructure assets. Unpredicted changes in factors such as population settlement patterns and working arrangements can have drastic effects on the demand for infrastructure.

4.2.4.2 Improvements

Innovative solutions to infrastructure financing include the use of asset recycling programs which sell existing assets to fund new infrastructure development. This was evident in the Transgrid Privatisation Asset Recycling Program in Australia, where the Australian state monetized their existing infrastructure assets through the sale of underperforming or surplus assets to fund new significant projects by offering a 15 percent top-up on the sale proceeds (Nicholls, 2015). Public private partnerships have also been used to crowd-in funding for infrastructure projects. This is evident in Gabon where a private entity, majority owned by French multinational Vivendi Water signed a contract with the government of Gabon to invest a minimum of $135 million for the provision of both water and electricity services (Farlam, 2005).

The diversification of funding streams for projects has also been an innovative solution to infrastructure financing. The extension of a line of credit by the Central Bank of Nigeria to its development finance institution, Bank of Industry, is an example of diversifying infrastructure funding sources to maintain infrastructure in situations of financial distress (BOI, 2019).

With regard to infrastructure usage uncertainty, an innovative approach to address this challenge is through having the client take the usage risk on the infrastructure asset until an operational steady state is reached. This will give rise to alternative options such as securitization on the mature tolling revenue (Pratiwi and Andriansyah, 2019). This was evident in the Jakarta Toll Road Securitization, which securitized its future toll revenues for the Jakarta-Bogor-Ciawi toll road over a period of five years for mature assets that have a greater certainty of usage demand. Under the securitization process, the toll revenue was sold in advance to institutional investors over a five-year term and the expected annual returns were between 8 to 9 percent.

To encourage private sector investment in infrastructure, an innovative solution has been to provide a sovereign guarantee for privately financed infrastructure to provide investors with a sense of comfort through the construction phase of a project. This was evident in

the Nairobi-Nakuru-Mau Summit Road project which attracted large investment due to the project being an International Development Association guaranteed project. The International Development Association guarantee aims to mitigate the risk of payment default either by the National Toll Fund or by the Government of Kenya to the special purpose vehicle (KeNHA, 2018).

4.2.5 Risk

4.2.5.1 Challenges

A challenge facing infrastructure delivery models is the imbalanced risk allocation between client and contractor, due to lack of consultation in the planning process. This can either result in insufficient appetite for contractors to deliver infrastructure projects or a substantial risk premium being priced into tenders (Lomoro, et al., 2020). Clients may inappropriately apply their risk experience from small scale social infrastructure projects to large scale civil projects. Clients may also inappropriately use precedents from prior projects with different characteristics in the allocation of risk.

4.2.5.2 Improvements

Improvements to the challenges above include using early works covering utility relocations, land acquisition and other investigations for the project owner or contractor to de-risk the project as much as possible. There is also a need for the careful consideration of risks transfer to contractors when there are unknown factors which are non-priceable. Risk allocation should also consider the project characteristics and test this with the market or through an interactive tendering process (Hovy, 2015). The best option would be to use a collaborative model that deals with such risk and allows the client and contractor to have equitable risk sharing mechanisms. This allows all parties to be commercially aligned to mitigate such risks and have realistic pricing from contractors with less risk premium.

This was evident in the Port of Miami Tunnel project in the United States of America where a contingency fund to pool risk in the event of unforeseen costs was created and the

operations and maintenance risk premium was shared between the public and private sectors. This was essential as the construction took place under a busy shipping channel in an environmentally sensitive area and the potential for unforeseen costs was high (Global Infrastructure Hub, 2014). The Global Infrastructure Hub Private Public Partnership risk allocation tool provides a reference guide which governments can make use of to appropriately allocate project risk for several project types. The use of market sounding can also be used to explore the key risk items that need to be addressed to structure project packaging and risk allocation to be able to meet the expectations of bidders in the market. This was seen in New Zealand where in the construction of the New Dunedin 411 bed hospital, a market engagement process was conducted to provide information on the project and to inform the market's view on risk allocation (Global Infrastructure Hub, 2021).

4.2.6 Sustainability

4.2.6.1 Challenges

A challenge about the sustainability of infrastructure delivery models is meeting the ever-changing society expectations of infrastructure regarding its ethical use of materials and labour, sustainability, and inclusive growth. Another challenge is the corruption that takes place during purchasing practices which is illegal, wastes resources and leads to poor construction (OECD, 2016). This results in construction that is conducted by incompetent, unqualified and unauthorized contractors which tends to be unsafe.

4.2.6.2 Improvements

An improvement to the above challenge is through ethical sourcing of labour and material, which was evident in the Crossrail high-frequency suburban passenger service project in the United Kingdom. This project included a requirement that all project material be procured in accordance with the ethical trading initiative base code, representing an internationally recognized code of labour practice (Crossrail, 2016). In South Africa, the government has since banned the use of imported cement in state-awarded contracts to

protect the local cement industry from cheaper imported cement coming from countries with excess capacity and lower production costs (Erasmus, 2021). Anti-dumping duties have also been imposed on cement imported from Pakistan (Cokayne, 2022).

It is also necessary to plan and identify social value outcomes early in the project through engaging the local communities. This will allow for the identification of local partners who can take part in the supply chain for the infrastructure project to ensure they have the capabilities to benefit from the infrastructure project. This will lead to inclusive growth which was seen in the Cairo Metro project in Egypt, where the youth and the vulnerable were identified from field surveys and stakeholder engagement plans. This resulted in 3000 – 4000 jobs being created during the construction phase, where many of the workers were previously unemployed youth (Global Infrastructure Hub, 2018).

Corrupt activities have also been curbed using anti-corruption construction systems, which are online systems that allow construction work to be monitored by officials and the public. This was seen in the Seoul Clean Construction System in South Korea, which was created by the Seoul Metropolitan Government to improve transparency of public construction and ensure the safety of infrastructure users (Jang and Lee, 2016). Infrastructure delivery should also use resources efficiently, reduce emissions over the life of the asset and build a sustainable infrastructure sector for future infrastructure projects. This was seen in the Agadir Mutualized Desalination Plant in Morocco which used output specifications to incentivise the private entity to optimise the plant and minimise energy use by linking payment to energy consumption. This allowed the private entity to make trade-offs between energy costs over the term and a design solution above minimum requirements. As such, the private entity included energy harvesting turbines to reduce overall energy use of the facility (Latrech, 2022).

5. Discussion of findings

5.1 Infrastructure Delivery at the DBSA

The Infrastructure Delivery Division in the DBSA is involved in implementing public sector infrastructure projects and its business practices are compliant with government regulations and leading international practice. The IDD adheres to all relevant regulatory requirements, technical standards, and best practice standards which include adherence to the Construction Industry Development Board (CIDB) Infrastructure Delivery Management System (IDMS) and the Framework for Infrastructure Delivery and Procurement Management (FIDPM). The IDD also adheres to the Public Finance Management Act, 1999 (Act No. 1 of 1999) and the Preferential Procurement Policy Framework Act, 2000 (DBSA, 2022).

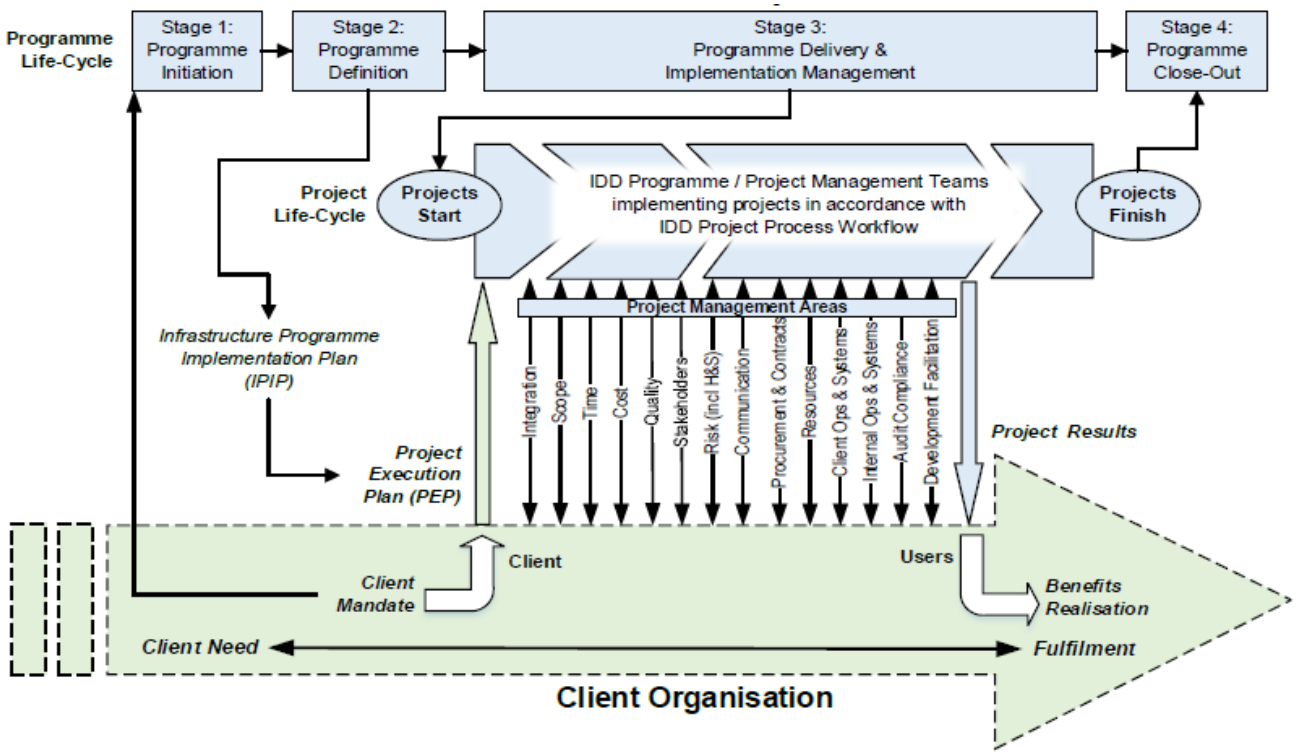
The FIDPM is focused on governance decision-making points as well as alignment and functions to support good management of infrastructure delivery and procurement processes. The framework prescribes minimum requirements for the implementation of the IDMS through the infrastructure delivery management processes. These processes consist of portfolio, programme, projects, operations, and maintenance of infrastructure. The framework also specifies the allocation of clear responsibilities for performing activities and making decisions at control points, stages, and procurement gates. This allows the framework to promote the concept of value for money to organs of state through infrastructure delivery management.

IDD has incorporated its business process into the FIDPM process flow through the addition of a pre-initiation stage and the expansion of other FIDPM stages to incorporate DBSA and IDD specific processes and governance requirements. In the IDD, programmes mostly start from client mandates to implement related projects on their behalf. The projects are evaluated and assessed against predefined criteria and

alignment to the strategic objectives of the Division prior to the signing of an agreement with the client, which can be seen in the figure below.

Figure 1 is an illustration of the relationship between the IDD and a client organization. As can be seen, based on the client needs and mandates, the IDD formulates the programme life cycle. This life cycle has four programme stages, namely, initiation, definition, delivery and implementation management, and close-out.

Figure 1 Relationship Between IDD and Client Organizations



Source: DBSA (2022)

The IDD has been established to serve as an implementing agent for the government of South Africa in all three spheres of government. The Division develops a strategy and plan to identify markets, estimate its market share and determine its financial targets. Due to its track record, IDD continues to be approached by government departments, and potential clients must submit a written request or commitment for getting IDD on board as its implementing agent. This request must include the availability and value of funds to

implement the programme. The mandate must be assessed by business development and costed by business performance culminating into a mandate assessment report that is presented to relevant DBSA committee(s) for approval. The approved mandate leads to the drafting of a Memorandum of Agreement that is signed by DBSA and the client. The programme is then allocated to an IDD implementation unit that follows the FIDPM stages to design and implement individual projects from start to finish and hand them over to the client. IDD also appoints a professional service provider and contractors that are paid from the programme budget for the work done in the individual project. Over and above this, IDD charges a management fee as a percentage of the total programme cost using its pricing model to cover all its overheads.

Regarding the capacity and capability of the IDD delivery model, it is worth noting that IDD appoints professional service providers and contractors who do the work on the ground under the supervision of an internal team, typically comprising:

- A Programme Manager who oversees each programme allocated to him/her;
- A Construction Project Manager who supervises the work on the ground for each project allocated to him/her;
- A Quantity Surveyor who prepares a Bill of Quantities and verifies invoices against it;
- A Social Facilitator who deals with stakeholder and community relations matters;
- A Clerk of Works who supports the Construction Project Manager on several issues;
- An Occupational Health and Safety Specialist who oversees and reports on issues related to this safety on project sites; and
- A Programme Administrator who is responsible for all administrative issues.

In addition to the above front-office roles, there is a finance team that is responsible for invoicing clients and processing claims from professional service providers and contractors.

The DBSA delivery model also partners with other connected parties to achieve improved shared outcomes. This was evident in the HIV voluntary counselling and testing project, where the National Department of Health in collaboration with the German Development Bank, Kreditanstalt fur Wiederaufbau (KfW) and the DBSA developed a long-term project for improving the delivery of HIV counselling and testing in South Africa in 2003. The DBSA was then appointed to serve as an implementing agent on behalf of the National Department of Health while KfW was the funder of the project, providing funding for the extension of clinics and the actual counselling and testing of people at the clinics.

The IDD infrastructure delivery model is efficient in terms of optimizing delivery to maximize infrastructure outcomes as during the infrastructure project implementation plan (IPIP) stage every quantitative output is documented and costed and development outcomes are captured. For instance, when a school is constructed, the number of classrooms are quantified from the onset including the estimated enrolment and IDD projects are funded from the fiscus.

The IDD infrastructure delivery model adequately plans, manages, allocates and accounts for risk as some risks are identified during the mandate assessment stage and project level risks are identified during the development of the infrastructure project implementation plan while emerging risks are documented during implementation. Reporting and mitigation happen throughout the project cycle. As much as possible, the DBSA delivery model is environmentally sustainable as the IDD includes green technology in their projects as the design considers factors such as optimizing natural lighting, recycling of waste and rainwater harvesting.

6. Case Studies

6.1 Greater Tzaneen Medium Term Revenue and Expenditure Framework Electricity Programme

The Greater Tzaneen Medium Term Revenue and Expenditure Framework (MTREF) Electricity Programme was in South Africa and focused on the local government sector (DBSA, 2022). The provision of electricity involves generation, transmission and distribution and Eskom owns the majority of generating and transmission capacity. Eskom also distributes electricity to some industrial clients, businesses and households. At the local government sphere, municipalities are the main suppliers of electricity to households and businesses. The distribution networks of municipalities and Eskom often overlap as is the case with Greater Tzaneen Local Municipality (GTLM).

The GTLM holds the distribution license for Tzaneen, Haenertsburg, Gravelotte and Letsitele which covers an area of approximately 3 500 square kilometers. However, a 2014 National Energy Regulator of South Africa (NERSA) audit showed that a significant portion of the distribution network was not functioning optimally and needed to be replaced as most of the infrastructure was older than 50 years. As such, the infrastructure has become financially unfeasible to maintain and repair to provide a reliable service. The distribution losses negatively impacted GTLM finances as electricity accounts for a large amount of their revenue.

The poor network resulted in incorrect readings and due to all the issues facing the municipality, GTLM approached the DBSA for a loan to fund the refurbishment and replacement of a section of the electricity distribution infrastructure. This was over three years between 2017/18 and 2019/20 and the DBSA approved a R90 million loan along with an infrastructure investment programme for South Africa grant of R10 million for the project. The funding was intended for the repair and replacement of the electricity distribution infrastructure and was expected to lead to a reduction in distribution losses

and improve the finances of the municipality. There were more than 20 projects that were funded as part of the MTREF Programme, which were implemented as per the municipality's 2014 Masterplan and the Integrated Development Plans in Tzaneen and Haenertsburg.

The repair and replacement included the upgrading and refurbishment of local substations, distribution lines and other infrastructure such as switchgear and retrofitting of panels. More households will be electrified and employment will be created during the construction and operational phases of the programme. The project resulted in the following:

- 3 400 new electricity connections with an electrical network that spans 250 km
- Replacement and extension of light poles, steel wires and brittle conductors
- Installation of substations (and their batteries) and auto reclosers on 33kV and 11kV overhead lines
- Installation and protection of transformers and 60 streetlights
- Replacement of conventional fencing with ClearVu fencing

The project resulted in the creation of 182 jobs which included women and the youth. Around 1986 households benefitted from this project and it resulted in reduced distribution losses and prevention of unnecessary tripping of the network. The increased streetlights resulted in reduced crime and road accidents and the improved capacity at the substations now accommodates additional connections. The municipality was also certified NERSA compliant in terms of its distribution license. Since the implementation of the project, there is now spacing of overhead power lines to minimize birds being electrocuted. There is also line clearance to prevent lines from tripping as well as avoiding trees catching fire which can damage the power lines.

The project was undertaken within the parameters of the GTLM environmental management plan, and the programme did not have a dedicated environmental strategy.

This means that the environmental impact of the project is unknown, although the GTLM officials state that the projects had minimal environmental consequences. The financial position of the municipality improved between 2018 and 2021 due to improved revenue collection from the upgrade of the electricity network as well as the implementation of the DBSA-led revenue enhancement plan.

6.2 Delville Extension 9 Social Housing Project

The Urban Renewal Programme was carried out by the City of Ekurhuleni (CoE) to transform and develop the urban settlements into sustainable human settlements and Germiston as an administrative capital for the city. Delville Extension 9 was one of the urban settlements earmarked for this development which was managed by the Ekurhuleni Housing Company, which is a social and rental housing company of the city responsible for scaling up the delivery of social housing (DBSA, 2018).

The programme aimed to manage the supply of commercially viable retail, business, hospitality, housing, and social facilities. The DBSA was appointed as an implementing agent for this programme to manage the design, overall construction, and contract management of the programme. The programme was implemented under the umbrella Memorandum of Agreement (MoA) signed with the City of Ekurhuleni in 2015. The MoA mandated the DBSA to implement its capacity building initiatives regarding infrastructure delivery on identified projects allocated by the City of Ekurhuleni from its capital projects programme between 2015 and 2019.

The project entailed the construction of 112 rental houses that are intended to provide rental accommodation to low- and middle-income houses. These units comprised of bachelor units, one-bedroom and three-bedroom units. The design and implementation approach was based on the development zones as identified in the city’s development plans. The implementation was also based on focused intervention on catalytic projects

and phased hierarchy development, as well as development through partnerships and shared facilities. Stakeholders who were part of the project included:

- City of Ekurhuleni Human Settlements Department
- Ekurhuleni Housing Company
- Gauteng Department of Human Settlements
- Social Housing Regulatory Authority
- The CoE Sector Departments – Water, Sanitation and Electricity
- Ward Councillor and the Ward Committee representatives

Constant communication between all stakeholders was key in completing the project as every stakeholder involved was on the same level of understanding and expectations. Public participation was also critical in the success of the project as the Ward Councillors and Ward Committees played a role in relaying critical information to the public and mobilizing local labour. The project achieved its object of scaling up social housing in the City of Ekurhuleni as the 112 units were completed.

6.3 Tembisa Pedestrian Cycle Rail Underpass Bridges

The Tembisa pedestrian cycle rail underpass bridges on either side of Andrew Mapheto Drive was a project in the City of Ekurhuleni supported by the DBSA through IDD. The project was identified as a response to fatalities which occurred on the railway line close to Isithame/Kopanong and Ibazelo/Temong sections where pedestrians were crossing. The objective of the project was to reduce pedestrian/train conflict and improve pedestrian safety in the surrounding area of the train crossing. More specifically the aim of the project was to reduce the number of fatalities on the route and provide a safe and user-friendly pedestrian and cycle underpass, which will improve pedestrian mobility overall. The Passenger Rail Agency of South Africa (PRASA) was also involved in the project.

Based on the MoA between the DBSA and the City of Ekurhuleni, the DBSA procured and supervised the management contractor to design permanent and temporary works. The DBSA also assisted the engineer in the compilation of as-built drawings and supervised the construction of two underpass bridges. The appointed contractor fulfilled the day-to-day project implementation role, which included managing sub-contractors. The project was implemented in two phases, the first phase of which included the following:

- Parking legs
- Laying of 600mm diameter pipe under the culvert centre line
- Opening of embankments
- Construction of six reinforcement concrete resting plinths and rail pavement layers
- Installation of electrical and signaling systems
- Craning of two culvert segments into position and placing them on the resting plinth

The project involved temporary disruption to rail services which were communicated to all stakeholders (particularly the community) and the construction work took place during weekends and December to meet the tight deadlines set by PRASA. The construction of the two bridges was completed in January 2018. Phase two of the project was completed in July 2018 and included the following:

- Provision of electrical lighting
- CCTV system
- Landscaping and grassing
- Interlocking brick paving on the ramps

7. Comparative analysis of case studies

The three case studies above have shown the different approaches of infrastructure delivery within the DBSA. In The Greater Tzaneen Medium Term Revenue and Expenditure Framework Electricity Programme, the DBSA was approached to provide loan financing for the refurbishment of a section of the electricity distribution infrastructure. This study has thus far assessed infrastructure delivery models based on the following six themes: capability and capacity, cooperation, efficiency, finance, risk, and sustainability. However, about the case study above, the capacity and capability of the infrastructure delivery lies upon the client (municipality), even though the DBSA does conduct municipal assessments, with regard to the municipality's ability to carry out the infrastructure and service the loan. As such, regarding this case study, the capacity and capability lies with the Municipality and their contractors and service providers and not with the DBSA whose main role is to fund the projects. The same can also be said regarding the efficiency and risk of the infrastructure delivery model, which lies with the municipality and their contractors.

However, the case study shows the collaboration and sustainability aspect of the DBSA infrastructure delivery model, as the DBSA has collaborated with the municipality. The DBSA has not only funded but has also provided expert knowledge on infrastructure on the project which created employment for marginalized groups such as women and the youth and provided infrastructure that meets the needs of the communities. In terms of sustainability, the GTLM officials state that the projects had minimal environmental consequences.

In both the Delville Extension 9 Social Housing Project and the Tembisa Pedestrian Cycle Rail Underpass Bridges project, the DBSA had entered into a Memorandum of Agreement (MoA) with the City of Ekurhuleni to implement its capacity building initiatives related to infrastructure delivery and carry out a full implementing agent's role on identified projects allocated by the City of Ekurhuleni from its capital projects programme between 2015 and 2019.

The DBSA had sufficient capacity and capability in both projects to deliver the infrastructure as the DBSA procured and supervised a management contractor to design permanent and temporary works. The DBSA also assisted the engineers in the compilation of as-built drawings and supervised overall construction in both projects. The appointed contractors fulfilled the day-to-day project implementation role, which included managing sub-contractors. The internal DBSA team which supervises such projects typically includes a programme and construction project manager, quantity surveyor and occupational health and safety specialist.

The two projects have also shown the cooperation aspect of the DBSA infrastructure delivery model, as different stakeholders have been involved in both projects such as the City of Ekurhuleni Human Settlements Department, Ward Councillor and the Ward Committee representatives. This has allowed constant communication between various stakeholders to ensure that everyone is on the same level of understanding and expectation. Public participation through Ward Councillors and Ward Committees was also key towards the successful delivery of both projects.

The projects have also shown the efficiency of the DBSA delivery model, as during the infrastructure project implementation plan for both projects, every quantitative output is documented and costed and development outcomes are captured. The Memorandum of Agreement between the DBSA and the City of Ekurhuleni clearly states what is mandated from the DBSA in terms of the infrastructure delivery, as an implementing agent. Such structured and documented mandates improve efficiencies.

The DBSA infrastructure delivery model identifies risks during the mandate assessment stage and some project level risks are identified during the development of the infrastructure project implementation plan phase and mitigation happens throughout the project cycle. This was evident in the Tembisa Pedestrian Cycle Rail Underpass Bridges project where the rail services temporarily shut down during the construction and the community was unable to use them. To minimize the risk of community mass action

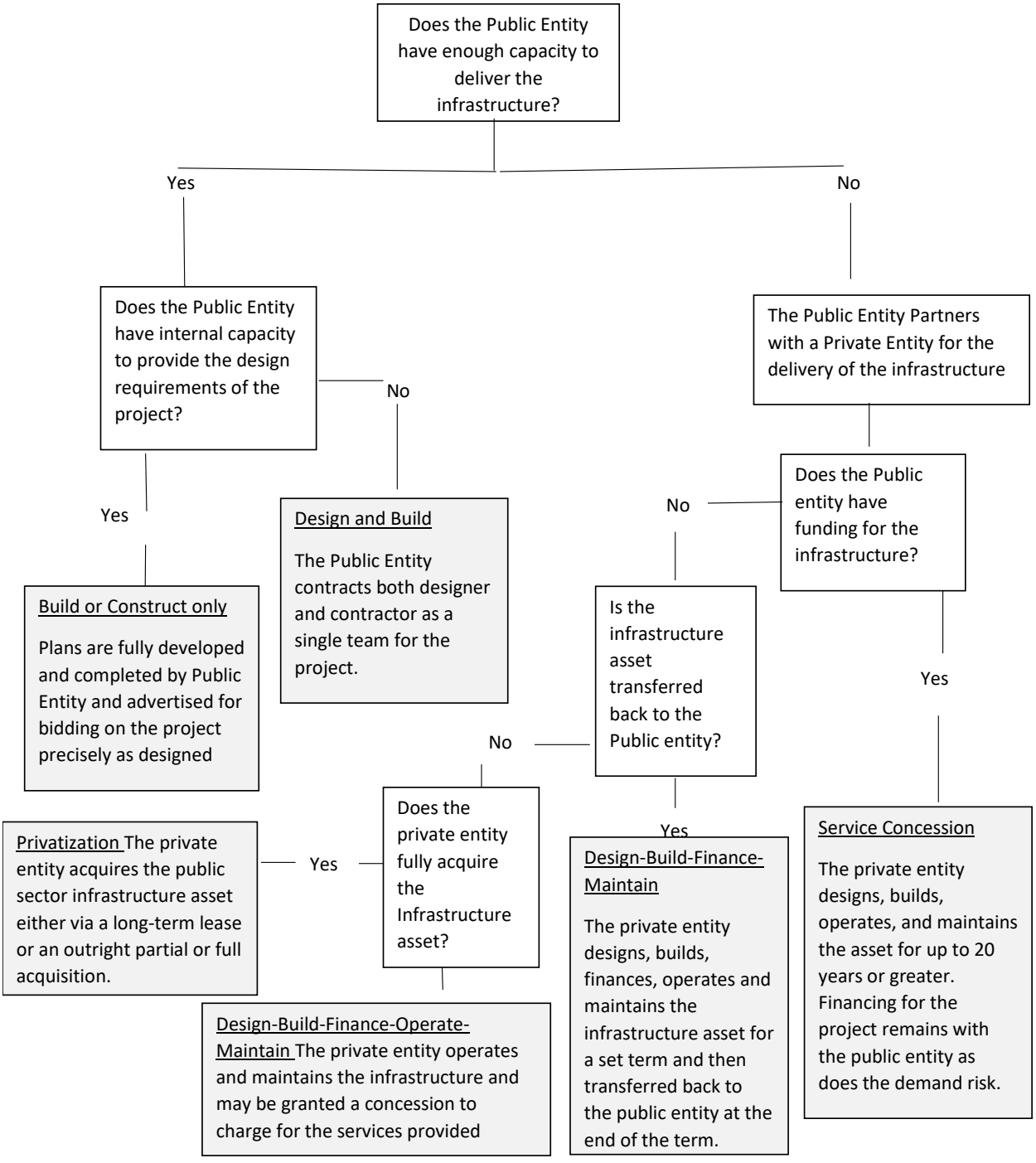
because of the shutdown, a communication campaign was implemented with all stakeholders to ensure adequate buy-in.

The delivery model is also financially sound as before the DBSA can agree to be an implementing agent in both case studies, a client such as the City of Ekurhuleni must submit a written request indicating the availability and value of funds to implement the programmes. The infrastructure constructed is also sustainable and has no adverse impact on the environment in both the City of Ekurhuleni projects.

8. Proposing generic working processes

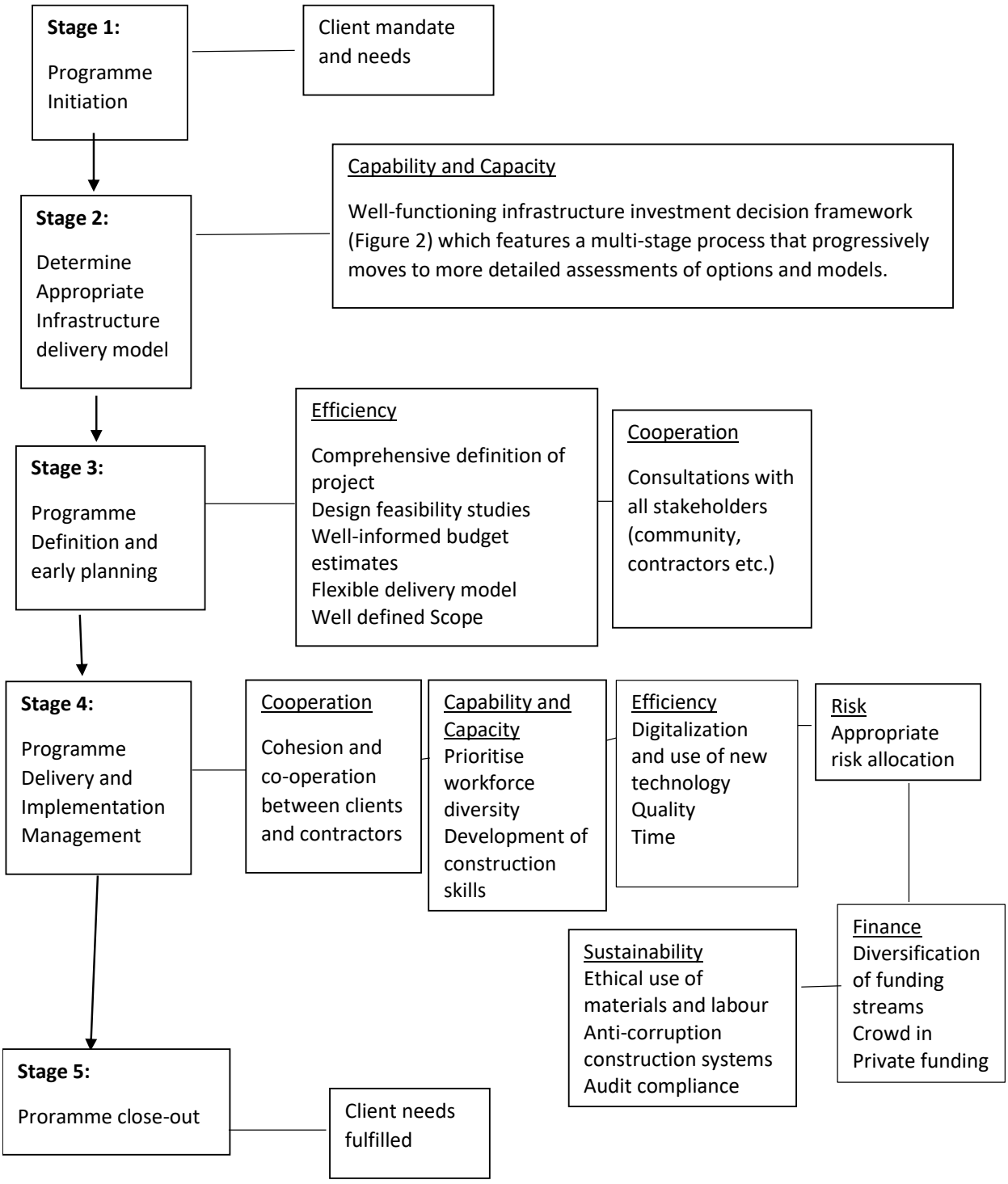
Based on the findings above, this study proposes the following generic working process with regarding infrastructure delivery to decide the appropriate delivery model to use. The study also proposed a generic model for infrastructure delivery using the DBSA model and an analysis of the six themes proposed in this study.

Figure 2 Decision tree for the selection of an appropriate infrastructure delivery model in South Africa



Source: Author's own

Figure 3 Proposed generic working process



Source: Author's own

9. Conclusion

The two objectives of this research were to investigate challenges and improvements for infrastructure delivery models and assess the DBSA infrastructure delivery model against the six key features. This was achieved by analyzing the overall delivery model through the Infrastructure Delivery Division and analyzing selected infrastructure delivery case studies. The six key features of delivery models were capability and capacity, cooperation, efficiency, finance, risk, and sustainability.

The findings from the study highlighted the different types of Infrastructure delivery models and their characteristics. These included Build or Construct Only, Design and Build, Public Private Partnerships, Privatization and Regulated Asset Base (covering design, build, operations, and maintenance). The findings also highlighted challenges facing the six key features of infrastructure delivery models, such as challenges facing the capacity, capability, and efficiency to deliver infrastructure and provide improvements and solutions for each challenge.

The findings from the analysis of the DBSA infrastructure delivery model and selected case studies have shown that through the IDD, the DBSA delivery model has sufficient capacity and capability to efficiently deliver infrastructure that is sustainable and has positive impacts on the environment. The different stages of the DBSA delivery model adequately account for project level risks and have sufficient risk mitigation measures in place. The delivery models also allow for effective co-operation that does not only include stakeholders such as contractors and professional service providers but also the community members who have a voice in the development of the infrastructure that will ultimately serve their needs.

10. References

AfDB. 2015. African Development Bank Kigali Bulk Water Supply Project. Retrieved from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Project_Brief_Bulk_Water_Supply_Project_Rwanda_2015.pdf

Arimah, B. 2016. Infrastructure as a Catalyst for the Prosperity of African Cities. Procedia Engineering, 198, 245 – 266.

Awosina, A., Ndihokubwayo, R., and Fapohunda, J. 2018. Effects Of Inaccurate Cost Estimate On Construction Project Stakeholders. University of Johannesburg.

BOI, 2019. Bank Of Industry Annual Report 2019. Lagos: Bank of Industry.

Chigangacha, P., Haupt, T., and Awuzie, B. 2021. Appraising Capacity-Related Challenges Negating Infrastructure Delivery Performance In Government Departments: Insights From The Resource-Based Theory. Journal of Construction Project Management and Innovation, 11(2), 49-70.

Cokayne, R. 2022. Government asks cement producers for 'no price increases'. Retrieved June 24, 2022, from https://www.moneyweb.co.za/news/companies-and-deals/government-asks-cement-producers-for-no-price-increases/

Corner, D. 2006. The United Kingdom Private Finance Initiative: The Challenge of Allocating Risk. OECD Journal On Budgeting, 5(3).

Crossrail. 2016. Ethical Sourcing Of Construction Products. Retrieved from https://learninglegacy.crossrail.co.uk/documents/ethical-sourcing-of-construction-products/

DBSA. 2018. Infrastructure Delivery Division. Midrand: Development Bank of Southern Africa.

DBSA. 2022. DBSA Sustainability Review 2022. Retrieved from https://www.dbsa.org/sites/default/files/media/documents/2022-08/DBSA%20Sustainability%20Review%202022.pdf

DBSA. 2022. IDD Project Management Process. Midrand: Development Bank of Southern Africa.

Deloitte Research. 2008. Building flexibility. New delivery models for public infrastructure projects. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/infrastructure-and-capital-projects/deloitte-uk-building-flexibility-report.pdf

Department of Tourism. 2023. Tourism hosts community engagement on infrastructure initiatives in Limpopo, 5 Apr. Retrieved from https://www.gov.za/speeches/tourism-host-community-engagement-infrastructure-initiatives-near-kruger-national-park%E2%80%99s

Erasmus, G. 2021. South Africa bans the use of imported cement on government-funded projects. Retrieved June 23, 2022, from https://www.tralac.org/blog/article/15406-south-africa-bans-the-use-of-imported-cement-on-government-funded-projects

Farlam, P. 2005. The South African Institute of International Affairs Assessing Public–Private Partnerships in Africa.

Global Infrastructure Hub. 2012. Mi Teleférico Cable Car. Retrieved from https://inclusiveinfra.gihub.org/case-studies/mi-teleferico-cable-car-bolivia/

Global Infrastructure Hub. 2014. Port of Miami Tunnel. Retrieved from https://managingppp.gihub.org/case-studies/port-of-miami-tunnel/

Global Infrastructure Hub. 2018. Cairo Metro. Retrieved from https://inclusiveinfra.gihub.org/case-studies/cairo-metro-egypt/

Global Infrastructure Hub. 2021. Jakarta Mass Rapid Transit. Retrieved from https://infrastructuredeliverymodels.gihub.org/case-studies/jakarta-mass-rapid-transit/

Global Infrastructure Hub. 2021. New Dunedin Hospital. Retrieved from https://infrastructuredeliverymodels.gihub.org/case-studies/new-dunedin-hospital/

Global Infrastructure Hub. 2022. Improving Delivery Models. Retrieved from https://infrastructuredeliverymodels.gihub.org/challenges-and-improvements-framework/risk/

Hospital Authority. 2013. Tin Shui Wai Hospital. Retrieved from http://www32.ha.org.hk/capitalworksprojects/en/Project/Others/Tin-Shui-Wai-Hospital/Introduction.html

Hovy, P. 2015. Risk Allocation in Public-Private Partnerships: Maximizing value for money. Retrieved January 9, 2023, from https://www.iisd.org/system/files/publications/risk-allocation-ppp-maximizing-value-for-money-discussion-paper.pdf

HS2. 2015. HS2 Phase One (London to West Midlands). Retrieved from https://www.hs2.org.uk/documents/collections/hs2-phase-one-london-to-west-midlands/

Jang, Y., and Lee, A. 2016. United Nations Development Programme and Seoul Metropolitan Government. Retrieved from https://www.local2030.org/library/246/Seouls-Clean-Construction-System-for-Efficient-Public-Administration-and-Transparent-Construction-Management-A-Resource-Book-for-Practitioners.pdf

JLM Strategic Talent Partners. 2020. Workforce Diversity in Infrastructure. Retrieved from https://jlm-strategic-talent-partners.medium.com/workforce-diversity-in-infrastructure-bca216e68826

KeNHA. 2018. Proposed Development, Operations And Maintenance Of The Nairobi - Nakuru – Mau Summit (A8) Highway (PPP) Project. Retrieved from https://www.jica.go.jp/english/our_work/social_environmental/id/africa/kenya/c8h0vm0000fhihet-att/c8h0vm0000fhihiu.pdf

Kumo, W. L. 2012. Infrastructure Investment and Economic Growth in South Africa: A Granger Causality Analysis. African Development Bank(160).

Latrech, O. 2022. Africa's Largest Desalination Plant in Chtouka Aitbaha To Open In March. Retrieved from https://www.moroccoworldnews.com/2022/02/346887/africas-largest-desalination-plant-in-chtouka-aitbaha-to-open-in-march

Laudy, R. 2021. Collaboration could be the solution for the African infrastructure delivery problem. Retrieved from https://www.pinsentmasons.com/out-law/analysis/collaboration-african-infrastructure-delivery

Lomoro, A., Mossa, G., Pellegrino, R., and Ranieri, L. 2020. Optimizing Risk Allocation in Public-Private Partnership Projects by Project Finance Contracts. The Case of Put-or-Pay Contract for Stranded Posidonia Disposal in the Municipality of Bari. Sustainability, 12(3).

Lunay, A. 2023. Constructing better infrastructure outcomes with community engagement. Retrieved January 10, 2023, from https://articulous.com.au/infrastructure-engagement/

Madikizela, K., and Michell, K. 2022. An investigation into the relationship between diversity, leadership and innovation in the South African construction industry. IOP Conf. Series: Earth and Environmental Science(1101).

Matshediso, M. 2023. Building women in construction. Retrieved from https://www.vukuzenzele.gov.za/building-women-construction#:~:text=The%20National%20Home%20Builders%20Registration,of%20Business%20Science%20(GIBS).

National Treasury. 2021. Annexure E: Public-Private Partnerships. . Retrieved September 8, 2022, from http://www.treasury.gov.za/documents/national%20budget/2021/review/Annexure%20E.pdf

Nicholls, S. 2015. NSW reaps $8 billion infrastructure bonanza from Transgrid privatisation. Retrieved from https://www.smh.com.au/national/nsw/nsw-reaps-8-billion-infrastructure-bonanza-from-transgrid-privatisation-20151125-gl7vv5.html

NSW Treasury. 2018. Bid Cost Contributions Policy. Retrieved from https://www.treasury.nsw.gov.au/sites/default/files/2021-08/Bid%20Costs%20Contribution%20Policy%202021.pdf

OECD. 2016. Preventing Corruption in Public Procurement. Retrieved March 4, 2023, from https://www.oecd.org/gov/ethics/Corruption-Public-Procurement-Brochure.pdf

OECD. 2020. The territorial impact of COVID-19: Managing the crisis across levels of government. Retrieved February 2, 2023, from https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/

OECD. 2021. Building Resilience New Strategies For Strengthening Infrastructure Resilience And Maintenance. Retrieved July 21, 2023, from https://www.oecd.org/g20/topics/infrastructure/Building-Infrastructure-Resilience-OECD-Report.pdf

Oke, A., Aigbavboa, C., and Khangale, T. 2018. Effect of Skills Shortage on Sustainable Construction. Conference Paper in Advances in Intelligent Systems and Computing.

Pacific Partnerships. 2014. Sydney Metro Northwest - Operations, Trains and Systems PPP. Retrieved from https://www.pacificpartnerships.com.au/en/our-assets/assets-listing-page/sydney-metro-northwest

Peoples Association. 2022. Singapore Government Agency Our Tampines Hub. Retrieved from https://www.pa.gov.sg/our-network/our-tampines-hub

Pratiwi, A. S., and Andriansyah, A. 2019. Asset Securitization to Address Infrastructure Financing Gap in Indonesia. Munich Personal RePEc Archive(Paper No. 111117).

Sarkodie, S. A., and Adams, S. 2020. Electricity access and income inequality in South Africa: Evidence from Bayesian and NARDL analyses. Energy Strategy Reviews, 29.

StatsSA. 2023. Statistical Release P0441. Retrieved from https://www.statssa.gov.za/publications/P0441/P04411stQuarter2023.pdf

Taliercio, R., and Estrada, E. A. 2020. IMF eLibrary Chapter 13 Best Practices in Project Appraisal and Selection. Retrieved from https://www.elibrary.imf.org/display/book/9781513511818/ch013.xml

Tideway. 2020. Thames Tideway Tunnel. Retrieved from https://www.tideway.london/media/4016/tideway-sustainable-finance-framework-2020_web.pdf

UK Government. 2021. Infrastructure and Projects Authority Cost Estimating Guidance . Retrieved from https://www.gov.uk/government/publications/cost-estimating-guidance

UK Government. 2021. Infrastructure and Projects Authority: assurance review toolkit. Retrieved from https://www.gov.uk/government/collections/infrastructure-and-projects-authority-assurance-review-toolkit

University Of Oxford. 2015. Major Projects Leadership Academy MPLA Handbook. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850739/MPLA_Handbook_for_IPA_Website__2_.pdf

Vautibault, M. d. 2022. Rethinking infrastructure delivery models towards a strategic and agnostic approach. Retrieved from https://www.gihub.org/resources/publications/rethinking-infrastructure-delivery-models-towards-a-strategic-and-agnostic-approach/

Vosloo, C. 2021. A Comparison Of Three Public Projects That Included Community Participation To Determine The Total Value Add. Acta Structilia, 28(2), 170-207.

Watermeyer, R. 2010. Alternative models for infrastructure delivery. Retrieved from http://ioptions.co.za/sites/default/files/rbwpapers/P7%2B%20P8%20papers/P7-2.pdf

Watermeyer, R., and Phillips, S. 2020. Public infrastructure delivery and construction sector dynamism in the South African. Retrieved from https://www.nationalplanningcommission.org.za/assets/Documents/Infrastructure%20delivery%20-Watermeyer%20Phillips%2025%20April%20final.pdf

WBHO. 2021. WBHO. Retrieved September 2021, 1, from https://www.wbho.co.za/about-us/

World Bank. 2019. Leading Practices in Governmental Processes Facilitating Infrastructure Project Preparation. Retrieved July 21, 2023, from https://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/2022-03/gih_project-preparation_full-document_final_art_web-2.pdf

World Bank. 2020. Access to electricity (% of population) - South Africa. Retrieved from https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=ZA

Personal Communication

Vusi Nkuna, Business Performance Specialist, DBSA

Sydwell Lekgau, Operations Evaluation Specialist, DBSA