ASSESSING SOUTH AFRICAN PUBLIC SECTOR MATURITY TO IMPLEMENT THE INFRASTRUCTURE DELIVERY MANAGEMENT SYSTEM (IDMS)

A thesis submitted to the College of Agriculture, Engineering and Science, the School of Engineering, Construction Studies Program, University of KwaZulu-Natal, South Africa, in fulfilment of the Degree of

DOCTOR OF PHILOSOPHY IN CONSTRUCTION MANAGEMENT

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DECLARATION OF ORIGINALITY

As the candidate's supervisors, we agree to the submission of this thesis

Signed:

Supervisor: Date: 18 September 2020

Co-Supervisor: Date: 18 September 2020

I, Progress Shingai Chigangacha, hereby state that this thesis was completed by myself, the candidate and is submitted for the Degree of Doctor of Philosophy in Construction Management at the University of KwaZulu-Natal, Durban, South Africa. The research was financially supported by the National Research Fund (NRF) of South Africa. Where the works of other authors have been used, they have been duly acknowledged and referenced. This research has not been submitted before for any degree or examination to any other university.

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DEDICATION

To my late loving parents, Jane and Marko Chigangacha, for all the sacrifices they made to ensure that I have a good education, and for always being supportive and encouraging. These two are the reason why I believe in myself and continuously strive for excellence and greatness. Forever indebted to them.

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ABSTRACT

Infrastructure is the fulcrum of a strong economy. It can be considered as the backbone of every economy as it directly impacts on some elements of expansive socio-economic development which contribute to economic growth and development thereby increasing societal value and quality of life. Undoubtedly, infrastructure is critical and a prerequisite for economic growth and power. Likewise, the paucity of and lack thereof of adequate infrastructure impedes national growth and development. For most developing countries, there are large infrastructural deficits and the infrastructure gap is large, with infrastructure delivery being characterized by slow progress and development. South Africa too is fraught with a myriad of challenges affecting infrastructure delivery and this has seen the South African government prioritizing and scaling up expenditure on infrastructure to support its economic growth and development plans.

In recent years, the South African government has made remarkable progress to support its economic growth and development plans and introduced recent enabling legislation and guidelines, in the process reducing poverty and inequality. However, it is still plagued with tremendous backlogs and shortfalls due to considerable bottlenecks, as a result of several systemic challenges that inhibit the effective delivery of infrastructural installations, the causes of which have not necessarily been identified or understood. Furthermore, there is severe persistence of infrastructure challenges facing the South African landscape despite numerous government interventions to scale up infrastructure delivery. The Infrastructure Delivery Management System (IDMS), a government model formulated to ameliorate infrastructure delivery has not been adequately utilized so as to achieve its full effectiveness and efficiency. This could potentially be emanating from deficiencies in institutional capacities and capabilities and the lack of organizational readiness to utilize this model. Suffice to note is the reality that the challenges of infrastructure in South Africa are not primarily attributed to lack of funding but are as a result of institutional failures and a lack of requisite capacity within the Public sector

Against this background, this study aimed primarily to develop and validate a maturity model for assessing and improving public sector organizations' readiness for effective IDMS implementation. Upon model development and validation, the study assessed the maturity of provincial government departments in engaging with the extant IDMS and it formulated evidence based interventions to improve delivery and management of infrastructure projects. This was achieved through analysis of data obtained from the use of a nine-dimension Maturity Modelling Questionnaire and semi-structured Interviews. The results obtained were used to indicate Organizational Maturity on a 5-level scale where Level 1 is the initial/adhoc level which is indicative of a regressive organization with a complete lack of attributes and Level 5 is indicative of an optimized organization with world class attributes.

An IDMS ready organization would ideally have a maturity rating at level 5. This study found that all three organizations that were surveyed had a maturity rating 3<organizational maturity level<4 signifying well defined and documented standard processes which can be improved over time. These results demonstrated the importance of the leadership dimension to improving organizational readiness to implement the IDMS. In other words, the leadership dimension can be viewed as a driver of all other dimensions, where a high maturity level under this dimension directly correlates with improved maturity in the other dimensions. In order to improve to the next level, the departments ought to focus on the low rated maturity items and dimensions and to provide constant training on IDMS activities.

Practical guidelines to improve organizational readiness to implement the IDMS are presented in the study. Furthermore, it was found that establishment of an organization's maturity level equips leadership with the right knowledge to make informed decisions, and this could help in formulating strategic plans and in fostering these organizations to effect necessary changes. Additionally, the

organization could potentially relook at the organizational theories and management models they utilize, which in some instances could be hindering organizational success. A practical example of an improvement plan which organizations can adapt to address the challenges they are faced with is also presented.

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CHAPTER 1
INTRODUCTION

1.1 Background

Infrastructure is the fulcrum of a strong economy (Quarterly Bulletin, 2012 and Calderon and Serven, 2004). It has long been recognized that infrastructure delivery and accumulation is pivotal in the promotion and determination of growth of a nation (Calderon and Serven, 2004). Furthermore, most governments around the world, together with various scholars concur with the notion that infrastructure is the backbone of any economy as it influences societal value (OECD, 2015; LPEPAU, 2012; DBSA, 2012; and Quarterly Bulletin, 2012). This concurrence is largely because infrastructural investments directly impact on some elements of expansive socio-economic developments, and that infrastructure is a profound determining factor of a nation's success, through growth and overall development (Department of Public Expenditure and Reform in Ireland, 2011; Fasoranti, 2012). Blom (2017) indicated that infrastructure underpins a nation's inclusive growth through support for diverse economic activities, thereby serving as a reflection of a nation's economic power. In other words, infrastructure is a critical and fundamental prerequisite for economic growth and power. It can therefore be construed that infrastructure can be used as a benchmark to measure a country's likely prosperity (SAICE, 2011). Australian Government: Department of Infrastructure and Transport (2012) further indicated that when infrastructural projects are adequately delivered and resourced, a nation's economy is revived, with added benefits to its citizens. Therefore, the link between social and economic development and infrastructure delivery is apparent (Civilution, 2016).

On the other hand, the paucity of and lack of adequate infrastructure, inter alia impedes a country's growth and development (Rust et al., 2008; Fedderke & Garlick, 2008; Fasoranti, 2012; Ehlers, 2014). For most developing nations, the infrastructure gap, that is, "*the amount of investment required to meet core infrastructure needs*", is large and on the rise (Corporate Africa, 2019). Even more so, it is evident that infrastructure development in these developing nations is characterized by its slow progress (Hagerman, 2012). The situation is further worsened by delays in the realisation of the need for and implementation of infrastructure which leads to dire economic and social costs (Ehlers, 2014). Examples of such costs include; crime, corruption, and financial market constraints (Foster, 2008). In most countries of the developing world, infrastructure has been cited as the major curtailment of business growth and productivity (Escribano et al., 2008). Therefore, most of these countries have embraced and focused on accentuating and prioritizing infrastructure delivery and management, as infrastructure's contribution towards sustained economic growth remains indisputable (World Bank, 2007). This could be attributed to the large infrastructure deficits which have brought about the need for extra infrastructure in many developing countries (Foster and Briceno-Garmendia, 2010).

According to Hassen (2000), there are purportedly two schools of thought regarding infrastructure delivery. The one school of thought suggests that infrastructure delivery aims at "*meeting basic needs, within fiscal constraints*", and that successful delivery is only attainable upon inclusion of the private sector (Ibid). The framework of fiscal constraints is concerned with ensuring that a country's infrastructure delivery stimulates national development within fiscal constraints (Department of Public Expenditure and Reform, 2011). On the other hand, infrastructure delivery has been viewed as a tool that stimulates economic growth, social inclusion and human development, through the eradication of poverty, fostering income equality and employment creation (OECD, 2015; Hassen, 2000; LPEPAU, 2012).

The South African government has prioritized spending on infrastructure development and improvement to support its economic growth and development plans (National Treasury, 2017). This fact is supported by the Policy Brief (2015) which indicated that the government was concentrated on ramping up public capital expenditure with an increase on infrastructure expenditure being the solution to a more robust and competitive economic market. During the 2012/13 fiscal year, infrastructure accounted for about 8% of Gross Domestic Product (GDP) (DBSA, 2012). Despite the high contribution infrastructure has on GDP, the SA government plans to further increase this percentage contribution to 10%, with the most focus placed on transport, energy, and water sectors (NDP2030, 2011). Furthermore, the government has continued to make a huge construction spend commitment as witnessed by the steady average annual increase of 6.8% in the funding allocated to infrastructure spending from 1998/99 to 2015/16 fiscal years (National Treasury, 2017). This average annual growth rate is expected to continue, resulting in an expenditure forecast of R244 billion by 2019/20 fiscal year, with higher focus on the infrastructure sector and industry (Ibid). The projected growth in infrastructure investments is further supported by CIDB (2007a) which predicted a growth rate of about 10% to 15% per annum within the near future.

Historically, governments around the world have been the major financiers and owners of infrastructure, and they deliver subsidised services to certain population groups on equity or other grounds (Chan et al, 2009). Therefore, as argued by DPME (2014), the discernible spatial and disparate distribution of infrastructure under the apartheid government is evident. Typically, in the post-1994 era, the government of South Africa realized the imbalances in infrastructure distribution and therefore prioritized the need to provide services to all its communities fairly and with equality (Bolton 2006; SAICE, 2011; DPME, 2014), largely because of huge public service backlogs in the previously disadvantaged black communities. A Municipal Infrastructure Investment Framework report for the period 2009/10 by DBSA (2011) consolidates the status of service backlogs as confirmed by the respective government departments, and it brings to light the percentile of backlogs with respect to service per sector as follows; Housing: 17%, Water supply: 9%, Sanitation: 24%, Electricity: 27%,

Solid waste: 7%, Roads: 75% of access roads in poor and Public Services: 12% and 65% inadequate in urban and rural areas respectively. The report covered the period 2009/10, that was 15 years post-apartheid, but the backlog was still an issue and is to this day being experienced (Policy Brief, 2015; DPME, 2014)

In response to levelling the imbalances and curbing the backlogs, when South Africa attained its democracy in 1994, it focused on transparency and service provision based on non-discrimination (Policy Brief, 2015; DPME, 2014). As a result, the Government re-evaluated its fiscal budget and allocations and prioritized on increasing the number of people with access to bulk economic infrastructure, thereby resulting in growth rates and improved quality of life of its citizens (Ibid). Additionally, the South African Constitution was also drafted to ensure that it upheld every citizen's right to access basic services such as health care, water and housing (South Africa Constitution, 1996). However, despite onerous interventions and remedies proposed and/or implemented by the government as a panacea to the problems associated with the dire, inadequate and in some worst cases, repugnant infrastructure, there remain tremendous shortfalls and inadequacies in infrastructure, thereby rendering it insufficient to nurture overall national growth.

1.2 The Infrastructure Delivery Management System (IDMS): A Brief Overview

The Infrastructure Delivery Management System (IDMS) is a government model formulated in 2004 to ameliorate infrastructure delivery. According to CIDB (2010), the IDMS acts as a benchmark and guide for best practice delivery of infrastructure management throughout all government departments. It describes the processes and procedures to be adhered to for public sector delivery and procurement management within the construction industry (WCG, 2010). It is a standardized approach, to the "*planning, budgeting, procurement, delivery, maintenance, operation, monitoring and evaluation of infrastructure"* (National Treasury, 2012).

The IDMS was formulated mainly to address the need for improved and adequate quality infrastructure and to curb the various challenges affecting infrastructure delivery. The main objectives of the IDMS could be summarized as; (i) to provide a benchmark through fostering best practice, (ii) to foster improvement in the delivery of infrastructure, (iii) to address skills deficiencies, (iv) to ensure a balance in infrastructural roll outs, (v) to enhance cost effectiveness, and (vi) improved infrastructure planning

1.3 Problem Statement

Effective, adequate and efficient infrastructure is fundamental to South Africa's prosperity and economic growth. This is more so as infrastructure is considered important by the government and government-owned businesses as it is a means to deliver services to citizens (SIPDM, 2015; CIDB, 2007b; CIDB, 2010). However, dubbed as "*the protest capital of the world*" by politicians and the

media, South Africa has frequent cases of public unrest and protests in the world (Bianco, 2013). These protests can take different forms and can include mass gatherings and meetings, drafting of memoranda, staying away from work, looting, destroying infrastructure and vehicles to mention but a few.

Although there are myriad issues which have been identified as contributing to the surge of these protests, reportedly, most of the protests are largely as a result of deficits in infrastructural installations which consequently result in poor service delivery which is predominant in the forgotten and underdeveloped townships, with the protesters requesting access to basic services such as, clean water, and housing (Parliament of RSA, 2009; Booysen, 2007). These protests can be regarded as rebellions and retaliations by the indigent as a plight against the socio-economic imbalances and inequalities in South Africa. The act of rebellion reinforces the notion that; when citizens are treated unfairly by those in authority, rebellion is duty. Based on calculations by Allan and Heese (2011) which were based on the National Treasury budget, there is a worrying disparate gap of annual expenditure per resident with those residents in affluent areas averaging about R4,500 per resident and those in impoverished areas averaging as low as R350 per resident. The findings from a more recent study conducted by StatsSA (2017) confirmed earlier findings by Allan and Heese (2011) which indicated that the distinct gap remains in expenditure per resident based on geographical location. StatsSA (2017) found that the average expenditure in metropolitan municipalities was between R8 035 and R8 446 per resident, as compared to just below R1 000 in predominately rural municipalities.

With the rise in public dissatisfaction and protest action, the fact that the government is experiencing challenges in delivering adequate infrastructure and services is evident (Allan & Heese, 2011). A typical example which stands as evidence of the appalling state of infrastructure in South Africa was cited by Draga (2017: 238) who focused on educational infrastructure and stated that, "*Crumbling classrooms, horrendous bathrooms, cracked fences, and non-existent libraries and laboratories remain a reality for thousands of school-going children across South Africa"*. The factors inhibiting the effective delivery of infrastructure were brought forward by the Parliament of RSA (2009) and were broadly categorized into:

- systemic such as maladministration, lack of capacity, fraud, nepotism and corruption in housing lists;
- structural such as healthcare, unemployment, recession and land issues; and governance such as weak leadership and the erosion of public confidence in leadership.

The irony of infrastructure investment in South Africa is that despite the reported high expenditure in infrastructure, the under-spending of budgets is highest in poor communities which require large expenditures (Allan and Heese, 2011). Furthermore, although the South African government has made

remarkable progress through the formulation of measures to curb poverty and inequality, the nation still has immense backlogs and shortfalls in public infrastructure (Policy Brief, 2015).

The South African government has made remarkable progress to support its economic growth and development plans and introduced recent enabling legislation and guidelines. However, in the process reducing poverty and inequality, it is still plagued with tremendous backlogs and shortfalls due to considerable bottlenecks, as a result of several systemic challenges that inhibit the effective delivery of infrastructural installations, the causes of which have not necessarily been identified or understood. Furthermore, there is severe persistence of infrastructure challenges facing the South African landscape despite numerous government interventions to scale up infrastructure delivery. The Infrastructure Delivery Management System (IDMS) has not been adequately utilized so as to achieve its full effectiveness and efficiency, potentially due to deficiencies in institutional capacities and capabilities and the lack of organizational readiness to utilize this model. Suffice to note is the reality that the challenges of infrastructure in South Africa are not primarily attributed to lack of funding but are as a result of institutional failures and a lack of requisite capacity within the Public sector (National Treasury, 2012). Therefore, the problem can be stated as:

'The Infrastructure Delivery Management System (IDMS), a government tool formulated to aid in the effective delivery of public infrastructural installations is not adequately implemented by public departments to achieve its effectiveness.'

1.4 Original Contribution to Knowledge

Identification of a knowledge gap is critical to undertaking a successful research study, as it is critical to the investigation of any problem. According to Miles (2017), there are seven research gaps, namely; (i) Evidence Gap, (ii) Knowledge Gap, (iii) Practical-Knowledge Conflict Gap, (iv) Methodological Ga, (v) Empirical Gap, (vi) Theoretical Gap, and, (vii) Population Gap. The researcher identified an empirical gap in prior research. According to Müller-Bloch & Kranz, (2014), this type of gap is concerned with gaps from studies previously undertaken, and its applicability is most dominant in cases where no prior study to date has directly attempted to evaluate a subject or topic from an empirical approach.

Since this study is the first of its kind in South Africa to assess the maturity of public entities to implement the IDMS, which is indicative of an evaluation void gap, the empirical gap is best suited. Furthermore, it is the first study which has developed a practical tool which public organizations can utilize to measure their maturity and to establish the areas in need of improvement. An empirical investigation of these issues is important so as establish the maturity levels of the public entities, which once assessed will provide an indication of the areas to improve on, ultimately improving the maturity

of organizations to implement the IDMS. Noteworthy to mention is that, previous research pertaining to assessing the maturity of organizations has been widely in the Software, and Project & Programme Management industries Willis & Rankin (2010) and Grim (2009), and not to infrastructure delivery. Very little empirical research has been done on assess the maturity of South Africa's public sector to implement the IDMS.

1.5 Research Questions

The key research question can be stated as:

What can be done to improve public sector infrastructure delivery?

Due to the key research question being broad, it was split into four research questions which are outlined below.

1. What are the contributions of the IDMS towards effective public infrastructure delivery in SA?
2. What is the state of readiness of public sector organizations to engage with effective implementation of the IDMS?
3. What are the factors influencing the state of organizational readiness observed?
4. How can the state of organizational readiness be improved upon to gain maturity?

1.6 Aim

This study aims primarily to develop and validate a maturity model for assessing and improving public sector organizations' readiness for effective IDMS implementation.

1.7 Objectives

To achieve its set aim, the study shall seek to achieve the following objectives, namely:

1. To establish the contributions of the IDMS towards effective infrastructure delivery in South Africa.
2. To determine the state of readiness of public sector to effectively implement the IDMS.
3. To investigate the factors affecting the state of organizational readiness by public entities to implement the IDMS
4. To establish how the state of organizational readiness can be improved upon to gain maturity.

Table 1-1 illustrates how the study research questions and objectives align.

Table 1-1: Alignment of the study Research Questions and Objectives

Research Questions	Objectives
1. What are the contributions of the IDMS towards effective public infrastructure delivery in SA? 2. What is the state of readiness of public sector organizations to engage with effective implementation of the IDMS? 3. What are the factors influencing the state of organizational readiness observed? 4. How can the state of organizational readiness be improved upon to gain maturity?	1. To establish the contributions of the IDMS towards effective infrastructure delivery in South Africa. 2. To determine the state of readiness of public sector to effectively implement the IDMS. 3. To investigate the factors affecting the state of organizational readiness by public entities to implement the IDMS 4. To establish how the state of organizational readiness can be improved upon to gain maturity.

1.8 Research Scope and Limitations

This aimed to primarily to develop and validate a maturity model for assessing and improving public sector organization's readiness for effective IDMS implementation. Upon model development and validation, the study assessed the maturity of provincial government departments in engaging with the extant IDMS and it formulated evidence based interventions to improve delivery and management of infrastructure projects. The scope of information gathered was limited to South Africa and it was based on perspectives and insights obtained from questionnaire surveys and interview respondents, namely, individuals in managerial and/or senior level capacity with the expert knowledge regarding IDMS implementation. It is anticipated that the status of infrastructure delivery varies across public organizations due to the expansive skills and organizational capabilities, management models and directives across Provincial Government Departments. This research focused on the three Provincial Government Departments which utilize the IDMS, namely Department of Public Works, Department of Education and Department of Health within the KwaZulu-Natal region to try to establish their level of readiness in the implementation of the IDMS. The model developed from in this study can be adopted to other Provincial Departments across the nation with the prospective of improving their level of readiness in implementing the IDMS.

Furthermore, the study also intends to establish the institutional and capacity challenges affecting infrastructure delivery. Lastly, the study aims at formulating solutions to curb infrastructure challenges resulting from the inefficient implementation of the IDMS, which subsequently lead to infrastructure deficits and inadequacies.

The research had several limitations which are listed as;

- Small sample size as a result of the specialist or expert input required from the study participants. Only those individuals with vast experience and detailed knowledge of the IDMS had the capability to partake in the study, thereby significantly limiting the number of participants.

- The study was confined to KwaZulu- Natal only due to the short survey period for information gathering and data collection as stipulated for the doctoral study programme. This short survey period had an impact on the research findings considering that a vast number of infrastructural installations are delivered over long-time frames.

- The Covid-19 Pandemic greatly impacted the candidate on the undertaking of some key research processes mostly affecting the research methodology chapter. As a key limitation. some of the individuals who were identified as key to providing information in relation to IDMS implementation were not available to contact. Furthermore, data collection was negatively impacted as one of the tools for data collection were interviews, and the candidate was not afforded the opportunity to conduct face to face interviews but rather telephonic interviews only.

- Due to the sensitive nature of some of the challenges/bottlenecks inhibiting infrastructure delivery such as, mal-administration, fraud, nepotism and corruption, some of the survey participants were not keen on addressing questions related to these aspects.

Units of Analysis for the Study

The units of analysis of the study are public organizations that implement the IDMS. The survey respondents will be individuals in management / leadership positions overseeing the implementation of the IDMS activities and the actual operational units tasked with performing IDMS activities. After descriptive statistical analysis has been conducted on the data collected from the units of analysis, inferential statistical analysis will be used to generalize the findings to the entire population.

1.9 Assumptions

The key assumptions of the study can be stated as;

- All public organizations are able to effectively implement the IDMS
- If the IDMS is effectively implemented, it could enhance improvement in infrastructure delivery

- Research participants will adhere to ethical procedures of the research and will respond to the maturity modeling questionnaire and interviews in an honest and candid manner.
- The research sample will be a true representative of the population

1.10 Significance of the Study

This study concentrates on public infrastructure delivery and initiatives that can be adopted to improve infrastructural projects. The significance of this research is underpinned in the notion that adequate infrastructure has been linked to improving the economic environment and societal well-being which entails, inter alia, higher life expectancies, eradication of poverty, job creation and minimization of crime, by ensuring equality and fair distribution of infrastructure regardless of discriminatory factors such as race, gender or political affiliations.

Furthermore, cognizant of the fact that every human being has rights with respect to basic human needs and the constitution was drafted to ensure continuous improvement of the lives of all citizens, this study finds its significance by formulating ideas that could impact on the improvement of infrastructure delivery to ensure that the rights of each citizen are upheld and that each citizen lives within the minimally accepted standards as set out in the constitution of the Republic of South Africa.

This study will not only demonstrate that although South Africa is almost a quarter of a century since it gained independence, the infrastructure stock is insufficient to carter for the entire population and the indigent members of society who happen to be the majority live in shanty areas and are plagued with inadequate and dilapidated infrastructure, with limited access to basic services. This study is of significance as it seeks to establish ways of bridging the infrastructural distribution gap between the rich and poor by proposing possible areas of improvement to ensure that infrastructure is distributed fairly and that all citizens have access to basic services. The problem of inadequate and dilapidated infrastructure is not isolated to South Africa only, but spreads across all developing nations and is a tale all too familiar. Developing countries have limited infrastructure to address serious national problems such as poverty and poor health care and education provisions. The extant infrastructure is inadequate to service the available population, yet population growth is on the rise in these countries, further worsening the infrastructure challenges. Finally, the study will provide insight and findings that have the potential to create actionable outcomes which can be used and easily adopted by policy makers and/or the individuals pioneering infrastructure delivery to improve the delivery of infrastructural installations. It is also significantly important to note that some findings of extant studies may have relevance in the South African environment; albeit the relevant findings ought to be tested.

1.11 Research Methodology

The study will assess the maturity of provincial government departments in engaging with the extant IDMS. The study further seeks to examine organizational readiness of these departments to engage with the IDMS in a manner that engenders the effective and optimal delivery of infrastructure assets and associated services to communities. Evaluation of the systems, processes and human interactions that are in place within such organizations; will assist in diagnosing the problems that are inherent in these organizations and will aid in the improvement of their efficiency and functionality.

A mixed methods research approach was adopted for the study, by making use of two data collection methods, namely; structured maturity modeling questionnaires and semi-structured interviews. Maturity modeling was used to assess the maturity of public sector entities to implement the IDMS so as to achieve improvement in infrastructure delivery. Maturity modeling was critical for assessing the maturity of these entities' performance by relating the maturity of a set of management and key operation processes inherent to infrastructure delivery, specifically in engaging with the IDMS with the aim of ensuring effectiveness and optimization of its usage. The entities were rated on five maturity levels ranging from level 1, initial (ad-hoc) - which denotes a total lack of attributes, to level 5, optimized - which represents world class required attributes. The rating was conducted against the nine dimensions/critical success factors of a maturity model. Once an organization's maturity level was determined, the organization ought to continuously strive to improve its processes through transitioning from one level to the next in pursuit of delivering improved outcomes. The main objective of a maturity model is to drive process improvement, and maturity modeling can be used as a control measure to ensure that processes are consistently adhered to within an organization, and these foster management excellences.

The questionnaire survey was structured and was administered to the selected sample, made up of individuals in managerial positions with experience and understanding in implementation of IDMS activities; to establish the extent of organizational readiness to utilize the IDMS. The literature review provided a foundation for maturity modelling. Semi-structured interviews were conducted to validate the findings from the questionnaire survey and to provide an in-depth understanding and narrative of the topic under study

Literature review was critical to this study as it unpacked what is already known about the subject. The review involves, books, journal articles, conference proceedings, policy/legislative documents of South Africa and dissertations and theses. The theoretical framework established the conceptual link and provided visual depiction of the relationships between the maturity of an organization and the nine dimensions of a maturity model. Maturity modeling aided the understanding of IDMS utilization utilization as well as with diagnosis of organizational capabilities and readiness in utilizing the IDMS,

and could establish possible points of improvement in its utilization. Thereafter, the results obtained from the study data analysis were used as input into the development and validation of the theoretical model respectively.

The structured nature of the research instruments makes data analysis and presentation easy; and the research findings enabled the formulation of evidence-based interventions to improve delivery and management of infrastructure projects.

1.12 Structure of the Thesis

This thesis consists of nine chapters in the order outlined:

Chapter 1 is an introductory chapter which broadly outlines and presents the research components of this thesis. Comments on the factors that initiated the research, its scope, purpose, methodology and significance of the study are outlined herein.

Chapter 2 explores extensive literature review of the study framework obtained from extant data sources such as textbooks, conference proceedings, journals, previous research theses and case studies. This chapter addresses the critical components of the study and it will adopt the funnel viewpoint by firstly considering the world view then narrowing it down to the South African context. It will cover topical areas which include but are not limited to; definition of infrastructure and the associated typology and characteristics thereof, the nexus between infrastructure and national development and drivers for improving infrastructure investment globally, infrastructure and infrastructure delivery models, success factors for effective delivery and challenges. Detailed findings from prior studies pertaining to the study area also contribute significantly to this research.

Chapter 3 is concerned with the political legislature and regulatory framework in which infrastructure delivery occurs. An in-depth discussion of the evolution of infrastructure delivery in SA from a governance and legislative framework perspective is scrutinized. The various administrative/governance and legislative framework which have been employed to improve infrastructure delivery, their potency or lack of, will also be discussed. Lastly, the success factors and shortfalls of these interventions will be discussed.

Chapter 4 will provide an insight into the various organizational theories and management models, their pros and cons as applied to organizations. The importance of organizational capabilities coupled with organizational capacity building are further outlined in this chapter.

Chapter 5 is the conceptual model chapter and discusses the maturity modeling concept and how the model could be applied to determine the readiness of public organizations to engage IDMS activities. This chapter will further portray the nexus between organizational readiness of the government

departments and the effective/optimal engagement with the IDMS to deliver infrastructure and infrastructure services to different communities. A maturity modeling standardized questionnaire will be developed and distributed to practitioners and researchers with understanding and experience with IDMS engagement.

Chapter 6 discusses the research methodology employed, the data collection techniques used, and the nature of data collected. Knowledge of research paradigms, research designs and methodologies will enable the researcher to employ the appropriate strategy and justification of the method utilized will be discussed.

Chapter 7 is the data analysis chapter and lays out detailed discussions of the study findings from the deployment of the maturity modeling questionnaire survey and interviews. Intra case and cross case analysis of the government departments and their maturity ratings are discussed in this chapter.

Chapter 8 seeks to provide guidelines for assessing and improving organizational maturity in relation to IDMS implementation. Furthermore, the nexus between study findings and extant literature, including the study's contributions to the body of knowledge are discussed in this chapter.

Chapter 9 concludes the study and sets forth recommendations and implications of the study. This chapter also sets out suggestions for adoption by policy makers to enhance improved infrastructural delivery not only in South Africa but in developing countries as a whole and proposes possible areas for future study. It is hoped that the research findings will provide information which will facilitate improvement in infrastructure delivery.

CHAPTER 2
INFRASTRUCTURE DELIVERY

2.1 Brief Chapter Overview

This first chapter of literature review will provide in-depth discussions and descriptions of the pertinent issues within the ambit of this study. The funnel view will be adopted by broadly taking into consideration the global viewpoint of the related issues under study which will then be narrowed to the South African context. The topical areas to be discussed include, among other factors; definition of infrastructure, its associated typology and characteristics thereof, the nexus between infrastructure and national/sustainable development, drivers for improving infrastructure investment globally, infrastructure and infrastructure delivery models, components of such models/systems, success factors for effective delivery and challenges. Detailed findings from prior studies pertaining to the study area will also be discussed.

2.2 Definition of Infrastructure

It has been indicated that infrastructure is an input to many industries and, its importance in driving a nation's long-term growth is apparent (Ehlers, 2014). Infrastructure provision entails infrastructure investment, funding and financing; which all contribute to economic efficiency (Chan et al., 2009). Torrisi (2009) highlighted that although the impact infrastructure has on the economy has been widely researched, not much has been said about what infrastructure actually is. According to Quarterly Bulletin (2012), in economic terms, infrastructure is referred to as "*gross fixed capital equipment or formation*". In simpler terms, this can be understood as the *"addition of fixed assets less the disposal thereof"* (Ibid). Chan et al. (2009) indicated that the term infrastructure included diverse types of physical structures which serve as inputs to many industries. This description takes into account *"social infrastructure*" and *"economic infrastructure"* (Ibid).

According to SIPDM (2015), infrastructure delivery can be described as;

> *"…. the combination of all planning, technical, administrative and managerial actions associated with the construction, supply, refurbishment, rehabilitation, alteration, maintenance, operation or disposal of infrastructure."*

Reungsri (2010) defined infrastructure as public capital which includes public buildings such as hospitals and schools; all transport nodes and networks and utility services such as water, power and waste services. On the other hand, OECD (2015) put forth the definition of infrastructure as;

> *"…. facilities, structures, networks, systems, plant, property, equipment, or physical assets – and the enterprises that employ them – that provide public goods, or goods that meet a politically mandated, fundamental need that the market is not able to provide on its own."*

The definition of infrastructure as put forth by Khumalo et al. (2017) is:

> *"… set of facilities and systems that are necessary for a community to function*", which include; roads, sanitation, electricity, water supply, telecommunication system, health and education facilities, shopping facilities, sport and entertainment facilities, security and police service.

OECD (2015) highlighted the clear correlation between public infrastructure and the provision of indispensable public services in most countries. In addition, it is worth mentioning that delivery and accumulation of infrastructure can take diverse timeframes with some spanning over a mere few years and others spanning over generations and centuries (Reungsri, 2010).

2.3 Characteristics of Adequate Infrastructure

Infrastructure facilitates and supports diverse human activities and should generally be accessible to the public without bias or discrimination (Frischmann, 2008). It should be noted that although infrastructural installations should be accessible to all, they do not necessarily have to be free, but rather affordable (Frischmann, 2008). Lall and Anand (2009) opine that infrastructure is characterised by *"non-recourse or limited recourse financing"*, and this is a scenario whereby investors are only paid from revenues generated from the activities of the infrastructure. According to Hassen (2000), it has been argued that infrastructure resources often have the following three characteristics, namely:

- the resource can be shared freely and fairly by all members of the public,
- there is social demand for the resource in which it creates social value; and
- the resource is used as an input into the production of a wide range of goods and services.

It is imperative that infrastructure, especially new, to be sustainable, technologically to date, appropriately timed and located, within cost, and easily accessible by its intended users (WFEO, 2010).

2.4 Global Perspective

Globally, infrastructure is retaining its priority recognition after focus had been primarily placed on health and HIV/AIDS programmes (Hagerman, 2012). This comes after the realization that the availability of properly maintained efficient infrastructure impacts positively on the general health and well-being of human lives. From an African perspective, with governments' plans to ameliorate infrastructure at the peak, several initiatives that focus on infrastructure have been implemented and examples of these initiatives include the Presidential Infrastructure Champion Initiative (PICI) and the World Bank African Infrastructure Country Diagnostic (AICD) study. Collectively, African nations

strive to eradicate poverty, through among other factors, the construction of robust transport infrastructure networks, which are key to African development and growth through, for example, facilitation of both intra-regional and international trade.

Arguably, with Africa being a major source of raw materials, minerals and oil, provision of infrastructure, namely roads, rail and power stations, that are needed for the extraction and transportation of raw materials to the intended markets, is of paramount importance. Reportedly, the benefits of these infrastructural installations do not always extend to the local communities (Hagerman, 2012).

2.4.1 Typology of Infrastructure

Public infrastructure impacts on both government and its citizens as it is concerned with the effective delivery and/or provision of key public services which include but are not limited to facilities, transport, electricity, water supplies, sports, telecommunications, science & technology, schools and hospital infrastructure (OECD, 2015; Quarterly Bulletin, 2012; Smith & Lomba, 2008). According to Spacey (2017), infrastructure can be classified as either hard or soft infrastructure:

- Hard infrastructure entails the large physical networks, such as roads, which enable the proper functioning of a society, and,

- Soft infrastructure refers to all the service offering institutions which are required to maintain the standards of a country to ensure that all citizens have access to basic services and are treated fairly and impartially, such as the education system, the health system, the governance system, and the security system

On the other hand, the Department of Public Expenditure and Reform in Ireland (2011) categorized infrastructure into four branches, namely;

- Economic infrastructure – entails buildings which necessitate the conduction of business transactions and it encompasses the provision of services such as transport networks (rail, ports & roads), energy (electricity sector) and telecommunications capacity. It is imperative that economic infrastructure is robust and extensive so as to meet the ever increasing industrial, commercial and household needs (NDP2030, 2011; Chan et al. 2009; Department of Public Expenditure and Reform in Ireland, 2011). Transport infrastructure, a sub-category of economic infrastructure is critical to economic growth and as such, it has been reported that in New Zealand, transport infrastructure account for almost 5% of New Zealand GDP (Ministry of Transport: New Zealand, 2014).

- Investment in the productive sector and human capital – encompasses factors such as training, research & development, and enterprise development, innovation advancement, and capital investment in education infrastructure (Department of Public Expenditure and Reform in Ireland, 2011).

- Environmental infrastructure – this includes provision for waste and water systems and investment for environmental sustainability (Frischmann, 2008). Although infrastructure is crucial for development and overall value of a city, the down side of such installations is that, if not adequately implemented and maintained, they often lead to environmental degradation, with effects and damaging consequences which include, inter alia, global warming, water pollution, erosion, waste generation and biodiversity loss (World Bank, 2007; SAICE, 2011; Department of Public Expenditure and Reform in Ireland, 2011).

- Social infrastructure – these are buildings that support social activities and within a community and include provision of services within the health care facilities, and social sectors such as housing programmes and educational facilities, e.g. public schools (Frolova et al., 2016)

2.4.2 Nexus Between Infrastructure and National Development

Empirical evidence abounds which highlights the apparent linkage between infrastructure and the development of a country through productivity and stimulation of private investment (LPEPAU, 2012). The fact that infrastructure plays a pivotal role in achieving national development goals cannot be overly emphasized (LPEPAU, 2012). Generally, all countries strive to grow in economic terms and infrastructure is a large contributor to overall economic development (Ibid). Uncertainties in other industries such as trades and exports in driving growth have driven most countries to re-strategize and focus on alternative factors that could expand their economies internally, for example, through infrastructure development (Quarterly Bulletin, 2012, WEF, 2012). Notwithstanding that, improvements in infrastructure facilitate domestic and international trade which ultimately promote sustainable growth (Calderon and Serven 2010). Arguably, infrastructure ensures that a country effectively functions; that is, taking into consideration the physical, economic and social aspects (Ibid). In some instances, infrastructure yields high rates of return on investment thereby impacting on national income and overall national growth (Ibid). Quarterly Bulletin (2012) postulated that during periods of recession and economic downturns, governments tended to drive labour intensive infrastructural projects as a means to create employment and stimulate national growth.

According to WEF (2012), infrastructure is one of the twelve pillars used as determinants of a country's productivity and competitiveness. Infrastructure is responsible for determining and positioning the economic hubs of a country (Ibid). Importantly, improved infrastructure development especially in the

transport and communications sectors is key for national development especially in emerging economies as it integrates markets and facilitates ease of access of the general public to economic hubs (Bhattacharya et al., 2014; Quarterly Bulletin, 2012 and WEF, 2012). Well-developed infrastructure sectors augment economic efficiency and impact national development, and the manner in which they do so is as follows (Ibid);

- Transport infrastructure – reduces the effect of distance in terms of both time and costs associated with travel and necessitates for timeous transportation of people, commodities and services to the desired designations, (Ministry of Transport: New Zealand, 2014; WEF, 2012; Bhattacharya et al., 2014). It ensures better public transport experience, bridges the inequality gap by facilitating the poor to access job opportunities and reduces traffic congestion thereby decreasing carbon emissions (Bhattacharya et al., 2014).

- Telecommunications infrastructure - allows for timeous flow of information which is essential for business operations

- Electricity – constant supply of electricity for the effective operation of businesses.

In a study of infrastructure development in Indonesia, LPEPAU (2012) indicated that the government having realized the importance of infrastructure, prioritized not only on ensuring that local governments provided facilities that supported business activities, but also increased overall infrastructure budget allocations. This prioritization is evident as infrastructure allocation was ranked third in public expenditure priority. The results of the study further concluded that in districts with high infrastructure expenditure, infrastructure investment supported economic growth, albeit the growth was insufficient to eliminate unemployment. On the other hand, it was also found that in districts with low infrastructure allocation there was minimal economic growth and therefore overall national development was limited.

The effect of infrastructure, particularly, transport infrastructure on national growth was further highlighted by Jedwab et al. (2017) in their study of Kenya wherein it was found that infrastructure investment enhanced long-term economic gains through the reduction of trade costs and integration of local markets, thereby positively impacting the poorer regions. A similar study of road infrastructure in Indonesia, found that infrastructure increased productivity and reduced poverty; with the poorest benefiting the most (Khandker et al., 2009)

2.4.3 Drivers for Improving Infrastructure Investment: Capacity and expertise

Previous research has emphasised on the link between project success and the availability of experienced project team members with the required expertise in the "*form of intellectual capital"* Australian Government: Department of Infrastructure and Transport (2012). This entails the combined

effort by the project team to address any anticipated project risks and/or challenges that are bound to occur during the life cycle of the infrastructural project (Ibid).

In most developing countries, South Africa included, the construction industry is beset by the lack of capacity of experienced individuals, thereby leaving a huge knowledge gap (Policy Brief, 2015; Foster, 2008; CIDB, 2007a). Bhattacharya et al. (2014) further pointed out that due to restricted institutional capacities, cost and time overruns are immanent in the majority of infrastructure projects, and escalate project costs by 20–50 percent, thus increasing overall project risks and costs. This could be partly attributed to the limited investment in human capital development and brain drain which is because of the emigration of highly qualified individuals, leading to skills shortages within the industry (CIDB, 2007a). Ideally, when the knowledge gap is identified, it is advised that key stakeholders with the knowledge, be introduced into the project to maximise the chances of successful project delivery and securing the benefits (Australian Government: Department of Infrastructure and Transport, 2012).

Reportedly, the increase in infrastructure investment in South Africa has resulted in job creation, thereby elevating the challenge of securing qualified personnel with the requisite skills (CIDB, 2007a). Typical examples of scenarios which highlighted this lack of expertise and skills shortage in South Africa were the construction of the Gautrain Rail Link and stadiums for the 2010 Fifa Soccer World Cup (Ibid). The report concluded that the construction of these projects required skilled expertise that required considerable amounts of time to develop to the required levels, which evidently were in shortage and therefore sourced on the international market. According to Quarterly Bulletin (2012), capacity constraints in South Africa are perceptible especially during the construction of complex structures such as power stations and dams, where the skilled individuals are sourced from other nations. This shortage of expertise can largely be attributed to the poor education structures which resulted from the previously poor apartheid educational systems, which to this day is, the educational environment is entrenched with the challenge of transformation so as to produce competent individuals to match the high-level skills required (DPME, 2014).

2.4.4 Risks Associated with Infrastructure

Due to the large capital outlay required for infrastructural installations, it is apparent that infrastructure investments involve complex risk analysis, risk allocation and risk mitigation (OECD, 2015). Lall and Anand (2009) and (Uppenberg et al. (2011) concur with that notion as they not only cited the large initial capital outlays required but also highlighted on the relatively prolonged periods of time associated with infrastructure delivery, and also that investors are repaid from revenues generated from the projects, indicating that the risks associated with infrastructural installations are apparent. While Calitz and Fourie (2007) and Lall and Anand (2009) identified these project risks as being market and/or business risks, OECD (2015) categorization of infrastructure risks was according to the main source of

the risk, that is whether the risk is political and regulatory, macroeconomic and business, or technical, as detailed out below.

- Political and regulatory risks – These types of risk are as a result of governmental actions, changes in the regulatory framework and policies, or they emerge from the behaviour of government contracting authorities. Examples of political risks include but are not limited to; change in tariff regulation, cancellation of permits and renegotiation of contract/s.

- Macroeconomic and business risks – These risks arise from the possible volatility of the industry and/or economic environment. Examples of these types of risks include, inter alia, inflation, fluctuations in interest and exchange rates and debt maturity

- Technical risks – these types of risks are not only linked to the experience and expertise of the individuals involved but also to features such as project complexity and construction technology. Technical risks include items such as; technology, force majeure, and schedule and cost overruns

Over and above the project risks, there are additional risks which are unique to infrastructure delivery because of the public nature of these projects, which according to Lall and Anand (2009) could include, *"tariff increase reversals due to public unacceptability of the tariffs determined, challenging on environmental clearances, arbitrary reneging of contracts"*. Risks, such as the potential cost associated with project delivery failure and not meeting key project objectives of time, budget, quality and health and safety requirements are embedded in every project (Australian Government: Department of Infrastructure and Transport, 2012). Cost overruns have been cited as common risks in major infrastructure projects, closely followed by the delay in attaining the anticipated benefits from completed infrastructure projects (Ibid). Notably, the nature, magnitude and impact of risks vary across countries, industrial sectors, individual projects and each specific project phase (OECD, 2015).

2.4.5 Infrastructure and Infrastructure Delivery Models

2.4.5.1 Delivery Models

There are ample project delivery methods that can be used to deliver infrastructure projects. Notwithstanding that, it is imperative that the client and consultant team make informed decisions on the choice of method to use, preference being on the method that would yield the best results and value for a project, taking into account the whole life cycle costs (Pakkala, 2002). To add to that, Chan et al. (2001) argued that the delivery method adopted is a prerequisite for optimizing project performance. The various delivery models applicable to infrastructure installations are discussed below:

2.4.5.1.1 Traditional Approach ('Design-Bid-Build' method)

According to Bennet (2003), the client is under two contractual obligations to both the consultants and contractor, and as such there are two procurement processes. Separate design and construction; consultants responsible for design and supervision of the works whereas contractor's responsibility is for construction; hence the poor integration between design and construction (Alharthi, 2014). Historically, infrastructure projects have been implemented using the traditional approach globally Bennett (2003), Regan et al. (2015) and Mathonsi and Thwala (2012). However, by the 1980's its usage has declined drastically as the construction industry has shifted to actively adopting alternative and innovative methods of procurement, especially in the developed nations in the UK, Europe, Asia and Australia (Turina et al., 2008; Jacquet, 2017). Alternative procurement methods are ideal for projects that are long-term and complex with a high-risk probability (Regan et al., 2015)

A study of Finland by Takkala (2002) indicated that, although some government entities had adopted the construction management contracting strategy, county and city-type government departments still predominantly utilized the traditional process, due to availability of high administrative staff. A separate study by Regan et al. (2015) found that the traditional approach in the delivery of public infrastructure in Australia was the default and most favored procurement method.

2.4.5.1.2 Design and Build

Under Design and Build, the client retains the services of a design-builder under a single contract, signifying one procurement process (Schierholz, 2012 and Bennett, 2003). Put in other terms, the contractor is responsible for producing both the design and undertaking of construction activities. This ensures good integration between design and construction and promotes innovation and construction efficiencies. Additionally, early contractor engagement is beneficial to the project as it facilitates better coordination (Watermeyer, 2012; Rashid et al., 2006). The Design and Build procurement method has three variants, namely; direct, develop and construct, and competitive (Mbanjwa, 2003).

A study of Hong Kong conducted by Lam et al. (2012) highlighted that the Design and Build method, due to its less-adversarial characteristic, and the increasing complexity in project design, its usage by the Public Sector to deliver infrastructure projects was on the rise. The study confirmed that the Public Sector was responsible for most of the projects contracted using D&B in the country. A typical example of a project undertaken using the Design and Build in Hong Kong is the Chek Lap Kok Airport constructed in 1997. Notable, the Design and Build method and its variants have been used in many infrastructural sectors, chiefly; water and wastewater, airports, rail and energy/power (Pakkala, 2002). In the USA, examples of projects contracted using the Design and Build include Erie Canal, New York & Ontario in 1825 and JFK International Arrivals Building, New York in 1994.

The findings of a study of USA by, Konchar and Sanvido (1998) cited in Mbanjwa (2003) found that the Design and Build procurement method achieved better cost and schedule advantages and sometimes more desirable quality performance than other procurement methods. Another separate study of Nigeria indicated that the Design and Build method was more cost effective when compare to other delivery methods (Oladinrin et al, 2013).

2.4.5.1.3 Construction Management

Under construction management, the client appoints a construction manager (normally a professional firm) as a point of contact, who will typically be responsible for the project design and co-ordination of the construction activities on site (CIOB, 2010; Mbanjwa, 2003; Davis et al., 2009). According to Oshungade and Kruger (2010), under this arrangement, the client enters into a contract directly with the works contractors, leaving the construction manager taking the role of being more of a consultant than a contractor. Generally, this form of contracting strategy is considered as the least adversarial (CIOB, 2010) and has been argued to offer the best project quality (Oladinrin et al., 2013).

2.4.5.1.4 Public Private Partnerships (PPPs)

The large funding required for most infrastructure projects has pushed many governments to increasingly consider PPPs in a bid to deliver efficient and cost-effective infrastructure and services (Pottas, n.d). The African Infrastructure Country Diagnostic (AICD) enunciated the persistent challenges of financial gaps which require the private sector to complement the public sector on infrastructure financing aspects (Hagerman, 2012). As a result, innovative ways of engaging the private sector to finance the projects are explored, which creating and maintaining an enabling environment to attract private sector investment and addressing capacity deficiencies and policy bottlenecks linked to the development and implementation of Public Private Partnerships (PPPs) (Hagerman, 2012). From an African perspective, apart from South Africa, the use of PPPs is generally not well developed, although it's on the rise. Reportedly, PPPs have intrinsic characteristics which include; shortening delivery times, sharing project risks, achieving better value for money and increasing innovation in infrastructure delivery. The benefits of utilizing the PPPs model include;

- The private sector can utilize their expertise to enhance improved infrastructure development and therefore increase the chances of project success through achievement of project objectives.
- Mobilization of finances for prolonged infrastructural projects.

2.4.6 Financing of Infrastructure

According to Bhattacharya et al. (2015), about US$90 trillion is required for sustainable infrastructure investment over the next fifteen years and a high percentage of these investment needs are for the

underdeveloped emerging nations. Alarmingly, it has become widely known that only a mere four percent of the 500 largest cities in the underdeveloped countries are capable of borrowing from the international financial markets due to their credit unworthiness, with only 20 percent are deemed creditworthy in their local markets (World Bank, 2013). Although the funding and financing of infrastructure development varies from country to country as it depends largely on a country's policies, infrastructure can be financed either through public investment, private debt and/or private equity (Estache et al., 2015). The government of a country has been cited as the major financier of infrastructure and the justification of this financing arrangement is that it is a response to natural monopolies which weaken fair competition as a means to ensure fair and neutral pricing (Chan et al., 2009; Lall and Anand, 2009; Uppenberg et al., 2011; Bhattacharya, 2014). Estache et al. (2015) concur with the assertion as they indicated that although infrastructure investment in most developing countries has been largely financed by national governments; fiscal constraints and competing public spending priorities limit the expansion of public financing. Pottas (n.d) further confirmed that school of thought as he attributed the restricted infrastructure on the African continent to constrained budgets. Bhattacharya et al. (2014) pointed out that the challenges affecting public investment have negative consequences in infrastructure delivery.

Governments have great potential to influence infrastructural investments, and the decisions they make impact on the economic well-being of a country (Productivity Commission, 2006). This is essential especially bearing in mind that funding of some infrastructural projects which span over several years can affect a country's economy (Reungsri, 2010). Furthermore, since infrastructure entails the provision of essential services, and the complexities involved in charging users (especially with the growing acceptance of the user pays principle), for example in the case of roads, these factors justify public provision of infrastructure (Productivity Commission, 2006; Uppenberg et al., 2011). According the World Bank (2006), the extent and nature of government and private sector involvement in infrastructure financing arrangements are determined by either; the level of technical efficiency required, externalities, elements of natural monopoly, and location.

Although, notably the government is the major financier of infrastructure projects (Bhattacharya et al. (2014), increase in private financing through public-private partnerships is undisputed (Estache et al., 2015; Chan et al., 2009; Lall and Anand, 2009; Pottas, n.d). Reportedly, this increase is propelled by insufficient public savings, fiscal constraints facing governments and lack of capacity to implement the large infrastructural projects (Lall and Anand, 2009; Pottas, n.d). Additionally, Uppenberg et al. (2011) indicated that private financing is at its highest ever. On the contrary, Calderon and Serven (2004) opine that there is a general reduction in government public infrastructure expenditure, with no counter rise in private sector expenditure, consequently resulting in the evident infrastructure inadequacies. According to Bhattacharya et al. (2014), the private sector which in most cases, is comprised of large

institutional investors, is responsible for the bulk of infrastructure financing. Bhattacharya et al. went on to affirm that as of 2014, it was estimated that US$110 trillion of investible assets belonged to the private sector globally, of which about 65% of that amount was dedicated to infrastructure investment. The following figure is a representation of the percentage split of the projected US$110 trillion according to the private sector class taxonomy.

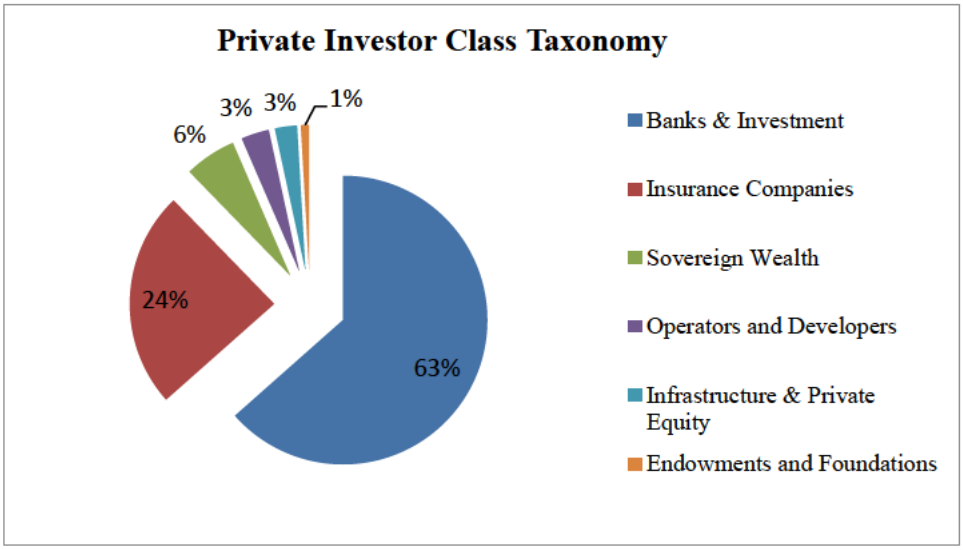

Figure 2-1: Private Investor Taxonomy (Source: Bhattacharya al. 2014)

Generally, private investors prefer engagement in attractive, stable, relatively low risk and high priority projects with strict adherence to proposed completion dates to ensure reasonable payback periods (Bhattacharya et al., 2014; Pottas, n.d). To ensure private sector participation and involvement, governments need to put forth regulatory frameworks that stimulate private sector engagement and the government ought to be well informed of the specific incentives, information problems and risks that confront private investors in infrastructure (Uppenberg et al. 2011; Calderon and Serven, 2004). Furthermore, the importance of guaranteed long-term policy stability and revenue certainty can never be overemphasized as they are some of the critical factors which private investors take into consideration before committing to a project (Pottas, n.d). It is therefore important that governments make informed fiscal decisions as to whether infrastructure should be financed through taxes or loans (Calitz and Fourie, 2007).

According to a study conducted by Uppenberg et al. (2011), it was indicated that because of the 2008/9 financial and economic crisis, many countries in Europe and beyond were left in huge public debt leaving them to find alternative sources of financing for their infrastructure investments. Bhattacharya et al. (2014) identified four prominent infrastructure investment failures which they indicated were more severe in developing nations. These failures are discussed as follows, namely

Public investment planning and spending failure – Notwithstanding that the public sector is solely responsible for infrastructure rollout plans and the implementation of such projects, it has become the norm that the private sector is engaged in the execution and/or financing thereof. It has emerged that in most countries the leadership role of the public sector is lacking and inadequate. According to Bhattacharya et al. (2014), as a factor to note, poor national infrastructure plans have led to investment failures and additional project costs and escalated corruption, thereby leaving infrastructure deficits barely addressed.

Policy risk failure / policy uncertainty- Generally, it takes more than double the time to realize the return on infrastructure investment than the actual construction of the projects. To put it into perspective, it typically takes between three to five years to construct infrastructure, with payback periods that span over ten years (Bhattacharya et al. 2014). The existence of highly sensitive and optimal regulatory/policy frameworks that support private sector involvement and reduce associated investment risks are therefore critical to project success (Uppenberg et al. 2011; Calderon and Serven, 2004; Bhattacharya, 2014).

Project development failure – These are project failures emanating from the lack of capacity and expertise during the various stages of the project life cycle. It has been pointed out that only a few governments have the ability to sustain the much-needed project development capacity (Bhattacharya et al. 2014). The absence of competent project development capacity directly impacts the quantity of projects undertaken to completion and poses much higher levels of project risk.

Private financing failure – The engagement of the private sector in financing public infrastructure projects is apparent and rising exponentially (Estache et al., 2015; Chan et al., 2009; Lall and Anand, 2009; Pottas, n.d). Despite that projected rise in private sector investment there are several systemic constraints that have seemingly led to underinvestment and financing failures in infrastructure, and these, according to Bhattacharya et al. (2014) include; (i) risks associated with weak policy frameworks; (ii) illiquidity; (iii) lack of standardised assets which can be easily invested; (iv) risks associated with currencies in use; and (v) the lack of capacity among institutional investors

2.4.7 Success factors for Infrastructure Delivery

According to Calitz and Fourie (2007), there is a consensus in that project design, the administrative/legislative framework and risk management strategies have a potential to positively impact the successful delivery of infrastructure. Furthermore, it has been highlighted that infrastructure development can enhance a country's overall improvement by significantly decreasing its reliance on international trade which is influenced by global forces (Quarterly Bulletin, 2012). LPEPAU (2012) highlighted that infrastructure enables people to have dignified livelihoods without privation; through; labour productivity, employment creation, macroeconomic stability, fiscal sustainability, the

development of credit markets, among other factors. On the other hand, Calderon and Serven (2004) argued that adequate provision of infrastructure is essential for trade liberalization which ensures efficient resource reallocation and export growth, therefore attracting private finance. In other words, adequate infrastructure decreases imports and increases exports which foster economic growth through, inter alia, job creation, which has the ripple effect of increasing buying power.

SAICE (2011) and Gurara et al. 2017) further expanded on the benefits of adequately designed and maintained infrastructural installations and indicated that these foster good relationships in society and increase productivity, therefore facilitating a robust economy. Fasoranti (2012), Stats SA (2016) and Blom (2017) believe that the availability of infrastructure such as efficient water and sanitation systems generally improve the quality of life of people in a given environment, thereby increasing their life expectancy. To further shed light on the importance and benefits of adequate infrastructure provision to a society, the following examples have been gathered;

- In relation to education and productivity output, a well maintained and safe road network helps in increasing school attendance.

- Electricity infrastructure facilitates increased study time and computer usages (Leipziger et al. 2003). Additionally, provision of electricity necessitates and boosts business activity thereby enhancing economic activity (Gurara et al., 2017)

- In relation to health, access to water and sanitation, these have been linked to significantly reducing child mortality and bettering standards of living.

According to Chan et al., (2009) the benefits of infrastructure can extend beyond the targeted direct users, a typical example being the effect of public transport on road congestion. They further highlighted the role played by infrastructure as a tool government uses as a source of fiscal stimulus, with the aim of creating employment and boosting economic efficiency (Ibid). Australian Government: Department of Infrastructure and Transport (2012) indicated that although infrastructure projects require large capital outlays for the effective planning, delivery and operation, the benefits these projects have to the community, such as, increased productivity, safety and amenity, although difficult to quantify in many cases far outweigh the original cost. For impoverished individuals and underdeveloped areas in society, infrastructure provides economic opportunities such as job creation and security which contributes to societal well-being (Estache, 2003). Table 2-1 depicts the success factors associated with successful infrastructure.

Table 2-1: Success factors of Infrastructure

Success factors	Description
Improved economy (Quarterly Bulletin, 2012; LPEPAU, 2012; Calderon and Serven, 2004; Civilution 2016; Fasoranti 2012)	Infrastructure promotes growth of a country's economy and influences a country's success and can be used to measure a country's competitiveness. In addition, infrastructure is an input to many industries thereby facilitating efficiency in the various industries. This has led many countries to target infrastructure development to support economic growth and development plans
Employment creation (LPEPAU, 2012; Estache, 2003)	Infrastructure is a source of employment opportunities through two important aspects; firstly, employment is created during the construction of the infrastructure projects, and secondly through businesses to be offered and/or housed within these constructed facilities. Additionally, infrastructure bridges inequality by ensuring everyone, especially the poor have access to job opportunities
Fosters good societal relations and well-being (SAICE, 2011; Gurara et al., 2017)	Infrastructure facilitates improved societal relations as a result of a general decrease in crime and poverty enhanced by increased productivity.
Improved quality of life (Fasoranti, 2012; Stats SA, 2016; South Africa Constitution, 1996 and Blom, 2017)	Adequate and properly maintained infrastructure results in improved quality of life and the well-being of individuals by ensuring access to basic services such as health care, water, housing and proper sanitation
Improves efficacy and efficiency in businesses (Bhattacharya, 2014)	Telecommunications necessitates timeous flow of information which is critical for business operations. Electricity necessitates operation of those businesses.

2.4.8 Challenges Affecting Infrastructure Delivery

In order to address and overcome the challenges impeding successful infrastructure delivery, it is imperative that these challenges are firstly identified. Even though infrastructure is vital for national development, every country, especially those of the developing world face various and often complex challenges affecting infrastructure delivery (Hexter and Mischke, 2013; Oyedele, 2016). Arguably, one of the major challenges inhibiting economic growth in many countries is the need for and paucity of

adequate and reliable infrastructure (LPEPAU, 2012). Hagerman (2012) argues that these challenges of inadequate infrastructure together with the failure to maintain infrastructure throughout its life cycle, consequently lead to economic losses. According to Pottas (n.d) and Oyedele (2016) inadequate infrastructure is the most dominant threat to Africa's long-term growth. Evidently, most African countries fail to provide infrastructure that meets societal demands which is one of the major challenges impeding economic development and growth (LPEPAU, 2012). Oyedele (2016) argued that although the demand for infrastructure in developing countries is high, the resources used in providing the infrastructure assets are scarce. Furthermore, the lack of maintenance of the existing infrastructure has further worsened the infrastructure challenges leading to costly expenses such as dilapidated infrastructure, unacceptable infrastructure conditions and infrastructure failures (Ibid). Major infrastructure failures have been argued to bear serious repercussions such as reducing a community's quality of life and productivity (LPEPAU, 2012).

It has been long argued that there is a direct link between available infrastructure and the quality of life of individuals in a country (Oyedele, 2016). Resultantly, it can therefore be deduced that the poor state of infrastructure in most developing countries is directly linked to the very low standards of living in those countries (Ibid). A study of challenges affecting infrastructure delivery in the Philippines by the World Bank (2005) indicated that underperformance in infrastructure emanated from multiple challenges, some of which include, a poor business environment namely inadequate cost recovery, corruption, insufficient competition, and low credibility of institutions, poor long-term infrastructure planning and coordination and reduction in private sector involvement. According to Oyedele (2016), there are several challenges affecting infrastructure delivery and these include, among other factors, inadequate finance, lack of knowledge, expertise and willpower to maintain existing infrastructure and failure to adhere to quality requirements of projects.

Examples gathered by Hexter and Mischke (2013) highlighting the extent of challenges associated with infrastructure include:

- In North America, the United States Department of Transport estimated that about 15% of roads were in dire conditions and needed immediate attention. To further worsen the situation, it was further highlighted that due to road congestion, an estimated US$100 billion annually was lost.

- Jakarta, Indonesia, experienced a huge challenge in transport infrastructure whereby the number of cars on the roads increased by almost 20% annually with a corresponding decline in usable road infrastructure.

As of 2013, it was cited by Hexter and Mischke that to match the infrastructure demands and development goals globally, and in order to tackle all backlogs, including building sustainable

infrastructure it was anticipated that a minimum of US$57 trillion should be invested into infrastructure alone within the next two decades. However, the tremendous amount of finance required to curb the infrastructure challenges proved to be a major setback, prohibitive and highly ambitious, especially at a time when most governments were in debt (Ibid). Although the challenges to infrastructure as identified in literature are many, these have been consolidated, summarized and merged in tabular format as shown in Table 2-2.

Table 2-2: Challenges associated with infrastructure delivery

Challenges	**Description**
Lack of finance or funding (Robinson and Torvik, 2004; Oyedele, 2016)	The lack of capital lends most governments having to borrow money which will be paid back with high interest rates. Due to the lack of finances, most governments are left having to conduct informed decisions on the various alternatives available for them to fund infrastructure, though in most cases these nations generally lack the capabilities for informed decision making. Arguably, the demand for infrastructure far outweighs the finance available and the challenge of funding not only affects the provision of new infrastructure, but the maintenance and repairs of defective existing infrastructure,
Foreign debt (Osuagwu and Orbunde, 2016; Zaman and Arslam, 2014)	External debt dating back to the 1970s and early 1980s has affected many developing nations through borrowing from international and capital markets to finance their increased investment needs. Due to the failure of these countries to pay off their debt timeously, the extent of debt has grown exponentially, making it near impossible to settle the debts. For this reason, previously strong economies that were established on foreign loans have deteriorated significantly.
Misallocation of Investment / investing in wrong projects (Robinson and Torvik, 2004)	Robinson and Torvik (2004) argue that Africa does not only suffer from under-investment, but equally from misallocation of funds and resources. 'White elephants', typically costly investment projects with little to no additional societal value and usefulness, which arise as results of, inter alia, poor predictability / inaccurate demand estimate calculations, inadequate research and the need for politicians to fulfill their promises made during campaigns. In most scenarios, misallocation of

	investment is as a result of political decisions outweighing economic decisions.
Poor governance (Levitt et al. 2010; Oyedele, 2016	Issues of poor governance such as corruption and procurement indiscipline are rife in the infrastructure sector, especially in developing countries. As a result, the cost of infrastructure is inversely increased to ensure that all involved have their own personal gains and/or enrichments from the larger whole, consequently leading to compromised quality of infrastructure projects. Sadly, public officials who are tasked to serve the public interests are always seeking to gain from any loopholes within the system
Poor planning (Keegan, 2004; Sturup, 2009; Othman, 2013)	Lack of proper planning, including aspects such as poor project estimates affect infrastructure delivery. The challenge of poor planning is compounded by the insurmountable lack of key skills, experienced and well-trained individuals with the capabilities to undertake the projects. Additionally, complex and long-term projects require high design skills and well-informed quality project front planning which is often lacking due to the lack of required human capital
Lack of human capital / skills shortage (Oyedele, 2016; Jacquet, 2017; Hagerman, 2012;	Lack of experienced and skilled individuals and tradesman with the knowhow and capabilities to carry a project to its completion is rampant. The challenge of lack of human capital is further exacerbated by 'brain drain', with the expertise emigrating to other countries. In a report by Burges Salmon (2017), it was indicated that the challenge of skills shortage in the UK infrastructure industry was a reality as evidently main contractors faced the challenge of hiring skilled individuals and key trades were generally undersupplied
Population growth (Asoka et al., 2013; Oyedele, 2016)	Population growth is a serious challenge to infrastructure delivery, especially in cases where population growth far exceeds a country's GDP growth rates resulting in negative growth rates, consequently compromising the quality of life of individuals and contributing to environmental degradation. A study of a neighborhood in Kenya by Asoka et al. (2013) found that the population growth in that area had severe strain on available infrastructure as a result of the overwhelming

imbalance between demand and supply of basic infrastructure.

2.5 Infrastructure Status: South African Context

The researcher borrows a school of thought from a famous quote by American Astronomer, Dr. Carl Sagan, who stated that, *"You have to know the past to understand the present"*. Ample evidence abounds which indicates that although infrastructure expenditure pre-1994 was high, this infrastructure was distributed mostly to the white minority and maintained the apartheid regime, leaving the black majority with minimum access to infrastructural installations (DPME, 2014). Infrastructure can be considered as a means to an end; an end to these challenges experienced due to its inadequacies and inefficiencies (DBSA, 2012). Some of the key points which highlight the unfair infrastructure provision and spatial patterns during the apartheid era, according to DPME (2014) include;

- The preponderance of blacks who had no access to basic municipal services, namely; clean water, sanitation, refuse collection and electricity;
- Expropriation of land without compensation, leaving black people with inadequate housing;
- Poor, inadequate and unreliable transport infrastructure and systems;
- Deliberate poor and manipulative educational structures in black communities, for example, very low per capita spending on black education as compared to their white counterparts, poor facilities usually without basic school amenities and under-qualified and poorly trained teachers; and
- Constrained public health service for the blacks, which was, similar to educational infrastructure; frequently in poor condition, had inadequate facilities and shortages of both health professionals and supplies.

The effects of the apartheid regime and its standpoint on spatial distribution of infrastructure are evident and still being addressed a quarter of a century later. The post-apartheid era was perceived by many, especially within the poor and marginalised black fraternity, as a new dawn regarding access to basic provisions; which meant better housing, health care and educational facilities, eradication of poverty and improvement of the quality of life, and access to sufficient clean water, electricity and sanitation. In a bid to reduce the apparent gap between infrastructure demand and supply within these previously disadvantaged and deprived black communities, the government, having realised the need to improve infrastructure delivery and distribution, prioritised extending basic services to these areas by increasing its budget commitment / allocation to infrastructure (NDP2030, 2011). DPME (2014) highlighted that the economy has grown since the apartheid period and this economic growth has led to increased demand for infrastructural installations such as, housing, road, rail, port, water, electricity and telecommunications.

The new democratic government set a new dispensation which aimed at rebuilding and reallocation of infrastructure (DPME, 2014). Despite the huge budget commitments made by the SA government towards the provision of infrastructure, the demand for infrastructure remains unmatched as it far outweighs its supply (Blom, 2017; NDP2030, 2011). Evidently, quite a substantial number of people are living in poverty and the society remains highly unequal (NDP2030; 2011; DPME. 2014). The National Planning Commission (2011) indicated that infrastructure is poorly located, inadequate and under-maintained. Furthermore, an alarming finding by SAICE (2017) demonstrated the sub-standard level of infrastructure in South Africa, where the current state of infrastructure was rated on a scale of A to E, with A being "world class" and E "unfit for purpose; it was found that the country was rated at an average of D+. The poor state of public infrastructure was further exposed by the Durban storm which occurred on the 10th October 2017, where reportedly according to ENCA News (11.10.17: 07H00) six public hospitals, namely, King Edward, R. K. Khan, Addington, King Dinuzulu, Wentworth and Prince Mshiyeni Memorial and 42 public schools were seriously affected leading to at least two deaths of those who were inside the affected infrastructure. The precarious state of infrastructure could partly be attributed to economic stagnation and political instability (apartheid period) which left infrastructure development in most parts of the country uncared for. This is despite infrastructure having been identified as one of the major solutions to the social and economic injustices in South Africa (SAICE, 2011).

Reportedly, the country is faced with considerable challenges associated with public infrastructure management, some of which include: the complexity and duration of large infrastructure projects, poor intergovernmental coordination processes, weak management and accountability systems and lack of capacity and expertise (Policy Brief, 2015). The situation is further worsened by the alarming fact that some public entities are oblivious of even the extent and capacity of the infrastructure assets they possess and therefore cannot make appropriate maintenance plans (CIDB, 2007b). This finding is reinforced by Blom (2017) and SAICE (2011) who attributed the failure of infrastructure delivery to be largely as a result of the lack of maintenance of vital installations.

Bhattacharya et al. (2014) argued that efficient infrastructure, in particular, transport infrastructure, inter alia, bridges the inequality gap by facilitating the poor to access job opportunities. Despite the effort and immediate need to fairly and impartially provide the basic services to all citizens, both rich and poor, South Africa has faced several challenges and bottlenecks that inhibit the effective delivery of infrastructural installations (Koma & Kuye, 2014). These challenges and bottlenecks have led to the health and safety of citizens being compromised, and the deprivation of social mobility and economic opportunities such as job prospects (Ibid). It has been indicated however, that regarding the equity of infrastructure delivery, there are significant differences in expenditure allocations between urban and rural areas, with the most spending predictably occurring in the metro areas (Allan and Heese, 2011).

In 2010, the percentage allocation ratio was reportedly 57:35:8 for the six largest metros (Tshwane, Johannesburg, Ekurhuleni, eThekwini, Nelson Mandela Bay and Cape Town), local municipalities and districts respectively (Ibid).

Interestingly, there is a negative correlation regarding infrastructure budget allocation and the state of infrastructure in SA, although infrastructure budget allocation by the SA government has been on the rise in recent years, according SAICE (2011) the state of infrastructure has been deteriorating at an exponential rate since 2006. To make things worse, there is a huge capital gap in infrastructure funding leading to municipal debt capacity to finance infrastructure (DBSA, 2012). This funding gap complicates the capital requirements for infrastructure provision which necessitate extending basic municipal services to all (DBSA, 2012). History and the current state of infrastructure delivery dictate that all regions with inadequate infrastructure are typically the impoverished areas, and the affected public entities tend to prioritize on factors affecting two key infrastructure delivery matters, which are

i) Providing municipal services which include but are not limited to clean water, electricity and solid waste removal), and

ii) Providing and maintaining extant infrastructure and services within municipal areas (Smith & Lomba, 2008).

Interestingly, despite the relatively poor infrastructure, evident mostly in the impoverished areas of South Africa, the country is viewed as a pioneer in driving infrastructure development in Africa (Hagerman, 2012). This is more so since South Africa is the sole representative for Africa at the G20, with involvement on the *"High-Level Panel on Infrastructure"* (Ibid). Furthermore, with the country being a member of BRICS, it is expected that the country will engage with and learn from other member states, especially China which is considered as the key driver of infrastructure on the Asian continent.

2.5.1 Typology of Infrastructure

The Infrastructure Barometer by the Development Bank of South Africa (DBSA) (2012b) classifies South African infrastructure into two categories, namely network and social infrastructure. These two categories were further sub-divided as follows;

- Network Infrastructure which encompasses: (i) Water and sanitation, including wastewater treatment works; (ii) Energy, particularly the electricity sector; (iii) Transport, including roads, rail and ports; and (iv) Information and communications technology (ICT), comprising telecommunications and access to the Internet

- Social Infrastructure which includes (i) Education, with specific focus on access to schools; and (ii) Health, with respect to access to healthcare facilities.

On the other hand, Fedderke & Garlick (2008), DPME (2014) and National Treasury (2018) broadly divided infrastructure into two categories, namely: social and economic infrastructure.

- Social infrastructure – includes health, education and housing sectors. In the case of South Africa, a typical example pertaining to social housing programmes includes initiatives such as 'The Botshabelo Housing Accord of 1994' which outlined a national housing strategy committed to providing all citizens with adequate and affordable permanent dwelling residences with sufficient provision of basic services such as water, sanitation, and electricity (Achiever, 2004).

- Economic infrastructure – includes energy, water and sanitation, and transport networks and facilities, and logistics

Table 2-3 is an extract from National Treasury (2018) which denotes the current infrastructure expenditure and allocation per sector in South Africa.

Table 2-3: Public-sector infrastructure expenditure and estimates

Sector		Expenditure (R/ billion)	% Allocation
Economic Infrastructure = 76,1% of infrastructure budget allocation	Energy	74,1	27,8
	Water & Sanitation	36,9	13,9
	Transport & Logistics	86,9	32,7
	Other Economic Services	4,6	1,7
Social Infrastructure = 23,9% of infrastructure budget allocation	Health	10,4	3,9
	Education	15,5	5,8
	Human Settlements	18,2	6,8
	Other Social Services	10	3,8
	Administrative Services	9,5	3,6
Total		266,1	100

It is apparent from Table 2-3 that government prioritizes expenditure in economic infrastructure (76%) largely because the economic sector is critical to overall economic growth and expansion and future economic competitiveness (DBSA, 2012). Additionally, the percentage allocation could be according to the need, that is, to address service backlogs.

According to Smith & Lomba (2008) the bracket of infrastructure does not only encompass the physical elements but also includes factors such as procedures, processes, operation techniques, management styles and developmental policies, and initiatives that ensure a well-designed infrastructure in response to socio-economic demand. Due to the wide-ranging management models, initiatives and directives across provincial departments, the cause of the disparate distribution of infrastructure in South Africa is therefore apparent (Ibid). This fact is further reinforced by CIDB (2007b) who highlighted the influence municipal infrastructure has on service provision to all communities. Furthermore, the South African Constitution (Act No. 108 of 1996) gives municipalities the authority and power to efficiently utilize its resources to improve the lives and welfare of all those served by that municipality and each municipality has its own operation and management strategy. Therefore, local authorities can be considered as independent and distinctive governing entities, mandated to provide basic services with the aim to facilitate social and economic inclusion and development. The local authorities therefore play a pivotal role, one which cannot be undermined, in ensuring adequate and successful infrastructure delivery.

Wall (2008) suggested that the government should focus on both the installation of new infrastructure to address cited service backlogs from the past and should also have the capacity to maintain both new and old infrastructure, as focusing only on new investment can have serious negative repercussions which could impede delivery of services. Several public entities in S.A have also realised the importance of maintaining existing infrastructure, as seen with the notable increase in infrastructure maintenance spending as opposed to spending on new infrastructure and the extension of services (CIDB, 2008). Noteworthy to mention is the example of the eThekwini Metro which is mainly focused on extensively upgrading its road maintenance program, and its water supply program by focusing on replacement of aging water pipes, with prioritization of areas affected by major water leakages (Ibid).

According to the Policy Brief (2015), South Africa infrastructure delivery should concentrate on providing solutions to the current challenges and/or threats to infrastructure and these entail:

- The provision of infrastructure and stimulation of the economy,
- Maintenance of existing infrastructure, and
- Provision of infrastructure and services to the poor to not only eradicate poverty but in which the reductions can be sustained

It is essential that before a government invests in infrastructure, research is conducted on the appropriate infrastructure to be constructed as infrastructure choice can affect the rate of economic growth (NIC, 2017)

2.5.2 Nexus Between Infrastructure and National/Sustainable Development

The government of South Africa has been aggressively pursuing infrastructure development as a means to foster economic growth and employment creation (Quarterly Bulletin, 2012 and DBSA, 2012). This has been facilitated through the country's initiatives to minimize reliance on trade, in the process increasing focus on growing the economy internally through implementing various strategies, such as, infrastructure developments. Needless to mention is the fact that infrastructure development can clear bottle necks hindering economic growth and employment creation, among other factors. The Infrastructure Consortium of Africa has conducted studies into the state of infrastructure in Africa and the results concluded that due to chronic transport infrastructure, costs of goods have been increased by an additional 30-40%. The setbacks associated with poor transport infrastructure could have propelled the South African government to further increase the percentage contribution allocated to the transport infrastructure (NDP2030, 2011). In the context of transport infrastructure, South Africa could adopt a similar structure like that of New Zealand, where the transport system is largely self-funded, where all costs incurred are paid directly by users or are funded initially by governments and recovered from transport. As earlier discussed in this study, adequate and efficient infrastructure improves economic efficiency and impacts national growth. The Table 2-4 discusses the possible infrastructure commitment areas which can be adopted by South Africa to bridge the infrastructure gap and augment national development.

Table 2-4: Addressing the infrastructure gap

Current state of infrastructure	Infrastructure towards national development
Inadequate infrastructure investment thereby restricting growth and development (NDP2030, 2011; DPME, 2014; Blom, 2017)	Increased sustainable infrastructure investment which boosts the economy
Inadequate provision of affordable infrastructure for the poor, thereby constraining development and poverty reduction (NDP2030, 2011; DPME, 2014; National Planning Commission, 2011)	Improved, affordable and accessible infrastructure for the poor, consequently resulting in improved development (DPME, 2014; Blom, 2017)
Investment and reliance on high-carbon infrastructure, leading to environmental degradation and the potential danger of irreversible climate change, for example, Eskom's reliance on fossil fuels as a means of power generation	Investing in low-carbon infrastructure and renewables which are more prone to mitigating the dangers associated with climate change risks and are environmentally friendly (Bhattacharya et al. (2014), such as, power generation through solar and wind energy in the case of Eskom

2.5.2.1.1 Drivers for Improving Infrastructure

The state of infrastructure in South Africa needs severe and onerous improvements. Annual reports by the World Economic Forum (WEF) and the Quarterly Bulletin (2012) accentuate the country's chronic and deteriorating state of infrastructure. The WEF uses twelve pillars to measure countries' Global Competitiveness Index (GCI) and these pillars can be classified according to Table 2-5.

Table 2-5: Global Competitiveness Index Pillars

Key for Factor-Driven Economies	**Key for Efficiency-Driven Economies**	**Key for Innovation-Driven Economies**
Pillar 1 - Institutions Pillar 2 -Infrastructure Pillar 3 - Macro-economic environment Pillar 4 - Health & primary education	Pillar 5 – Higher education & training Pillar 6 – Goods market efficiency Pillar 7 – Labour market efficiency Pillar 8 - Financial market development Pillar 9 – Technological readiness Pillar 10 – Market size	Pillar 11 – Business sophistication Pillar 12 – Innovation

Source: (WEF; 2016, 2017 & 2018)

By focusing solely on pillar number two which concerns itself with the extensiveness and efficiency of infrastructure, on the GCI, which is a comparison of a country's infrastructure competitiveness against other nations, South Africa in 2018 was ranked 61 out of 137 countries (WEF, 2018). On the other hand, when only considering the quality of overall infrastructure, South Africa dropped in rankings to 72 (Ibid). Competitiveness has been defined by WEF (2012) as "*the set of institutions, policies, and factors that determine the level of productivity of a country".* It has been alluded that a more competitive economy has the potential of rapid growth over time, thereby expanding a nation's development (Ibid). To add on to that, competitiveness rankings demonstrate the importance placed on a pillar, in this instance the pillar placed emphasis on is infrastructure which has the potential to impact the investment climate in South Africa.

WEF (2016) ranked inadequate infrastructure supply as the third highest problematic factor affecting doing business in South Africa. A more recent similar report in 2018 indicated that inadequate infrastructure supply had dropped down the list to number twelve. This move, however, does not necessarily indicate an improvement in infrastructure but could be a signal of worsening conditions in other problematic areas such as corruption, crime and theft, inflation and tax rates to mention but a few.

From the results of WEF annual reports and to shed light and an understanding into the state of infrastructure in South Africa, comparisons have been made against:(1) the top five ranked African countries, and (2) against the BRICS nations (Brazil, Russia, India, China and South Africa). Justification of comparison with other African countries lies in the fact that they are all developing nations and generally underdeveloped and are plagued with problems of poverty and income inequality. On the other hand, the rationale in comparisons with the BRICS nations was postulated by Quarterly Bulletin (2012) and it is embedded in the political relationships among the BRICS nations that were formed for mutual economic and social benefits. The Global Competitiveness Index for the two categories are tabulated and discussed below.

- **South Africa in comparison with other African Countries**

Table 2-6 is a summary of the Global Competitive Index extracted from WEF reports for the years 2015 to 2018, depicting the status of infrastructure between the five top ranking African countries over the past three years. Table 2-6 shows the ranking and positioning of the listed countries on the GCI from a total of 138 economies. From the rankings, it is clear that compared to other African countries which are to a large extent either underdeveloped or developing, expectedly, South Africa ranks quite high, third in overall. Although rated relatively good in the African context, there is still a mammoth amount of work required to bring the infrastructure to world class levels as South Africa barely makes it in the top half of the rankings.

Table 2-6: Infrastructure GCI of the top five ranking African countries

	2015/16	**2016/17**	**2017/18**	***Ave***
Mauritius	37	41	40	*39*
Morocco	55	58	54	*56*
South Africa	68	64	61	*64*
Namibia	66	66	67	*66*
Tunisia	80	83	82	*82*

Source: (WEF; 2016, 2017 & 2018)

- **South Africa in Comparison with (Brazil, Russia, India, China & South Africa) BRICS nations**

Table 2-7 is a summary of the Global Competitive Index extracted from WEF reports for the years 2015 to 2018, depicting the status of infrastructure in the BRICS group over the past three years. The data shows that South Africa ranks quite fairly. However, the results further depict the large gap in infrastructure between South Africa and the developed nations of the BRICS group, that is Russia and China. This gap therefore indicates the amount of improvement required to bring South Africa's

infrastructure competitiveness to the level of the developed nations. Despite that fact, the rating for South Africa has gradually improved in competitive infrastructure throughout the reviewed period.

Table 2-7: Infrastructure GCI of BRICS nations

	2015/16	2016/17	2017/18	*Ave*
Russia	35	35	35	*35*
China	39	42	46	*42*
South Africa	68	64	61	*64*
Brazil	74	72	73	*73*
India	81	68	66	*74*

Source: (WEF; 2016, 2017 & 2018)

2.5.3 Infrastructure and Infrastructure Delivery Models

2.5.3.1 Delivery Models

The delivery strategy selected is a major determinant of project objectives being achieved. In the South African context, project objectives are no longer considered only in the historical triad of time, cost and quality, but now encompass critical project/client objectives such as employment creation, transfer of skills, community empowerment (Oshungade and Kruger, 2014; Mbanjwa, 2003). The project objectives can in one way or another be affected by the project delivery model used. When considering the improvement of infrastructure delivery, all things being equal, it is imperative to adopt the appropriate delivery model which necessitates getting things right from the onset. This could be done through selection of the best suited delivery model that would meet both primary and secondary project/client objectives.

The infrastructure delivery methods commonly used in South Africa are; the traditional, design and build, and construction management (Oshungade and Kruger, 2015). Table 2.8 is an extract from Grobbler and Pretorius (2002) highlighting the percentage usage of the delivery methods utilized in South Africa and it is clear that the traditional method usage far outweighs all other methods.

Table 2-8: Rankings of usage of procurement methods in South Africa

Method	**Traditional**	**D & B**	**CM**	**Other**
(Grobler and Pretorius, 2002)	1	2	3	4
(Thwala and Mathonsi, 2012)	1	4	2	3
(Oshungade and Kruger, 2015)	1	2	3	4

2.5.3.1.1 Traditional Model ('Design, Bid, Build')

This is the default delivery model for most public infrastructure projects in South Africa (Oshungade and Kruger, 2015). That fact is further buttressed by Manqoba (2014) whose study affirmed the high usage of the traditional procurement method for construction projects when compared to the Design and Build and Construction Management methods. The bulk of public projects have been delivered under this method.

The high usage of the traditional method despite its overly disseminated shortcomings could be adding to the already poor infrastructure delivery in the country. The trend with most infrastructure projects contracted using this method is that they are bedeviled with time and cost overruns (CIOB, 2010).

2.5.3.1.2 Design& Build

Mbanjwa (2003) found that this method of contracting was rarely utilized when compared to the traditional and construction management methods. Though not widely used in South Africa, the Design and Build method is widely gaining acceptance (Oshungade and Kruger, 2015). According to (Grobler and Pretorius, 2002), for the construction of the Nelson Mandela Bridge, the City of Johannesburg utilised the Design and Build procurement method.

2.5.3.1.3 Construction Management

Within the South African context, construction management contracting strategy has neither been widely used nor fully understood although it is gradually gaining prominence (Mbanjwa, 2003). As such, there are a few isolated cases in which it has been used and an example is that of the construction of the new taxi rank at the Johannesburg Park Station with the City of Johannesburg as client (Ibid).

2.5.3.2 Financing of infrastructure

Reportedly, the Government of South Africa funds about 40% of the country's overall infrastructure investment (CIDB, 2018). DBSA (2012) asserted that over half of all municipal infrastructure in South Africa, especially the district and local municipalities in most rural areas, are funded by grants. Unequivocally, the government largely supports the idea of using taxes to finance major infrastructural projects, among other alternatives (Ibid). One of the consequences of relying on tax revenue to finance infrastructure is increase in the amount of money retrieved from taxes and the proposed action plan to achieve this objective is through introducing a new top personal income tax bracket of 45% for taxable incomes above R1.5 million per year (National Treasury, 2017).

According to Hagerman (2012), it is commendable that several international banks and the private sector have reiterated their commitment to funding infrastructure development in Africa. However, the

assurances of a long-term enabling environment and political climate will in most African nations remain a major challenge to private sector financing. On the contrary, the down side of engaging the private sector in infrastructure investment is that large interest rates and/or premiums tend to be inherent in private financing (Engel et al., 2013). On the contrary, the benefits of private sector engagement include improved efficiency in delivery (Lall and Anand, 2009). Typical examples of public private partnerships in infrastructure in South Africa include Aeroporti de Roma's 20% share in the Airport Company of South Africa (with the SA Government owning 74.6%) and the investment of private entities in government infrastructure (via the Development Bank of Southern Africa) (Calitz and Fourie, 2007).

Calitz and Fourie (2007) suggest that regarding infrastructure financing which is dependent on organizational forms within public institutions; South Africa could adopt one of the three alternatives, namely:

- If the proposed infrastructure forms part of the functions of intergovernmental jurisdiction, that is, if it falls within national, provincial or local government and is financed in cash through fiscal allocation of the annual budget, the financing can be through reprioritization, additional taxes or loan finance. Calitz and Fourie (2007) advise that budget deficits through loan finance could be repaid through future tax revenue and/or user charges.

- If the activity is the responsibility of a designated government agency other than a normal government department such as, public monopolies like Transnet and Eskom, financing can either be internal or external loans and/or equity. However, caution must be taken in that the government ought to retain authority to regulate costs through price setting. User charges will cover the debt and operational costs; however, in other cases the entities may obtain government loans and/or guarantees to reduce private-sector loan cost.

- When infrastructure delivery is the responsibility of the private sector either on its own or in partnership with public entities, financing can be in the form of equity in lieu of loans. In response to the high business and political risk exposure, the private sector may require government guarantees or high incentives leading to large profit margins. Since there remains a strong rationale for state intervention in cases where the private sector is involved, the government retains authority to regulate prices, this often receives negative backlashes as witnessed by the withdrawal or non-supply of private equity and in some cases the withdrawal of private businesses who in the case of most developing countries are often foreign investors.

To ensure optimum private sector investment, South Africa ought to ensure that the right conditions that attract funding are in place, both domestically and internationally. Bhattacharya et al. (2014) reiterate that these conditions are well-documented in a plethora of extant documents and these include;

- Optimal policy frameworks and contractual arrangements that would provide an equal and fair treatment of investors over time;

- Adoption of tools and instruments that aid in the mitigation of non-market related risks (for example, state-directed changes in utility pricing, to reiterate an example for South Africa as stated earlier, in the case of public monopolies such as Transnet and Eskom, the government is responsible for regulating costs through price setting;

- Mixed financing structures to ensure that the overall project is more affordable, thereby making an allowance for other critical factors such as sustainability to be covered by the investment; and

- Investor friendly environment through capital market regulations which encourage investment

2.5.4 Success factors for Effective Infrastructure Delivery

According to NIC (2017) improving the overall quantity and quality of infrastructure can lower production costs of companies, thereby boosting economic efficiency. Additionally, infrastructure facilitates ease of interaction of people for economic activity which enhances the productivity of a society.

According to Bhattacharya et al., (2015) infrastructure facilitates growth, development, poverty eradication, and environmental sustainability of a nation. The South African government, just like many other governments target investment in infrastructure to improve the movement of all goods and services (Quarterly Bulletin, 2012). Indisputably, the delivery of infrastructure has been used in short-term interventions to stimulate economic recovery with the larger long-term focus being on economic growth (DBSA, 2012). The rationale of South Africa constructing massive infrastructure projects is detailed out in the opportunities and success factors discussed as follows, namely:

- **Job creation**

  Most infrastructure projects tend to be labour intensive and therefore require substantial number of both skilled and unskilled labour (Quarterly Bulletin, 2012). According to DBSA (2012), the construction of socio-economic infrastructure requires less skilled labour and therefore the skills base is readily available and can be sourced from the local economy or surrounding community. Additionally, infrastructure projects tend to create employment opportunities especially during

depressed economic periods with high unemployment rates (Quarterly Bulletin 2012). According to Stats SA (2018) more than 1.43 million people are employed by the construction industry, either on a contract basis or permanently. The NGP identified infrastructure as one the sectors which would facilitate achieving the target five million new jobs by 2020.

- **Social development**

The provision of adequate infrastructure can be viewed as a panacea to some social challenges being faced in South Africa by ensuring access to basic services and consequently contributing to the improvement of the general quality of life of citizens (Quarterly Bulletin, 2012). Social infrastructure has a direct impact on the quality of life of individuals (Pottas, n.d). The government of South Africa is committed to social development through infrastructure development by implementing various government rollout plans which facilitate the construction of social housing, public schools, hospital and clinics. An example of the social development roll-out plans initiated by the government include the various housing assistance programmes since 1994 which provide citizens with sustainable human settlements including sufficient provision to essential services such as water, sanitation, and electricity (Department of Human Settlements, 2010).

The availability of adequate and efficient infrastructure results in the provision of basic services to communities. This therefore translates to the minimization and/or eradication of public protests emanating from service delivery shortfalls (Booysen, 2007).

- **Economic efficiency**

Infrastructure is the fulcrum of economic development and efficiency (Quarterly Bulletin, 2012). According to Pottas (n.d), physical infrastructure which encompasses transport, power and communication infrastructure enhances growth. Economic efficiency is achieved through improvements in infrastructure, for example, transport infrastructure which if well managed has the capacity of transporting goods in a cheaper way for society. Road congestion and accidents are decreased thereby minimizing travel time and damages done on road surfaces. One of the factors which multinational companies consider before investing in a country is the state of infrastructure (Quarterly Bulletin, 2012). Pottas (n.d) is of similar opinion by highlighting that the world is hampered from doing business on the African markets due to poor infrastructure.

- **Skills development**

Skills are critical for the realization of opportunities which foster local economic development brought about by the development and maintenance of municipal infrastructure (DBSA, 2012). The construction of infrastructure more often than note requires expertise and skilled labour which in

most cases is not available locally (Quarterly Bulletin, 2012). This expertise is frequently sourced in from other countries, and as a result leads to the impartation of knowledge and skills transfer to the local communities.

2.5.5 Challenges in Infrastructure Delivery

According to and Pottas (n.d), the inability by Africa to attain economic growth is beset by infrastructure inefficiency and inadequacy. Further to that, Pottas (n.d) suggested that insufficient infrastructure is a major hindrance to growth and development of nations. OECD (2015) and DBSA (2012) posited that challenges affecting development of infrastructure are common worldwide. As confirmed by Pottas (n.d) in sub-Saharan Africa, South Africa included, the shortage of physical infrastructure is one of the top challenges thwarting development. Therefore, based on the commonalities of infrastructure challenges encountered, South Africa can learn and/or adopt, after careful trials and testing, some international good practices that can help better seize opportunities and meet related challenges.

Some of the challenges and causes of inefficiency in infrastructure emanate from skills shortage required to propel growth and development, lack of administrative capacity and ineffective implementation of development policy frameworks (Koma & Kuye, 2014; SAICE, 2011; CIDB, 2007a). On the other hand, Parliament of RSA (2009) cited, inter alia, lack of capacity, poverty and unemployment, economic recession, under-spending by public entities, outstanding debt payments for municipal services from clients, as some of the factors affecting effective infrastructural delivery. However, Blom (2017) linked the challenges of infrastructure delivery to the state organs' responsibility for infrastructure delivery, citing that they are plagued by poor planning and management, skills and capacity shortage and corruption, among other factors. As a result of ineffective infrastructure delivery in some parts of South Africa, the country has been hit by widespread by public outcry and protests that have become rampant and sometimes extremely violent and radical (Gqaji et al. 2016; Parliament of RSA, 2009).

Undoubtedly, inadequate and poor-quality infrastructure impedes economic efficiency in developing and emerging countries like South Africa. However, cognizant of the significant progress and improvement South Africa has made towards infrastructure development, the country is still faces major infrastructural challenges (Quarterly Bulletin, 2012). Without detracting from the gains and opportunities made, generally some provinces are more affected by the challenges, especially those in the more rural and/or poorer areas, the backlogs in services and infrastructure are substantial (DBSA, 2012). These challenges in infrastructure delivery are summarised in Table 2-9.

Table 2-9: Challenges of infrastructure delivery

Challenges	Description
Lack of Funding (Quarterly Bulletin, 2012; Parliament of RSA, 2009)	Funding is a challenge in infrastructure delivery as most infrastructure projects are financed through loans. The lack of funding is further exacerbated by outstanding debt payments for municipal services from clients.
Many Projects (WCG, 2010; DBSA, 2012)	As a means of targeting small emerging enterprises and to increase the number of projects in South Africa, the public sector normally "unbundles" contracts. This proliferation of small projects and appropriations further exacerbated by political intervention impede efficient infrastructure delivery. Furthermore, it leads to the unintended consequence of increased workload and higher contract administration for the project staff often resulting in shoddy workmanship due to inadequate supervision. Frequently, this leads to rework and increased maintenance. Furthermore, the expanding scope of infrastructure functions to public entities could be overwhelming, and in some instances the lines of responsibility could be undefined for various departments
Under-spending on Budgets (WCG, 2010; Parliament of RSA, 2009; Civilution 2016; CIDB, 2018)	Under-spending on budgets and capital expenditure in the public sector, especially in local government, has been cited as a major challenge to infrastructure delivery. Key state-owned enterprises (SOE) such as Eskom have also reported a fair share of frequently missed budget targets. Under-spending further nullifies the prioritised objective of job creation as it has been reported that the collective unspent amounts translate to unavailability of jobs, which would have been created had all the budgets been spent accordingly.
Costly Delays e.g. In Approval Processes (WCG, 2010; CIDB, 2018)	According to a KPMG survey of 2011, public sector officials have cited the slow approval processes as a challenge in spending infrastructure funds quickly and effectively. Lengthy decision-making processes especially in matters relating to regulations & policies. Sadly, these lengthy delays in progressing on a project due to the inability of the appropriate government representatives to give the go-ahead on specific projects are a common phenomenon on public projects.

Wrong choice of delivery models (Quarterly Bulletin, 2012; Civilution, 2016).	The use of inappropriate infrastructure delivery models poses as a threat to successful installation of infrastructure projects. The wrong choice of delivery method, coupled with poor procurement practices often lead to various infrastructure delivery challenges such as time and cost overruns, poor quality work and workmanship and disputes; to mention but a few.
Lack of administrative capacity and lack of proper planning (WCG, 2010; Koma & Kuye, 2014; SAICE, 2011; CIDB, 2007a)	Lack of capacity, whether at the regional level or within and among relevant government departments, to effectively implement and coordinate the arduous processes within which all government entities must comply, poses as a major threat to successful infrastructure delivery. Furthermore, lack of capacity to manage the planning process and, and to make the appropriate decisions when needed impede successful infrastructure delivery
Policy inadequacies (Quarterly Bulletin, 2012; Koma & Kuye, 2014; SAICE, 2011; CIDB, 2007a, Hagerman, 2012)	Some bureaucratic protocols and policies in place do not provide an enabling and conducive environment for infrastructure investment. On the other hand, the ineffective implementation of development policy frameworks by the various government departments has been cited as a major challenge to infrastructure delivery. The policy terms ought to convey some degree of trust and commitment that enables and supports private sector needs to operate
Poor Quality Construction (WCG, 2010; CIDB, 2018)	Despite the increased budget for infrastructure, quality issues are a major challenge in public infrastructural projects.
Skills shortage (Quarterly Bulletin, 2012; WCG, 2010; DBSA, 2012; Koma & Kuye, 2014; SAICE, 2011; CIDB, 2007a; National Treasury, 2016)	Skills shortage remains one of the biggest challenges facing most economies in Africa. South Africa is no exception as the public sector is beset by the scarcity of professionals. It has been argued DBSA (2012) that, despite the tremendous progress made in the provision of infrastructure; skills shortages have a retrogressive impact on the maintenance of the constructed infrastructure. Most government departments suffer from low productivity as a result of skills deficiencies. The following typical examples succinctly highlight these challenges; Eskom, a state-owned enterprise employs welders from China to work at various projects around the country as the industry lacks skills in these fields. Furthermore, due to skills shortages in water infrastructure, the Department of Water Affairs has indicated that water quality management has been largely compromised and the situation is further worsened by lack of infrastructure maintenance due to skills shortages, which has led to degradation and in some worse cases non-functionality of infrastructure. Lastly, skills deficiencies have been cited as the

	center of the widespread community protests over inefficiencies in service delivery emanating from infrastructure deficits.
Lack of accountability (Bardhan and Mookherjee, 2003)	Problems of accountability are a huge setback to infrastructure delivery, especially in the developing nations. The poor are the most affected, as the World Development Report (2004) put it, *"Too often, services fail poor people — in access, in quantity, in quality"*. The lack of accountability subsequently leads to issues such as; service diversion, limited access to services and high prices for service provisions.

2.6 Summary

From the literature reviewed, it is clear that when compared to other countries, and focusing on the current state of infrastructure in South Africa, the government is not realising value for money from public sector construction. In addition to that, the state of infrastructure in the country is generally in a poor and deteriorating state, and the indigent areas of the country are the most affected. The situation is further exacerbated by the multiple challenges and bottlenecks inhibiting the efficient and optimal delivery of infrastructure. In a bid to improve infrastructure delivery and to engender infrastructure competitiveness, which both act as catalysts for increased foreign investment, the country could learn and/or adopt tried and tested initiatives from other countries, especially those of the developed world. Notwithstanding the above, the importance of quality infrastructure, which is delivered to all, fairly and impartially, is key to a stable socio-economic environment and overall national growth. The next chapter is concerned with infrastructure delivery from a governance and legislative framework perspective.

CHAPTER 3

LEGISLATIVE AND GOVERNANCE FRAMEWORK FOR INFRASTRUCTURE DELIVERY IN SOUTH AFRICA

3.1 Brief Chapter Overview:

This second chapter of literature review is dedicated to reviewing extant literature on the key legislative and governance/administrative framework pertaining to infrastructure delivery in South Africa and it will provide an in-depth overview of the underlying contextual issues pertaining to this study. It also takes into account policy formulation and implementation.

3.2 Legislative Framework Regulating Infrastructure Delivery in South Africa

Although the country has made notable steps in alleviating poverty and inequality through infrastructure investment, it has been widely reported that South Africa still faces huge backlogs in infrastructure (NDP2030, 2011; Blom, 2017). To curb these shortfalls, the government has adopted important steps to improve infrastructure planning and delivery (DPME, 2014). These steps entail the formulation and adoption of several public governance initiatives to create an enabling environment for infrastructure investment Zarenda (2013). The Infrastructure Consortium for Africa (ICA) Guide (2006) refers to the enabling environment as *"the relevant policies, laws, regulations and institutions which allow and support the development of infrastructure projects."* According to ICA (2006) the steps to creating such an investor conducive environment entail:

- Designing enabling legislation;
- Designing regulatory approaches;
- Project-related institutional reforms;
- Capacity building; and,
- Consensus building

In a bid to improve local economies, both developed and developing nations have implemented several policy initiatives to ensure adequate expenditure on infrastructure delivery and public procurement. This is so as to encourage private sector involvement which seeks guarantees and assurances of a sound regulatory and institutional environment before project commitment and kick off (Hagerman, 2012). Furthermore, most governments have realised the need of high-quality infrastructure that supports the delivery of effective public services throughout all sectors, or policy areas that affect people's lives (OECD, 2015). Priority has been brought to the need of making infrastructure services available to the public and the public sector (Ibid).

Policies and procedures that govern both public and private organizations are of utmost importance as they not only regulate the economic landscape but the competitive one as well, Srivastava and Thompson (2009) and successful infrastructural installations are therefore somewhat dependent on the adoption and implementation of these policies. Needless to mention is the fact that, alike all areas pertaining to public governance, the governance of infrastructure is immanent with a clear set of challenges (OECD, 2015). Furthermore, these systems coupled with the appropriate skills are required for efficient and effective infrastructure delivery (Watermeyer, 2012). To ensure optimum implementation of these systems, it is imperative that they be supported by policy, governance and/or management arrangements, and relevant documentation (Ibid). Evidence abounds in the plethora of policy documents that indicates that the government is committed to the improvement of socio-economic conditions through infrastructural provision.

3.2.1 Policy

The importance of public policy is embedded in the notion that it determines the general quality of life of populace, as it affects and influences all spheres of life (Torjman, 2005). A public policy takes into account the best interest of all members of society and it is concerned with ensuring that a desired result is achieved (Ibid). A policy intends to solve problems and improve the quality of life of populace. In a nutshell, a public policy concerns itself with the following issues, which include, among other factors; clean water, good health, vibrant economy, high educational attainment, decent and affordable housing, minimal levels of poverty (Ibid). Torjman (2005) noted the clear link between infrastructure and policies in place, as evidenced by the list of issues which are inherent to both public policy and infrastructure.

According to Torjman (2005), a public policy is enacted to:

- Regulate industry and business,
- To protect citizens both within the borders of the country and abroad,
- To assist governments and people through funding initiatives, and
- To encourage social goals to be achieved.

There is plethora of definitions of the term policy depending on the context in which the term is used. Normak Project (2007) defined a policy as a *"course of action or inaction chosen by the Government to address a given problem or interrelated set of problems, or the way in which the courses of action for achieving the appropriate goals are determined"*. Normak Project (2007) went on to provide an alternative definition of the term policy by stating that it as the *"deliberate action of Government that in some way alters or influences the society or economy outside the government".* It was further proffered that a policy includes matters pertaining to, inter alia, taxation, regulation, expenditures, legal requirements, and prohibitions (Ibid). On the other hand, Considine (1994) defined a public policy as

an action which utilizes government authority to allocate resources in support of a preferred value. Briefly stated, a policy aims at rational problem solving at national level and addresses political conflict (DiNitto and Johnson, 2016).

In post 1994 South Africa, numerous policies were developed by the democratic government to ensure that the needs of the communities were met. Awuzie (2014) reinforced that assertion as he postulated that policies ought to be action plans prepared by the government to deliver certain benefits to the target population and must be enforceable and enacted by statute. Roux (2002) put forth the assertion that, as a means to ensure survival, growth and the ability to render quality services to the public by government institutions, it is of utmost importance that they effectively formulate policies that align with the immediate need. In some cases, the policy choice does not yield the desired / expected outcomes (Ahmed, 2012). Ahmed further argued that, for any given policy to succeed, it ought to be well implemented. Due to some policies experiencing challenges and falling short in implementation, it is common practice for these policies to be replaced or altered. This fact is buttressed by Ahmed (2012), who highlighted that in the event that unforeseen circumstances complicate policy implementation, amendments can be added to the policy. On the issue of policy amendments, Normak Project (2007) suggested that the need for any alterations to the existing policies may come from multiple sources.

The combined list of challenges / shortfalls affecting effective policy implementation as identified by Ahmed (2012) include:

- Lack of expertise and sufficiently skilled managers to formulate, implement and coordinate these policies,
- Inability of the government to build the necessary state capacity, for example, limited infrastructure,
- Untested and untried policy co-ordination and implementation methods which were not proven effective,
- Fiscal constraint due to the poor fiscal and economic landscape as a result of apartheid,
- Poor information flows or learning problems,
- Management style and conflict,
- Organization culture, and
- Subconscious forces.

3.2.2 The Policy Cycle

A policy emanates from the policy process, and it is normally initiated by a political decision (Normak Project, 2007). According to DiNitto and Johnson (2016), the public policy-making process is a

multistage process, with five key steps which are not always clear cut and often overlap and it is tabulated in Table 3-1:

Table 3-1: Stages of the policy cycle

No	Stages	Applied Problem Solving
i.	Agenda Setting	Identification and prioritization of the problems facing government
ii.	Policy Formulation	Planning and proposal of solution
iii.	Policy Adoption	Formal government action to adopt or endorse a solution. Enacted the policy into law
iv.	Policy Implementation	Carrying out of policy / implementation of solution: frequently accomplished by institutions other than those that formulated and adopted it.
v	Policy Evaluation	Final stage in the policy cycle - Monitoring results and measuring policy impact on a society

3.2.3 Primary Legislation that Regulates Infrastructure Delivery

Various policies, legislations and initiatives affecting infrastructure were formulated post 1994 to address and redress the gross inequalities of apartheid and the failures in government institutions to deliver quality infrastructure timeously. According to CIDB (2010), these legislations impact on infrastructure planning, budgeting and management. The optimal and effective application and implementation of the legislation in place ensures cost effectiveness and engenders value for money with quality end products (Civilution, 2016). The Infrastructure Delivery Management System (IDMS), a key model the study seeks to examine, was birthed as a response to several constraints impacting infrastructure delivery, with its first usage being in the Education Sector, followed by the Health Sector.

3.2.3.1 Infrastructure Delivery Management Systems (IDMS)

The Infrastructure Delivery Management System (IDMS) is a model utilised within the public sector to foster best practice in the delivery and management of infrastructure. It was formulated by the SA government, through the collaboration of National Treasury, Department of Public Works (DPW), Construction Industry Development Board (CIDB), and the Development Bank of Southern Africa (DBSA). The IDMS is a standardized approach to the *"planning, budgeting, procurement, delivery, maintenance, operation, monitoring and evaluation of infrastructure"* (National Treasury, 2012), and it acts as a benchmark and guide for best practice delivery of infrastructure management (CIDB, 2010).

The IDMS describes and outlines all the processes of public sector delivery and procurement management within the construction industry (CIDB, 2010 and WCG, 2010). According to WCG (2012) the IDMS comprises a set of interrelating and interacting elements that establish processes which transform infrastructure inputs into outputs. It has been concluded that IDMS is the foundational element in the management of infrastructure delivery and maintenance (Watermeyer, 2012). Furthermore, it has been cited as a strategic discipline that enhances the effective rollout of infrastructural installations and the management of those that already exist (National Treasury, 2012). Its importance lies in its strategic theme of addressing the four dimensions of the infrastructure delivery process, namely: institutions, people, organisational behaviour and human resource systems. It targets the people who execute the works, middle to lower management and top management and executives (WCG, 2010). Therefore, it stands to reason that every human resource involved in infrastructure delivery ought to be well informed on utilizing the IDMS. Figure 3-1 is an illustration of the four dimensions addressed by the IDMS.

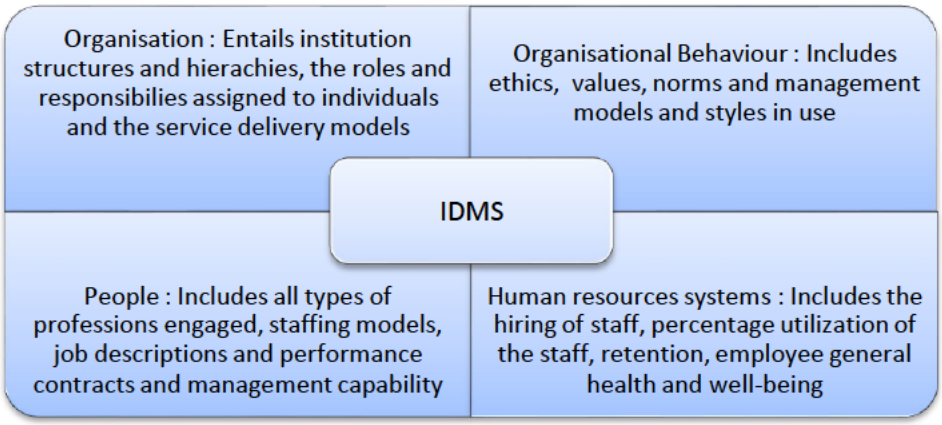

Figure 3-1: Dimensions of the IDMS

According to SIPDM (2015), National Treasury SIPDM (2017), Civilution (2016) and National Treasury (2017), the Government's IDMS comprises three core systems, namely: a planning and budgeting system, a supply chain management system and an asset management system. These systems are located within three delivery processes, namely: portfolio management, programme and project management, and operation and maintenance processes. These collective systems and processes combined with the performance management system establish the institutional system for infrastructure delivery. Figure 3-2 depicts the IDMS model.

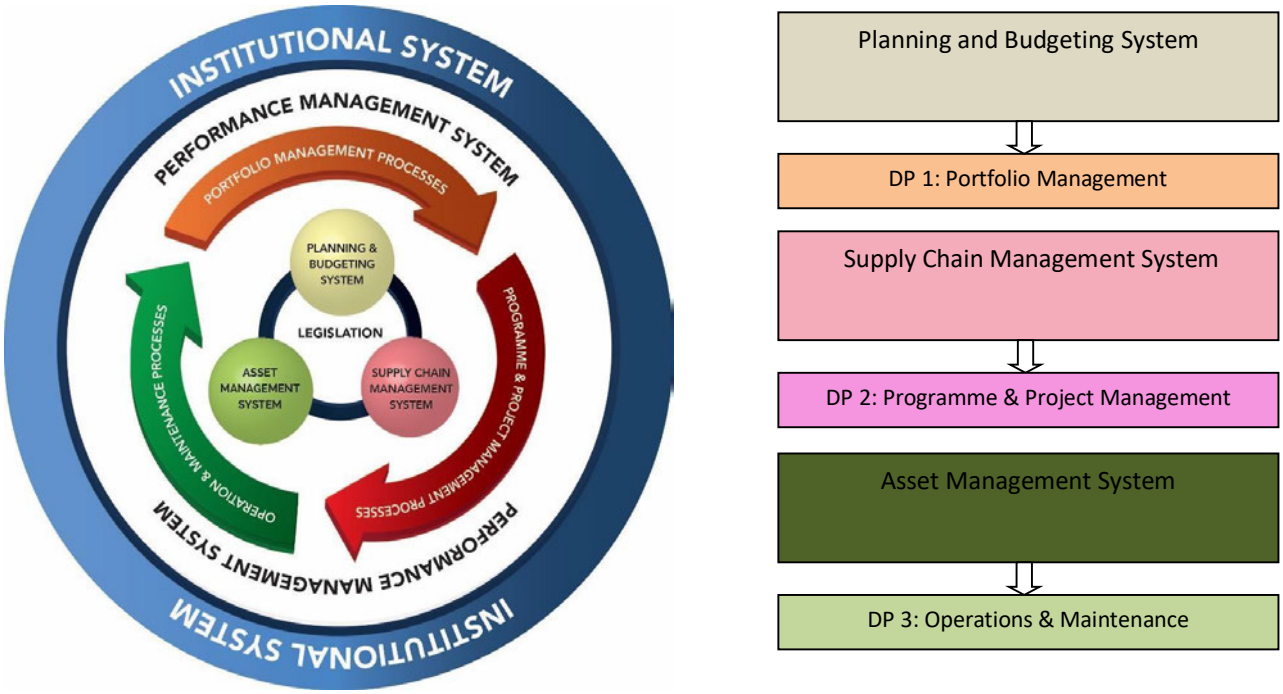

Figure 3-2: Infrastructure Delivery Management System

3.2.3.1.1 Evolution of the IDMS

The IDMS was formulated in 2004 as a tool to address and manage infrastructure service delivery. Its evolution has seen a shift from focus being mostly on project management to asset management where it is concerned with the full life cycle of infrastructure assets. Figure 3-3 illustrates the IDMS timeline since its inception.

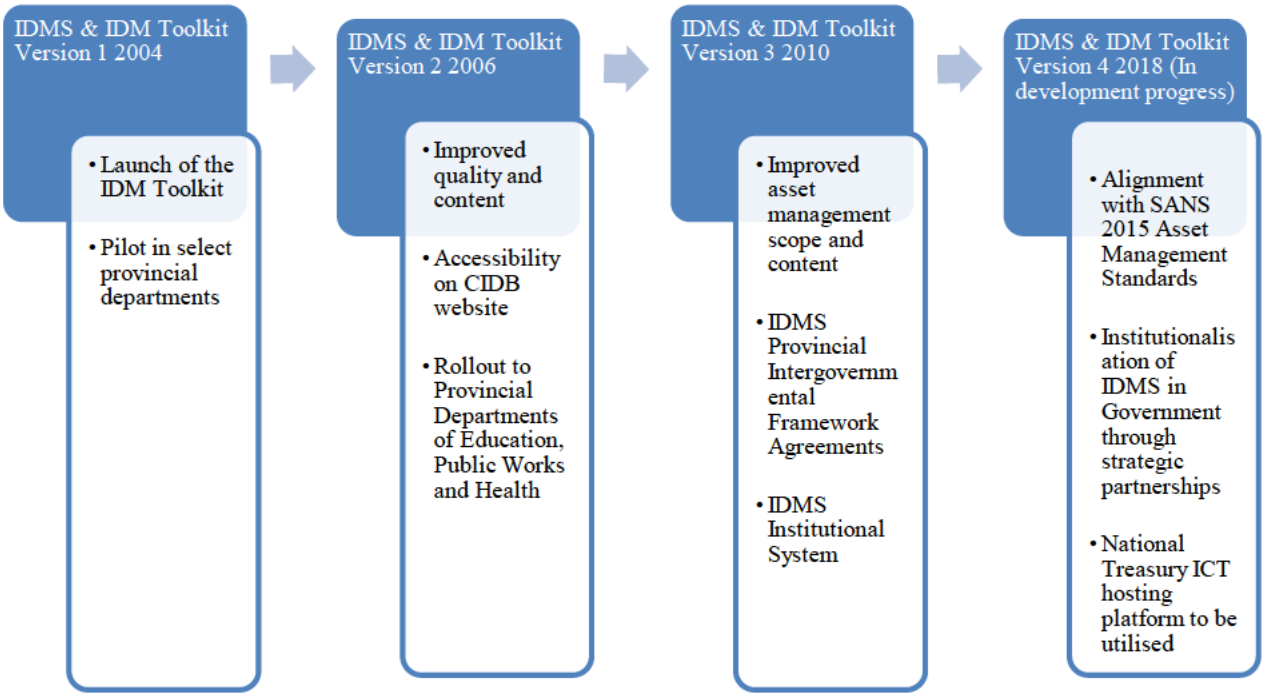

Figure 3-3: Evolution of the IDMS and IDM Toolkit

3.2.3.1.2 Systems within the IDMS

Systems are made up of a combination of processes, procedures and methods that can standardized for uniformity and ease for repeated use (Watermeyer, 2012). In the context of infrastructure, three systems were developed by the state organs in collaboration with the Construction Industry Development Board (CIDB) and these systems are discussed in Table 3-2 (Ibid).

Table 3-2: Systems in the IDMS

System	Description
Planning and Budgeting System	The planning and budgeting system aims to clearly define all objectives and desired end results, as well as setting timeframes, budget parameters and the risks associated with infrastructure delivery (National Treasury, 2015). The planning process within infrastructure delivery is iterative and recurrent, occurring within multiple layers. It commences in the portfolio management delivery process as a response to service delivery requirements and public sector business

	needs. Planning is then conducted for each project (CIDB, 2012; National Treasury, 2012)
Supply Chain Management System	The SIPDM forms part of and is a guideline for the supply chain management system (SCM) within the infrastructure delivery realm. The SCM regulates all organs of state in the national, provincial or local spheres of government which are mandated to adhere to the Public Finance Management Act, the Local Government: Municipal Finance Management Act, or which implement infrastructure projects on behalf of another organ of state (National Treasury, 2012).
Asset Management System	Asset management commences once assets have been identified in the asset register right through to the disposal of an asset, including all strategic decisions that ought to be taken during the asset portfolio planning and project implementation processes (IDM Toolkit, 2010). Asset management is a process-improvement strategy for improving and maintaining the condition and availability of assets (Davis, 2007).

3.2.3.1.3 Delivery Processes within the IDMS

The three-delivery process which are embedded in the IDMS are; portfolio management, project management and operations and maintenance.

3.2.3.1.3.1 DP1Portfolio Management

The Portfolio Management delivery process is subdivided into two categories; Infrastructure Planning and Programme Management. According to CIDB (2010), it is during this delivery process that management practices are applied to infrastructure assets in order to develop, implement, monitor and control prioritized projects within available budgets and organizational management capacity. Portfolio Management is also responsible for ensuring the right conditions that facilitate the delivery of an organization's services are in place. Basically, it concerns itself with "*doing the right work*" (Civilution, 2016; National Treasury, 2015). Table 3-3 depicts the Portfolio Management processes.

Table 3-3: Portfolio Management Processes

DP1 Portfolio Management	
Infrastructure Planning	**Programme Management**
Develop / review user asset management plan (U-AMP)	Develop / review construction procurement strategy
Develop / review custodian asset management plan (C-AMP)	Develop / review Infrastructure Programme Management Plan (IPMP)

	Authorize implementation Monitor and control implementation Programme review and close-out

3.2.3.1.3.2 DP2 Project Management

The second delivery process is concerned with the implementation of the projects initiated during the Portfolio Planning process. Basically, it concerns itself with "*doing the work right*". The broad and generic phases within the project management process are depicted in Figure 3-4.

Figure 3-4: Project Implementation Phases

These activities and processes which constitute the project management delivery process are further expanded and are depicted in Table 3-4

Table 3-4: Project Management Processes

DP2 Project Management			
Implementation Planning	**Design**	**Works**	**Close Out**
Prepare packages	Design development	Construct works	Contract close-out
Define packages	Detailed design	Handover works	Administration close-out
Develop / review Infrastructure Programme Implementation Plan (IPIP)	Compile Manufacture Fabrication and Construction (MFC) information		

3.2.3.1.3.3 DP3 Operations and Maintenance

The Operations and Maintenance delivery process entails the operation, maintenance and disposal of the infrastructure assets. The activities and processes which constitute the operations and maintenance delivery process are further depicted in Table 3-5

Table 3-5: Operations and Maintenance

DP3 Operations and Maintenance		
Recognise & accept assets	Mobilization for Operations Maintenance Facilities Management	Demobilization of Facilities Management

3.2.3.2 Objectives of the IDMS

The IDMS was formulated mainly to address the need for improved and adequate quality infrastructure and to curb the various challenges affecting infrastructure delivery, as tabulated in Table 3.6

Table 3-6: Objectives of the IDMS

Objective/s of IDMS	Description
Best Practice (CIDB, 2010; Civilution, 2016).	To have a benchmark and guide for best practice delivery of infrastructure management
Improved delivery (Civilution, 2016; CIDB, 2018)	To facilitate improved infrastructure delivery and efficiency
To address skills deficiency challenges (Civilution, 2016)	To address the persistent challenges faced by government in attracting and retaining a competent and efficient skills base
Improved Planning (Civilution, 2016)	To improve planning and the management of construction works
Cost effectiveness (CIDB, 2010)	To enhance cost effectiveness and value for money on infrastructure projects
Balance in infrastructure rollouts (National Treasury, 2012	To ensure the balance between the installation of new infrastructure and maintenance of the existing infrastructural projects

3.2.3.3 Competencies and skills required for engagement with the IDMS

The onus is on public entities to see to it that the calibre of people they employ possess the appropriate competency and knowledge levels required for effective and successful task execution (National Treasury, 2016). Competencies are defined as a set of skills, knowledge, attitudes and attributes required to perform a task to predetermined standards. Competence, on the other hand, relates to the ability to perform effectively and successfully (National Treasury, 2010). It is imperative to ensure that before responsibilities are assigned, employee skills and competence levels are assessed to ensure adequate task allocation, which enhances organization effectiveness and stability (Prophix, 2015). Upon task assignment, the subsequent critical step is to provide an adequate environment and the proper tools for successful task execution (Ibid).

The Government Gazette (2018) provided a list of occupations that are in demand in South Africa. The list indicated an alarming though well-known trend which indicated the extent of scarcity of skills. The occupations under the highest demand comprised mostly of managerial skills and technical skills, some of which are critical to infrastructure delivery and IDMS implementation.

3.2.3.3.1 Planning and Budgeting System

Due to the mounting pressure on public entities to be accountable for public expenditure, the planning and budgeting system has gained more relevance (KPMG, 2015). Furthermore, the Presidential Review Committee, which was established by former South African President, Nelson Mandela indicated that the poor performance by public entities was largely attributed to poor strategic planning processes (Barclay et al., 2011). Strategic planning seeks to understand challenges and trends; to establish and understand who the intended beneficiaries are and what their needs are, and to achieve organization goals in an effective and efficient manner (UN, 2015). Strategic planning defines the strategic aims of an organization, sets strategic goals and objectives, and details high level activities required to achieve these goals (Hilyard, 2016 and KPMG, 2015). Budgeting on the other hand, ensures resource allocation is in-line with the organization's strategic goals and objectives (Ibid). While goals help in organization vision creation, objectives facilitate breaking down a strategic plan into manageable tasks.

According to National Treasury (2010), planning and budgeting falls within the management accounting branch. Financial management specialists are employed by the Office of the Chief Financial Officer (CFO) within various government departments and their occupation and responsibility levels vary. The Chief Financial Officer occupation, together with other occupations which are tasked with the planning and budgeting within public entities such as Finance Managers and Management Accountants are in highest demand, thereby indicating the scarcity of the skills (Government Gazette, 2018). The lack of properly trained and well-informed executives and management, coupled with the lack of technically skilled workforce impedes the effective utilization of the IDMS.

3.2.3.3.2 Supply Chain Management System

Supply Chain Management (SCM) integrates business processes on the supply chain, that is supply and demand between companies, and it is concerned with the management of materials, information, and financial flows within a network of suppliers, manufacturers, distributors, and customers (Croxton et al., 2001). The need for a robust SCM system is to ensure organizations' growth and sustainability, coupled with the need to deliver goods and services to customers and end users in an effective and efficient manner. With the Government of South Africa being the biggest spender, it is critical to have in place a well-functioning SCM system in order to achieve national strategic objectives and goals (National Treasury, 2016). Common features of inefficient public sector SCM include exorbitant prices of goods and services, poor quality and quantity of goods and services, and poor governance and corruption (National Treasury, 2015).

A study by National Treasury (2016) demonstrated a serious capacity and capabilities constraints within the SCM function of government. Table 3-7 illustrates the qualifications of the people employed with

the SCM function of national departments, and of a total of 1373, only 19% have a SCM related qualification (National Treasury, 2016).

Table 3-7: Extract of Completed Qualifications for people employed National Level

Accounting	11%	151
Auditing	2%	22
Asset Management	0%	1
Law	0%	4
Logistics	12%	163
Marketing	1%	10
Policing	0%	1
Procurement Management	2%	27
Purchasing Management	3%	38
Project Management	0%	4
Public Administration	6%	82
Public Management	10%	141
SCM	2%	28
SCM Risk Management	0%	1
Strategic SCM	0%	1
Store Control	0%	5
Transport	1%	8
Other	13%	184
Unknown	6%	89
Not Applicable	30%	413
Total	100%	1373

Of the SM courses offered at national level, less than 10% of the staff had completed a course in each of the 18 out of 19 courses offered, with 12 courses recording less than 5% of the staff having completed the courses. These figures demonstrate the serious skills shortages within this government function (National Treasury, 2016). The study further established that most of the management and officials were oblivious of the existence of the SCM Professional Body and Associations which are beneficial for their knowledge and experience enhancement. Further exacerbating the inadequacies of the SCM function of government departments is the reluctance of employees to attend short term SCM training courses.

3.2.3.3.3 Asset Management System

Asset Management is a systematic process primarily focused on the performance of the life cycle of an asset in the long term. Asset management, according to Vanini (2018) is a *"systematic process of analyzing, trading, lending and borrowing assets of all kinds".* In terms of infrastructure, asset management entails the management of technical infrastructure which facilitates business operations (Reyes, 2015). Asset management is contained within the operation and maintenance processes of the IDMS and it comprises both the maintenance and/or replacement of infrastructure assets. (CIDB, 2010). Asset management, if implemented adequately aims to improve and increase the use of a particular asset and in the instance sustain economic growth and service delivery (Reyes, 2015). Suffice to

mention that, if the assets are well managed, best value outputs are achieved, and efficiency and quality are realised (Ibid).

Arguably, the public sector is the largest owner and occupier of immovable assets worldwide (Yusof, 2013). Given the long-life spans and large capital outlays associated with infrastructure assets, good infrastructure asset management is vital (NWPG, 2004). It is critical therefore, for public sector entities to be adequately resourced and to possess a skilled and competent workforce. The qualifications required for one to be an asset manager include finance, economics and/or accounting. The bulk of the skills required within the Asset Management branch are considered scarce and are under highest demand, and these include Physical Asset Managers and Sustainability Managers (Government Gazette, 2018).

3.2.3.4 Possible Bottlenecks/Challenges

The challenges inhibiting improvement in infrastructure delivery can be attributed to the inability of the relevant public sector departments to optimally implement the IDMS. This is debilitating to economy of a country especially when most governments use infrastructure as a tool to address macro socio-economic policy objectives. Table 3-8 illustrates the challenges inhibiting optimal usage of the IDMS.

Table 3-8: Challenges affecting optimal usage of the IDMS

Challenges	Description
Prevalence of poor interdepartmental relationships and unclear communication channels (Thiry and Deguire 2007; Thumbiran and Raphiri, 2016)	As a result of the various inter-organizational and interdepartmental structures, poor relations between these departments are unavoidable because of the different cultures, and therefore these poor relations pose challenges to the optimal usage of the IDMS
Poor leadership and management structures (Adetola et al., 2011; Thumbiran and Raphiri, 2016)	The lack of adequate skilled leadership and management systems has led to decreased proper implementation of the IDMS, consequently leading to poor infrastructure delivery and dissatisfied clients.
Limited technical capacity (Thumbiran and Raphiri, 2016)	The challenge of capacity constraints culminates to the improper and/or lack of utilization of the IDMS, therefore resulting in the ineffective application of the system.

Governance Issues and collusion within the industry (Thumbiran and Raphiri, 2016)	Widespread corruption and poor governance undermine the proper utilization of the IDMS, as individuals and public officials seek ways to exploit the system for personal gain.

3.2.3.4.1 Infrastructure Gateway System (IGS)

The IGS provides several control points (or gates) throughout the life cycle of an infrastructural asset. The gates are control points which prohibit proceeding to the next level before informed decision making, acceptance and sign-off of a particular stage by the relevant decision makers (Watermeyer, 2012; Gharehbaghi and Georgy, 2015; CIDB, 2010b). Gharehbaghi and Georgy (2015) further highlighted that the IGS facilitates the delivery and management of infrastructure to be coordinated in a planned logical and methodical manner. Further to that, CIDB (2010) posited that the decision gates can be used to ensure that the proposed infrastructure asset:

- Does not deviate from the authorized plan and therefore remains within the agreed mandates and strategic priorities;
- Is in accordance with and aligns with the purpose and reason behind its conception; and
- Can progress successfully from one stage to another.

According to Gharehbaghi and Georgy (2015), within the IDMS, the IGS interacts with four systems, namely: infrastructure planning system, program and project management system, construction procurement system (CPS), and lastly the operations and maintenance system.

Figure 3-5: Infrastructure Gateway System

3.2.3.5 Other Legislation Impacting Infrastructure Delivery

Table 3-9 summarises the legislation in place pertaining to infrastructure delivery and management practices in South Africa.

Table 3-9: Primary legislation that regulated Infrastructure Delivery

New Growth Path (NGP) 2010	The NGP was released by the then Economic Development Minister, Ebrahim Patel. The main objective of the NGP was job creation, with infrastructure delivery making it in the list of the six priority areas documented. The New Growth Path identified economic problems and highlighted possible job opportunities in specific sectors which would facilitate achieving the target five million new jobs by 2020.The NGP also made special emphasis on social equity, which is a very crucial factor and milestone in driving the nation forward considering the disparate state of infrastructure in South Africa which limits social inclusion and faster economic growth. This could be attained partly due to strengthening public sector investment in infrastructure
National Development Plan (NDP) 2012	The NDP aims to eradicate poverty and foster equality by 2030, thereby ensuring that every citizen attains a decent standard of living. Infrastructure development underpins the NDP, and so expectedly, there would be continued upsurge in the levels of investment regarding infrastructure. According to the NDP, one of the critical action items is the proposed increase in public infrastructure investment; with emphasis on transport, energy and water, at 10 percent of GDP. Furthermore, the plan envisioned higher investment, and better public infrastructure and skills, as tools that would accelerate economic growth. This therefore justifies government spending being aligned with the objectives of the NDP (National Treasury, 2017).
Constitution of the Republic of South Africa, 1996	The Constitution of the Republic of South Africa, 1996, is an important role player in the development of the law and it regulates the functions of government and all public entities (SACQSP, 2016). It contains several important characteristics which entail, among other factors; the bill of rights and the protection of property, and it further stipulates that all spheres of government must secure the well-being of all citizens (CIP Bill, 2015; SACQSP, 2016). This therefore highlights the importance of implementing well-functioning and the protection of critical infrastructure which is essential

	for public safety, national security and the continuous provision of essential public services (CIP Bill, 2015)
Municipal Finance Management Act of 2003	This Act impacts infrastructure delivery as it covers the costs associated with the provision of municipal infrastructure entailing the provision of new infrastructure and maintenance of existing
Municipal Systems Act of 2000	According to DBSA (2011), Municipal infrastructure is defined as 'the capital works required to provide municipal services' and it encompasses all the activities necessary to ensure that the works are delivered effectively. Municipalities are tasked with the responsibility of providing both new infrastructure and rehabilitating existing ones. This responsibility therefore calls for sound operation and maintenance arrangements, including customer interface arrangements, to provide adequate infrastructure and services to the public (Ibid). The Municipal Systems Act requires all municipalities to formulate an integrated development plan (IDP) to guide all such activities and to ensure development within municipality.
Infrastructure Development Act, 2014	This Act is concerned with the upliftment of socio-economic welfare of the public through the advancement of public infrastructure development. It aims to ensure that infrastructure development is prioritized; the nation's development goals are promoted through infrastructure development, and to improve infrastructure management throughout its life-cycle phases.
Public Finance Management Act (PFMA), 1999	A study by Ajam (2016) found that the PFMA facilitates good management, safeguarding and the maintenance of public finances and assets, which in turn contributes to improved infrastructure and service delivery, and maximizes accountability, through efficient use of limited resources. The "object of this Act is to secure transparency, accountability, and sound management of the revenue, expenditure, assets and liabilities of the institutions to which this Act applies,"and these institutions include departments, public entities, constitutional institutions and the provincial legislatures (PFMA, 1999).
Government Immovable Asset Management Act (GIAMA), 2007	It is needless to mention that adequate maintenance of a nation's immovable assets is essential for the general wellbeing of its citizens. The GIAMA is aimed at improving long-term infrastructure maintenance through effective immovable asset management with assigned accountability

	and clearly defined responsibility between entities involved. One of the objectives of the GIAMA is to ensure that all immovable assets are well managed, controlled and adequately safeguarded (IAMP, 2015).
Intergovernmental Relations Framework Act (IGRFA), 2005	Intergovernmental relations can best be described as complicated and interdependent relations, including the coordination of public policies, among the three spheres of government, namely; national, provincial and local (DPLG, 2007). In response to the disparate distribution of infrastructure and services in South Africa during the apartheid era, the country adopted the democratic model of co-operative governance which is enshrined in its Constitution, as well as the promulgation of the IGRFA whose sole mandate is ensuring, inter alia, the adequate provision of service and the realisation of developmental goals of the state (Ibid). This entails ensuring that the standards of living of all citizens are within the minimal acceptable limits, which is achievable through fostering the provision of fundamental infrastructure such as housing, education, medical and health care and employment opportunities.
Construction Industry Development Board Act, 2000	The main aim of the CIDB Act is to implement an integrated strategy for the advancement of the construction industry and to provide for matters connected therewith. One of the objectives of this Act which is strongly aligned to infrastructure delivery is its emphasis on the prioritization of the contribution of the construction industry to meet national construction demand and advancement of national, social and economic development objectives.
Division of Revenue Act, annual	This Act is concerned with the division of revenue and spending by public entities. It allocates funds and redistributes resources from accumulated taxes for expenditure across the three spheres of government (National Treasury, 2017). This redistribution of funds is mainly centred around areas with the greatest impact on the economy and where public services are most required. Furthermore, it has been reported by National Treasury (2017) that the funds are used in the provision of infrastructure and services some of which include; basic education, health, roads and human settlements, water, sanitation and electricity reticulation.
National Infrastructure Maintenance Strategy (NIMS)	In a bid to deliver infrastructure services to all, the SA government formulated the National Infrastructure Maintenance Strategy (NIMS) (CIDB, 2008). NIMS is a

	coordinated programme of actions that is integral to effective infrastructure and it was approved by Cabinet on 23 August 2006 and launched by Minister Thoko Didiza in May 2008 (Ibid). NIMS focuses on the need and importance of adequately maintained and operated infrastructure which will result in, among other factors, improved socio-economic conditions, economic growth and job creation. It focuses on the core aspects of improved infrastructure delivery, which are asset management planning, budgeting and implementation.
Presidential Infrastructure Coordinating Commission (PICC) of 2012	The PICC developed the country's first National Infrastructure Plan and its main objective was to improve the planning, coordination and monitoring of core infrastructure development in South Africa. The PICC was formulated in response to the impetus for the African Heads of States to take initiatives to fast track regional infrastructure development by proposing that projects be championed by Heads of State (Hagerman, 2012). According to Quarterly Bulletin (2012), the PICC was created mainly to enhance the clearing of any challenges affecting the implementation of infrastructure projects on a national, provincial and local level. A speech by then Minister of Transport, Honourable Sibusiso Ndebele, held in Cape Town on the 28th of February 2012, highlighted on the importance of the PICC in ensuring that infrastructure projects stimulated both social and economic growth. One of the objectives of the PICC was to address capacity constraints and to improve coordination in infrastructure delivery in the process ameliorating the lives of all citizens especially the poor (Quarterly Bulletin, 2012).

The importance of and the value adequate and well-maintained infrastructure has to all citizens of a country can never be overly emphasized (SAICE, 2011). According to CIDB (2008), the SA government has realised the importance of infrastructure maintenance and the role that effectivele maintenance will play in support of Accelerated and Shared Growth Initiative for South Africa (ASGISA).

Sadly, despite the formulation of a plethora of legislation and policies, evidence abounds from extant research which indicates that there has not been much progress made regarding improved infrastructure delivery and distribution in South Africa. Additionally, due to poor governance and mal administration of legislature, infrastructure projects frequently fail to meet their project objectives in relation to time,

budget and service delivery (OECD, 2015). This lack of progress could be attributed to, as Thiry and Deguire (2007) posit, policy adoption rarely progressing to the implementation stages.

3.3 Governance/Administrative Framework for Infrastructure Delivery in South Africa

Sheng (2012) defined governance as the *"process of decision-making and the process by which decisions are implemented (or not implemented)."* In the infrastructural context, OECD (2015) defined infrastructure governance as the combined "*processes, tools and norms of interaction, decision-making and monitoring used by governmental organizations and their counterparts with respect to making infrastructure services available to the public and the public sector."* Kaufman et al (1999) cited in Pillay (2004) defined governance *as "traditions and institutions by which authority in a country is exercised for [the] common good."* According to Delloite (2011), typical aspects that pertain to governance, include:

- Decision-making authority indicating who the responsibility of making crucial decisions lies with.
- Organizational structures detailing the roles and responsibilities for overall organizational processes like, operational, control, and reporting processes
- Organizational design which must be easily understood by all stakeholders.

3.3.1 Principles of Good Governance

The King Report on Corporate Governance for South Africa 2016, with the latest edition being "King IV" defines corporate governance as *"the exercise of ethical and effective leadership towards the achievement of governance outcomes"*. The King reports consider effective and ethical leadership to be key components of good governance. Governance outcomes can be considered to be outputs or benefits of good governance achieved by organizations, and these were stated by (King IV, 2016) as:

- Ethical culture,
- Good performance,
- Effective control and
- Legitimacy.

Additionally, an organization forms part of a society, as such, aspects of corporate governance, especially pertaining to public entities, affect the society at large (King IV, 2016). In the infrastructure delivery context, a governance framework facilitates the provision of infrastructure in a cost effective and legitimate manner (Kenny, 2007). Sound governance is critical and a prerequisite for successful infrastructure delivery (Kenny, 2007 and OECD, 2015). Furthermore, OECD (2015) opines that good governance is a commensurate for increased private sector investment and national growth. On the

contrary, poor governance has been cited as correlating to project failures which include time and cost overruns underperformance, under-utilization of constructed facilities and failure to meet service delivery objectives (Ibid). Sheng (2011) noted eight major characteristics of good governance as depicted in Figure 3-6;

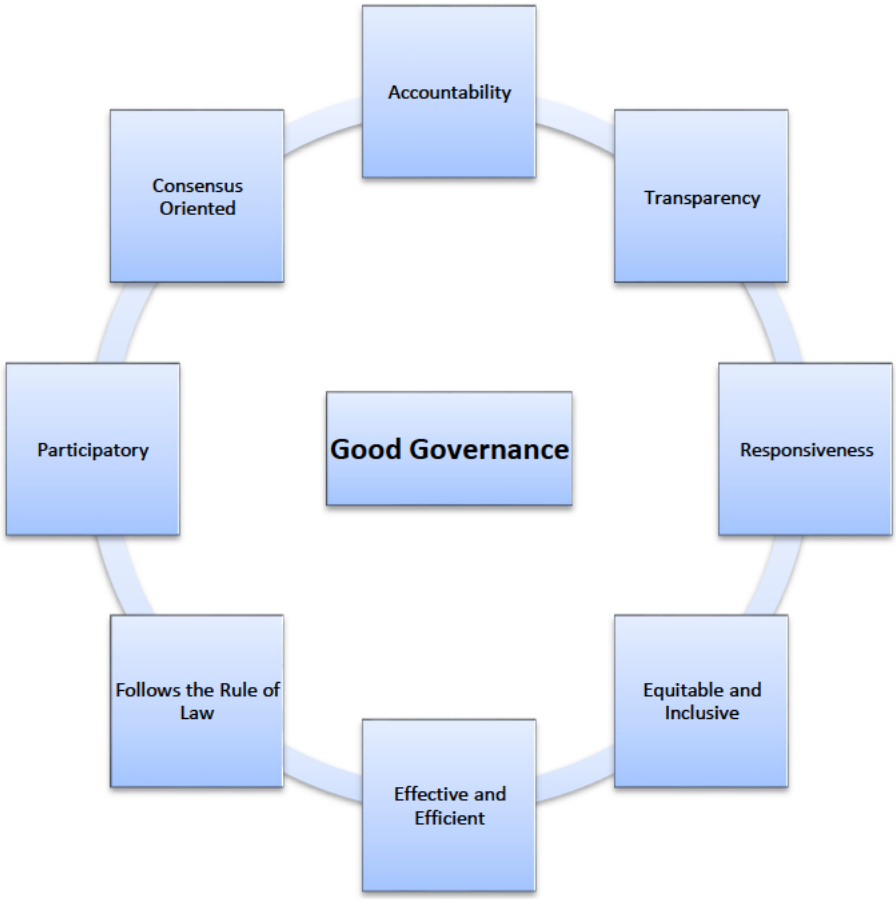

Figure 3-6: Principles of Good Governance (Source: Sheng, 2011)

- Accountability – The Constitution of the Republic of South Africa (1996) sets out the importance of and need for accountability in public administration. All holders of public office and in some cases, the private sector and civil society organizations ought to be held accountable for their decisions and actions to the public, and they must be willing to undergo any scrutiny as may be necessary, including being answerable for their execution of responsibilities (King IV, 2016; Sheng, 2011; SACQSP, 2016;). Accountability also entails the promotion of independent judgement, balance of power and discharge of duties including evaluation of both individual and organizational performance, to enhance continued improvements in processes and performance (King IV, 2016).

- Transparency – The Constitution of the Republic of South Africa (1996) is committed to greater openness and transparency within public institutions. Sheng (2011) described transparency as the application of rules and regulations in decision making and enforcement. SACQSP (2016) and King IV (2016) emphasized on the need for the holders of public office to be very open and transparent about all the decisions and actions they take, as well as justifying both their decisions and the restrictions on information when the public clearly demands answers.

- Responsiveness – According to Sheng (2011), it is imperative that holders of public office serve all stakeholders timeously. UN (2015) affirm that it is a requirement that all levels and actors of governance respond to the needs of the people

- Equitable and Inclusive - Fair representation of both men and women is now being widely considered as an obligation for good governance (Sheng, 2011).

- Effective and Efficient – Optimal usage and implementation of resources and processes to ensure best results are achieved while maintaining cost effectiveness. Basically, processes and institutions must produce results that meet needs while utilizing the resources they have available (UN, 2015).

- Participatory – In relation to governance, the Constitution of the Republic of South Africa (1996) encourages public participation to ensure democracy. Sheng (2011) emphasized that good governance must engage the public in the complete policymaking processes. Public participation is fueled by access to public information which is a prerequisite for democratic governance and social inclusion (UN, 2015). Citizens' participation and control in defining public problems that affect their lives is a necessity to any democracy (Ibid).

- Consensus Oriented – Taking into consideration the diverse public opinions and interests, good governance must consider all options and make decisions on the grounds of what is good for everyone, while also bearing in mind that it is impossible to please everyone. Generally, a broad consensus on what is in the best interests of the group is adopted.

- Follows the Rule of Law – Good governance ought to be guided by rule of law. All decisions and actions taken must be in adherence to the laws and regulations of a country. Good governance promotes fair and impartial enforcement of laws and an incorruptible police force (Sheng, 2011).

3.3.2 The Challenges of Good Governance

Despite having 'how-to' guideline documents which seek to address the aspects of corporate governance, such as for example, the evolution of the King reports, with King I - 1994, 2002 King II - 200), and King III - 2009 and a fourth revision King IV - 2016, the South African environment is fraught with challenges to good governance. Infrastructure governance has not only influenced the decision-making processes of many governments in relation to infrastructure delivery and allocation, but it has also drawn special attention to the challenges affecting these decision-making processes (Wegrich and Hammerschmid, 2017). Anheier and Alter (2016) cited in Wegrich and Hammerschmid (2017) mentioned two challenges affecting decision making, namely:

i. The substantive quality of decisions – Mainly pertains to the lack of prioritization of needs by government and the inability of government to determine the levels of investments required, and the leverage of the private sector. Generally, the majority of governments have been unable to forecast the investment required and end up either investing less than is required or way more than is required in the wrong sectors and/or projects.

ii. The procedural and institutional quality of the decision-making process – This dimension concerns itself with the inability of government to make smart and well-informed decisions due to capacity constraints within government departments. Here, governments are fraught with tools and capacity deficiencies that ought to provide the grounds for good decision-making.

Prinsloo (2013), highlighted that deficiencies in governance have led to informal decision-making which often results in, to mention but a few; authority abuse, corrupt practices, fraud and violation of the legal systems, consequently leading to failure of otherwise good governments. Most of these challenges are two faced; acting either as a catalyst to or can flourish from poor governance, but ultimately, they hamper development with lasting effects to the targeted users of the infrastructure (Kenny, 2007). The repercussions of poor governance are often felt throughout the different stages of the infrastructure life cycle, for example, by escalating the price of infrastructure from the onset or they can reduce the quality of and economic returns of infrastructure (Ibid).

In 2011 alone, an alarming R21 billion was unaccounted for by the South African government departments due to irregular expenditure (Business Day, 2011). That amount slipped through cracks of corruption, incompetence and negligence by public servants (Ibid). In response to the lack of accountability and supportive structures in public procurement of infrastructure projects, and in a bid to foster good governance, South Africa reformed its public procurement system (Ambe & Badenhorst-Weiss, 2012).

Bad governance and administration undermine the rights of citizens, are a threat the security of nations and to democracy (Fourie, 2015). Pillay (2004) suggested that bad governance in South Africa was on the rise and it thrived on institutional weaknesses, such as; unfair promotions, nepotism, loss of institutional vision and purpose, and inadequate resources, to mention but a few. Pillay went further to summarize the threats to good governance within the public sector as listed below:

- Power and authority abuse
- Obsolete laws and regulations
- Excess demand for a product or service
- Undesirable social controls
- Defective and inefficient administrative control
- Bureaucratism

The challenges to good governance have had detractive and regressive effects on the environmental and societal well-being, giving rise to, among other factors; injustice, inefficiencies in the delivery of public goods and services, waste of public expenditure and resources, discouragement of the public and private investors, political instability and restrictions on government policy (Pillay, 2004).

3.3.3 Addressing Factors Affecting Good Governance

Notwithstanding the various initiatives made by the South African government to curb the widespread bad governance, corruption continues to hinder progress and development of the nation (Fourie, 2015). As such, the persistent fight against bad governance coupled with impartial democracy, free and fair elections, sound leadership, public participation and access to information by all, collectively contribute to good governance (Pillay, 2004). The tools for good governance entail:

3.3.3.1 The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996)

As the supreme law, the Constitution of the Republic of South Africa (1996) is a major tool used to create and advance good governance (Fourie, 2015; Pillay, 2004). The Constitution has tackled the branch of public administration and called for increased accountability, transparency and openness in relation to public resources and expenditure.

3.3.3.2 The White Paper on Transformation of the Public Service, 1997

The White Paper provides a policy framework and implementation strategies for public service delivery. It fostered the government to up-hold its citizen's rights by adopting a more inclusive and participatory environment with improved service delivery. The White Paper enhanced good public administration and governance.

In light of the pivotal role public procurement has on the successful delivery and management of public infrastructure, and the rise in manipulation of procurement systems through mismanagement and corruption, many nations, South Africa included, have made tremendous efforts to *'nip in the bud'* these malpractices by formulating procurement reforms and integrating procurement into a more strategic view of government efforts (Fourie, 2015; Pillay, 2004). According to Ambe & Badenhorst-Weiss (2012) multiple legislative frameworks are in place to regulate public procurement some of which include the following:

- Section 112 of the Municipal Financial Management Act No 56 of 2003 (MFMA)
- Section 76(4) (C) of the Public Finance Management Act No 1 of 1999 (PFMA)
- Preferential Procurement Policy Framework Act No 5 of 2000 (PPPFA).

According to Business Day (2011), the provision of infrastructure and public services in South Africa is fraught with the lack of perceived quality of governance, fraud and corruption in some spheres of the economy and lack of enforcement of empowerment policies. This was due to institutional challenges as many public entities overpaid service providers for products and services or generally failed to monitor expenditures (Ibid). Corruption, in isolation, is a major inhibitor of and a great threat to good governance (Fourie, 2015; Pillay, 2004). Pillay (2004) went further to propose that, to improve public administration and governance within the South African National Public Service, the following objectives could be adopted:

- Increasing investigation into and prosecuting corruption
- Rationalising agencies fighting corruption such as: The Directorate of Special Operations, commonly known as the Scorpions, the Asset Forfeiture Unit, the Public Protector, Commercial Crime Units, Special Investigation Units, to mention but a few.
- Improving discipline and the management systems at all government institutions
- Reviewing and revising current legislation as necessary.

3.4 Chapter Summary

This chapter tackled aspects of infrastructure delivery from a governance and legislative framework perspective. Policies and procedures promulgated to govern both public and private sectors in relation to infrastructure delivery were discussed. The IDMS, a critical government initiative to guide and implement the execution of all public sector infrastructure projects, and the challenges affecting its optimum utilization were discussed in detail. The next chapter, discusses the various organizational theories and management models

CHAPTER 4

ORGANIZATIONAL THEORIES AND MANAGEMENT MODELS

4.1 Organization Theory

For one to understand what 'organization theory' is, it is imperative that one initially understands what a 'theory' is and what an 'organization' is. In summary, a theory tries to establish why things happen by putting forth a cause and effect link (McAuley et al., 2007). Theory can be used to drive the much-needed change within an organization and may improve organizational performance (Ferdous, 2016). McAuley et al. (2007) allude to the intrinsic characteristics of a theory as follows:

- Theories try to explain the behavior of people and causal relationships in social contexts
- Theories provide for the definition and classification of things and people
- Theories propose the reasons of any variation or deviation in the form of cause-and-effect relationships of the phenomenon under study
- Theories seek to determine the circumstances under which these cause and effect relationships are applicable or not, and therefore set parameters where applicable
- Theories offer predictions and try to control events, and hence can be used to guide people's actions
- Lastly, theories can be used to describe, explain and justify people's actions

As far back as almost 60 years ago, Talcott Parsons (1960) cited by McAuley et al. (2007) defined an organization as a social institution driven by an aim to achieve a specific goal or purpose. Through division of labour and hierarchies of authority added Schein (1970) also cited in (McAuley et al., 2007). Needless to mention that organizations can tend to be complex and the understanding of these organizations can prove challenging. Laegaard and Bindslev (2006) therefore recommended a simplified manner of organizational analysis by adopting Scott's three-point analysis of organizations, namely:

i. Socio-psychological level which pertains to individual and interpersonal interactions,

ii. Structural level which pertains to the internal dynamics of the organization and the sub-divisions within the organization, such as the various departments and teams, and;

iii. Macro level which focuses on the organization's external dynamics, that is, how the organization interacts with other organizations and the society at large

4.2 Relevance of Organizational Theory on the Application of the IDMS

According to McAuley et al. (2007), organization theory seeks to define what an organization is and its purpose. They went further to illustrate that organization theory also seeks to establish social

interactions between diverse individuals in a group setting. Nicholson (1995) offers an alternative definition of organization theory as diverse academic viewpoints with the aim of describing the various organizational structures and their operating processes. On the other hand, Ferdous (2016) asserted that organization theory seeks to understand how organizations function in an attempt to improve its overall competency levels and operations to enhance attainment of organizational goals.

Ferdous (2016) highlighted that organizational theories have been used in the formulation of ideas that are applicable to any organization. The growth and pervasive acknowledgement of organization theory has been attributed to protagonists such as Taylor, Fayol and Weber (Ferdous, 2016). Task performance and structure of an organization are critical factors to be considered when seeking to understand organizational theories (Laegaard and Bindslev, 2006). The IDMS is central to the public sector's infrastructure delivery processes and it impacts on key management functions within these organizations (National Treasury 2012. As a tool which unpacks public sector's infrastructure delivery processes, its influence on organizational structures and operational processes is therefore apparent. According to WCG (2010), the IDMS seeks to address the four dimensions of the infrastructure delivery process, namely: institutions, people, organisational behaviour and human resource systems, all of which are critical to organizational theory.

According to Shafritz et al., (2005), there various viewpoints regarding organizational theories such as, inter alia; Theories of Classical Management, Theories of Humanistic Management, Politics Organization Theory and Theories of Situational Management. As a point of departure, Mahmood et al. (2012) and Laegaard and Bindslev (2006) allude to the pivotal role of classical organization theory contributions to this regard as it lays the foundation for all other management concepts.

4.2.1 Classical Organization Theory

The major contributors to classical theory are Frederick Taylor with Scientific Management, Henri Fayol with Administrative Management and Max Weber with Bureaucratic Management and organization behavior as depicted on Figure 4-1. According to Shafritz et al. (2005) classical organization theory addresses the hierarchical levels of responsibility, authority and coordination between different individuals and departments. The underlying tenets of classical organization theory have been laid down by Shafritz et al. (2011) as:

- The goal of an organization is to accomplish best productivity and to be economic
- The only best way to organize for production is achieved through systematic and scientific enquiry.
- Specialization and division of work increase efficiency and productivity
- Individual and organizations ought to enhance rational economic principles.

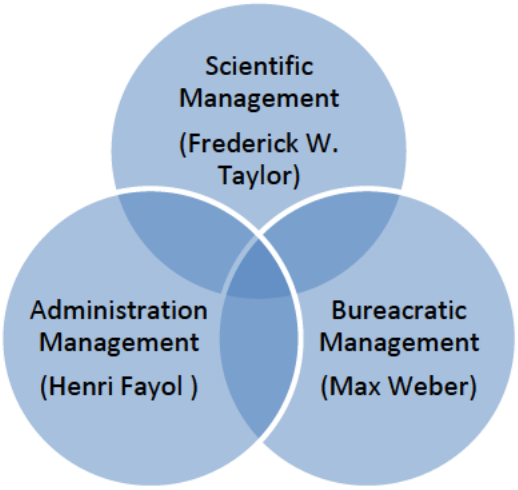

Figure 4-1: Three prominent contributions to Classical Theory [Ferdous, 2016; Shafritz et al. 2005)

4.2.1.1 Scientific Management

Frederick W. Taylor (1856-1915) is considered a protagonist in the scientific management theory due to his significant contributions (Laegaard and Bindslev, 2006; Sarker and Khan, 2013). Systemization underpins this organization theory, and focus is laid on efficiency to achieve best results through the utilization of scientific methods, experiments and procedures (Laegaard and Bindslev, 2006). It pre-supposes the possibility of having predetermined processes which utilize the least resources to attain maximum output (Ibid). The scientific method dictates that there is only one best way to enhance productivity and this through systematic and scientific enquiry (Shafritz et al., 2005). Proper planning of work to achieve efficiency is the foundational principle in the scientific management approach, in pursuit of standardization, specialization and simplification (Ferdous, 2016). Consequently, the scientific method reinforces the need for an organization to engage specialists to optimize their work processes. To increase efficiency, efficacy and proficiency of an organization, Taylor put forth four fundaments principles of management which can be summarized as:

- To develop a science governing every man's work
- To train and improve workman through scientific ways
- Collaboration and dedication by all workmen to complete a task or assignment successfully and scientifically
- Division of labour and responsibilities between management and workmen (Ferdous, 2016).

The scientific management advocates for cooperation between worker and management, and Taylor was the pioneer in attempting to understand human behavior within the work environment through the systematic approach (Ferdous, 2016).

4.2.1.1.1 Systems Approach

Systems approach considers an organization as a complex set of interconnected and linked elements made up of inputs, processes, outputs, feedback loops and the environment (Jackson et al, 2010). This approach aims at identifying the constraints that could be hindering effective and efficient output within a system, in this case, infrastructure delivery. It considers the system in its entirety and takes into consideration the whole life cycle of infrastructure delivery. Ideally, the critical constraint which can be considered as a weak link is dealt with first followed by the next most critical until such time that all constraints are addressed. Crucially, the constraints need to be addressed based on priority. The systems approach will not be fully effective if only a few of the constraints are addressed. Only after attending to all constraints and/or restrictions will the system improve significantly. Figure 4-2, which depicts some of the possible constraints to infrastructure delivery was borrowed from WFEO (2010) and adapted to this study.

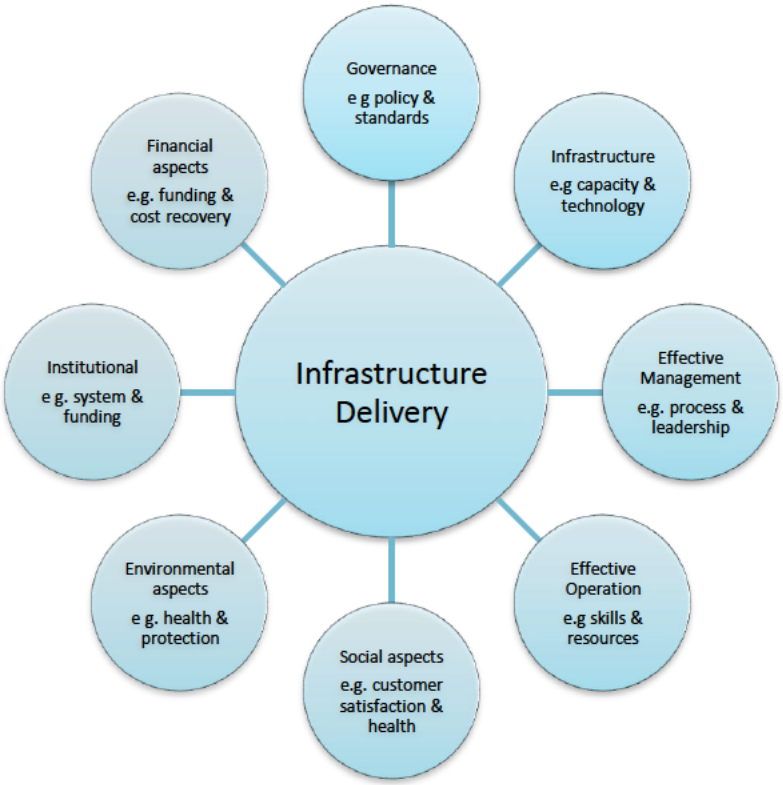

Figure 4-2: Key elements / constraints to infrastructure delivery

4.2.1.2 Administrative Management

The administrative management theory is attributed to Henri Fayol (1841-1925), with his experience and understanding underpinning his contributions to this theory (Ferdous, 2016). The gist of and key focus of this theory lies in the overall management of an organization (Ibid). Fayol suggested six functions of management, namely; forecasting, planning, organizing, commanding, coordinating and

monitoring (Mahmood et al., 2012). In a way, administrative management complements the scientific management as the former focuses on administrative processes and the latter on technical processes (Laegaard and Bindslev, 2006). Administrative management places emphasis on hierarchy within an organization (Ibid).

According to Laegaard and Bindslev (2006), the administrative theory pays special attention to two fundamental principles; coordination and specialization.

i. Coordination: Hierarchical Pyramid

- Every employee reports to and is accountable to one superior only
- A superior can supervise only a limited and manageable number of people
- Routine work is the responsibility of employees and management attends to specialist tasks.

ii. Specialization: Division of Work

Homogeneous groups are formed within the organization according to work activities, for instance; the purpose of the organization, processes conducted with the organization, customer type and base, and geographical location. Sometimes it is loosely termed as departmentalization where related work activities are grouped together, and unity of direction is crucial.

4.2.1.3 Bureaucratic Management

Scott (1998: 48) described bureaucracy as *"a specific administrative structure, which is based on legal or rule orientated authority*. Max Weber (1864-1920) is the protagonist of the sociological study of bureaucracy in organizations (Ferdous, 2016). Weber highlighted that the best way to understand an organization is to initially understand its history (Laegaard and Bindslev, 2006). Under the bureaucratic model, a 'public' employee ought to prioritize a superior's interest as if there were their own (Ibid). The core characteristics of bureaucracy were summarised by Laegaard and Bindslev (2006) as;

- Pre-set division of work between employees based on employee's abilities
- Administration hierarchy, that is, position within the organization should be organized in a hierarchical structure of authority.
- Established rules which members of an organization need to abide to. All official decisions and actions should be governed by a formally established system of rules and regulations.
- Employment and promotion of staff should be according to qualifications and abilities
- Separation of personal and company property

4.3 Resource Based Theory

Earlier studies by Barney (1991) suggested that an organization is only as good as its internal human capital, that is, the knowledge acquired, its competence and skills-levels, and interactions between employees, which are all critical for both productivity and sustainability. These characteristics are important as they constitute the intangible assets for organizations (Anantadjaya, 2008). Wu (2007) posited that an organization's performance therefore depended on the firm's ability to gather and utilize such intangible resources. These resources encapsulate all aspects of resources utilized by an organization, namely; assets, capacity, skills set, competence, business practice and processes, systems and procedures, information management, and intellectual property (Ibid). According to Barney (1991), these resources should be valuable, efficient, unique, inimitable and non-substitutable.

The resource-based theory places emphasis on collective teamwork and highlights that an isolated resource, despite its competence and value, cannot make a huge impact by itself (Anantadjaya, 2008). A central premise of resource-based theory is that, it is one of the "*most prominent and powerful theories for understanding organizations" (*Barney et al., 2011). Contextually, the resource-based view accentuates the principle that an organization's performance is dependent on the resources available and it directly represents capabilities of the firm (Bridoux, 2003). Also, organizational success is determined by the competence level of human capital, especially that of management (Berger and Bonaccorsi di Patti, 2003). Cognizant of the heterogeneous nature of firms, Anantadjaya (2008) and Andrews et al. (2015) corroborate that to ensure optimal performance and growth, organizations must rely on the resources that they gather, both productive and unproductive.

The importance of human resources stretches to and is crucial within governmental departments, especially those responsible for the formulation and implementation of public policy (Andrews et al., 2015). Even more important is the ability of these organizations to skilfully deploy their human resources, so as to realise their full potential and accomplish set objectives which are often of a complex nature (Rainey, 2009). The resource-based theory focuses on an organization from within and argues that performance is a result of utilizing available resources and capabilities to seize any market opportunities (Barney, 1991). Contemporary views by Anantadjaya (2008) and Andrews et al. (2015) affirm that the resource-based theory pointed to the organizations' performance being insulated from market forces and not being impacted by any externalities.

The resource-based theory falls short in explaining why some organizations succeed in dynamic environments whereas others fail to cope (Aminu and Mahmood, 2015). This shortfall then contributed to the formulation of the Organizational Dynamic Capabilities, responsible for the determination of an organization's performance in rapidly changing environments (Teece et al., 1997; Peteraf et al, 2013). According to Aminu and Mahmood (2015), the main difference between the resource-based theory and

the organizational capabilities theory is that the Resource Based Theory concerns itself with the heterogeneous nature of firms and their inimitable resources; whereas the Dynamic Capabilities Theory takes into account the importance of competences and capabilities to the organizational and managerial processes.

4.4 Organizational Capabilities

Organizational capabilities enable organizations to manage and utilize their resources to improve performance (Barney, 2002). According to Grant (1991) capabilities entail the coordination of resources, organizational routines, and interactions within an organization to improve productivity. Despite organizations having common resources at their disposal, differentiation in their performance and competitive edges arise from their abilities to coordinate and deploy these resources, in the process acquiring unique services (Ticha, 2010). Many researchers have reiterated the importance and link between organizational capabilities and the success of not only the projects executed but that of the organization itself (Abderisak & Göran, 2017).

Most of the challenges encountered within the infrastructure delivery realm could be minimized through viewing them from a dynamic capabilities' lens. The researcher's logic in pursuing understanding the dynamic organizational capabilities is engrossed in the need to improve infrastructure delivery. Within the past five years, organisational capabilities of the public sector have been a subject of major interest for many researchers and analysts alike (Abderisak & Göran, 2017; Teece et al., 2016; Andrews et al., 2016; Winch & Leiringer, 2015). This interest has been a response to the need to ameliorate the management and performance of public organizations whose poor efficiency is salient when compared to their private sector counterparts (O'Toole and Meier, 2015). Typically, organizational capability is intrinsic to increased productivity and performance of a firm. As such, dynamic capabilities translate to competent management teams and strong organizational designs.

There are various classifications of organizational capabilities as put forth by different authors; while Helfat et al. (2007) identified dynamic and operational capabilities; Davies and Hobday (2005) summarised the capabilities into, pre-bid, bid, offer, project (execution) and post-project capabilities, whereas, Winch & Leiringer, 2015 categorised these capabilities into commercial and project coordination capabilities. This study will focus mainly on Helfat et al.'s (2007) categorisation due to its intention to holistically scrutinise the internal dynamics of Government Departments.

Organisational capabilities were described by Helfat and Peteraf (2003) as the principles and operations undertaken by an organization to combine its human resources with the aim of achieving organisational objectives. On the contrary, Teece et al. (1997) defined dynamic capabilities as the process of integrating, building and reconfiguring a firm's intangible resources. Teece et al. (2016) stated that dynamic capabilities can sub-divided into three categories, namely:

- identification, development, co-development, and assessment of opportunities and risks in relation to customer needs
- resource mobilisation to address needs and opportunities, and in the process realise value
- Continued renewal

As such, an organization's capability is partly dependent on its flexibility and ability to ensure constant transformations (Teece et al., 2016). According to Ticha (2010), the importance of organizational capabilities can be summarized as, inter alia:

- Influencing and increasing competitive advantage
- Establishing and facilitating organizational outcomes, such as, customer satisfaction
- Improving organizational interactions resulting in positive employee outcomes
- Increasing competency levels and communication lines within the organization
- Establishing Human Resource Development function as important and strategic to the organization which enhances pro-activity in realising performance gaps

Laegaard and Bindslev (2006) point to the core characteristics required for organizations to be dynamic and sustainable in an ever-changing environment and these characteristics have been tabulated in Table 4-1.

Table 4-1: Characteristics required for a Dynamic Organization [Adapted from Laegaard and Bindslev (2006)]

Characteristic	**Requirement**
Co-operation within the organization, especially at the top	Cooperation at top level is essential as no individual can manage change in isolation. Teamwork is considered a critical prerequisite for organization success
Excellent short-term results	Priority is placed on short term results to ensure and make evident that the organization is on track
Structure which facilitates changes	The organization ought to be structured in such a manner so as to maintain flexibility and adaptation to the dynamic environment
Ability to implement changes as necessary	The staff within an organization ought to be competent and well trained to be able to implement any changes
Proactive work to facilitate growth	Meetings and organization building initiatives for leadership and management

Need for change perception	Effective feedback tool needs to be in place. This entails, among other factors; open and honest feedback and dialogue about results.

4.5 Capacity Building

The delivery of infrastructure is partly dependent on the capacity and capabilities of the people tasked with coordinating and managing the delivery process (Civilution, 2016). The Western Cape Provincial Treasury WCG (2012) defined capacity as *"management and operational ability to fulfil defined functions in an accountable and responsible manner."* On the other hand, PEPFAR (2012) defined capacity as, "*the ability of individuals and organizations or organizational units to perform functions effectively, efficiently and sustainably"*. Hagerman (2012) indicated that local capacity generally applies to the public sector's ability or capacity to manage a project through all its phases using either its own capacity or in conjunction with the private sector. However, due to the widely reported capacity constraints experienced in most public sector institutions (WFEO, 2010; Hagerman 2012), the priority placed on capacity building is critical. Principally, countries strive to continually enhance and expand their human, organizational and infrastructure capacity to secure a more stable and sustainable environment (WFEO, 2010). Technologically educated, trained and orientated individuals are a pre-requisite to ensure that such an environment is attained, which translates to improved economies and quality of life. Generally, the lack of human capacity presents major challenges to infrastructure delivery (Hagerman, 2012). With the increase in urbanization globally, capacity building has become even more crucial in order to meet the extensive and complex infrastructure demands.

It has been increasingly evident that many countries lack informed decision-making capacity in infrastructure delivery (WFEO, 2010). Having said that, Hagerman (2012) advised that, it is therefore critical to investigate and determine the capacity needs and gaps very early on a project, especially on large infrastructural projects. Jacquet (2017) asserted that public entities are the most affected by capacity deficiencies. Complexities in capacity building include aspects such as (i) failure to retain capacity that has been built in the form of brain drain and seeking of so called greener pastures in pursuit of better salaries and incentives; (ii) Urgency in delivery of infrastructure projects (sometimes in response to infrastructure failure emanating from, for example, "force majeure") with limited time to build capacity (Hagerman, 2012).

Hatch (2004) cited in WFEO (2010) defined capacity building as:

> *"The building of human, institutional, and infrastructure capacity to help societies develop secure, stable, and sustainable economies, governments, and other institutions through*

mentoring, training, education, physical projects, the infusion of financial and other resources, and, most importantly, the motivation and inspiration of people to improve their lives."

An alternative definition cited by WFEO (2010) is stated as;

"Capacity building is the process of assisting people to develop the technical and decision-making skills to address their own needs for improving the living standards and prosperity of their own people and building an environmentally sustainable society."

PEPFAR (2012) defined capacity building as;

"Capacity building is an evidence-driven process of strengthening the abilities of individuals, organizations, and systems to perform core functions sustainably, and to continue to improve and develop over time."

Capacity building ought to be cost effective and should enable appropriate, efficient, affordable and sustainable service delivery through infrastructure (WFEO, 2010). The WFEO (2010) and PEPFAR (2012) identified that capacity building could be applied on three distinct levels, namely; individual, institutional and systems levels. PEPFAR (2012) created a table illustrating typical skills and competencies to be acquired upon capacity building in the three distinct categories. Although the PEPFAR research was conducted for an AIDS relief programme, the principle behind the capacity building strategy is very similar across industries and Table 4-2, adopted and aligned to the infrastructure context, is an illustration of the possible areas of improvement in the management and technical aspects of capacity building.

Table 4-2: Capacity Building Effects [Source: PEPFAR, 2012)]

	Effects of Capacity Building	Management	Technical
System	Systems and policy level capacity building may be conducted at the national level or below. It is generally concerned with improving the environment external to the organization, however, which could impact both the organization's and/or individuals' function, so as to ensure that the environment is enabling. Such as setting standards, guidelines and requirements. It includes structures supporting the way organizations interact. In general, the system level refers to the functions and structures that support activities that cut across organizations or government units.	• Policies, laws, and regulations • Human resource management systems • Resource generation and allocation • Guidelines and systems development for management and accountability	• National technical leadership • Human resource technical accreditation • Technical guidelines • Technical policies and standards • Technical training program accreditation and guidelines
Organizational	Organizational level capacity building improves intra-organizational performance through improvement of systems and processes which when improved ultimately lead to robust organizations with the ability to adapt and continue to develop over time.	• Organizational management • Human resource management • Financial management systems • Change management • Organizational tools and standard operating systems • Information technology systems • Project management • Performance management systems	• Organizational technical leadership • Technical guidelines • Standard operating procedures • Results monitoring and reporting • Organizational training systems

Individual	Individual level capacity building improves overall performance, through enhancement of competencies and adept individuals in their respective fields of expertise.	Skills, training and/or degrees in the following areas: • Leadership • Strategic thinking • Organizational management • Performance management • Financial management • Supervision	Skills, training and/or degrees in the following areas: • Infrastructure and related built environment courses • Technical training and mentoring • Project management • Evaluation, monitoring and research

Importantly, capacity building should be conducted only when the systems approach method has identified it as critical and a constraint to infrastructure delivery. It is equally important to assess the system improvement after the capacity building initiatives, and as such, if no significant improvements in the system are noted, it can therefore be argued that capacity deficiencies are not to blame for the challenges, but other constraints (Hagerman, 2012 & WFEO, 2010). The purpose of improving capacity is to improve delivery by those in whom capacity is being built. Generally, the areas of attention where capacity can be built include (WFEO, 2010);

- Skills: specific and appropriate skills that improve overall infrastructure delivery which can either be in the technical, financial and people-oriented skills.
- Resources: which encompass, among other factors, training programmes and mentoring processes, and policies (particularly public policies).
- Decision-making mechanisms: basically, entails making an informed choice between alternatives also considering the trade-off mechanisms. As a general rule, the priority items are identified and treated with the priority required and the "nice-to-haves" will follow only if resources are still available. Typically, decision-making mechanisms apply to, inter alia, risk analysis and policies, incentives, ethics prioritization rules and mechanisms and standards
- Administration and systems: which include, among others, policy and governance issues, procurement strategies, monitoring and evaluation, and feedback loops.

According to Civilution (2016) a study by the Government of South Africa pertaining to infrastructure found that there were deficiencies in delivery systems and skills. These deficiencies led to various public entities which are concerned with the delivery of infrastructure, such as National Treasury, the Construction Industry Development Board (CIDB), the Department of Public Works (DPW) and the Development Bank of Southern Africa (DBSA) to establish partnerships which drove capacity building

programmes. Infrastructure Delivery Improvement Programme (IDIP) was therefore birthed to address the capacity constraints and to facilitate capacity building initiatives in government institutions.

4.6 Chapter Summary

The various management models, their pros and cons as applied to organizations were discussed in this chapter. The importance of organizational capabilities coupled with organizational capacity building were outlined and discussed herein. The next chapter provides an overview of the conceptual framework, namely Maturity Modeling.

CHAPTER 5

MATURITY MODEL: CONCEPTUAL FRAMEWORK

5.1 Background

The Maturity Model (MM) originated in 1986, as a brainchild of the US based Software Engineering Institute (SEI), in association with the Mitre Corporation, with the aim of improving organizations' software processes (Paulk, et al. 1993; Willis and Rankin, 2010). The MM as a measurement approach assesses processes and not end-results, on the premise that if best processes or practices are followed, quality outcomes are bound to be achieved (Grim, 2009). Although MM, originated in the Software Industry, these models have found wide acceptance and applicability in various other industries such as the Project and Program Management fields (Willis and Rankin, 2010; Grim, 2009). The substantial adaptability of the MM to other industries could be attributed to the fact that the MM did not only pertain to software development, but was more engrossed on the process improvement aspect, and therefore could be applied to any industry without reservations (Bayraksan, 2009; Grim, 2009). Eventually, this adaptability of the MM to various fields led to the evolution of the Capability Maturity Model Integration (CMMI) to indicate that the MM could be integrated to any industry (Ibid).

5.2 Maturity Models Explained

A maturity model is a tool that measures the effectiveness of an individual or organization to achieve desired outcomes, and establishes the capabilities required to enhance improvement (Fowler, 2014). Additionally, Silvius and Schipper (2010) indicated that MM assess organizational capabilities and provide support for controlling and monitoring progress. As such, MMs - generally comprising a structure of capabilities, can be used as a control measure to ensure that processes are consistently adhered to within an organization, and these foster management excellence (Heler and Varney, 2013; Paulk, et al. 1993). This stems from the fundamental principle of a maturity model which dictates that the quality of the end product is greatly influenced by the quality of the processes involved (Paulk, et al. 1993).

The main objective of a Capability Maturity Model Integration (CMMI) is to drive process improvement within an organization. The CMMI aims to improve process performance through a process improvement approach which ensures organizations are adequately equipped with the necessary elements to effectively manage processes (Paulk, et al. 1993). According to Bayraksan (2009), depending on the services and/or products an organization offers, and the various processes involved, including the need for process improvement, the CMMI can be applied to any of these six branches which entail;

i. Product and service development (CMMI for Development)

ii. Service establishment, management, and delivery (CMMI for Services)
iii. Product and service acquisition (CMMI for Acquisition)
iv. Security (CMMI for Security)
v. Risk (CMMI for Risk)
vi. Systems Design (CMMI for Systems design)

Maturity models can be applied at either the Macro or Organisational level (Willis and Rankin, 2010). Since this study seeks to assess organizational readiness in the implementation and utilization of the IDMS, the model will be applied at the organizational level to assess the management and implementation of the IDMS to ensure improved processes pertaining to the engagement of the IDMS.

5.3 Maturity Framework

A maturity model is structured with different levels of effectiveness which define practices and processes implemented within an organization (Fowler, 2014; Heler and Varney, 2013). Maturity modelling is concerned with process improvements and asserts that there is a roadmap – a maturity framework, which every process must follow (Willis and Rankin, 2010). This maturity framework is made up of five levels, which when adequately followed; enhances organizational effectiveness (Ibid). A very important aspect of a maturity model, which can somewhat be referred to as the 'point of departure' of the model, is that it's not so much about what level an organization is on, but rather, what items they ought to improve on (Fowler, 2014).

5.3.1 Levels of Maturity Modeling

When striving to improve processes through a MM, emphasis is placed on taking small evolutionary steps in lieu of giant revolutionary ones (Paulk, et al. 1993). Pioneers of the Maturity Modeling concept at the Software Engineering Institute developed the Capability Maturity Model (CMM), which arranges the evolutionary steps of the maturity model into five maturity levels which are necessary for enhancing the efficiency and effectiveness of processes, and this leads an increase in the process capability of the organization (Willis and Rankin, 2010). Figure 5-1 depicts these levels of process maturity.

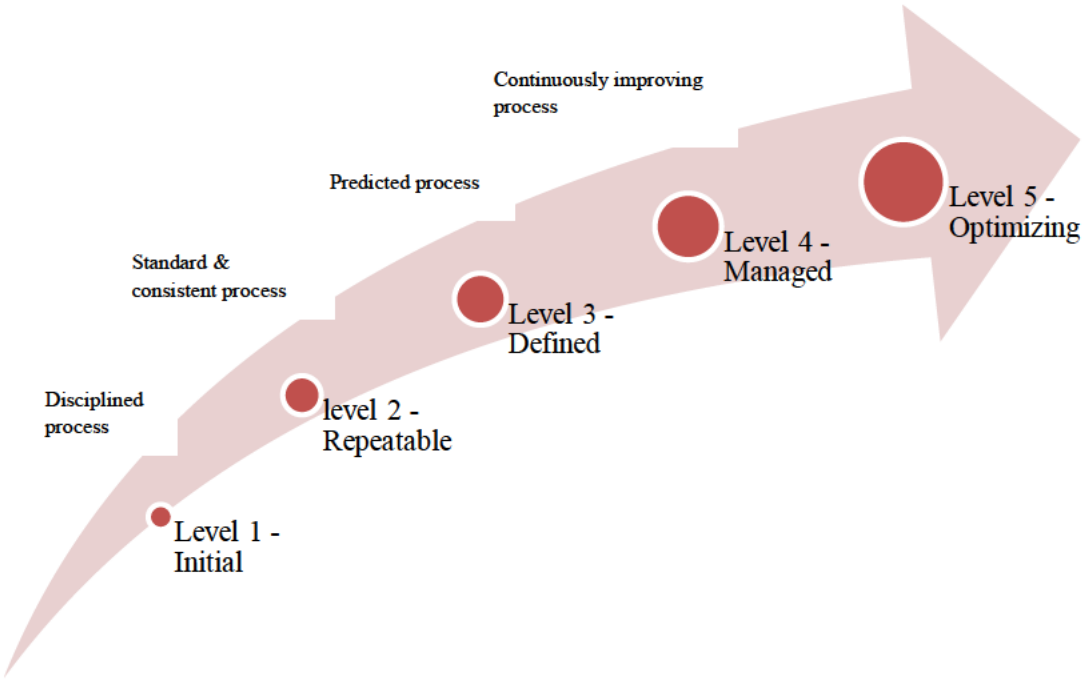

Figure 5-1 Levels and processes of the Maturity Model [Source: (Willis and Rankin, 2010)]

5.3.1.1 Level 1 – Initial or Ad-hoc

At the beginning processes are chaotic as they are typically undocumented, subject to dynamic changes and are ordinarily reactive to circumstances and therefore the environment is bound to be unpredictable (Bayraksan, 2009; Grim, 2009).

5.3.1.2 Level 2 – Repeatable

Processes at this level can generally be repeated with possibilities of attaining consistent results. The need for adherence to processes is not intense but benefits of process discipline help ensure stability of the processes at all times (Bayraksan, 2009). It is at this level that an organization is aware of industry best practices and processes and it learns these from external sources and/or experience (Grim, 2009)

5.3.1.3 Level 3 – Defined

This level contains well defined and documented standard processes which can be improved over time. These standard processes, if adhered to, provide a foundation for the establishment of consistency in overall performance within an organization (Bayraksan, 2009; Willis and Rankin, 2010; Grim, 2009).

5.3.1.4 Level 4 – Managed

Within this level, process metrics are used by management to control the standard processes. The onus is on management to adapt processes to suit each unique circumstance while maintaining quality and specified standards (Bayraksan, 2009; Willis and Rankin, 2010). At this level, processes are consistent and advanced throughout the organization (Grim, 2009)

5.3.1.5 Level 5 – Optimized

Processes at level 5 are concerned with continuous improvement of process performance throughout the organization through feedback and innovative technologies (Willis and Rankin, 2010).

It is in the interest of an organization to continuously strive to improve its processes through transitioning from one level to the next in pursuit of delivering improved outcomes. Table 5-1 proposes the steps and activities required to be undertaken in order to transition between the levels

Table 5-1: Transition requirements/steps on Maturity Levels

Transition from	Requirements / steps
Level 1 to level 2	• Educational qualifications • Best practices • Experience and lessons learnt
Level 2 to level 3	• In-depth / advanced education • Shared experiences • Determine capability in group
Level 3 to level 4	• Shared knowledge across group • Internal quality audits and reviews for consistency • Continual educational and professional development and support
Level 4 to level 5	• Creation of new processes and methods • Continual research and development including publications • Timeous feedback

Source: (Grim, 2009)

5.4 Immature Versus Mature Organizations

When an organization is considered immature, employees and management generally improvise processes and procedures, with neither regard nor adherence to existing specified processes and best practices (Paulk, et al. 1993; OGC, 2006). Immature organizations are generally reactive, responding to situations as they arise. Common problems encountered in immature organizations include but are not limited to; unrealistic estimates leading to cost and time overruns, the inability to deliver quality projects, and difficulties in defining and predicting product quality (Ibid).

Mature organizations on the other hand are proactive and possess the ability to efficiently manage and maintain processes (Paulk, et al. 1993; OGC, 2006). Both employees and management are made

explicitly aware of the processes and work activities, and these are conducted in accordance with planned processes. The processes are subject to continuous improvement and are updated whenever necessary. Roles and responsibilities are defined and clear-cut leaving no room for interpretation whatsoever. In these types of organizations, management is responsible for monitoring processes and conducting quality checks to ensure that all activities are conducted according to the quality standards specified. Unlike immature organizations, mature organizations frequently execute their projects within the specified time and budget schedules as a result of accurate historic forecasts and sufficient planning activities (Ibid).

5.5 Maturity Scale in Public Sector Utilization of the IDMS

Public sector organizations can decide whether operational units are employed solely to engage the IDMS, or they are tasked with other roles and responsibilities over and above utilization of the IDMS. Whichever is the scenario, for successful and effective implementation of the IDMS, it is imperative that both operational units and management possess the capabilities to work independently and the ability for informed decision-making.

The maturity model for this research was developed from literature review highlighting the challenges impeding effective utilization of the IDMS (Schumacher et al., 2016; Heller & Varney, 2013). The development of the maturity modelling stemmed from two critical research articles by Schumacher et al. (2017) and Heller and Varney (2013). While Heller & Varney (2013) identified seven tenets of a Maturity Model, Schumacher et al. (2017) listed nine. Building on the foundation of both studies, the researcher developed a structured maturity model, which was divided into nine constructs namely, dimensions / critical success factors (CSFs), with definite pre-determined questions was utilized. The maturity model adopted contain five maturity levels, ranging from regressive to optimized level. Schumacher et al. (2016) posit that level 1 demonstrates a complete lack of attributes, whereas level 5 describes world class attributes. Table 5-2 illustrates the maturity scale in relation to organization level of implementation of the IDMS.

Table 5-2: Proposed maturity scale to assess the effectiveness of IDMS utilization

Maturity Scale	**Organization Level**
Level 1: Regressive	No defined tasks and responsibilities relating to implementation of the IDMS
Level 2: Initial	Operational units are irregularly encouraged to utilize the IDMS
Level 3: Proactive	Operational units are encouraged to utilize the IDMS

Level 4: Managed	Standard roles and responsibilities for all tasked with engagement of the IDMS are developed
Level 5: Optimized	Responsibility for IDMS utilization lies with decision makers

Adapted from Heller and Varney (2013 and Grim (2009)

5.6 Application of the Maturity Model in IDMS Utilization

Maturity modeling facilitated through gathering expert input was used to assess the extent of maturity regarding implementation of the IDMS within public sector organizations. Individuals with diverse backgrounds and experience of IDMS utilization were selected. The individuals forming the panel were briefed about the study prior to commencement of data collection. The following criteria was used to select the respondents contributing input towards the development of the maturity model

- Management expertise in relation to the implementation of the IDMS; and
- Individuals' experience in the implementation of the IDMS in terms of practical work experience, publication/s and educational background.

5.7 Evaluating Maturity of an Organization

Organization assessments through maturity modelling enhance establishment of an organization's level of maturity rating on the model (Heller and Varney, 2013). This according to Heller and Varney (2013) provides an indication of the process management strategies in place and how these affect organizational capabilities and efficiency. The maturity rating equips organizations with the necessary developmental steps and changes required for them to progress to the next level of maturity.

Figure 5-2 illustrates the steps to be undertaken to evaluate an organisation's maturity level

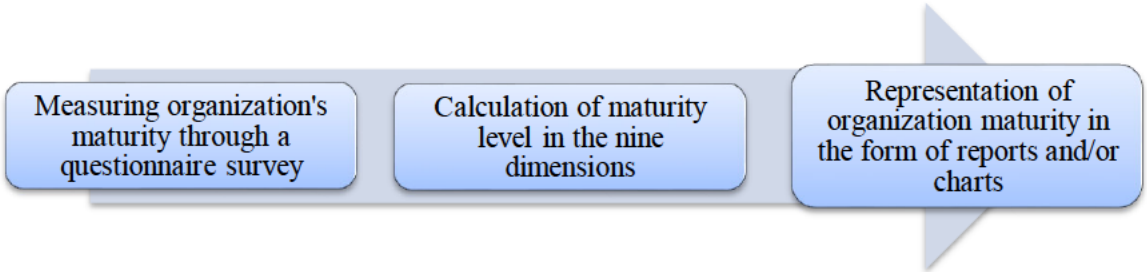

Figure 5-2: Steps to assess organizational maturity (readiness) to implement the IDMS [Adapted from Schumacher et al. (2016)]

To assess the maturity / organizational readiness to engage the IDMS, a structured questionnaire was adopted, and respondents were required to rate the questions on a 5-point Likert scale indicating their perception relating to the level of implementation of each item. The questionnaire was split into the nine maturity dimensions or constructs.

5.8 Conceptual Framework - Critical Success Factors for Achieving Maturity in Utilization of the IDMS

Rockart and the Sloan School of Management are credited with the development of the concept of critical success factors (CFSs) (Jefferies, et al. 2002). CSFs were defined by Rockart (1982) quoted in Jefferies et al. (2002) as;

> *"Those few key areas of activity in which favourable results are absolutely necessary for a particular manager to reach his or her own goals"*

On the other hand, Kerzner (1987) defined project success factors as a set of circumstances or elements which when altered could act as catalysts to or impede project success. Typically, CSFs are core activities in a project that must be closely monitored and nurtured to create an efficient and effective environment for success.

Literature review suggests that the IDMS seeks to address four areas which constitute the CSFs of infrastructure delivery, namely;

- Organization - includes the institution structures, roles and responsibilities assigned and the delivery models applied
- Organizational behaviour – entails ethics, values and management styles in use
- People – includes all individuals employed, staffing models, job descriptions and management capabilities
- HR Systems – pertain to the hiring and retention of staff and employee general health and well-being.

These areas can be expanded into critical success factors (CSFs) which facilitate achieving maturity in IDMS utilization as advised by Schumacher et al. (2016) and Heller and Varney (2009). While Schumacher et al. (2016), posit nine dimensions / CSFs impacting utilization of the IDMS, namely, people, leadership, governance, strategy, processes / operations, information technology (IT), products, culture and customers. Heller and Varney (2009) summarized these dimensions into 7 tenets / CSFs, namely, strategic alignment, governance, process models, change management, process performance, process improvement and tools and technology. Building on the foundation of both studies, the

researcher developed a structured maturity model as depicted in Table 5-3 which expands on these CSFs.

Table 5-3: Conceptual Model – Dimensions and Maturity Items of a Maturity Model

Dimension	Description
1. Strategy	Entails strategic understanding and informed decision-making of organizational role, positioning and vision in support of its objectives, such as, for example, development and implementation of business models and strategies
2. Leadership	Entails the role of leadership and how leaders possess the power to transform an organization. Leadership helps organizations to transform vision into action such as, for example, leaders who lead by example
3. Customers	Entails all existing and potential new clients including strategies to expand the client base, such as, for example, digitalization of sales/services
4. Products	This dimension is concerned with product outcomes acquired from the processes implemented, such as, for example, customization of products
5. Operations / Processes	Entails procedures, methods and practices which establish the manner through which activities are performed, process performance and process improvement aspects, such as, decentralization of processes
6. Culture	Entails organizational culture and organizational structure, such as, for example, knowledge sharing and company collaboration
7. People	Covers the HR function such as skills and competences of employees and their roles and responsibilities.
8. Governance	Covers the governance and administration aspects of an entity, such as, for example, labour regulation and enterprise wide authority
9. Technology	Is concerned with creating an enabling technology environment encompassing information systems, applications, and infrastructure, such as, for example, existence of updated information and communications technology

Adopted from Fisher (2004) and Schumacher, et al, (2016)

5.9 Chapter Summary

This chapter discussed the maturity model, its origination and the value it adds to organizations, by enhancing effectiveness and efficiency within these entities. The relevance and application of the maturity models to IDMS implementation within public organizations was discussed in detail.

Additionally, its importance and ability to be used as a yardstick by organizations to evaluate their maturity is presented. The next chapter provides an overview of the Research Methodology.

CHAPTER 6

RESEARCH METHODOLOGY

6.1 Overview

This chapter provides an overview of the research methods, the data gathering techniques and data analysis used in this study. According to Creswell (2003), research methodology entails a set of skills and techniques that the researcher will use to collect, collate, analyse and present the research findings. Therefore, the research methodology is crucial in determining the sequencing of research activities and sequencing the steps that will be adopted in the study to address the research problem. This study employed a mixed methods approach through structured maturity modeling questionnaires which were used to determine organizational readiness to engage the IDMS. Thereafter, semi-structured interviews were conducted to validate the findings from the questionnaire survey and to provide an in-depth understanding and narrative of the topic under study.

Since this study sought to formulate practical interventions to curb the challenges inhibiting optimum utilization of the IDMS, the pragmatic paradigm was employed to determine practical solutions to problems (Shannon-Baker, 2016). Lastly, this chapter addressed validity and reliability of the study and research ethics aspects.

6.2 Research Design

Research design is a plan of action to address the research question/s (Kazdin, 2003). The research design expands on what type of data is required, and the methods of data collection that would facilitate the answering of the research question. Kazdin (2003) advised that research designs can be categorized into four major categories, namely; descriptive, correlational, quasi-experimental or experimental. However, Van Wyk (2010) classified research designs into; exploratory, descriptive, explanatory, predictive, evaluative and historic studies. This study adopts a descriptive research design as it seeks to provide a presentation of the factors impacting organizational readiness to implement the IDMS in relation to the nine critical success factors of the maturity model.

6.2.1 Units of analysis

The study unit/s of analysis were public organizations, namely Departments of Health, Public Works and Education, tasked with implementation of the IDMS. The study sought to assess the maturity of the organizations' to implement the IDMS, and to formulate evidence-based interventions based on the study results. On the other hand, unit/s of observation are; (i) the individuals in management or leadership tasked with overseeing and management of those tasked with undertaking the activities, (ii)_actual operational units in senior positions who have experience with IDMS utilization.

A unit of analysis is the phenomena which the study seeks to analyze, that is the 'who' or the 'what'; it can be an individual, group or organization, whereas, a unit of observation is that which data is collected from, for example, individual survey respondents.

6.3 Research Paradigm

The research process has three major facets, namely: ontology, epistemology and methodology (TerreBlanche and Durrheim, 1999). According to TerreBlanche and Durrheim (1999) a research paradigm is a system of interrelated practice and thinking that defines the nature of enquiry along these three facets. Morgan (2007) described a paradigm as a shared belief system by researchers that influences the types of knowledge they sought, including the interpretation of their findings. On the other hand, Olsen et al. (1992) described a paradigm as a pattern, structure and a system of scientific and academic ideas, values and assumptions. The paradigm determines the methodological approach to be adopted.

6.3.1 Research as Continuum

Ontology concerns itself with what knowledge is; basically, it specifies the form and nature of reality and what we can know (McAuley et al., 2007). McAuley et al. further posit that ontology is concerned with determining whether a phenomenon exists in actuality independent of either knowing it or perceiving it. On the other hand, epistemology pertains to how we can know it, with the understanding that knowledge can be acquired through different types of inquiry and alternative methods of investigation (Creswell, 1994; McAuley et al., 2007). Streubert Speziale & Rinaldi Carpenter (2003) described epistemology as the research philosophy concerned with how individuals determine what is true. Ontological and epistemological aspects can be viewed from an individual's lens of the world and how one perceives the relative importance of the aspects of reality. This study will adopt the sequential steps of enquiry as depicted in Figure 6-1.

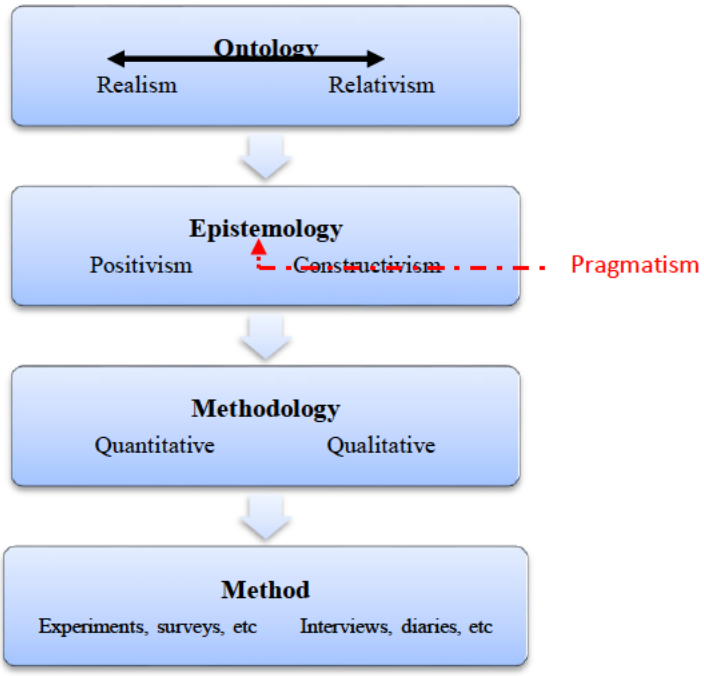

Figure 6-1: The relationship between ontology, epistemology, and methodology [Sources: (Brierley, 2017) and (Marsh & Stoker, 2010)

The schools of thought about knowledge claims are discussed as follows:

- Positivism - the positivist paradigm of exploring social reality assumes that reality and facts are out there, and that knowledge is objective and quantifiable, independent of intuition and social construction (McAuley et al., 2007). Positivism is concerned with uncovering truth and presenting it by empirical means (Henning et al., 2004). Positivism underpins the notion, "the facts speak for themselves" (McAuley et al. 2007:34). Positivists assume that it is possible for a trained individual to compare any knowledge claims to 'real' facts and to ascertain its truthfulness through data collected. In principle, positivism adopts an objectivist epistemology and a realist ontology (Ibid). Due to positivistic researchers adopting scientific methods, positivism is strongly linked to quantitative research where they can utilize a methodology that relies on control and manipulation of reality.

- Constructivism / Interpretivism – this came in as an alternative paradigm to positivism due to the positivism's lack of subjectivity in interpreting social reality (Gephart, 1999). Interpretivists believe that reality consists of people's subjective experiences of the external world and that reality is socially constructed. According to McAuley et al. (2007), people's behavior is assumed to be a result of how they subjectively make sense of their surroundings or how they interpret them.

- Pragmatism – the pragmatist view focuses on actions, situations, and consequences (Creswell, 1994). It places emphasis on a problem and researchers employ various approaches to understand the problem with the aim of coming up with a solution (Rossman and Wilson, 1985 cited in Creswell, 1994). Pragmatism is philosophical underpinning for mixed methods studies as it combines both the positivism and constructivism paradigms. As such, the researcher is able to be subjective during the inquiry process and objective during data collection and analysis (Shannon-Baker, 2016).

The research paradigm adopted in the study is pragmatism as displayed in Table 5.1. Pragmatism was the paradigm of choice due to its characteristic of exploring what works in practice. Table 6-1 is categorized into; the purpose of the research, what can we know (ontology), how can we know (epistemology) and the methodology employed.

Table 6-1: Characteristics of Pragmatism

Feature	**Description**
Purpose of research	To develop and validate a maturity model for assessing and improving public sector organizations' readiness for effective IDMS implementation.
Ontology	• The world is not an absolute unity, there are multiple socially constructed realities • Many realities exist due to varying human experience, including people's knowledge, views, and experiences. • Discover what actions give rise to certain consequences • Discover what the problems/bottlenecks in infrastructure delivery are
Epistemology	Pragmatism • Truth is characterized by its consequences • Valid knowledge comes from the interaction of symbols with the world • Events are understood through adopting the *"what works"* viewpoint • The world is changed through action and reason and action must be guided by purpose and knowledge,
Methodology	Mixed methods research methodology
Methods	• Maturity Modeling questionnaire survey • Semi-structured interviews

6.4 Research Approaches / Methods

Research methods refer to all techniques and/or methods that are used when conducting research (Kothari, 2009).

6.4.1 Quantitative Research

Quantitative research is scientific in nature and involves the collection of data in a quantitative manner and analysis of the data can be conducted in a formal and rigid fashion (Kothari, 2009). According to Plano Clark and Creswell (2015), quantitative research contains the following important characteristics:

i. The researcher studies a problem that could be explained through assessing variables
ii. Specific structured questions are asked by the researcher
iii. Statistical and quantifiable data is collected from respondents
iv. Numerical data is analyzed using statistics and graphs;
v. The researcher is objective and conducts the inquiry in a systematic and unbiased manner

6.4.2 Qualitative Research

Kothari (2009) described qualitative research as a subjective inquiry of attitudes and behaviours which is exploratory in nature. Plano Clark and Creswell (2015) indicated that the following important characteristics are embedded within qualitative research:

i. The researcher studies a problem that could be understood through exploration of a phenomenon;
ii. Views of respondents are of significant importance;
iii. General and unstructured questions are asked by the researcher;
iv. Data collected mainly consists of words from respondents
v. Analysis and description of words is undertaken to come up with themes
vi. The inquiry is subjective and reflexive in manner.

6.4.3 Mixed Method Approaches

Mixed method approaches, like the name suggests, combines both quantitative and qualitative research approaches in a single research study. According to Tashakkori & Teddlie (2008), mixed methods approaches are most applicable to the pragmatist paradigm, and they combine both quantitative and qualitative methods at different stages of the research process. This study therefore adopted a mixed methods approach by following a sequential explanatory strategy as suggested by (Terrell, 2012). This was conducted by applying the quantitative method through structured maturity modelling questionnaires followed by employing the qualitative method via semi structured interviews as data collection tools. Figure 6-2 presents the Sequential Explanatory Strategy

Figure 6-2: Sequential Exploratory Strategy

The use and application of both these approaches was mainly through *"offset"*, where both approaches were used to offset their weaknesses by building on their complementary strengths (Bryman, 2012; Morgan, 2007).

6.5 Sources of Data for this study

6.5.1 Maturity Modeling

Maturity models are used to evaluate an organization's capability of maturity elements, from a rating of 1 – initial (ad-hoc) to 5 – optimized, and to undertake the necessary steps for the organization to progress to the next level of maturity (Kohlegger, et al. 2009).

6.5.2 Questionnaire Surveys

Assessing maturity of an organization through maturity items of the nine dimensions is done through the questionnaire survey (Schumacher, et al. 2016). A survey provides a numerical description of the opinions and trends by studying a sample whose findings can be generalized to the population (Creswell, 2009). A questionnaire is a measurement tool that is used to acquire information from individuals thought to have knowledge about a subject matter or based on their opinion or attitudes towards the matter (Bhattacharyya, 2006; Bird, 2009). A questionnaire primarily ought to have the same format and all questions asked to the respondents must be the same and uniform thereby making data collection and analysis comparable and easier. A questionnaire can either be structured, semi-structured or unstructured. Application of the questionnaire survey is ideal for large sample sizes, and the questionnaire can be sent to respondents online, via email or post or hand delivered (Kothari, 2009). The questionnaire was used for data collection in this research as it makes the quantification of information possible and data analysis is generally made easier.

6.5.2.1 Design of the Questionnaire Survey

The development of the maturity modelling questionnaire stemmed from two critical research articles by Schumacher et al. (2017) and Heller and Varney (2013). While Heller & Varney (2013) identified seven tenets of a Maturity Model, Schumacher et al. (2017) listed nine. Building on the foundation of both studies, the researcher developed a structured maturity modelling questionnaire, which was divided

into nine constructs namely, dimensions / critical success factors (CSFs), with definite pre-determined questions was utilized. The structured nature of the questionnaires ensured simplicity in their administration and facilitated a simplified statistical data analysis process. The questionnaire was standardised and ensured uniformity by containing the same wording and order to each respondent. Hand distribution of questionnaires was the delivery mode for all questionnaires. The nature of questions and their sequence was of paramount importance in questionnaire development.

The nine constructs of the questionnaire are listed as:

1. strategy,
2. leadership,
3. customers,
4. products,
5. operations,
6. culture,
7. people,
8. governance, and
9. technology.

The respondents were then requested to rate statements relating to the rate of implementation of the constructs (dimensions) from a rating level of 1 – not implemented to 5 – fully implemented. As advised by Kothari (2009), the questions were simple, clear and avoided ambiguity and the questionnaire was laid out in such manner that the easy questions that also capture human interest were found at the beginning of the questionnaire. Similarly, the more difficult and demanding questions were added towards the end of the questionnaire, so that in the event that a respondent decided against answering the question, most of the solicitated information world have already been provided for (Ibid). In overall, the researcher strived to produce a questionnaire that was short and simple.

6.5.3 Interviews

Interviews seek to provide in-depth descriptions of a phenomenon through investigation of people's views in their natural settings (Cohen et al., 2007). In a similar vein, Blaxter et al., (2006) noted that interviews enhance uncovering information which could otherwise not be accessed via other research methods such as questionnaires. An important feature of interviews is that, unlike other data collection methods, they allow for dialogue and are interactive, leaving room for emerging related topics to be discussed and providing clarity when needed (Alshenqeeti, 2014). As a result, the study employed interviews to provide greater flexibility, and gave the researcher the control to focus on any aspects as they deemed necessary. Most prominent interview types take the form of one-on-one interviews or focus groups (Ibid).

6.5.3.1 Types of Interviews

i. Structured – rigid in nature and usually contain pre-determined dichotomous questions
ii. Open ended /Unstructured – flexible in nature. This type of interview also grants the interviewee the opportunity to fully expand on the pertinent issues
iii. Semi structured – this interview type is more flexible than the structured interview as it affords the interviewer the opportunity to probe the answers provided by the interviewee thereby giving the interviewee an opportunity to elaborate on those specific issues.
iv. Focus groups – simply put, it is a group discussion (facilitated by a researcher) on a particular phenomenon solely for research purposes (Kitzinger, 1994).

6.5.3.2 Conducting Interviews: Specific to this Study

Interviews were conducted to provide detailed insights from respondents and to validate the findings from the maturity modeling questionnaire surveys. Additionally, interviews were used to offset the weaknesses and disadvantages of the questionnaire survey (Bryman, 2012). This study employed semi structured interviews as they allowed for the probing of the interviewee's responses, in the process providing a holistic snapshot of the status of IDMS implementation. In adherence to the advice provided by Berg (2007), the researcher used a checklist to ensure that the interview questions did not diverge and aligned with the study aim and research questions, while ensuring that all relevant topics were covered. Pursuant to conducting a good qualitative interview, the researcher ensured that the interview entailed two key features which according to Dörnyei (2007) are a requisite for a good interview, which are that the interview ought to flow naturally and it must be rich in detail.

The interview followed a general interview guide approach, which according to Valenzuela and Shrivastava (2005) ensures consistency in the information sought from interviewees. Prior to interview commencement, respondents were briefed about the aim of the interview. The interviews were conducted either telephonically or via Skype. In addition to the added advantage of putting respondents at ease and boosting confidence, the interview schedule was arranged in such manner that the easy questions were placed at the top, with the difficult ones coming thereafter. Since the interview method was a follow-up to the questionnaire survey, the study was limited to one interview session for each respondent. As advised by Schostack (2002) each session was capped to no more than 30 minutes to ensure that the respondents were captivated throughout the interview process. At conclusion of the interview, interviewees were given the opportunity to comment or ask any questions within the interview parameters.

6.5.4 Final data collection instruments

A sample of the questionnaire and interview schedule are enclosed in Appendices 2 and 3 respectively. A gate keepers' letters was provided and is attached as Appendix 5. In addition, support letters and

ethical clearance forms were provided by the University of KwaZulu Natal to inform the respondents about the significance and relevance of the research (Refer Appendix 1, 6, 7 & 8 attached).

6.6 Sampling

A sample is a portion of elements / units selected from a population for investigation purposes and are considered to be a true reflection of the population (Alvi, 2016; Etikan et al., 2015). A population is all the elements which meet specific criteria under investigation (Alvi, 2016). On the other hand, Kothari (2009) defined a population as all items being investigated in a field of inquiry. The population in this study refers to all individuals in managerial positions within the infrastructure departments of the KwaZulu-Natal Provincial Government Departments of Health, Public Works and Education. Sampling is defined as the selection of study units / elements from the population. Sampling finds its importance in that in most cases it is practically impossible to study all elements of the population and therefore a smaller sample is selected for assessment (Alvi, 2016). An important aspect of sampling is that, any findings and/or outcomes obtained from the sample can be inferred and/or generalized to the entire population (Ibid). Table 6-2 presents the study sample design and procedures

Table 6-2: Sampling Design and Procedures

Sampling Design / Procedure	Department of Education	Department of Health	Department of Public Works
Target Population	i. Individuals in management or leadership positions tasked with overseeing and management of those tasked with undertaking the activities, ii. Actual operational units in senior positions who possess extensive knowledge of IDMS utilization.	i. Individuals in management or leadership positions tasked with overseeing and management of those tasked with undertaking the activities, ii. Actual operational units in senior positions who possess extensive knowledge of IDMS utilization.	i. Individuals in management or leadership positions tasked with overseeing and management of those tasked with undertaking the activities, ii. Actual operational units in senior positions who possess extensive knowledge of IDMS utilization.
Sampling Method	i. Convenience sampling technique	Convenience sampling technique	Convenience sampling technique
Sample Size	18 Professionals	16 Professionals	20 Professionals
Conduct Fieldwork (Data Collection)	Maturity modelling questionnaire survey and semi structured interviews	Maturity modelling questionnaire survey and semi structured interviews	Maturity modelling questionnaire survey and semi structured interviews

6.6.1 Sample Design

Sample design is determining and deciding on the sample selection criteria (Kothari, 2009). Sampling can either be probability or non-probability sampling, with probability sampling, an element has a known non-zero probability of being chosen, whereas with non-probability, the researcher cannot determine this probability. According to Etikan et al. (2016), under non-probability sampling all the

units in the population do not have an equal chance of being included in the sample. Probability sampling includes sampling techniques such as simple random sampling, systematic sampling and stratified sampling. Non-probability sampling includes techniques such as convenience sampling, snowball sampling, judgement sampling and quota sampling.

6.6.2 Sampling Design adopted for this Study

Two non-probability sampling techniques were selected for this study, namely; snowballing and convenience sampling.

6.6.2.1 Snowball sampling

Under snowball sampling, the sample is selected based on other people's suggestions (Mugo, 2002). It is particularly important for referrals, when an individual knows cases which are information rich and they suggest them. The snowball technique will be utilized to select samples to be respondents to the maturity modeling questionnaire largely because the population of individuals in management / leadership positions in the management of IDMS operational units is limited.

Due to the short survey period, the researcher utilized this sampling technique to enhance a higher response rate quickly. The operational units were referrals suggested by the leadership participants. The study assumes that sample/s to be selected are homogeneous with the population and therefore the results can be inferred to the population. Table 6-3 is an illustration of the sampling design and procedures applicable to this study

Table 6-3: Sampling procedures adopted for this study

Data Collection Technique	**Questionnaire Survey**
Target Population	• Management and/or leadership employed by the three provincial government departments of Education, Health and Public Works to manage / oversee operational units tasked with undertaking IDMS activities. • Senior professionals (operational units) undertaking IDMS activities
Sampling Method	Snowball Sampling
Sample Size	In total, 54 individuals in senior, management and leadership positions from all three Departments
Geographical location of respondents	KwaZulu-Natal Provincial Departments of; Public Works, Education and Health

6.7 Research Process Flowchart

This sub-section describes the research strategy this study will follow throughout the research process commencing with the generation of research questions right through to validation of results. The research methods and sampling techniques utilized in the study are key as they determine the extent to which the results of the study can be generalized to the population.

6.7.1 Stages of the Study

6.7.1.1 Stage 1: Exploratory stage

Exploratory research is used when a study seeks to gain more information on a topic / phenomenon or to achieve new insights into it (Rajasekar et al. 2013; Kothari, 2009). Through detailed literature review, this study seeks to gain insights about the challenges and possible areas of improvement regarding the current state of infrastructure delivery through the IDMS lens. The exploratory stage contributed to the formulation of the research problem, research questions and objectives. Thereafter, detailed literature review was conducted which assisted in the development of the conceptual framework and the initial questions included in the maturity modeling questionnaire. The draft structured questionnaire was developed which led the study into stage two, which is the descriptive stage.

6.7.1.2 Stage 2: Descriptive stage and Stage 3: Data validation

According to Kothari (2009), descriptive studies seek to depict the characteristics of a phenomenon. Based on the nine dimensions of maturity modeling obtained from literature, the structured questionnaire was developed and distributed to respondents. The questionnaire survey was the quantitative tool utilized to collect data used to validate the proposed conceptual model. Results from the data analysis were then used to validate the model.

Figure 6-3 is a depiction of the research process flowchart followed for this research study,

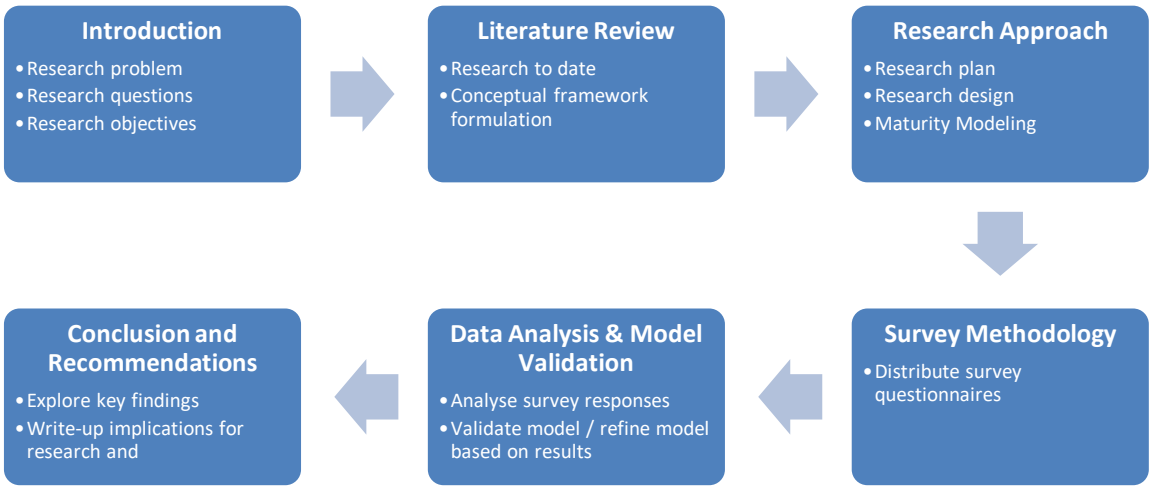

Figure 6-3 : Research process flowchart

6.8 Validity and Reliability of Research Findings

The measurement of validity and reliability of a tool are essential components of good research as they enhance the accuracy of the findings. Mohajan (2017) described validity as determining whether an instrument measures what it ought to measure, whereas reliability refers to the accuracy and precision of the measurement procedure. Taherdoost (2016) adduced that repeatability is an important aspect of reliability as it indicates the presence of consistency. Heale and Twycross (2015) identified three types of validity, namely; content validity, criterion validity and construct validity; while, Mohajan (2016) added face validity to the list, Heale and Twycross considered it as a variant of content validity. Table 6-3 presents the different types of validity which will be adopted in this study.

Table 6-4: Types of Validity [Source: Heale and Twycross, 2015; Mohajan, 2016; Brown, 2000)]

Type of validity	**Description**	**Measuring validity**
Content validity	The extent that measurement instruments adequately and accurately measure all aspects of the target construct	Expert panels
Face validity	A variation of content validity where experts are engaged to determine whether an instrument measures the concept intended.	Expert panels, Literature review
Construct validity	The extent that measurement instruments measure the intended construct	Multi-trait / multi-method studies, content analysis, correlation

		coefficients, factor analysis, ANOVA studies
Criterion validity	The extent that a measure is related to another measure	Regression analysis, T-tests
Reliability	The extent to which a measurement provides consistent and stable results	Cronbach's alpha

When conducting quantitative data analysis, it is imperative to ensure validity and reliability of the survey instrument, so as to ensure that the results are accurate. Since the study utilized the questionnaire survey as a data collection tool, this form of survey aims at obtaining relevant and specific data in an efficient and valid manner, and therefore accuracy and validity of the questionnaire was of paramount importance to the research process.

6.8.1 Cronbach's Alpha Test

Although there exist a variety of methods to measure reliability of a scale, the Cronbach's alpha is the most dominant method (Tavakol and Dennick, 2011). When a measure is considered reliable, it means the extent to which the measure is free of bias. Sekaran (2003) indicated that the Cronbach's alpha measures the consistency of respondents' responses to all questions within an instrument, in the case of the study the instrument being a questionnaire. Cronbach's coefficient ranges from 0 to 1 inclusive and a higher score indicates a reliable scale and that the results and conclusions can be generalised (Ramada et al., 2014). A value of alpha, greater than 0.7 is generally accepted as being high and acceptable.

6.9 Data Analysis

Data analysis is the process of arranging, structuring and interpretation of the data collected (Marshall and Rossman, 1999). It reduces the amount of data collected to create meaning out of it (Kawulich, 2004). Flick (2013) indicated that data analysis is critical in a research study as it is used to obtain usable and useful information, through;

- describing and summarizing collected data
- establishing relationships and differences between variables and
- comparing the variables

The choice of the appropriate statistical analysis method is important for data analysis (Abowitz and Toole, 2010).

6.9.1 Qualitative Data Analysis

There are abundant ways in which a researcher can undertake the analysis of qualitative data (Kawulich, 2004). Qualitative data analysis includes approaches such as content analysis, narrative analysis and interpretive analysis.

6.9.2 Quantitative Data Analysis

Before commencing with the statistical analysis of quantitative data analysis, it is imperative that the type of data collected is identified. Quantitative data can be categorized into two variables, either numerical/continuous or categorical. Categorical data groups can be summarised by determining the frequency with which a category occurs within that data group in the form of frequency tables, graphs and percentages. Descriptive statistics deals with the collection and presentation of data. It is normally used to analyse numerical variables, and these entail the centre (for example, mean, mode, median) and the spread (for example, range and standard deviation) (USGAO, 1992). The data can be presented in the form of graphs or histograms to aid the understanding of the data.

The three types of quantitative measures or levels of measurement are nominal, ordinal and interval scales (Schneider, 2005) are as shown in Table 6-4.

Table 6-5: Quantitative Scales

Scales	**Description**	**Examples**
Nominal	Assigning names or enumeration of categories. No logical order	Gender: male or female
Ordinal	Ranking or rating data in ascending or descending order. Differences in consecutive items not constant	Ratings: 1^{st}, 2^{nd}, 3^{rd} and 4^{th}
Interval	Specific intervals and expressed in number form	Likert scales: (1) strongly agree, (2) agree, (3) somewhat agree

Inferential statistics, on the other hand, are used to draw conclusions about a population based on the results from descriptive statistical analysis. Inferential statistics make it possible to study a small sample and necessitates generalization of the findings. It is important to take cognizant of the fact that when conducting statistical analysis, it is not so much about choose one form of analysis over the other, but that these two forms of statistical analysis complement each other.

6.10 Research Ethics

Hickey (2018) described research ethics as a set of principles that guide all individuals conducting research to ensure that during the process of research no harm is caused to anyone. Similar to most institutions which partake in research, the University of KwaZulu-Natal has ethics committees which ensure compliance and the ethical integrity of all research undertaken by staff and students through it. The code of ethical conduct for this study research was guided by the Humanities and Social Sciences Research Ethics Committee (HSSREC) of the University of KwaZulu-Natal since the study involved human subjects but was non-biomedical. This study strictly adhered to the tenets of the guidelines as set out.

The sources of data of this study were maturity modeling survey questionnaires and semi-structured interviews, and prior to conducting any data collection ethical clearance was sought and obtained from the HSSREC university ethics committee. This study complied with all ethical requirements as demonstrated by the certificate of full ethical approval, Protocol Reference Number, HSS/0395/019D, Appendix 4. Critical ethical considerations which included maintaining confidentiality and anonymity of respondents' identities, no harm caused on respondents and freewill participation of respondents, were all adhered to.

6.11 Chapter Summary

This chapter detailed out the research design, methodology and strategies utilized in this study, and offered justifications for the adopted choices. The research strategy flowchart was also presented, which indicated a step by step guide of how the research process unfolded from introduction to conclusion of the research study. The sampling techniques, data collection methods and data analysis methods were also tackled. The next chapter focuses on the presentation and analysis of data as well as model validation

CHAPTER 7

DATA ANALYSIS

7.1 Introduction

This chapter presents the analysis of results obtained from the questionnaire surveys and interviews conducted within and across the selected cases. A pilot study preceded the questionnaire survey to improve instrument design and to provide valuable feedback that could be incorporated into the instrument. Upon receipt of pilot study feedback, an amended questionnaire was then distributed to the study sample. The analysis of questionnaire data is presented in two stages, the first stage being an Intra Case Analyses, and the second stage is the Cross-Case Analyses. For the Cross-Case Analyses, the statistical analysis used is the One-Way ANOVA, which aimed at conducting comparative analysis of differences between the three entities/organizations (provincial government departments) which utilise the IDMS. Additionally, qualitative research was used as a component of the larger quantitative research. Consequently, the deductive approach was used to analyse data obtained from interviews to establish similarities and differences between the three groups. Descriptive statistical analysis which includes the measures of central tendency and measures of dispersion namely; mean and standard deviation including reliability and validity tests were also conducted.

7.2 Questionnaire Survey Data Analysis

7.2.1 Pilot Study

A pilot study was conducted to test the adequacy, clarity and completeness of the questionnaire and to identify any potential problems that could be encountered during the data collection stage. Initially, this research intended to collect data from all the individuals responsible for the implementation of the IDMS activities, that is, individuals in operational units and senior/managerial positions. The pilot questionnaire was sent to four individuals per Provincial Government Department; three staff members from the operational units and one senior manager, resulting in twelve pilot questionnaires being administered.

Table 7-1: Pilot Study Respondent composition

Department	Frequency	Percent	Responses	Response rate
DoE	4	33.3	3	25.0
DoH	4	33.3	2	16.7
DPW	4	33.3	2	16.7
Total	12	100.0	7	58.4

The response rate was calculated according to the suggestion of Mitchell (1989) as follows:

> Response rate = number of returned questionnaires / total sample who were sent the survey initially.

Seven responses were received indicative of a 58% response rate. The pilot questionnaires were sent via email over a seven-day period.

Based on the responses, comments and suggestions obtained from the pilot study, the following points and/or modifications to the questionnaire design and implementation were effected:

- Distribution of questionnaires was streamlined to only individuals in senior positions and those in managerial capacity with the requisite knowledge and experience relating to IDMS implementation, in-lieu of distribution to everyone engaging the IDMS. Due to the nature of data sought to be collected, it was suggested that the questionnaire respondents be only individuals with the expertise, experience and knowledge of IDMS activities. Interestingly, when conducting follow-ups on the respondents who had not sent in their responses during the pilot study, all five indicated that they were not sufficiently knowledgeable about IDMS to respond to the questionnaire and were therefore reluctant to submit misleading information, advising that responses should be solicited from their managers instead.
- The pilot questionnaire did not include the option for one to indicate which provincial government department they worked for. This item was then incorporated in the questionnaire, becoming question 2 of the questionnaire.

Following the input and questionnaire restructuring informed by the pilot study, amended questionnaires were then distributed to management and senior professionals from each department. Important to note is the fact that of the 12 individuals who were part of the pilot study, only three, namely those in managerial capacity became part of the actual study and were resurveyed. The questionnaire was structured in nature and was divided into nine constructs of the maturity model (refer Appendix X). The constructs had statements which the respondents were expected to rank and the results from the survey are discussed below.

7.2.2 Respondents' Background Information

Respondents were asked to indicate which provincial government department they worked for. Their responses are shown in Table 7-2. Exactly one-third (33.3%) worked for the DoE, and just less than one-third (29.6 % were from DoH and 37% worked for DPW.

Table 7-2: Provincial Government Department composition

Department	Frequency	Percent	Responses	Response Rate
DoE	18	33.3	12	22.2
DoH	16	29.6	10	18.50
DPW	20	37.0	12	22.2
Total	54	100.0	34	62.9

7.2.2.1 Sampling Adequacy

Regarding small sample size bias, there are various other studies such as, for example, studies conducted by Hernandez et al. (2006) and Feskens and Hox (2011) which, when appropriate statistical methods and models were applied, produced useful results despite having small sample sizes of 5, 10, 15, 20 and 30.

7.3 Descriptive Statistics

Descriptive statistics measure the central tendencies and the measures of dispersion of the data collected. The concepts of the mean, standard deviation and reliability tests are described below.

- Mean – this is the average score. It is calculated by summing up the scores and dividing by the total number of units
- Standard Deviation (SD) – this is the most common measure of dispersion/variability to be used and it measures the data concentration around the mean; the greater the SD the wider the spread of the data (Rumsey, 2005).

- Reliability Tests - the Cronbach's alpha test was used to determine the consistency and reliability of the 5-point Likert scale for the 9 Dimensions of the Maturity Modeling questionnaire as shown in Table 7-3. The reliability test was done for each dimension and the reliability coefficients are as shown.

Table 7-3: Summary of reliability test across the 9 Dimensions

Construct	Cronbach's Alpha	Reliability
Strategy	0.73	Good
Leadership	0.84	Very good
Customers	0.86	Very good
Products	0.91	High
Operations	0.70	Good
Culture	0.71	Good
People	0.70	Good
Governance	0.81	Very good
Technology	0.82	Very good

Table 7-3 shows that the Cronbach's Alpha coefficient was consistently greater than 0.70 across the scales for all nine dimensions, which is indicative of at least a "good" level of reliability and is therefore acceptable.

Respondents were presented with nine constructs of the maturity modeling questionnaire and were asked to indicate their perceived level of implementation pertaining to the statements under each dimension. A 5-point Likert scale was used where 1=20% implementation level, 2=40% implementation level, 3=60% implementation level, 4=80% implementation level and 5=100% implementation level.

7.3.1 Intra Case Analyses

7.3.1.1 Case 1: Department of Education

Respondents from DoE were presented with a series of statements within the nine dimensions / constructs of the Maturity Modeling questionnaire and their responses are presented in ranking order in Table 7-4

Table 7-4: DoE Respondents' perceived implementation level of the 9 dimensions tasks

Code	Description	Mean	Std. Deviation	Rank
S7	Our organization employs technically skilled operational units with the appropriate competencies and skills base	4,083	0,793	1
S2	We have clearly defined core knowledge, skills and abilities to be possessed by employees	3,750	0,866	2
S5	We strictly adhere to IDMS instruction manuals and toolkits such as the Gateway System and Infrastructure Delivery Management Toolkit	3,583	0,669	3
S1	We use a road map for the planning of IDMS activities in our enterprise	3,500	0,905	4
S4	We have adapted our business models to accommodate IDMS objectives	3,417	0,669	5
S3	We allocate sufficient resources for the realization of IDMS activities	3,417	0,669	5
S6	We have structures in place that ensure workers undergo general induction before commencing work	2,727	0,647	7
	Strategy Maturity Index	**3,497**	**0,745**	
L6	We have skilled leadership which leads by example	3,750	0,754	1
L1	Our senior/top management are committed to implementation of the IDMS in our enterprise	3,583	0,793	2
L2	Our enterprise has the necessary management competences and systems in place for IDMS implementation	3,583	0,793	2

L5	Our senior/top management encourage and support worker participation, commitment and involvement	3,250	0,866	4
L3	We have centrally co-ordinated systems in place for IDMS activities	3,083	0,515	5
L4	Each system of the IDMS has at least one qualified manager who has the requisite training to oversee their respective departments	2,833	1,115	6
	Leadership Maturity Index	**3,347**	**0,806**	
C3	We are responsive to customer needs	3,167	1,193	1
C5	We are committed to improved customer service to ensure customer satisfaction	3,167	1,267	1
C4	We utilize customer data to provide services as per need	2,833	1,030	3
C2	We conduct research to profile customer infrastructure needs	2,750	1,215	4
C1	We conduct detailed customer identification	2,583	1,311	5
C6	We digitalize our services	2,417	1,165	6
	Customers Maturity Index	**2,819**	**1,197**	
P7	We ensure that our products/services are produced to cater for population growth	3,455	1,214	1
P1	We are committed to providing quality products and services	3,250	1,357	2
P2	We are committed to ensuring continual product/service quality improvement	3,250	1,215	2
P8	We are sensitive to the impact our products/services have on sustainable development goals	2,917	1,240	4
P6	We ensure that our products/services are adequate	2,909	1,221	5
P4	We ensure that our products/services are accessible to the customers they serve	2,750	1,138	6
P5	We ensure that our products/services are affordable	2,636	1,206	7
P3	We ensure that our products/services are provided timeously and within budget	2,583	0,996	8
	Products Maturity Index	**2,969**	**1,198**	
O3	We have periodic and random quality checks to ensure procedures and processes are adhered to	3,250	0,754	1
O4	Our organization conducts regular audits to ensure that the quality management system is adhered to	3,250	0,965	2
O2	We have interdisciplinary and interdepartmental collaboration	3,167	0,835	3
O5	We have performance evaluation structures in place	3,083	1,165	4
O1	We have decentralized operations and processes	2,750	0,965	5
	Operations Maturity Index	**3,100**	**0,937**	
CU1	Our organization provides an enabling environment which promotes knowledge sharing	2,750	0,452	1
CU3	Our organization recognizes and rewards outstanding behaviour and achievements	2,667	0,985	2
CU2	Our organization promotes innovation and cross company collaboration	2,333	0,778	3
CU4	Our organization conducts team building initiatives that boost morale of the employees	2,333	1,155	4

CU5	There is provision of periodic training regarding implementation of the IDMS through seminars and workshops	1,750	0,866	5
	Culture Maturity Index	**2,367**	**0,847**	
PE3	We have the autonomy to work independently without constant supervision and management	3,667	0,985	1
PE4	We are committed to continual professional development	3,417	0,793	2
PE1	Our organization employs people based on the merits of their qualifications	3,333	1,303	3
PE5	We are trustworthy and honest	3,333	1,231	3
PE2	We possess the adequate technical skills and competences to effectively perform IDMS activities	3,250	1,055	5
	People Maturity Index	**3,400**	**1,073**	
G3	Our organization conforms to and supports protection of intellectual property	3,750	0,622	1
G2	Our organization complies with employment policies and labour regulations	3,500	1,000	2
G4	We have disciplinary measures in place to deal with any issues of misconduct and bad governance	3,500	0,905	2
G1	Our organization upholds and strictly adheres to governance principles	3,417	1,084	4
	Governance Maturity Index	**3,542**	**0,902**	
T6	We are open to new technologies	3,250	0,866	1
T1	Our organization utilizes modern information and communications technology	2,917	0,900	2
T3	We possess infrastructure which facilitates efficiency in the implementation of the IDMS	2,583	1,084	3
T2	Our organization has provision of correct tools, equipment and resources to implement the IDMS	2,500	1,168	4
T5	Our infrastructure necessitates adequate free flow of information among all employees	2,417	0,996	5
T4	We have current and future knowledge networks	2,250	1,138	6
	Technology Maturity Index	**2,653**	**1,025**	

7.3.1.1.1 DOE Strategy Dimension

Evidently, from Table 7-4 the Department employed individuals who were technically skilled and possessed the appropriate competencies (mean=4.08). On the other hand, having structures in place that ensured general worker induction prior to work commencement was not as evident (mean=2.73). Arguably, the lack of worker induction is a major factor affecting successful infrastructure delivery as indicated by Koma & Kuye (2014) and SAICE (2011). The composite mean for the strategy dimension is 3,50. Only three out of the seven items (43%) had means >3.50, thereby implying that over half of the items were not adequately implemented.

The leadership aspect has an average low SD = 0.85 which suggests that

7.3.1.1.2 DOE Leadership Dimension

It is apparent from the results in Table 7-4 that respondents considered most of the items under this dimension (67%) to be fairly implemented (mean<4,20>3,41). The results further suggest that the Department employed skilled leadership which led by example (mean=3.75). However, having centrally coordinated systems in place and at least one qualified manager per department were ranked low (mean=2.83). Interestingly, despite the Department having exemplary skilled leadership, it still fell short in the quantity of leadership required. The lack of administrative capacity further reinforces the skills shortages which have been highlighted by many sources as impeding the successful delivery of infrastructure (WCG, 2010; Koma & Kuye, 2014; SAICE, 2011; CIDB, 2007a). It could be argued that the lack of adequate administrative capacity could be linked to the poorly co-ordinated systems and arduous processes relating to IDMS implementation. The composite mean for the leadership dimension is 3,35. Three out of the six items (50%) making up this construct had means >3.35.

7.3.1.1.3 DOE Customers Dimension

Evidently this dimension scored generally on the low side with the highest mean=3,17. The results suggest that the organization did not prioritize understanding their customers and was therefore not fully aware of their customer needs. The inadequate knowledge about their customer profile and needs could be to some extent linked to the high protests and civil unrest signifying customer dissatisfaction with the services rendered. Digitalizing of services was not as evident (mean=2,42)

7.3.1.1.4 DOE Products Dimension

It appears from Table 7-4 that the Department was committed to providing quality products (mean=3,25) and designing their products to cater for population growth (3,45). Although topping the list, the mean score attached to providing quality products is not significantly high as expected and could probably be linked to the myriad of quality issues which have been reported to be a huge setback in the construction of public infrastructure (CIDB, 2018, WCG, 2010). In relation to the aspect of population growth, Osaka et al. (2013) and Oyedele (2016) indicated that population growth is a challenge prevalent mostly in developing countries which needs to be curbed, probably the reason why it is up the list. Timeous project completion is the lowest ranked (mean=2,583), and these results are consistent with the findings by CIDB (2018) which indicated that timeous project completion is a rare occurrence in most public infrastructure projects which are bedevilled by abounding cost and time overruns.

7.3.1.1.5 DOE Operations Dimension

The results indicate that the Department conducted periodic and random quality checks of operations and regular quality audits both at (mean=3,25). Expectedly, in line with the findings pertaining to the Products Dimension where priority was placed on ensuring quality standards, a related quality aspect was atop the list. On the other hand, having decentralized operations and processes was ranked low

mean=2,75. The low ranking on the decentralization aspect negates the advantages of decentralization which include but are not limited to improved, more timeous decisions and increased worker motivation, which could impact on successful infrastructure delivery. Arguably, the low mean associated with the decentralization aspect could to some extent be linked to the low ranking given to the timeous completion of projects under the Products Dimension.

7.3.1.1.6 DOE Culture Dimension

It is clear from the results that the Department does not only provide an enabling environment for its employees (mean=2.75), but also rewards outstanding behaviour (mean=2.67) Although these top two ranked items generally have a low mean in relation to the maximum score of 5, it is worth noting being atop the list could be interpreted as the Department recognizing the need for an environment which boosts morale, recognizes outstanding behaviour and promotes knowledge sharing, which all contribute to motivation of workers, thereby catalysing capacity building (Hatch, 2004 cited in WFEO,2010). However, periodic training regarding IDMS was not as evident (mean=1.75). This low priority given to training could imply that the Department might be oblivious of the importance of adequate IDMS training and this could be impacting on the low success rates generally associated with the provision of public infrastructure as the employees are not fully aware of how the system works.

7.3.1.1.7 DOE People Dimension

The findings in Table 7-4 indicate the Department employs individuals who have the ability to work without constant supervision (mean=3.67) and that it is committed to employee continual professional development (mean=3,42). These results are consistent with what was reported under the Strategy Dimension where the highest ranked item (mean=4,08) indicated that the Department employed technically skilled employees, thereby signifying minimum supervision required. On the other hand, the item with the least ranking is that the employees possess the adequate skills to effectively perform IDMS activities (mean=3.25). These results confirm the findings reported under the Culture Dimension where the training aspect was ranked the lowest, therefore implying that the employees were not adequately trained in IDMS and therefore did not possess the adequate skills necessary for IDMS implementation.

7.3.1.1.8 DOE Governance Dimension

It is apparent from the results that the Department supported protection of intellectual property (mean=3.75). The high score attached to this aspect could be viewed as a form of encouragement for individuals to be innovative with the understanding that their intellectual property will be fully protected by the Department. On the contrary, the need for governance principles was not as evident (mean=3,42). Findings by Kenny (2007) and OECD (2015) suggested a correlation between good governance and successful infrastructure delivery, perhaps the low score attached to this aspect contributes to the reported poor levels of infrastructure delivery. Furthermore, the reported poor implementation of

governance principles aligned with findings by Thumbiran and Raphiri (2016) who reported high levels of corruption and poor governance within public offices, which in turn undermined effective IDMS utilization. Availability of measures in place to deal with aspects of bad governance also received a low ranking (mean=3,50). Arguably, the lack of accountability, where those in power abuse resources without repercussions is one of the major setbacks affecting infrastructure delivery (Bardhan and Mookherjee, 2003; World Development Bank, 2004 and RSA Parliament, 2009).

7.3.1.1.9 DOE Technology Dimension

From Table 7-4, it is evident that the Department was open to new technologies mean=3,25. On the contrary, the items which were ranked low were that Departmental infrastructure necessitated effective flow of information (mean=2.42) and that the Department has knowledge networks (mean=2.25).Interestingly, only 2 out of the 6 (33%) items under this construct had a mean greater than the composite mean, thereby indicative of the need to improve implementation of aspects under this construct.

7.3.1.1.10 DOE Organizational Maturity Level

Table 7-5 presents a summary of the dimensions in ranking order of importance.

Table 7-5 Overall DOE Maturity Index across all nine dimensions

Dimension	DoE		
	Maturity Index		**Rank**
Governance	3,542	0,902	1
Strategy	3,497	0,745	2
People	3,400	1,073	3
Leadership	3,347	0,806	4
Operations	3,100	0,937	5
Products	2,969	1,198	6
Customers	2,819	1,197	7
Technology	2,653	1,025	8
Culture	2,367	0,847	9
Overall Maturity Index	**3,077**	**0,970**	

Despite the results indicating that the Department had a composite mean of 3,077 across all 9 dimensions, four out of the nine dimensions are at a maturity level of two. At level two, these results indicate that processes at this level can generally be repeated with possibilities of attaining consistent results. Furthermore, at level two, operational units are irregularly encouraged to utilize the IDMS. Figure 7-1 visually depicts the maturity level of the Department in the 9 dimensions in the form of a radar chart.

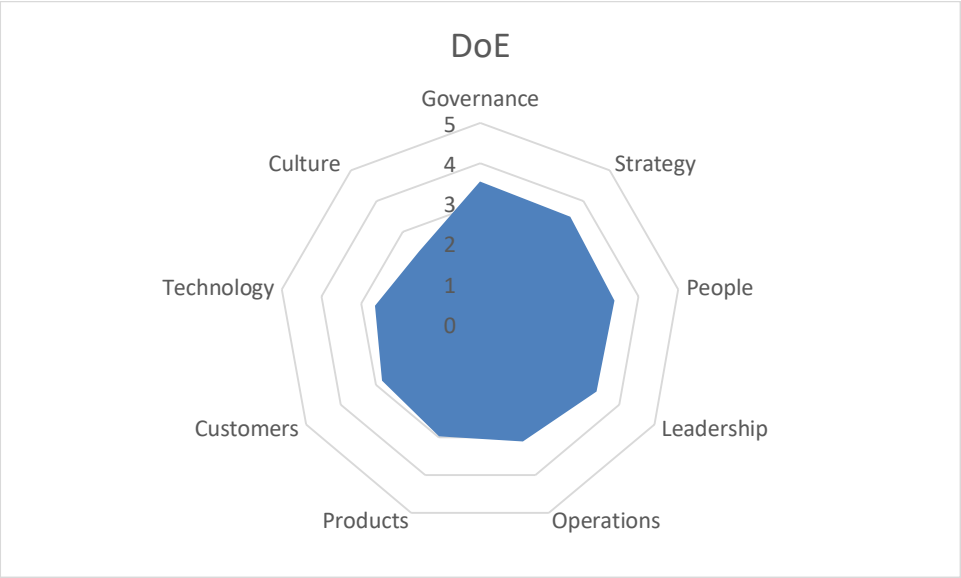

Figure 7-1: Radar chart visualizing DoE Maturity

It is clear from both Table 7-5 and Figure 7-1 that the Department had a Level 3 maturity rating for five out of the nine dimensions; with the balance being on Level 2. The Governance dimension had a seemingly high level of implementation which is somewhat justifiable since public entities have stringent rules pertaining to their modus operandi as they utilize public funding and are therefore accountable for every expenditure. The Culture and Technology dimensions scored generally low as depicted, thereby contributing to the reportedly low organizational maturity rating which is indicative of organizational non-readiness to implement the IDMS.

As discussed in the preceding chapter, Table 7-7 illustrates organizational maturity scale in relation to readiness for IDMS implementation.

Table 7-6: Maturity scale for IDMS implementation

Maturity Scale	**Organization Level**
Level 1: Regressive	No defined tasks and responsibilities relating to implementation of the IDMS
Level 2: Initial	Operational units are irregularly encouraged to utilize the IDMS
Level 3: Proactive	Operational units are encouraged to utilize the IDMS
Level 4: Managed	Standard roles and responsibilities for all tasked with engagement of the IDMS are developed
Level 5: Optimized	Responsibility for IDMS utilization lies with decision makers

It is evident that with the composite maturity score of 3,07, the Department is at Level 3 where the operational units are encouraged to utilize the IDMS. Based on the results and as advised by Grimm

(2009), in order to move to Level 4, the Department ought to improve by following a predicted process focusing mainly on:

- Shared knowledge across group
- Internal quality audits and reviews for consistency
- Continual educational and professional development and support
- Promotion of organizational culture aspects and team work
- Improving on technology aspects

7.3.2 Case 2: Department of Health

Respondents from DoH were presented with a series of statements within the nine dimensions / constructs of the Maturity Modeling questionnaire and their responses are presented in ranking order in Table 7-7

Table 7-7: DoH Respondents' perceived implementation level of the 9 dimensions tasks

Strategy	Maturity Index	Mean	Std. Deviation	Rank
S1	We use a road map for the planning of IDMS activities in our enterprise	4,40	0,516	1
S5	We strictly adhere to IDMS instruction manuals and toolkits such as the Gateway System and Infrastructure Delivery Management Toolkit	4,20	0,789	2
S2	We have clearly defined core knowledge, skills and abilities to be possessed by employees	4,10	0,738	3
S4	We have adapted our business models to accommodate IDMS objectives	4,00	0,667	4
S7	Our organization employs technically skilled operational units with the appropriate competencies and skills base	4,00	0,707	4
S3	We allocate sufficient resources for the realization of IDMS activities	3,10	1,449	6
S6	We have structures in place that ensure workers undergo general induction before commencing work	1,60	0,699	7
	Strategy Maturity Index	**3,629**	**0,795**	
L1	Our senior/top management are committed to implementation of the IDMS in our enterprise	4,50	0,707	1
L6	We have skilled leadership which leads by example	4,20	0,789	2
L5	Our senior/top management encourage and support worker participation, commitment and involvement	4,10	0,568	3
L3	We have centrally co-ordinated systems in place for IDMS activities	3,90	0,876	4
L2	Our enterprise has the necessary management competences and systems in place for IDMS implementation	3,60	0,843	5
L4	Each system of the IDMS has at least one qualified manager who has the requisite training to oversee their respective departments	3,60	0,843	5
	Leadership Maturity Index	**3,983**	**0,771**	

C5	We are committed to improved customer service to ensure customer satisfaction	3,90	0,738	1
C4	We utilize customer data to provide services as per need	3,30	1,252	2
C1	We conduct detailed customer identification	3,00	0,471	3
C3	We are responsive to customer needs	3,00	0,500	3
C2	We conduct research to profile customer infrastructure needs	2,80	0,789	5
C6	We digitalize our services	2,30	0,675	6
	Customers Maturity Index	**3,050**	**0,737**	
P1	We are committed to providing quality products and services	4,40	0,516	1
P2	We are committed to ensuring continual product/service quality improvement	3,60	0,966	2
P8	We are sensitive to the impact our products/services have on sustainable development goals	3,60	0,699	2
P6	We ensure that our products/services are adequate	3,50	0,850	4
P5	We ensure that our products/services are affordable	3,22	0,667	5
P4	We ensure that our products/services are accessible to the customers they serve	3,18	0,738	6
P7	We ensure that our products/services are produced to cater for population growth	3,16	1,197	6
P3	We ensure that our products/services are provided timeously and within budget	2,90	0,919	8
	Products Maturity Index	**3,445**	**0,819**	
O5	We have performance evaluation structures in place	3,90	0,738	1
O2	We have interdisciplinary and interdepartmental collaboration	3,50	0,850	2
O3	We have periodic and random quality checks to ensure procedures and processes are adhered to	3,50	0,850	2
O1	We have decentralized operations and processes	3,40	1,265	4
O4	Our organization conducts regular audits to ensure that the quality management system is adhered to	3,40	0,516	4
	Operations Maturity Index	**3,540**	**0,844**	
CU1	Our organization provides an enabling environment which promotes knowledge sharing	4,10	0,738	1
CU2	Our organization promotes innovation and cross company collaboration	3,20	0,789	
CU5	There is provision of periodic training regarding implementation of the IDMS through seminars and workshops	3,20	1,317	
CU3	Our organization recognizes and rewards outstanding behaviour and achievements	2,70	0,675	
CU4	Our organization conducts team building initiatives that boost morale of the employees	2,00	0,667	
	Culture Maturity Index	**3,040**	**0,837**	
PE5	We are trustworthy and honest	4,40	0,516	1
PE1	Our organization employs people based on the merits of their qualifications	4,00	0,816	2
PE2	We possess the adequate technical skills and competences to effectively perform IDMS activities	4,00	0,943	2

PE3	We have the autonomy to work independently without constant supervision and management	4,00	0,667	2
PE4	We are committed to continual professional development	2,50	1,080	5
	People Maturity Index	**3,780**	**0,804**	
G2	Our organization complies with employment policies and labour regulations	4,20	0,789	1
G1	Our organization upholds and strictly adheres to governance principles	4,00	0,667	2
G3	Our organization conforms to and supports protection of intellectual property	3,90	0,876	3
G4	We have disciplinary measures in place to deal with any issues of misconduct and bad governance	3,30	1,160	4
	Governance Maturity Index	**3,850**	**0,873**	
T6	We are open to new technologies	3,80	0,789	1
T2	Our organization has provision of correct tools, equipment and resources to implement the IDMS	3,70	0,823	2
T5	Our infrastructure necessitates adequate free flow of information among all employees	3,70	0,675	2
T3	We possess infrastructure which facilitates efficiency in the implementation of the IDMS	3,50	1,080	4
T4	We have current and future knowledge networks	3,40	0,699	5
T1	Our organization utilizes modern information and communications technology	3,10	0,994	6
	Technology Maturity Index	**3,533**	**0,843**	

7.3.2.1 DOH Strategy Dimension

The results in Table 7-7 suggest that the Department conducts planning of activities relating to IDMS implementation (mean=4,40). These results contradict the findings by Koma and Kuye (2014) and WCG (2010) who attributed the challenges impacting infrastructure delivery to be emanating from poor planning. On the other hand, having structures that ensured that workers underwent induction before commencement was not as evident (mean=1,60). The fact that worker induction was not fully implemented could be hindering effective infrastructure delivery through the possibility of slowing worker participation and familiarization with the organization culture and operations.

7.3.2.2 DOH Leadership Dimension

Evidently, the results indicate that the Department's senior management was committed to IDMS implementation (mean=4,10). On the other hand, having at least one qualified manager with the requisite training to oversee their respective departments ranked low at (mean=3,60). The results reinforce the extent of challenges of skills shortages and limited technical capacity, which, arguably could be impeding successful infrastructure delivery (Thumbiran and Raphiri, 2016; National Treasury, 2016 and Quarterly Bulletin, 2012).

7.3.2.3 DOH Customers Dimension

It appears from the results that the Department was committed to improved customer service (mean=3.90). The high mean score associated this aspect could be in response to the reported widespread service protests over poor service and infrastructural deficits by disgruntled citizens (Booysen, 2007). The results could indicate the realization by the Department to ensure customer satisfaction and hence prioritization of infrastructure delivery. It is apparent that digitalization of services was no as evident (mean=2.30). The low ranking of items relating to the digitalization aspect could to some extent be an indication that the Department might not be aware of the benefits associated with digitalization in relation to improved infrastructure delivery, such as, integration of business systems, since the IDMS is implemented by different departments.

7.3.2.4 DOH Products Dimension

Evidently, the department is committed to producing quality products (mean=4,40). This commitment could be in response to the report by WEF (2018) which reported that South Africa had dropped in rankings pertaining to the overall quality of infrastructure. Additionally, NIC (2017) indicated that quality products can lower production costs and the possibility of reworks thereby reducing life cycle costs associated with infrastructure delivery. The results also suggest that the Department's commitment to timeous completion of projects within budget and the affordability of the products is not as evident (mean=2,90). This reduced commitment in relation to some of the key project objectives are demonstrated through the prevalence of time and cost overruns associated with the delivery of public projects OECD (2015) and Bhattacharya et al., (2014).

7.3.2.5 DOH Operations Dimension

This dimension generally had a fair level of implementation with the highest ranked item at (mean=3.90) and the lowest ranked (mean=3.40) It is evident that the Department had performance evaluation structures in place (mean=3.90) and interdisciplinary collaboration (mean=3,50). Performance evaluation structures have been cited to improve job performance of a team and added benefits are acquired through collective teamwork rather than an isolated resource Anantadjaya (2008), and probably the reason this aspect tops the list. The high ranking allocated to the interdisciplinary collaboration could be in response to the prevalence of poor interdepartmental collaboration as reported by Thiry and Deguire (2007) in a bid to improve interaction between departments. On the contrary, the conduction of regular audits was not as evident (mean=3,40). Arguably, the widely reported poor quality of infrastructural installations CIDB (2018) could be attributed to the limited implementation of regular audits.

7.3.2.6 DOH Culture Dimension

It appears from Table 7-7 that the respondents perceived implementation levels of aspects under this dimension to be varied. The Department provided an enabling environment (mean=4.10). On the other hand, conduction of team building initiatives was not as evident (mean=2.00. The low implementation level associated with team building is a cause of concern and could be linked to the poor delivery of public infrastructure. This link is emphasized by Laegaard and Bindslev (2006) who considered teamwork to be a critical requisite for both project and organization success. Importantly, an enabling environment could be linked to boosting productivity which in turn contributes to the improvement in infrastructure delivery; hence the high implementation level attached to this aspect.

7.3.2.7 DOH People Dimension

It is evident from the results that employees considered themselves to be honest and trustworthy (mean=4,40). These results suggest that the organization upheld issues of trust, perhaps to instil a sense of accountability and reliability within the organization and to stakeholders alike. On the other hand, the Department could improve on its support and commitment to employee continual professional development (mean=2.50)

7.3.2.8 DOH Governance Dimension

Evidently, the Department adhered to governance principles and it complied with labour regulations (mean=4,20). These findings contradict findings by Oyedele (2016) who reported extensive issues of corruption within public entities, which would otherwise be low should the Department had effectively implemented governance principles as reported. On the other hand, having disciplinary measures in place to deal with issues of bad governance was not as evident (mean=3,30). The low ranking in aspects of dealing with bad governance is worrying especially at a time when bad governance is rife and negatively affecting effective delivery of infrastructure delivery as reported by Oyedele (2016) and Levitt et al. (2010).

7.3.2.9 DOH Technology Dimension

It is clear from Table 7- that the Department was open to new technologies (mean=3,80). On the other hand, the use of modern information and technology by the Department was not as evident (mean=3,10). These results suggest that the Department could be open to new technologies probably because they are currently utilizing old and perhaps obsolete technology. Given the direction the Industry is taking regarding technology, taking Industry 4.0 and aspects such as the Internet of Things and Cyber Physical Systems for example, the Department could therefore be aware of the need to be dynamic and embrace new technologies.

7.3.2.9.1 DOH Organizational Maturity Level

Table 7-8 presents the summary of the responses relating to the 9 Dimensions in ranking order from the respondents' perspective.

Table 7-8: Overall DOH Maturity Index across all nine dimensions

Dimension	Maturity Index	SD	Rank
Leadership	3,983	0,771	1
Governance	3,850	0,873	2
People	3,780	0,804	3
Strategy	3,629	0,795	4
Operations	3,540	0,844	5
Technology	3,533	0,843	6
Products	3,445	0,819	7
Customers	3,050	0,737	8
Culture	3,040	0,837	9
Overall Maturity Index	**3,539**	**0,814**	

The Department had an overall maturity rating of 3.54, with all the 9 dimensions being consistently on Level 3. Figure 7-2 provides a holistic visualization of the Department's performance in the 9 dimensions.

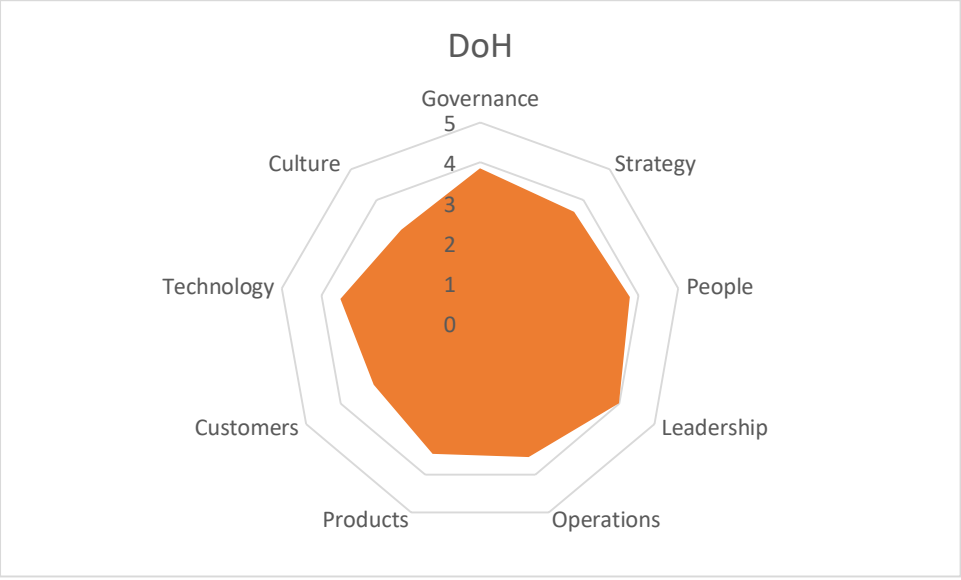

Figure 7-2: Radar chart visualizing DoH Maturity

Table 7-8 and Figure 7-2 show that the Department's maturity rating per dimension was generally consistent for all 9 dimensions, with the highest ratings recorded for the Leadership (3.983) and Governance (3,850) dimensions, and the lowest ranking allocated to the Customers (3.050) and Culture

(3.040) dimensions. As indicated by the King IV report (2016), effective and ethical leadership are key components of good governance, and as such, the Leadership and Governance dimensions are evidently interrelated, hence the notable corresponding high scores within these two dimensions. The results suggest that the Department places more emphasis on leadership probably because it recognizes that leadership is the driver of an organization. The Governance dimension also received a relatively high ranking, probably to promote aspects of good governance and to minimize the rife issues of maladministration and bad governance which have been reported in most public offices. On the other hand, the low score attached to Customers dimension could be because the Department strives to provide health facilities which are to the most part standard, hence the limited need to conduct customer profiling and research. The Culture dimension had the lowest ranking, indicative of that it requires the most improvement so as to boost employee morale and motivation, which ultimately impacts on infrastructure delivery.

7.3.3 Case 3: Department of Public Works

Respondents from DPW were presented with a series of statements within the nine dimensions of the Industry 4.0 Maturity Modeling questionnaire and their responses are presented in ranking order in Table 7-9

Table 7-9: DPW Respondents' perceived implementation level of the 9 dimensions tasks

Strategy	Maturity Index	Mean	Std. Deviation	Rank
S2	We have clearly defined core knowledge, skills and abilities to be possessed by employees	3,67	0,651	1
S7	Our organization employs technically skilled operational units with the appropriate competencies and skills base	3,42	1,165	2
S6	We have structures in place that ensure workers undergo general induction before commencing work	3,00	1,044	3
S1	We use a road map for the planning of IDMS activities in our enterprise	2,67	0,492	4
S3	We allocate sufficient resources for the realization of IDMS activities	2,42	0,669	5
S4	We have adapted our business models to accommodate IDMS objectives	2,17	0,718	6
S5	We strictly adhere to IDMS instruction manuals and toolkits such as the Gateway System and Infrastructure Delivery Management Toolkit	2,08	0,793	7
	Strategy Maturity Index	**2,774**	**0,790**	
L5	Our senior/top management encourage and support worker participation, commitment and involvement	3,33	0,651	1
L4	Each system of the IDMS has at least one qualified manager who has the requisite training to oversee their respective departments	3,08	1,443	2

L1	Our senior/top management are committed to implementation of the IDMS in our enterprise	2,92	0,793	3
L6	We have skilled leadership which leads by example	2,92	0,900	3
L3	We have centrally co-ordinated systems in place for IDMS activities	2,25	1,055	6
L2	Our enterprise has the necessary management competences and systems in place for IDMS implementation	2,17	0,718	5
	Leadership Maturity Index	**2,778**	**0,927**	
C5	We are committed to improved customer service to ensure customer satisfaction	3,25	0,965	1
C4	We utilize customer data to provide services as per need	3,08	1,240	2
C3	We are responsive to customer needs	2,92	0,900	3
C1	We conduct detailed customer identification	2,75	0,866	4
C6	We digitalize our services	2,50	1,168	5
C2	We conduct research to profile customer infrastructure needs	2,08	0,793	6
	Customers Maturity Index	**2,764**	**0,989**	
P1	We are committed to providing quality products and services	3,92	0,900	1
P5	We ensure that our products/services are affordable	3,73	1,104	2
P2	We are committed to ensuring continual product/service quality improvement	3,67	0,651	3
P8	We are sensitive to the impact our products/services have on sustainable development goals	3,58	0,996	4
P4	We ensure that our products/services are accessible to the customers they serve	3,50	1,314	5
P6	We ensure that our products/services are adequate	3,45	1,036	6
P3	We ensure that our products/services are provided timeously and within budget	2,83	1,030	7
P7	We ensure that our products/services are produced to cater for population growth	2,82	1,328	8
	Products Maturity Index	**3,438**	**1,045**	
O2	We have interdisciplinary and interdepartmental collaboration	2,92	0,669	1
O5	We have performance evaluation structures in place	2,92	1,165	1
O4	Our organization conducts regular audits to ensure that the quality management system is adhered to	2,58	0,900	3
O1	We have decentralized operations and processes	2,50	1,087	4
O3	We have periodic and random quality checks to ensure procedures and processes are adhered to	2,50	1,168	4
	Operations Maturity Index	**2,683**	**0,998**	
CU5	There is provision of periodic training regarding implementation of the IDMS through seminars and workshops	3,00	0,953	1
CU1	Our organization provides an enabling environment which promotes knowledge sharing	2,42	0,793	2
CU2	Our organization promotes innovation and cross company collaboration	2,25	0,622	3
CU3	Our organization recognizes and rewards outstanding behaviour and achievements	2,08	0,996	4

CU4	Our organization conducts team building initiatives that boost morale of the employees	1,75	0,754	5
	Culture Maturity Index	**2,300**	**0,824**	
PE5	We are trustworthy and honest	4,08	0,669	1
PE4	We are committed to continual professional development	3,92	1,240	2
PE2	We possess the adequate technical skills and competences to effectively perform IDMS activities	3,25	1,138	3
PE3	We have the autonomy to work independently without constant supervision and management	3,17	0,937	4
PE1	Our organization employs people based on the merits of their qualifications	3,08	1,311	5
	People Maturity Index	**3,500**	**1,059**	
G4	We have disciplinary measures in place to deal with any issues of misconduct and bad governance	4,25	0,452	1
G1	Our organization upholds and strictly adheres to governance principles	4,00	0,953	2
G2	Our organization complies with employment policies and labour regulations	4,00	0,853	2
G3	Our organization conforms to and supports protection of intellectual property	4,00	0,603	2
	Governance Maturity Index	**4,063**	**0,715**	
T6	We are open to new technologies	3,56	0,882	1
T1	Our organization utilizes modern information and communications technology	3,08	0,996	2
T2	Our organization has provision of correct tools, equipment and resources to implement the IDMS	2,92	0,996	3
T3	We possess infrastructure which facilitates efficiency in the implementation of the IDMS	2,58	0,996	4
T5	Our infrastructure necessitates adequate free flow of information among all employees	2,22	0,441	5
T4	We have current and future knowledge networks	2,00	0,603	6
	Technology Maturity Index	**2,727**	**0,819**	

7.3.3.1 DPW Strategy Dimension

It is clear from Table 7-9 that the Department has clearly defined core skills to be possessed by its employees (mean=3,67) and it employs technically skilled operational units with the appropriate competencies and skills base (mean=3.42). The results suggest that the Department aims to ensure that all those it employs have the adequate capacity and capability to perform their duties. However, ensuring strict adherence to IDMS manuals was not as evident (mean=2,08). It could be argued that the low ranking allocated to adherence to IDMS manuals could be leading to ineffective utilization of the IDMS, which consequently result in poor infrastructure delivery.

7.3.3.2 DPW Leadership Dimension

The results suggest that senior management within the Department supports worker participation and involvement (mean=3,33). It could be argued that the Department is cognizant of the added benefits associated with good employee welfare on productivity, hence the high employee support. On the other hand, having the necessary management competences and systems in place for IDMS implementation was not as evident (mean=2,17). The low score associated with management competencies and systems coordination could potentially be resulting to the delays affecting infrastructure delivery, as poorly coordinated systems pose challenges to the optimal usage of the IDMS (Thiry and Deguire, 2007).

7.3.3.3 DPW Customers Dimension

It is evident from Table 7-9 that the Department is committed to improved customer service (mean=3,25). This commitment could be to enhance customer satisfaction and to minimise disruptive and costly rampant protests as a result of poor infrastructure delivery. On the contrary, the conduction of research to profile customer infrastructure needs is not as evident (mean=2.17). Arguably, inadequate customer needs profiling could result in the misallocation of investments, resulting in the construction of projects with little societal value, which is a major challenge affecting infrastructure projects (Ganuza and Llobert, 2016).

7.3.3.4 DPW Products Dimension

It is apparent from the results that the Department is committed to providing quality products (mean=3.92). These findings are consistent with the findings from the Customer dimension where the Department is committed to improved customer service. On the other hand, the aspect with the lowest ranking is the Department's commitment to ensuring timeous provision of products within budget (mean=2.83) and ensuring that products/services are produced to cater for population growth (mean=2.83). Arguably, the rampant time and cost overruns affecting public infrastructure delivery CIDB (2018) could be attributed to the inadequate implementation of processes that ensure timely project completion. Furthermore, the inadequate infrastructure provisions and infrastructure shortfalls could be as a direct result of the Department's failure to take into account the impact of population growth.

7.3.3.5 DPW Operations Dimension

The results suggest that the Department has interdisciplinary and interdepartmental collaboration and performance evaluation structures in place (both at mean=2.92). Collaboration between the departments is critical since the implementation of IDMS overlaps between the departments, probably that is why this aspect hand a high ranking with the dimension. Performance evaluation structures help keep people in check and facilitates efficient operations which could enhance improved IDMS implementation. On

the other hand, periodic and random quality checks are not as evident (mean=2,50). The low ranking allocated to the quality checks aspect contradicts the Departments commitment to providing quality products under the Products dimension. Additionally, it could be argued that the quality issues which are a major challenge in the delivery of public infrastructure projects are as a result of the inadequate quality checks.

7.3.3.6 DPW Culture Dimension

Evidently, the Department provides periodic IDMS training (mean=3,00). This periodic training could be in response to the skills shortages which have been widely reported (Quarterly Bulletin, 2012; National Treasury, 2017 and DBSA, 2012), to ensure that the individuals who implement the IDMS are equipped with the requisite skills and knowledge to ensure effective implementation which enhances successful infrastructure delivery. However, team building initiatives within the Department are not as evident (mean=1,75), which could lead to decreased employee morale, potentially impacting negatively to infrastructure delivery

7.3.3.7 DPW People Dimension

The results pertaining to the People dimension suggest that the Department employment people who upheld honesty values (mean=4,08). The high score attached to aspects of honesty could be to linked to the importance the Department places on the Governance dimension so as to promote aspects of good governance. On the other hand, the ability of employees to work independently (mean=3.17) and the employment of staff based on the merits of their qualifications (mean=3.08) were ranked low. It could be argued that since the employees cannot adequately work without constant supervision, the Department therefore prioritized training as evident under the Culture dimension where training is atop the list.

7.3.3.8 DPW Governance Dimension

Evidently, the results indicate that aspects under this dimension generally had a high level of implementation (composite mean=4,06). These results contradict the plethora of reports which highlight the high levels of poor governance and mal-administration within public offices (Oyedele, 2016; Levitt et al., 2010; Thumbiran and Raphiri, 2016 and World Development Report, 2016). Arguably, the high implementation score could also indicate a radical response by the Department to tackle the issues of poor governance.

7.3.3.9 DPW Technology Dimension

It is apparent from the results that the Department is open to new technologies (mean=3,56). The high score attached to being open to new technologies could be that the Department is aware utilizing old

technologies and is open to the exploration of new technologies and the benefits of utilizing such modern technologies On the other hand, current and future knowledge networks are not as evident. (mean=2.00). The results further show that the composite mean for this dimension is 2.73 and only 50% of the aspects are above this mean indicative for the need for improvement in implementation of aspects under this dimension.

7.3.3.10 DPW Maturity Ranking

Table 7-10 is a presentation of the mean rankings pertaining to the implementation of the 9 dimensions by DPW.

Table 7-10: Overall DPW Maturity Index across all nine dimensions

Dimension	Maturity Index	SD	Rank
Governance	4,063	0,715	1
People	3,500	1,059	2
Products	3,438	1,045	3
Leadership	2,778	0,927	4
Strategy	2,774	0,790	5
Customers	2,764	0,989	6
Technology	2,727	0,819	7
Operations	2,683	0,998	8
Culture	2,300	0,824	9
Overall Maturity Index	**3,003**	**0,907**	

The Department had an overall maturity rating of 3,00 across all 9 dimensions. Figure 7-3 provides a holistic visualization of the Department's performance in the 9 dimensions.

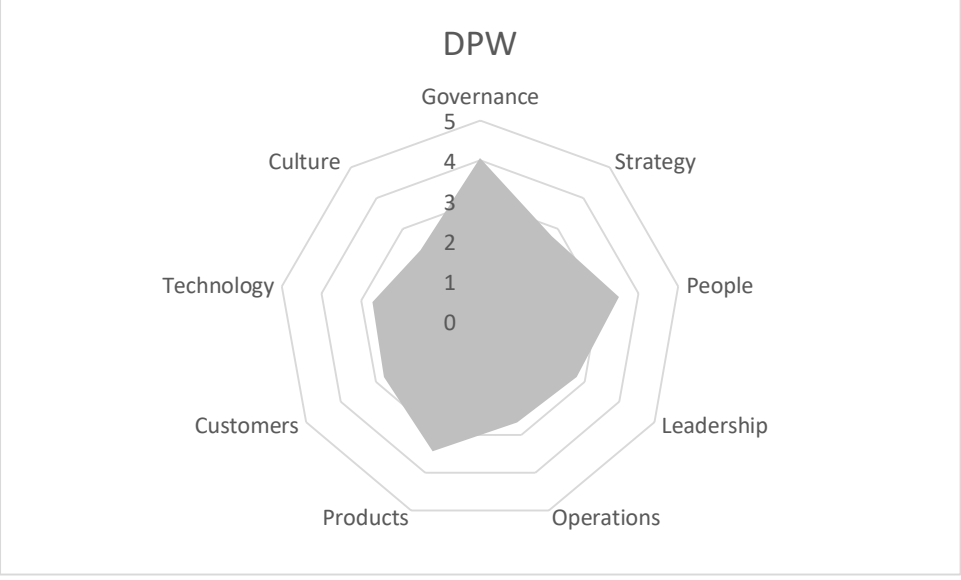

Figure 7-3: Radar chart visualizing DPW Maturity

Table 7-10 and Figure 7-3 both show that the Department performs better on the Governance and Products dimensions. This indicates that the Department prioritizes and seemingly upholds the aspects of governance probably in a bid to address the aspects of widespread corruption, fraud and mal-administration within government departments. Additionally, the Department is concerned about the products it delivers probably to ensure that infrastructure projects are delivered according to the need and are fit for purpose; this is so as to potentially avoid constructing white elephants which are an economic cost. Although the overall maturity rating for the organization is just above the Level 3 mark, implementation of six out of the nine dimensions is at Level 2 and the Department could improve on these aspects.

7.4 Cross Case Analyses

7.4.1 Descriptive statistics

Table 7-11 presents the comparative means and rankings of the 9 dimensions between the Departments.

Table 7-11: Maturity comparisons between Departments

Dimension	**DoE**		**DoH**		**DPW**	
	Maturity Index	**Rank**	**Maturity Index**	**Rank**	**Maturity Index**	**Rank**
Governance	3,542	1	3,850	2	4,063	1
Strategy	3,497	2	3,629	4	2,774	5
People	3,400	3	3,780	3	3,500	2
Leadership	3,347	4	3,983	1	2,778	4
Operations	3,100	5	3,540	5	2,683	8
Products	2,969	6	3,445	7	3,438	3
Customers	2,819	7	3,050	8	2,764	6
Technology	2,653	8	3,533	6	2,727	7
Culture	2,367	9	3,040	9	2,300	9
Overall Maturity Index	**3,077**		**3,539**		**3,003**	

The results indicate that DoH has the highest maturity rating (mean=3,54), followed by DoE (mean=3,08) and DPW third (mean=3,00). It could be argued that the overall maturity index of the DoH is higher than that of the other two departments because of the high maturity of the leadership dimension. The pivotal role of upper management (leadership) is critical to setting strategic direction, policy planning and general management and monitoring of all employees, which are all imperative for organizational success. In other words, the leadership dimension can be viewed as a driver of all other dimensions, where a high maturity level under this dimension directly correlates with improved

maturity in the other dimensions. Similarly, committing to tackle any other dimension without leadership commitment could have a negative impact on the overall organizational maturity index as leadership should be the driving force for all initiatives. It could therefore be argued that the lower overall maturity indices for DPW and DoE could be attributed to their focus and priority being on other dimensions and not on leadership where it was ranked 4th within both departments. Figure 7-4 is a radar chart used to provide a holistic visualization of the comparative results in the 9 dimensions between the departments.

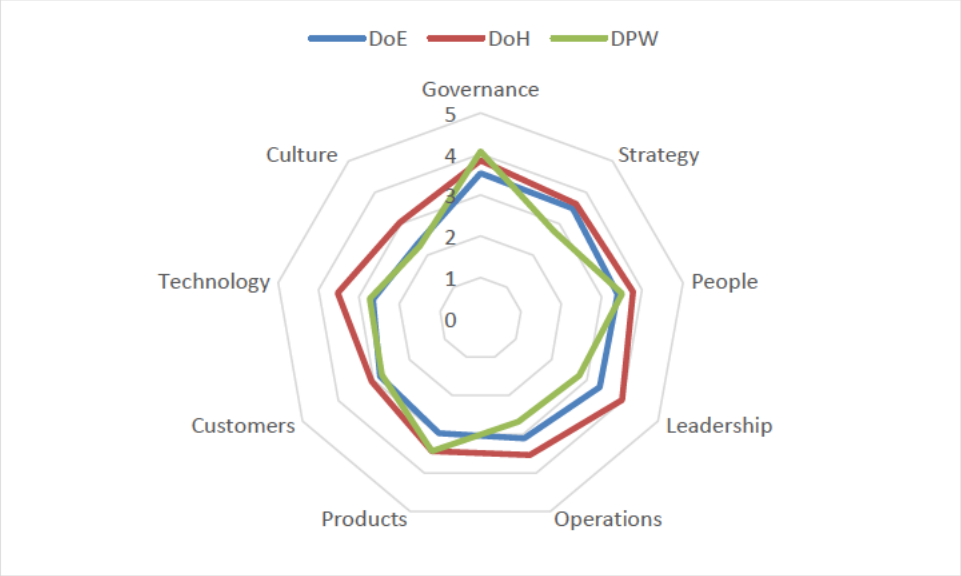

Figure 7-4: Radar chart visualizing Maturity comparisons between Departments

It is evident that DoH consistently performed high in all but two dimensions, namely Customers and Culture. While the DoH performed better within the leadership dimension, both the DoE and DPW had the highest implementation in the governance dimension. Notable, all three departments had a relatively high implementation level for the governance dimension, probably as an effort to curb the reported widespread poor governance issues in and across public entities. The Culture dimension however shows a very different picture as it was generally ranked low across all departments. Evidently, DoH performed significantly better when compared to the other two departments in the Technology and Operations dimensions. On the other hand, DPW had a seemingly low rating in the Technology and Operations dimensions. Generally, Figure 7-4 suggests that in order to improve on organizational maturity and overall organizational readiness, the departments could improve on all dimensions, as all but one dimension have scores < 4, namely the Governance dimension within DPW.

7.4.2 Comparison Between Maturity of Provincial Government Departments Against the Maturity Levels Needed to Effectively Implement the IDMS

For an organization to be considered mature, it has to be rated at level 5 of the maturity model, which denotes systems and processes being optimized. An IDMS ready organization would therefore be

proactive and will possess the ability to efficiently manage and maintain its portfolio management, programme and project management, and operations and maintenance processes. It is therefore evident that even though a maturity rating of 5.0 is required for the ideal implementation, the departments are all ranked within level 3. This calls for the departments to constantly work on improving their processes, especially within the leadership and people dimensions which have been identified in the study and in literature respectively as carrying more weighting with respect to improving organizational maturity. To support the importance of the people dimension to improving maturity of an organization, Prophix (2015), found that people are key to the effective utilization of the IDMS and therefore, it is imperative to ensure that before responsibilities are assigned, employee skills and competence levels are assessed to ensure adequate task allocation, which enhances organization effectiveness and stability.

7.4.3 ANOVA Statistical Analysis

The one-way analysis of variance (ANOVA) was used to determine whether there were any statistically significant differences between the means of the three departments. Table 7-12 is a summary of the ANOVA findings

Table 7-12: One way ANOVA for significant differences between departments in relation to IDMS implementation

Item	Description		SS	df	F	Sig.	
S1	We use a road map for the planning of IDMS activities in our enterprise	Between Groups	16,404	2	18,075	0,000	#
		Within Groups	14,067	31			
		Total	30,471	33			
S2	We have clearly defined core knowledge, skills and abilities to be possessed by employees	Between Groups	1,125	2	0,978	0,387	
		Within Groups	17,817	31			
		Total	18,941	33			
S3	We allocate sufficient resources for the realization of IDMS activities	Between Groups	6,237	2	3,365	0,048	#
		Within Groups	28,733	31			
		Total	34,971	33			
S4	We have adapted our business models to accommodate IDMS objectives	Between Groups	19,681	2	20,918	0,000	#
		Within Groups	14,583	31			
		Total	34,265	33			
S5	We strictly adhere to IDMS instruction manuals and toolkits such as the Gateway System and Infrastructure Delivery Management Toolkit	Between Groups	26,684	2	23,725	0,000	#
		Within Groups	17,433	31			
		Total	44,118	33			
S6	We have structures in place that ensure workers undergo general induction before commencing work	Between Groups	11,661	2	8,498	0,001	#

		Within Groups	20,582	30			
		Total	32,242	32			
S7	Our organization employs technically skilled operational units with the appropriate competencies and skills base	Between Groups	3,076	2	1,786	0,185	
		Within Groups	25,833	30			
		Total	28,909	32			
L1	Our senior/top management are committed to implementation of the IDMS in our enterprise	Between Groups	13,696	2	11,579	0,000	#
		Within Groups	18,333	31			
		Total	32,029	33			
L2	Our enterprise has the necessary management competences and systems in place for IDMS implementation	Between Groups	15,752	2	12,862	0,000	#
		Within Groups	18,983	31			
		Total	34,735	33			
L3	We have centrally co-ordinated systems in place for IDMS activities	Between Groups	14,904	2	10,469	0,000	#
		Within Groups	22,067	31			
		Total	36,971	33			
L4	Each system of the IDMS has at least one qualified manager who has the requisite training to oversee their respective departments	Between Groups	3,281	2	1,183	0,320	
		Within Groups	42,983	31			
		Total	46,265	33			
L5	Our senior/top management encourage and support worker participation, commitment and involvement	Between Groups	4,654	2	4,561	0,018	#
		Within Groups	15,817	31			
		Total	20,471	33			
L6	We have skilled leadership which leads by example	Between Groups	9,469	2	7,067	0,003	#
		Within Groups	20,767	31			
		Total	30,235	33			
C1	We conduct detailed customer identification	Between Groups	0,951	2	0,505	0,608	
		Within Groups	29,167	31			
		Total	30,118	33			
C2	We conduct research to profile customer infrastructure needs	Between Groups	3,704	2	1,996	0,153	
		Within Groups	28,767	31			
		Total	32,471	33			
C3	We are responsive to customer needs	Between Groups	0,386	2	0,218	0,805	
		Within Groups	26,583	30			
		Total	26,970	32			

C4	We utilize customer data to provide services as per need	Between Groups	1,199	2	0,435	0,651	
		Within Groups	42,683	31			
		Total	43,882	33			
C5	We are committed to improved customer service to ensure customer satisfaction	Between Groups	3,419	2	1,615	0,215	
		Within Groups	32,817	31			
		Total	36,235	33			
C6	We digitalize our services	Between Groups	0,219	2	0,100	0,905	
		Within Groups	34,017	31			
		Total	34,235	33			
P1	We are committed to providing quality products and services	Between Groups	7,375	2	3,621	0,039	#
		Within Groups	31,567	31			
		Total	38,941	33			
P2	We are committed to ensuring continual product/service quality improvement	Between Groups	1,183	2	0,626	0,542	
		Within Groups	29,317	31			
		Total	30,500	33			
P3	We ensure that our products/services are provided timeously and within budget	Between Groups	0,434	2	0,223	0,801	
		Within Groups	30,183	31			
		Total	30,618	33			
P4	We ensure that our products/services are accessible to the customers they serve	Between Groups	3,732	2	1,516	0,235	
		Within Groups	38,150	31			
		Total	41,882	33			
P5	We ensure that our products/services are affordable	Between Groups	6,556	2	3,031	0,064	
		Within Groups	30,283	28			
		Total	36,839	30			
P6	We ensure that our products/services are adequate	Between Groups	2,332	2	1,052	0,362	
		Within Groups	32,136	29			
		Total	34,469	31			
P7	We ensure that our products/services are produced to cater for population growth	Between Groups	2,611	2	0,837	0,443	
		Within Groups	45,264	29			
		Total	47,875	31			
P8	We are sensitive to the impact our products/services have on sustainable development goals	Between Groups	3,531	2	1,698	0,200	
		Within Groups	32,233	31			
		Total	35,765	33			
O1	We have decentralized operations and processes	Between Groups	4,615	2	1,900	0,167	

		Within Groups	37,650	31			
		Total	42,265	33			
O2	We have interdisciplinary and interdepartmental collaboration	Between Groups	1,858	2	1,509	0,237	
		Within Groups	19,083	31			
		Total	20,941	33			
O3	We have periodic and random quality checks to ensure procedures and processes are adhered to	Between Groups	6,132	2	3,425	0,045	#
		Within Groups	27,750	31			
		Total	33,882	33			
O4	Our organization conducts regular audits to ensure that the quality management system is adhered to	Between Groups	4,316	2	3,102	0,059	
		Within Groups	21,567	31			
		Total	25,882	33			
O5	We have performance evaluation structures in place	Between Groups	5,884	2	2,626	0,088	
		Within Groups	34,733	31			
		Total	40,618	33			
CU1	Our organization provides an enabling environment which promotes knowledge sharing	Between Groups	16,904	2	18,626	0,000	#
		Within Groups	14,067	31			
		Total	30,971	33			
CU2	Our organization promotes innovation and cross company collaboration	Between Groups	5,866	2	5,505	0,009	#
		Within Groups	16,517	31			
		Total	22,382	33			
CU3	Our organization recognizes and rewards outstanding behaviour and achievements	Between Groups	2,787	2	1,682	0,203	
		Within Groups	25,683	31			
		Total	28,471	33			
CU4	Our organization conducts team building initiatives that boost morale of the employees	Between Groups	2,054	2	1,278	0,293	
		Within Groups	24,917	31			
		Total	26,971	33			
CU5	There is provision of periodic training regarding implementation of the IDMS through seminars and workshops	Between Groups	14,179	2	6,493	0,004	#
		Within Groups	33,850	31			
		Total	48,029	33			
PE1	Our organization employs people based on the merits of their qualifications	Between Groups	4,799	2	1,707	0,198	
		Within Groups	43,583	31			
		Total	48,382	33			

PE2	We possess the adequate technical skills and competences to effectively perform IDMS activities	Between Groups	3,971	2	1,784	0,185	
		Within Groups	34,500	31			
		Total	38,471	33			
PE3	We have the autonomy to work independently without constant supervision and management	Between Groups	3,902	2	2,485	0,100	
		Within Groups	24,333	31			
		Total	28,235	33			
PE4	We are committed to continual professional development	Between Groups	11,108	2	5,015	0,013	#
		Within Groups	34,333	31			
		Total	45,441	33			
PE5	We are trustworthy and honest	Between Groups	6,752	2	4,364	0,021	#
		Within Groups	23,983	31			
		Total	30,735	33			
G1	Our organization upholds and strictly adheres to governance principles	Between Groups	2,642	2	1,521	0,234	
		Within Groups	26,917	31			
		Total	29,559	33			
G2	Our organization complies with employment policies and labour regulations	Between Groups	2,929	2	1,846	0,175	
		Within Groups	24,600	31			
		Total	27,529	33			
G3	Our organization conforms to and supports protection of intellectual property	Between Groups	0,379	2	0,388	0,682	
		Within Groups	15,150	31			
		Total	15,529	33			
G4	We have disciplinary measures in place to deal with any issues of misconduct and bad governance	Between Groups	5,709	2	3,790	0,034	#
		Within Groups	23,350	31			
		Total	29,059	33			
T1	Our organization utilizes modern information and communications technology	Between Groups	0,237	2	0,128	0,880	
		Within Groups	28,733	31			
		Total	28,971	33			
T2	Our organization has provision of correct tools, equipment and resources to implement the IDMS	Between Groups	7,983	2	3,865	0,032	#
		Within Groups	32,017	31			
		Total	40,000	33			
T3	We possess infrastructure which facilitates efficiency in the implementation of the IDMS	Between Groups	5,931	2	2,678	0,085	
		Within Groups	34,333	31			
		Total	40,265	33			

T4	We have current and future knowledge networks	Between Groups	11,850	2	8,109	0,001	#
		Within Groups	22,650	31			
		Total	34,500	33			
T5	Our infrastructure necessitates adequate free flow of information among all employees	Between Groups	12,847	2	10,853	0,000	#
		Within Groups	16,572	28			
		Total	29,419	30			
T6	We are open to new technologies	Between Groups	1,670	2	1,165	0,327	
		Within Groups	20,072	28			
		Total	21,742	30			

Note: # indicates a statistically significant difference between groups, $p < 0.05$

The significant values, $p < 0.05$ are shaded. Evidently, 21 out of 52 items were ranked significantly different by the three departments. Of those 21 items, the ANOVA test further shows that four out of the nine dimensions, namely: Strategy, Leadership, Culture and Technology each have > 50% of their statements with a $p < 0.05$ indicative of significant differences in these dimensions. These differences indicate that each organization is unique and has its own management styles, further supporting the need to use the IDMS as a guide, and to further adapt it to be organization specific to enhance its effective utilization. Additionally, these differences could explain the disparity in maturity to implement the IDMS by the departments. On the other hand, for the balance of the statements across all dimensions (31 out of 52) (60%) where P value > 0.05, it implies that there are no statistically significant differences between the groups. This could signify that intervention could be applied at national level to address any challenges in IDMS implementation across the dimensions in a bid to improve both dimension and organization maturity ratings.

7.5 Interviews Data Analysis

Interviews were conducted with Directors of Infrastructure and/or Senior Managers within each Department to validate the findings from the questionnaire surveys. The interviews were face to face with interviewees in their natural setting (work environment) and lasted an average 30 minutes each. The data collected was in the form of field notes and audio recordings. Important to note is that the interviewees expressed their opinions and perceptions and not groups ideas.

The interviews focused on the lowest ranked items from each dimension, as improving on these aspects would result in an improvement of the dimension and possibly increase organizational readiness to engage the IDMS, consequently resulting in improved organizational maturity rating.

7.5.1 Department of Education

7.5.1.1 Interview validation of the Questionnaire Survey

Table 7-14 presents the aspects regarded as having the least implementation per dimension according to the questionnaire survey and their related interview explanations

Table 7-134: Interview validation of the questionnaire survey

Dimension	Questionnaire lowest ranked items	Score	Interview explanation/s
Strategy	We have structures in place that ensure workers undergo general induction before commencing work	2.833	Respondent X indicated that the results are *"partly correct. However, as a result of the government Human Resource capacitation programme, many of the people come into the system from a parallel system, having worked in similar public positions"*. He further elaborated that the department is not a training ground and all individuals recruited are all qualified professionals who have had the exposure and experience, hence a minimised need for induction to be undertaken. He further noted that, as a department they will however relook at the general employee induction to establish whether more needs to be done.
Leadership	Each system of the IDMS has at least one qualified manager who has the requisite training to oversee their respective departments	3,143	Respondent X indicated that leadership is the driver of an organization and it is individual based; it is how an individual manages the resources available. Respondent X however disputes the low score attached to having qualified managers by virtue of the Human Resource capacitation programme, where an individual / manager is employed only if they meet specific qualification criteria and the department cannot employ an individual who does not meet the minimum requirements. However, "*It could be a possibility but less so, that the individuals appointed by the department are coming from the private sector*", with minimum knowledge of the public sector modus operandi, perhaps the perceived low score attached to having a qualified manager per department.
Customers	We utilize customer data to provide services as per need	2,833	Respondent X indicated that the department has a customer data / project priority list which they utilize but however it is often interfered with, *"thereby giving an impression that customer data is not utilized within the department, hence the low score*".

Products	We ensure that our products/services are accessible to the customers they serve	3.000	Respondent X indicated that one of the department's major objective is to ensure that they build schools which are accessible to their learners and that cater for the disabled learners, "*which is part of our strategic designs, we embrace that"*. However, due to soaring unplanned settlements, resulting from the province being largely rural and a lot of the land belonging to the Ingonyama Trust Board and Tribal Land, land restitution then occurs were large pieces of land are given to a community. Legal community settlements then occur without any plans, thereby leaving a gap for services such as schools and roads.
Operations	We have decentralized operations and processes	2,429	Respondent X concurs with the low score associated with this aspect largely due to transparency required when managing the budget or when dealing with public funding. He further stated that when systems are completely decentralized, one loses control, and as such *"Financial control is the main reason why the systems are not decentralized".*
Culture	Our organization promotes innovation and cross company collaboration	2,286	It was noted by Respondent X that due to the magnitude of infrastructure backlogs, standardization could be the best way to curb these infrastructure challenges. However, he stated that there are circumstances where innovation is promoted by the department, giving an example of a typical project funded by Oprah Winfrey where the architects were afforded the opportunity to be innovative. He further stated that, "*we allow for innovation if the architect is prepared to spend more time on the project, but however, since the department works with large volumes of projects, innovation is kept to a minimum*", hence the low score associated with promotion of innovation.
People	We possess the adequate technical skills and competences to effectively perform IDMS activities	3,429	Respondent X disputes the low score attached to this aspect due to the recently initiated government Human Resource capacitation programme. He went further to mention that *"the department is sitting at over 80% capacitation with adequately skilled and competent individuals"*.
Governance	Our organization upholds and strictly adheres to governance principles	3,417	Respondent X disagrees with the low score stating that the Department strictly adheres to governance aspects, *"however, it could be a few individuals who disregard these aspects"*. He went further to highlight that bearing in mind that the civil service is generally poor at

			governance and disciplining people, “it really has to be bad before anything is done”.
Technology	Our infrastructure necessitates adequate free flow of information among all employees	2,429	Respondent X emphasized that the technology aspect goes far beyond communication and information flow. Their department however utilizes mostly emails, and the absence of a web based system is the biggest problem and hopefully that will be addressed in the near future.

7.5.1.2 Ranking of the 9 Dimensions

When asked to rank both the implementation level of each dimension by the department and the importance of the dimension in improving organizational maturity, the respondent’s responses are tabulated in Table 7-14.

Table 7-14: Dimension Ranking

Dimension	Implementation level / Org readiness	Importance
Strategy	5	5
Leadership	4	5
Customers	4	4
Products	4	4
Operations	2	4
Culture	3	3
People	4	4
Governance	4	4
Technology	2	5
Mean Score	**3,56**	**4,22**

The results indicate that the operations and technology dimensions have low implementation scores = 2, yet their importance to improving organizational maturity was rated high, at 4 and 5 respectively. Similarly, the leadership dimension also requires some minimal improvement as the implementation score = 4 has been suggested to be lower than the importance score = 5. This indicates that the

organization has to improve on the implementation of these three dimensions to ensure progressive transition and improvement of overall organizational maturity. Interestingly, all six other dimensions were given similar implementation and importance scores, implying that the respondent perceived the organization as optimally implementing those dimensions. However, apart from the strategy dimension where both implementation and importance score = 5, there is a gap and need for improvement as these dimensions have been rated < 5.

7.5.2 Department of Health

7.5.2.1 Interview validation of the Questionnaire Survey

Table 7-15 presents each dimension's lowest ranked questionnaire survey aspects and their related respondent's interview explanations.

Table 7-15: Interview validation of the questionnaire survey

Dimension	Questionnaire lowest ranked items	Score	Interview explanation/s
Strategy	We have structures in place that ensure workers undergo general induction before commencing work	1,67	Respondent Y to some extent agrees with the low implementation score attached to this aspect from the questionnaire survey. He further explains that there are probably some workers who have not been properly inducted. However, in relation to the IDMS, in particular the past 6 months for instance, all managers have been urged to have all their new employees and those that have not been properly inducted to attend workshops and training. Respondent Y further highlighted the importance of induction by stating that, *"Induction has been suggested to have a huge impact in relation to IDMS implementation; otherwise it's bewildering to engage the IDMS without prior training".* Despite respondent X having significant experience with the IDMS, he indicated that he still battles with most of the language used within IDMS toolkits and instruction manuals, his job is therefore to try and make sense of those manuals and to write-up simplified versions. He further stated that induction improves familiarity with the IDMS thus making the aspect of induction very critical to improving readiness to engage it.
Leadership	Each system of the IDMS has at least one qualified manager who	3,50	Respondent Y stated that the department has excellent managers and that they are qualified to be in those

	has the requisite training to oversee their respective departments		positions based on merit and qualifications. The respondent highlighted however, that it must be noted that it is not all managers who deem IDMS as important and are therefore not supportive, and they somewhat lack the understanding of the system, hence the perceived lack of adequately trained managers
Customers	We digitalize our services	2,17	Respondent Y indicated that the possible reason this aspect was lowly ranked is because they do not deal with customers directly although they have beneficiaries, hence they build facilities staffed by their staff and the public come to their facilities. He further explained that *"the entire public being our beneficiaries"*
Products	We ensure that our products/services are provided timeously and within budget	2,67	Respondent Y indicated that meeting key project objectives of time and budget is "*a high priority within the department but it's a very difficult one to achieve*". He further indicated that "*the planning at top management prioritises this aspect; it is actually a major priority. However, very often, because of other challenges, those targets are not reached. Therefore, in response to the questionnaire, people might have misinterpreted and/or misconstrued the question."* Respondent Y further attributed the lack of timeous project completion to various issues, such as bad planning in the part of the department which can include; bad planning by the department which encompasses misjudgement of the appropriate contract duration; SCM issues, public works issues and contractor issues. However, it was further reiterated that targets were a high priority within the department.
Operations	Our organization conducts regular audits to ensure that the quality management system is adhered to	3,33	Respondent Y indicated that he did not agree with this aspect stating that "*regular audits do happen. They are conducted on a monthly basis*". He went further to emphasize that, as a public entity which utilizes public funding, regular audits are very necessary and quality is at the top of their objectives. Respondent Y emphasized that given the infrastructure backlogs they are faced with, they cannot afford to compromise on quality as they would have to revisit the same project, the resources and funding to address reworks which they lack.

			However, respondent Y having looked at the score of all aspects within the operations dimension, suggested a possibly reason for the low score attached to this aspect as he compared it to the other aspects within this dimension which he indicated were generally implemented more as they were of greater priority to IDMS implementation.
Culture	Our organization conducts team building initiatives that boost morale of the employees	2,00	Respondent Y concurs with the low score attached to this aspect as he indicated that this is an area they could strengthen. He further advised that, "*As an organization that is an area we ought to invest more in."*
People	We are committed to continual professional development	2,33	Despite the low score associated with this aspect, respondent Y indicated that their organization supports continual professional development. However, he highlighted that the respondents to the questionnaire might not be realising and/or experiencing the consequences of that. As a result, he suggested on the need to improve on this aspect.
Governance	We have disciplinary measures in place to deal with any issues of misconduct and bad governance	3,50	Respondent Y indicated that the overall high scores attached to governance aspects is justifiable. He highlighted that it would be very difficult to conduct bad governance within the organization as it is well managed. The respondent further highlighted that the department is a *"proactive one rather that a reactive one",* hence the low implementation score attached to the disciplinary measures aspects
Technology	Our organization utilizes modern information and communications technology	3,17	Respondent why was baffled by this aspect being ranked low as he considered their organization to be a computerised one which utilizes industry specific software for each discipline. He however states that with technology evolving on a constant basis, there could be room for improvement as it is difficult to keep up to date with technology

7.5.2.2 Ranking of the 9 Dimensions

Table 7-17 presents the respondent's perceived implementation levels of the 9 dimensions of the maturity model and the importance attached to each dimension in improving organizational maturity rating.

Table 7-16: DoH Dimension Ranking

Dimension	Implementation level / Org readiness	Importance
Strategy	3	4
Leadership	4	5
Customers	3	3
Products	3	3
Operations	3	4
Culture	3	3
People	4	5
Governance	3	5
Technology	3	3
Mean Score	**3,22**	**3,89**

The results indicate that five out of the nine dimensions, namely, strategy, leadership, operations, people and governance, require improvement as the implementation scores < importance scores. On the other hand, the balance of the dimensions had the same implementation and importance scores all = 3. Interestingly, none of the dimensions had an implementation score = 5, which is indicative of dire need to improve on each of the nine dimensions, which would consequently result in overall improvements in the organizational readiness to implement the IDMS, hence improving the overall maturity index.

7.5.3 Department of Public Works

In response to being asked to provide possible explanations for the lowest ranked questionnaire aspects, Respondent Z's responses are shown in Table 7-18.

Table 7-17: Interview validation of the questionnaire survey

Dimension	Questionnaire lowest ranked items	Score	Interview explanation/s
Strategy	We strictly adhere to IDMS instruction manuals and toolkits such as the Gateway System and Infrastructure Delivery Management Toolkit	2,167	Respondent Z indicated that the low score attached to this aspect could be somewhat justified as some *"managers who oversee the implementation of the IDMS are not knowledgeable about its operations and processes and are not as supportive"*. This therefore implies that adherence to IDMS manual is not completely enforced
Leadership	Our enterprise has the necessary management competences and systems in place for IDMS implementation	2,167	Respondent Z advised that it ought to be noted that their *"organization employs individuals based on their experience, qualifications and merit". However some individuals in management capacity have no experience engaging the IDMS and have not attended any training, hence lacking to some extent in competences relating to IDMS implementation.*
Customers	We conduct research to profile customer infrastructure needs	2,833	Respondent Z disputes the low score attached to customer research. He indicated that, "*it must be noted that all projects that are undertaken by the Department are well planned and prepared for before execution. The planning entails conducting detailed customer research to establish which projects are needed and in which location"*. To avoid construction of projects that are not a necessity resulting in wastage of finances, research to conduct customer infrastructure needs is conducted.
Products	We ensure that our products/services are provided timeously and within budget	2,833	According to Respondent Z, "*meeting key project objectives is very crucial. We strive to deliver quality projects within the specified time and budget parameters, but however due to various other factors such as contractors issues, this is not always achievable".*
Operations	We have periodic and random quality checks to ensure procedures and processes are adhered to	2,333	Respondent Z advised that *"the Department strives to ensure that all the infrastructure projects they undertake and/or oversee are of the quality standards specified"*. Given how the Department prioritizes the aspects of quality, it therefore can be argued that periodic and random quality checks are periodically conducted.

Culture	Our organization conducts team building initiatives that boost morale of the employees	1,833	"*Admittedly, this is an area the Department could improve on",* as they have not been supporting team building initiatives advised Respondent Z.
People	We have the autonomy to work independently without constant supervision and management	2,833	Respondent Z indicated that he disputes the low score attached to this aspect. He further explained that the people employed by their organization possess the adequate skills and competences to perform their duties independently. However, the junior staff might require constant supervision as they might still require the exposure, guidance and mentorship from senior staff.
Governance	Our organization upholds and strictly adheres to governance principles Our organization conforms to and supports protection of intellectual property	4,167	Respondent Z advised that their organization generally upholds all aspects related to governance as they are subject to stringent audits as they utilize public funding.
Technology	We have current and future knowledge networks	2,000	It was indicated by respondent Z that the technology dimension in its entirety requires improvement and the department could do more to improve given the direction in which the world is taking, taking into consideration, items such as for example, Internet of Things

7.5.3.1 Ranking of the 9 Dimensions

Respondent Z was asked to rank the perceived implementation levels of the 9 dimensions of the maturity model and the importance attached to each dimension in improving organizational maturity, the results are as shown in Table 7-18.

Table 7-18: DPW Dimension Ranking

Dimension	Implementation level / Org readiness	Importance
Strategy	3	5
Leadership	3	5
Customers	3	4
Products	3	4
Operations	3	5
Culture	3	4
People	3	3
Governance	4	5
Technology	3	4
Mean Score	**3,11**	**4,33**

It is apparent from the results that the score attached to the implementation levels < the importance attached to these aspects. This implies that all the dimensions except the people dimension (89%) have been indicated to require improvement in implementation to enhance organizational readiness. Importantly, the dimensions that require the most improvement are the strategy, leadership and operations dimensions as the implementation levels are 2 points below the importance scores, in comparison to the balance with only a point difference.

7.5.4 Challenges affecting infrastructure delivery

Interviewees were asked to list infrastructure delivery challenges affecting their respective departments and their responses are tabulated in Table 7-19.

Table 7-19: Infrastructure challenges

DoE: Respondent X	**DoH: Respondent Y**	**DPW: Respondent Z**
• Lack of continuation between financial years - the biggest challenge was cited as getting momentum going between financial years.	• Component of infrastructure delivery having too much power and slowing the entire process - Supply chain management is heavily regulated and people are afraid to make decisions as it involves public funding, therefore delaying the entire process, consequently resulting in targets not being met and under expenditure.	• Budget Allocation shortfalls – the demand in infrastructure is greater than supply (available budget)
• Systems challenges – The department manages 6000+ schools but is working from spreadsheets instead of a webpage. The system is manual and decentralized	• Unplanned urgent requirements – In some instances, things are done in a hurry in response to urgent requirements, therefore making it difficult to apply the adequate processes and procedures	• Poor coordination between project teams
• Industry challenges – The department works with implementing agents who have their own challenges; the implementing agents in turn work with consultants & contractors who have their own challenges	• Industry / subcontracting challenges – subcontracting parties often have their own inherent challenges affecting them, such as cash-flow issues, which inadvertently affect the	• Industry challenges – these emanate from working with diverse industry participants each with their inherent challenges

	overall infrastructure delivery process	
• Business Forums such as "*Delangokubonas"* – these are disruptive on sites and consequently lead to, inter alia time and cost overruns	• Confusion & misinterpretation of documents - there is a lot of confusion that comes out in documents, some emanating from committees of engineers, architects, quantity surveyors, etc. which are so generic trying to address all organizations, e.g. Eskom, Transnet, etc. for all types of infrastructure projects	• Misunderstanding of contract documents sometimes resulting in disputes between project stakeholders
• Sabotage – the labour force of some contractors, both skilled and unskilled, retard progress to prolong their project duration, the longer the project the longer they are on the payroll. The respondent further elaborated that despite a no work no pay arrangement by most contractors, it is not practically easy to implement.	• Poor workmanship – which ultimately results in rework consequently leading to increased project durations	• Shoddy workmanship
• Poor workmanship by some contractors	• Lack of contactor capacity – some contractors have been	

	cited to lack the capacity and experience	
• Contractor inexperience and lack of capacity		
• Inadequate budget allocation to meet the demand and backlogs – According to Respondent X, the department requires R59 billion for the construction of new facilities not taking into account the maintenance of those existing. "*As a consequence, there is always a demand".*		
• Political interference – The projects priority list is often interfered with hence pushing some projects further down the list, "*leading to community demands for projects maybe because they have been waiting for their projects for years only to be pushed further down"*		

7.5.5 Chapter Summary

This chapter presented the results and their analysis thereof, including the discussion of the findings of the research. Before data analysis of the results commenced, the data was screened to identify and deal with responses with missing data, outliers and extreme values. The ranking of variables was undertaken and the ANOVA was performed to lead to the development of conclusions which provided a useful basis for the formulation of guidelines to improve organizational readiness to implement the IDMS. Qualitative analysis of semi-structured interviews was also conducted to validate the findings from the questionnaire survey.

It was found that all three departments had maturity on level 3, with the Department of Health demonstrating more maturity than the other two Departments. A maturity rating at level 3 implies that the organizations have defined and documented standard processes in relation to IDMS implementation, however these ought to be improved over time. This study further demonstrated that, out of the nine dimension of the IDMS, the leadership dimension carried more weight in relation to improving organizational maturity. This was demonstrated through the fact that the Department of Health which scored highest on the leadership dimension, had a greater overall organizational maturity when compared to the other two.

CHAPTER 8

GUIDELINES TO IMPROVE ORGANIZATIONAL READINESS TO IMPLEMENT THE IDMS

8.1 Introduction

The previous chapter presented intra and cross case analyses obtained from surveys and interviews, including calculations of public sector organizational maturity levels to implement the IDMS. However, this chapter seeks to provide guidelines for assessing and improving organizational maturity in relation to IDMS implementation. Furthermore, the nexus between study findings and extant literature, including the study's contributions to the body of knowledge are discussed hereunder.

8.2 Brief Background of Maturity Modelling

This study adopted a Maturity Model to assess organizational maturity which was comprised of nine (9) dimensions, each with associated maturity items grouped under their respective dimensions. The maturity model was then adapted to measure specific maturity on a 5-level scale as was required, and an example is shown in Table 8-2 which illustrates an overview of the dimensions and exemplary maturity items as extracted from this study.

Table 8-1: Dimension and Maturity Items of a Maturity Model

Dimension	Description
1. Strategy	Use of a road map for the planning of IDMS activities
2. Leadership	Senior/top management's commitment to implementation of the IDMS within the organization
3. Customers	Conduction of detailed customer identification and research
4. Products	Commitment to providing quality products and services
5. Operations / Processes	Availability of decentralized systems
6. Culture	Provision of an enabling environment which promotes knowledge sharing within the organization
7. People	Employment of individuals based on the merits of their qualifications and experience
8. Governance	Upholding and strict adheres to governance principles
9. Technology	Utilization of modern information and communications technology

8.2.1 Nexus Between Findings and Existing Theoretical Lenses

8.2.2 Infrastructure Delivery Challenges

Previous studies found that there were deficiencies in public infrastructure delivery systems and skills (Hagerman, 2012 Hexter and Mischke, 2013; Oyedele, 2016). These deficits in infrastructure delivery and installations plaguing South Africa have been widely reported. Historically, infrastructure was unfairly distributed, consequently resulting in huge service backlogs in mostly previously disadvantaged communities (Bolton 2006; SAICE, 2011; DPME, 2014). This has led the government to scale up expenditure in infrastructure, among other interventions. However, despite these interventions being put in place, tremendous infrastructure shortfalls and backlogs are still persistent. Additionally, OECD (2015) and Bhattacharya et al., (2014) reported that the public sector infrastructure delivery process is affected by time and cost overruns, which are evident in most projects.

This study confirms the huge infrastructural backlogs and the challenges associated with infrastructure delivery. The challenge of infrastructural backlogs is further exacerbated by the soaring unplanned settlements, mostly in the rural areas where the land is largely tribal land, thereby leaving a gap for the need for infrastructure and services such as schools and roads. In relation to the aspects of time and cost overruns, this study indicated that, although it is a priority for government departments to meet key project objectives, this is however not always the scenario due to numerous challenges they encounter.

8.2.3 Public Sector Organizations

The public sector is the largest owner and occupier of immovable assets, and given the long-life spans and large capital outlays associated with infrastructure assets, it is therefore crucial, for public sector entities to be adequately resourced and to possess a skilled and competent workforce that can adequately manage these assets (Yusof, 2013). However, South Africa's public sector has been widely reported as lacking capacity and expertise Thumbiran and Raphiri (2016), WCG (2010) and Koma & Kuye (2014), and therefore experiences difficulties with public infrastructure delivery and management, poor intergovernmental coordination processes, and weak management and accountability systems. Hagerman (2012) argued that public entities are the most affected by capacity deficiencies, largely as a result of, among other factors; the urgency in delivery of infrastructure projects with limited time to build capacity. In some instances, public entities are unaware of the extent and capacity of the infrastructure assets they possess and therefore cannot make appropriate maintenance plans.

On the contrary, this study found that public sector organizations are no-longer experiencing challenges with the lack of capacity and skilled professionals largely as a result of the resource capacitation programme. Generally, the departments are sitting at an average 80% occupancy rate.

8.2.4 IDMS Implementation

The IDMS was formulated mainly to address the need for improved and adequate quality infrastructure and to curb the various challenges affecting infrastructure delivery (CIDB, 2010). It is a standardized approach that describes and outlines all the processes of public sector infrastructure delivery and procurement management within the construction industry (CIDB, 2010 and WCG, 2010). It is a step by step guide which is comprised of a set of interrelating and interacting elements that establish processes which transform infrastructure inputs into outputs (WCG, 2012). The IDMS is to be implemented throughout a project's full life cycle, from the planning and concept stage right through to project disposal. As such, it has to be strictly adhered to and effectively implemented so as to realize its benefits of improving infrastructure delivery.

This study indicated that the IDMS is not being effectively utilized by public departments as some operational units are not familiar or aware of the processes within the IDMS. Additionally, the policy documentation for IDMS implementation is interpreted from various policy documents, such as, Toolkits, CIDB or National Treasury documents which can be onerous and confusing for some individuals, hence compromising effective utilization of the IDMS. Furthermore, these policy documents in some instances are not very well formulated and tend to be too generic, despite having excellent objectives further inhibiting successful infrastructure delivery through effective IDMS implementation. As such, to enhance affective IDMS implementation, these policy documents have to be reformulated, reinterpreted and measured into project procedures.

8.3 Guidelines to Efficiently Utilising a Maturity Model to Assess Organizational Readiness to Implement the IDMS

A step by step guide to providing guidance on improving IDMS implementation will be proposed and discussed under two stages, namely;

- Assessing organizational maturity to efficiently implement the IDMS – provision of maturity guidance indices
- How to improve IDMS implementation?

8.3.1 Assessing Organizational Readiness Maturity

Organizational maturity is assessed on a 5-level scale where Level 1 is the initial/adhoc level which is indicative of a regressive organization with a complete lack of attributes and Level 5 is indicative of an optimized organization with world class attributes. Measuring an organization's overall maturity level follows a four-step process of identification, measurement, calculation and presentation of findings as shown in figure 8-1.

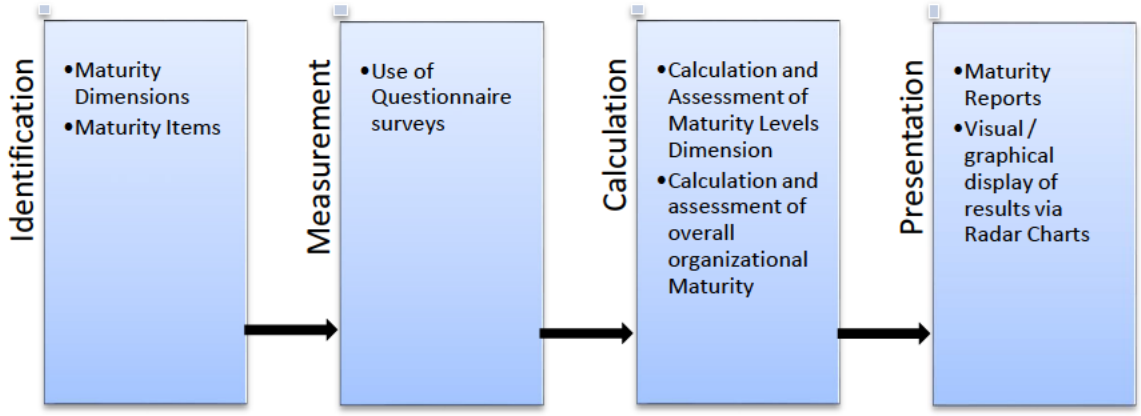

Figure 8-1 Process to assess organizational maturity

Once identification of the maturity dimensions is conducted, the next step would be to identify maturity items which fall under each dimension. Thereafter, a standardized closed ended questionnaire, with answers to be provided on a 5-point Likert scale, where 1 indicates a 20% level of implementation and 5 a 100% level of implementation. The next step would be to calculate the maturity level of each dimension by averaging the scores attached to the items under each dimension. The overall organizational maturity would then be calculated from the dimensional averages. The final step would be a representation and visualization of the maturity of the dimensions and overall organization maturity via charts, tables, graphs and radar charts as may be necessary.

8.3.2 How to Improve IDMS Implementation?

Once an organization's maturity has been assessed, it is crucial that the organization strives to improve on its implementation of the IDMS. This could be achieved in two ways; (i) by focusing on the low rated maturity items and dimensions and providing constant training on IDMS activities and (ii) enhancing dynamic organizational capabilities.

8.3.2.1 Through Focusing on Maturity Items and Dimensions

In pursuit of continuous organizational maturity improvement, it is imperative that the organization transitions from one level to the next. Table 8-2 proposes the steps and activities required to be undertaken in order to transition from one level to another.

Table 8-2: Key Transition Steps

Transition from	Requirements / steps
Level 1 to level 2	• Individuals involved in IDMS implementation possess the relevant educational qualifications • Induction in relation to IDMS implementation before commencing work • Strict adherence to IDMS best practice • Lessons learnt from prior IDMS implementation experiences discussed and shared across the organization • IDMS implementation training to be regularly conducted
Level 2 to level 3	• In-depth / advanced education specific to IDMS activities and implementation • Shared IDMS experiences within the organization through interaction, group sessions and in-house seminars • Determination of capability within the group and coordination of resources, organizational routines, and interactions within the organization to improve IDMS implementation • Technology support and improvements to enhance IDMS implementation • IDMS implementation training to be regularly conducted
Level 3 to level 4	• IDMS knowledge sharing seminars across the organization • Internal quality audits and reviews for consistency • Continual educational and professional development and support • Technology support and improvements to enhance IDMS implementation
Level 4 to level 5	• Process improvement and innovative processes • Continual research and development in improving the IDMS and its implementation • Timeous feedback and lessons learnt

Over and above the proposed key transition steps as shown on Table 8-2, the following activities are to be regularly conducted throughout all levels in order to improve organizational readiness to engage the IDMS;

- Capacity building in the areas of;
    i. Skills - namely technical, financial and people-oriented skills
    ii. Resources - namely training programmes and mentoring processes, and policies (particularly IDMS implementation)

iii. Decision making
iv. Administration and systems which include among other factors, policy and governance issues, procurement strategies, monitoring and evaluation, and feedback loops.

- Technology and IT support
- Team building initiatives
- Promotion of innovation and cross company collaboration

8.3.2.2 Improvement Plan: An Example

Practical examples, using extracts from this study were used to demonstrate on how organizations could improve their maturity in relation to IDMS implementation by focusing on the low rated aspects. This would be done through establishing short, medium and long-term improvement plans. For the purposes of this study, the following timeframes will be used:

- Short Term – < 1 year
- Medium Term – More than 1 year but less than 5 years
- Long Term – > 5 years

In order to achieve the long term plans, it is imperative that the short and medium term plans are adhered to. By using the DoE as an example, and taking into account the lowest ranked dimension, namely Culture, Table 8-3 presents the proposed improvement action plan for this aspect. This process can/should be followed for every aspect in the department and become a valuable tool to be used in the process of continuous improvement in implementing the IDMS.

Table 8-3: Improvement action plan

Specific Dimension	**Performance concern (Item with lowest maturity) / Maturity Level**	**Desired performance standard**	**Short term improvement action**	**Medium term improvement action**	**Long term improvement action**	**Review Information**	**Date to achieve desired maturity level**
Culture	Lack of periodic training regarding implementation of the IDMS Maturity level = 1.75	To have skilled individuals adequately trained in IDMS implementation Maturity level < 4.50	To ensure that there is allocation for periodic training, say once every 4 months	Monitoring of training schedules to ensure strict adherence	Adequate budget provision to cater for training sessions Continued monitoring for adherence to the scheduled training sessions	To be reviewed once every year where the maturity of the organization is to be assessed through a maturity model	A year from implementing periodic training schedule. Dimension maturity level is expected to improve following adherence to periodic training by the department

8.3.2.3 Enhancing Dynamic Organizational Capabilities

As discussed in Chapter 4, organizational capabilities enhance a firm's productivity and performance (Barney, 2002), therefore implying a direct improvement in IDMS implementation. When assessing the organization's performance, it is critical not only look at the organization from within, but take into account all other external factors which are subject to changing environments. The public sector has been reported as being mostly affected by poor management, performance and efficiency when compared to the private sector; and these poor attributes have been largely linked to poor dynamic organizational capabilities. Typically, improvements in infrastructure delivery could be realized through a dynamic capabilities' lens, hence the researcher's logic in proposing this route.

The need for public organizations to be dynamic in an ever changing environment is imperative for their effective operations and success, and this could be achieved through enhancing and ensuring strict adherence to the following.

- Co-operation and cross organization collaboration – to promote teamwork and to ensure every individual is aware of their role and that tasks are completed timeously. Co-operation and collaboration is essential in infrastructure delivery, particularly IDMS implementation as it involves and requires diverse individuals and their input, from different department.

- Excellent short-term results – short-term results can be used as a yard stick to measure whether objectives are being met. If an organization does not meet short term deliverables, it is nearly impossible to achieve the long term goals. As such, aspects such as audits on short term goals can be used as a tool to assess whether an organization is on track on achieving long term results.

- Structure which facilitates changes – in light of the dynamic environment in which organizations operate in, it is critical that public entities have structures in place that enable them to effectively deal with changes that might affect their effective operations. Change, whether at project, departmental, systems and/or organizational levels, is inevitable and therefore the organization must be structured in a way to effectively manage all changes.

- Ability of individuals to implement changes as necessary – all individuals involved in IDMS implementation ought to be trained and well equipped to implement any changes as may be encountered

- Team building initiatives – team building initiatives ought to be regularly undertaken to ensure employee morale is boosted which ultimately enhances productivity and performance.

- Regular Meetings - to ensure that everyone is up-to-date with all requirements and to address any risks and challenges that could be inhibiting effective IDMS implementation.

- Feedback - Effective feedback needs to be in place. This entails, among other factors; open and honest feedback and dialogue about those results, including discussions of lessons learnt.

8.4 Contributions of the Study

This study is the first of its kind that seeks to assess the maturity of South Africa's public sector to implement the IDMS. Establishing the maturity level of an organization is critical, because once assessed the areas in need of improvement will be highlighted, which is addressed would impact on improving the maturity of organizations to implement the IDMS. This study was also critical in establishing that prior to or accompanying the introduction of the IDMS to organizations, the level of maturity of an organization must be assessed. The instrument that was developed to measure an organization's maturity could prove to be a very important tool in identifying organizational weaknesses and in improving the level of maturity of the organization.

Furthermore, this study counters the argument that the government perceives the implementation of its tools, the IDMS in this case, to be effective upon launching/implementation. It is apparent that the

government has to do ensure that organizations are well equipped and are mature to an extent that ensures effectiveness in implementation of the tools before launching its tools.

This study provides practical guidelines which organizations can use to assess their readiness and maturity in relation to IDMS implementation. Furthermore, it is important to note that these guidelines can be adapted to measure the maturity of an organization in relation to other operations, processes and performances, and is not strictly applicable to the IDMS only. Assessing an organization's maturity level is critical to improving its overall performance as the organization will become aware of its weaknesses and therefore will have a starting point at working to improve in those areas.

Another contribution this study has made is that establishment of an organization's maturity level equips leadership with the right knowledge to make informed decisions, and this could help in formulating strategic plans and in fostering these organizations to effect necessary changes. Additionally, the organization can potentially relook at the organizational theories and management models they utilize, which in some instances could be hindering organizational success.

This study also provided a practical example of an improvement plan which organizations can adapt to address the challenges they are faced with. Furthermore, this study proposed ways of potentially improving an organization's maturity rating in two ways which can be performed concurrently.

- Upon assessing their organization's maturity level, organizations have to follow the required transition key steps to enhance transition from one level to the next. Following these guidelines will result in an organization to improve on its low rated items and therefore resulting in an improvement in the overall organizational rating.
- Secondly, organizations have to enhance their dynamic organization capabilities by following the proposed guidelines. When strict adherence to the aspects dynamic capabilities, an organization's effectiveness and improvements in performance, processes and productivity are achieved.

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

This research sought primarily to develop and validate a maturity model for assessing and improving public sector organizations' readiness for effective IDMS implementation. Upon model development and validation, the study assessed the maturity of provincial government departments in engaging with the extant IDMS and formulated evidence based interventions to improve delivery and management of infrastructure projects. This was conducted through the use of a maturity model, which was validated with a series of interviews. This chapter highlights the research questions and objectives, and summarizes the research's keys findings. Conclusions are then drawn based on the findings and recommendations for future research are made.

9.2 Research Questions and Aim

The key research question for this study was to establish "*What can be done to improve public sector infrastructure delivery?"* As such, this study aimed primarily to develop and validate a maturity model for assessing and improving public sector organization's readiness for effective IDMS implementation. The specific research questions were:

1. What are the contributions of the IDMS towards effective public infrastructure delivery in SA?
2. What is the state of readiness of public sector organizations to engage with effective implementation of the IDMS?
3. What are the factors influencing the state of organizational readiness observed?
4. How can the state of organizational readiness be improved upon to gain maturity?

9.3 Key Research Findings and Conclusions

The key findings and related summaries for each research question are discussed.

9.3.1.1 What are the Contributions of the IDMS Towards Effective Public Infrastructure Delivery in SA?

According to extant literature, the contributions of the IDMS to improved infrastructure delivery include but are not limited to:

- The IDMS provides a benchmark and guide for best practice delivery of infrastructure management (CIDB, 2010; Civilution, 2016)
- To facilitate improved infrastructure delivery and efficiency (Civilution, 2016; CIDB, 2018)

- To address the persistent challenges faced by government in attracting and retaining a competent and efficient skills base (Civilution, 2016)
- To improve planning and the management of construction works (Civilution, 2016)
- To enhance cost effectiveness and value for money on infrastructure projects (CIDB, 2010)
- To ensure the balance between the installation of new infrastructure and maintenance of the existing infrastructural projects (National Treasury, 2012)

9.3.1.2 Conclusion

The IDMS was formulated to address the need for improved and adequate quality infrastructure and to curb the various challenges affecting infrastructure delivery. It ought to be effectively utilized throughout all project phases which include the, "*planning, budgeting, procurement, delivery, maintenance, operation, monitoring and evaluation of infrastructure"* to achieve its effectiveness. According to CIDB (2010) and WCG (2010), it describes and outlines all the processes of public sector delivery and procurement management within the construction industry.

9.3.2 What is the State of Readiness of Public Sector Organizations to Engage with Effective Implementation of the IDMS?

9.3.2.1 Findings

Based on empirical evidence, the three departments' organizational readiness / maturity ratings in relation to IDMS implementation are as shown in Table 9-1:

Table 9-1: Departmental Maturity Ratings

Department	Organizational Maturity Rating
Education	3.077
Health	3.539
Public Works	3.003

Despite all three departments being on level 3, it is evident that the Department of Health is more mature than the other two Departments. Level 3 maturity rating implies that the organizations have defined and documented standard processes in relation to IDMS implementation which can be improved over time. These standard processes, if adhered to, provide a foundation for the establishment of consistency in overall performance within an organization.

9.3.2.2 Summary

A key feature of a maturity model as used in this study is to assess organizational maturity in IDMS implementation. Maturity models provide an indication of the process management strategies in place

and how these affect organizational capabilities and efficiency. The maturity rating equips organizations with the necessary developmental steps and changes required for them to progress to the next level of maturity. A very important aspect of a maturity model is that it is not so much about what level an organization is on, but rather, what items they ought to improve on. Bearing that in mind, it is imperative that each department, as a point of departure for maturity rating improvements, focuses on the low ranked dimensions and their related sub-items.

9.3.2.3 What are the Factors Influencing the State of Organizational Readiness Observed?

9.3.2.4 Findings

The critical success factors that influence the state of organizational readiness to implement the IDMS were obtained both from extant literature and empirical evidence.

Based on extant research, it was found that the IDMS aims at addressing four critical success factors, namely; the organization, organizational behaviour, people and human resource systems. These four critical success factors can be further expanded into nine factors which enhance the achievement of organizational readiness in IDMS utilization, and these according to Schumacher et al. (2016), include; people, leadership, governance, strategy, processes / operations, technology, products, culture and customers

Based on this study, it was found that although all the nine factors / dimensions are critical to influencing the state of organizational readiness, the leadership dimension carried more weight. This was demonstrated through the fact that the department which had the most maturity / implementation of the leadership dimension had a greater overall organizational maturity when compared to the other two.

9.3.2.5 Summary

It is imperative that in order to improve organizational readiness, the factors that influence maturity must be improved on. The pivotal role of upper management (leadership) is critical to enhancing organizational performance and hence it can be viewed as a driver of all other dimensions, where increased leadership maturity influences maturity of other dimensions. Similarly, committing to tackle any other dimension without leadership commitment could have a negative impact on the overall organizational maturity index as leadership should be the driving force for all initiatives.

9.3.3 How Can the State of Organizational Readiness Be Improved Upon to Gain Maturity?

9.3.3.1 Findings

Based on empirical evidence, the various ways in which the IDMS could be better implemented were listed as:

- To use the IDMS as a guide and then alter it to be project specific. Taking into account the uniqueness and complexities associated with each organization and project, there is need for adaptation of the standard model to align with organization and project specifics.
- To provide frequent training to all individuals who utilize the IDMS could better ease understanding and implementation of the IDMS

9.3.3.2 Summary

The IDMS was formulated mainly to address the need for improved and adequate quality infrastructure and to curb the various challenges affecting infrastructure delivery. It is used as a benchmark and guide to foster best practice in the delivery and management of infrastructure. It has been concluded that IDMS is the foundational element in the management of infrastructure delivery and maintenance and it has been cited as a strategic discipline that enhances the effective rollout of infrastructural installations and the management of those that already exist. It is against this background that better implementation of the IDMS is key to overall improvement in infrastructure delivery.

9.3.4 Conclusion

A maturity model is a tool that measures the effectiveness of an organization to achieve desired outcomes, and establishes the capabilities required to enhance improvement. Additionally, a maturity model assesses organizational capabilities and provides support for controlling and monitoring progress, as such, they can be used as a control measure to ensure that processes are consistently adhered to within an organization, hence fostering management excellence. The main objective of a maturity model is to drive process improvement within an organization through a process improvement approach which ensures organizations are adequately equipped with the necessary elements to effectively manage processes. In overall, a maturity model actually measures the level of maturity and provides indications of where weaknesses within an organization are situated. This enables the organization to focus its attention on improving these weaknesses. The model (tool) can be used periodically to audit performance and improvements in applying IDMS and infrastructure delivery improvement.

9.3.5 Limitations of the Study

The study limitations were;

- Small sample size as a result of the specialist or expert input required from the study participants. Only those individuals with vast experience and detailed knowledge of the IDMS had the capability to partake in the study, thereby significantly limiting the number of participants.

- The study was confined to KwaZulu- Natal only due to the short survey period for information gathering and data collection as stipulated for the doctoral study programme. This short survey period had an impact on the research findings considering that a vast number of infrastructural installations are delivered over long-time frames.

- The Covid-19 Pandemic greatly impacted the candidate on the undertaking of some key research processes mostly affecting the research methodology chapter. As a key limitation. some of the individuals who were identified as key to providing information in relation to IDMS implementation were not available to contact. Furthermore, data collection was negatively impacted as one of the tools for data collection were interviews, and the candidate was not afforded the opportunity to conduct face to face interviews but rather telephonic interviews only.

- Due to the sensitive nature of some of the challenges/bottlenecks inhibiting infrastructure delivery such as, mal-administration, fraud, nepotism and corruption, some of the survey participants were not keen on addressing questions related to these aspects.

9.3.6 Recommendations

Based on the study limitations and research findings, these are the proposed areas of future research.

- The study recommends that prior to or accompanying the government launch of tools to be utilized by public organizations, it is critical that it ensures that organizations are well equipped and are mature to implement that tool so as to ensure its effective utilization.
- Furthermore, the study recommends that organizations should measure their maturity at least once or twice a year to establish their maturity rating, and to determine where their weaknesses as organizations lie.
- Organizations could frequently employ maturity models as a means to track their improvement progress to foster their maturity

- Furthermore, a similar and broader study can be undertaken, albeit, on a national level so as to compare the maturity of public entities throughout the country and to establish provincial differences. Once the maturity level of each public entity is assessed and the weakness pointed out, each entity would then work on improving on those aspects, which would lead to improvements in overall readiness to implement the IDMS consequently resulting in overall national infrastructure delivery improvements. Additionally, the entities with lower maturity ratings could adopt some processes and possibly learn from those that are more mature.
- Future studies could also explore alternative ways in which improvements in infrastructure can be afforded other than through the IDMS lens only.
- Based on limitations due to limited questionnaire responses and sampling, future studies could employ web-based instruments or online surveys which are easily accessible to respondents as a means to boost the response rate. Additionally, future studies could also employ a sampling strategy that ensures that a more representative sample is utilized.

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APPENDICES

Appendix 1 - Informed Consent: Research Introduction Letter

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

PROJECT TITLE: IMPROVED INFRASTRUCTURE DELIVERY AND MANAGEMENT MODELS

Information Sheet and Consent to Participate in Research

Thursday, 12 September, 2019

To whom it may Concern

My name is **Progress S. Chigangacha**, Student no. 216073498, a PhD student, in the School of Engineering, Property Development Program at the University of KwaZulu Natal.

You are invited to voluntarily participate in a research project entitled: Improved Infrastructure Delivery and Management Models**.** The study aims to investigate the level of maturity of provincial government departments of Education, Health and Public Works, to be able to implement IDMS effectively and successfully and to achieve the development of a framework/mechanism for facilitating optimal engagement by municipalities with the extant IDMS to engender successful delivery of infrastructure assets and associated services to their beneficiaries.

The study is expected to enroll 30 participants in total, to take part in a maturity modeling structured questionnaire survey. The duration of your participation if you choose to enroll and remain in the study is expected to be about 10 (ten) minutes. No costs will be incurred by you as a result of participation in the study. The study is funded by the National Research Fund (NRF).

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee **(approval number HSS/0395/019D).**

In the event of any problems or concerns/questions you may contact the researcher at (provide contact details) or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

I guarantee your anonymity in that your responses will not be identified or linked with you personally. No identifiers or personal information will be recorded on any research instrument. All data collected will be aggregated to ensure that anonymity and confidentiality are achieved. Your participation is completely voluntary and there is no penalty if you do not wish to participate in the study, and you may withdraw participation at any point. In the event of refusal/withdrawal of participation, you will not incur penalty or loss of treatment or other benefit to which you are normally entitled. Should you wish to receive a summary of the key findings of the study, may you provide your contact information for that purpose only.

DECLARATION OF CONSENT

I …… have been informed about the study entitled Improved Infrastructure Delivery and Management Models by Ms. P. S. Chigangacha.

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher on 084 031 9175.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 - Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Please sign on the dotted line to show that you have read and understood the contents of this letter.

_____ _____

Signature of Participant **Date**

Appendix 2 – Maturity Model Questionnaire for IDMS Implementation

1. Number of years engaging with the IDMS

2. Department

DoE DoH DPW

3. Career Level

Entry level (operational unit) Mid-career (operational unit) Management/leadership

Indicate your rating of IDMS implementation by your organization with the following statements based on your experience on a Likert scale of 1 - not implemented to 5 - fully implemented. Put an **"X"** in the box that indicates your answer.

NO	DIMENSION	ITEM NO	EXTERNAL QUESTION	1	2	3	4	5
1	**STRATEGY**	1.1	We use a road map for the planning of IDMS activities in our enterprise					
		1.2	We have clearly defined core knowledge, skills and abilities to be possessed by employees					
		1.3	We allocate sufficient resources for the realization of IDMS activities					
		1.4	We have adapted our business models to accommodate IDMS objectives					
		1.5	We strictly adhere to IDMS instruction manuals and toolkits such as the Gateway System and Infrastructure Delivery Management Toolkit					
		1.6	We have structures in place that ensure workers undergo general induction before commencing work					
		1.7	Our organization employs technically skilled operational units with the appropriate competencies and skills base					
2	**LEADERSHIP**	2.1	Our senior/top management are committed to implementation of the IDMS in our enterprise					
		2.2	Our enterprise has the necessary management competences and systems in place for IDMS implementation					
		2.3	We have centrally co-ordinated systems in place for IDMS activities					
		2.4	Each system of the IDMS has at least one qualified manager who has the requisite training to oversee their respective departments					
		2.5	Our senior/top management encourage and support worker participation, commitment and involvement					
		2.6	We have skilled leadership which leads by example					
3	**CUSTOMERS**	3.1	We conduct detailed customer identification					
		3.2	We conduct research to profile customer infrastructure needs					
		3.3	We are responsive to customer needs					
		3.4	We utilize customer data to provide services as per need					
		3.5	We are committed to improved customer service to ensure customer satisfaction					

		3.6	We digitalize our services					
4	**PRODUCTS**	4.1	We are commited to providing quality products and services					
		4.2	We are commited to ensuring continual product/service quality improvement					
		4.3	We ensure that our products/services are provided timeously and within budget					
		4.4	We ensure that our products/services are accessible to the customers they serve					
		4.5	We ensure that our products/services are affordable					
		4.6	We ensure that our products/services are adequate					
		4.7	We ensure that our products/services are produced to cater for population growth					
		4.8	We are sensitive to the impact our products/services have on sustainable development goals					
5	**OPERATIONS**	5.1	We have decentralized operations and processes					
		5.2	We have interdisciplinary and interdepartmental collaboration					
		5.3	We have periodic and random quality checks to ensure procedures and processes are adhered to					
		5.4	Our organization conducts regular audits to ensure that the quality management system is adhered to					
		5.5	We have performance evaluation structures in place					
6	**CULTURE**	6.1	Our organization provides an enabling environment which promotes knowledge sharing					
		6.2	Our organization promotes innovation and cross company collaboration					
		6.3	Our organization recognizes and rewards outstanding behaviour and achievements					
		6.4	Our organization conducts team building initiatives that boost morale of the employees					
		6.5	There is provision of periodic training regarding implementation of the IDMS through seminars and workshops					
7	**PEOPLE**	7.1	Our organization employs people based on the merits of their qualifications					
		7.2	We possess the adequate technical skills and competences to effectively perform IDMS activities					
		7.3	We have the autonomy to work independently without constant supervision and management					
		7.4	We are commited to continual professional development					
		7.5	We are trustworthy and honest					
8	**GOVERNANCE**	8.1	Our organization upholds and strictly adheres to governance principles					
		8.2	Our organization complies with employment policies and labour regulations					
		8.3	Our organization conforms to and supports protection of intellectual property					
		8.4	We have disciplinary measures in place to deal with any issues of misconduct and bad governance					

9	**TECHNOLOGY**	9.1	Our organization utilizes modern information and communications technology					
		9.2	Our organization has provision of correct tools, equipment and resources to implement the IDMS					
		9.3	We possess infrastructure which facilitates efficiency in the implementation of the IDMS					
		9.4	We have current and future knowledge networks					
		9.5	Our infrastructure necessitates adequate free flow of information among all employees					
		9.6	We are open to new technologies					

Appendix 3 - Interview Schedule: Infrastructure Delivery Management System (IDMS) Implementation Maturity

Strategy

1. What are the bottlenecks/challenges faced by your organization in the delivery of infrastructure?
2. How are these challenges being addressed?
3. What is your level of satisfaction regarding IDMS implementation?
4. Do you think if implemented correctly, the IDMS can enhance successful infrastructure delivery? Why?

Leadership

5. Would you say Senior Management / Leadership is committed to IDMS implementation? How so?
6. To what extent do you think having senior management that possesses the skills and expertise to support IDMS implementation affects its implementation?

Customers / End users

7. Do you have a profile of who your clients are and what their needs are?
8. Would you say your organization is committed to ensuring customer satisfaction of your products/services? How?

Products

9. Are your products/services affordable to your end users?

Operations

10. In relation to IDMS implementation, in particular the overlap between the different systems, how do different departments interact?
11. Do you have interdepartmental collaboration?
12. How frequent are audit checks conducted? Are these done at random?

Culture

13. Do you think training in IDMS is a requisite for all those engaging with the IDMS?
14. Does your organization offer training facilities pertaining to IDMS implementation?
15. Welfare and job satisfaction of employees? What structures are put in place to boost morale and uphold employee rights?

People

16. Does your organization have sufficient resources to optimally engage the IDMS? In terms of Capacity, Skills base?
17. Do those employed by your organization, particularly those engaging in IDMS implementation, have the right qualification. i.e., do they possess at least a diploma related to the job profile?

Governance

18. Would you say your organization strictly upholds governance issues, how?
19. Have you witnessed any issues of maladministration and/or poor governance, (such as corruption, fraud, nepotism, etc), kindly name them. Did you report?
20. Are there measures in place to deal with issues of lack of governance and mal-administration?

Technology

21. Taking into account the 4th industrial revolution, would you say your organization is dynamic and would you consider your organization's technology to be up to date?
22. Is your infrastructure/resources adequate for IDMS implementation?

Appendix 4 – Full Ethical Clearance Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

11 September 2019

Ms Progress Shingai Chigangacha (216073498)
School of Engineering
Pietermaritzburg Campus

Dear Ms Chigangacha,

Protocol reference number: HSS/0395/019D
Project title: Improved Infrastructure Delivery and Management Models

Approval Notification-Expedited Application

In response to your application received on 29 April 2019, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study must be reviewed and approved through the amendment /modification prior to its implementation. Please quote the above reference number for all queries relating to this study.

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

[redacted]

.....
Dr Rosemary Sibanda (Chair)

/dd

Cc Supervisor: Prof C Haupt and Dr B Awuzie
cc Academic Leader Research: Professor Akshay Saha
cc School Administrator: Ms N Dlamini

Humanities & Social Sciences Research Ethics Committee
Dr Rosemary Sibanda (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Appendix 5– Sample Gate Keeper Application Letter

Name: **Progress S. Chigangacha**

Student No.: **216073498**

Research Topic: **Improved Infrastructure Delivery and Management Models**

Thursday, 20 June 2019

To whom it may concern,

Re: Gatekeeper's Letter – Permission to Conduct Research as Part of the Doctor of Philosophy Degree in Construction Management

I am writing to request your assistance in facilitating my research study through recruitment of participants from your organisation. The study aims to investigate the challenges/bottlenecks affecting infrastructure delivery and to achieve the development of a framework/mechanism for facilitating optimal engagement by public entities with the extant IDMS to engender successful delivery of infrastructure assets and associated services to their beneficiaries.

I have attached a copy of my questionnaire template for your information. The gatekeeper's role is simply one of distributing information and to ensure that interested participants should contact the researcher directly, not the gatekeeper. Additionally, the gatekeeper being an expert in the field under study will provide invaluable input to the study.

Participation in the study is voluntary, and the duration of the respondents' participation if they choose to enroll and remain in the study is expected to be about 10 (ten) minutes. No costs will be incurred by the respondents as a result of participation in the study. Furthermore, I guarantee the respondents' anonymity and confidentiality.

If you grant permission for the candidate to gather data from you and your organization, the University of KwaZulu- Natal requires that this permission is given in writing on a letterhead and signed by the relevant authority.

I hope that you find the research study of interest and will be interested in working with me on it. Please feel free to contact me if you have any queries. Alternatively, you may wish to contact my supervisors, if you would like a reference or other information.

RESEARCHER

Full Name: PROGRESS S CHIGANGACHA
School: SCHOOL OF ENGINEERING, PROP. DEV.
College: AGRI, ENGI & SCIENCE
Campus:HOWARD COLLEGE
University: UKZN
Proposed Qualification: PhD Construction Management
Contact: 078 869 7119
Email: pschigangacha@gmail.com

SUPERVISOR

Full Name of Supervisor: PROF. THEO HAUPT
School: SCHOOL OF ENGINEERING, PROP. DEV.
College: AGRI, ENGI & SCIENCE
Campus: HOWARD COLLEGE
University: UKZN
Contact details: 031 260 2712
Email: haupt@ukzn.co.za

CO-SUPERVISOR
Full Name: DR. B O AWUZIE
Department: BUILT ENVIRONMENT
College: ENGINEERING AND INFORMATION TECHNOLOGY
University: CENTRAL UNIVERSITY OF TECHNOLOGY (CUT)
Contact: 051 507 3532
Email:bawuzie@cut.ac.za

Many thanks for your assistance in this regard.

Yours sincerely.

Progress S. Chigangacha
pschigangacha@gmail.com

THANK YOU

Appendix 6 – Support Letter by the Department of Health

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:
Infrastructure Development

Physical Address: TownHill office park , 35 Hyslop road, Pietermaritzburg 3200
Postal Address: Private Bag X 9051, Pietermaritzburg 3201
Tel: 033 940 2505 Email: Zamabovu.ngubane@kznhealth.gov.za
www.kznhealth.gov.za

Enquiries : Mr. Mhlongo
Telephone : 033 940 2512

Progress S. Chigangacha – PhD Candidate: UKZN School of Engineering
9 Jung Crescent
Padfield Park
New Germany
3610

RE: SUPPORT FOR RESEARCH STUDY ON "IMPROVED INFRASTRUCTURE DELIVERY AND MANAGEMENT MODELS"

I have pleasure in informing you that I support your conduct of the research study entitled "Improved Infrastructure Delivery and Management Models"

Please note the following:

1. Please ensure that you adhere to all the policies, procedures, protocols and guidelines of the Department of Health with regards to this research.
2. This research will only commence once this office has received confirmation from the Provincial Health Research Committee in the KZN Department of Health.
3. Please ensure this office is informed before you commence your research.
4. The District Office/Facility will not provide any resources for this research.
5. You will be expected to provide feedback on your findings to the District Office/Facility.

Thanking you.

Sincerely

[redacted]

MR MHLONGO
ACTING CHIEF DIRECTOR
INFRASTRUCTURE DEVELOPMENT
DATE 28/10/2019

Fighting Disease, Fighting Poverty, Giving Hope

Appendix 7 – Research Approval Letter: Department of Health

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Physical Address: 330 Langalibalele Street, Pietermaritzburg
Postal Address: Private Bag X9051
Tel: 033 395 2805/ 3186/ 3123 Fax: 033 394 5782
Email:
www.kznhealth.gov.za

DIRECTORATE:
Health Research & Knowledge Management

NHRD Ref No.: KZ_201910_015

Dear Ms PS Chigangacha
UKZN

Approval of research

1. The research proposal titled **'Improved infrastructure delivery and management models'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken among managers involved in implementation of Infrastructure Delivery Management Systems (IDMS) activities in the department.

2. You are requested to take note of the following:
   a. Kindly liaise with the facility manager BEFORE your research begins in order to ensure that conditions in the facility are conducive to the conduct of your research. These include, but are not limited to, an assurance that the numbers of patients attending the facility are sufficient to support your sample size requirements, and that the space and physical infrastructure of the facility can accommodate the research team and any additional equipment required for the research.
   b. Please ensure that you provide your letter of ethics re-certification to this unit, when the current approval expires.
   c. Provide an interim progress report and final report (electronic and hard copies) when your research is complete to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

[redacted]

Dr E Lutge

Chairperson, Health Research Committee

Date: 31/10/19

Fighting Disease, Fighting Poverty, Giving Hope

Appendix 8 – Research Approval Letter: Department of Public Works

public works
Department:
Public Works
PROVINCE OF KWAZULU-NATAL

Directorate: Corporate Services
Private Bag X9041
PIETERMARITZBURG
3200
Tel: 033-260 4089
Enquiries: PW Duma
Email: phiwayo.duma@kznworks.gov.za

Progress S. Chigangacha
Howard Collage
UKZN

Dear P.S Chigangacha

RE: PERMISSION TO CONDUCT RESEARCH

I do hereby grant Progress S. Chigangacha, student number 216073498, permission to gather data specific to the area under study as detailed out in her Gatekeeper's Permission request letter from me and within our organization.

Yours Sincerely,

SUPPORTED/ ~~NOT SUPPORTED~~

[redacted]

DEPUTY DIRECTOR-GENERAL: CORPORATE SERVICES
DATE: 2021/02/08

APPROVED/ ~~NOT APPROVED~~

[redacted]

DR. G.G. SHARPLEY
HEAD OF DEPARTMENT
DATE: 08/02/2021