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EXAMINING THE MATURITY OF SOUTH AFRICA'S GOVERNMENT DEPARTMENTS TO IMPLEMENT THE INFRASTRUCTURE DELIVERY MANAGEMENT SYSTEM (IDMS)

RESEARCH ARTICLE[1]

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ABSTRACT

The purpose of this exploratory study is to examine the maturity of South Africa's provincial government departments in engaging with the Infrastructure Delivery Management System (IDMS) towards facilitating effective infrastructure delivery. Furthermore, the study sought to formulate evidence-based interventions that could be utilised by these government departments to engender successful delivery of infrastructure assets and associated services to their beneficiaries. This research was descriptive and employed the quantitative research approach. Data was elicited from three provincial government departments in KwaZulu-Natal, South Africa. Structured maturity modelling questionnaires were deployed for data collection from the respondents. The emergent data was analysed using the *Statistical Package for the Social Sciences* (SPSS), Version 26. A One-Way ANOVA, aimed at enabling a comparative analysis of differences in the degree of maturity between

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the three provincial government departments that utilise the IDMS, was conducted. Results from the study indicate that the three departments (cases) had a maturity rating between 3 and 4, signifying well-defined and documented standard processes that can be improved over time. However, an IDMS-ready organisation would ideally have a maturity rating at level 5. In addition, the leadership dimension was found to be a driver of all other dimensions, where a high maturity level under this dimension directly correlates with improved maturity in the other dimensions. It is recommended that adequate management and leadership support is needed to improve organisational maturity in relation to IDMS implementation. The study was confined to KwaZulu-Natal, due to the short survey period for information gathering and data collection. The COVID-19 pandemic also had a great impact on the undertaking of some key research processes mostly affecting the research methodology, particularly during data collection. This study is the first of its kind in South Africa to assess the maturity of provincial government departments to implement the IDMS, which is indicative of an evaluation void gap.

ABSTRAK

Die doel van hierdie verkennende studie is om die volwassenheid van die provinsiale regeringsdepartemente in Suid-Afrika te ondersoek deur met die infrastruktuurleweringsbestuurstelsel (IDMS) in verbinding te tree om effektiewe infrastruktuurlewering te vergemaklik. Verder wou die studie bewysgebaseerde intervensies formuleer wat deur hierdie regeringsdepartemente gebruik kan word om ’n suksesvolle aflewering van infrastruktuurbates en verwante dienste aan hul begunstigdes te verseker. Hierdie beskrywende navorsing maak gebruik van die kwantitatiewe navorsingsbenadering. Data is verkry uit drie provinsiale regeringsdepartemente in KwaZulu-Natal, Suid-Afrika. Gestruktureerde volwassenheidsmodelle-vraelyste is ontplooi vir data-insameling vanaf die respondente. Die opkomende data is ontleed met behulp van die *Statistical Package for the Social Sciences* (SPSS), Weergawe 26. ’n Eenrigting ANOVA is gebruik, om ’n vergelykende ontleding van die verskille in die mate van volwassenheid tussen die drie provinsiale staatsdepartemente wat die IDMS gebruik, moontlik te maak. Resultate uit die studie dui aan dat die drie departemente (gevalle) ’n volwassenheidsgraad tussen 3 en 4 gehad het, wat goed gedefinieerde en gedokumenteerde standaardprosesse aandui wat mettertyd verbeter kan word. ’n Organisasie wat gereed is vir IDMS het egter ideaal ’n volwassenheidsgraad op vlak 5. Die leierskapdimensie was ook ’n drywer van alle ander dimensies, waar ’n hoë volwassenheidsvlak onder hierdie dimensie direk korreleer met verbeterde volwassenheid in die ander dimensies. Dit word aanbeveel dat voldoende bestuurs- en leierskapsteun nodig is om organisatoriese volwassenheid ten opsigte van IDMS-implementering te verbeter. Die studie was beperk tot KwaZulu-Natal weens die kort opnametydperk vir die versameling van inligting en die insameling van data. Boonop het die COVID-19-pandemie ’n groot impak gehad op die uitvoering van enkele belangrike navorsingsprosesse wat meestal die navorsingsmetodologie beïnvloed het, veral tydens die insameling van data. Hierdie studie is die eerste in sy soort in Suid-Afrika wat die volwassenheid van provinsiale regeringsdepartemente beoordeel het om die IDMS te implementeer, wat ’n teken is van ’n leemte in die evaluering.

Sleutelwoorde: Afleweringbestuurstelsel vir infrastruktuur, openbare sektor, organisatoriese gereedheid, organisatoriese volwassenheid, Suid-Afrika

1. INTRODUCTION

Infrastructure has been described as an enabler of business growth and productivity (Quarterly Bulletin, 2012: 1; OECD, 2015: 1). Its contribution towards the actualisation of most of the sustainable development goals (SDGs) resonates in extant literature (Fasoranti, 2012: 513; Mahamadu, Manu, Booth, Olomolaiye, Coker, Ibrahim & Lamond, 2018: 2-24; Manu, Asiedu, Mahamadu, Olomolaiye, Booth, Manu, Ajayi & Agyekum, 2021). In addition, such contributions are known to extend to the achievement of goals associated with national development plans of successive governments across the globe. The attainment of these goals culminates in improved levels of economic growth, national competitiveness, and citizen well-being (Watermeyer 2018: 1; OECD, 2015: 1; Australian Government, Department of Infrastructure and Transport, 2012; Calderon & Serven, 2004: 2). The importance of adequate infrastructure is further demonstrated in its ability to impact on the well-being of individuals, as it affects several key functional societal elements such as the adequate provision of transport, electricity and water supplies, telecommunications, schools, and hospital infrastructure (OECD, 2015: 1; Quarterly Bulletin, 2012: 4).

The need to capacitate public sector organisations to enhance successful infrastructure delivery has assumed a frontline position in contemporary infrastructure delivery discourse, globally over the past two decades (Malete & Khatleli, 2019: 133; Thumbiran & Raphiri, 2016: 4). Organisations such as the UK's Infrastructure and Projects Authority and the Infrastructure Client Group have played significant roles in proposing guidelines for assisting infrastructure client organisations in improving their infrastructure procurement capabilities (ICE, 2021). In Australia, individual agencies and scholars are publishing and adopting their own guidelines, in some instances with hardly any or no coordination by government. This led to the publication of guidelines such as the Project Initiation Routemap (IPA, 2016), the ICE's Intelligent Client Capability Framework (Madter & Bower, 2015: 6-7), and the RICS Informed Infrastructure Client guidance document (RICS, 2015: 1-25).

Within the South African infrastructure procurement landscape, the Infrastructure Delivery Management System (IDMS) serves as a predominant guide for public sector organisations seeking to procure infrastructure assets and associated services (National Treasury, 2012: 3). In addition, a client guide for improving infrastructure project outcomes has also been proposed to support infrastructure clients within the South African context (Watermeyer, 2018). In as much as these guidelines are expected to guide clients towards effective infrastructure delivery, impediments to efficient infrastructure delivery persist, due to a seeming lack of capacity in public sector organisations to implement the IDMS. This much is confirmed

by Thumbiran and Raphiri (2016: 4), who maintain that improper and/or lack of utilisation of the IDMS could be the cause of the underwhelming public sector infrastructure procurement performance. This study is prompted by this observation. Accordingly, this study seeks to assess the maturity of public sector infrastructure client organisations within the South African context to engage with the IDMS in the required manner, in order to achieve optimal infrastructure procurement. Furthermore, this study stems from the central proposition that poor interpretation and implementation of the IDMS by these organisations can lead to poor procurement performance. The lack of studies into this aspect has been observed, hence rendering this study imperative.

2. LITERATURE REVIEW

2.1 Nexus between infrastructure and national economic growth

Fourie (2006: 531) defines infrastructure in terms of "capitalness" and "publicness", with the former taking into account the degree of capital intensity, comprising of capital-intensive facilities, and the latter tackling the: social significance of infrastructure. An alternative definition of infrastructure reads "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" (OECD, 2015: 2). On the other hand, Khumalo, Choga and Munapo (2017: 38) define infrastructure as a "set of facilities and systems that are necessary for a community to function". Gaal and Afrah (2017: 49) opine that infrastructure is the basic equipment and structures which are prerequisites for a country, region, or organisation to function properly. In the vast majority of the developing nations, the paucity of basic infrastructure has hampered economic progress and national competitiveness (Kodongo & Ojah, 2016: 105; Oxford Analytica, 2017: 3; Wethal, 2019: 2-3).

The correlation between infrastructure and national economic growth, as well as the interest in this area has long been a subject of research (Palei, 2015: 169-170; OECD, 2015: 2-4; Seadi, 2012: 1; Kim, 2006: 1; Agénor, 2010: 933). As far back as 1989, researchers such as Aschauer have sought to quantify the impact of infrastructure assets on economic growth. The effects of infrastructure productivity have been studied using economic models (Lakshmanan, 2011: 1-12). In some instances, behavioural approaches have been used to calculate the impact of infrastructure on national growth (Chatterjee & Mahbub Morshed, 2011: 1288-1306). Irrespective of the methods used, there appears to be consensus that

infrastructure stimulates economic growth (Seidu, Young, Robinson & Ryan 2020: 225; Calderon & Serven, 2004: 1). Aschauer (1989), cited in Ramirez and Esfahani (1999: 1), observed a dip in economic growth rates following a reduction in investment. Furthermore, the International Monetary Fund (IMF) (2014) reported that one percentage point in infrastructure investment in relation to GDP results in long-term gain outputs averaging 1% to 5%. Seadi (2012: 1-2) went further to posit that infrastructure is crucial for the achievement of a country's development plans and economic goals, as it drives production processes across all economic facets. Despite the added benefits of infrastructure investment, the choice of investment must be carefully planned to ensure that infrastructure does not outweigh demand, as overinvestment can prove to be counterproductive (Seidu *et al*., 2020: 219-220). The fact that infrastructure impacts on productivity and national growth can be substantiated from different angles, some of which have been summarised as:

- Trade, as a significant contributor of economic and national development, is largely dependent on the availability of adequate infrastructure (Calderon & Serven, 2004: 1; Watermeyer & Phillips, 2020: 2).
- Many governments have used infrastructure as a driver for economic growth through job creation, as they resort to funding labour-intensive infrastructural projects, especially during times of recession (Quarterly Bulletin, 2012: 1; Watermeyer, 2018: 1).
- In some instances, infrastructure yields high rates of return on investment, leading to increased national income and overall national growth (Quarterly Bulletin, 2012: 1; Watermeyer, 2018: 1).
- Infrastructure has also been a key factor in the integration and augmentation of markets and industries such as linking citizens to economic hubs through transport infrastructure, hence boosting economic activity (WEF, 2012: 2; Watermeyer, 2018: 1).
- Transport infrastructure reduces time lost in traffic and the impact of distance, leading to greater productivity (Watermeyer, 2018: 1).
- Telecommunications infrastructure allows for speedy flow of information, which is a requisite for business operations (Watermeyer, 2018: 1).
- Electricity and water infrastructure is important for a well-functioning society and business operations (Watermeyer, 2018: 1).

2.2 Infrastructure delivery

There is persuasive evidence that infrastructure is an indispensable panacea to the challenges faced in most of the developing countries including South Africa, as it stimulates a robust and growing economic market (Malete & Khatleli, 2019: 129; Policy Brief, 2015: 3). Some of these challenges include, *inter alia*, poverty, huge public service delivery backlogs, and job deficiencies. As such, various scholars have argued for the improved ease of public access to infrastructure as a means of contributing to a reduction in income inequality prevalent in the vast majority of countries (Estache 2003; Zolfaghari, Kabiri & Saadatmanesh, 2020: 1147; Medeiros & Ribeiro, 2020). Consequently, South Africa has increased its expenditure on infrastructure development and improvement, in order to support its economic growth and development plans in a bid to reduce poverty and inequality, whilst addressing infrastructure backlogs and shortages (National Treasury, 2017: 3). According to Watermeyer and Phillips (2020: 1), the South African National Development Plan 2030 had set a public infrastructure investment target of 10% of the gross domestic product (GDP). Such ambitious targets are not peculiar to South Africa, as countries situated across the developed and developing world contexts have set similar targets. Corroborating this trend, Serebrisky, Suárez-Alemán, Pastor and Wohlhueter (2017: 8) confirmed that infrastructure investments as a proportion of GDP stood at 8.5% in China, 5% in India and Japan, and 4% in Australia, Canada and South Korea, respectively.

Despite the increased construction spend to alleviate the infrastructure deficit being experienced in South Africa, a considerable infrastructure gap persists (Malete & Khatleli, 2019: 129; Policy Brief, 2015: 2; Watermeyer & Phillips, 2020: 2). Notably, the challenges impacting on efficient infrastructure delivery cannot be exclusively attributed only to funding challenges but also to institutional failures and a lack of requisite capacity within the public sector (Rwelamila, 2007: 56-57; National Treasury, 2012; Khumalo *et al.*, 2017: 35; Laryea, 2019: 618; Watermeyer, 2018; Watermeyer & Phillips, 2020: 6). The lack of organisational/institutional capacity within public sector organisations to engage in effective infrastructure procurement appears commonplace in the literature (Brook, 2021: 6; Khumalo *et al*., 2017: 35; Mahamadu *et al*., 2018: 3; Awuzie & McDermott, 2019; Laryea, 2019: 618; Watermeyer & Phillips, 2020: 6; Manu *et al*. 2021: 4). Various scholars admit to the criticality of institutional/organisational procurement capacity of public sector organisations in engendering the actualisation of procurement objectives associated with the commissioning of infrastructure projects. Relying on quantitative data gathered from 590 respondents in Nigeria and Ghana, Manu *et al.* (2021: 17) established that certain procurement capabilities contributed to the attainment of more procurement objectives

when compared to other capabilities. Similarly, Winch and Leiringer (2016) postulated the potential of the 'strong owner' infrastructure client to bring about positive project delivery performance based on inherent capabilities. This resulted in the development of the 'owner project capabilities' based on the dynamic capabilities theoretical lens. Awuzie, Farag and McDermott (2017) corroborate this through the findings of their investigation into the influence of client attributes on successful social value implementation during infrastructure procurement. Lindblad and Gustavsson (2021) reiterate the ability of public sector clients to foster a change in working practices within the construction industry using a BIM exemplar. However, the ability to achieve this will be predicated on the procurement capabilities inherent in such organisations. Based on the foregoing, the contribution of properly capacitated public sector organisations to successful infrastructure procurement cannot be overemphasised (Watermeyer, 2018: 2).

2.3 Infrastructure Delivery Management System (IDMS)

The IDMS is a brainchild of the South African Government, in collaboration with the National Treasury, the Department of Public Works (DPW), the Construction Industry Development Board (CIDB), and the Development Bank of Southern Africa (DBSA) (CIDB, 2010: 9). 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 can be summarised as providing a benchmark through fostering best practice; fostering improvement in the delivery of infrastructure; addressing skills deficiencies; ensuring a balance in infrastructural roll outs; enhancing cost effectiveness, and improving infrastructure planning (Malete & Khatleli; 2020: 130; Civilution, 2016: 2-3; National Treasury, 2012; WCG, 2012: 3).

This strategic guideline consists of a sequence of interrelated activities responsible for the transformation of infrastructural inputs into outputs (WCG, 2012: 2). Value placed on the IDMS is embedded in its strategic attributes to address the four key dimensions relating to infrastructure delivery, namely institutions, people, organisational behaviour, and human resource systems. As a standardised approach to public sector infrastructure delivery and management, the IDMS describes and outlines the processes pertaining to infrastructure delivery, from planning to asset disposal, thereby setting a benchmark for best practice guide (CIDB, 2010: 13). WCG (2012: 1) advises that the IDMS must be used throughout the entire life cycle of an infrastructural asset, incorporating activities such as "planning, budgeting, procurement, delivery, maintenance, operation, monitoring and evaluation of infrastructure".

2.3.1 Evolution of the IDMS

Formulated in 2004 as a tool to manage the delivery of infrastructure, the IDMS has evolved and has since shifted its focus from being substantially on project management to asset management, where it considers the full life cycle of infrastructure assets. Figure 1 illustrates the IDMS evolution since its inception.

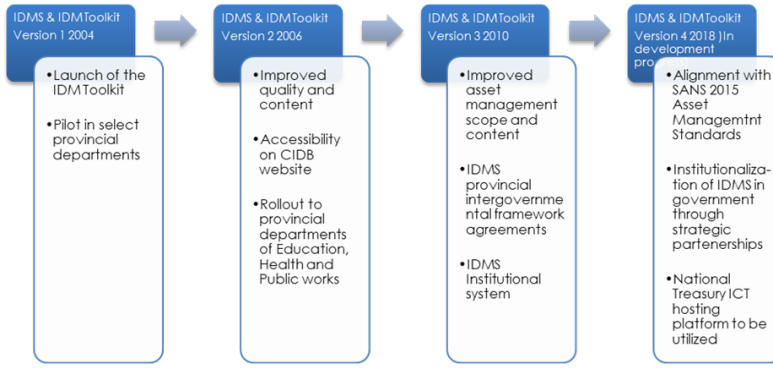

Figure 1: Evolution of the IDMS and IDM Toolkit
Source: Authors

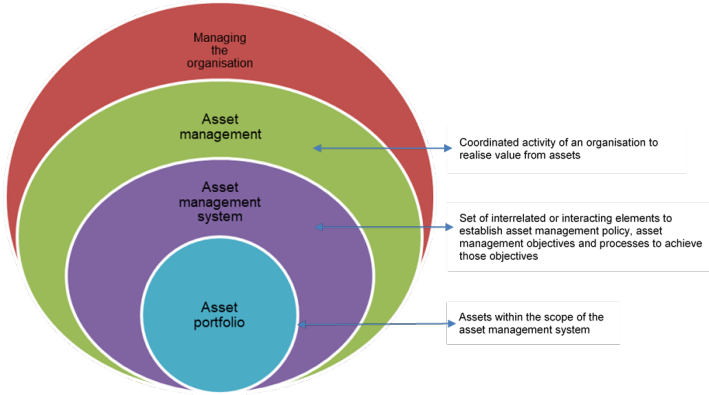

Figure 2: Relationships between key asset management terms
Source: ISO 55000

2.3.2 IDMS alignment with ISO 55000 Asset Management System

Asset management, according to ISO 55000: 10, is a "coordinated activity of an organisation to realise value from assets". Infrastructure asset management strives to achieve a desired level of service in a cost-effective manner. Similar to IDMS processes, asset management processes are integral to the organisation's infrastructure planning, budgeting, and delivery processes. Figure 2 shows the relationship between key asset management terms.

The International Infrastructure Management Manual (2011), cited in Department of Higher Education and Training (DHET) – University Macro Infrastructure Framework (MIF) [Annexure 4] (DHET, 2019: 1) describes the key elements of asset management for infrastructure as:

- Performance assessment defining the level of service and monitoring performance.
- Gap assessment – demand management and infrastructure investment.
- Risk management – identifying, assessing and appropriately managing risks.
- Financial assessment – long-term financial plans identifying required expenditure and funding.
- Service life approach to developing cost-effective management strategies for the long term that meet the desired level of service.

Figure 3 illustrates the relationship between the IDMS adaptation of ISO 55000 elements of an asset management system.

2.3.3 Objectives of the IDMS

The main objectives of the IDMS can be listed as:

- Best practice guide. To set a guideline and act as a benchmark to public sector infrastructure delivery (CIDB, 2010: 13; Civilution, 2016: 3).
- Improved delivery. To enhance improved infrastructure delivery (Civilution, 2016: 2; CIDB, 2018).
- Shortage of skills. To address the apparent deficiencies in the availability of a skilled and competent workforce (Civilution, 2016: 2).
- Improved planning. The IDMS seeks to curb the challenges of poor planning that have bedevilled South Africa's public sector infrastructure delivery (Civilution, 2016: 2).

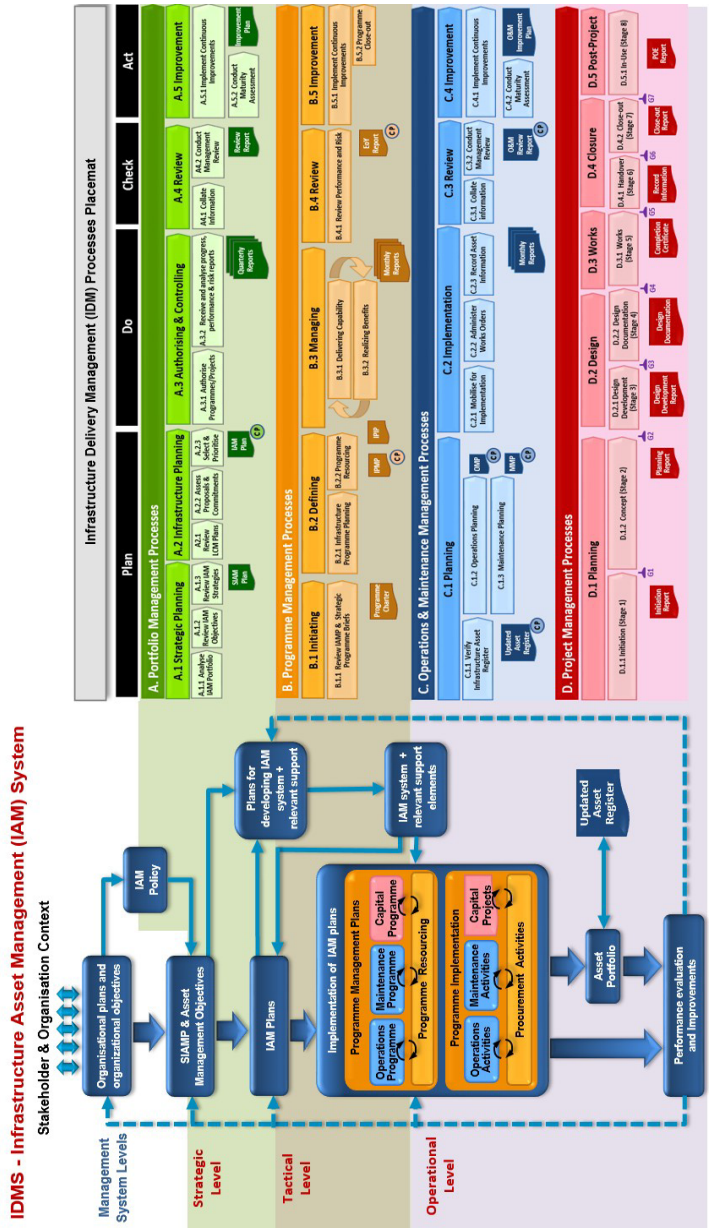

Figure 3: Asset management system aligned to the IDM Processes Placemat
Source: Municipal Infrastructure Support Agent (MISA), 2019: 17

- Cost effectiveness. The IDMS seeks to ensure value for money during infrastructure delivery (CIDB, 2010: 101).
- Reduction of the infrastructure gap. The IDMS seeks to reduce the infrastructure gap and to make affordable quality infrastructure available (National Treasury, 2012: 3)

2.3.4 Impediments to optimal IDMS implementation

The impediments affecting IDMS implementation are in part responsible for the failure by the relevant provincial government departments to successfully deliver infrastructure and associated services. As a result of these challenges, the economic conditions of a country are negatively impacted, due to the overt dependence on infrastructure to address developmental aspirations and policy objectives. Some of these challenges include:

- Prevalence of poor interdepartmental relationships and unclear communication channels (Thiry & Deguire 2007: 653; Thumbiran & Raphiri, 2016: 4; Awuzie & McDermott, 2019: 115-142).
- Poor leadership and management structures (Awuzie & McDermott, 2019: 115-142; Thumbiran & Raphiri, 2016: 4).
- Limited technical capacity (Thumbiran & Raphiri, 2016: 4).
- Governance issues and collusion within the industry (Thumbiran & Raphiri, 2016: 4; Awuzie & McDermott, 2019: 115-142).

2.4 Maturity modelling

Fowler (2014) defined a maturity model as a tool that measures the effectiveness of an individual or organisation to achieve desired outcomes. Furthermore, the model enables an establishment of the capabilities required to enhance process or organisational improvement. Maturity models facilitate an identification and performance of the relevant steps required by organisations and/or individuals to attain higher levels of maturity concerning a phenomenon (Kohlegger, Maier & Thalmann, 2009: 59). The use of maturity models has been on the rise since its initial development by US-based Software Engineering Institute (SEI), in association with the Mitre Corporation in 1986 (Willis & Rankin, 2010: 87). At that point, it was saddled with an initial aim of improving the software processes of certain organisations. Despite having evolved from the software industry, the use of maturity models has since spread to other industries such as project and programme management, among others (Willis & Rankin, 2010: 88; Grim, 2009: 71). The utility of these models across various domains has been

attributed to their process-oriented nature and ease of adaptation to other domains (Bayraksan, 2009: 3; Grim, 2009: 74).

Maturity models are used to evaluate an organisation's capability of maturity elements, usually from a rating of 1 – initial (*ad hoc*) to 5 – optimised. Schumacher, Enrol and Sihn (2016: 164) as well as Grim (2009: 72) posit that level 1 shows a complete lack of attributes, whereas level 5 describes world-class attributes. According to ISO 8000-62 (2018: 2-3) as well as Carretero, Caballero and Piattini (2016: 249), maturity assessments consider the following process attributes to determine the level of maturity:

- Process performance.
- Performance management.
- Work product management.
- Process definition.
- Process deployment.
- Quantitative analysis (Process measurement).
- Quantitative control (Process control).
- Process innovation (Process optimisation.
- Process innovation implementation.

2.4.1 Maturity scale for appraising public sector readiness to utilise the IDMS

The main objective of maturity modelling is to drive process improvement. As such, maturity models can be applied as a control measure to ensure that processes are consistently adhered to within an organisation, consequently fostering management excellence. While Heller and Varney (2013: 7) identified seven tenets of a maturity model, Schumacher *et al*. (2017: 163) identified nine. Building on the foundation laid by both studies, a structured maturity model matrix was developed. This emergent maturity model matrix was divided into nine dimensions. (See Table 1.)

Table 1: Dimensions and maturity items of a maturity model

Dimension	*Description*
Strategy	Entails strategic understanding and informed decision-making of organisational role, positioning, and vision in support of its objectives
Leadership	Entails the role of leadership and how leaders possess the power to transform an organisation.
Customers	Entails all existing and potential new clients including strategies to expand the client base such as, for example, digitalisation of sales/ services

Dimension	*Description*
Products	This dimension is concerned with product outcomes acquired from the processes implemented such as, for example, customisation of products
Operations/ Processes	Entails procedures, methods and practices which establish the manner through which activities are performed, process performance and process improvement aspects such as, decentralisation of processes
Culture	Entails organisational culture and organisational structure such as, for example, knowledge sharing and company collaboration
People	Covers the HR function such as skills and competences of employees and their roles and responsibilities
Governance	Covers the governance and administration aspects of an entity such as, for example, labour regulation and enterprise-wide authority
Technology	Is concerned with creating an enabling technology environment encompassing information systems, applications, and infrastructure

Source: Adapted from Fisher, 2004: 1-7; Schumacher *et al.,* 2016: 164

3. METHODOLOGY

3.1 Research methods

This study examined the maturity of South Africa's provincial government departments in engaging with the extant IDMS. A multi-case study research design was used, and data was collected quantitatively through structured maturity modelling questionnaire surveys. Three provincial government departments of Education, Health and Public Works in the KwaZulu-Natal region that utilise the IDMS were identified and used as case studies. This allowed for an in-depth understanding of the level of maturity of each department and for comparative analysis purposes via a cross-case analysis of the findings and to subsequently evaluate the critical areas of where major variances were noted. Given that the cases could not be considered without the context, only provincial government departments that engage the IDMS were selected for this study.

3.2 Population and sample

The target respondents were architects, engineers and quantity surveyors in senior, management and leadership positions with over five years' working experience in the industry. They were required to have extensive knowledge of IDMS implementation. As informed by the outcome from a pilot study, the population was greatly reduced and distribution of questionnaires was streamlined to only individuals in senior positions and those in a managerial capacity with the requisite knowledge and experience relating to IDMS

implementation, in lieu of distribution to everyone engaging the IDMS. This resulted in a combined list of 54 professionals forming the population. Krejcie and Morgan (1970: 608) recommend that, for a population of 55, the sample size ought to be 44. This study, however, surveyed the entire population due to its small size. In addition, the study placed priority on obtaining quality results rather than population and sample sizes.

Questionnaires were sent to 54 participants by email and a total of 34 questionnaires were completed correctly and returned, representing a 63% response rate (Table 2). Taking a proposition by Moyo and Crafford (2010: 68) into account where survey responses within the built environment vary between 7% and 40%, the response is good to support this empirical study.

Table 2: Provincial government department composition

Department	*Frequency*	*%*	*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

3.3 Data collection

Initially, expert interviews were conducted to facilitate the development of the maturity model by establishing the key maturity items to be included. Thereafter, a preliminary maturity model was developed, and a pilot study was undertaken to improve the data-collection instrument (questionnaire) and to provide valuable feedback that would subsequently be incorporated. Questionnaires were distributed electronically from October 2019 to July 2020. This study reports on the latter stage only.

The structured maturity modelling questionnaire was divided into two sections. The first section captured data about, for example, the respondents' years of experience with IDMS implementation and the government department with which they were associated. The second section collected data on the perceived maturity across the nine dimensions of the maturity model. The maturity items were developed via a two-step process, which entailed a systematic literature review and expert interviews. The proposed model, consisting of nine dimensions, was subdivided into a total of 52 maturity items. Respondents were required to rate the maturity items on a 5-point Likert scale (1 = not fully implemented, 5= fully implemented). However, the maturity items had differing importance towards maturity in IDMS implementation, as an example, on the leadership dimension, the item "We have skilled leadership which leads by example" could have a higher contribution when compared to the

item “Our senior/top management are committed to implementation of the IDMS in our enterprise”. This, therefore, called for a practical importance rating to be included in the questionnaire, in order to establish the item’s maturity contribution, where (rating = 1) meant “not important” and (rating = 4) meant very important. To reduce the respondents’ bias, closed-ended questions were used for section two (Akintoye & Main, 2007: 601).

3.4 Data analysis and interpretation of the findings

The following formula was used to calculate the maturity level:

$$M_D = \frac{\sum_{i=1}^{n} M_{DIi} * g_{DIi}}{\sum_{i=1}^{n} g_{DIi}}.$$

Where M = Maturity

D = Dimension

I = Item

g = Weighting factor

n = Number of maturity item

Table 3 presents the proposed maturity scale.

Table 3: Proposed maturity scale to assess IDMS implementation

Maturity scale	*Process attribute*	*Common feature*	*Organisation level*
Level 1: Initial	Process performance	Commitment to perform	Competent people employed. The processes in relation to IDMS implementation at this level are undocumented and subject to dynamic change. Therefore, they tend to be undertaken on an ad hoc basis.
Level 2: Repeatable	Process performance Performance management Work product management	Ability to perform	Minimum specified standards are established and process discipline is unlikely to be rigorous. Standard roles and responsibilities for all tasked with engagement of the IDMS are developed. Operational units are irregularly encouraged to utilise the IDMS

Maturity scale	*Process attribute*	*Common feature*	*Organisation level*
Level 3: Defined	Process performance Performance management Work product management Process definition Process deployment	Activities performed	Standard processes are defined and in place. Operational units are encouraged to utilise the IDMS
Level 4: Managed	Process performance Performance management Work product management Process definition Process deployment Process measurement (Quantitative analysis) Process control (Quantitative control)	Measurement and analysis	The organisation uses process metrics to effectively control its processes and operational units. At this level, adherence to IDMS implementation is monitored, measured, and controlled by management.
Level 5: Optimised	Process performance Performance management Work product management Process definition Process deployment Process measurement (Quantitative analysis) Process control (Quantitative control) Process optimisation & innovation Process innovation implementation	Continuous improvement and verifying implementation	Continuous improvement via constant feedback and innovation is undertaken. In addition, the organisation must be able to cope and succeed in a dynamic environment, in order to adequately tackle changes, especially those affecting IDMS implementation in the wake of knowledge revolution and evolution of the IDMS itself (see Figure 1). Responsibility for IDMS implementation lies with operational units and management with assigned IDMS roles and responsibilities in the organisation

Source: Adapted from ISO 8000-62, 2018: 4; Heller & Varney, 2013; Grim, 2009

Table 3 illustrates the maturity scale in relation to organisation level of implementation of the IDMS. It is in the interest of an organisation to continuously strive to improve its processes, in order to transition from

one level to the next in pursuit of delivering improved outcomes. Figure 4 illustrates the organisational process capabilities to foster such transition.

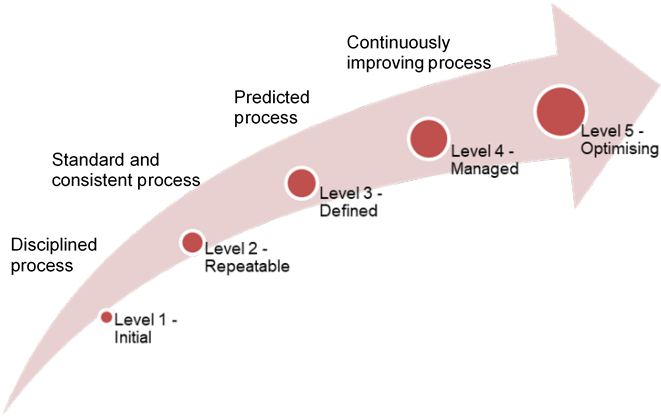

Figure 4: Levels and processes of the maturity model
Source: Willis & Rankin, 2010: 90

Descriptive statistical analysis was conducted, using the *Statistical Package for the Social Sciences* (*SPSS*), version 25 (Pallant, 2013: 134). The analysis of questionnaire data is presented in two stages, the first stage being an intra-case analysis, and the second stage being the cross-case analysis. For the cross-case analysis, the statistical analysis used is the One-Way ANOVA, which aimed at conducting a comparative analysis of differences between the three entities/organisations (provincial government departments) that utilise the IDMS.

The collected data was subjected to a reliability and consistency test using the Cronbach *alpha* test. The *alpha* values ranged between 0.70 and 0.91, which is indicative of at least a "good" level of reliability and is, therefore, acceptable. It is recommended that acceptable values of Cronbach's *alpha* should range from 0.60 to 0.95 (Taber, 2018: 1279).

3.5 Limitations of the study

A small sample size was used because of the specialist or expert input required from the study participants. Only those individuals with substantial experience and detailed knowledge of the IDMS had the capability to partake in the study, thereby significantly limiting the number of participants. Furthermore, the study was confined to KwaZulu-Natal, due to the short survey period for information gathering and data collection. The COVID-19 pandemic greatly impacted on data collection, as some of the individuals who were identified as key to providing information in relation to IDMS implementation were not available to contact.

4. RESULTS

4.1 Respondents' profile

The results in Table 4 are indicative of a good mix and a fair representation of each department in the study population. Based on frequency of occurrence, most of the respondents (61.8%) were males; 8.8% of the respondents were in the age group 18-25 years, with 26.5% of the respondents having experience in IDMS implementation of between 1 to 5 years. This shows that there were few participants aged between 18 and 25 years. These results further demonstrate the much-needed experience in IDMS implementation.

Table 4: Respondents' profile

		F	*%*	*F*	*%*	*F*	*%*	*F*	*%*
Characteristic	*Category*	*DOE (n = 12)*		*DOH (n = 10)*		*DPW (n = 12)*		*Total (n = 34)*	
Age	18-25 years	0	-	1	10.0	2	16.7	3	8.80
	26-39 years	3	25.0	4	40.0	4	33.3	11	32.4
	40-49 years	5	41.7	3	30.0	4	33.3	12	35.3
	50-59 years	3	25.0	1	10.0	2	16.7	6	17.7
	60-65 years	1	8.3	1	10.0	0	-	2	5.9
Gender	Female	5	41.7	4	40.0	4	33.3	13	38.2
	Male	7	58.3	6	60.0	8	66.7	21	61.8
Profession	Architect	5	41.7	3	30.0	6	50.0	14	41.2
	Quantity surveyor	4	33.3	4	40.0	4	33.3	12	35.3
	Engineer	3	25.0	3	30.0	2	16.7	8	23.5
Position	Manage-ment	4	33.3	3	30.0	3	25.0	10	29.4
	Senior level	8	66.7	7	70.0	9	75.0	24	70.6
Experience with IDMS	1-5 years	2	16.7	2	20.0	5	41.7	9	26.5
	6-10 years	8	66.7	7	70.0	5	41.7	20	58.8
	11-15 years	2	16.7	1	10.0	2	16.7	5	14.7

4.2 IDMS implementation: Cross-case analysis

Table 5 shows the comparative maturity indices and rankings of the nine dimensions between the three governmental departments.

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

Table 5: 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 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 as well as general management and monitoring of all employees, which are all imperative for organisational 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 organisational 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, which was ranked 4th within both departments. Figure 5 is a radar chart used to provide a holistic visualisation of the comparative results in the nine dimensions between the departments.

It is evident that DoH consistently performed high in all but two dimensions, namely customers and culture. While the DoH performed better in the leadership dimension, both the DoE and DPW had the highest implementation in the governance dimension. It is notable that 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 5 suggests that, in order to improve on organisational maturity and overall organisational readiness, the departments could improve on all dimensions, as all but the governance dimension within DPW have scores <4.

Figure 5: Radar chart visualising maturity comparisons between departments

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 6 summarises the ANOVA findings.

The significant values, p <0.05, are indicated with a *. Evidently, the three departments ranked 21 out of 52 items as significantly different. 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 organisation 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 organisation specific, in order to enhance its effective utilisation. In addition, 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

Table 6: One-way ANOVA for significant differences between departments in relation to IDMS implementation

Item	*Description*		*SS*	*df*	*F*	*Sig*
Strategy (N=33)						
S1	We use a road map for planning IDMS activities in our enterprise	Between groups	16,404	2	18,075	0,000*
		Within groups	14,067	31		
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		
S3	We allocate sufficient resources for the realisation of IDMS activities	Between groups	6,237	2	3,365	0,048*
		Within groups	28,733	31		
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		
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		
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		
S7	Our organisation 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	31		
Leadership (N=33)						
L1	Our senior/top management are committed to implementation of IDMS in our enterprise	Between groups	13,696	2	11,579	0,000*
		Within groups	18,333	31		
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		

Item	*Description*		*SS*	*df*	*F*	*Sig*
L3	We have centrally coordinated systems in place for IDMS activities	Between groups	14,904	2	10,469	0,000*
		Within groups	22,067	31		
L4	Each system of the IDMS has at least one qualified manager with the requisite training to oversee his/her respective departments	Between groups	3,281	2	1,183	0,320
		Within groups	42,983	31		
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		
L6	We have skilled leadership that leads by example	Between groups	9,469	2	7,067	0,003*
		Within groups	20,767	31		
Culture (N=33)						
C1	We conduct detailed customer identification	Between groups	0,951	2	0,505	0,608
		Within groups	29,167	31		
C2	We conduct research to profile customer infrastructure needs	Between groups	3,704	2	1,996	0,153
		Within groups	28,767	31		
C3	We are responsive to customer needs	Between groups	0,386	2	0,218	0,805
		Within groups	26,583	30		
C4	We utilise customer data to provide services as per need	Between groups	1,199	2	0,435	0,651
		Within groups	42,683	31		
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		
C6	We digitalise our services	Between groups	0,219	2	0,100	0,905
		Within groups	34,017	31		

Item	*Description*		*SS*	*df*	*F*	*Sig*
Products (N=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		
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		
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		
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		
P5	We ensure that our products/services are affordable	Between groups	6,556	2	3,031	0,064
		Within groups	30,283	28		
P6	We ensure that our products/services are adequate	Between groups	2,332	2	1,052	0,362
		Within groups	32,136	29		
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		
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		
Operations (N=33)						
O1	We have decentralised operations and processes	Between groups	4,615	2	1,900	0,167
		Within groups	37,650	31		

Item	*Description*		*SS*	*df*	*F*	*Sig*
O2	We have interdisciplinary and interdepartmental collaboration	Between groups	1,858	2	1,509	0,237
		Within groups	19,083	31		
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		
O4	Our organisation 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		
O5	We have performance evaluation structures in place	Between groups	5,884	2	2,626	0,088
		Within groups	34,733	31		
Culture (N=33)						
CU1	Our organisation provides an enabling environment that promotes knowledge sharing	Between groups	16,904	2	18,626	0,000*
		Within groups	14,067	31		
CU2	Our organisation promotes innovation and cross-company collaboration	Between groups	5,866	2	5,505	0,009*
		Within groups	16,517	31		
CU3	Our organisation recognises and rewards outstanding behaviour and achievements	Between groups	2,787	2	1,682	0,203
		Within Groups	25,683	31		
CU4	Our organisation conducts team-building initiatives that boost the employees' morale	Between Groups	2,054	2	1,278	0,293
		Within groups	24,917	31		
CU5	Seminars and workshops provide periodic training regarding implementation of IDMS	Between groups	14,179	2	6,493	0,004*
		Within groups	33,850	31		

Item	*Description*		*SS*	*df*	*F*	*Sig*
People (N=33)						
PE1	Our organisation employs people based on the merits of their qualifications	Between groups	4,799	2	1,707	0,198
		Within groups	43,583	31		
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		
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		
PE4	We are committed to continual professional development	Between Groups	11,108	2	5,015	0,013*
		Within groups	34,333	31		
PE5	We are trustworthy and honest	Between groups	6,752	2	4,364	0,021*
		Within groups	23,983	31		
Governance (N=33)						
G1	Our organisation upholds and strictly adheres to governance principles	Between groups	2,642	2	1,521	0,234
		Within groups	26,917	31		
G2	Our organisation complies with employment policies and labour regulations	Between groups	2,929	2	1,846	0,175
		Within groups	24,600	31		
G3	Our organisation conforms to and supports protection of intellectual property	Between groups	0,379	2	0,388	0,682
		Within groups	15,150	31		
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		

Item	*Description*		*SS*	*df*	*F*	*Sig*
Technology (N=33)						
T1	Our organisation utilises modern information and communications technology	Between groups	0,237	2	0,128	0,880
		Within groups	28,733	31		
T2	Our organisation provides correct tools, equipment and resources to implement the IDMS	Between groups	7,983	2	3,865	0,032*
		Within groups	32,017	31		
T3	We possess infrastructure that facilitates efficiency in the implementation of the IDMS	Between groups	5,931	2	2,678	0,085
		Within groups	34,333	31		
T4	We have current and future knowledge networks	Between groups	11,850	2	8,109	0,001*
		Within groups	22,650	31		
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		
T6	We are open to new technologies	Between groups	1,670	2	1,165	0,327
		Within groups	20,072	28		

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

any challenges in IDMS implementation across the dimensions in a bid to improve both dimension and organisation maturity ratings.

4.4 Comparison between maturities of provincial government departments against the maturity levels needed to effectively implement IDMS

For an organisation to be considered mature, it has to be rated at level 5 of the maturity model, which denotes systems and processes being optimised. An IDMS-ready organisation would, therefore, be proactive and will possess the ability to efficiently manage and maintain its portfolio management, programme and project management, as well as operations and maintenance processes. It is, therefore, evident that, even though a maturity rating of 5.0 is required for the 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 that have been identified in the study and in literature, respectively as carrying more weighting with respect to improving organisational maturity. Furthermore, as noted in Figure 1, the IDMS is bound to evolve, and its evolution has seen a shift from focus being mostly on project management to asset management. This evolution consequently requires the departments to adapt to such changes by realigning their organisational processes and constantly building their capacity.

Previous studies have identified the leadership dimension as having a huge impact on organisational or project performance. A case study conducted by Watermeyer (2018), which surveyed 130 senior officials in public office involved in infrastructure projects, found leadership, among other factors, as critical to influencing successful project outcomes. Another study by Chaudhry, Kalyar, Rehman and Kouassi (2012: 21) found that leadership, responsible for providing organisational direction by giving guidelines to its employees and managing them, ought to work closely with them and address any problems as they arise. IDMS implementation begins at the strategic level, indicative of the need for adequate leadership and expertise in infrastructure planning and management, with calculated decision-making, in order to attain optimal project performance. Importantly, SANS ISO 55000 identifies leadership and organisational culture as key determinants of value realisation. There is a positive correlation between effective leadership and improved project performance (Watermeyer & Phillips, 2020: 5; Yukl, 2009: 49-53). As such, effective leadership can be considered a requisite throughout the project's life cycle, commencing at a strategic level up to project close out (Watermeyer, 2018: 3). It is, imperative to ensure that, before responsibilities are assigned, employee skills and competence levels be assessed to ensure adequate task

allocation that enhances organisation effectiveness and stability. A major impediment to infrastructure delivery and IDMS implementation has been attributed to the people dimension. The public sector has been cited as lacking sufficient expertise and capacity (Civilution, 2016: 2; Rwelamila, 2007: 56-57; National Treasury, 2012; Khumalo *et al.*, 2017: 35; Laryea 2019: 618; Watermeyer, 2018; Malete & Khatleli, 2019; Watermeyer & Phillips, 2020: 6).

5. CONCLUSION

This study set out to examine the maturity of South Africa's government departments to implement the IDMS. By utilising a well-structured maturity modelling questionnaire by electronic means and purposive sampling techniques, data were collected from experienced individuals within the three government departments. Appropriate analytical tools were adopted, and the study was able to make meaningful findings.

The study found that, although all the nine dimensions of the maturity model, namely strategy, leadership, customers, products, operations, culture, people, governance, and technology, were critical to the state of organisational readiness, the leadership dimension carried more weight. The Department of Health, which had the most maturity/implementation of the leadership dimension, had a greater overall organisational maturity when compared to the departments of Education, and Public Works. It is, therefore, imperative that, in order to improve organisational readiness, the factors that influence maturity must be improved on. The pivotal role of upper management (leadership) is critical to enhancing organisational performance and is a driver of all other dimensions because increased leadership maturity influences the maturity of other dimensions. Similarly, committing to improve on any other dimension without leadership commitment would be futile and could have a negative impact on the overall organisational maturity index, as leadership should be the driving force for all initiatives.

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 organisation is critical, because once assessed the areas in need of improvement will be highlighted, which if addressed would impact on improving the maturity of organisations to implement the IDMS. This study was also critical in establishing that the level of maturity of an organisation must be assessed prior to or accompanying the introduction of the IDMS to organisations. The instrument developed to measure an organisation's maturity could prove to be a very important tool in identifying organisational weaknesses and improving the level of maturity of the organisation.

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 more to ensure that organisations are well equipped and are mature to an extent that ensures effectiveness in implementation of the tools before launching. In addition, establishing an organisation's maturity level equips leadership with the right knowledge to make informed decisions. This could help in formulating strategic plans and in fostering these organisations to effect the necessary changes. Therefore, the organisation can potentially reconsider the organisational theories and management models they utilise, which, in some instances, could be hindering organisational success.

6. RECOMMENDATIONS FOR FUTURE STUDIES

This study was carried out in the KwaZulu-Natal province of South Africa, and this is a critical limitation toward the generalisation of the findings. A similar and broader study could be undertaken, albeit, on a national level to compare the maturity of public entities throughout the country and to establish provincial differences.

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