

# Framing Data Governance Amid AI Advancements in a Public University in South Africa

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**Abstract:** Data governance (DG) has emerged as a critical domain within information technology, especially in light of growing data volumes, regulatory pressures, and institutional performance demands. In higher education institutions (HEIs), the shift toward data-driven decision-making is intensifying amid increasing accountability, financial constraints, and the rapid digital transformation of administrative and academic functions. DG encompasses the policies, processes, roles, and technologies that inter-alia ensures data quality, consistency, compliance, oversight and security across the institutional landscape. However, many universities continue to face challenges with fragmented data systems, inconsistent data definitions, data silos, and underutilised data assets—issues that inhibit institutional effectiveness and strategic planning. This study proposes a structured Data Governance Framework (DGF) tailored to the unique context of South African universities. Drawing on a mixed-methods approach anchored in design science research methodology, data was collected through a DG maturity assessment survey and qualitative focus group sessions with key university stakeholders. The findings informed the design of a framework for the governance of data which is sensitive to the specific context while addressing governance gaps, roles and responsibilities, quality management, continuous improvement, change management, standardisation and regulatory alignment. Crucially, this study situates data governance within the emergent challenges and opportunities presented by Artificial Intelligence (AI) and Large Language Models (LLMs). As HEIs begin to adopt AI-powered tools for administration, research, and teaching, the need for robust DG becomes more urgent. The proposed framework incorporates AI-readiness and ethical oversight mechanisms to ensure trustworthy data handling, algorithmic transparency, data privacy, and responsible innovation in an AI-augmented environment. The resulting DGF provides a structured approach for universities to manage and safeguard their data assets, reduce institutional risk, foster data trust, and optimise data value—while aligning governance practices with the ethical imperatives introduced by AI and LLM technologies.

**Keywords:** Data governance framework, Data governance maturity assessment, Data governance organisational operating model, Data governance program, Data governance in higher education

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## 1. Introduction

The volume of data created worldwide continues to grow exponentially, driven by increased digital transformation, IoT, AI, and edge computing. IDC forecasts that by 2029, the total amount of data created annually will reach hundreds of zettabytes (1 zettabyte=100,000,000,000 gigabytes) (IDC, 2025). The increasing volume of data raises concerns regarding DG, which seeks to ensure its integrity and accessibility (Soares, 2010).

Data breaches affecting prominent organisations such as eBay, LinkedIn, Yahoo, and Facebook are increasingly common. These encompasses sensitive data, including numbers for credit cards, email addresses, personal photographs, and passwords, which have been rendered publicly accessible or made available for purchase on the dark web (Swinhoe et al., 2024). In these cases, corporate boards are responsible for guaranteeing the correctness and security of their organisation's data.

Understanding the role of DG is crucial for effective corporate governance, as it enhances data quality, protection, and other vital elements, including data integration from various sources and the amalgamation of diverse systems and applications, such as IoT devices, enterprise resource planning, analytics for data, and large-scale data sets (Cheong & Chang, 2007).

Data assets are not always treated as valuable assets, leading to various problems (Mahanti, 2021). Genuine and trustworthy data are essential, since misleading, or ineffective outputs can result from poor regulation, deficient data availability, erosion in data quality, or a disconnect between data collection and information creation (University of St Andrews, 2025).

In summary, establishing effective DG practices and ensuring the reliability and trustworthiness of data are crucial to overcome these challenges and making informed decisions (Eryurek et al., 2021; Seiner, 2021).

## **2. Literature Review**

### **2.1 Data Governance (DG)**

Panian (2010) provided an extensive definition of DG, characterising it as the amalgamation of processes, policies, standards, organisations, and technologies essential for managing and ensuring the availability, accessibility, quality, consistency, auditability, and security of data within an organisation.

Atlan (2023a) states that universities produce and oversee extensive data, including student records, financial details, research outcomes, and faculty assessments. Effective governance of this data is crucial for preserving its quality and integrity, thereby facilitating informed decision-making, ensuring regulatory compliance, promoting academic excellence, and enhancing operational efficiency. In a context where data serves as a vital resource for planning and strategy, innovation, cooperation, and competition, DG functions as a fundamental component, enabling higher educational institutions to achieve their diverse missions efficiently and responsibly.

In higher education, the evolution of AI data governance and management reflects a growing recognition of ethical considerations, regulatory compliance, and data privacy (Selvaratnam et al., 2024). Current practices emphasize the importance of aligning data privacy policies with the rapid advancements in AI, highlighting the need for comprehensive reforms to protect sensitive information (O'Donnell & Beil, 2024). Furthermore, the establishment of clear governance frameworks is essential for ensuring data accuracy and reliability, which are critical for informed decision-making and quality assurance in educational settings (Contreras et al., 2024).

### **2.2 Identifying Core Elements From Frameworks for DG**

To address the creation of a proposed DGF, two well-known frameworks were selected from literature. These frameworks are briefly outlined with the aim of only identifying and listing the relevant core components that inform the development of the draft proposed framework artifact.

The IBM DG maturity model (IBM, 2007), supported by Soares (2010), aims to ensure data precision, accessibility, dependability, and quality, enabling strategic DG solution implementation. It features eleven categories organized into four interconnected groups: outcomes, facilitators, core disciplines, and supporting disciplines. The list includes risk management and compliance, value creation, organisational structures and awareness, policy, stewardship, data quality management, information lifecycle management, information security and privacy, data architecture, metadata and data classification, audit information, logging, and reporting (IBM, 2007; Soares, 2010).

DAMA-DMBOK 2 was released in 2017 to address significant developments in managing data (DAMA, 2017). Aimed at aiding organisations in enhancing their data-handling processes and in achieving optimal outcomes by providing a holistic and integrated view of the data management process. The framework consists of 11 core data management knowledge areas. These areas include data architecture, and data security, data architecture, data modelling and design, data storage and operations, data security, data integration and interoperability, document and content management, reference and master data, data warehousing and business intelligence, metadata, data quality, with DG as the primary element that integrates them (DAMA, 2017).

This study contends that a list of pertinent elements found in these frameworks relevant to the university governance of data are: 1) risk management, 2) data compliance and regulatory control, 3) data security and data classification, 4) data access, 5) master data management, 6) data warehousing and business intelligence, 7) data governance and data stewardship, 8) data integration and interoperability, 9) metadata management, 10) data quality management.

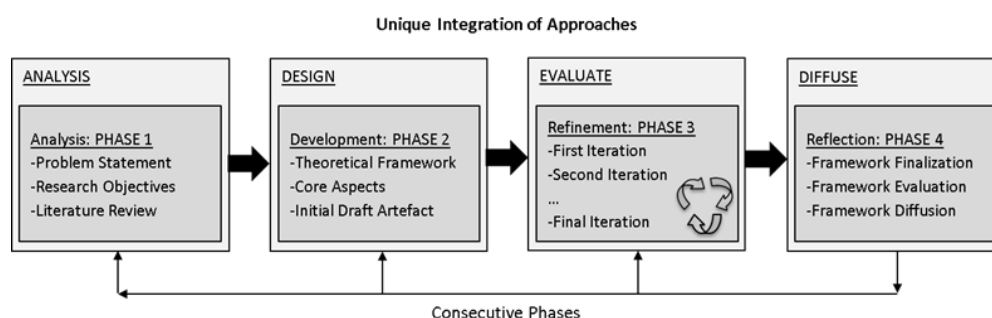
## **3. Research Design**

### **3.1 Research Paradigm**

Groenewald (2004) defines a paradigm as a framework of thought. Building on this, Österle et al. (2011) explain that the design science research (DSR) paradigm focuses on creating tangible artifacts to solve real-world problems involving multiple stakeholders who contribute to and benefit from the research. Consequently, the DSR paradigm, specifically utilizing the Nelson Mandela University Design Science Framework Methodology (NMU-DSM), was chosen for this study.

### 3.2 NMU-DSM Approach

According to Delpont et al. (2024), NMU-DSM is a novel integrated research methodology created to guide the researcher through the research process. This unique integrated research approach stems from design-oriented information system research and design-based research. The NMU-DSM combines design-oriented and design-based techniques shown in Figure1.



**Figure 1: NMU-DSM unique integrated approach process (Delpont et al., 2024)**

A framework is evaluated against four phases throughout the research process and each phase operates iteratively toward the construction of an artifact. Delpont et al. (2024) provide clear instructions for each phase of the NMU-DSM, guaranteeing a thorough grasp of how to navigate and finish each phase. NMU-DSM phases are interrelated, each comprising specific elements that guide the development and refinement of educational interventions. The analysis, design, evaluate, and diffuse phases are guided by principles that prioritise the creation of a framework as the desired output through various elements that must be satisfied during each phase (Delpont et al., 2024).

### 3.3 Research Methodology

#### 3.3.1 Research approach

This study used a mixed-method approach, aligning with the researcher freedom noted by Österle et al. (2011). As Johnson (2012) suggests, this design prioritizes a real-world context by using rigorous quantitative and qualitative techniques to integrate and triangulate data, thereby maximizing strengths and addressing limitations.

#### 3.3.2 Research objectives

The structured research objectives of the study as outlined in Table 1.

**Table 1: Research Objectives**

Research objective	Research method	Outcome/Output/Deliverable
PO	Literature review	Develop a university DGF.
SO1	Literature review	A list of core elements required to develop a DGF.
SO2	Survey	Current DG maturity level.
PO	Modelling	Draft framework.
	Focus groups	Proposed framework.
PO	Survey	Final framework validity against NMU-DSM core principles.

To address the Primary Objective (PO) a comprehensive examination was conducted of the literature that pertains to the problem under investigation to understand the context and aspects needed to develop a DGF for the university, outputting a framework artifact that will provide DG within the university. The PO was achieved by investigating two sub-objectives (SO), namely SO1 and SO2.

To address SO1, literature on the selected best practice frameworks (IBM and DAMA) were studied and presented in a summary format for evaluation towards identifying common core elements for the development of a proposed DGF for the university.

To address SO2, a survey instrument, as described by Franklin and Osborne (1971), was developed, and distributed to key data protagonist officials. This survey, adapted from Seiner (2021) assessed the university's

DG maturity by gathering inputs from staff with extensive knowledge in data usage, processing, analysis, reporting, and strategic institutional understanding, using a 1-5 rating scale.

Additionally, to address the PO, the research conducted focus group sessions, as described by Longhurst (2003), enabling in-depth discussion from diverse perspectives. These sessions, held with university Directors, Deputy Directors, and Senior Specialists selected for their extensive data and institutional knowledge, informed the preliminary framework draft, building upon literature and maturity assessment survey insights. Modelling (Olivier, 2009) then integrated these insights to develop the proposed framework.

Subsequently, a second, survey adapted from (Delpont, 2017) was administered to the focus group participants to examine the framework's validity. Responses were descriptively analyzed using a Likert-type scale (strongly disagree to strongly agree) and an open-ended question to evaluate the framework's alignment with the NMU-DSM principles of relevance, usability, scalability, and simplicity (Delpont et al., 2024), while identifying areas for improvement.

### 3.4 Research Methods Positioned in Relation to NMU-DSM Phases

The positioning of all research objectives and methods in relation the NMU-DSM phases of the study (Figure 1) are shown in Table 2.

**Table 2: Research methods positioned in NMU-DSM phases, adapted from (Delpont et al., 2024)**

Method	Phase of NMU-DSM	Research objective
Literature study	Phase 1, 2 & 3	PO, SO1, SO2
DG maturity survey	Phase 1	SO2
Modelling	Phase 2 & 3	PO
Focus groups	Phase 3	PO
Validity survey	Phase 4	PO

For this study, NMU-DSM's Phase 1 – Analysis leveraged a literature review to define the initial problem (the lack of comprehensive university DGF) and research objectives (PO, SO1, SO2). A list of DG elements was selected from two prominent frameworks in literature to achieve SO1. Concurrently, a literature-derived DG maturity survey was conducted with university stakeholders to understand the issue and assess current maturity, fulfilling SO2.

Building on this, NMU-DSM Phase 2 -Design aims to develop solutions guided by fundamental elements and technological advancements (Herrington et al., 2004). This phase, informed by literature, identifies core theoretical framework principles: simplicity, relevance, scalability, and usability. Also in Phase 2, a theoretical framework for an effective DGF is established using literature. This foundational understanding is crucial, as existing literature provides essential criteria for DGF development (Delpont et al., 2024). Mahanti (2021) succinctly describes these fundamental criteria as the intersection of people, process, and technology (PPT), placing DG at its core. DG thus relies on these three core criteria: people, who are responsible for adherence to data management practices (Mahanti, 2021); process, involving procedures to manage security and compliance, and to monitor data across IT systems (Griffin, 2005); and technology, which provides the tools for automation, utilized by people and processes (Mahanti, 2021). Phase 2 builds upon the knowledge gained from the previous phase and identifies essential principles and criteria that constitute an effective DGF. Subsequently, an initial framework was developed based on the identified core elements, principles and criteria using modelling (Olivier, 2009). The outcome of this phase is the development of an initial draft of the DGF specifically designed for the university. Next, the modelled framework was presented to stakeholders to gather their input.

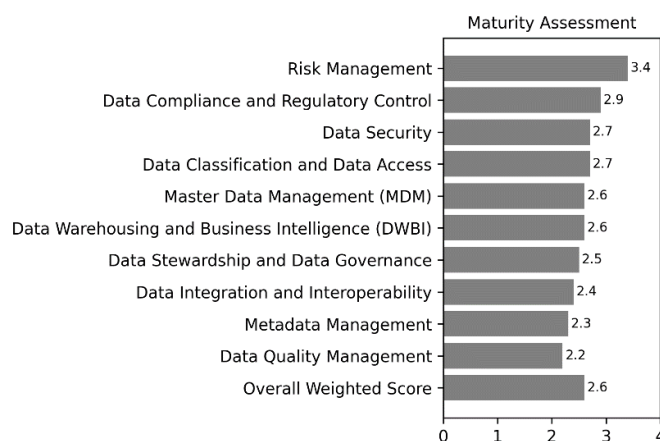
During Phase 3 - Refinement, a focus group approach was employed to assess the acceptability of the draft DGF. The feedback obtained from the focus groups was carefully analysed, and necessary adjustments were made to the draft framework, based on their input, and modelled further. This process was iterated until the framework was approved and deemed to be the final DGF (Olivier, 2009).

Last, Phase 4 - Reflection involved evaluating the final DGF using the core aspects identified in Phase 2 which were achieved using a final evaluation survey directed at the focus group participants on a scale from strongly agree to strongly disagree. In this study, PO links to NMU-DSM Phases 1, 2, 3 and 4.

### 3.5 Data Collection Results

#### 3.5.1 Maturity assessment

A DG maturity evaluation assesses an organization's current data maturity to guide future steps (Varshney, 2023). In section 2.2 the key DG elements identified were incorporated into the maturity survey from the two selected DGF's assessed by different staff groupings according to job profile. These staff are from a few groupings, including academics (12.5%), executive/admin./management professionals (33.3%), specialised/support professionals (33.3%), technical (4.2%) and non-professional administration (16.7%). Seiner (2021) recommended that the responses be aggregated for each element, and the average of those separate element scores should finally contribute to an overall maturity assessment score as shown in Figure 2 below.



**Figure 2: DG maturity assessment results**

With the current DG maturity levels known, pinpointing areas for intervention becomes clear. Seiner (2021) recommends identifying relevant best practices for problematic data disciplines, then evaluating leverageable aspects, opportunities, and associated risks and benefits to address the maturity gap. This knowledge subsequently informs the development of a program and communications plan to improve DG in those areas, ultimately leading to the establishment of a DGF.

#### 3.5.2 Focus group

A prepared first draft of the framework was presented to the focus group participant stakeholders and their comments were gathered after discussions. The framework structure and design were accepted, but stakeholders suggested improvements. These inputs from the participants were incorporated into the next and final modelling iteration of the framework artifact (Olivier, 2009).

#### 3.5.3 Modelling

Further modelling was undertaken to enact improvement, including the criteria and core elements identified, considering the maturity assessment results and gap, and further literature study, as per Seiner's (2021) recommendations on current best practice leverageable components and opportunities in the problem data discipline areas to meet stakeholder's expectations (Österle, et al., 2011).

#### 3.5.4 Evaluation survey

Upon completion of the survey, the responses were gathered for subsequent analysis. Results for framework principles adherence showed high agreement: for scalability, 42.9% strongly concurred and 57.1% agreed; for usability, 28.6% strongly concurred and 71.4% agreed; for relevancy, 85.7% highly concurred and 14.3% agreed; and for simplicity, 28.6% strongly agreed and 71.4% agreed. There were no responses for disagree or strongly disagree from participants. The analysis results demonstrate that the DGF artifact aligns with the all NMU-DSM principles and was thus accepted to be valid (Delpont et al., 2024).

## 4. Proposed Final Framework Artifact

### 4.1 Final Framework

The phases of the NMU-DSM, assisted in formulating the final DGF for the institution. To achieve effective DG, the university should address the problem and gap identified in Phase 1 in the various data disciplines, and other components of the DG model, as shown in Figure 3, when conducting data management and related activities. The identified fundamental criterion and data disciplines are contextualised further in more detail in the subsections that follow with some of these data disciplines areas grouped under an overarching element to resolve the problem at hand. The final proposed framework for DG, as shown in Figure 3 evaluated and accepted in Phase 4 by stakeholders.

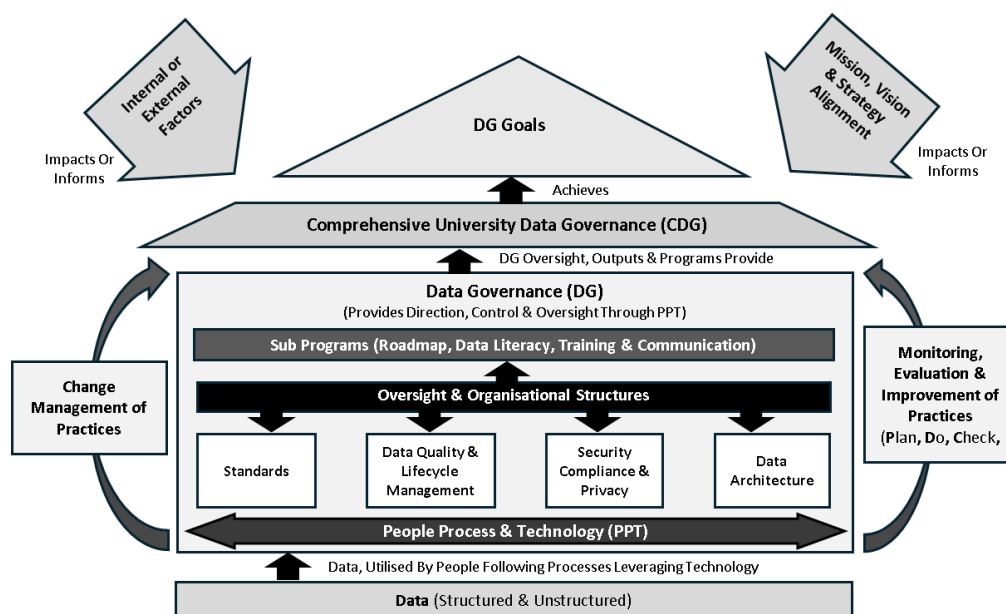


Figure 3: Final DGF model after refinement

### 4.2 DG Drivers and Goals

According to Panian (2010), DG aims to: ensure data meets business needs; protect and manage data as a valued enterprise asset; and lower data management costs. Corresponding drivers include growing revenue through enhanced customer understanding; lowering costs by increasing operational efficiency; and ensuring compliance with regulations and internal policies. These drivers collectively facilitate security and privacy compliance, thereby reducing risk and fostering trust in data (Atlan, 2023b).

### 4.3 Internal and External Impact (Antecedents)

Abraham et al. (2019) defines antecedents as internal and external variables that predict DG adoption. External factors include legal, regulatory, security, and data retention considerations, while internal university antecedents encompass strategic, institutional, systemic, and cultural elements.

### 4.4 Mission, Vision, and Strategy Alignment

Good DG can only be meaningful when it aligns with the institutional goals and values in a sustainable manner (Jim & Chang, 2018). Powers (2019) asserts that the development of a mature data strategy is essential as it facilitates effective data management and utilisation, resulting in enhanced decision-making, increased operational efficiency, risk reduction, and value generation.

### 4.5 DG Program

Seiner (2021) recommends delivering an actionable work plan or program. Ladley (2019) emphasises the design, implementation, and upkeep of a comprehensive DG program and presents an iterative technique with eight steps. Starting with scope and initiation, followed by establishing a vision and organizational value alignment. The process then moves to functional design, the creation of an organizational structure with identified data stewardship, and the development of an implementation roadmap. Concluding with program rollout and maintenance.

#### 4.6 Sub-Programs (Roadmap, Data Literacy, Training and Communication)

Soares (2010) outlines three sub-tasks for a DG roadmap: summarizing maturity evaluation results, identifying essential staff, and detailing processes and technology to address maturity gaps. This process begins with a loosely organized DG working group of mid-managers from functional areas and IT, aiming to establish executive alignment, define the DG body, assign data stewards, pilot MDM, and set system-of-record characteristics and key metrics. Data literacy is the ability to understand, analyze, communicate, and apply data for informed decisions and outcomes. To foster DG, a key objective is continually enhancing the university community's data literacy through training initiatives (University of Virginia, 2025). Designing, building, and implementing a communication plan involves selecting a qualified communications leader and team, formulating a strategy, securing funding, and executing a mutually agreed-upon project plan (Reichental, 2022).

#### 4.7 Organisation (Operating Model)

Arguably the most critical issue for universities is organizational structure design. An effective structure ensures appropriate personnel involvement in decision-making, clear accountability for data assets, and consistent application of governance policies (Knight, 2023; Panian, 2010).

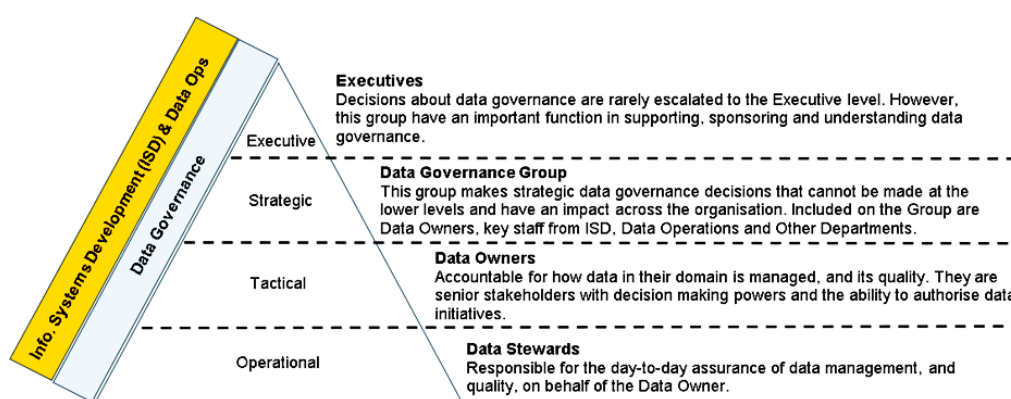


Figure 4: DG structure and roles adapted from (Knight, 2023)

DG roles and responsibilities operate at four levels, namely executive, strategic, tactical, and operational, provided that appropriate support is in place. Each grouping within this operating model of roles and responsibilities fulfils a vital function; however, institutions may modify the specifics to align with their requirements (Knight, 2023), shown in Figure 4.

#### 4.8 Standards (Policies, Best Practice and Technology)

Data standards define how the organisation should structure, format, and present data. These standards improve system and application consistency, interoperability, and data integration. They can include, inter alia, naming conventions, classification schemes, meta and master data management standards to aid in preventing duplication and inconsistencies (Loshin, 2010). DG policies tell institutions what to do, why, and who is responsible (Batchelder, 2024). Atlan (2023a) and Varshney (2023) list data classification, access and authorisation, privacy, retention and deletion, quality, security, ethics, responsible use policies, inter-alia, as essential DG policies for higher education institutions. Many best practice guidelines exist today for DG which can be leveraged to guide the DG implementation process (DAMA, 2017) that will compliment this hybrid framework for the university. The technological elements of DG can include, inter alia, data dictionaries, meta and master data tools, data lineage, data catalog and data discovery to create a “single source of truth” across the university (Loshin, 2010).

#### 4.9 Data Lifecycle Management

Involves defining, producing, retaining, and deleting data (Al Hassan et al., 2019). Data lifecycle management is accomplished by implementing a data lifecycle policy that stakeholders (stewards, proprietors, custodians, users, etc.) must adhere to in their daily data consumption and processing tasks.

#### 4.10 Data Quality Management

Primarily entails the improvement of data quality measures, such as correctness, timeliness, credibility, completeness, and consistency (Microsoft, 2024). Data stewards serve as the guardians of data quality,

consistently overseeing the condition of data within the institution. In summary, data profiling involves knowing the data; data cleansing pertains to rectifying it; and data monitoring focuses on sustaining it (Lee, 2024).

#### **4.11 Data Security**

Often performed by data stewards who help secure an institution's data and thought of as a set of mechanisms to prevent and block unauthorised access (Eryurek et al., 2021). Data classification is the method of systematically arranging data into coherent categories that facilitate retrieval, sorting, and identification for subsequent utilisation (Lee, 2024). Data access is often managed using role-based access control (RBAC), which grants access based on a user's institutions role, but access control lists (ACL) can provide more granular control than RBAC (IBM, 2024).

#### **4.12 Data Risk Management**

Data risk management encompasses the identification, assessment, and mitigation of risks related to data. DG risks can include data breaches, data loss, and penalties for non-compliance (Lee, 2024). Including representatives from risk management in DG organisation structures as partners forming part of a larger governance planning team will be of benefit regarding this element (Knight, 2023).

#### **4.13 Data Compliance**

Data compliance throughout the data life cycle means following DG and compliance rules. Data regulations must be followed to reduce risks, protect data, avoid legal and financial penalties (Lee, 2024).

#### **4.14 Data Architecture**

A complete data architecture outlines people, processes, and technologies employed to govern data over its lifecycle. Data architecture is essential to understanding data, where it is stored, how it is moved between systems, and how it is integrated. Data architecture policies govern data modelling, naming including data extraction, transformation, and loading (ETL) methods (Hopper, 2023). Data integration and DWBI draw on architecture frameworks like the DAMA-DMBOK and the Zachman framework (IBM, n.d.).

#### **4.15 Change Management**

Change management necessitates meticulous consideration to guarantee that affected team members comprehend how the alterations introduced by the DG program influence them and their responsibilities. Some institutions typically include a communications process of alerting stakeholders in advance, during, and after an underlying data change (Reichental, 2022).

#### **4.16 Monitoring Evaluation and Improvement**

Continuous measurement of DGF performance is essential to implement enhancements or major modifications that ensure program value (Reichental, 2022). The PDCA (Plan, Do, Check, Act) cycle provides a scientific method for proposing, implementing, measuring, and acting on changes to ensure process control and ongoing improvement (Swamidass, 2000).

#### **4.17 People Process and technology**

As in any university, data are utilised by people following processes leveraging technology (Mahanti, 2021). In the context of the final framework artifact, these three core components underpin all the abovementioned data disciplines and other elements in the framework.

#### **4.18 Data**

At a high level, data can be structured data, which is formatted according to a predefined structure and is organised in a manner suitable for analysis within a database, while unstructured data is maintained in its original format and requires processing for utilisation (Reichental, 2022). In the context of the study, data is the foundation element upon which all the other DG disciplines and elements depend.

## **5. Conclusion**

This study developed a context-specific Data Governance Framework for South African universities. Drawing on maturity assessment findings and best practices, it enhances trust, includes strategy alignment and integrates AI-readiness. Validated against NMU-DSM principles, the framework achieved its objectives. Limitations include single institution focus and absent longitudinal analysis. Future research should explore AI-enabled data governance in higher education.

**Ethics declaration:** The research adhered to university ethics protocols, obtaining clearance from the Research Ethics Committee (Human) before commencement. No personal information was collected, and all survey participants provided voluntary consent.

**AI declaration:** AI tools have not been used in this study other than grammatical checking.

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