

# Identifying the Constructs and Agile Capabilities of Data Governance and Data Management: A Review of the Literature

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**Abstract.** Data has become an invaluable asset to organizations. However, it is evident from the existing literature that despite the increased awareness of the importance of their data assets, many organizations fail to manage and govern these assets with the agility required in a highly competitive and volatile business environment. For data governance to be effective and sustainable in a turbulent, increasingly regulated, and competitive organizational environment, all of the elements of data governance should enable and support agility in the organization's management of its data and information assets. As a result of increased local and global data regulations, a high reliance on technical skills, and economic constraints, organizations in developing countries have experienced challenges with implementing data governance programs. Governance within an organization comprises the internal processes and policies that enable human capital performance, legal and regulatory compliance and organizational alignment. There is no single approach to achieving successful data governance, and factors pertaining to the organization's strategy, structure, business requirements and culture need to be considered. In this study a systematic review of existing academic literature was conducted to investigate (1) the scope and constructs of data governance and data management, (2) the agile capabilities that are required in data governance and data management for the timeous delivery of useful data to business, and (3) the need for African organizations to establish agile capabilities in their data governance and data management functions. The results of this review should be helpful with assisting organizations in African countries to achieve agility in the governance and management of data that supports business requirements and organizational agility.

**Keywords:** Data governance, data management, organizational agility, agile governance, complex adaptive systems, agile capabilities.

## 1 Introduction

This study contends that there is an existing requirement for agility in the data governance (DG) and data management (DM) functions of organizations, which stems from a need for the timeous delivery of useful data to business functions in order to enable and support the execution of business strategy. To be agile is to have the ability to become aware of, acclimate and respond swiftly and sustainably to environmental changes through a coordinated combination of lean and agile skills, and capabilities with the purpose of delivering greater value to business [1]. It is evident from documented research that, despite increased awareness of the importance of their data assets, many organizations fail to manage and govern these assets with the agility required in a highly competitive and volatile business environment [2, 3]. Effective and efficient DG and DM is required to support risk management and regulatory compliance [4, 5, 6], enhance decision-making [7, 8, 9], improve customer satisfaction, increase operational efficiency and improve business integration [7, 6].

Varying points of view have emerged in research and industry regarding the scope of DG and the methods that should be used to put sound DG and DM methods into practice [6, 10, 11, 12]. A systematic literature review (SLR) was conducted with the objective being to first identify the scope and constructs of DG and DM, and to then identify agile capabilities and how these capabilities apply to DG and DM. Subsequently, the importance of agility in DG and DM was investigated and the implications of DG and DM for organizations in Africa were considered. In cases where organizations already have successful information technology (IT) governance in place, the need for DG might be questioned as it is often seen as a function of IT governance. Weill and Ross [13] identify “Information and IT assets”, which include digitized data and IT systems, as one of the six key corporate assets that should be governed in support of achieving organizational goals. However, IT governance is more focused on governing the overall IT infrastructure and ensuring that business value is derived from IT investments [14]. IT governance does not address privacy and security risks related to data flows and should work in concert with other control frameworks such as the International Organization for Standardization (ISO) and Control Objectives for Information and Related Technologies (COBIT) [14].

There is currently a gap in the research literature regarding how to establish agile capabilities and embed a culture of agility in organizations [15]. Moreover, academic research in DG and DM seems to be in its early stages [16, 17, 18]. To sustain growth and competitiveness, organizations need to be agile at both the business and organizational levels. This requires enterprises to establish flexible and adaptable DG functions with responsive governance in place in order to deliver optimum value to business [1, 19]. This study sets out to first clarify the underlying individual concepts of DG, DM and agility and to then synthesize these individual components into a comprehensive whole, and propose a novel preliminary framework for the constructs and agile capabilities of DG and DM. Although many of the referenced studies focus on developed countries [20], the challenges associated with DG in these countries are not unique as they are also relevant to organizations in Africa [21].

## 2 Methodology

This research followed the systematic literature review (SLR) process as described by Templier and Paré [22]: Formulating the problem, searching the literature, screening for inclusion, assessing quality, extracting data, and analyzing and synthesizing the data. The objective of the SLR in this study was twofold: (1) to identify the constructs of DG and DM, and (2) to identify agile capabilities applicable to DG and DM. The subsequent findings of the SLR were synthesized in order to develop a research model for agile DG and DM. Thereafter, the model was applied to highlight the need for agility in the governance and management of data in African countries.

The primary search terms used were “data governance” and “data management”. The word “agility” was used as a secondary search term. Most of the research considered for this study was conducted from 2008 onwards. The main libraries used in the search were ACM, AISEL, Emerald Insight, IEEE, ProQuest, ScienceDirect and Springerlink. Additional searches were conducted in Google Scholar. The search process posed some challenges. The search term “data management” returned software engineering articles and conference proceedings pertaining to the technical management of data at a hardware/software level, which lies outside the focus of this study. Conference proceedings and journals were included in the searches. Seminal articles were identified by comparing the reference lists of the articles that were closely aligned with the topic of this study. Due to the variation in the definition of the terms “data governance” and “data management”, as well as the interchangeability of the terms “data” and “information”, refining the initial searches was an important step in eliminating research that was not relevant to this study.

## 3 Constructs of Data Governance and Data Management

With the growing emphasis on governance in organizations, the application of “good governance” has become crucial to organizational competitiveness [23]. DG specifies a framework that encourages constructive behavior in data use and management through the specification of accountabilities and decision rights regarding the data [12]. This step in the SLR aimed to answer this study’s first research question:

*RQ 1: What are the constructs of data governance and data management?*

### 3.1 Findings: Constructs of Data Governance and Data Management

Governance within an organization comprises the internal processes and policies that enable human capital performance, legal and regulatory compliance and organizational alignment [24]. Principle 12 of the King IV Report specifies that “[the] governing body should govern technology and information in a way that supports the organization setting and achieving its strategic objectives” [25, p. 62]. DG should, therefore, be seen as a subfunction of corporate governance.

There is no “one-size-fits-all” prescription for how an organization should implement and optimize the governance and management of data [12]. However, for

organizations to remain competitive and compliant with regulatory requirements, business-critical data must be readily available, accurate and integrated. Most documented research places DG within the context of information technology governance [11]. DG derives concepts from organizational theory and information technology (IT) governance theory. IT governance researchers highlight the importance of aligning IT governance with the strategic and operational business goals of the organization [12, 26]. Data quality is highlighted in published research as one of the main components of DG [6, 11, 27, 28].

DG is a socio-technical function that involves all of the processes used in the planning, specification, designing, enabling, creation, acquisition, maintenance, use, archiving, securing, retrieval, control and purging of an organization's data assets [10]. DAMA International (2014) has identified and defined 10 DG knowledge areas: data architecture, data modelling and design, data storage and operations, data security, data integration and interoperability, documents and content, reference and master data, data warehousing and business intelligence (BI), metadata, and data quality.

Governance can be viewed as a socio-technical activity that involves people in a context where technology plays a key role [29]. DG is central to DM and controls, plans and monitors all DM activities [10, 30]. DG refers to the specific roles of accountability and decision rights pertaining to data assets [11]. By adhering to regulatory compliance requirements, such as those set out by the Basel Committee on Banking Supervision (BCBS 239), organizations can improve their DG practices and develop a data-oriented culture which, in turn, will lead to better governance [5]. DG and DM can, therefore, be considered interdependent functions of an integrated domain involving people, processes, technologies and interactions at individual, team and organizational levels that span the entire organization.

## **4 Agility in Data Governance and Data Management**

Existing models for DG and DM do not appear to address the agility requirement that business has of DG and DM. Searches were conducted for academic research on agile capabilities. The relevance of these capabilities for the governance and management of data was considered in order to address this study's second research question:

*RQ 2: What capabilities are needed in DG and DM for the agile delivery of data requirements to business?*

### **4.1 Data Governance and Data Management as a Complex Adaptive System**

Before exploring the factors that influence agility in DG and DM, the relevance of agility in the governance and management of data should be considered. Complex adaptive systems (CAS) are coevolving systems that continuously tune themselves towards a point of maximum fitness, producing stability and becoming sustainable [31]. Agents are the semi-autonomous units that form the basic elements of a CAS. Agents evolve over time by continuously seeking to maximize their capability in order to sustain their existence within a changing environment [32]. According to Dooley's

nominal definition of a CAS, agents develop mental templates, or schemas, whereby they can define how to interpret reality and respond appropriately to given stimuli [32]. The phenomena associated with agile governance are positioned in the intersection between chaos and order, where innovation and agile practices emerge and interface with governance best practices [29].

Teams are CASs comprising people as the active agents and are in themselves agents at a higher composite level that continuously evolve through self-organization [33]. DG and DM teams comprise project teams, committees and other collaborative networks of people who are continuously organizing and reorganizing in an attempt to align with business requirements for data delivery [19, 34]. CAS models provide a way of simplifying complexity and are characterized by four key elements: agents applying schemata, networks of self-organization, emergence from the chaordic state (coevolution at the edge of chaos), and system evolution through recombination [35]. When CAS models are applied to strategic management, an approach unfolds that focuses on building systems that can swiftly evolve effective adaptive solutions [35].

## 4.2 Findings: Agile Capabilities

The more turbulent the information management environment becomes, the higher the level of agile capabilities required [36]. Agile capabilities in combination with governance capabilities enable better management and control of the effects of environmental and moderator factors [1]. Seven agile capabilities, which typically coexist with agility, were identified from the literature and are summarized in Table 1.

**Table 1.** A summary of the seven agile capabilities identified in the literature.

<b>Agile capability</b>	<b>Description of agile capability</b>
1 Competence	The competency of individuals and teams, which includes their knowledge, skill, expertise and understanding, is a critical factor in successfully accomplishing assignments in an agile manner [37]. An agile team continuously develops its inherent capability, thus its competency, to deal with change [1]. Incorporating a diversity of knowledge, experience and skills in a team improves the team's ability to cope with turbulence and complexity [36].
2 Flexibility	Flexibility, as a capability, is required in governance for agile value delivery to business [29]. Risk data aggregation capabilities require flexibility [5].
3 Leanness	Leanness refers to limiting wastage of resources and striving for simplicity [29] and contributes to overall organizational agility [38]. Smart management combined with new technology may enable fewer people to achieve more [39].
4 Reusability	Reusability ensures sustained efficiency, productivity and value for the business [1]. Reuse has a strong influence on speed through repeatability [40].

<b>Agile capability</b>	<b>Description of agile capability</b>
5 Scalability	Scalability enables the operational environment to quickly add or remove resources without impacting availability or functionality [41]. Scalability in DG and DM plans and provides for future growth and enables the organization to quickly scale-up to accommodate and service emerging business requirements because the predicted growth is catered for [41].
6 Speed	The speed offered by agile practices is required for quick delivery [40]. Speed refers to how quickly and effectively raw data can be made available to the business as usable information [42].
7 Responsiveness	The ability to sense, adapt and respond to change is required in governance for agile value delivery to business [29]. Risk data aggregation capabilities require adaptability in order to meet risk data aggregation requirements as and when they arise [5].

## **5 The Need for Agile Data Governance and Data Management in African Organizations**

Research conducted by Mann [43] concludes that as digital economies emerge in developing countries data is becoming increasingly important as a source of power in economic governance. Data for development (D4D) should move away from having a purely humanitarian focus toward a stronger consideration for economic development, whereby African citizens may have opportunities to benefit from their data for power, revenue and knowledge development [43].

DG processes are becoming increasingly complex [6, 5], but at the same time, DG is of growing importance to organizations worldwide [5, 8, 44, 45]. DG spans the whole enterprise and should align with business goals [6]. Recent research has found that organizations are having trouble with deriving value from their data initiatives [46]. Access to reliable data is needed for risk management and fulfilling regulatory, compliance and legal requirements, which are of paramount importance to organizations [47]. The proposed need for agility in the governance and management of data was investigated to answer to this study's third research question:

*RQ 3: What is the need for African organizations to establish agile capabilities in data governance and data management?*

### **5.1 Decision-making**

In a competitive world, the business that is ahead of its competition in obtaining the correct data and is first in gaining insights from high-quality data through analytics, is most likely to sustain its competitive position [7, 8, p. 6]. Businesses require accurate, reliable data to support effective decision-making based on data analysis rather than on intuition [8]. According to Pawelke et al. [48], access to technology and the internet is vital for people living in the remote areas of developing countries in order for them to

benefit from utilizing data for improved accountability, transparency, decision-making and public service delivery.

Where there is a lack of trustworthy information, risks and costs increase, and business change and growth are hampered by misguided managerial decisions [49]. The significance of data in decision-making is stressed by Schalkwyk et al. [50, p. 6], “South African university councils need accurate and informative data on the state of their institutions in order to shift the debate from one that is driven by ideology and self-interest to one that is empirically based and in the interest of the performance of the institution”. If the data is not reliable, managers revert to using intuition for decision-making and strategy implementation [44]. Accurate data, available at the exact moment that a business needs it, is required for effective, timeous decision-making [28]. A DG capability forms an essential part of data-driven decision-making capability [8].

## **5.2 Risk Management**

When clarifying the role of data as an asset, the regulatory environment’s influence on how the business uses data must be considered [11]. Organizations are at higher risk given the increased number of regulatory compliance requirements that enforce deadlines for timeous adherence. In most developing countries, frameworks for the protection of personal data are inadequately implemented and governed [48]. The Protection of Personal Information (POPI) Act, which was signed into South African law on 19 November 2013, holds organizations and their employees accountable and responsible for all of the personal information that they collect, store, disseminate and destroy during the course of conducting their business. Non-compliance with the POPI act holds significant criminal and reputational risks for businesses [51].

The Sarbanes-Oxley Act (SOX) was instituted in 2002 and requires Chief Executive Officers (CEOs) and Chief Financial Officers (CFOs) to certify corporate financial reports [13]. In January 2013, the Basel Committee on Banking Supervision (BCBS) published Principles for Effective Risk Data Aggregation and Risk Reporting (BCBS 239). Contained therein are the 14 principles which aim to strengthen the internal risk-reporting and risk-data aggregation capabilities of global, systematically important banks (G-SIB), which includes banks in Africa. The BCBS 239 requires banks to implement robust frameworks for DG [4]. The expected effects on banks that are implementing these principles include enhanced decision-making processes and risk management resulting in an increased ability to cope with crisis and stress situations [5]. Integration and automation of governance, risk and compliance (GRC) are becoming essential, and DG plays a vital part in data aggregation and risk reporting for GRC [47]. Chakravorty [5] explains that banks commonly use two types of reporting for regulatory and compliance requirements. The first type of reporting is run on financial transactional and administration systems. These reports are generally inflexible and inconsistent as a result of manual adjustments being made on the systems. The second type is ad hoc reporting, which usually involves manual, once-off data extracts from source systems with aggregation performed on the data in spreadsheets. These reporting methods are unreliable as the “correctness” of the data is often based on the user’s opinion [5].

### 5.3 Data Quality: Operational Efficiency, Integration and Interoperability

Recent research indicates that the management of data quality and its value proposition to business is posing an increasingly complex challenge to business enterprises [9]. In a study conducted in Ghana, it was found that only 53% of organizations had implemented any form of data quality management [52]. As pointed out by Azumah and Quarshie [52], a data quality initiative can only be successful if it is supported by the organization's executive management. Improving and maintaining the quality of an organization's data is viewed as crucial in achieving strategic business goals [6]. DG should promote increased operational efficiency, improve customer satisfaction and support business integration [6]. Missing or incorrect operational data can cause major problems for an organization. It can prevent sales, upset customers, and cause businesses to lose track of assets [9].

Best data practices focus on preventing data errors at the source by considering both the quality and the accurate business meaning of the data. An organization can be impacted by bad data quality at both the operational and strategic levels [11]. Redman [28] proposes that the solution to fixing bad data comes in the form of better collaboration between data creators and data users.

Data quality considers four characteristics of data: *accuracy* refers to the data's correctness and its congruence in terms of stored value, actual value and intended use; *timeliness* refers to the right data being available at the right time; *completeness* refers to the required data value being stored to the required breadth and depth; and *credibility* refers to the trustworthiness of the data source and its data [11]. Even though the specific culture and structure of an organization need to be considered when designing DG, and the focus of DG might vary from organization to organization [27, 34], data quality seems to be a requirement common to all organizations [9, 53].

Implementing a data standards layer is important, as it enables automation of data take-on, data quality and data integration processes [42]. Wixom advises that if standardization of data sources is not feasible, a master data management initiative should be considered. Master data management (MDM) refers to a process that is application-independent, owns, describes and manages the significant business data entities, and ensures the veracity and consistency of data by using a single set of guidelines. This provides a uniform view of key organizational data regardless of its storage location [54].

Companies should identify and continuously improve the quality of the data that drives the organization's profits [28]. Data errors will cause a business to question the reliability and usefulness of the data [52]. However, instead of directing the responsibility for data quality back to the data source for correction, the tendency is for business to spend time, often repetitively, checking and correcting the data. This creates inefficiencies in business processes, and incorrect data puts a business at perpetual risk of bad decision-making [44].



## 6 Summary of Findings

The main academic research and practitioner frameworks that underpin this study are summarized in Table 2.

**Table 2.** Summary of main theories and frameworks for constructs and agile capabilities

Author	Study or framework name	Contribution to this study
[35]	Complexity theory and organization science	Considers organizations and teams as CASs.
[19]	Data Infrastructures for Asset Management Viewed as Complex Adaptive Systems	Provides research-based evidence that DG and DM could be considered CASs.
[37]	Agile software development, the people factor	Emphasizes the importance of competence as an agile capability.
[10]	DAMA-DMBOK2 Framework	Provides a framework for the definition and function of each of the DM disciplines including DG.
[47]	Governance, risk and compliance (GRC): Conceptual muddle and technological tangle	Highlights the importance of governance, risk management and compliance in organizations.
[25]	King IV: Report on Corporate Governance for South Africa 2016	Provides the locus of and requirement for information governance, including DG, within corporate governance.
[8]	The Conceptualization of Data-driven Decision Making Capability	Emphasizes the importance of DG and DM for effective decision-making in the organization.
[11]	Designing Data Governance	Provides a framework for understanding the roles and decision rights in the DG domain.
[30]	Data Governance: How to design, deploy, and sustain an effective data governance program	Provides definitions, goals and implementation strategy for DG and DM.
[1]	Agile Governance Theory: conceptual development	Provides a theory for governance that is based on agile values and principles.
[40]	Enablers and inhibitors for speed with reuse	Provides a set of constructs for investigating factors that influence agility (speed and reuse) within manageable areas of the organization.

<b>Author</b>	<b>Study or framework name</b>	<b>Contribution to this study</b>
[9]	Quality and Value of the Data Resource in Large Enterprises	Emphasizes the important role of data quality in deriving value from an organization's data assets.
[41]	Scalable SQL	Emphasizes the importance of scalability as an agile capability.
[34]	Non-invasive Data Governance	Describes an approach to implementing DG that utilizes existing organizational structures and roles.

## 7 Discussion

It is apparent from the available literature that there is a clear need for DG in organizations to promote effective decision-making [8], risk management [5, 13], and increased operational efficiency and integration [6, 34]. Agile governance is a socio-technical phenomenon, which merges current best practices for governance with innovation and rising practices from agile and lean philosophy [1].

Existing academic and practitioner literature indicates that organizations currently do not have clearly defined and effective methods to establish and maintain agility in their DG and DM functions [2]. Furthermore, it is evident that there is a need for researchers to contribute to the limited body of knowledge relating to the field of DG and DM governance [17, 18].

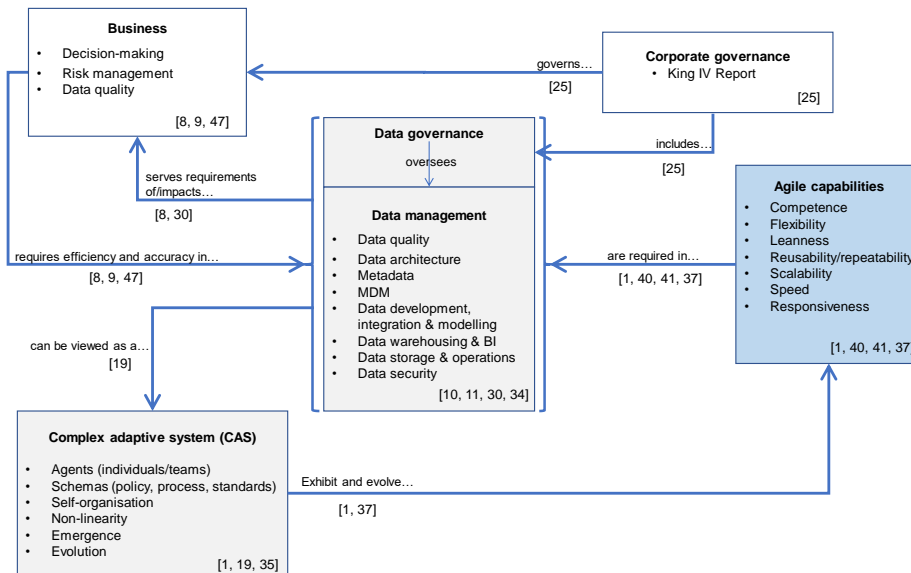
Research conducted by Otto [6], recognizes the need to consider the organizational goals in conjunction with the organizational structure when designing and shaping DG and DM. The substructures within an organization must serve the organization's current goals with an increased organizational emphasis on adaptability and participation [39]. Fruehauf et al. [27] conclude that it is vital to gain an in-depth understanding of an organization and how its people collaborate with each other in the use of its data when designing an effective DG framework. Challenges are presented to the DG organization in the form of data silos, politics and data ownership battles where data decisions affect multiple operational business units [34].

There are some variations in the literature concerning what constitutes the exact scope and locus of DG [6, 10, 11] and there is no single, prescribed approach for implementing DG and DM [12]. However, there seems to be a consensus that data quality is a common concern and requirement in the realm of DG [7, 9, 24, 27, 34, 44]. The organization of DG should have representation and involvement at all levels of the business that have an interest in the data being governed [6, 34].

Research conducted in the IT, legal and business fields respectively, highlights the importance of effective, thorough information and DG [5, 47, 51]. DG must be closely aligned with IT governance in its structure, processes, relationships with IT and business, as well as its goals for creating value for business [11, 45]. Sound DG enables sourcing of good quality data for analytics purposes [8, 28]. The importance of

developing and maintaining data standards is also emphasized [42, 44]. DG must support an organization's decision-making processes [7, 8, 24 ].

The realm of DG and DM can be viewed as a CAS [19] where agents are the individuals and teams that perform the roles of DG and DM. Agents continuously seek to maximize their capability to sustain their existence within a changing environment [32]. Agile capabilities in organizations lead to higher levels of organizational performance [1, 15, 26, 55]. Agility is viewed as a key element of competitiveness, which better enables the organization to survive in volatile market conditions [26]. Agile governance capabilities have been hypothesized to increase value delivery to business resulting in the overall improved performance of the organization [1]. As shown in Table 1, seven agile capabilities were identified from the documented research as aspects that typically coexist with agility. The findings of this study were synthesized and are presented in Fig. 1.



**Fig. 1.** A preliminary framework for the constructs and agile capabilities of data governance and data management.

## 8 Conclusion

This research proposed that agility is required in the organization and execution of DG and DM in order to deliver value to business and support business agility [15, 26, 29, 36]. The study of DG across entire organizations is of recent interest to researchers [56]. It is worthwhile researching the optimization of efficiencies in DG and DM as agility

is required at all levels of the DG and DM functions in order to fulfil the business requirements for timeous, useful data for both operational and strategic reasons.

There is currently a limited amount of research available that looks specifically at the phenomenon of agility in the organization and execution of DG and DM. The agents and schemas of DG and DM operate within a CAS [19]. The non-linear relationships and interactions amongst the agents and teams of agents within the DG and DM domains create the chaos within the CAS. Data must survive this chaos to retain its value. The data itself creates complexity as it passes through many processes, business rules, applications, manual and automated processes, and integration points which are internal or external to the organization. The emergence of agile capabilities and innovation occurs at the edge of order and chaos [29, 35].

A limitation of the SLR conducted for this study exists in the possibility that not all of the relevant literature was located, and that the types of studies, as well as the methods used in the studies were not specifically considered [57]. Furthermore, the identified agile capabilities were not empirically tested within the context of DG and DM. Similar research might benefit from a wider investigation of widely-used practitioner frameworks. The focus of research in the domains of technology and business seems to have largely been on Agile software development and organizational agility. Data is, however, fundamental to all aspects of organizational activities, from strategy to regulatory compliance. If data is not governed and managed in a way that delivers trustworthy information exactly where and when it is needed, business agility is negatively impacted.

Although organizations in developing countries currently face challenges in establishing effective and responsive DG and DM practices, it is an important consideration for their sustainability in a volatile, competitive and increasingly regulated global environment [20, 21, 52]. The constructs and agile capabilities of DG and DM identified in this study, are potentially useful for future research looking to develop a framework for agile DG and DM that is applicable to organizations in both developed and developing countries. Even though the literature review conducted in this study is not exhaustive, it served to highlight the importance of organizing and executing the governance and management of data in an agile way that supports business requirements and organizational agility.

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