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AN INVESTIGATION INTO THE ROLE OF DATA GOVERNANCE IN IMPROVING DATA QUALITY: A CASE STUDY OF THE OMANI BANKING SECTOR

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Research Paper

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Abstract

In the era of big data analytics, data is widely recognised as a valuable asset that can enable organisations to achieve their strategic objectives. Despite that, banks are still struggling to maintain high-quality data. Prior studies show that a data governance programme can play a critical role in improving data quality. It can provide data quality professionals with a holistic approach to formally define policies, procedures and decision rights required for managing data quality in a more systematic manner. However, few empirical studies were conducted in this area. Therefore, the present paper aims to close this gap by investigating the data quality problem in the Omani banking industry to understand how various data governance mechanisms can address this issue. The study adopted a qualitative case study with semi-structured interviews and document reviews being used to collect data. A theoretical framework by Abraham et al. (2019) was adopted to guide the collection and analysis of the data. A thematic analysis (TA) by Braun and Clark was followed for data analysis. Findings of the study suggest that the data governance mechanisms, namely 'performance measurement', 'compliance monitoring' and 'training', have positively contributed to mitigating data quality issues in the Omani banking sector.

Keywords: Data quality, data governance, information governance, the banking industry

1 Introduction

In the banking industry, data are increasingly seen as a valuable asset due to their use in making strategic decisions and maintaining competitive advantage (De Abreu Faria *et al.*, 2013; Najjar and Bishu, 2005; Redman, 1995). In essence, banks are highly regulated by national and international laws mandating them to maintain high-quality data to respond to regulatory requirements and external pressures such as market changes (Bonollo and Neri, 2012; Dadashzade, 2018; Khan *et al.*, 2019). Also, banking institutions need to rely on accurate data to improve customer satisfaction, develop new products, perform data analytics and achieve profitability (De Abreu Faria *et al.*, 2013; Du and Zhou, 2012; Jung, 2004). Likewise, central banks have to collect high-quality data from their supervised institutions to ensure effective supervision and financial stability (Motjolopane and Lutu, 2012). However, poor data quality can negatively affect the organisation's bottom line, resulting in ineffective strategies, higher operational costs, compliance risks, and loss of reputation (Najjar and Bishu, 2005; Redman, 1998; Wende, 2007). According to recent research by Gartner, poor data quality is estimated to cause losses of 15 million US dollars per year (Moore, 2018). Furthermore, it has been reported that banking professionals spent between 25 and 50 per cent of their time in finding, assembling, correcting, validating, and cleaning data, preventing them from concentrating on core tasks that contribute to the achievement of corporate's strategic goals (Dadashzade, 2018; Du and Zhou, 2012).

However, banking data are either outdated, incomplete, inconsistent, irrelevant or stored in fragmented databases, making it difficult for data stakeholders to trust the data source (Redman, 1998; Najjar and Bishu. Moreover, core banking systems such as credit facilities and deposits have increased in size and complexity, leading to many silo databases (Dadashzade, 2018). In Oman, for example, banks maintain thousands of databases with customers' data being stored in a different data repository, making it difficult to obtain a single source of truth. This problem calls for a holistic data management framework to address data quality issues in banks and other financial intuitions.

A growing body of literature attempts to investigate the data quality issues in the banking sector (e.g., Dadashzade, 2018; Karkošková, 2022; Motjolopane and Lutu. Also, a search[1] of data quality management literature revealed a variety of frameworks (e.g., Cai & Zhu, 2015; English, 1999; Otto et al., 2007; Sebastian-Coleman, 2013; Stvilia et al., 2007) that aim to guide organisations on how to define, assess and improve data quality. Cichy and Rass (2019) provide a comprehensive review of different data quality frameworks categorised based on their primary purpose, components and data quality dimensions. Although the identified frameworks provide practical steps for improving data quality, they have limitations. Most frameworks focus on a particular aspect of data management activity like data ownership (e.g., Vilminko-Heikkinen & Pekkola, 2019). Furthermore, the existing frameworks provide limited information about the precise data management practices that need to be adopted by the organisation in order to address data quality issues. However, from the practitioners' perspective, these specific details are critical to formularise the data quality activities among the key stakeholders (Cheong and Chang, 2007). Given the shortcomings of existing data quality frameworks, this paper intends to propose a different approach based on a data governance framework.

Data governance (DG) has gained popularity as a helpful framework for enhancing data quality (Cheong and Chang, 2007; Koltay, 2016). Data governance is an organisation-wide framework that "specifies decision rights and accountabilities for an organisation's decision making about its data. Furthermore, [it] formalises data policies, standards, and procedures and monitors compliance" (Abraham et al., 2019, p. 425-426). Given its potential benefits in organising the data management activities, few studies have investigated the role of data governance mechanisms in improving the data quality in the banking industry (De Abreu Faria *et al.*, 2013; Traulsen and Tröbs, 2011). To our best knowledge, no previous research has empirically investigated the research problem in the Omani banking sector. In sum, the review of the literature shows two key gaps exist. First, the IS literature has provided little empirical evidence and understanding about the effects of data governance mechanisms on data quality. Second, most of the reviewed studies only focused on top management views (e.g., Issn & Dadashzade, 2018), neglecting the views of other business functions like compliance and IT that deal with data quality issues on a daily basis. To close these gaps, this study aims to contribute to the literature by empirically applying the data governance framework in a real-world context of the Omani banking industry. To achieve this goal, the following research question was formulated:

RQ: How can various data governance mechanisms help address the data quality problem in the Omani banking industry?

The remaining part of the paper is organised as follows: Section 2 summarises the relevant literature on data quality and data governance. Section 3 describes the research methodology, data analysis process, and the theoretical framework of the study. In section 4, the findings of the study are presented, followed by a further discussion of these findings in section 5. Finally, section 6 concludes the paper by describing the theoretical and practical implications of findings, as well as some key limitations.

[1] To identify relevant data quality studies and frameworks, the following terms were used: "data quality", "data quality frameworks" "data quality management" and "data management"

2 Literature review

This section summarises the relevant literature to help the reader understand data quality and its quality dimensions, approaches to improve data quality, and data governance mechanisms to improve data quality.

2.1 Definition of Data Quality

In the era of big data analytics, data quality (DQ) has gained much attention from academia and industry (Cai and Zhu, 2015; Juddoo, 2016; Redman, 1998). The term data quality has been widely defined as "data fitness", which implies that data are suitable for use to satisfy their intended purpose in a specific context (Data, 1998; Liu, 2013; Strong *et al.*, 1997). It has been argued that 'data fitness' is not a one-size-fits-all organisation because DQ is measured and analysed from multiple attributes or dimensions (Fox *et al.*, 1994; Shanks and Corbitt, 1999; Weber *et al.*, 2009).

2.2 Data Quality Dimensions

Wang and Strong (1996) defines the DQ dimension as "a set of data quality attributes that represent a single aspect or construct of data quality" (p. 6). According to previous studies, in order for the data to be valuable to data users, it must be evaluated from multiple dimensions rather than just one dimension (Bovee *et al.*, 2003; Shankaranarayanan and Cai, 2006; Wang and Strong, 1996). However, some researchers (e.g. Olson, 2003) believe that data quality can be measured solely by accuracy, neglecting to consider and analyse other important dimensions for achieving higher quality (Sidi *et al.*, 2012). The review of data quality literature reveals a plethora of quality dimensions (Fox *et al.*, 1994; Sidi *et al.*, 2012); yet, there is no consensus on the exact definition of each dimension due to the contextual nature of quality (Batini *et al.*, 2009). Recent research by Jayawardene et al. (2013) and Sidi *et al.* (2012) provided a comprehensive description of data quality dimensions and their related definitions. Among these dimensions, most data quality researchers (e.g., Fox *et al.*, 1994; Redman, 1997) highlighted the following four dimensions: accuracy, completeness, consistency, and accuracy as the most critical dimensions for improving data quality. These four dimensions were chosen for this study because, according to Najjar and Bishu (2005), they are more commonly used in the financial and banking industries. Table 1 below provides brief definitions for each data quality dimension.

Dimensions	Definitions
Accuracy	"Data accuracy refers to the degree with which data values agree with an identified source of correct information" (p. 17)
Completeness	"Degree of the presence of data in a given data collection" (p. 9)
Consistency	"Data consistency refers to data values in one data set being consistent with values in another data set" (p. 26)
Currency	"The extent to which a datum or information is sufficiently up-to-date and appropriate for the task at hand" (p. 16)

Table 1. Data quality dimensions and definitions (Adapted from Jayawardene et al., 2013)

2.3 The importance of data quality in the banking industry

The importance of high-quality data in the banking industry cannot be overemphasised given the strict and ever-changing regulations that require continuous improvement of data management programmes (Bruno *et al.*, 2017; Dadashzade, 2018; Najjar and Bishu, 2005; Parker, 2007). Banks and other financial institutions have to collect and maintain high-quality information to comply with existing regulatory requirements on data quality, such as Basel II and anti-money laundering (AML) legislation (Bonollo and Neri, 2012; Khan *et al.*, 2019). Thus, it is not surprising that regulatory bodies like central banks impose mandatory compliance requirements on data quality since it directly impacts the reputation and profitability of the bank (Dadashzade, 2018; Khan *et al.*, 2019; Najjar and Bishu, 2005). In practice, banks and financial institutions use data to make critical decisions related to customers, loan applications, risk assessment, investments and anti-money laundering (Parker, 2007; Al Wahshi *et al.*, 2021). Therefore, managers and data stakeholders must rely on accurate and reliable information to operate efficiently and effectively (Du and Zhou, 2012; Jung, 2004; Najjar and Bishu, 2005). From the compliance perspective, having accurate and complete information can help reduce frauds and financial crimes by assigning customers to the appropriate risk categorisation: 'low', 'medium', 'high' (Khan *et al.*, 2019).

2.4 Data quality problem in the banking industry

Poor data quality can negatively impact the banking and financial sectors (Haug *et al.*, 2011). Given its importance, many researchers (e.g., Bruno et al., 2017; Issn & Dadashzade, 2018; Lutu & Motjolopane, 2012; Najjar & Bishu, 2005) have attempted to investigate the impact of poor data quality in the banking industry. A recent case study conducted by Issn and Dadashzade (2018) found that data quality problems in local commercial banks have been attributed to poor corporate governance, lack of data standardisation, unintegrated systems, incorrect data, and inability to calculate the costs of low data quality. In comparison, Lutu and Motjolopane (2012) have identified different issues relating to data quality in central banks, which may indicate a need for a holistic approach tailored to the specific goal of each banking institution. However, due to data quality issues, many banks have failed to implement data quality improvement initiatives such as data warehousing projects and business intelligence tools (Debbarma *et al.*, 2013; Li *et al.*, 2010; Najjar and Bishu, 2005). In this regard, it is argued that creating awareness around the importance of high-quality data and assigning clear roles and responsibilities are the critical success factors for ensuring effective data management in an organisation (Cheong and Chang, 2007; Redman, 1998; Wende, 2007). Indeed, fixing and enhancing data quality is a complex process that goes beyond the technical aspects; it requires expertise, robust data strategy, policies, standards, decision rights, accountabilities, and ongoing training (Abraham *et al.*, 2019; Koltay, 2016; Wende, 2007).

2.5 The need for data governance to improve data quality

According to Cheong et al. (2007), addressing data quality issues requires people, technology, and processes that collectively contribute to the data management process. With these requirements in mind, it seems that data governance (DG) can help organisations in addressing the key limitation of 'physical IT artefacts' (i.e., hardware, software, network) that inadequately handle the data assets over their lifecycle (Kooper *et al.*, 2011; Tallon *et al.*, 2013). Data governance is a new concept in information management (IM) literature that has emerged due to the inadequacy of IT governance (ITG) in managing data assets (Abraham *et al.*, 2019; Tallon *et al.*, 2013). Therefore, it is suggested that DG not be incorporated into ITG, but rather, should co-exist with ITG and overall corporate governance (Traulsen and Tröbs, 2011). In essence, a data governance program aims to maximise the value of enterprise data while minimising their potential risks by ensuring data quality, security and compliance (Abraham *et al.*, 2019; Khatri and Brown, 2010). Whilst there is no generally accepted definition for data governance in current literature, it can be broadly defined as a cross-functional framework that "specifies decision rights and accountabilities for an organisation's decision making about its data. Furthermore, data governance formalises data policies, standards and procedures, and monitors compliance" (Abraham et

al., 2019, p. 425-426). Despite its potential benefits, calculating the return on investment (ROI) for a data governance project is challenging, resulting in a delay in obtaining the management buy-in and approval. Additionally, previous studies reveal several challenges that may hinder the implementation of data governance in organisations (Cai and Zhu, 2015). The most common challenges, perhaps, include lack of clear data roles and responsibilities, lack of awareness, and inadequate controls or metrics (Cheong and Chang, 2007; Ndamase, 2020; Tallon *et al.*, 2013). In order to overcome such organisational barriers and improve data management, several data governance frameworks have been developed for the banking industry (e.g., De Abreu Faria, F., Macada, A., & Kumar, 2013; Egan, 2011; Traulsen & Tröbs, 2011), healthcare sector (e.g., Donaldson & Walker, 2004), defence manufacturing (e.g., Lajara & Maçada, 2013), and country-level (e.g., Mullon & Ngoepe, 2019). However, most of these frameworks are incomplete or focus on a specific issue, such as the distribution of decision-making rights and responsibilities, providing little actionable direction for the organisation (Ndamase, 2020). Therefore, in order for organisations to select a suitable data governance framework, they must consider their unique requirements, aims, and internal and external contextual factors (for example, laws, regulations and organisational structure) that could enable or inhibit its implementation (Abraham *et al.*, 2019; Weber *et al.*, 2009).

3 Research methodology

The study adopted a qualitative case study approach (Stake, 2005) that involved eight months of fieldwork in the research setting to understand the problem from the participants' social and cultural context. Nine Omani banks from different categories: 1 regulatory, 5 local, 1 Islamic, 1 specialised and 1 foreign (international).

Data for this study included semi-structured interviews and documents review. Different data collection methods such as field notes were used to triangulate data (Carter *et al.*, 2014; Flick, 2004), improving the validity and reliability of the research data. Participants of different groups were purposely chosen based on their involvement in data management related domains (e.g., IT, compliance, information security). Data were collected until they were replicated or saturated (i.e., "no new codes or themes 'emerge' from data" (Braun & Clarke, 2021, p. 201). However, additional interviews were conducted to ensure no relevant information was missing. In this study, the sample size was fifty-one.

Semi-structured interviews were conducted with data stakeholders from different business functions, including chief technology officers, chief information security officers, chief compliance officers; chief audit officers, IT managers, data quality analysts, data stewards, database administrators, data analytics professionals, compliance officers, heads of big data/business intelligence, risk managers, heads of performance management, heads of IT governance, and heads of legal. Regarding the participants' demographic details (see Appendix A), 43 were male compared to 8 females (n = 51). In terms of their academic qualifications, the majority of participants held a master's degree (n = 30) followed by a bachelor's degree (n = 18) and diploma (n = 3). The total years of participants' experience ranged from 5 to 40 years.

Given the COVID-19 pandemic, most interviews were conducted virtually using video conferencing tools (Gray *et al.*, 2020). Before conducting the interviews, participants were briefed about the purpose of the research, data confidentiality procedures, benefits and potential risks associated with taking part in this study. Interviews were audio-recorded after obtaining permission from the participants except for two people who showed some concerns related to the confidentiality and privacy of data. In these specific cases, handwritten notes were taken by the researcher and then cross-checked with the participant to validate his or her responses. The interview guide was designed based on a priori understanding and theoretical concepts drawn from the theoretical framework of the study (i.e., Abraham *et al.*, 2019). A sample interview questions can be found in Appendix B. Each interview lasted between 45-90 minutes and was conducted entirely in English. All audio-recorded interview data was transcribed verbatim in order to improve the analysis and interpretation of verbal data (Halcomb and Davidson, 2006).

Data collected for this study were analysed using thematic analysis (TA) by Braun and Clarke (2006, 2019), which involves data familiarisation, coding, theme identification, analysis, and reporting of themes within data. Field notes and memo-writing were captured at different stages of the research to record the researcher's initial thoughts and reflections. NVivo 2020 software was used to facilitate the data analysis and coding process. The codes for this study were systematically generated through two recursive phases. In phase one, a deductive (or top-down) coding was applied by which a predefined list of codes was used to code the data (Saldaña, 2013). In the second phase, inductive coding was used to develop new codes directly from the raw data (Saldaña, 2013). In terms of coding strategy, both descriptive (i.e., a word or short phrase) and In-Vivo (i.e., exact participant's words) were applied to label the codes. Finally, themes were identified using a sorting strategy that involved grouping codes based on their similarities (Adu, 2019). The themes/categories for this study were chosen based on their prevalence across the datasets (i.e., interviews) and their keyness to the research question (see section 1).

3.1 The research context

The banking sector of Oman plays a significant role in ensuring financial stability and growth in the country (Al Ghassani *et al.*, 2017). The sector is regulated by the Central Bank of Oman (CBO)[2], which has the overall accountability of ensuring that banks and other financial institutions are compliant with national and international regulations. The institutional banking framework in Oman combines seven local banks, nine foreign banks, two specialised banks, and two fully-fledged Islamic banks with a total network of 559 branches (CBO, 2020). Broadly, the sector is dominated by commercial banks that hold about 92 per cent of the total assets (CBO, 2020). Despite the significant impacts of the COVID-19 pandemic, the banking industry of Oman remained resilient and supportive of diverse economic activities by offering necessary credit facilities (CBO, 2020). The banking law (Royal Decree 114/2000) was enacted in December 2000, highlighting the regulations and obligations of banking institutions in terms of data requirements and other compliance issues.

3.2 The theoretical framework of the study

The data governance framework depicted in Figure 1 was adopted as a theoretical lens to investigate how various data governance mechanisms can address the data quality problem in the Omani banking industry. It is worth noting that the highlighted concepts in this framework have been inspired by a seminal work conducted by Tallon et al. (2013). Generally speaking, the theoretical framework presented below encompasses three core components, namely antecedents, governance mechanisms, and consequences. On the lift-hand side of Figure 1, the term' antecedents' refers to internal and external conditions that could enable or inhibit the adoption of data governance mechanisms in an organisation (Abraham *et al.*, 2019). However, these antecedent factors may vary according to the industry or country in which the organisation operates (DAMA International, 2010; Tallon *et al.*, 2013). In this study, external antecedents may include banking laws and regulations such as FATF and Basel II, whereas internal antecedents may include organisation strategy and senior management support. Though some antecedents are not predictable, such as market conditions, they have a direct influence on the implementation and expansiveness (or scope) of DG mechanisms in an organisation (Abraham *et al.*, 2019). Depending on their intended goals, data governance mechanisms can be applied to a single project, or entire functions within a firm (intra-organisational scope), or an ecosystem of a large number of firms, including industry peers and vendors (inter-organisational scope) (e.g., Abraham *et al.*, 2019; Tiwana *et al.*, 2013). The present research has focused primarily on data governance at the organisation or bank level. Before embarking on any DG efforts, it is crucial to specify which type of data needs to be governed (Weller, 2008).

[2] See https://cbo.gov.om/

As shown in the "data scope" dimension of the framework, the organisations can either focus on the governance of traditional data –typically structured data, or big data (Lee *et al.*, 2014). Traditional data, as noted by Lee et al. (2014), serves as the backbone of corporate operations, whereas big data provides new business opportunities and insights that traditional data cannot offer. In this study, transactional data such as customers' deposits and withdrawals are deemed the most valuable assets for banks because they enable them to increase profitability, improve customer satisfaction, and comply with regulatory requirements (Dadashzade, 2018; Weller, 2008). According to the theoretical framework of this study, organisations may achieve data governance goals by focusing on one or more data decision domains. These include (1) data quality; (2) data security; (3) data architecture; (4) data lifecycle; (5) metadata; and (6) data storage and infrastructure. Given the aim of this paper, the data quality domain is selected and investigated from four dimensions mentioned in section 2.1.2 above.

In their data governance framework, Abraham et al. (2019) identified three primary governance mechanisms (shown in the middle of Figure 1) for managing data assets in a structured manner. These are considered as core pillars of any DG programme and include the following: (1) structural, (2) procedural, and (3) relational mechanisms. First, structural mechanisms focus on the locus data ownership responsibilities and decision-making authority (i.e., hierarchical or functional positioning), holding employees accountable for any issues that arise due to inadequate management of enterprise data (Borgman *et al.*, 2016). Second, procedural mechanisms involve a set of activities that span over the entire information lifecycle (Tallon *et al.*, 2013), aiming to ensure data are "recorded accurately, held securely, used effectively, and shared appropriately" (Abraham *et al.*, 2019, p. 429). These may encompass data strategy, data quality policies, contractual agreements, compliance monitoring, data backups, and performance measurement (Abraham *et al.*, 2019; Borgman *et al.*, 2016; Tallon *et al.*, 2013). Third, relational practices aim to raise the awareness of data professionals and stakeholders through active collaboration, communication, and continuous training (Abraham *et al.*, 2019; Tallon *et al.*, 2013). Finally, as illustrated on the right-hand side of the framework, adopting data governance mechanisms may lead to two possible consequences: (1) intermediate performance effects and (2) risk management. In the banking industry, DG mechanisms can improve data-driven decision-making and reduce data-related risks associated with fraud and financial crimes (Karkošková, 2022).

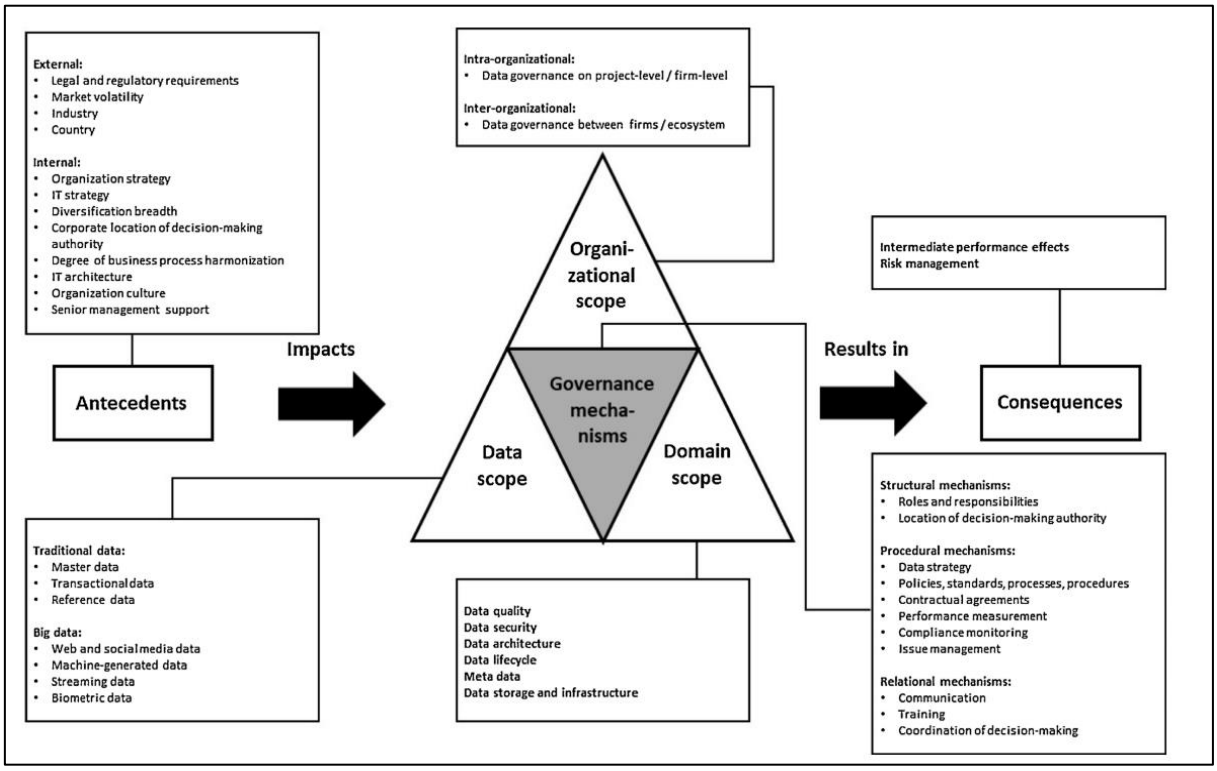

Figure 1. The theoretical framework of study (Abraham et al., 2019)

4 Findings

This research aimed to investigate how various data governance mechanisms can help Omani banks address data quality issues. Three key themes emerged from the analysis of interview data: (1) compliance monitoring (procedural mechanisms), (2) performance measurement (procedural mechanisms), and (3) training (relational mechanisms). While these themes emerged from the theoretical framework of the study, they were chosen due to their prevalence among interviewees and their keyness (or importance) to the research question (Braun and Clarke, 2006). The participants highlighted various data quality issues they experienced, including outdated customer data, erroneous data entry, missing or incomplete data, and data redundancy. However, the majority of compliance officers considered data quality issues a key impediment to their analysis and monitoring of suspicious transactions. On the other hand, the results of this study show that most participants realise the critical role of data governance in improving the quality of data in the Omani banking industry. As a chief compliance officer said: *"nowadays more and more attention is [are] on the data quality and data governance" (P026)*

Another chief internal auditor (P045) added that "…*for us to be able to achieve the business objectives, data governance and [data] quality comes first in the list… [it is] a key element for the bank to succeed. Everybody, you know, used to say garbage in, garbage out"*

The following section summarises the findings of key themes identified in this study.

4.1 Procedural mechanism - Compliance monitoring

This theme represents participants' views on how they used various measures and tools to ensure that data quality policies and regulations were followed. The analysis of interview data shows that compliance departments, in particular, were more concerned about the data quality. Therefore, they adopted various controls to monitor the employee's compliance with the organisational data policies and procedures. During the fieldwork, it was reported that this task was accomplished through periodic audits and data quality assurance reviews. As one Chief Internal Auditor put it:

*"We, as part of every audit, we look at the data quality, any data anomalies, any errors and mistakes in the data, that is the third level. And then obviously the external auditor and central bank examiners, they also look at these aspects, and they keep on giving their observations from their side" (*P021*)*

In addition, the majority of compliance managers (e.g., P004, P007, P008) indicated that they cross-checked customers details through their branch managers before they analysed or reported any suspicious transactions to the Financial Intelligence Unit (FIU):

"…*when we review the customer data, we ensure that all the requisite information is updated and correct and quality information has been captured in the system …so we look at compliance with the policies, compliance with the standards, compliance with the regulations" (P008)*

From the regulatory perspective, compliance was considered everyone's responsibility, and therefore department heads were encouraged to have a comprehensive process in place to ensure their adherence to the established data quality standards. For example, a senior banking examiner (P001) said:

"… *business [departments] should carry that kind of responsibility. So you don't wait for internal audit and compliance and CBO [Central Bank of Oman] and other authorities to come and assess you. You do self-assessment for your adherence to the requirement when it comes to data gathering and data quality …."*

On the other hand, two chief officers (P043 and P011) from the compliance and audit departments alluded to some preventive actions they took when non-compliance cases were detected. These include: (1) sending a warning letter to the employee; (2) recording the problem on the audit observation report, and (3) escalating the matter to the senior management. In sum, the findings show that the Omani banks adopted several monitoring mechanisms to improve data quality, including auditing, supervising data stakeholders, and making suggestions or recommendations for data quality improvement.

4.2 Procedural mechanism - Performance measurement

According to the interview findings, measuring the performance of a data quality program was a common practice followed by the majority of Omani banks that participated in this study. Participants from various functions indicated that they often used key performance indicators (KPIs) to evaluate the effectiveness of data quality at the departmental and organisational levels. Interestingly, employees' appraisals were linked to these KPIs to ensure that they adhered to organisational policies and procedures. For example, ahead of IT auditor from an Islamic bank stated:

"The good thing is that staff KPIs hold some amount of value to the data quality issue. So, employees tend to work very hard to get a better quality of data …" (P037)

Similarly, another IT director (P047) mentioned that they held regular staff meetings to address any data quality issue and track progress towards the intended goals. In this regard, he commented that "…*if a staff has [been] found that he is not securing or maintaining a good quality of data in the bank, then he [they] may have some negative points in his [their] performance …*" (P047)

On the other hand, a database administrator (P042) proposed using computer-based technology, such as data warehouse or data analytics to better monitor KPI compliance:

"*If we have a solution like a data warehouse or a BI [business intelligence], I will be having my own KPIs dashboard … I [can] see a division wise profitability. I [can] see a branch wise profitability… so naturally the data quality [will] go to the top ….*"

4.3 Relational mechanism - Training

Training was the most prevalent theme throughout the interview data. Of fifty-one participants, forty-six indicated they reported that they had attended data-related training sessions (in-person or online). This assertion was supported by a chief compliance officer (P026) who stated: *"training starts from on-boarding of staff. When anybody joins the bank. From there, they start instructing [them] about the data quality and data governance, roles and responsibilities, security of the data …"*

As evidenced by the data analysis, most Omani banks that participated in this research allocated the necessary budget and resources for training their staff on various aspects of data management. The analysis further shows that all employees, including the Board of Directors, had to complete mandatory data-related courses to satisfy national and international laws like AML, and Sarbanes-Oxley Act. Participants used a variety of methods, including emails, social media, posters, and corporate websites, to ensure that all employees were aware of recent training and awareness programmes

However, a chief internal auditor (P045) argued that regular staff meetings were a far more effective approach than others:

"*I am one of the strong believers on the weekly team meetings … where you [we] basically discuss key elements such as information, data quality and strategic elements. Weekly meetings for me is the best approach to educate staff…"*

Given the COVID-19 pandemic, several participants (e.g., P046, P049, P030) confirmed that they moved most of the training courses online. However, to ensure that staff had completed the required data courses, the annual appraisal allocated a particular score for training. As put by the vice president of information governance:

"… as a part of everybody's KPI, we have the learning development center, on an annual basis, we have a special training given on information security, data quality …, and then there's an exam …which they have to pass, and the passing marks is 70% and above. And if they fail, basically, they have to repeat it or otherwise, … it goes into their annual KPI appraisals" (P032)

5 Discussion

As indicated previously, prior studies (Cheong and Chang, 2007; Egan, 2011; Karkošková, 2022; Koltay, 2016) have argued that data governance can significantly improve data quality. This study supports this view by showing how various data governance mechanisms, particularly performance measurement, compliance monitoring, and training were used by Omani banks to address data quality issues. Existing research has focused on a specific component of data management practices such as roles and responsibilities (Redman, 1995; Vilminko-Heikkinen & Pekkola, 2019), neglecting other organisational issues related to policies, procedures and people (Abraham *et al.*, 2019). However, our findings show that these mechanisms do not work in isolation; rather, they complement each other to ensure effective management of data quality throughout the data lifecycle. In this study, participants applied a combination of data governance mechanisms to assign data ownership responsibilities and develop an information culture through an intense training program and ongoing monitoring of data quality performance. While the literature shows that assigning KPIs at the departmental and organisational levels are relevant for enhancing and managing data quality (Masayna et al., 2007; Otto et al., 2007), our findings further suggest that KPIs should be linked to the employees level. Surprisingly, employees' performance measurement has not been discussed thoroughly in the quality management literature, although data quality is considered an operational, organisational and personal problem (Kunttu *et al.*, 2014). The results further indicated that incorporating data quality scorecards into employees' KPIs improves data quality since employees have to fulfil such requirements to achieve a good appraisal. Consistent with Otto et al. (2007), Cheong et al. (2007), and Loshin (2006), the analysis shows that the creation of DQ scorecards improve compliance monitoring and encourage employees to follow defined data quality policies, procedures and guidelines.

Additionally, this study revealed that monitoring tools and organisational practices such as auditing and oversight positively impact data quality performance. This outcome is contrary to Issn and Dadashzade (2018), who reported that strict monitoring and control could negatively impact data quality. This result may be explained by the fact that external entities strictly monitor the Omani banks, and therefore associated data quality standards have to be followed to avoid compliance risks. Our participants reported that audit observations and modern technology like business intelligence enabled them to reduce data quality issues by identifying, correcting, and cleaning data flaws from their sources. Nevertheless, the findings show that employees need to be overseen and motivated to actively engage in any data quality initiative. Lastly, and most importantly, the findings of this study suggested that having an effective training program for data stakeholders increased compliance with data quality requirements, reduced data errors and improved the productivity and agility of the banking institutions. Whilst these findings reflect those of Kerr et al. (2007), Issn and Dadashzade (2018), Otto et al. (2007) and Tallon et al. (2013), it differs from them by linking user training programs to the employees' KPIs. One unanticipated finding was that data quality courses are mandatory for all staff, including the Board of directors, who must pass specific data quality exams before being promoted to higher positions. Furthermore, it was evident that the study participants used various training methods to break down the organisational silos and bring all data stakeholders into a mutual understanding about the importance of high-quality data for the organisation.

6 Conclusion and future work

This study explored the data quality problems in the Omani banking sector to understand how various data governance mechanisms can help improve data quality. We used Abraham et al.'s (2019) data governance framework to guide the collection and analysis of data. Broadly, the findings of this study confirm the relevance and usefulness of the data governance programmes in addressing data quality issues by providing empirical evidence. Specifically, this study found that performance measurement, compliance monitoring and training were among other governance mechanisms that improved data quality in Omani banks. The evidence from this study further suggests the need to include procedural and relational practices in any data quality management approach, which were often ignored in previous studies.

The research contributes to the literature on data governance and data quality. Theoretically, the study provides empirical evidence into the role of data governance mechanisms in addressing the data quality problem by operationalising the data governance framework into the real-world context of the Omani banking industry. As a result, data quality and IS researchers can utilise the findings of this study to modify, refine or extend their existing data quality frameworks. Practically, the study outcomes may provide data professionals and data quality managers in the Omani banks with valuable guidance on approaching the data quality problem in a more systematic manner. Data quality professionals from different business functions may incorporate some of the data governance mechanisms into their day-to-day activities.

Despite these promising findings, the study was limited to a specific context and hence cannot be generalised given the unique contextual factors of the banking industry. Future research may be conducted to validate whether or not the presented findings can be applied in other organisations with different conditions. A further study may also investigate how internal and external factors can influence the adoption of various data governance mechanisms for data quality improvement. Moreover, further research could assess the effects of increased data quality via governance mechanisms on the banks' (intermediate) performance.

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Appendices

To support the description of the participants' characteristics in this research, the following appendix is attached.

Appendix A: Participants' demographic information

Participant ID	Gender	Educational level	Occupation	Years of experience	Bank category
P001	Female	Master's degree	Senior banking development Analyst	11	Regulatory bank
P002	Male	Diploma	Head of compliance	17	Islamic bank
P003	Male	Master's degree	Head of compliance	14	Local bank
P004	Male	Master's degree	Head of compliance	15	Local bank
P005	Male	Master's degree	Head of compliance	11	Foreign bank
P006	Female	Master's degree	Senior banking examiner	9	Regulatory bank
P007	Male	Bachelor's degree	Chief compliance officer	17	Islamic bank
P008	Female	Bachelor's degree	Head of Compliance	8	Local bank
P009	Male	Master's degree	Chief Compliance officer	22	Local bank
P010	Male	Bachelor's degree	Chief compliance officer	11	Islamic bank
P011	Male	Bachelor's degree	Chief compliance officer	23	Local bank
P012	Male	Bachelor's degree	Head of transactions monitoring	7	Local bank
P013	Male	Master's degree	Chief internal audit	25	Local bank
P014	Male	Bachelor's degree	Head of information security	18	Local bank
P015	Male	Master's degree	Head of big data	20	Local bank
P016	Male	Master's degree	Head of business intelligence	15	Local bank
P017	Male	Master's degree	VP, Head of performance management and business intelligence	25	Local bank
P018	Male	Bachelor's degree	Compliance officer	19	Specialised bank
P019	Female	Master's degree	Head of IT governance	12	Islamic bank
P020	Female	Bachelor's degree	Head of information security and data governance	16	Islamic bank
P021	Male	Master's degree	Chief internal auditor	26	Islamic bank
P022	Male	Master's degree	Head of information security and business continuity	20	Local bank
P023	Male	Master's degree	Head of IT core systems and business intelligence	10	Local bank
P024	Male	Master's degree	Deputy head of internal audit	11	Local bank
P025	Male	Bachelor's degree	Head of IT	33	Local bank
P026	Male	Master's degree	Chief compliance officer	31	Local bank
P027	Male	Master's degree	Compliance officer	20	Local bank
P028	Male	Master's degree	Head of IT	40	Specialised bank

P029	Male	Master's degree	Head of information Security	20	Local bank
P030	Male	Master's degree	VP, Head of information security and business continuity	16	Local bank
P031	Male	Bachelor's degree	Information security officer	22	Local bank
P032	Male	Master's degree	VP, Head of IT governance	15	Foreign bank
P033	Male	Master's degree	Head of credit and market risk	28	Local bank
P034	Male	Master's degree	Assistant manager, information security	10	Local bank
P035	Male	Diploma	Deputy head of internal audit	25	Local bank
P036	Male	Master's degree	Executive banking examiner	22	Regulatory bank
P037	Male	Bachelor's degree	Head of IT auditor	20	Islamic bank
P038	Female	Master's degree	Assistant manager, banking surveillance department	14	Regulatory bank
P039	Male	Bachelor's degree	Database administrator	6	Local bank
P040	Male	Bachelor's degree	Head of database and data backups	14	Local bank
P041	Male	Bachelor's degree	Head of digital banking and data analytics	16	Local bank
P042	Female	Bachelor's degree	Database Administrator	5	Local bank
P043	Male	Bachelor's degree	Chief internal auditor	17	Local bank
P044	Female	Master's degree	Operational and market risk Manager	13	Specialised bank
P045	Male	Master's degree	Chief internal auditor	16	Local bank
P046	Male	Bachelor's degree	Head of data quality support and monitoring	26	Local bank
P047	Male	Master's degree	Head of IT	23	Local bank
P048	Male	Master's degree	Head of IT core systems and big data	10	Local bank
P049	Male	Master's degree	Head of legal	13	Local bank
P050	Male	Master's degree	Head IT infrastructure	17	Islamic bank
P051	Male	Bachelor's degree	Data quality analyst	8	Islamic bank

Appendix B: Sample interview questions

1. What policies have you enacted to manage the information lifecycle in your organisation?
2. What measures or controls do you have in place to monitor the data quality performance?
3. How do you ensure that employees in your department/ organisation adhere to established data quality standards and procedures?
4. Who is responsible for the data quality in your organisation?
5. What training does your organisation provide to educate staff on the different aspects of data management? How effective are these training courses in improving compliance with various activities of data management, such as data security and data quality?