Data governance activities: a comparison between scientific and practice-oriented literature

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Abstract

Purpose – The purpose of this paper is to explore the current literature on data governance in scientific and practice-oriented publications, and to provide a comparative analysis of the activities reported for data governance. Data have become a key organisational asset and data governance both a necessary and critical activity.

Design/methodology/approach – A comprehensive literature review is conducted in order to identify the published material that reflects the current state of knowledge. A systematic procedure was followed that identified 61 publications that explicitly mention data governance activities. Open coding techniques were applied to conduct content analysis, resulting in the identification of 591 concepts. A critical analysis also identified gaps in the literature.

Findings – The analysis identified 120 data governance activities which are understood as: "action" plus "area of governance" plus "decision domain" (e.g. define data policies for data quality). The authors define and present a data governance activities model based on the analysis. The analysis also shows a higher volume of data governance activities reported by practice-oriented publications that are associated with the "implement" and "monitor" actions of the areas of governance across the decision domains compared with scientific publications, whereas The authors found that the scientific publications focus more on defining activities. The results contribute to identifying research gaps and concerns on which ongoing and future research efforts can be focused.

Research limitations/implications – This paper is of interest to both academics and practitioners, as it helps them understand the activities associated with a data governance programme. Current literature fails to provide a comprehensive understanding of the data governance activities that are required when considering a data governance programme. Therefore, the proposed model for data governance activities can be used to give insights into these activities.

Originality/value – To the knowledge of the authors, this study is the first to explicitly consider data governance activities from both an academic and practice-oriented perspective.

Keywords Content analysis, Data governance, Data governance activities, Open coding

Paper type Literature review

1. Introduction

The absence of a data governance programme may cause failure in the running of an organisation, as the worth of an organisation's data cannot be determined precisely. To know what data are worth, an organisation is required to know where the data are, how they are used, and where and when they are integrated. In recent years, the volume of data used within organisations has increased dramatically, playing a critical role in business operations (Tallon *et al.*, 2013). In particular, data influence both operational and strategic decisions. The governance of these data has also become critical, where data are treated as a valuable asset (Khatri and Brown, 2010). Data governance has rapidly gained in popularity (Cheong and Chang, 2007; Khatri and Brown, 2010; Weber *et al.*, 2009) and is considered to be an emerging subject in the information systems (IS) field (Hagmann, 2013; Kamioka *et al.*, 2016; Rasouli *et al.*, 2016). Practitioners also consider data governance as a promising approach for enterprises to improve and maintain the quality and use of their data (Otto, 2011a).

It can be argued that data governance, from both the academic and practitioner points of view, should be a universal approach to data accountability, fitting all data aspects and needs of an organisation (Weber *et al.*, 2009; Wende, 2007). A survey of 200 organisations

(Pierce *et al.*, 2008) found that 58 per cent recognised data as a strategic asset, whereas a recent study by Holt *et al.* (2015) indicated that 45 per cent of their participants within the global community of database and data professionals did not have data governance policies in place. Hence, data governance continuously requires more attention from stakeholders (Fisher, 2006).

Academics and practitioners have developed several data governance models that enable us to understand the boundaries of data governance (Cheong and Chang, 2007; Guetat and Dakhli, 2015; Khatri and Brown, 2010; Lajara and Maçada, 2013; Otto, 2011b; Vayghan *et al.*, 2007; Wende and Otto, 2007) and part of the associated activities (DAMA International, 2009; Panian, 2010; Rifaie *et al.*, 2009; Thomas, 2006; Weber *et al.*, 2009). For example, Weber *et al.* (2009) proposed a contingency model for data governance and Otto (2011b) contributed a data governance organisation framework. However, none of these models mentioned explicitly consider data governance activities, although these might form part of the activities that support the proposed models. In addition, to our knowledge, few, if any, publications have the activities associated with data governance with the aim of benefiting academics and practitioners in carrying out a data governance programme.

Therefore, this paper aims to contribute to the IS community by filling the gap identified in the literature through a categorisation of current scientific and practice-oriented publications in the domain of data governance. This categorisation is undertaken in order to understand the activities involved in data governance and to compare scientific with practice-oriented publications in terms of the activities reported. These activities highlight the tasks that need to be performed in order to carry out a data governance programme. Three constructs emerged inductively, representing each of the data governance activities: action, area of governance, and decision domain. The paper concludes with a proposed data governance activities model composed of all the activities, including their order of priority.

This paper is organised as follows: Section 2 presents an overview of the data governance literature and concludes with the research questions considered in this paper; Section 3 describes the research approach used to conduct the literature review, including the publication selection strategy and the data analysis techniques applied; and Section 4 presents the results of our analysis of the reported data governance activities from both scientific and practice-oriented publications including the data governance activities model. We conclude by addressing the limitations in this study and making recommendations for future work in the area.

2. Data governance background
Data governance is defined as "a companywide framework for assigning decision-related rights and duties in order to be able to adequately handle data as a company asset" (Otto, 2011b, p. 47). The main driver for data governance is considering data as an asset of the firm (Panian, 2010). Horne (1995) connected governance with optimal uses of assets, then treated data and information as an asset, which drives the importance of the governance of the data within an organisation. The concept of data as an asset was developed in a report by the Hawley Committee in 1994, which defined data assets as "data that is or should be documented and that has value or potential value" (Oppenheim *et al.*, 2003. p. 159).

It can be argued that "data governance" is a new term with novel implications for data as an asset. However, there are many terms and approaches in the academic literature that deal with data and information under the IS field, such as total data quality management (Wang, 1998), data quality management (Wang and Strong, 1996), among many different approaches and terms (Lucas, 2010; Otto *et al.*, 2007).

The main difference between the terms "governance" and "management" is that governance refers to the decisions that must be made and who makes these decisions in order to ensure effective management and use of resources, whereas management involves

implementing decisions (Fu *et al.*, 2011; Khatri and Brown, 2010). Hence, management is influenced by governance (Otto, 2011c). Therefore, we can distinguish between the activities for data governance and the activities required for data management.

The definition of data governance indicates who holds the decision rights and accountability regarding an enterprise's data assets. Therefore, the decision domains should be identified in order to assign the right responsibilities and duties. In reviewing the literature related to data governance frameworks, the framework proposed by Khatri and Brown (2010) was selected to present the decision domains that should be considered for data governance. The framework contains five interrelated decision domains: data principles, data quality, metadata, data access, and data lifecycle as shown in Table I. These five decision domains follow a similar pattern to the IT governance decision domains proposed by Weill and Ross (2004). Each of the five decision domains addresses a set of core issues, which are explained below.

According to Khatri and Brown (2010), data principles are shown at the top of the framework as they are intended to establish the direction for all other decision domains. Hence, the principles set the boundary requirements for the use of data assets, which in turn addresses the enterprise's standards for data quality. The data quality then refines the basis for how data are interpreted (metadata) as well as accessed (data access) by users. Finally, the data lifecycle decision defines the production, retention, and retirement of data assets which plays a fundamental role in operationalising the data principles into the IT infrastructure.

The purpose of this study is to identify and categorise the literature that explicitly mentions data governance activities in scientific publications and practice-oriented publications as well as comparing the different perspectives in order to formulate a data governance activities model. The aim is also to answer the following research questions:

RQ1. What data governance activities have been reported around the five decision domains in scientific and practice-oriented publications?

RQ2. What are the most important data governance activities presented in the scientific and practice-oriented publications?

3. Research approach

Given that the goal of this study is to gain an in-depth understanding of data governance activities, as reported in scientific and practice-oriented publications, content analysis was deemed an appropriate analysis approach. Content analysis is a frequently used technique when analysing texts (written or visual sources) especially where the meaning of the text is relatively straightforward and obvious (Myers, 2009). Content analysis requires the researcher to code the texts in a systematic way; therefore, through searching for "structures and patterned regularities in the text" (cf. Myers, 2009), the researcher applies a code to a unit of text that seeks to demonstrate the meaning of that text. Once coded, the resulting output can be both quantified and interpreted. Therefore, in effect, content analysis is best understood as "a quantitative method of analysing the content of qualitative data" (Myers, 2009, p. 172). Similar to Finney and Corbett (2007), this research adopted eight

Data principles		
Data quality	Metadata	Data lifecycle
	Data access	

Source: Khatri and Brown (2010)

coding steps in order to conduct content analysis on a selection of scientific and practice-oriented publications. These steps consist of data collection and coding procedures which enable researchers to ensure clarity and transparency in the processes undertaken. These steps and the associated decisions are explained below.

Step 1: decide the level of analysis
This step involves deciding what level of analysis should be conducted. The level of analysis can be a single word, a set of words, phrases, or an entire document (Finney and Corbett, 2007). The level of analysis in this research considered the entire publication in order to identify which of the publications were addressing data governance-related concepts. Therefore, the data collection phase followed a systematic literature review and was initiated by collecting publications through searches of the following databases: the AIS Electronic Library, CiteSeerX, EBSCO Online, Emerald Insight, ScienceDirect, and the ACM Digital Library. These six databases cover the majority of IS journals and conferences (Otto, 2011a). Search criteria were established in each database using the advanced search function. The keyword search criterion of having "data governance" or "information governance" in either the title or abstract was applied on 10 April 2017, followed by a systematic review of the references and citations of the scientific publications that resulted from the initial research. The overall data collection resulted in a total of 307 publications. The scientific publications were published in peer-reviewed academic journals and for conferences, while practice-oriented publications were published by industry associations, software vendors, and analysts.

The abstracts of these publications were reviewed in order to enable the researchers to classify them in terms of scientific or practice-oriented publications, as well as to identify publications that could be excluded or included (see Table II). Of the 307 publications, 151 were excluded and 156 included. The majority of the excluded publications were not related to the data governance domain. They had been published to serve a different interest of study that was not related to data governance, although they mentioned data governance in the abstract. For example, the Martin *et al.* (2014) publication, where data governance is mentioned in the context of "there is a need for data governance in healthcare", was not considered to be directly related to the data governance domain or focusing on the study of data governance activities.

Step 2: decide how many concepts to code for
Here, researchers should decide whether to code text using a predefined set of concepts or develop a list of concepts incrementally during the process of coding (Finney and Corbett, 2007). For this research, the researchers decided to code concepts inductively that could be interpreted as data governance activities. Therefore, all the concepts emerged incrementally through the processes of open coding. Each of these concepts was then categorised as a data governance activity.

Classification	Include/exclude	Number of publications
Scientific publication	Include	80
Practice-oriented publications	Include	76
Not related to the data governance domain	Exclude	126
Not in English	Exclude	5
Duplicates	Exclude	20

Table II.
Initial classification
of publications

Step 3: decide whether to code for the existence or frequency of a concept
After a certain number of concepts have emerged, researchers should decide whether to code the concepts for existence or frequency (Finney and Corbett, 2007). If the concepts are coded for existence, this involves listing only the concepts that emerge. However, coding for frequency makes possible a discussion of saliency and emphasis (Finney and Corbett, 2007). For this research, it was decided to code for frequency in order to gain a deeper insight into the concepts that emerged, as well as to enable the researchers to compare the results between scientific and practice-oriented publications.

Step 4: decide on how you will distinguish between concepts
During this step, researchers should decide whether to code the concepts exactly as they appear, or if they can be coded in some altered or collapsed form (Finney and Corbett, 2007). For this research, it was decided to follow open coding analysis techniques suggested by Corbin and Strauss (1990), whereby concepts that appear to be similar are grouped together under a higher order, more abstract concept called a category.

Step 5: develop rules for coding your text
It is necessary to define certain translation rules in order to ensure the consistency of the coding procedures (Finney and Corbett, 2007). The following translation rules were established and applied during the coding procedure:

- All publications were read the first time in order to code data governance activities. There should be an imperative verb that indicates that an action should be taken around data governance.

- All the concepts that emerged from the publications were compared to identify similarities and differences in order for them to be labelled together in categories.

- Once all the publications had been coded, the researchers examined the concepts that emerged and their properties within the actual text in order to ensure that they reflected the meaning of the text and that they were being related to the correct category.

Step 6: decide what to do with "irrelevant" information
This stage involves determining what to do with information in the text that was not coded (Finney and Corbett, 2007). Carley (1993) suggested that deleting irrelevant information can facilitate content analysis procedures by generating simplified text. In this research, the 156 publications initially included received a more in-depth review in order to identify which of the publications explicitly mention data governance activities. Of the 156 publications, only 61 explicitly mention the required or recommended data governance activities. These activities are the conditions or things that need to be performed in order to be considered as doing data governance. In order to be coded as concepts, the sentence had to contain an action (imperative verb), such as "define", "establish", "manage", and "create".

Step 7: coding the text
Once the decision relating to irrelevant information is made, the coding procedure should start following the translation rules identified in Step 5 (Finney and Corbett, 2007). As mentioned earlier, this research adopted an open coding analysis technique, which is part of a grounded theory approach (Corbin and Strauss, 1990). Open coding analysis is widely applied in conducting content analysis for a set of publications (Finney and Corbett, 2007; Goode and Gregor, 2009; Grahlmann *et al.*, 2012) and is described as "the process of breaking down, examining, comparing, conceptualising, and categorising data" (Corbin and Strauss, 1990, p. 61). Analysing the publications using open coding enables identification of

the related concepts that can be considered as emerging activities for data governance within the text of each publication within a recognised procedure.

Open coding is a process that aims to identify the concepts or key ideas that may be hidden within data and are likely to be related to a phenomenon of interest (Bhattacherjee, 2012). Concepts and categories are generated in the open coding stage (Glaser, 1992) and, when the categories are developed, their properties and the dimensions of the properties are identified (Corbin and Strauss, 1990). Table III shows the terms that are involved in open coding relevant to this study as defined by Corbin and Strauss (1990).

Step 8: analysing the results
After coding the data, researchers should decide how to review and present the results (Finney and Corbett, 2007). For this research, a frequency count was the principal method of representing the data governance activities. However, in order for the results to be compared fairly, they were translated to a scale reflecting levels of reporting, namely: none, low, medium, and high. The scale levels were calculated by applying the "percentile" (Anderson *et al.*, 2011) which provides information about how the data are spread over the interval from the smallest value to the largest value. The scale was of four levels for the scientific publications and other scale for the practice-oriented publications. Table IV shows the frequency scale for each of the levels.

4. Data governance activities analysis
A total of 156 publications were reviewed, 61 of which explicitly mention data governance activities. The 61 publications were classified by publication type: either scientific publications, including peer-review publications, or practice-oriented publications, including publications by industry associations, software vendors, and analysts. The 61 publications are listed in Table V.

While reviewing and applying the open coding analysis procedure to the 61 selected publications, an MS Excel spreadsheet was developed. The spreadsheet was constructed to include a reference to each open coding stage, including referencing the original text using Mendeley, a document management application.

Term	Definition
Concept	Conceptual labels placed on discrete happenings, events, and other instances of phenomena
Category	A classification of concepts. This classification is revealed when concepts are compared one against another and appear to pertain to a similar phenomenon. Thus, the concepts are grouped together under a higher order, more abstract concept called a category
Coding	The process of analysing data
Properties	Attributes or characteristics pertaining to a category

Source: Adapted from Corbin and Strauss (1990, p. 61)

Table III.
Definitions of
the terms that
are included in
open coding

	Scientific publications		Practice-oriented publications	
	From	To	From	To
None	0	0	0	0
Low	1	3	1	3
Medium	4	7	4	7
High	8	18	8	14

Table IV.
Scale of the levels
of the frequency
count for each type
of publication

Scientific publications (35 in total)	Al-Ruithe *et al.* (2016), Becker (2007), Cheong and Chang (2007), Cousins (2016), Donaldson and Walker (2004), Elliott *et al.* (2013), Fu *et al.* (2011), Gillies and Howard (2005), Guetat and Dakhli (2015), Kersten (2013), Khatri and Brown (2010), Kooper *et al.* (2011), Lajara and Maçada (2013), Larkin (2008), Lomas (2010), Meyers (2014), Otto (2011a, b, c, 2012), Palczewska *et al.* (2013), Panian (2010), Rickards and Ritsert (2012), Rifaie *et al.* (2009), Rosenbaum (2010), Shaw-Taylor (2014), Silic and Back (2013), Tallon *et al.* (2013), Tallon *et al.* (2013), Vayghan *et al.* (2007), Watson *et al.* (2004), Weber *et al.* (2009), Weller (2008), Wende (2007), Wende and Otto (2007)
Practice-oriented publications (26 in total)	Alderson (2014), Bach (2006), Blair (2010), Bowen and Smith (2014), CDI Institute (2006), Cohen (2006), DAMA International (2009), Dember (2006), Dyché (2007), Economist Intelligence Unit (2008), Hutchinson and Sharples (2006), IBM (2007), Informatica (2013), Information Builders (2011), Khatcherian and Jefferson (2009), Loshin (2013), Moghe (2009), Nwolie (2011), Oracle (2011), Reeves and Bowen (2013), Russom (2008), Sheridan and Watzlaf (2016), Suer and Nolan (2015), The Data Warehousing Institute (2010), Thomas (2006), Wood (2013)

Table V.
List of
publications selected

The open coding analysis procedure was conducted in an iterative manner (as described in Step 7), starting with reading each publication and searching for any actions (imperative verbs) (see Step 6). These concepts were then compared for similarities and differences in order to categorise them into higher abstracted categories which are considered as data governance activities. Reviewing the concepts that emerged allowed us to maintain their meaning by deconstructing each of the concepts to consist of three constructs: action, area of governance, and decision domain. These constructs were later considered as the constructs of the abstracted categories (data governance activities). The actions are imperative verbs that should be undertaken within an activity, whereas the areas of governance are those aspects or functions that should have an action around them. Finally, the decision domains are one of the five referred to by Khatri and Brown (2010) in which activities are performed. Table VI shows the terms used in the coding procedure associated with the number of results counted after reviewing the 61 publications. This is followed by an explanation of the three constructs.

Reviewing the 591 concepts, three "actions" across the "areas of data governance" emerged. These "actions" indicated the doing of data governance, and were named as follows: define, implement, and monitor. The researchers found that all the imperative verbs in the concepts could be turned into one of these three actions. For example, according to Cheong and Chang (2007, p. 1007), "The first step to setting up a formal data governance programme is to determine a Data Governance structure", in which the verb "determine" can be interpreted as "define". Another example comes from Weber *et al.* (2009, p. 4:2): "It establishes organisation wide guidelines and standards", in which the verb "establish" can be deemed to mean "define".

However, an interpretation of these actions relies upon the context itself. Therefore, each imperative verb could be interpreted as one of the three actions in one case and to another

Term	Count	Coding example
Concept	591	Define guidelines for data quality management
Action	3	Define
Area of governance	8	Data guidelines
Decision domain	5	Data quality
Category/DG activity	120	Define data guidelines for data quality

Table VI.
Terms included
in coding procedures
and the total
number of results

action in others, such as the verb "develop" in some contexts means to "define" and in others can mean "implement". For example, in an excerpt from Weber *et al.* (2009, p. 4:6), "data governance develops and implements corporate-wide data policies", the verb "develop" means to "define". In contrast, in an excerpt from Panian (2010, p. 943), "to establish data definitions and taxonomies, define master data, develop enterprise data models", the verb "develop" can be interpreted as "implement", as it is related to implementing a data model.

Eight "areas of governance" emerged inductively during the comparison procedure for the concepts that were then categorised as follows: data roles and responsibilities, data policies, data processes and procedures, data standards, data strategy, data technologies, data guidelines, and data requirements. Each of the 591 concepts could be placed into one of these areas of governance.

The third construct is the "decision domain". The analysis found that honouring the five decision domains defined by Khatri and Brown (2010) gave in-depth insights into the actual focus of the activity. However, some of the 591 concepts were reported to cover more than one decision domain, and in some instances all the five decision domains. For example, a concept labelled as "define data policies" without any specified domain was considered to cover all five domains.

The illustrative example below shows how the concepts were placed into a category which was considered to be a data governance activity that consisted of the three constructs. Wende (2007, p. 417) stated that "data governance defines roles, and it assigns responsibilities for decision areas to these roles. It establishes organisation-wide guidelines and standards for DQM". Through coding this excerpt, four concepts emerged, which were placed into categories of data governance activities. Table VII illustrates the four concepts and the breakdown of the constructs.

During the comparison procedure, using the schema as outlined in Table VII, the 591 concepts were categorised into 120 data governance activities from either a scientific or practice-oriented point of view. Figure 1 illustrates the three constructs with the values that emerged for each of them.

| Concept | Category | | |
	Action	Area of governance	Decision domain
Defines roles	Define	Data roles and responsibilities	For all decision domains
Assigns responsibilities for decision areas	Implement	Data roles and responsibilities	For all decision domains
Establishes guidelines for data quality management	Define	Data guidelines	For data quality
Establishes standards for data quality management	Define	Data standards	For data quality

Table VII.
The concepts that emerged and their categories
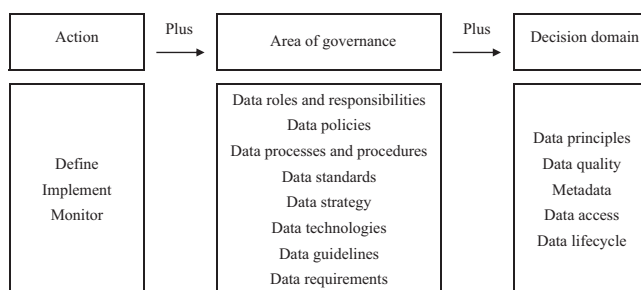
Figure 1.
Illustration of the three data governance activities constructs, including possible values

4.1 Findings

In order to answer the first research question, Table VIII illustrates the results of the open coding analysis, including the level of frequency reported for the "areas of data governance" under each respective "action" across the five "decision domains" for the scientific (S) publications compared with the practice-oriented (P) publications. In the event that a publication mentioned an activity more than once, the frequency was noted as "1", unless that same area was mentioned with different actions or associated with another decision domain.

Our analysis shows a considerable degree of ambiguity on the data governance activities, as none of the publications explain in detail the activities that are required to conduct a data governance programme. The actions that are reported are mostly mentioned as part of a definition of data governance or in the context of the roles and responsibilities of data governance stakeholders. Therefore, from a comprehensive view, it was found that the highest frequency count was for the area of "data roles and responsibilities" under the "define" and "implement" actions across the five "decision domains" from both scientific and practice-oriented publications. Hence, it can be argued that to "define" and "implement" "data roles and responsibilities" across the five "decision domains" is seen as the initial

Actions	Area of governance	Decision domains									
		Data principles		Data quality		Metadata		Data access		Data lifecycle	
		S	P	S	P	S	P	S	P	S	P
Define	Data roles and responsibilities	High	High	High	High	High	High	High	High	High	High
	Data policies	High	High	High	High	High	High	High	High	High	High
	Data processes and procedures	Low	High	High	High	Low	High	Low	High	High	High
	Data standards	High	High	High	High	High	High	High	High	High	High
	Data strategy	High	Low	Low	High	High	High	High	High	High	Low
	Data technologies	Low	Low	Low	Low	High	High	Low	Low	High	Low
	Data guidelines	Low	Low	Low	Low	Low	Medium	Medium	Low	Medium	Low
	Data requirements	Low	High	High	Low	Low	Medium	Medium	Low	Low	Low
Implement	Data roles and responsibilities	High	High	High	High	High	High	High	High	High	High
	Data policies	Low	High	High	Low	Low	Low	Low	Low	Low	High
	Data processes and procedures	Medium	Medium	Medium	Low	Medium	Low	Medium	Medium	Medium	Low
	Data standards	Medium	Medium	Low	High	Low	Low	Low	High	Medium	Low
	Data strategy	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Data technologies	None	Medium	Low	Medium	Low	None	Medium	Medium	Medium	High
	Data guidelines	Low	Medium	Medium	Low	Low	Low	Low	Medium	Medium	Low
	Data requirements	Medium	Low	Low	Medium	Medium	Low	Medium	Medium	Medium	Low
Monitor	Data roles and responsibilities	Low	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium	Medium
	Data policies	Low	Low	Medium	Medium	Medium	Medium	Low	Medium	Low	Low
	Data processes and procedures	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Data standards	Medium	Low	Low	High	Medium	Low	Medium	Medium	Medium	Medium
	Data strategy	Medium	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Data technologies	None	Medium	None	Medium	None	Medium	None	Medium	None	Medium
	Data guidelines	Medium	Medium	None	Low	Medium	Medium	None	Medium	Medium	None
	Data requirements	Low	Low	High	Low	Low	Medium	High	Medium	High	High

S: Scientific publications
P: Practice-oriented publications
High · Medium · Low · None

Table VIII.
Frequency level analysis of the data governance activities mentioned in the selected publications

activity for conducting a data governance programme, as stated by Cheong and Chang (2007, p. 1007): "The first step to setting up a formal data governance program is to determine a Data Governance structure. The structure provides escalation authority and a basis for a transparent decision making process". The assigned roles and responsibilities will, in turn, influence how the other activities will be performed within the structure of the data governance programme.

Another noticeable finding is that the majority of the publications report activities under the "define" action. Significantly less publications consider the "implement" action, and only a few reported activities under the "monitor" action. This is especially so in the scientific publications. As can be seen in Figure 2, the 591 concepts that emerged were classified into the three actions – "define", "implement", and "monitor" – in the scientific and practice-oriented publications. There is a comparative lack of research into activities under the "implement" and "monitor" actions.

In comparison, for the eight "areas of governance" across the five "decision domains", the "define" action was reported more frequently by scientific publications than by practice-oriented publications. However, for the "implement" and "monitor" actions, it was observed that the practice-oriented publications focused more on these two actions compared with scientific publications. Therefore, this indicates a higher level of maturity by scientific publications in terms of defining the areas of governance across the five "decision domains". It can also be argued that the practice-oriented publications, particularly those from traders (such as Loshin, 2013; Russom, 2008; Thomas, 2006), focus more on the operations aspects of a data governance programme, which are mostly under the actions of "implement" and "monitor". This argument is also applicable in the case of "data technology", as this receives more in-depth focus from practice-oriented publications compared with scientific publications. On the other hand, "data requirements" under the "monitor" action receive more attention from both types of publication compared with other "areas of governance". This could be due to the actual components of the "data requirements", as compliance to internal and external regulations is categorised under "data requirements". Therefore, because of the nature of governance, monitoring compliance with regulations is a fundamental activity for any governance type.

Additionally, as can be seen in Figure 2, although the total number of reported activities for the "define" action is higher than for other actions in the practice-oriented publications, the difference is not as dramatic as in the scientific publications. Upon examining the 591 concepts that emerged in more detail, it was found that the majority of publications that report activities with "implement" and "monitor" actions had already reported the "define" action in the same publication (such as DAMA International, 2009; Panian, 2010; Russom, 2008; Wende, 2007). This comprehensive perspective provides a direction for
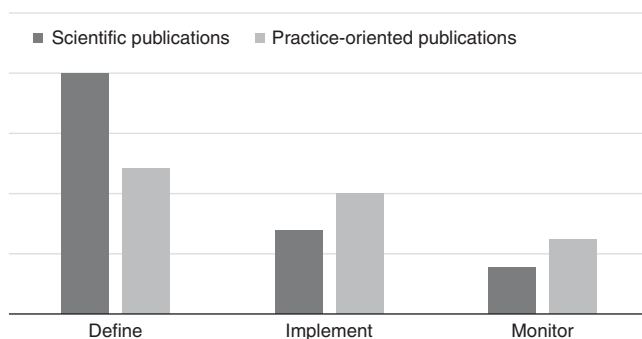
Figure 2.
Comparison of the total number of concepts that emerged classified into the three actions

conducting a data governance programme by focusing initially on defining the areas of governance across the five decision domains and then implementing and monitoring them.

When considering the five decision domains, many of the publications mention such activities without specifying the decision domain. For example, according to Panian (2010, p. 942), "It establishes the rigorous data standards", whereby establishing data standards is considered to be the case for all the five decision domains. However, some of the reported activities explicitly focus on one of the decision domains, such as Weber *et al.* (2009), who mention the need to "develop a corporate data quality strategy" in order to develop a data strategy for data quality as a decision domain. Figure 3 shows the level of focus for each of the five decision domains from scientific and practice-oriented publications.

It can clearly be seen in Figure 3 that the majority of reported activities are placed explicitly under "data quality" as a decision domain, which is not surprising as data quality plays a fundamental role in conducting a data governance programme. It can also be argued that one of the motivations for having a data governance programme is to increase the data quality level (Otto, 2011c). However, "data access", "data lifecycle", and "metadata" have been reported by practice-oriented publications more frequently than scientific publications as they are considered a technical part and more the remit of IT function. For example, Khatri and Brown (2010, p. 149) refer to the data lifecycle as "Determining the definition, production, retention and retirement of data". Therefore, the data lifecycle as a decision domain includes the technical processes (definition, production, retention, retirement of data, and more) that determine how data are treated.
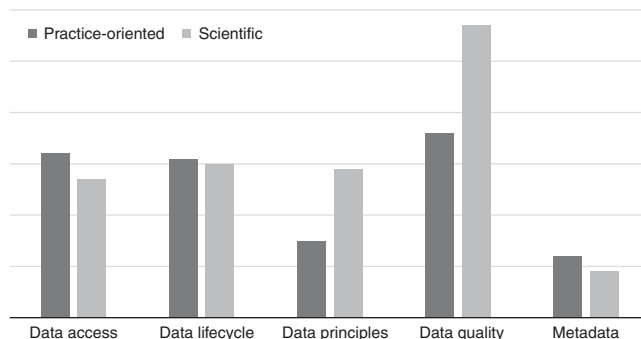
4.2 Data governance activities model

The previous arguments led to the identification of data governance activities that are recommended in conducting a mature data governance programme in any organisation. This also answers the second research question: What are the most important data governance activities presented in the scientific and practice-oriented publications?
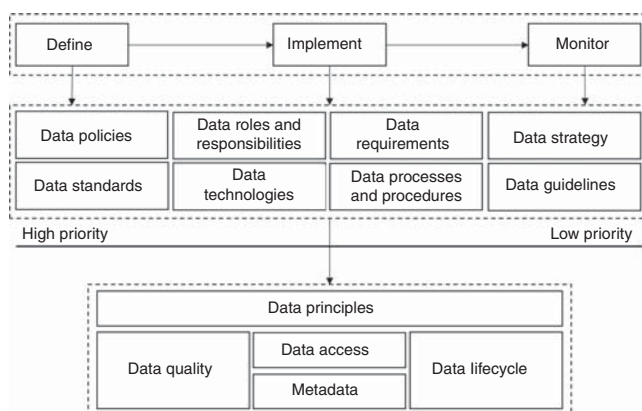
Figure 4 presents the data governance activities model, which consists of the three data governance activities constructs: action, area of governance, and decision domain.

The model recommends beginning with the activities by defining the eight areas of governance across the five decision domains. These areas of governance can then be implemented and monitored. Nevertheless, at a high level, the model suggests the priority for the areas of governance based on the frequency count from both scientific and practice-oriented publications.

The main areas of governance that overweigh the other areas from the perspective of the frequency count of the reported activities around the eight areas of governance from both scientific and practice-oriented publications are "data policy", "data standards", and "data roles and responsibilities". These areas are reported in greater depth compared with

Figure 3.
Comparison of the total number of concepts that emerged classified into the five decision domains

Figure 4.
Data governance
activities model

other areas of governance. DAMA International (2009) considers data policies and data standards to be the primary deliverables in a data governance programme. In addition, many of the publications such as Weber *et al.* (2009) and Wende (2007) consider determining data roles and responsibilities as the initial activities for conducting a data governance programme. For example, the data governance model by Wende (2007) focuses only on the data roles and responsibilities in a data governance programme.

Having said that, the other areas of governance should be in place in order to conduct a data governance programme. For example, data technologies is an area of governance that receives more attention from practitioners as it is related more to the technology artefact. For example, the CDI Institute (2006, p. 12) stated that, in the context of performing data governance from an IT perspective, it involves "developing architecture best practices and standards" and "building governance infrastructure, technology and supporting organization" that emphasise the importance of considering the technologies that relate to conducting a data governance programme.

5. Conclusions and research implications

Research in the data governance domain is growing in IS, as is the need for research in this area as more organisations consider data as a valuable asset. A review of the data governance literature shows that there is a lack of research that explicitly studies activities for governing data. Nevertheless, there is some research that contributes to our understanding of data governance through modelling (Khatri and Brown, 2010; Otto, 2011b; Tallon *et al.,* 2013). These studies reveal some progress in exploring the activities that are required for governing data.

According to Rowe (2014), there is a need within the IS community to publish more literature reviews. He argues that "literature reviews can be highly valuable" and "every researcher looks for [a literature review] when starting a research study" (Rowe, 2014, p. 242). So where the main goal of a literature review is "to classify what has been produced by the literature" (Rowe, 2014, p. 243), we believe that we have achieved this for data governance activities and mapped the territory (see Table VIII) using the defining structure provided for a data governance activity (see Figure 1).

Rowe (2014, p. 246) suggests that "the quality of a literature review depends on its systematicity, since systematicity implies reproducibility through documenting the search process and potentially indicates comprehensiveness". This research study identified and analysed 61 scientific and practice-oriented publications that focus on data governance activities. Using a systematic approach, through the eight coding steps of content analysis, the selection process yielded 307 publications that were subjected to selection and exclusion

criteria, which led to the exclusion of 151. Following a more in-depth review of the remaining 156 publications, 61 were found to serve the research purpose explicitly. These 61 publications were analysed using an open coding analysis technique suggested by Corbin and Strauss (1990). This technique was selected to conduct an in-depth content analysis of the data governance activities mentioned in these publications. Therefore, we believe that we have achieved the systematicity required to ensure the reproducibility of our work by others.

5.1 Implication to theory and practice

This research concluded with a comparison of the data governance activities that are reported in scientific publications with those reported by practice-oriented publications. It was found that the scientific publications focus more on defining activities, whereas the practice-orientated publications consider the implementation and monitoring of activities. Therefore, more academic research is needed around the "implement" and "monitor" actions in data governance. This research is concluded by presenting a data governance activities model which consists of the three constructs of data governance activities: action, area of governance, decision domain. The proposed data governance activities model (see Figure 4) can support practitioners when organising or auditing a data governance programme by helping them understand the activities involved as well as the priorities for each activity. Furthermore, the model can be used as a conceptual framework for future field study research on data governance activities.

One of the main contributions of this research is the defining structure provided for a data governance activity. We argue that a data governance activity is best understood as a combination of "action" plus "area of governance" plus "decision domain" (see Figure 1). This defining structure is a step forward in helping academics and practitioners examine the realities of data governance activities. For example, defining the data policies for data quality is very different to defining the data roles and responsibilities for data quality; therefore, our analysis and resulting activities model allows for a greater depth of understanding across data governance.

5.2 Limitations and future work

This research has two key limitations. First, the research presented in this paper concluded with a frequency count of data governance activities and a data governance activities model. There is no detailed description of each of the 120 activities identified in this paper due to page length limitations. Second, due to the nature of this research (a literature review), the data governance activities model that emerged has not been tested and validated through empirical research. Therefore, as a recommendation for further research, we suggest that the data governance activities should be validated by conducting field studies, as well as being described in greater detail, in order to be more valuable to both academics and practitioners.

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