A CONTINGENCY APPROACH TO DATA GOVERNANCE

(Research Paper)

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Abstract: Enterprises need data quality management (DQM) to respond to strategic and operational challenges demanding high-quality corporate data. Hitherto, companies have assigned accountabilities for DQM mostly to IT departments. They have thereby ignored the organizational issues that are critical to the success of DQM. With data governance, however, companies implement corporate-wide accountabilities for DQM that encompass professionals from business and IT. This paper outlines a data governance model comprised of three components that build a matrix comparable to an RACI chart: data quality roles, decision areas, and responsibilities. The data governance model documents the data quality roles and their type of interaction with DQM activities. In addition, the paper identifies contingency factors that impact the model configuration. Companies can structure their company-specific data governance model based on these findings.

Key Words: Data governance, IT governance, data quality management, data governance model, contingency theory

INTRODUCTION

Companies are forced to continuously adapt their business models. Global presence requires harmonized business processes across different continents, customers ask for individualized products, and service offerings must be industrialized [cp. 1]. These factors certainly impact the business process architecture and the IT strategy of organizations. Ultimately, however, data of high quality are a prerequisite for fulfilling these changing business requirements and for achieving enterprise agility objectives [2]. In addition to such strategic factors, some operational domains directly rely on high-quality corporate data, such as business networking [3-5], customer management, [6-8], decision-making and business intelligence [9, 10], and regulatory compliance [11].

Data quality management (DQM) focuses on the collection, organization, storage, processing, and presentation of high-quality data. In addition, there are organizational issues that must be addressed, such as maintaining sponsorship, managing expectation, avoiding scope creep, and handling political issues [12-15]. Despite the organizational and business relevance of DQM, however, responsibility for improving data quality and managing corporate data is often assigned to IT departments [11]. Also, many companies try to cope with data quality (DQ) issues by simply implementing data management or data warehouse systems. Surveys on data warehousing failures reveal that organizational rather than technical issues are more critical to their success [16].

Integrated DQM is required in order to address both organizational and technical perspectives. Successful data quality programs identify the organizational processes behind data quality [17]. With data governance, companies implement corporate-wide accountabilities for data quality management that encompass professionals from both business and IT. Data governance defines roles and assigns

responsibilities for decision areas to these roles. It sets up organization-wide guidelines and standards for DQM, and assures compliance with corporate strategy and laws governing data.

There is only limited research on data governance. Apart from a few DQM approaches dealing with accountabilities [13, 18], an elaborate analysis of the interaction of roles and responsibilities and the design of decision-making structures is missing. Therefore, this investigation incorporates data governance sources from consultants, analysts and practitioners [17, 19-24].

Both academic and practical sources presume data governance to be a universal approach – one that fits all enterprises alike. Research on IT governance indicates that the distribution of accountabilities for IT management differs between companies based on contingencies, such as corporate governance mode or firm size. Moreover, several IT governance models exist, such as centralized and decentralized IT governance [25-27]. Previous research falls short of providing a comparable analysis for data governance and the accountabilities for DQM.

As data governance comprises parts of IT governance, this paper suggests that contingencies affect data governance and that a data governance configuration is specific to a given company. Essentially, it proposes a flexible data governance model composed of roles, decision areas and responsibilities; and it outlines which contingencies influence the company-specific configuration of the model. Whereas this paper focuses on the accountability aspect of data governance, it does not examine guidelines and compliance facets.

This investigation contributes to data quality management research by advancing the state of the art regarding data governance. In contrast to prior research, it proposes a contingency approach to decision-making frameworks as part of DQM. The data governance model outlines the three components of such a framework, namely roles, decision areas, and responsibilities. For the components, the paper identifies typical data quality roles and decision areas, and proposes a method to assign responsibilities. It proposes a first set of contingencies and demonstrates their impact on the data governance model. More specifically, the contingencies impact two main parameters of the model, the organizational structuring of DQM activities and the coordination mechanisms of decision-making. This approach respects the fact that each company needs a specific data governance configuration contingent on a set of context factors. A data governance model helps companies to structure and document their data quality accountabilities. The contingencies and their impact on the model demonstrate which configuration best fit their company. Finding the best model configuration ensures that DQM contributes to the above mentioned business goals of a company. Neglecting it means that DQM runs the risk of being just an end in itself.

The remainder of the paper is structured as follows: The next section introduces and relates IT governance to data governance. The following section outlines the idea and the components of the data governance model. It proposes data quality roles, decision areas, and responsibilities. Subsequently, a section is devoted to the contingency theory of data governance. It outlines a contingency model based on two parameters – organizational structuring and coordination mechanisms. The last section summarizes this paper and discusses its managerial and research implications.

BACKGROUND

Governance for Data Quality Management

Governance in general “refers to the way the organization goes about ensuring that strategies are set, monitored, and achieved” [28, p.35]. Corporate governance sets the institutional and policy framework

for corporations. Different accepted sources give recommendations for the definition of concrete policies and principles for corporate governance [e.g. 29]. Based on these principles, companies must translate the overall guidance into concrete guidelines for different organizational domains, such as the accounting department, the IT organization, etc. Establishing governance for data quality management requires a clear understanding of its scope and its relationships to other domains.

To a certain extent data governance is comprised by IT governance [20]. This perception is related to the understanding of data management being a discipline of IT management. On the other hand, most IT governance research analyzes technological, IT systems focused IT management functions and decision areas, such as IT infrastructure management, IT use management, IT architecture, and IT investment [25, 30]. Organizational issues that are outside the scope of IT management, such as maintaining sponsorship, managing expectation, avoiding scope creep, and handling political issues are an important aspect of DQM [12-15]. For example, data governance publications demand business data stewards assuring that data quality policies are followed by business processes [13, 20, 22]. Business data stewards are professionals from functional departments and are not part of the IT organization. Furthermore, data is owned by the enterprise or the shareholders of the enterprise [13, 17]. In contrast, IT assets, such as IT systems or databases, are owned by the IT organization. Moreover, data and information[1] are often treated as an "asset" or "product", i.e. an integral production factor of the company [32]. Figure 1 shows the scope of DQM within the context of IT and quality management.

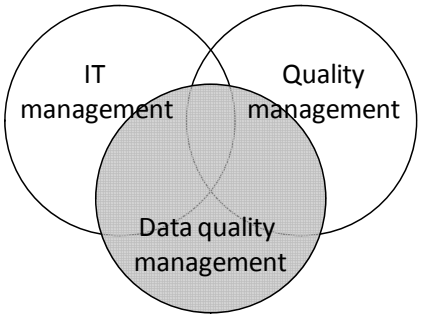

Figure 1. Data quality management in the context of IT and quality management

This paper refers to data quality management as quality-oriented data management, i.e. data management focusing on collecting, organizing, storing, processing, and presenting high-quality data. Data or information quality is defined on the basis of two consentient aspects: first, the dependence of perceived quality on the user's needs; second, the so-called "fitness for use", which is the ability to satisfy the requirements of intended use in a specific situation [33, 34]. One common denominator of these definitions is that DQ is considered a multi-facet construct, consisting of a set of DQ attributes (referred to as data quality dimensions) requiring consumer assessment [35]. Examples of these dimensions are accuracy, completeness, consistency, relevancy and timeliness.

IT Governance

Besides lower costs and more informed employees, enterprises seek competitive advantages through investments in IT. Enterprises have often been unable to realize the expected value from strategic IT investments. Henderson and Venkatraman [36] argue that this inability results from misalignment between business and IT strategy. Successful initiatives demand the combined efforts of technology and business specialists which are directed, controlled and coordinated through IT governance arrangements

[1] The term data is often distinguished from information by referring to data as "raw" or simple facts and to information as data put in a context or data that has been processed [10, 31]. In line with most data or information quality publications, the terms data and information are used interchangeably throughout the paper.

[25]. IT governance – as a subset of corporate governance – "assists in the achievement of corporate success by both efficiently and effectively deploying secure and reliable information through the application of technology" [37, p. 9].

Prior IT governance research points to the importance of aligning IT governance arrangements with the overall enterprise context. Scholars investigated the relationship between a firm's IT governance design and its organizational context factors [25-27, 37, 38]. The underlying assumption is that there is no universal IT governance design for all enterprises and that the context factors impact the contribution of IT governance in enhancing corporate performance.

Contingency theory of organizational design has outlined similar dependencies: The relationship between some characteristic of an organization and its organizational effectiveness is determined by contingencies. Traditionally, contingency theory addressed environmental fit or fit of organizational structure with environmental conditions [39-41]. Scholars later enhanced contingency theory by taking into account internal conditions, such as structural formalization and specialization, as contingencies [42-44].

Following this contingency approach, IT governance research came up with IT governance patterns or models – each model fitting a different set of contingencies. Early studies examined the singular effects of organizational context variables taken from classical contingency theory (such as organization size, competitive strategy, locus of decision-making authority/control) on single IT functions [45-48]. They proposed two IT governance models: In *centralized models* corporate IT performs all IT functions, whereas in *decentralized models* business units' IT performs these tasks. A third pattern, the *federal model*, distinguishes between two types of IT functions: The management of the use of IT is decentralized to business units, and the management of IT is centralized [49, 50]. The federal form is associated with hybrid (including matrix) structures within multidivisional firms [51].

Acknowledging the reality that firms are influenced by more than one contingency factor simultaneously, Sambamurthy and Zmud [25] investigated the influence of multiple contingencies on the location of IT decision rights (decentralized, centralized, and federal). Further, they added a third type of IT functions and distinguished between IT infrastructure management, IT use management and project management. The reasoning behind IT governance shifted from *performance of IT functions* to *authority for IT decision-making* within these functions. Brown [27] shifted the focus from the organizational level to the business unit level. In the *hybrid model* she proposed, the IT use function is decentralized to some but not all business units within the same enterprise. She argued that to understand these different arrangements, context variables need to be addressed at the business unit level.

The IT governance archetypes proposed by Weill [30] further contribute to a more elaborated view on IT governance models. Instead of two organizational units (corporate IT vs. line IT), he considers senior business executives, IT professionals from corporate teams and business units, and business unit leaders or business process owners having decision authority for IT management functions. In addition, he distinguishes five major decision areas, namely IT principles, IT architecture, IT infrastructure strategies, business application needs, and IT investment and prioritization. Finally, he extends IT governance models by a third element, the distinction between decision rights and input rights. However, he limited the number of possible combinations of those three dimensions to six mutually exclusive archetypes. Although the archetypes define IT governance on an enterprise-wide level, Weill suggested that IT governance in large enterprises should also be designed and assessed on a business unit level or by region or groups of business units. Weill [30] named certain factors as contingent on IT governance, but did not specify how these factors influence the IT governance archetypes. Later, Weill and Ross [38] partly filled this gap by analyzing the contingency factor performance .

In conclusion, IT governance research has analyzed two domains: the organizational structuring of IT activities and the placement of decision-making authority, and the effect of multiple contingencies on the contribution of IT governance to corporate performance. It proposes three dimensions that compose an IT governance model: roles, major decisions areas and assignment of accountabilities. IT governance models can be designed on several organizational levels.

Data Governance

Data governance specifies the framework for decision rights and accountabilities to encourage desirable behavior in the use of data.[2] To promote a desirable behavior, data governance develops and implements corporate-wide data policies, guidelines and standards that are consistent with the organization's mission, strategy, values, norms and culture [cp. 30]. Compared with the extensive body of IT governance research, academic research on data governance is in its infancy. Data quality management approaches address tasks for improving and sustaining high-quality data. For example, Total Data Quality Management (TDQM) [12, 31, 32] proposes detailed tasks for defining, measuring, analyzing and improving information quality organized in a cycle. These approaches deal with DQM accountabilities by describing data quality roles and their responsibilities. English [13], for example, portrays 19 roles and their responsibilities in his Total Quality data Management (TQdM) approach. He distinguishes business from IT responsibilities and suggests three teams with overarching accountability for specific decisions. Table 1 depicts the contribution of these two DQM approaches, that of the framework for Information Quality Management (IQM) [15], and of the DQ program by Redman [18] to data governance.[3]

DQM approach	Roles	Decision areas / tasks	Accountabilities
TDQM [12, 31, 32]	Information product manager (IPM)	TDQM cycle (define, measure, analyze, improve)	IPM manages information process and resulting product
TQdM [13]	19 different roles (from business and IT, incl. three teams)	TQdM methodology (five processes for measuring and improving DQ)	Each role has defined accountabilities; teams have overall and problem-solving authority
Framework for IQM [15]	Line managers, domain experts, IT managers, IT support staff, and top management	Matrix with four views (target community, information product, information processes, infrastructure) and four phases in the information life cycle	Each role is responsible for one view; top management has additional strategic and tactical tasks
DQ for the information age [18]	Leaders, process owners, information professionals	DQ program (error detection, process control and improvement, process design, DQ policy)	Each role has defined accountabilities

Table 1. Data quality management approaches and their contribution to data governance

In addition to these DQM approaches, this investigation analyzed data governance [17, 19, 20, 22, 24], master data governance [23] and information governance [21] sources from consultants, analysts and practitioners. All these approaches propose between three and five key roles for data quality programs and outline their responsibilities. They use the term "data stewardship" to refer to accountabilities, committal, and collaborative business practices for managing data as an asset [17]. In their book on customer data integration (CDI) Dyché and Levy [20] devote a chapter to data governance and stewardship. For their twelve CDI roles, they suggest detailed skill profiles to facilitate the assignment of employees to roles.

[2] In the absence of academic definitions of data governance, this definition was adapted from the IT governance definition of Weill [30].

[3] These four approaches have been chosen because they are comprehensive DQM examinations with a substantial portion of business-related responsibilities. They focus on long-term data quality improvement and error prevention rather than error correction.

In conclusion, all available data governance sources from scholars and practitioners focus on organizational structuring and the placement of decision-making authority for DQM. However, an elaborate analysis of the interaction of roles and responsibilities and the design of decision-making structures is missing. Compared with IT governance research, data governance sources have hitherto only addressed one of the two domains. All sources postulate a universal data governance approach – one that should fit all companies alike. They fall short of analyzing the interrelation of the distribution of accountabilities for DQM and contingency factors. Moreover, they do not distinguish more than one data governance design. This might be the reason why companies find it difficult to set up and maintain organizational structures designed to assure and sustain high-quality data throughout the enterprise.[4]

The next two sections aim at narrowing the gap between the insights IT governance research provides and the state of current data governance research. They suggest that contingencies affect data governance and that a data governance configuration is specific to a given company. The first section presents a flexible data governance model composed of roles, decision areas and responsibilities. The second section outlines how contingencies influence the company-specific configuration of the model.

DATA GOVERNANCE MODEL

The data governance model is comprised of data quality management roles, decision areas and main activities, and responsibilities, i.e. the assignment of roles to decision areas and main activities. The three components are arranged in a matrix (cp. Figure 2). The columns of the matrix indicate the roles in DQM. The rows of the matrix identify the key decision areas and main activities. The cells of the matrix are filled with the responsibilities, i.e. they specify degrees of authority between roles and decision areas. A company outlines its individual data governance configuration by defining data quality roles, decision areas and responsibilities, and by subsequently arranging the components into the model. This configuration is unique for each company.[5]

Roles / Decision Areas	Executive Sponsor	Data Quality Board	Chief Steward	Business Data Steward	Technical Data Steward
Plan data quality initiatives	A	R	C	I	I
Establish a data quality review process	I	A	R	C	C
Define data producing processes		A	R	C	C
Define roles and responsibilities	A	R	C	I	I
Establish policies, procedures and standards for data quality	A	R	R	C	C
Create a business data dictionary		A	C	C	R
Define information systems support		I	A	C	R

R – Responsible; A – Accountable; C – Consulted; I – Informed

Figure 2. Draft of a data governance model

[4] The findings of a recent survey among data management professionals indicate that data governance is rarely adopted [19]. Only 8% of respondents had deployed a data governance initiative, 17% were in the design or implementation phase.

[5] For a more extensive overview of the data governance model please refer to [52].

From the analysis of literature relating to DQM and data governance (as outlined in the previous section), the data governance model uses a set of four *roles* and one committee – the data quality board. Table 2 compares the roles and the committee. It provides a short description, the level and part of the organization to which the roles typically belong, and alternative names found in the sources. Names in brackets only partly match either the description or organizational assignment.

Role	**Description**	**Organizational Assignment**	**Sources**
Executive Sponsor	Provides sponsorship, strategic direction, funding, advocacy and oversight for DQM	Executive or senior manager (e.g. CEO, CFO, CIO)	Strategic information steward [13], executive level [21], executive sponsor [22], (executive council) [24]
Data Quality Board	Defines the data governance framework for the whole enterprise and controls its implementation	Committee, chaired by chief steward, members are business unit and IT leaders as well as data stewards	Business information stewardship team [13], data governance council [20, 22], data governance committee [19], GRCS board [24], trustee council [20], (legislative level) [21]
Chief Steward	Puts the board's decisions into practice, enforces the adoption of standards, helps establish DQ metrics and targets	Senior manager with data management background	Master data coordinator [23], director of data management [20], chief steward [22], corporate steward [19], lead stewards [24], (data czar) [20]
Business Data Steward	Details the corporate-wide DQ standards and policies for his area of responsibility from a business perspective	Professional from business unit or functional department	Information professionals [18], business information steward [13], business data steward [20], subject area steward [21], master data lead [23], domain steward [19], business steward [22], subject matter expert [20]
Technical Data Steward	Provides standardized data element definitions and formats, profiles and explains source system details and data flows between systems	Professional from IT department	Database steward & information architecture steward [13], technical steward [22], source system data steward [20]

Table 2. Set of data quality roles

Data quality management not only covers technical or system-related aspects but also business-related and organizational issues. This interdependency between a company's IT and its business goals has been emphasized by [53], addressing the overall linkage between strategy and IT via processes; and [54], who explicitly deal with the supportive role of IT for business processes. Inter-linkage between business strategy, processes and IT has further been concretized and operationalized in the field of Business Engineering [55]. With reference to Business Engineering, the data governance model addresses DQM on three horizontal layers: strategy, organization, and information systems. The following *decision areas and key tasks* are a consensus from existing approaches to DQM [12-15, 18].

Strategy – Design a Data Quality Strategy
A DQ strategy is required to manage and direct all DQ activities in line with the business strategy. It includes the strategic objectives which are pursued by DQM, how it is aligned with the company's strategic business goals and its overall functional scope. Main tasks include:

- develop a data quality strategy including strategic objectives,
- define a portfolio of strategic data quality initiatives,
- formulate the business case, and
- carry out a status quo assessment and establish a review process.

Organization – Design the Operational and Organizational Data Quality Structure

Designing the operational and organizational DQ structure includes defining roles and responsibilities, determining information needs, defining metrics and standards, and designing data processes. More particularly, main activities include:

- determine consumers' information needs,
- define "data manufacturing" processes,
- define roles and responsibilities across divisional boundaries,
- specify data quality metrics and standards, and
- establish policies and procedures.

Information Systems – Design the Data Quality Architecture
On this layer, DQM comprises the development of a common information object model that ensures a consistent understanding of data. Information system support includes the definition of systems that store and distribute data as well as support data management processes, and tools that support the DQ improvement process. The main activities on the information systems layer are:

- develop a common information object model,
- create a business data dictionary, and
- define information systems support incl. DQ tools.

The *assignment of responsibilities* to roles in the data governance model follows the idea of a Responsibility Assignment Matrix (RAM) [e.g. 56]. The most popular type of RAM is the RACI chart. For example, the IT Governance reference framework COBIT uses the RACI chart to define responsibilities [57]. RACI is an acronym for the four types of interaction: Responsible, Accountable, Consulted and Informed. Mapped to the domain of DQM, they denote:

- Responsible ("R"): role that is responsible for executing a particular DQM activity.
- Accountable ("A"): role that is ultimately accountable for authorizing a decision regarding a particular DQM activity.
- Consulted ("C"): role that may or must be asked to provide input and support for a DQM activity or decision before it is finished.
- Informed ("I"): role that may or must be notified of the completion or output of a decision or activity.

The abbreviations "R", "A", "C", "I" fill the cells of the matrix and depict the kind of responsibility a role has for a specific DQM activity or decision. Contrary to project and change management handbooks [e.g., 56, 58], the data governance model allows more than one "A" in a row, i.e. more than one role may be accountable for authorizing a decision. This approach respects a cooperative culture and conjointly made decisions. However, only one "R" is allowed per row, i.e. only one role is ultimately responsible for executing an activity. This rule guarantees the commitment of one single role for finishing the task. With more than one "R", no role will actually feel responsible.

The presented data governance model with its decisions areas, roles, and responsibility assignments represents a common denominator. When applying the model in practice, however, companies will configure it to their individual needs by elaborating the distribution of interaction types on the one hand, and by using additional roles and decision areas responding to specific requirements on the other hand.

TOWARDS A CONTINGENCY APPROACH FOR DATA GOVERNANCE

Methodology

Prior data governance research has provided organizational structures that should fit all companies alike. It has thereby ignored the fact that each company requires a specific data governance configuration that fits a set of contingencies. The data governance model described in the previous section allows for

company-specific configurations of data governance. However, the model on its own does not provide an indication of how to build and fill in the matrix. This chapter aims at investigating this question. It translates IT governance research into a contingency approach for data governance (cp. Figure 3).

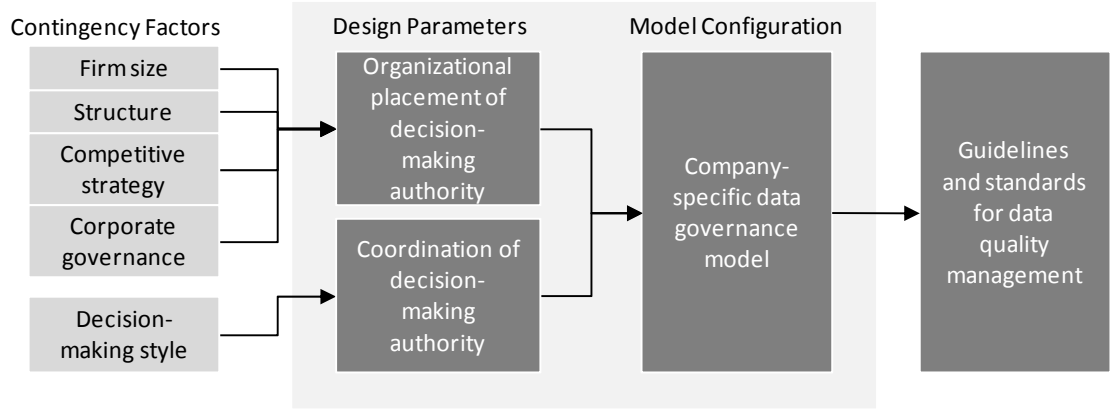

Figure 3. A contingency model for data governance

A company-specific data governance configuration depends on organizational contingencies. Two design parameters facilitate understanding the way contingencies affect the individual design of a company's data governance model: organizational placement and coordination of the decision-making authority. They range between the two opposed value pairs centralized/decentralized and hierarchical/cooperative as described below. The design parameters affect the configuration of the data governance model, i.e. their value influences the assignment of responsibilities within the matrix. It says which role is responsible for a specific activity, who needs to be consulted and informed, and who is ultimately accountable.

The following two sections justify the two parameters by referring to IT governance publications. They explain contingency factors to these parameters and demonstrate how the parameters affect the configuration of the data governance model. Two tables summarize these effects, i.e. they specify the assignment of responsibilities to the data quality roles using the RACI notation.

Organizational placement of decision-making authority

IT governance research using a contingency approach has analyzed the *organizational placement of decision-making authority* and the organizational structuring of IT activities in large, multidivisional firms [26, 27, 59, 60]. It distinguishes two patterns: a centralized and a decentralized IT governance design. The *centralized design* places all decision-making authority in a central IT department. The *decentralized design* is present when all decision-making authority is allocated to individual business units, business divisions or lines of business. The centralized form was found to fit smaller firms, defender (conservative) strategies, centralized control, and mechanistic decision-making; the decentralized form is associated with large firms, prospector (aggressive) strategies, decentralized control, and organic decision-making [45-48].

Centralized IT governance leads to greater control over IT standards and enables the realization of economies of scale; decentralized IT governance allows greater responsiveness and flexibility with regard to business needs and customized solutions for each business unit [26, 60]. Consequently, companies need to balance the trade-off between standardization and centralized direction on the one hand, and flexibility and decentralized input to IT decisions on the other hand. Scholars responded to this dilemma and introduced more complex IT governance models [25, 27, 30].

Role	Centralized Data Governance Design	Decentralized Data Governance Design

Executive sponsor	"A" in some decisions of major relevance	"C" (recommending, not commanding)
Data quality board	Many "A"	Many "C", "I", no "A" alone
Chief steward	Many "A"	"C", (obsolete)
Business & technical data steward	"R", few "A"	Many "A", "R"

Table 3. Specification of data governance model for parameter "organizational structuring"

The *organizational structuring of DQM activities* is the first design parameter for the data governance model. The parameter spans a continuum between the two extremes of centralized and decentralized data governance (cf. Table 3). In a strict *centralized data governance approach* all decision-making authority resides in a central DQM role, such as the chief steward or the data quality board. The chief steward is employed at the corporate center. The executive sponsor regularly participates in DQ board meetings and authorizes essential decisions, such as the data quality strategy. Decisions made with respect to processes, metrics, standards, architecture, guidelines, etc. are valid throughout the whole enterprise. A strict *decentralized data governance approach* places decision-making authority in the hands of business and technical data stewards. A chief data steward might even be obsolete in this design. Decisions made by the DQ board are recommendations rather than rules or standards. Alternatively, the company may establish two levels of DQ boards: one at the corporate level having an advisory function, and one in each business unit with decision-making authority [cp. 28, 60]. Business and technical data stewards decide autonomously for their area of responsibility. In addition to the top management executive sponsor, every business unit might have their own sponsor from the business unit management.

Coordination of decision-making authority

Although scholars suggested more and more complex IT governance models, they essentially focused on structural considerations regarding IT governance. These considerations have been questioned recently, and IT governance research augmented the structural perspective with a process perspective [60-62]. This perspective acknowledges how complex organizations operate, which integration devices they use, how information flows between actors, and how the decision-making processes are configured [60]. The *coordination of decision-making authority* and influence relies on either hierarchical (or vertical) lines or collaborative (or horizontal) capabilities [60]. The *hierarchical IT governance design* is characterized by a pyramid-like structure with power at the top exercised by a person or group, such as the CIO or IT governance board. Coordination is achieved through superiors delegating to, communicating with, controlling and monitoring their direct subordinates, who in turn delegate to, control, etc. their direct subordinates. Information flows from top to bottom and vice versa. In *cooperative IT governance design* direct control is replaced with collaborative and democratic behavior to clarify differences and solve problems [60, 63]. It integrates formal and informal coordination mechanisms across business units (and IT) [64].

There is only limited research regarding contingency factors to this perspective. Brown [64] analyzed the interrelation of centralized and federal IT governance designs and horizontal coordination mechanisms. She found that firms with centralized IT governance used formal and informal mechanisms to build lateral organization capabilities between business units and IT units. Firms with federal IT governance used these mechanisms to coordinate corporate and decentralized IT units. Dallas [63, 65] argued that IT governance design must reflect and support the decision-making style and the prevailing culture of the company to maximize its effectiveness. Enterprises relying on consensus-building should adopt a cooperative IT governance design. Enterprises with a "command and control" culture fit the hierarchical IT governance design.

Role	Hierarchical Data Governance Design	Cooperative Data Governance Design
Executive sponsor	"A" in some decisions of major	"A" (conjointly)

	relevance	
Data quality board	"A" (separately)	Many "C" and "A" (conjointly)
Chief steward	"A" (separately)	"C", "I", few "A"
Business & technical data steward	"R", "I", few "C"	Many "A" (conjointly) and "C"

Table 4. Specification of data governance model for parameter "coordination of decision-making"

The *coordination of decision-making for DQM activities* is the second design parameter for the data governance model. The two extremes of this parameter's continuum are hierarchical and cooperative data governance (cf. Table 4). The *hierarchical data governance model* is characterized by a top-down decision-making approach. Either the chief steward or the data quality board has decision-making authority for a single DQM activity. The DQ board has few members, usually from first and second level management. Tasks are delegated to business and technical data stewards. However, they will not be directly involved in decision-making. The *cooperative data governance model* applies formal and informal coordination mechanisms to reach decisions. Working groups, task forces, and committees with members from multiple disciplines complement the DQ board [cp. 63]. No single role will make a decision on its own. New integrator roles, such as process owners or data architects that report to business units, establish a high degree of cross-unit collaboration [cp. 64]. These formal coordination mechanisms can be complemented by informal mechanisms, such as interdepartmental events, job rotation or cross-unit input to performance reviews [64].

DISCUSSION

Companies need data quality management that combines business-driven and technical perspectives in order to respond to strategic and operational challenges demanding high-quality corporate data. Data governance specifies the framework for decision rights and accountabilities as part of corporate-wide data quality management. This paper contributes to the accountabilities aspect of data governance which has not been well elaborated by DQM research so far. Instead of following the universal approach of prior research, this investigation respects the fact that each company requires a specific data governance configuration which fits a set of contingencies. More specifically, it defines a flexible data governance model comprised of data quality roles, decision areas and responsibilities. The model distinguishes four data quality roles and one committee that present a balanced and useful set when focusing on the strategic notion of DQM. The fundamental decision areas and main activities of DQM can be structured according to strategic, organizational and technical aspects. The model uses the RACI chart to document and structure DQ roles, their type of interaction with the DQM activities, and how they make a decision. The contingencies firm size, structure, competitive strategy, corporate governance, and decision-making style impact two parameters of the model: organizational structuring spanning centralized and decentralized models, and coordination mechanisms spanning hierarchical and cooperative designs.

A data governance model helps companies in structuring their data quality accountabilities. Based on the proposed roles, decision areas and responsibilities, they can outline their individual data governance configuration as an RACI chart. They can use the data governance model as a company-wide communication device for DQM roles and their type of interaction with specific activities and decisions. The contingencies and their impact on the model help them to find a configuration that best fits their company, and hence, maximize the positive contribution of DQM to a company's overall business objectives. Depending on the level of granularity, a company might even define more than one data governance model. For example, they can define one model per decision area or one model for the corporate level and one additional model per business unit.

Finally, a number of limitations need to be considered. This paper transfers knowledge from IT

governance research to data governance. More specifically, it reveals that data quality management is not fully comparable to IT management because of the business perspective involved in DQM; and neither are data governance and IT governance. Nevertheless, IT governance research pursues similar objectives; moreover, it has a longer and more profound track record. The research on contingencies influencing IT governance models is used as starting point for the contingency research on data governance. So far, the proposed contingencies and their impact lack validation in the context of data governance. To mitigate the influence of IT governance and for a more elaborate investigation of the allocation of decision rights, organizational studies such as corporate governance, organizational theory, and organizational psychology as well as quality management research need to be considered.

This research has thrown up many questions in need of further investigation. An analysis of the guidelines and policy aspect of data governance is recommended in order to enforce accountability as defined in the data governance model. Furthermore, the data governance model might be characterized by additional parameters, such as a time dimension which respects the fact that the configuration might evolve over time [28, 65]. Finally, the design of a method for defining and implementing the data governance model would help companies to assure and sustain high-quality data throughout the enterprise.

REFERENCES

[1] Borzo, J., Business 2010 - Embracing the challenge of change. Report from the Economist Intelligence Unit sponsored by SAP, London, 2005.

[2] Newman, D., Logan, D., Achieving Agility: How Enterprise Information Management Overcomes Information Silos. Gartner Research, Stamford, CT, 2006.

[3] Vermeer, B. H. P. J., How Important is Data Quality for Evaluating the Impact of EDI on Global Supply Chains? Proceedings of the 33rd Annual Hawaii International Conference on System Sciences (HICSS-33), 2000.

[4] Madnick, S., Wang, R., Chettayar, K., Dravis, F., Funk, J., Katz-Haas, R., Lee, C., Lee, Y., Xian, X., Bhansali, S., Exemplifying Business Opportunities for Improving Data Quality through Corporate Household Research. MIT Sloan School of Management, Cambridge, MA, 2004.

[5] Tellkamp, C., Angerer, A., Fleisch, E., Corsten, D., From Pallet to Shelf: Improving Data Quality in Retail Supply Chains Using RFID. *Cutter IT Journal*, 17 (9) 2004, pp. 19-24.

[6] Crié, D., Micheaux, A., From customer data to value: What is lacking in the information chain? *Database Marketing & Customer Strategy Management*, 13 (4) 2006, pp. 282-299.

[7] Reid, A., Catterall, M., Invisible data quality issues in a CRM implementation. *Journal of Database Marketing & Customer Strategy Management*, 12 (4) 2005, pp. 305-314.

[8] Zahay, D., Griffin, A., Information antecedents of personalisation and customisation in business-to-business service markets. *Journal of Database Marketing*, 10 (3) 2003, pp. 255-271.

[9] Shankaranarayan, G., Ziad, M., Wang, R. Y., Managing Data Quality in Dynamic Decision Environments: An Information Product Approach. *Journal of Database Management*, 14 (4) 2003, pp. 14-32.

[10] Price, R., Shanks, G., A semiotic information quality framework: development and comparative analysis. *Journal of Information Technology*, 2005 (20) 2005, pp. 88-102.

[11] Friedman, T., Gartner Study on Data Quality Shows That IT Still Bears the Burden. Gartner Group, Stamford, 2006.

[12] Wang, R. Y., Lee, Y. W., Pipino, L. L., Strong, D. M., Manage Your Information as a Product. *Sloan Management Review*, 39 (4) 1998, pp. 95-105.

[13] English, L. P., *Improving Data Warehouse and Business Information Quality*, 1 ed. John Wiley & Sons, Inc. New York, NY, 1999.

[14] Nohr, H., Management der Informationsqualität. Fachhochschule Stuttgart, Stuttgart Nr. 3/2001, 2001.

[15] Eppler, M. J., *Managing Information Quality*, 2nd Edition ed. Springer. Berlin, Heidelberg, 2006.
[16] Watson, H. J., Fuller, C., Ariyachandra, T., Data warehouse governance: best practices at Blue Cross and Blue Shield of North Carolina. *Decision Support Systems*, 38 (3) 2004, pp. 435-450.
[17] Bitterer, A., Newman, D., Organizing for Data Quality. Gartner Research, Stamford, CT, 2007.
[18] Redman, T. C., *Data Quality for the Information Age*. Artech House. Boston, London, 1996.
[19] Russom, P., Taking Data Quality to the Enterprise through Data Governance. The Data Warehousing Institute, Seattle, 2006.
[20] Dyché, J., Levy, E., *Customer Data Integration*. John Wiley & Sons. Hoboken, New Jersey, 2006.
[21] Newman, D., Logan, D., Governance Is an Essential Building Block for Enterprise Information Management. Gartner Research, Stamford, CT, 2006.
[22] Marco, D., Smith, A. M., Metadata Management & Enterprise Architecture: Understanding Data Governance and Stewardship. *DM Review* (Sep/Okt/Nov) 2006, pp.
[23] Swanton, B., Master Data Management Organizations: A Balance of Control and Responsibility. AMR Research, Boston, 2005.
[24] Dember, M., Case Study: Gaining Efficiencies as a Result of Implementing a Data Governance Program. 2006.
[25] Sambamurthy, V., Zmud, R. W., Arrangements for Information Technology Governance: A Theory of Multiple Contingencies. *MIS Quarterly*, 23 (2) 1999, pp. 261-290.
[26] Brown, A. E., Grant, G. G., Framing the Frameworks: A Review of IT Governance Research. *Communications of the Association for Information Systems*, 15 (May) 2005, pp. 696-712.
[27] Brown, C. V., Examining the Emergence of Hybrid IS Governance Solutions: Evidence from a Single Case Site. *Information Systems Research*, 8 (1) 1997, pp. 69-94.
[28] Rau, K. G., Effective Governance of IT: Design Objectives, Roles, and Relationships. *Information Systems Management*, 21 (4) 2004, pp. 35-42.
[29] OECD, OECD Principles of Corporate Governance. OECD Publications Service, Paris, 2004.
[30] Weill, P., Don't just lead, govern: How top-performing firms govern IT. *MIS Quarterly Executive*, 3 (1) 2004, pp. 1-17.
[31] Huang, K.-T., Lee, Y. W., Wang, R. Y., *Quality Information and Knowledge*. Prentice Hall. New Jersey, 1999.
[32] Wang, R. Y., A Product Perspective on Total Data Quality Management. *Communications of the ACM*, 41 (2) 1998, pp. 58-65.
[33] Olson, J., *Data Quality - The Accuracy Dimension*. Morgan Kaufmann. San Francisco, 2003.
[34] Redman, T. C., *Data Quality*. Digital Press. Boston, 2000.
[35] Wang, R. Y., Strong, D. M., Beyond Accuracy: What Data Quality Means to Data Consumers. *Journal of Management Information Systems*, 12 (4) 1996, pp. 5-34.
[36] Henderson, J. C., Venkatraman, N., Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal*, 32 (1) 1993, pp. 472-484.
[37] Korac-Kakabadse, N., Kakabadse, A., IS/IT Governance: Need for an Integrated Model. *Corporate Governance*, 1 (4) 2001, pp. 9-11.
[38] Weill, P., Ross, J., A Matrixed Approach to Designing IT Governance. *MIT Sloan Management Review*, 46 (2) 2005, pp. 25-34.
[39] Lawrence, P. R., Lorsch, J. W., *Organization and Environment*. Harvard University Press. Boston, 1967.
[40] Thompson, J. D., *Organizations in Action - Social Science Bases of Administrative Theory*. McGraw-Hill. New York etc., 1967.
[41] Burns, T., Stalker, G., *The Management of Innovation*. Tavistock. London, 1961.
[42] Miller, D., Environmental Fit versus Internal Fit. *Organization Science*, 3 (2) 1992, pp. 159-178.
[43] Donaldson, L., *The Contingency Theory of Organizations*. Sage Publications. Thousand Oaks, CA, USA, 2001.

[44] Keats, B., O'Neill, H. M., Organizational Structure: Looking through a strategy lens. in *The Blackwell Handbook of Strategic Management*, M. A. Hitt, R. E. Freeman, and J. S. Harrison, Eds. Blackwell Publishing, 2001, pp. 520-542.
[45] Olson, M. H., Chervany, N. L., The Relationship Between Organizational Characteristics and the Structure of the Information Services Function. *MIS Quarterly*, 4 (2) 1980, pp. 57-68.
[46] Ein-Dor, P., Segev, E., Organizational Context and MIS Structure: Some Emprirical Evidence. *MIS Quarterly*, 6 (3) 1982, pp. 55-68.
[47] Ahituv, N., Neumann, S., Zviran, M., Factors Affecting the Policy for Distributing Computing Resources. *MIS Quarterly*, 13 (4) 1989, pp. 389-401.
[48] Tavakolian, H., Linking the Information Technology Structure With Organizational Competitive Strategy: A Survey. *MIS Quarterly*, 13 (3) 1989, pp. 308-318.
[49] Boynton, A. C., Zmud, R. W., Information Technology planning in the 1990's: Directions for practice and research. *MIS Quarterly*, 11 (1) 1987, pp. 58-71.
[50] Hodgkinson, S. L., The Role of the Corporate IT Function in the Federal IT Organization. in *Information Management: The Organisational Dimension*, M. J. Earl, Ed. Oxford University Press. Oxford, 1996.
[51] Earl, M. J., *Management Strategies for Information Technology*. Prentice Hall. Englewood Cliffs, NJ, 1989.
[52] Wende, K., A Model for Data Governance – Organising Accountabilities for Data Quality Management. Accepted at 18th Australasian Conference on Information Systems, Toowoomba, Australia, 2007.
[53] Davenport, T. H., *Process Innovation: Reengineering Work through Information Technology*. Harvard Business School Press. Boston, 1993.
[54] Hammer, M., Champy, J., *Reengineering the Corporation: A Manifesto for Business Revolution*. Nicholas Brealey Publishing. London, 1993.
[55] Österle, H., Winter, R., Business Engineering. in *Business Engineering*, H. Österle and R. Winter, Eds. Springer. Berlin, 2003, pp. 3-18.
[56] Crowe, A., *The Pmp Exam: How to Pass on Your First Try*, 3rd Ed. ed. Velociteach Press. Kennesaw, GE, 2005.
[57] IT Governance Institute, CobiT 4.0: Control Objectives, Management Guidelines, Maturity Models. IT Governance Institut, Rolling Meadows/IL, 2005.
[58] Cohen, S., Roussel, J., *Strategic Supply Chain Management: The Five Disciplines for Top Performance*. McGraw-Hill Professional, 2004.
[59] Brown, C. V., Magill, S. L., Reconceptualizing the Context-Design Issue for the Information Systems Function. *Organization Science*, 9 (2) 1998, pp. 176-194.
[60] Peterson, R., Crafting Information Technology Governance. *Information Systems Management*, 21 (4) 2004, pp. 7-22.
[61] Dahlberg, T., Kivijärvi, H., An Integrated Framework for IT Governance and the Development and Validation of an Assessment Instrument. Proceedings of the 39th Annual Hawaii International Conference on System Sciences, 2006.
[62] Patel, N. V., Emergent Forms of IT Governance to Support Global E-Business Models. *Journal of Information Technology Theory and Application*, 4 (2) 2002, pp. 33-48.
[63] Dallas, S., IT Governance Requires Decision-Making Guidelines. Gartner Research, Stamford, CT, 2004.
[64] Brown, C. V., Horizontal Mechanisms under Differing IS Organization Contexts. *MIS Quarterly*, 23 (3) 1999, pp. 421-454.
[65] Dallas, S., Six IT Governance Rules to Boost IT and User Credibility. Gartner Research, Stamford, CT, 2002.