

2007

The Need for Data Governance: A Case Study

Lai Kuan Cheong

Curtin University of Technology, lkcheong@yahoo.com

Vanessa Chang

Curtin University of Technology, vanessa.chang@curtin.edu.au

Follow this and additional works at: <http://aisel.aisnet.org/acis2007>

Recommended Citation

Cheong, Lai Kuan and Chang, Vanessa, "The Need for Data Governance: A Case Study" (2007). *ACIS 2007 Proceedings*. 100.
<http://aisel.aisnet.org/acis2007/100>

This material is brought to you by the Australasian (ACIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ACIS 2007 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

The Need for Data Governance: A Case Study

Lai Kuan Cheong, Vanessa Chang
School of Information Systems
Curtin Business School
Curtin University of Technology
Western Australia, Australia

Email: lkcheong@yahoo.com; vanessa.chang@curtin.edu.au

Abstract

Data governance is an emerging trend in enterprise information management. This paper explores the relationship between IT Governance and Data Governance. Sarbanes-Oxley (SOX) compliance requires accurate financial data and to achieve this IT controls are designed to ensure that data is correct and protected from unauthorised change. Data quality is measured by its accuracy, timeliness, relevance, completeness, trustworthiness and contextual definition. Good data quality requires effective data management. The research looks at the need for Data Governance to manage data effectively. This study examines a large organisation that has adopted an ad-hoc Data Governance model to manage its data. It was found that its data management efforts were hampered mainly by the lack of clear roles and responsibilities and the lack of mandate to carry out data quality improvement initiatives. In order to promote effective data management, this research identifies a Data Governance Structure and Framework with the emphasis on collaboration between business and IT to support organisations.

Keywords

Data Governance, Data Quality, Data Management, Enterprise Information Management

Introduction

This paper presents a research into data governance and enterprise data management. The literature review on enterprise information management highlights that a high percentage of organisations across the world are engaged in the management of data as an enterprise asset (Newman, 2006). Recently in the USA, the downfall of major public companies called for the introduction of controls to certify the accuracy and credibility of financial reports. Senior executives are being held responsible for the accuracy of an organisation's financial reports. Due to the prevalent use of information technology (IT) systems today, it is imperative that controls are in place to ensure the proper use of IT applications and to protect data from unauthorised change. Issues with managing data emerged with the implementation of various data integration projects (for example, migrating data from legacy system to Enterprise Resource Planning systems) (Clemmons & Simon, 2001), data warehousing projects (Watson, Fuller & Ariyachandra, 2004) and business intelligence efforts (Matney and Larson, 2004).

The conclusion from various readings is that data can be managed more effectively and successfully through the adoption of a data governance structure and framework. To validate this conclusion, a utility company was selected in this study to determine the justification for formal data governance. The process of implementing a data governance structure within the company is also examined in this study.

Literature Review

The management of data is important to many organisations as advances in IT enables organisations to capture structured and unstructured data (Lee, 2000). The literature also revealed emerging issues related to management of data and data quality. Wright (2006) stated that the confidence of the decision maker in the data is characterised by the quality of the data. The viewpoint that data is a valuable resource has grown increasingly prevalent among business and IT executives. Recognition of data as corporate assets imply that some form of data governance would be beneficial for effective data management (Wright, 2006). Lee (2000) and Newman (2005) identified similar issues relating to data management and enterprise information management (EIM). Newman (2006) conducted a research in EIM programs and identified EIM governance scored the lowest compared to all other types of EIM programs. Newman (2006) concluded that organisations need guidance to incorporate EIM governance into their software development methodology. He also found that companies surveyed in the US, UK and Europe are more aware of EIM governance than other companies in Asia Pacific. His research shows that there is a lack of awareness of the importance of using logical data model during

initiation phase for scoping, assessing data quality, consulting data steward, records retention policies, and saving, cataloguing and reusing project metadata. In another study by Newman (2005), he found that the management of information is unfocused and undisciplined. He highlighted the following problems; (1) costly, redundant and resource hungry integration projects, (2) data and information sources that are not rationalised, and (3) inflexible system design that does not cater for changing business needs. The above observations were accentuated by organisations moving towards service-oriented architecture (SOA). SOA is characterised by decoupling of data, processes and applications that magnified the need for authoritative source of the information (master data stores); information location, structure, context and usage (metadata management); semantic reconciliation; profiling and ensuring data quality; data integration method (data exchange); and the ability to encapsulate an information model to support various business processes (Newman, 2005).

The importance of Data Quality

According to Bair (2004), data quality can be defined by data type and domain, correctness and completeness, uniqueness and referential integrity, consistency across all databases, freshness and timeliness, and business rules conformance. In order to determine that the data is 'fit for purpose', like Bair, Olson (2003) defines 6 data quality dimensions of accuracy, timeliness, relevance, completeness, understood and trusted.

Data quality is important to businesses in order to leverage IT initiatives such as data mining and warehousing for business intelligence (Freidman, 2006). Olson (2003) associated poor data quality with the increase in cost and the complexity of developing customer relationship management (CRM), supply chain management (SCM) and enterprise resource planning (ERP) systems. The success of such IT investments depends a lot on the quality of the source data. The saying 'Garbage In, Garbage Out' is most applicable in this situation. Wadehra (2006) also emphasised the need to create the 'single truth' of the data in cases where data is stored in various disparate databases. It is apparent that effective business intelligence leads to effective decision making (Friedman, 2006) with a trajectory to increase productivity as a result of less rework (Olson, 2003). This will also allow for regulatory compliance by providing complete, accurate and timely data.

The effectiveness of any IT initiatives depends on the quality of the data. The reports generated and decisions made can only be as good as the quality of data. The issues surrounding data quality or the lack of quality are compounded by the fact that (1) data is spread across disparate systems within an organisation, (2) data is collected, maintained and used by various levels of an organisation, and (3) many system development methodologies do not incorporate data quality assurance.

The abovementioned data quality issues can be addressed by having an effective master data management. Effective master data management ensures good data quality through the use of a data governance program. Data governance program gives data managers the mandate to manage the data quality as an enterprise asset (Russom, 2006).

IT Governance and Data Governance

In recent years, publicly traded American companies are required to comply with Sarbanes-Oxley (SOX) Act of 2002. This was enacted after the collapse of Enron in 2001. It requires executives of publicly traded companies to be held personally responsible for the creditability of the financial reporting supplied to the shareholders. Section 302 of SOX compliance is directly related to IT (Brown and Nasuti, 2005) as most businesses engage in e-business. This requires IT infrastructure to be managed in a transparent, accountable manner and proof that internal controls are in place to prevent fraudulent activities. SOX compliance had brought about the introduction of Control Objectives for Information and Related Technology (COBIT) as the generally accepted framework for IT auditors to assess SOX compliance. The financial reporting process in COBIT is based on an internal control of the COSO framework (Hawkins, Alhajjaj & Kelley, 2003). COSO was introduced in 1992 by the Committee of Sponsoring Organisations of the Treadway Commission, a management framework for internal controls. Table 1 shows the relationship between data and the five components of internal control as stipulated by the COSO framework (Marinos, 2004b).

It can be concluded that the success of the COBIT framework depends on the quality of the underlying corporate data. This is supported by Marinos (2004b), who states that "data quality is the hidden assumption behind COSO". This shows that in addition to IT governance there is a need for data governance framework for effective data management.

Table 1: The relationship between data and the five COSO framework internal control components (adapted from Marinos, 2004b)

Components of Internal Control (COSO)	Importance of Corporate Data
Control environment	Data quality must be an explicit priority as it acts as a foundational platform for internal control where data management is a process and the outcome is information quality.
Risk assessment	The COSO framework requires risks to be identified in association with the business ability to achieve pre-specified objectives. The quality of data affects the extend of the identified risks associated with achieving the pre-specified objectives.
Control Activities	Data represent the means of control. Data need to be measured in order to be managed. Control activities are procedures and policies which are aligned with business objectives and for carrying out risk mitigation strategies. These control activities produce reports from the corporate data in order to measure the achievement of pre-specified objectives.
Information and Communication	It is data that enables reporting and action. Information needs to be accessible, consistent, accurate and complete for effective communication and decision making.
Monitoring	Data either drives or compromises its effectiveness. The monitoring process depends on accurate, timely and secure data. This is important for measuring actual performance against acceptable operation ranges of a specific activity.

Data Governance

In order to address data quality issues, Friedman (2006) recommends that organisations adopt a holistic approach, focusing on “people, processes and technology” and organisations need to constantly quantify and measure their data quality. This implies that in order to address data quality issues, data needs to be governed. According to Thomas (2006), “data needs to be governed as it has neither will nor intent of its own. Tools and people shape the data and tell it where to go. Therefore, data governance is the governance of people and technology”.

There are various definitions of data governance. Cohen (2006) defines data governance as “the process by which a company manages the quantity, consistency, usability, security and availability of data”. Newman and Logan (2006) define data governance as “the collection of decision rights, processes, standards, policies and technologies required to manage, maintain and exploit information as an enterprise resource”. Thomas (2006) states that data governance “refers to the organisational bodies, rules, decision rights, and accountabilities of people and information systems as they perform information-related processes”. She goes on to state “data governance sets the rules of engagement that management will follow as the organisation uses data”.

In light of the above definitions, data governance is important because it defines policies and procedures to ensure proactive and effective data management. The adoption of a data governance framework also enables collaboration from various levels of the organisations to manage enterprise-wide data and it provides the ability to align various data related programs with corporate objectives.

Who should drive the Data Governance Program?

Should IT or business drive the data governance program? Should IT governance incorporate the governance of data as well? The COBIT framework incorporates financial reporting component from the COSO framework (Hawkins, Alhajjaj & Kelley, 2003). This implies that data quality is important for preparing accurate financial reporting. The Chief Executive Officers and Chief Financial Officers are held accountable over the credibility of these financial reports. Therefore, it is the business’ responsibility to ensure that the data is correct, available, reliable, and fit for purpose. IT is responsible for the infrastructure that holds, processes and reports on the data. These infrastructures have to be built with capabilities for preventing data being used fraudulently.

However, this only relates to financial data. What about other business related data, such as, customer data, supplier data, or spatial data? The quality of these data is also important for the business. Therefore it seems logical that data governance program should be driven by the business as the business uses the data to make decisions. Therefore, the business should control the data, determine who can access the data and the context that it should be used (Thomas, 2005).

IT governance ensures that the IT infrastructure aligns with business objectives and utilised cost effectively (Luftman, 2004). Therefore, the governance of IT infrastructure (the pipe) should be the responsibility of IT and the data (the information that flows through the pipe) should be the business' responsibility. This indicates that there is a need for IT and business to work together (the need to build the pipe to carry the data) to align data and IT initiatives (Dember, 2006). It is imperative that organisations realise the critical success factors of data governance.

Data Governance Critical Success Factors

Critical success factors for data governance can be determined by addressing the top 10 corporate oversights identified by Marinis (2004a). They are:

- Accountability and strategic accountability. There is a need for executive leadership to drive data governance process. Cohen (2006) and Thomas (2006) stress that in order to implement data governance successfully, the roles and responsibilities for various people in the organisations who are involved in the data governance process need to be clearly defined.
- Standards. Definition of data standards is important as corporate data needs to be defined and made sure that it is 'fit for purpose'.
- Managerial blindspot. There is a need for the alignment of data specific technology, process and organisation bodies with business objectives.
- Embracing complexity. Data stakeholders are the producers and consumers of data. The data stakeholder management is complex as data could be collected, enriched, distributed, consumed and maintained by different data stakeholders.
- Cross divisional issue. The data governance structure must be designed in such a way that it includes participation from all levels of the organisation to reconcile priorities, expedite conflict resolution and encourage the support of data quality.
- Metrics. Definition of outcome specific data quality metrics is important for measuring data governance success.
- Partnership. When an organisation shares data with other organisations (partner) there is a requirement for its partner to be held accountable for its data quality so that the data management efforts of both organisations are not undermined.
- Choosing strategic points of control. Controls need to be put in place to determine where and when quality of the data is to be assessed and addressed.
- Compliance monitoring. Data management policies and procedures need to be assessed periodically in order to ensure that the policies and procedures are being followed.
- Training and awareness. Data stakeholders need to be aware of the value of data governance. The importance of data quality and the benefits of quality data need to be communicated to all data stakeholders in order to raise their awareness.

Research Methodology

A case study research strategy was the selected method for this study as it is the most commonly known management information systems research strategy (Ives, et al, 1980). Case study is an appropriate tool as it allows the researcher to carry out this study in a natural setting, learn about the actual process of managing data and generate theories from practice. This also allows the researcher to answer the 'how' and the 'what' questions in order to understand the nature and complexity of the processes taking place. This is an appropriate research method for an area that had few previous researches (Benbasat, et al, 1987). This is particularly true as there is little or no publication on data governance in Australia and as highlighted by Newman (2006), data governance is an emerging topic that needs further development and research.

The chosen utility organisation (Company A) manages data from various disparate systems or sources, and the data involves different line of business units from multiple users and stakeholders. The current user base is more than 100 users and data quality is the priority concern for the organisation.

The data collected from interviews with the IT Managers and Data Management Managers were primarily qualitative in nature. The interviews were recorded and later transcribed and analysed. The interview questions were designed to ascertain the IT view of data-related issues and problems and the business view of data-related

issues and problems within the organisation. In addition, the study also investigated the resolution and mediation methods that the organisation employed; and the deployment of such methods. Additional information was also gathered from reviewing data management documentation of the organisation. The documentation review provided insight into the style of data management, methodology used for developing and enhancing application systems, and the interaction between IT and business.

The Organisation

Company A is a large utility organisation with complex data integration issues. This organisation provides essential services to approximately 890,000 industrial, commercial and residential customers. Its main mission is to provide reliable supply by maintaining the network and to restore the supply in the event when the supply was interrupted. It is also responsible for building new network to meet the demands of existing and future customers.

It employs more than 1,850 core staff with an asset base of nearly \$3 billion. It operates in a regulated market so to ensure quality of service and that its network is accessible to all service retailer and supplier. Through its recent restructure, it had been charged with \$2.23 million of investment to increase the network reliability by 25% over the next four years.

Company A operates within a regulatory environment which requires it to report to a government regulatory authority. The government regulatory authority requires report such as maintenance plans and proof that the organisation had performed its duties in maintaining public safety, ensuring reliable supply and efficient management of its network infrastructure. The building and maintenance of the network infrastructure requires the cooperation of several divisions, namely, the asset management division (sets the strategy for managing network assets), field services (packaging of inspection and maintenance program) and works delivery (planning and construction of new infrastructure).

The network stretches across the state for about 89,700 kilometres. The network consists of more than 950,000 assets. These assets need to be maintained regularly in order to ensure safe, reliable and efficient supply. The asset data is located in an asset management application system (inspection result and condition of asset) which is tightly coupled with a Geographical Information System (GIS). The GIS contains spatially related data of the asset. It also shows the location and the connectivity of the assets graphically along with their connectivity details. The spatial data needs to be accurate so that assets can be easily located and that network connectivity maintains its integrity.

A few years ago, several incidents related to the lack of maintenance on network asset affected public safety and reliability of supply. This resulted in an inspection of the conditions of the network assets. Data for these assets need to be current and accurate so that a maintenance program can be planned efficiently. With this maintenance program, the condition of the assets can be accurately determined and aging assets can be targeted for replacement ensuring the reliability of the service network.

Company A is also in the process of migrating its asset related data from its legacy asset management systems to Ellipse (an asset management module), an ERP and is also planning to replace its GIS with an off-the-shelf GIS. The successful migration of these legacy systems depends largely upon the quality of the asset and spatial data.

Recently a dedicated Data Management area was created to manage asset data and its related information systems for the Asset Management division. This area is responsible for ensuring data quality and providing strategic direction for the asset related data initiatives. This area consists of 3 teams; the Data Management team responsible for providing strategic and tactical direction on data related issues, conducting quality assurance and data cleansing activities; the Data Services team whose responsibility involved entering data for asset related application systems (distribution network), providing underground asset information to external parties conducting trenching activities; and the GIS Strategist team, responsible for the strategic direction of any spatial data related issues (for examples, positional accuracy, graphical representation of data).

The Study – Data Management Issues

This research focuses on the activities within the Data Management team. This team acts as data stewards as it has knowledge of the business processes and it also has an in depth knowledge of the asset related information systems. Currently, it is facing difficulties with managing the asset related data as an enterprise asset. The problems started from the inception of this organisation in that it was managing data in a reactive and ad hoc manner, it has no direct access to its source database, it has difficulty obtaining consensus on data related issues, its data improvement projects were mostly overrun and over budget; and any attempt to set any standards had not been taken seriously by other groups of the business and IT. In light of this, the Data Management team had begun some data governance initiatives and the following remediations were instigated to address these issues:

- *Reactive data management.*
In order, to be more proactive, the Data Management team is establishing a data strategy to improve and maintain data quality. This allows the Data Management team to accurately project a work plan for IT related project and resource management.
- *Asset data not easily accessible.*
Some of the data resides in an IMS database which is not accessible by the Data Management team. Access is via replicated data in DB2. However not all data is replicated across to DB2. In addition, the asset data is stored in several disparate databases. Data is spread across Oracle, Ingres, DB2 and IMS databases and maintained by different application systems.
- *Data improvement project mostly overrun and over budget.*
A dedicated project manager is appointed to liaise between the business and IT. The client project manager ensures that the data stakeholders' expectation and communication are managed effectively. There is also a lack of IT tools for data profiling and data cleansing.
- *Difficulty in setting data standards.*
The key to data standards adherence is that it can be communicated to the data user community. Data standards are also important for the migration of data from legacy systems to Ellipse ERP (Clemmons & Simon, 2001). The Data Management team is currently working on purchasing a metadata repository.
- *Difficulty in obtaining consensus on data related issues.*
This is a difficult and political issue to resolve. The data users are spread across the organisation, spanning different divisions. A data custodianship policy was drawn up but was difficult to put into action as it did not have a governance structure to endorse and mandate this policy.

According to Thomas (2006), this model of informal data governance is called 'Governance via Stewardship'. However, this form of stewardship is not working for the Data Management team due to the following reasons; (1) a lack of mandate from the senior executives means that it has no power to act, (2) the lack of mandate means that sometimes its projects are not given priority as senior executives do not understand the importance of the projects; and (3) a lack of clear roles and responsibilities, i.e., there no clear definition of data stewards and data owners.

As highlighted by Thomas (2006), the lack of authority and clear roles and responsibilities are common contributors to the failure of 'Governance via Stewardship'. In this situation, there is obviously a lack of connection between those at the operational level who knows the problem and those who have the power to make decision but are removed from the problem. In order to address the issue with decision making authority, the Data Management team with the executive support of the Asset Management General Manager put together a plan for 'Governance via Governance' model of Data Governance for this organisation. To this end, a Data Governance framework for Company A was established.

The Data Governance frameworks from the Data Governance Institute (Thomas, 2006) and Informatica (2007) were utilised to develop the Data Governance Structure for Company A. The ideals were chosen from both framework and customised to suit Company A's organisational structure. The components of the data governance framework are shown in Table 2.

Table 2: Components of the Data Governance Framework

Organisational Bodies and Policies	Standards and Processes	Data Governance Technology
<ul style="list-style-type: none"> - Governance Structure - Data Custodianship - User Group Charter - Decision Rights - Issue Escalation Process 	<ul style="list-style-type: none"> - Data Definition and Standard (Meta data management) - Third Party Data Extract - Metrics Development and Monitoring - Data Profiling - Data Cleansing 	<ul style="list-style-type: none"> - Metadata Repository - Data Profiling tool - Data Cleansing tool

The Data Governance Structure

A Data Governance (DG) structure as shown in Figure 1 was developed based on the following roles and responsibilities:

- Data Governance Council.

Membership of this council consists of executives from various divisions who have an interest in the management of asset data. They are responsible for endorsing policies, resolving cross divisional issues, engaging the IT council at the strategic level, strategically aligning business and IT initiatives, and reviewing budget submission for IT and non IT related projects.

- **Data Custodian.**
Asset data is managed by the data custodian on behalf of Company A. It is responsible and accountable for the quality of asset data. The data custodian is responsible for resolving issues raised in user group meetings. If issues become political and impacts stakeholders from other divisions, they are escalated to the DG council level. They are also responsible for endorsing data management plan, endorsing data cleansing plan, ensuring data is fit for purpose, converting strategic plans into tactical plans, change management, and stakeholder management.
- **Data Steward.**
Data Stewards have detail knowledge of the business process and data requirements. At the same time they also have good IT knowledge to be able to translate business requirements into technical requirements. They are led by the Data Custodians and are responsible for carrying out the tactical plans. They also act on behalf of the Data Custodians in stakeholder management, change management, asset related information systems management and project management. They manage user group meetings, train and educate data users.
- **User Groups.**
Data stakeholders from various divisions are invited to the user group meetings. These key data stakeholders consist of people who collect the data, process and report off the data. Technical IT staff is also invited to these meetings so that their technical expertise is available during the meeting. This is also a venue where urgent operational data issues can be tabled. The data users are responsible for reporting any data related issues, requesting functionality that would help them collect data more efficiently, and specifying reporting requirements.

The Data Governance structure as shown in Figure 1 shows the business engagement with IT at the strategic, tactical and operational levels. This level of engagement ensures that IT and business are kept informed and IT initiatives align with the business data governance objectives.

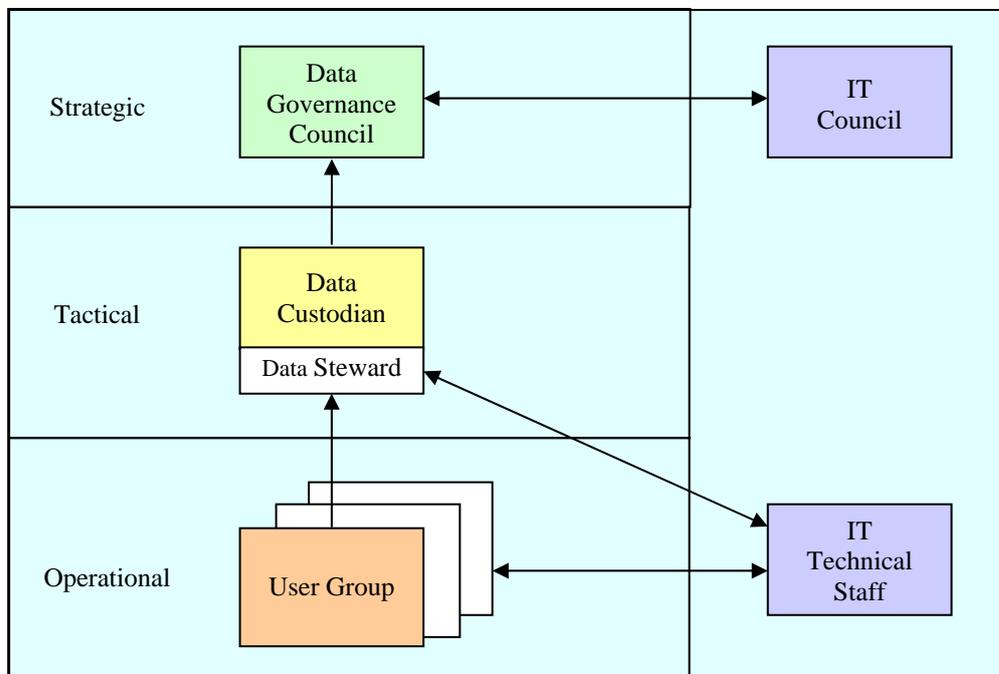


Figure 1: Data Governance Structure

Discussion

The Data Governance structure provides a structured framework for mitigating the risks of data management. The Data Governance Structure is scalable to include other divisions as the data governance efforts within the

Data Management team mature. The Data Custodianship and User Groups structure can be adopted by other division (federated data governance model) with the Data Governance Council acting as the ‘organisational glue’ (see Figure 2).

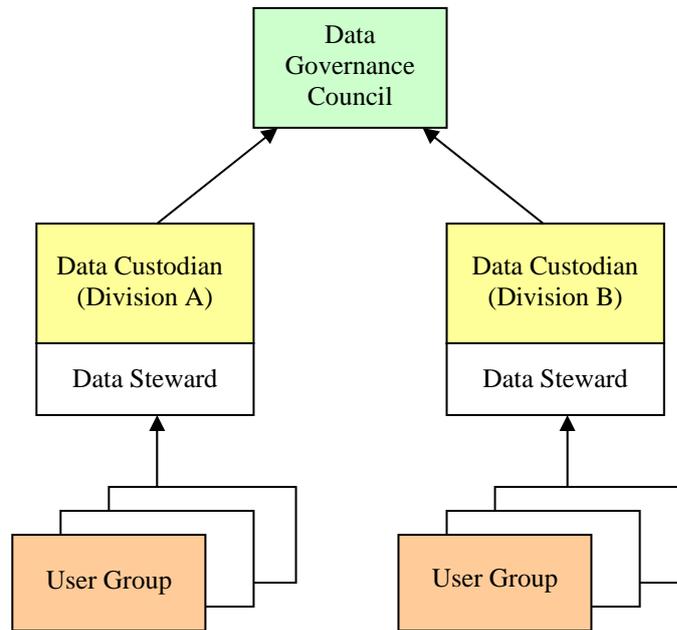


Figure 2: Scalable Data Governance Structure

Company A had shown that business and IT need to work together in order to manage corporate data effectively. Figure 3 shows the relationship between corporate, IT and Data Governance. When data governance initiatives become more mature it should interact with the Corporate Governance framework. The IT Governance council and the Data Governance council should report to the members of the corporate governance council as shown by the one way arrow. The two-way arrow indicates that the IT governance council and the Data governance council should work collaboratively. Incidentally, Dember (2006) defines Data Governance that “... provides the framework for the intersection of IT and business working together to establish confidence and credibility in the enterprise’s information”.

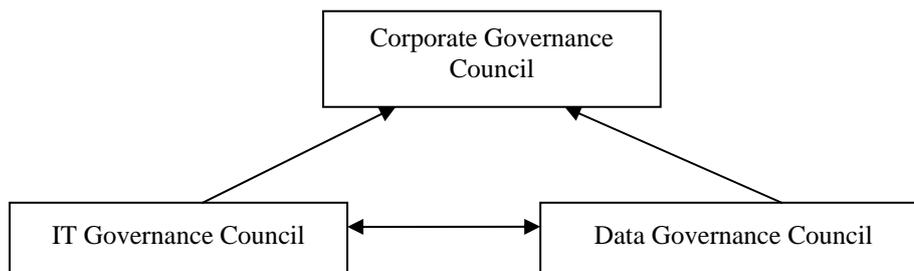


Figure 3: Relationship between Corporate, IT and Data Governance

The Data Management team had provided insights into the difficulties in managing data as corporate asset without proper authority. The following summarises the findings of this research:

- *The justification for formal data governance.*
This study had shown that managing the data quality of enterprise data is not effective without a formal data governance model. The reason for this is because of the lack of clear roles and responsibilities among data stakeholders. The ten corporate critical success factors raised by Marinos (2004a) were issues faced by the Data Management team with informal data governance. The Data Management team had to ensure each of the critical success factors were incorporated into the introduced Data Governance Framework and Structure. Data Governance also assists business in engaging IT (vice versa) to manage corporate data collaboratively.
- *The process of setting up a formal data governance program.*

The first step to setting up a formal data governance program is to determine a Data Governance structure. The structure provide escalation authority and a basis for a transparent decision making process. Roles and responsibilities are defined so that members within the Data Governance structure are held accountable for their actions. Company A had largely achieved this, however as this structure was recently introduced the success of its implementation cannot be determined in this study.

- *Ability to carry out actions as a result of a formal data governance structure.*
Given the clear structure, the Data Management team is able to purchase a data profiling and metadata repository tool. The data profiling tool will allow the Data Management team to discover anomalies more efficiently. The metadata repository tool captures information about data so that it can be accessed by the whole organisation. Metrics measuring the quality of data had also been developed. The publication of these metrics will help management to determine the success of data improvement initiatives.
- *Simple data governance structure and framework.*
The Data Management team did not want a cumbersome framework that could cause bottlenecks and delays in existing and future projects. With a proper structure and framework, the Data Governance team is able to steer strategic projects to conform to and maintain good data governance.

Conclusion and Future Work

The paper investigates whether effective enterprise wide data management can be achieved without formal data governance. Some insights into data governance initiatives in a large utility organisation were obtained from this study. This paper underscores the importance of a Data Governance structure together with policies and procedures for managing data effectively. A data governance framework also enables collaboration from various levels of the organisations and it also provides the ability to align various data related programs with corporate objectives. This paper highlights that Data Governance provides a structured framework for mitigating the risks of data management. Given that Company A had only recently introduced a data governance structure, a longitudinal study would give a better indication of the benefits and success of the data governance structure implementation.

References

- Bair, J 2004. Practical Data Quality: Sophistication Levels, viewed 25 Mar 2006 <www.knightsbridge.com/pdfs/in_the_news/Practical_DQ_Sophistication_Levels.pdf>
- Benbasat, I, Goldstein, D & Mead, M 1987. The Case Research Strategies in Studies of Information Systems, *MIS Quarterly*, September.
- Brown, W, & Nasuti, F 2005. What ERP Systems can tell us about Sarbanes-Oxley. *Information Management & Computer Security*, vol. 13, no. 4, pp. 311-327.
- Clemmons, S, & Simon, S 2001. Control and Coordination in Global ERP configuration. *Business Process Management Journal*, vol. 7, no. 3, pp. 205-215.
- Cohen, R 2006. BI Strategy: What's in a Name? Data Governance Roles, Responsibilities and Results Factors. *DM Review*, viewed 12 Jan 2007 <http://www.dmreview.com/article_sub.cfm?articleId=1057220>
- Dember, M 2006. The 7 Stages of Highly Effective Data Governance: Advanced Methodology for Implementation. *CIBER Whitepaper*, viewed 12 Jan 2007 <www.ciber.com>
- Friedman, T 2006. Key Issues for Data Management and Integration, 2006, *Gartner Research*. ID Number: G00138812, March.
- Hawkins, K, Alhajjaj, S, & Kelley, S 2003. Using COBIT to Secure Information Assets. *The Journal of Government Financial Management*, vol. 52, no. 2, pp 22-33.
- Informatica. Data Governance. Why it Matters to the Business. White Paper. Informatica, viewed 13 Jun 2007 <www.computerworlduk.com/cmsdata/whitepapers/3802/infa_datagov_wp_6697_web.pdf>.
- Ives, B, Hamilton, S, & Davies, G 1982. Choosing Appropriate Information Systems Research in Computer-Based Management Information Systems. *Management Science*, vol. 26, no. 9, pp 910-932.

- Lee, R 2000. The Role of Data Management in Transforming an Enterprise. Auerbach Publications, viewed 27 May 2006 <www.auerbach-publications.com>.
- Luftman, J 2004. *Managing the Information Technology Resource*. Pearson Prentice Hall, Upper Saddle River, New Jersey, USA.
- Marinos, G 2004a. We're Not Doing What? The Top 10 Corporate Oversights in Data Governance. *DM Review*, September, viewed 6 Mar 2006 <www.dmreview.com>.
- Marinos, G 2004b. Data Quality: The Hidden Assumption Behind COSO, *DM Review*, October, p. 12.
- Matney, D. & Larson, D 2004. The Four Components of BI Governance. *Business Intelligence Journal*, vol. 9, no. 3, pp. 29-36.
- Newman, D. 2005. Business Drivers and Issues in Enterprise Information Management. *Gartner Research*. ID Number: G00129712.
- Newman, D 2006. Gartner Study on EIM Highlights Early Adopter Trends and Issues. *Gartner Research*, February.
- Newman, D. & Logan, D. 2006. Governance Is an Essential Building Block for Enterprise Information System. *Gartner Research*, May.
- Olson, J 2003. Data Quality: The Accuracy Dimension. Published by Morgan Kaufmann Publishers, USA.
- Russom, P 2006. Taking Data to the Enterprise Through Data Governance. TWDI Report Series, March, viewed 16 July 2006 <www.tdwi.org>.
- Thomas G 2006. Alpha Males and Data Disaster. Published by Brass Cannon Press, USA.
- Wahedra, A 2006. Why Customer Data Integration Projects Fail. *DM Review*, viewed 25 Jun 2006 <www.dmreview.com/article_sub.cfm?articleID=1048642>.
- Watson H, Fuller C, & Ariyachandra T 2004. Data Warehouse Governance: Best Practices at the Blue Cross and Blue Shield of North Carolina. *Decision Support Systems*. vol. 38, pp. 435-450.
- Wright T. 2006. Global Research Meeting: Organizations Must Consider the Impact of IT Innovation on Enterprise Information Management. *Gartner Research*, February.

Copyright

Lai Kuan Cheong and Vanessa Chang © 2007. The authors assign to ACIS and educational and non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to ACIS to publish this document in full in the Conference Proceedings. Those documents may be published on the World Wide Web, CD-ROM, in printed form, and on mirror sites on the World Wide Web. Any other usage is prohibited without the express permission of the authors.