ASSESSING AND ENHANCING THE INFORMATION QUALITY MATURITY LEVEL IN AN ORGANISATION

THE CASE OF SHELL GLOBAL FUNCTIONS IT

UNRESTRICTED

Priscilla Kisubika

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UNIVERSITY OF TWENTE, ENSCHEDE   SHELL (GLOBAL FUNCTIONS IT)

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Author

Kisubika Priscilla
Student number: S1018310

Master of Science in Business Information Technology
School of Management and Governance.
University of Twente, Enschede, Netherlands .

University Supervisors:

Klaas Sikkel

Chintan Amrit

Shell Supervisors:

Theo Eckyenschild (Supervisor)

Alan Clarke   (Mentor)

Preface

This Thesis is the epitome of my study in 'Business and IT' during which I got particular interest in the applicability and practicality of IT in business and governance. The courses of ICT Management and Knowledge Management propelled my interest in taking up an internship where I could see them in practice in a business setting. An internship opportunity opened up in the Shell global functions IT department directing me towards the research of 'assessing and improving information quality' in GF IT. Although an interesting topic, its sensitivity indicated that I could find enormous problems in getting helpful interviewee's feedback but I was surprised by the cooperation of the 30 people I interviewed or had dialogue with regardless of their roles. My respondents entailed ;the CIO/VP, managers, team leaders in GF IT and other managers outside GF IT in other countries outside the Netherlands like; Malaysia, UK and USA. Although the interviews would be set anytime within 24 hours of the interviewees' availability, their responses and allotted time indicated a great interest in the research and apparently, this was the most interesting part of my research.

Apart from my research colleagues, I made a lot of friends from shell activities & networks like; connectIT in which we enjoyed lunches, evenings of laughter, games and movies together. I learnt important life skills during my internship; It is definite that, part of the 'person' I will become, will be indebted to those lessons. In addition to improving my interpersonal skills, I got a very important foundation which is necessary in any person's development and that is 'exposure'. To me the 9 months of internship formed a very necessary part of my master's in business IT without which this masters would have been incomplete.

Am thankful to all my research respondents, university friends, fellow interns at Shell, Shell office mates Nona and Eunice and, my buddies in Shell, Charmaine and William. Above all the people who supported me during my internship and research, am heartily grateful to my four supervisors from Shell and the university; to Alan Clarke, Klaas Sikkel, Chintan Amrit and Theo Eckyenschild who were always willing to guide me, to read through my research findings and support me in every way to see to it that the project ends successfully.

Am thankful to my sweet parents, relatives and friends around the world who supported me in prayer but mostly to Goran my best friend who was there behind-the-scenes and shared my personal difficulties. Last but not least, I thank Jesus for giving me life and opening doors beyond my reach. I will end with a note that ,
The best is yet to come and latter days will always be better than the former.

Thank you,
With regards from
Priscilla Kisubika
December, 2011

Management Summary

In this era of information dynamism, the concern is not whether an organization experiences information quality challenges but how an organization deals with them however to avert those challenges one has to identify them first. The information quality challenges are common to all expanding organizations and GF IT is not an exception. 2/3rd of the interviewed GF IT respondents associated most information quality challenges to four dimensions as outlined;

- Comprehensiveness /Completeness: Information tends to miss all the necessary values therefore it is usually unclear to the users.
- Consistency: facts which should supposedly be similar are usually found to differ.
- Accuracy: recorded values lack the necessary precision and are usually estimates.
- Traceability: it takes a lot of effort to associate particular facts to 'who' made updates and 'when'.

These and other challenges are explained in the report. The advantage is that GF IT is already taking considerable steps towards improving the quality of its information in the individual functions. However at this stage, it is important to make careful choices of which approaches to take. In this report, we conclude that enhancing information quality in GF IT would take three approaches, one being the 'desired' approach, the next is 'most demanding' and the other the most urgent and 'most feasible' approach

Desired approach:
 In this one, GF IT has to follow well stipulated continuous information quality management (IQM) procedures aligned to its OneIT information governance framework.

The most feasible approach:
 GF IT should first deal with the major quality problems of incomprehensive, inconsistent, inaccurate and untraceable information by: first creating an awareness of the importance of improving quality aspects by function and then precisely attaching quality roles to specific or all individuals and then identifying critical information by function and by processes and, identifying quality requirements associated to that information and finally adhering to those requirements.

The most demanding approach: simply requires taking the two approaches at the same time, i.e., the desired and most feasible.

However the choice between the three approaches will also depend on which information quality maturity level GF IT seeks to attain. A good suggestion is to start with the most feasible approach and later on adopt the desired approach in this way, GF IT should use the 3 approaches but at different times. Nevertheless GF IT should take the quality of its information as a matter of urgency.

Table of contents

CHAPTER 1   INTRODUCTION

1.   Project Context

1.1 Research background

Information is a critical strategic asset in all successful organizations. The availability of the right information to the right people at the right time greatly influences the organization's ability to achieve its business goals. The right information is required to make smart decisions, create strategic advantages, and improve business processes among other things(Al-Hakim, 2007). There is an undeniable quest for the 'right' information in organizations, but what is this 'right' information? For long, researchers on information quality have pondered the question of what can qualify as 'good' or 'right' information(Ruževičius & Gedminaitė, 2007). This quest has fostered a cross section of researches on frameworks, models, methodologies focusing at many data and information aspects.

Earlier researches tended to emphasize improvement of various aspects concerning the quality of information by first developing techniques that could refine the quality of data in databases, e.g., by querying multiple data sources and building large data warehouses. Later studies showed that challenges surrounding data and information quality required both technical and non-technical improvement approaches The non-technical approaches particularly focused on developing cross organizational strategies which would ensure that the right stakeholders acquired the right information in the right format at the right place and time yet regardless of the differences in research contexts, terminologies, disciplines, goals and methodologies, there is an emanating common drive to accelerate the value derived from data and information.

As West (2003) puts it, poor information can cost as much as good information to capture, process and store in addition to costs of reconciling and correcting it. In a recent Gartner study of more than 260 organizations running data quality improvement projects (figure below), 36% of participants estimated annual losses of more than $1 million from data quality issues. Many cited losses of more than $25 million, $50 million, or even $100 million. An almost equal percentage (35%) had no visibility to the quantified impact of poor-quality data.
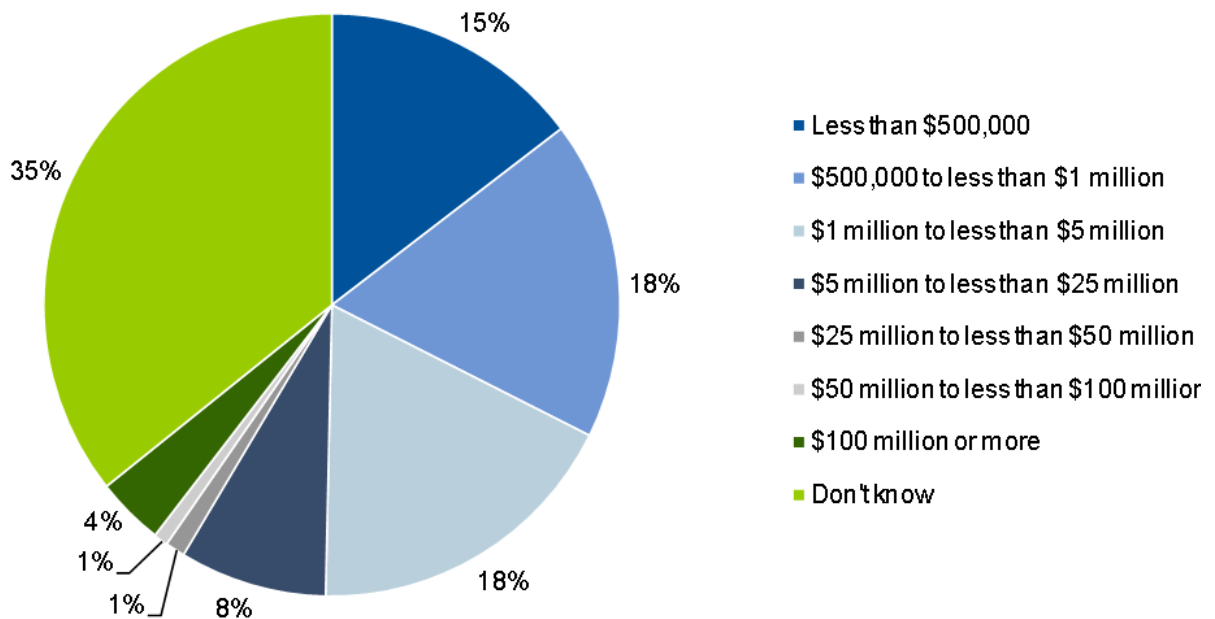
Source: Gartner Data Quality Tools Adoption and Usage Study 2010

In addition to affecting business decision making, data quality issues have a negative financial impact on virtually every organization yet such costs could be reduced by improving and monitoring data quality levels. Having grown to a level of crisis in many organizations, enhancing data or information quality is no longer an issue of contention but of urgency. Organizations require more than just the available 'information'; they require 'good quality' information to survive. Perhaps information quality problems had always been but had not received the attention demanded. In addition to increased number of researches focusing on an assortment of information quality frameworks, there is widespread information quality discussion in enterprises geared towards increasing awareness of the need for information quality. Nevertheless a vast majority of organizations are still facing issues on how to manage information quality effectively,. Concerning the high information quality quest, organizations require specialized practical strategies derived from their own organizational perspective but incorporated with best practices; such specialized practical information quality strategies are the focus of this research which seeks to devise practical approaches through which the quality of information in Shell Global Functions IT can be improved.

1.2   The Organization

1.2.1   Introduction to Shell

Shell was created in 1907 when Shell trading and Royal Dutch Oil merged to become Royal Dutch Shell also known as Shell group or simply 'Shell' in this case. As of the year 2010, the Shell group spanned more than 90 countries with more than 93,000 employees. Shell group is involved in Upstream and Downstream businesses. Upstream businesses explore and extract crude oil and natural gas whereas downstream stream businesses refine, supply, trade and ship crude oil worldwide in addition to manufacturing and marketing a range of products, and petrochemicals produces for industrial customers. Upstream businesses include; Exploration and Production , Gas and Power whereas downstream businesses include ;Shell oil sands , Shell Chemicals, Shell Oil Products which makes, moves and sells a range of petroleum products , Shell corporate and others. Besides the main two businesses, Projects & Technology manages delivery of Shell's major projects and drives research and innovation of creating technology solutions ,it includes businesses like; Shell Trading and Shell Global Solutions. In support of the businesses, Shell has functions namely; Finance ,Contracting & Procurement ,Corporate Affairs ,Human Resources ,Information Technology(IT) ,International Department ,Legal ,Operational Security ,Shell Real Estate ,Strategy and Business Development (www.shell.com).

Information Technology being one of the functions in Shell provides strategic direction on information and communications technology. It supports global[1] standards and processes, allows seamless working across geographical and organizational boundaries (collaboration), and creates the flexibility to move work wherever it is best executed. IT has three delivery channels, i.e., to improve the Function, deliver to the Business and support of the Function.

1.2.2   Case study area: Shell Global Functions IT

Global Functions IT is one of the IT delivery channels with its major locations spanning geographical boundaries in; Netherlands (The Hague), United Kingdom (London), Malaysia (Kuala Lumpur) and in USA (Houston). GF IT has the responsibility of taking care of all IT for Functions, such as; Finance, Human Resources, Tax, Legal, Real Estate, Contract & Procurement, Treasury, Health, Safety, Security, Environment and SAMCO (Shell Asset Management Company) whose activities also span geographical boundaries. GF IT supports five LOBs (Lines of businesses) and consists of shared resource and cross-functional organizations which have diverse roles and responsibilities.

1.2.3   GF IT organizational model
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[1] The term 'global' in the case of Shell implies 'organizational –wide' spanning.

1.3 Research Motivation

Information management, in Shell Global Functions IT, goes beyond just the information technology involved in managing the information life cycle of acquiring/creating/updating, assuring quality, storing/archiving, publishing, searching/using/manipulating/exploiting and discarding information. Managing information also involves the people, business processes, and practices in addition to the content itself. Although important, the processes and information management technologies should not be overemphasized above the value of the 'very' information being managed. It should be ascertained that the information derived is of quality and therefore is valuable towards timely decision making.

Therefore the main motivation of this research is best stated by the concern that the VP/CIO of GF IT (at that time) expressed during a dialogue concerning GF IT challenges with information. *"How can we get value from our information and deliver the right information to the right people at the right time?"* this concern propelled the commencement of this research and subsequently the motivation of enabling GF IT get value from its information by enhancing operating with quality information.

CHAPTER 2   RESEARCH APPROACH

This chapter illustrates why and how the research was carried out. It stipulates the objective of the research and which questions and methodologies were followed to arrive at the recommendations in the final chapters. The researcher applied the '5Ws and H approach' of; what is the problem, where is the problem, why and when it is a problem and how can it be solved. The model below reflects the thought process that the research followed to devise the objectives, methodology, to identify the scope, structure and design of the research so as to answer the needed questions.
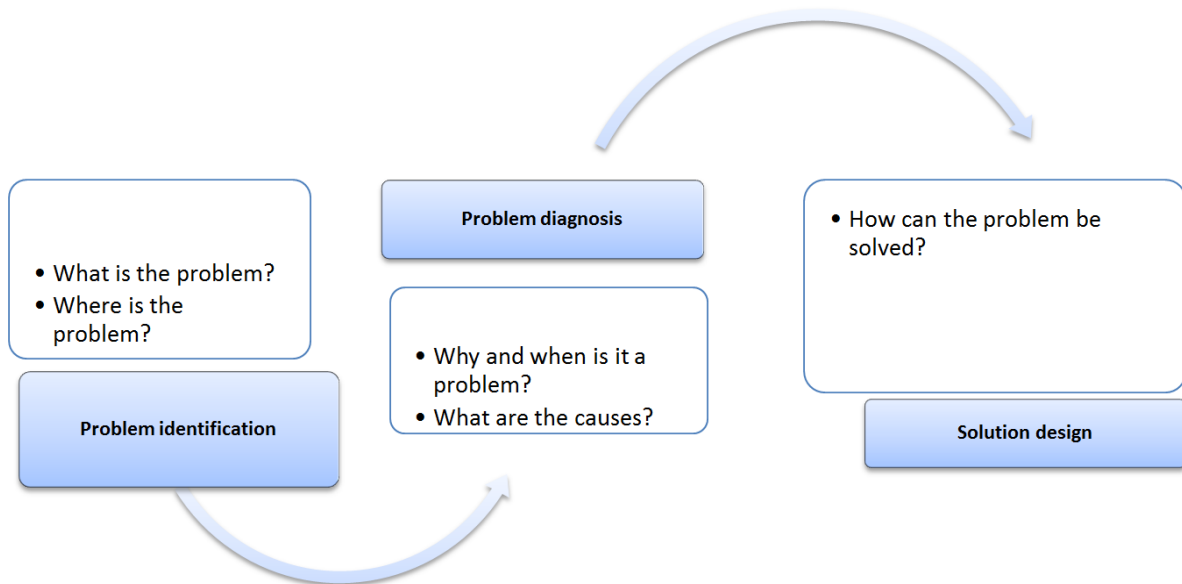
2.1   Research context

Objective

The objective of this research is to assess the current information quality maturity level of GF IT with a purpose of recommending the most feasible approach towards enhancing the quality of information in GF IT.

Research questions

Main question

How to improve the information quality maturity level of GF IT?

Sub questions

1. What is information quality?
2. How can information quality be assessed?
3. What are the current information quality challenges in GF IT?
    a. What are the root causes/origins of current information quality challenges?
    b. What are the consequences of these challenges?
4. Which information quality maturity level is GF IT?
5. What are the alternative best approaches towards improving information quality in GF IT?
6. What is the most feasible approach towards improved information quality in GF IT?

Scope

The research is carried out within Shell Global functions IT. The researcher was situated in PDAS during the research. Note that the, subject of scope is the unstructured information which is used by GF IT knowledge workers to make daily operations' decisions and not the documented Shell records.

2.2 Research Methodology

2.2.1 Theory of problem solving

The research analyses the knowledge question using a problem driven investigation methodology. According to (Wieringa, 2009), this nested problem solving methodology is a type of regulative cycle research methodology of solving design science problems. It starts with identification of a problem, diagnosis of problem situation (finding root causes and possible remedies),diagnosis then results into a plan of action in which the remedy is elaborated, this is followed by an 'intervention' which brings about the desired changes then the last stage is 'evaluation' of the new situation. The last two stages are out of scope in this research.

2.2.2 Problem solving in practice

What is the problem?

The initial stage was to identify what GF IT means by "getting more value from the current information and providing the 'right' information to the right people. Through informal dialogues with five selected Shell GF IT stakeholders, a number of information challenges such; incorrect data in databases, inefficient document management, limited information sharing, need to have similar data definitions and others. From these challenges, the researcher drew a conclusion that 'GF IT is concerned with the quality of its information' not just the processes of producing it. The next step was then to conduct interviews with a wider range of stakeholders to identify the quality problems on ground and identify their root causes. After the organizational structure and operations of GF IT had become clearer to the researcher, it was pertinent to narrow the focus to information quality challenges to one function to get in-depth view .The step narrowed the research to analyzing the

causes of 'incorrect project cost reporting' in PDAS so as to analyze how GF IT currently handles quality challenges . This led to another set of interviews to concerned PDAS stakeholders. From the findings, the researcher was able to assess the level of maturity of information quality in GFIT.

Design of solution

Alternative solutions were identified from; academic literature, interviews of Shell GF IT stakeholders, from Gartner's renown business best practices, from observations and documentation of the operations of Shell GF IT as a whole

Data collection: application of theory to practice

The research design illustrates the approach followed in answering the research questions,it depicts the cycle followed between theory and practise so as to come to fulfill the objectives as illustrated below:

Objective	Methodology
1. **What is information quality?** 2. **How can information quality be assessed?**	Literature study of articles ,books ,journals ,research papers with keywords related to; frameworks, assessment and theories concerning information and data quality.
3. **What are the current information quality challenges in GF IT?**	Unstructured and structured interviews, stakeholder analysis, Observation of current environment, formal and Informal interactions with stakeholders. Review of reports and documents, Online information Search on Shell portal
4. **Which information quality maturity level is GF IT?**	Literature study of articles ,books ,journals ,research papers concerning information and data quality management
5. **What are the alternative best approaches towards improving information quality in GF IT?** 6. **What is the most feasible approach towards improved information quality in GF IT?**	Observation and study of current environment. Structured interviews with stakeholders and experts within Shell GF IT and non-Global Functions. Structured interviews

2.3   Research contributions

This research elucidates the implications and practicality of assessing information quality in a multi-national corporation. The approach followed is not limited to a multi-national corporations or energy companies but can be adopted on a smaller scale for smaller organizations. The research illustrates the applicability of Eppler (2006) problem identification framework in addition to modeling an information quality maturity model adopted from business best practices and an academic perspective, i.e., Gartner data maturity model and a proposed information quality maturity model by Baskarada (2006) which is still under research. This depicts that the research not only contributes improvement recommendations to Shell GF IT but also contributes to academic and business best practices of assessing and improving information quality.

2.4   Report Structure

The report follows two phases which are carried out in parallel. As the methodology specifies, theoretical and practical approaches are followed. The first 3 chapters give the research and theoretical background and the following chapters depict how the case analysis was done as illustrated below. Note that some chapters or parts of this report are left out as there 'confidential'.
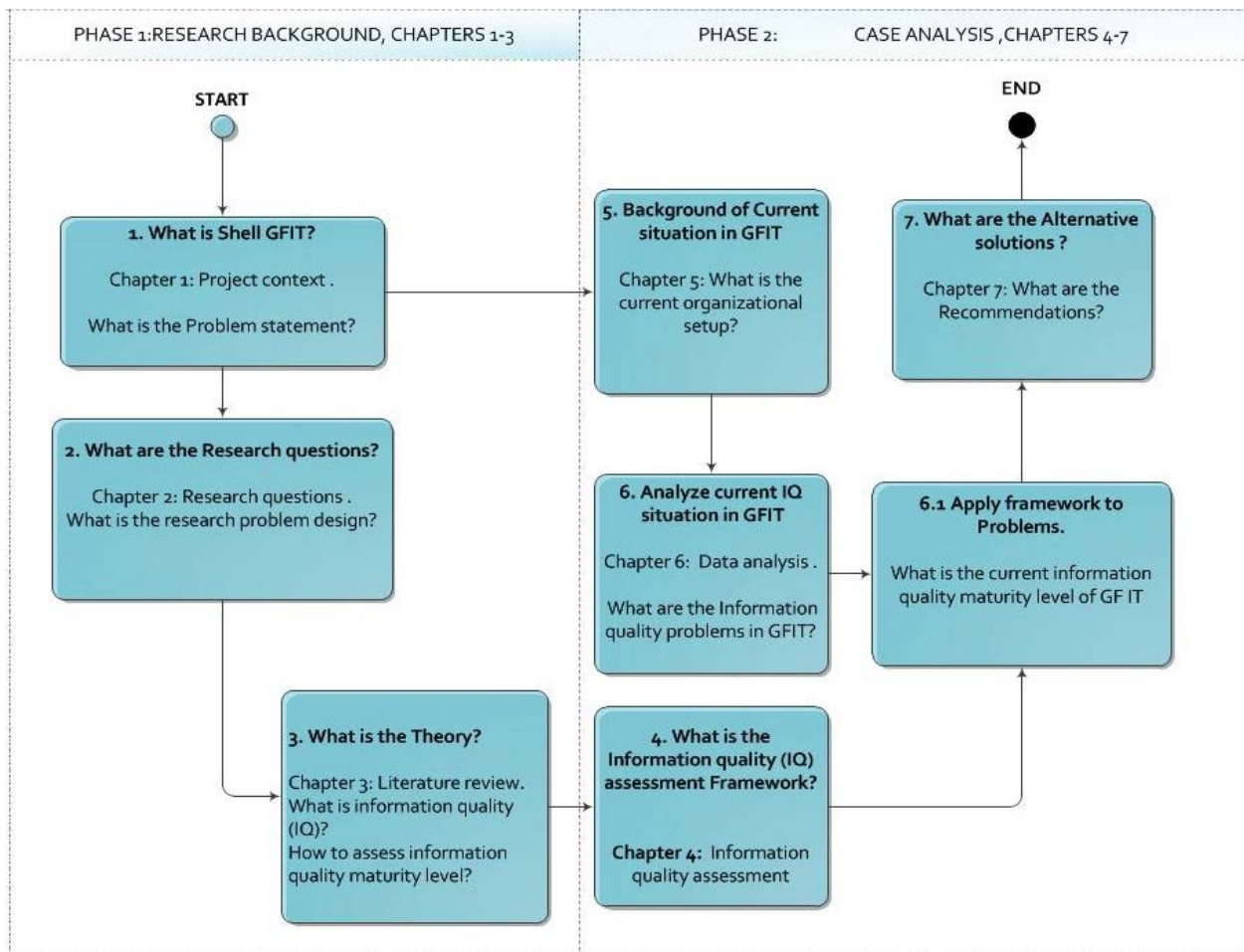
CHAPTER 3   INFORMATION QUALITY IN ORGANIZATIONS

A number of authors (Larry P., 2009 ;Al-Hakim, 2007 ;Mouzhi, 2007) concur that enterprises have more data than they can possibly use, yet again they do not have the data they actually need. In the 'Realized Information Age', more enterprises have come to a realization that they have achieved 'quantity 'but not 'quality' of information. In this chapter, we consider the diverse perspectives of the term 'quality' as a basis for distinct authors' views concerning 'information quality'. The chapter highlights diverse 'information quality' terms that re-occur in the rest of the research and finalizes with a discussion on the current highlights of Information quality (information quality) research from which the structure of this study is derived in the proceeding sections.

3.1   Definitions

3.1.1   Defining Quality

It is imperative that we understand the term 'quality' before delving into the 'information' aspect of it. Although 'quality' can be defined in numerous ways, Fountain (Alavi, 2001)'s citations of four types of quality from two authors summarizes quality as either; conformance to requirements, fitness for use, innate excellence or value. Additionally, the ISO 9000 standard highlights a commonality behind all quality definitions; i.e., the quality of an entity is determined by comparing a set of inherent 'characteristics' with a set of 'requirements'. If those inherent characteristics meet all requirements, high or excellent quality is achieved whereas if they don't meet minimum requirements, a low or poor level of quality is achieved therefore 'quality' is measured or assessed against a set of requirements. Hence the inherent characteristics of 'data' and 'information' are similarly data or information attributes and in this case we refer to them as 'dimensions'. We apply these quality dimensions in assessing the quality of data or information quality; they determine if data or information is of good quality or not according to the user's requirements.

3.1.2   Distinction between data and information quality

Is this report, the intricacies of the variations between the terms 'data quality' and 'information quality' are out of our scope but a general differentiation between these terms will highlight the scope of this study. We use a concise exposition of the definitions of data and information to differentiate DQ from information quality.

Data versus information quality

Although there clear definitions between data and information, practical delineation between the two terms when dealing with 'quality' is still obscure. Data and information are often used synonymously. A number of authors (Wang, 2002 ;Ge, 2007 ;Richard Y. Wang, 1995) and many others opt to use the terms Information quality (information quality) and Data Quality (DQ)

interchangeably whereas others like Wang et al,2002 occasionally adopt the term "DQ' in their publications and others prefer to use the term "information quality".

Turban et al (Tuomi, 1999) define data as items that are the most elementary descriptions of things, events, activities, and transactions; these items could be numeric; alpha numeric, sounds, figures or images .The authors also define information as 'organized' data that has meaning and value to the recipient. Additionally, (Davenport, 1999) describe data as structured records of transactions, which describe what happened but provides no judgment or interpretation of how the findings can be used. In this sense, data in itself may have no value until judgment or interpretation is appended to it and it is this judgment which is termed as 'information'. It is on this basis that Allen et al (Keith Allen, 2008) also concludes that the consideration of 'processing' distinguishes information quality from data quality.

A number of authors, (Pipino, 2002 ;Kahn, 2002;Al-Hakim, 2007) denote that the term information quality encompasses traditional indicators of data quality. Al Hakim (Al-Hakim, 2007) in his book states that good information quality implies good DQ, poor DQ causes poor information quality but good DQ may not necessarily imply good information quality because poor information quality could have resulted from errors with in the process of transforming data to information. He cites an example that a researcher may collect accurate, timely and complete data but conclude poor quality information from the good data.

Basing on the above statement, Al Hakim agrees with authors like (Yang W. Lee, 2002) to conclude that the term 'Information quality' can be used to refer to both information quality and data quality but the reverse may not applicable. He points out that the focus of authors speaking only about DQ is primarily on the issue of data as a raw material; for example concerning quality of data in data ware houses. According to Pipino, (2002), there is a tendency to use data quality to refer to technical issues and information quality to refer to nontechnical issues but in practice managers differentiate information from data intuitively, and describe information as data that has been processed

This study does not analyze data quality problems in databases, data ware houses therefore we mainly use the term 'information quality' and in some cases we interchangeably use the two terms due to their extensive use in both literature and the case study organization. We scope the boundaries of the 'information' in consideration in chapter 5 basing on Shell GF IT which is the case study organization in this research.

3.2   Defining Information quality

From the disparate views of what 'quality' is, it is not a surprise that a number of authors (Popovic, 2009 ;Keith Allen, 2008 ;Eppler, 2006) consent to the vagueness of the definition of the term 'information quality'. (Wang, 1998), gives an extensive outline of 'Information quality' definitions from various authors from both consumer and data perspectives as follows:

> *"Information quality is defined as information that is fit for use by data consumers"(Wang Richard, 1998)*

> *"Information quality is defined as the information that meets specifications or requirements" (Kahn, 2002)*

> *"Information has quality if it satisfies the requirements of its intended use " (Tuomi, 1999)*

> *"Information quality can be thought of as information's inherent usefulness to customers in assessing the utility" (Keith Allen, 2008)*

> *"Information is of high quality if it is fit for its intended uses in operations, decision-making, and planning. Information is fit for use if it is free of defects and possesses desired features. (Redman, 2001)*

> *"Information quality is defined as information which consistently meets knowledge workers' and end-customer's expectations"*

> *"Information quality is defined as the degree to which information has content, form and time characteristics which give it value to specific end users"(Brien, 1991)*

> *"Information quality is the characteristic of information to meet the functional, technical, cognitive and aesthetic requirements of information producers, administrators, consumers and experts"*

> *"Information quality is defined as information which satisfies criteria of appreciation specified by the user, together with a certain standard of requirements" (Salaün and Flores, 2001)*

It is noticeable that most of definitions of information quality are derived from the user perspective because most researchers posit that it is the information consumer who determines the quality of an information product/service based on his/her requirements. However for this research, we assert that 'information quality is not only based on a consumer's requirements per se but 'requirements at a given time' since requirements change ; what was quality today may not be quality tomorrow .

We therefore adapted Eppler (2006) explicit definition that :

"Information quality is the characteristic of information to meet the functional, technical, cognitive and aesthetic requirements of information producers, administrators, consumers and experts"

3.3   Information quality dimensions

Janse (2011) simply defines an information quality dimension as an information quality attribute that represents a single aspect or construct of the quality of information, examples are; accuracy, completeness, consistency, timeliness etc. We expound on how to assess these 'dimensions' in chapter 4 but in the next section, we introduce the concepts of data and information quality.

CHAPTER 4 INFORMATION QUALITY ASSESSMENT

One cannot manage Information quality without assessing it appropriately Stvilia (2007).Even though the last decade has brought with it a number of information quality assessment frameworks, Ge (2007) state that many organizations are still facing difficulties when implementing these assessment frameworks in practice. They attach some of these difficulties to the fact that most frameworks are complex to comprehend and apply because most of them are only specialized to specific organizations and cannot be generally applied to a variety of cases. On the same note, the authors argue that information quality problems can differ by organization therefore generalized information quality assessment frameworks will not entirely befit all organizations. Furthermore Eppler (2006) affirms that a framework should provide a conceptual language which practitioners can use to facilitate their mutual problem understanding and coordinate their collaborative actions; He suggests five aspects which every comprehensive information quality framework should achieve. First, it should help them to *identify* information quality problems more systematically and more comprehensively. Second, it should enable them to *analyze* these problems in more detail and rigor, and find their root causes. Third, the framework should be useful to *evaluate* (or *monitor*) solutions to information quality problems based on this problem analysis. Fourth, it should provide means to *design* and *manage* sustainable solutions based on the prior evaluation of feasible improvement measures. Finally, the framework should also be applicable as an instrument for teaching the aforementioned four processes.

4.1   Information Quality Assessment Frameworks

Eppler (2006) 's perspective is that during information quality assessments practical use of both subjective and objective metrics to improve organizational data quality requires three steps of; first, performing subjective and objective data quality assessments; then comparing the results of the assessments, identifying discrepancies, and determining root causes of discrepancies; and finally determining and taking necessary actions for improvement.

In spite of the propositions about comprehensive frameworks, Stvilia, (2007) highlight that most frameworks are ad hoc, intuitive, incomplete, do not identify and describe the roots of information quality problems nor link them consistently with affected information process activities. In practice it is important to not only focus on elucidating information quality dimensions but to also give attention to how those dimensions can be practically used in identifying and analyzing organizational information quality problems. This argument determined the choice of framework used in the case after consideration of alternative frameworks, as depicted in the next section.

4.1.1 Information quality assessment framework by

The authors devise a framework which bases Information quality assessment on three elements; The 'Who' aspect is a consideration of who carries out the data or information assessment. This "Who" represents an actor who is usually an evaluator a person / or a software program. The "What" element represents the objects that are measured and accordingly these are either, raw data stored in the databases or information products that are the outcomes from information manufacturing systems and "Which" represents the set of information quality dimensions that are used in the assessment. As mentioned by the authors, the framework is based on the idea of "who uses which dimensions to measure what "and is based on three layers including: the evaluators, assessment dimensions and assessment target.
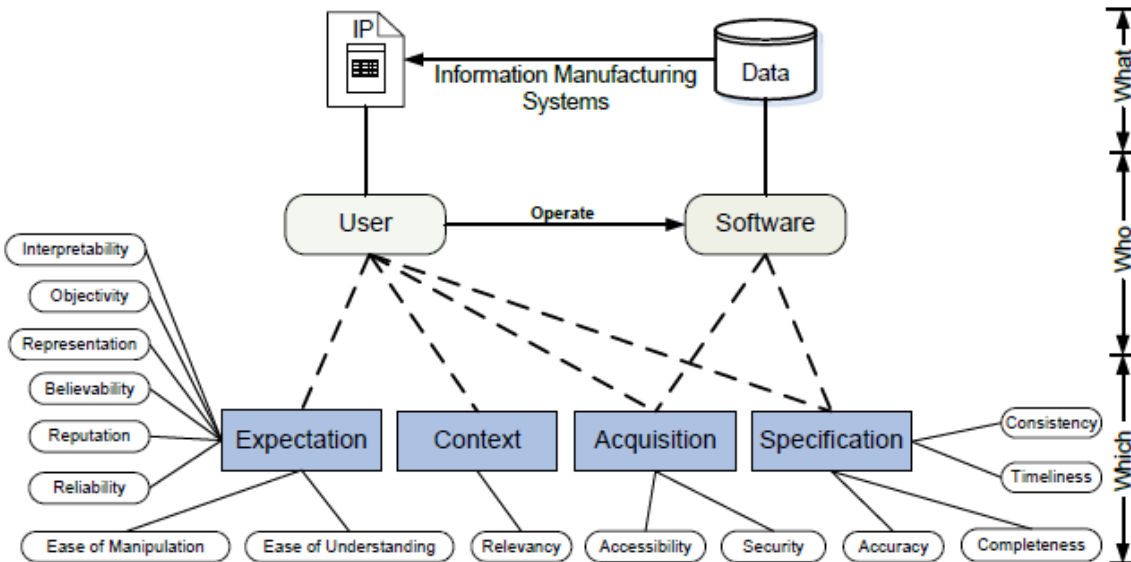
Information quality assessment framework

The framework is comprehensive as it views quality issues of both raw data in databases and the quality of information products along the information life cycle. The assessment of raw data is from an objective information quality assessment perspective based on database integrity rules, which are measured by software systems whereas subjective information quality assessments are used to assess the quality of information products by employing user opinions. Affirm that it is of importance to deal with both the subjective perceptions of the individuals involved with the data, and the objective measurements based on the data set in question. Also assert that subjective data quality assessments reflect the needs and experiences of stakeholders like the; collectors, custodians, and consumers of data products. It is important to emphasize that subjective data quality assessments are usually used to identify information product problems.

In a previous research review by Ge (2007), the identification and classification of information quality problems is outlined as a key component in information quality assessment. The authors later developed a framework which does not focus much into the analysis of information quality problems but focuses more on classifying information quality dimensions and creating a survey to validate the classification approach. The authors identify surveys as a tool to be used to identify information quality gaps and later on explain how these gaps can be aligned to Information quality dimensions. However, in this framework there is no in depth clarification of how to analyze those information quality problems and related information quality dimensions in relation to solution areas especially in the case of subjective information quality assessments which base on user's opinions. With this framework, it is still unclear how the information quality dimensions can be related to devising solutions to the information quality problems. It is on the above reasons that the framework suggested may not be so wholly feasible with our case.

4.2   Information quality problems

Ge (2007) asserts that most information quality research is motivated by organizations' information quality problems. As organizations try to find out how good their data or information is, the most probable challenge encountered, is the quest of 'practically assessing their data or information'. Propose three steps necessary to improve organizational data quality assessment in practice. They allege that it is of paramount importance to first perform both subjective and objective data quality assessments; then compare the results of the assessments, identify discrepancies, and determine root causes of discrepancies; and finally determine and take necessary actions for improvement. Suggest that companies must deal with both the subjective perceptions about data quality by individuals and the objective measurements based on the data sets.

4.2.1   Identifying information quality problems

In cases of information quality assessment, subjective quality assessments should be taken as important since they reflect the needs and experiences of users who in most cases are the main determinants of the quality requirements. Surveys in terms of questionnaires and interviews are a sample of subjective methods that can be used to measure stakeholder's perceptions about data quality in addition to enabling quality evaluators to identify gaps and concerns that can be related to information quality problems.

Surveys in questionnaire format can be applied where the information quality evaluators are part of the information users i.e., they are conversant with the information whose quality is being assessed. In cases where the type of information being assessed is hardly known by the information quality assessors, it would be advisable to first identify and scope the information being assessed by consulting or dialoging with the information stakeholders (producers, maintainers and consumers).In such cases interviews can be applied. The use of interviews permits researchers to obtain detailed information and more explanation regarding quality issues.

4.2.2 Selection of information quality dimensions

As introduced in chapter 3, an information quality dimension represents a single aspect or construct of the quality of information. The intricacies of how many dimensions information can have are out of scope in this report, as these are subjective to diverse author's opinions and user's requirements but   sums up seventy information quality dimensions from various authors like; Lesca and Lesca, (1995) and Redman, (1996) into sixteen dimensions. Eppler (2006)   intuitively and empirically eliminates synonyms and closely related terms thereby excluding dimensions that are either too context-specific or too vague. Whereas some dimensions relate to the information consumer and his or her judgment of information, others relate to the information product itself, while still others focus on the process of information provision. Therefore we adapt Eppler (2006) choice of sixteen dimensions shown in appendix 1.1.

4.2.3 Aligning information quality gaps to selected information quality dimensions

Interview questions similar to descriptive questions can be used to identify indicators from interview responses which could be associated to specific quality dimensions as illustrated in Appendix 1.1. Dimensions most related to the information quality problem statements mentioned by interviewees in are then selected by aligning mentioned problem statements to the related information quality dimensions as shown in Appendix 2.

It should be noted that each dimension summarizes specific information quality problems. Note that terms related to a particular dimension i.e.; synonyms or opposites are represented by one keyword. The results can be translated into a suitable chart revealing the quality dimension to which the highest number of information quality problems

 Eppler 's categorization of information quality problems can then be applied to associate the 'quality dimensions' to root causes of problems, consequences to users (consumers) and to the management roles concerned with rectifying them. The root causes to which most problems relate are the areas requiring significant improvement.

4.2.4 Classification of information quality problems

As already mentioned, emphasizes that a comprehensive information quality framework should be usable to achieve five specific goals as   respectively ; identifying information quality problems, analyzing those problems, evaluating solutions and providing a means to design and manage solutions as well as being understandable enough to be taught and applied.

After information quality problems have been identified, one can then categorize them according to their origin (what causes the problems), consequences to the information consumer, and according to the responsibilities or roles of stakeholders concerned with solving the problems.

Categorize by origin

Eppler (2006) distinguishes four possible causes of information quality problems as illustrated below. The first being that information is not targeted at the intended users who are supposed to use it. In such cases problems exist because information is addressed to the wrong audience resulting into irrelevant, incomplete, or simply not useful information for the information consumers. Secondly, information producers could create 'bad' information resulting into incorrect, inconsistent, or outdate information. The origin is not a wrong allocation of the information as in the first cause, but a wrong production to begin with. A third cause may arise when information is not provided in the right way or through the right process even though it may be correct and targeted to the needs of the information consumer. And finally, infrastructural problems with the hardware and software information systems may make information hardly accessible, insecure and unreliable. These categories are illustrated below;
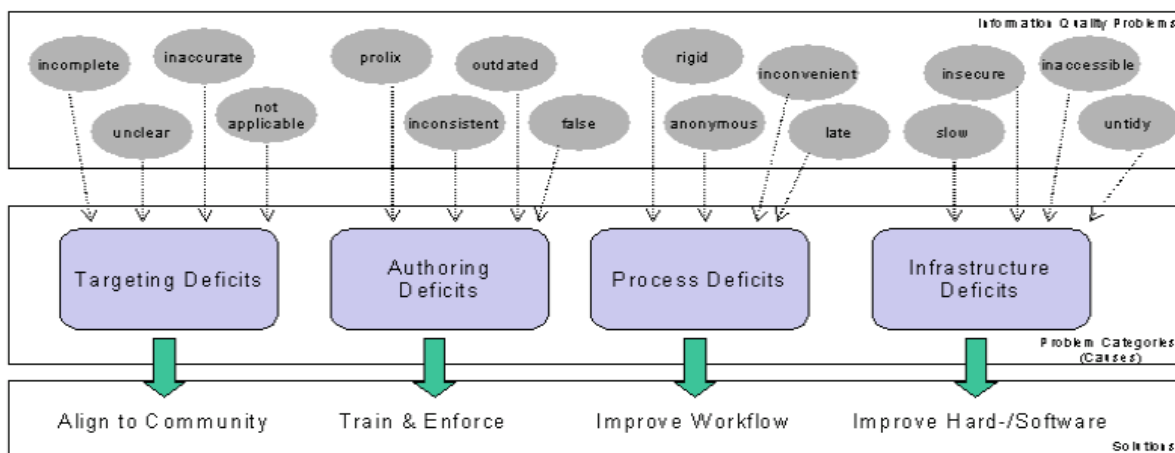
Information quality problems categorized in terms of their origins

Categorize by consequence

As illustrated, asserts that there are mainly four consequences are a result of insufficient information quality from an information consumer's perspective: the first being that the user cannot identify the right information, then misjudgment of information in that a user cannot judge or evaluate the information. Misinterpretation of information in that the user cannot understand or interpret the information and finally misusing the information in that the information consumer cannot use or apply the information.
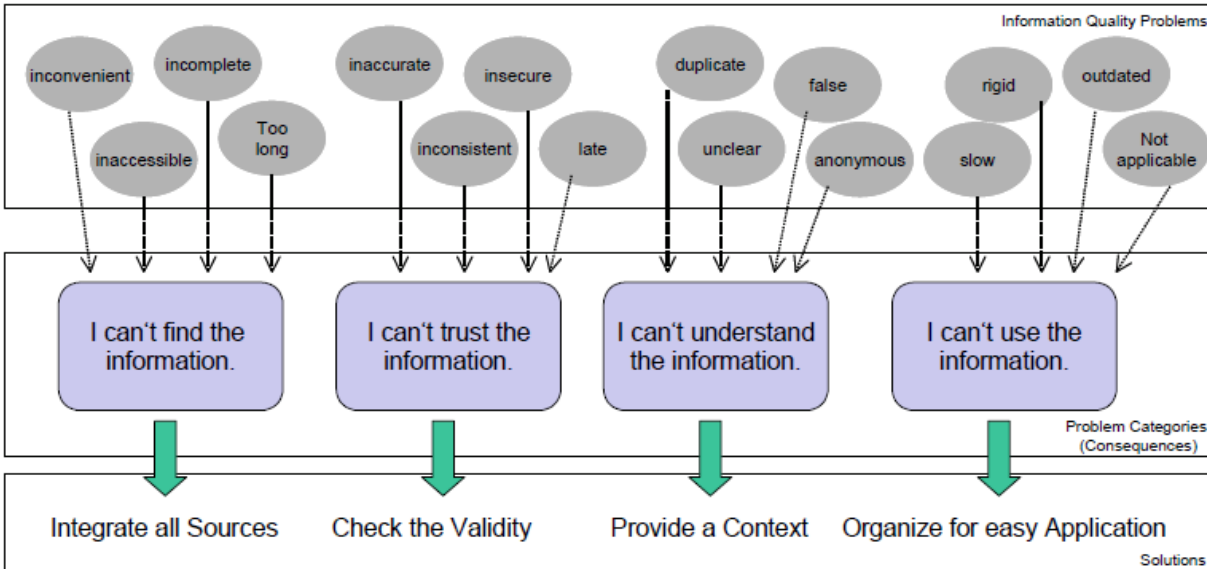
Categorize by responsibility

Finally information quality problems can be categorized according to the responsibility for the problems ie; who should do something about them. For this case Eppler (2006) identifies three professional communities: the information producers or authors, their superiors or managers, and their support staff or IT-managers. If the information quality problems result from providing the wrong kind of information then the managers must get authors to produce a different kind of information. If the information is relevant, but often false, outdated, or inconsistent, then the authors need to improve their content either on their own or with the help of their management. In contrast, if the way that information is provided is sub-optimal (slow, complicated, untraceable), then the information technology managers need to become active. He concludes that information quality problems are content problems that must be resolved by the information producers and their management, or as media problems that need to be resolved with the help of the information technology department that should improve the content management processes and infrastructures.
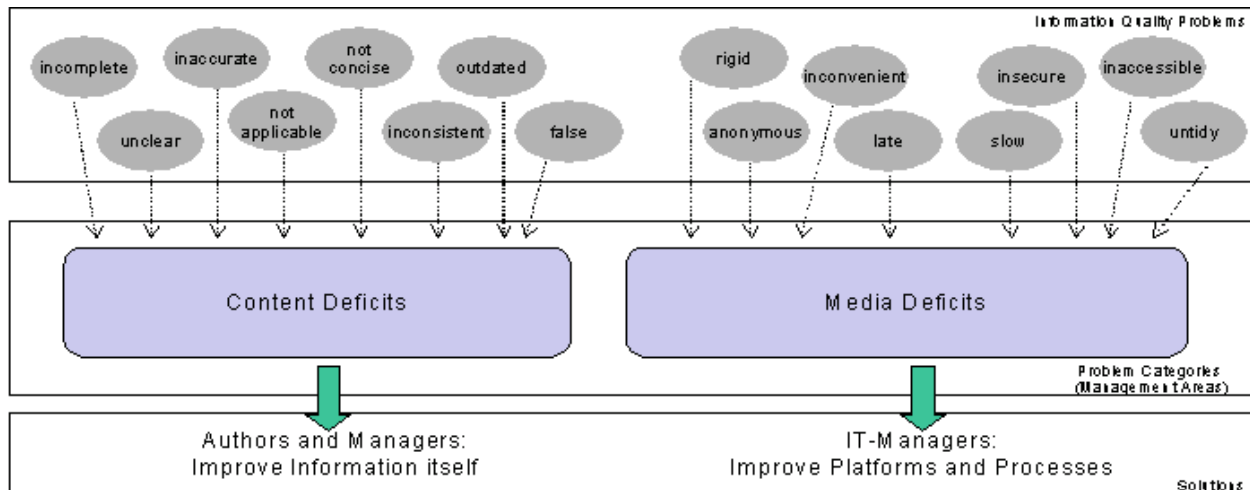
Information quality cannot be assessed prior to identifying information requirements as required by the information consumers, it is therefore inevitable to identify information requirements and then pinpoint gaps. These gaps are considered to be the information quality problems. In addition to identifying gaps, the information quality evaluator will then need to identify root causes for these gaps and later align the problems to solution areas which can be looked into in details.

Whereas most frameworks don't stipulate how one can relate information quality gaps to particular causes and solutions, gives a clearly understandable methodology of classifying information quality problems. His approach represents a logical sequence from identifying the causes of information quality problems, the consequences of such problems but most of all evaluates remedies for such information quality gaps, it is therefore applied as the main framework for identifying and classifying information quality problems, analyzing those problems and evaluating solutions.

4.3   Assessing the level of Information quality Maturity

After organizations have recognized that they are having a number of problems with the quality of information in their Information Systems (IS),it is important that they assess their current Information quality maturity level .A maturity model would assist such organizations in assessing and enhancing their Information quality management capability, by addressing a wide range of Information Management and Information quality management process areas and organizing those process areas into staged levels (Baskarada, 2006).

The original Capability Maturity Model (CMM) was developed by the Software Engineering Institute (SEI); even though CMM doesn't itself address any IM/information quality management issues, there a number of information quality management related maturity models that have been built from it.

4.3.1 Data Quality Maturity Model (Gartner, 2006)

According to Gartner, only a handful of companies can be considered mature in how they manage information as a corporate asset, by ensuring the accuracy, completeness, consistency and other attributes of information quality In this section, we focus on a Gartner's maturity model adapted from Capability Maturity Model CMM since it has been used by a number of Gartner's client organizations to assess their level of data quality sophistication, through common indicators and benchmarks. It provides a number of improvement strategies to raise an organization's information management capabilities.

Gartner's levels of data maturity

Level 1: Aware

Organizations at Level 1 have the lowest level of data quality maturity, with only a few people aware of data or information quality issues and their impact. These organizations have no or little understanding of data quality as an important concept in IM. Although there may be some awareness that data quality problems are affecting decision-making or execution, any side effects of bad data are not considered particularly important and are largely ignored. No formal initiative to cleanse data exists, users have no incentive to raise data quality issues, and information emerging from computer information systems is generally held to be "correct by default." Even when a problem with data quality is obvious, there is a tendency to ignore it and to hope that it will disappear of its own accord or when a new system or upgrade is installed.

Within the entire organization, no person, department or business function claims responsibility for data. If anything, data is considered to be an occasionally interesting application byproduct part of the IT environment and, as such, the IT department's problem. Business users are largely unaware of a variety of data quality problems, their impact and possible solutions, partly because they see no benefit for themselves in keeping data clean. Basic activities such as de-duplicating customer records in marketing databases happen only very sporadically, based on pressing business needs.

Level 2: Reactive

Organizations at Level 2 are starting to react to the need for new processes that improve the relevance of information for daily business. To address the issue of data quality early in an application's life cycle, application developers implement simple edits and controls to standardize data formats, check on mandatory entry fields and validate possible attribute values. A few organizations at Level 2 use manual or homegrown batch cleansing, typically performed at a departmental or application level within a relatively limited scope.

However, this approach rarely yields significant results. Business decisions and system transactions are regularly questioned due to suspicions about data quality. Data, for example, in a document or report is believed to be erroneous, based on gut instinct or experience. Employees have a general awareness that information provides a means for enabling greater business-process understanding and improvement. But, throughout the enterprise, data is trusted only in aggregate for high-level strategic decision-making. Although field or service personnel need access to accurate operational data to perform their roles effectively, businesses take a wait-and-see approach in relation to data quality.

At this maturity level, the typical business user waits for problems to occur, instead of taking proactive steps to prevent them, and data quality problems are still perceived to be solely the IT department's responsibility.

Level 3: Proactive

Organizations at Level 3 are proactive in their data quality efforts. They have seen the value of information assets as a foundation for improved enterprise performance and moved from project level of information management to a coordinated enterprise Information management strategy to support their enterprise agility objectives .At this stage, business analysts feel data quality issues most acutely, in both operational and decision-making contexts, and data quality gradually becomes part of the IT charter. Data quality tools, for tasks such as profiling or cleansing, are acquired and used on a project-by-project basis, but housekeeping is typically performed "downstream" that is, by the IT department or data warehouse teams. Levels of data quality are considered "good enough" for most tactical and strategic decision-making. At this level of maturity, the organization's culture still does not fully promote data as an enterprise wide asset, but key steps are being taken. Major data quality issues are documented, but not completely remediated. Department managers and IT managers are starting to communicate data administration and data quality guidelines, but compliance is not monitored or enforced. Decision-makers are beginning to discuss the concept of "data ownership."

Level 4: Managed

At Level 4, information is part of the IT portfolio and considered an enterprise wide asset, and the data quality process becomes part of an EIM program. Data quality is now a prime concern of the IT department and a major business responsibility. In addition, commercial data quality software is implemented more widely. The organization regularly measures and monitors its data quality for accuracy, completeness and integrity at an enterprise level and across multiple systems. An impact analysis is carried out, linking data quality to business issues and process performance. Most cleansing and standardization functions are performed either at the data integration layer or directly at the data source. Data quality functionality progresses from the cleansing merely of customers' names and addresses, to cover product data, supplier data and multilingual records. Rigorous yet flexible data quality processes make incorporating new data sources straight-forward, and data quality functionality is introduced beyond business intelligence and data warehousing programs — it is built into major business applications and therefore enables confident operational decision-making. Multiple data stewardship roles are established within the organization, to work collectively on business rules, definitions and metrics. The data quality champion, as part of a formalized data governance activity, establishes and communicates clear data quality mandates and mandates and policies, which are continuously, monitored using metrics-based data quality dashboards.

Level 5: Optimized

Companies at Level 5 have fully evolved enterprise Information management programs for their information assets with the same rigor as other vital resources, such as financial and material assets. Rigorous processes are in place to keep data quality as high as possible, through ongoing housekeeping exercises, continuous monitoring of quality levels, and by attaching quality metrics to

the compensation plans of data stewards and other employees. Data quality becomes an ongoing strategic initiative, and the value of high-quality information is demonstrated by significant returns on investment. Businesses at Level 5 also start to measure and monitor fringe characteristics of data quality, such as latency, currency, breadth, depth, position and relationships. They do the same for subjective aspects of data quality, such as believability, relevance and trust factors. In this way, data stewards obtain a complete view of data quality, including both hard metrics (on completeness, correctness, duplication and such like) and subjective opinions (user perceptions). Data is enriched in real time by third-party providers with additional credit, demographic, sociographic, household, geospatial or market data. Also, any unstructured mission-critical information, such as documents and policies, becomes subject to data quality controls. At this level quality indicators are attached to metadata and data relevant to decision-making, to associate levels of confidence or known problems with information — especially in data warehouses. Data quality rules are sufficient for confident real-time business process automation, enabling the organization to transfer some decision-making to the business process itself.

According to Gartner (2006) only a few organizations have mature data quality initiatives and levels 1 and 2 are still the most common among Gartner clients, implying that many organizations are still struggling with data quality as an enterprise wide problem. Between 75% and 80% of all organizations analyzed are said to be on the lowest two levels. Only a few companies worldwide have reached Level 5 by embracing ongoing data quality initiatives, of taking care of data quality processes, metrics, assessing impact and managing information as an enterprise wide asset through information management approaches. In the next section, we introduce approaches that can be adopted to follow through information quality management.

Summary of Gartner's Data Maturity Model

LEVEL	INDICATOR
Level 1	Understanding data and information quality issues and their impact
AWARE	Ignoring incidents of occurrences of bad data
	No formal initiatives to cleanse data
	Information systems data is assumed 'correct by default'
	No person or department responsible for data
	Data is entirely an IT department problem
	Data correction happens when there pressing business needs
Level 2	Initialized new processes for improving relevant data
REACTIVE	Data quality checking features part of operational information systems
	Good understanding of information as an asset
	Data is trusted only in aggregate for high-level strategic decision-making, (unsure whether necessary details are accurate)
	Wait and see approach to data quality issues
	Data quality concerns are perceived as mainly IT department's responsibility
Level 3 PROACTIVE	Moved from project information management to coordinated Enterprise information management strategy
	Proactive data quality efforts
	Data quality considerably given attention in the IT charter
Level 4	Data quality is inculcated into the organizational culture
MANAGED	Data roles and responsibilities are well defined
	Data quality tools are regularly used on a project-by-project basis
	Data quality is a prime concern of both IT and business
	Regular measures and monitors for data quality at an enterprise level and across multiple systems.
	Data quality functionality is built into major business applications for confident operational decision-making.
	Multiple data stewardship roles are established within the organization,
Level 5	Ongoing housekeeping exercises
OPTIMIZED	Quality metrics attached to compensation plans of data stewards and other employees
	Data quality is an ongoing strategic initiative,
	In-depth quality analysis for both objective and subjective quality attributes such as latency, trust, currency, breadth, believability, depth, position and relationships.
	Unstructured mission-critical information, such as documents and policies, is subject to data quality controls.

4.4　Information quality Management

Information quality problems are not solvable with one-time projects or only implementing quality software systems as such problems are usually a result of ineffective management systems, out-of-control processes and other human behavior factors during information production. Information quality requires continuously management and this may call for restructuring organizations' management systems that set performance measures and influence employee behavior (English, 2009). Proper Information quality Management requires sound, defined set of processes implemented and executed with discipline and a number of information or data quality management concepts and approaches have been available over the last two decades for this reason.

In addition to Total Data Quality Management (TDQM) one of the best known approaches started in 1991 at MIT (Huang, Lee & Wang 1999; Wang et al. 1998), there many other upcoming quality management approaches such as; the framework for information quality management by (Eppler, 2006) and Total Information quality Management by (English, 2009).

Total Information quality Management (IQM)

Total Information quality Management (TIQM) by English (2009) is one of the simplified, comprehensive and practical quality principles, and processes that can be easily applied to measure information quality and improve processes to eliminate the causes of poor quality information and its resulting process failures, losses, and costs. English (2009) summarizes Total Information Quality Management as ABC; i.e., Assessment, Betterment and Culture transformation. Below, we outline the three quality management phases;

A. Assessment; during assessment the information quality gaps are identified and costs of poor quality information are measured .In this stage, organizations;
- Determine how mature the Enterprise is in applying Quality Management Principles, processes, and techniques to its information processes as a business management tool.
- Determine if processes are in control and consistently producing quality information.
- Identify where processes need improvement to meet the Information quality Requirements of all Knowledge Workers.
- Identify where data definition or information content and presentation processes need to be improved to prevent communication failure.
- Quantify the real Costs of Poor Quality Information and its effect on business profit (surplus) and on customer and Knowledge Workers satisfaction and productivity.

B. Betterment; in this phase the already started quality management processes are continually improved so as to:

- Eliminate the causes of defects at the information source to prevent defective information, by identifying most important to next most important Information and identifying the magnitude of the costs or impact of defective information on the organization.
- Prevent process failure and costs to recover from failure caused by defective information.
- Eliminate the costs and waste of Information Scrap and Rework to fix the defects or scrap the unfixable defects.
- Increase Knowledge Worker satisfaction and productivity by reducing irrelevant information and rework and, providing them more time for value work and innovation.
- Increase the satisfaction of all stakeholders, including end-Customers ,Shareholders, Suppliers, Business Partners, and all who benefit from the organization's success.

C. Culture Transformation; involves transforming the culture of the organization to value "Information Customers" and empower "Information Producers," providing training and other resources to manage information horizontally across the business.

According to English (2009), all three ABC Components are necessary for a complete and sustainable Information quality environment that optimizes the enterprise as a whole system, English quotes Dr. Deming's caution that, "transformation can only be accomplished by people, not by hardware and a company cannot buy its way into quality.

CHAPTER 6 ANALYSIS OF INFORMATION QUALITY IN GF IT

In this section, we will mostly highlight the five most frequent information quality problem areas from the GFIT information consumers' perspective. This study indicates that almost three quarters of user concerns about information quality in GFIT ,i.e., 72% are associated with five of the eleven dimensions with the two major dimensions being comprehensiveness and consistency of information (see figure below). Note that, it is important to understand these dimensions before relating them to the problems therefore their descriptions of are outlined in Appendix 1.1

6.1   Information quality problems in GFIT

The information quality gaps in GFIT as a whole were analyzed. We identified the biggest improvement areas by aligning mentioned problem statements to the related information quality dimensions.

It should be noted that each dimension summarizes specific information quality problems. The results from were translated into a pie chart revealing the quality dimensions to which the highest number of information quality problems in GFIT can be attributed to.

BiggestIQ problem areas in GFIT
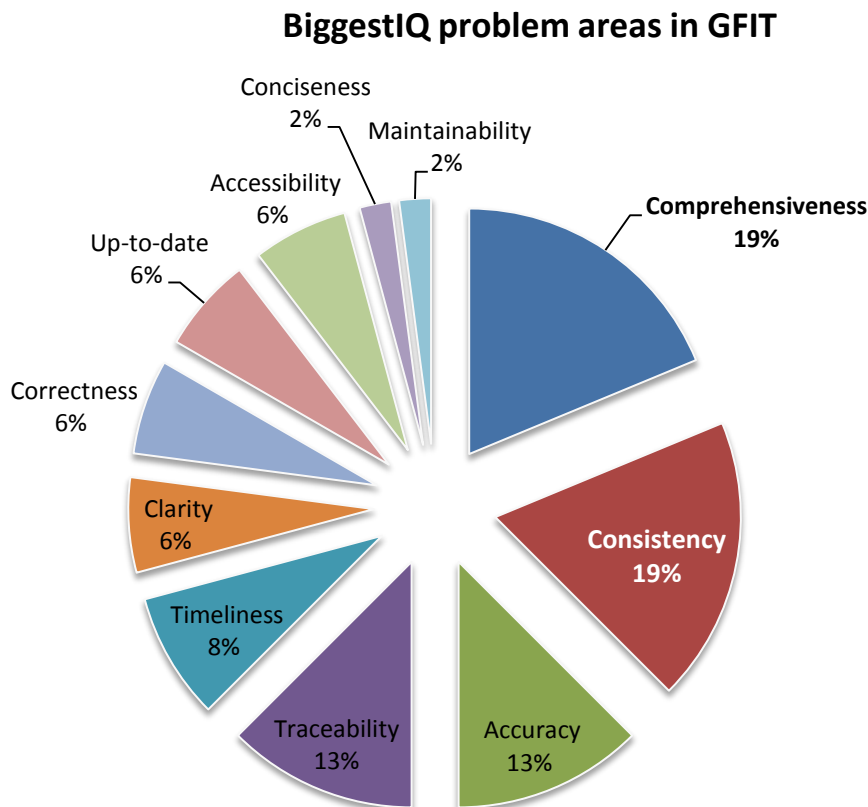
Of the 47 collected information quality problem statements relating to in GF IT ,38% related to incomprehensiveness and inconsistency, whereas 26% to gaps in traceability and accuracy and, the remaining 36% of issues were attributed to timeliness(8%), clarity, correctness, up-to-datedness, accessibility, conciseness and maintainability.

6.1.1   Comprehensiveness

Whereas Eppler (2006) prefers to refer to the dimension 'completeness' as 'comprehensiveness', other authors ; Kahn (2002) and Richard Y. Wang (1998) use the term 'completeness' therefore in this section we will interchangeably use the two terms.

The oxford dictionary defines "comprehensive" as including or dealing with all or nearly all elements or aspects of something. Eppler (2006) states that comprehensiveness can be assessed by the adequacy of the scope of information and from the view of (Wang, 2002)by missing values, especially those values used or needed by information consumers. (Wang, 1997) define completeness as the extent to which information is not missing or is of sufficient breadth and depth for the task at hand. It is important to note that the deficiencies in particular dimensions can result into gaps in other dimension, in the case of clarity and completeness/comprehensiveness; if an information product is unclear to the recipient, he/she is likely to produce incomplete information from it. An example of such a scenario concerns the problem of wrongly booking GFIT project costs. Interviewee 3 (in appendix 2.1) stated that gaps in financial data could be arising from lack of understanding of particular financial aspects by the cost data entrants denoting that in some cases they make assumptions. This incompleteness of data could also be linked to a lack of traceability or accessibility of the necessary details. To find the root causes of inputting wrong cost estimates, it is important to trace the problems backwards; we have expounded the root causes of project costs reporting in the next section.

Strong (1997) refer to completeness as a contextual dimension which relates to the context of information thereby implying that the completeness of information must be considered within the context of the task at hand because of variation between user's information quality expectations; i.e., what is complete to one may be incomplete to another. Interviewee 6 (in appendix 2.1) mentioned one such challenge with situation notifications in BAM which are written by technical people yet they are read by the business stakeholders implying that they may not be semantically understood and this affects proper monitoring of service performance.

Incomprehensiveness as a targeting deficit can be averted by aligning the needs of information consumers to the information users. It is therefore important that consumers discuss their expectations with the producers so it is necessary to have open channels of communication between the two stakeholders for example; the above mentioned case of the BAM technical situation notifications sent to non-technical stakeholders may never be rectified until the information recipient and producers agree on what is useful and understandable to both and making changes.

6.1.2 Consistency

Eppler (2006) indicates that consistency occurs when information is free of contradictions or convention breaks and Strong et al (1997) assert that consistency occurs when the representation of the data value is the same in all cases. 19% of the information problem statements in GF IT relate to inconsistent information. Interviewee 1, finance manager in ITS and GF IT, stated that the challenge of unreliable and inaccurate management information (MI) was due to the simultaneous organizational, system and process changes that occasionally take place. These changes resulted into unstable processes which reflect a number of inconsistencies in management information (MI).

The finance manager also stated that due to inconsistent financial caps , it was difficult to make long term strategic plans; financial caps are useful in limiting the amount by which 'adjustable-rates' such as interest rates can be increased over a specific period of time. In this case, an executive decision to sharpen financial caps was made thereby implying a re-definition of strategic plans which in turn required other consequential changes.

Inconsistencies usually arise due to authoring problems; i.e. information producers produce incorrect or wrong information. One way of reducing inconsistencies is by training information producers or enforcing particular standards or rules on information production. In the examples above, the inconsistencies arose because the standards were no longer clear due to the process changes.

6.1.3 Accuracy

(Wang, 2002, and Wang) are of the view that accuracy occurs when the recorded value is in conformity with the actual value, whereas Eppler (2006) relates accuracy to precision or closeness of values to reality. BAM is responsible for delivering application support for over 700 applications for all GF IT functions, but one concern asserted in supply and demand management is the lack of details on which to base their estimates concerning the applications requirements and how they are used. Estimations are based on past projects which makes it highly probable that the regular estimates don't match up to the situation on ground; therefore budgets may be based on inaccurate details.

On highlighting the effects of inaccurate information in BIM, the Business Infrastructure Manager cautioned that overbilling could result from inaccurate billing information, whereas budgetary problems and mis-match of estimates would arise from inaccurate demand planning information which would greatly affect planning. If situations/incidents information is inaccurate, BIM is unable to respond in time as they are unaware of the right people to notify when the system goes because correct asset information is necessary to ascertain who the right application, process owner is so as to notify them. Without asset information, a lot of effort and time would be required to get the right people informed.

Currently BIM is taking steps in reviewing and cleaning up configuration data to avert some of these issues but there still issues concerning how to ensure that data is cleaned up , up dated and stored in one trusted source database.

6.1.4 Traceability

Traceability is related to the visibility of the background of information; one is able to follow through how certain information came to be in terms of when and who created it. Traceability in some aspects relates to completeness of information as traceability adds context to information thereby making it relevant for that time and finally Wang, (2002) explain that timeliness occurs when the recorded value is not out of date. Other definitions are well outlined in Appendix 1.2.

As seen in interview 3, a lack of traceability to how facts come up is a common concern. Concerning cost reporting for projects, project managers are usually caught up in the cycle of receiving inaccurate cost reports from financial analysts and then taking more time than needed to trace how project costs come to be. It could be that the financial system used doesn't allow certain traceability features or that the users are not aware of how to use the application for their benefit. On the other hand, it could be that project managers cannot account for how financial analysts come up with costs.

Gaps in process workflows highly contribute to most concerns of anonymity of information therefore improving process workflows could greatly improve traceability but additionally all involved stakeholders have to participate in following through the processes and identifying gaps. In this case lack of traceability could also be linked with the financial system or with the information producers or both. We look into this case in detail in the next section.

6.2 Cost reporting for projects

Providing a reliable view on project financials and delivery during (and after) project management has been a significant challenge in GFIT PDAS especially concerning cost reports intended to depict project actual costs, estimates and compare them with the budget at hand. The main setback is that project managers are unable to ascertain why they regularly receive inaccurate cost reports from financial analysts. In this section we reflect on the concerns with project cost reporting, analyze the root causes to of poor quality reports and how these gaps are being dealt with currently. In the next chapters we reflect on how similar quality gaps elsewhere could be avoided, controlled and better managed by implementing structured information quality management controls in GFIT.

6.2.1 Problem Scenario

Project managers are regularly complaining of receiving inaccurate project costs reporting from financial analysts. Wrong project costs reporting entails inaccurate and inconsistent costs data. For example, one project director attributed unreliable project costs to a number of complaints related to errors in booking costs. Costs were booked against wrong account codes or not booked at all because in some cases account codes couldn't be found and in some other cases, costs were booked to wrong account codes not connected to the respective projects. This is an example of unreliable project costs that are projected in reports thereby explaining the 'wrong' project costs reporting'.

In addition to the frustration of being unable to check the details behind the reports as project managers do not have access to financial databases and cannot make analyses themselves, project managers assert that the financial analysts who produce these reports do not understand the business content of their customers (department heads) that is why the report do not relate to the reality that project managers have. Most of the problems reflected in these complaints reveal

limited prior understanding of the stakeholder's requirements by financial analysts who developed the financial system (SERP) which is the single source of truth for cost reporting. Project managers were not engaged in analyzing their requirements before setting up the systems. This is depicted in their lack of understanding of constraints of the systems and tools they are using. Although expressed differently in various complaints, the project managers' major complaint is, "How can we use our systems and tools to meet our requirements?"

6.2.2 Causes of the reporting problems

At the design stage of one of the new finance systems containing the cost data for projects in Global Function IT, there was not enough time spent on identifying requirements concerning project cost reporting because at the time of the project of developing the systems, the finance department was reorganizing and reducing in size. New financial analysts were assigned to the project, cost-data structures changed due to changes in organizations, testing had been carried on technical functionality not on the meaning of data, new receivers of cost reports highlighted new requirements, new financial analysts intended to generate the reports were appointed in Shell off-shore organizations and this required much more education and training than anticipated. As a result many managers did not comprehend the data highlighted in the reports.

To avert this concern, an improvement initiative team was set up with the objective of locating the origin of gaps in cost reporting and recommending to the PDAS management team how cost reporting could be improved but the ultimate Solution is to re-design project cost reporting with experts in Finance and project management discipline, involve important stakeholders and develop proper test-sets.

6.3 Summary of analysis

Information consumers in GF IT have general understanding of information quality issues affecting them and their impact to decision-making or execution of business objectives. Nevertheless individuals seem more concerned about the quality of the information they receive than they produce. Due to the organizational structure of GF IT, data or information quality is not taken as a role for the IT department but it is taken as everybody's responsibility. Everybody is assumed to be responsible for the quality of information they handle, but there are no clear specific and definite roles responsible for data quality, therefore when quality issues occur, it takes a lot of effort to trace how they arise. For example, as seen in the case of cost reporting of projects in section 6.2, a workforce team had to be created to trace the origins and causes of errors in project cost reports. Similarly, producing quality information is taken as a collective effort and 'everybody's' responsibility but when quality problems arise, not 'everybody' is accountable since 'somebody' has to account for the quality problems, that is why quality improvements projects are set up to trace how these issues arise. An example is the 'projects financials reporting improvement initiative' in the preceding section; such a project was set up to identify the reasons behind re-occurring erroneous project cost reports in PDAS. GF IT is yet to move from project level information management to a coordinated enterprise information management

Users relatively often raise data quality issues especially if they affect their roles. Individual users' in GF IT don't usually quality issues which are pertinent to their roles but ignore quality issues which require a combination of roles because everybody asserts that someone else is responsible. Some quality cases have to regularly re-occur in order to be dealt with. Similar to the example above, there are a number of functional initiatives to cleanse data and to deal with other data quality issues.

There is a shared function, IRM (Information Risk Management), which is responsible for data although it deals with only a few aspects of data; ie, confidentiality, integrity, accessibility and security. IRM does not look into other quality aspects of accuracy, comprehensiveness, completeness, timeliness and the like.

There is still a wait-and-see approach in relation to data quality where information users wait for problems to occur, instead of taking proactive steps to prevent them. Nevertheless, key steps are being taken towards this view. There is a general awareness and acceptance of data as an enterprise wide asset even though an organizational culture that fully promotes data and information as an enterprise wide asset is yet to be adopted.

From this assessment we conclude that GFIT is at level 2 of data quality maturity model but is already taking steps towards level 3; this report is an indication to that effort.

Analysis conclusion

The identification of information quality problems in GF IT in this research was not for the purpose of defining solutions to individual problems as each of the 47 problems statements are linked to other root causes which cannot be assumed but cannot be determines without further surveys at functional teams level. This argument is based on one problem which was surveyed, i.e, wrong project cost reporting .It was found that this problem was as a result of poor requirements analysis of project managers by the financial department due to the organizational changes that took place in the financial department in 2008.Therefore this research analysis focused on identifying the level of awareness concerning information quality issues in GFIT, identifying information quality challenges and from those assessing the quality maturity level of GF IT.

We first focused on GF IT organization as a whole by interviewing respondents from a cross section of GF IT functions. Their responses highlighted the level of awareness concerning information quality and brought us to conclusions regarding the information quality challenges being faced in the organization however these responses were not enough to bring us to a judgment of the level of information maturity therefore we focused on a significant information quality problem ie; wrong reporting of projects costs in one function (PDAS) and we analyzed how it was being handled so as to make a judgment of GF IT's level of information maturity. With the use of the information quality maturity model in chapter 4, GF IT is at maturity level two but is considering steps to level three.

CHAPTER 7   RECOMMENDATIONS

GF IT is already considering steps to improve the quality of its information. As assessed in the previous chapter, GF IT is at information maturity level two and it would require steps towards the next higher level 3. The benefit is that information quality improvement initiatives are currently acquiring considerable attention at GF IT organizational level. How the proceeding steps of improvement are taken is very important for successfully achieving improvement therefore we start by focusing on the inherent core steps toward managed information quality which are relatively similar regardless of which approach is chosen. We then conclude with the three approaches or steps which GF IT could adopt to implement these core steps. These approaches differ by how fast they can be implemented and what resources could be required. A good choice is important and critical to whether GF IT successfully attains quality improvement cost effectively or develops a complex unending quality improvement project.

7.1   Managing information quality

The inherent core steps towards managed information quality are in alignment to English (2009) ABC's of Assessment, Betterment and Culture transformation in attaining Total Information quality Management. As mentioned in chapter 4, GF IT can apply the three phases as outlined below.

A. Assessment;

The various functions in GF IT have to each take up internal in-depth subjective and objective data and process assessments at the various operational and knowledge levels in attempts to create more awareness to their information users of the importance of quality data and so as to do a personal assessment of their information quality problems and maturity level concerning their processes, and data. They could assess whether their processes are in control and consistently producing quality information, identify where processes need improvement to meet the information quality requirements of all knowledge workers .And lastly they should quantify the real costs of poor quality information and its effect on business profit (surplus) and on customer and Knowledge Workers satisfaction and productivity.

B. Betterment ;

In the Betterment phase, causes of defective information in GF IT should be followed, starting with most critical information. The magnitude of the costs or impact of defective information on the organization should be identified so as to prevent process failure and reduce costs to recover from failure caused by defective information as well as increase Knowledge Worker satisfaction and productivity.

C. Culture Transformation;

 The biggest step entails creating an information quality culture, which would probably take years to grow as such a culture has to evolve through numerous organizational transformations, and behavioral changes .GF IT would have adopt a culture which encourages and advocates for quality

information, and empowers "Information Producers," providing training and other resources to manage information horizontally across the business.

7.2   Desired approach:

Align information quality improvement objectives to the information governance framework.

This approach starts with ascertaining that GF IT develops an information governance framework which is integrated to the already existent IT governance framework in OneIT since effective information quality improvement and management may not be achieved without the foundational information management structures being available. The initiative of maturing to information quality level 3 has to be built on an already existent information governance framework which allows proper management of enterprise information based on business value categories and best practices by stipulating uniform policies and processes for ensuring the quality of data. It is not helpful in the long ran to improve information quality at an organizational level without the foundational information governance or management structures being available. Information governance is an instrument for the strategic alignment of data quality management and the definition of standards, definition of responsibilities, Integration of data quality initiatives into organizational structure and enforcement of mandates. Through data governance, clear roles and responsibilities for data quality management are defined.

The challenge with this approach is that it will take longer as it is a top-down approach which involves first the main GF IT stakeholders to make decisions and agreements starting with the top executives, managers, sponsors, teams. The likely problem with such top-down initiatives is that they require more motivation of stakeholders at operational level, who may argue that they are already busy with their own roles. It is important that other stakeholders apart from the executives understand the role of improved quality and are ready for change.

7.3   The most feasible approach:

This approach focusses on improving information quality bottom up from functional team or workgroup level .In this approach GF IT first deals with the major quality problems of incomprehensive, inconsistent, inaccurate and untraceable information by: first creating an awareness of the importance of improving quality aspects by function and then precisely attaching quality roles to specific or all individuals and then identifying critical information by function and by processes and, identifying quality requirements associated to that information and finally adhering to those requirements.

Defining roles and responsibilities

New accountabilities (such as information stewards) should be assigned in GF IT organizational and workgroup/team level to improve the accuracy and consistency of reporting. For example, information stewards address information quality practices daily, while information governors

oversee actions at a business unit or cross team level. At organizational level, a department different from the IRM group can be created to take up these roles which are shared across business and IT units .This department should establish roles for the appropriate levels and functions. Service-level agreements (SLAs) must be established between information producers and information consumers, which guarantee acceptable levels of data quality for enterprise information.

GF IT should also appoint individuals who are accountable for the production, definition, security and integrity of enterprise information in the different functions and workgroup, note that, their role should be different from the organizational information stewards, as these serve smaller teams or workgroups. These workgroup information governors' roles should be defined assigned and measured on individual performance plans. Metrics should be developed to measure and monitor data accuracy and data quality based on predetermined schedules.

Identify critical information

After defining responsible roles, GF IT should scope the information quality management efforts around those information assets deemed most significant to the organization (for example, they are critical to the business strategy, required by legislative mandate or justified based on cost-benefit analysis). Otherwise, the objective becomes a "boil the ocean" exercise with little chance of success. The most important information is that which supports the most important activities. Information is critical to an activity if an uncorrected problem with the information would have a serious impact. At functional level, the function or sector business process model can help identify where information is used, and hence its impact on the business. This information must then be traced back to its original source to determine its quality. Information governors should ensure that all of the information is relevant to GF IT activities. Business rules that tell the business and the system what information, data, and processes are most critical and what the business response should be to drive positive result can be created. These rules would automate the method of maintaining information quality.

Identify quality requirements

After roles are created and critical information is identified, individual groups in charge of different processes can then decide which information quality requirements are important per critical information. For example; finance department or workgroups can agree to what unit of precision is acceptable in order to get consistent costs data.

Challenge: This is a short fix approach which can be used to solve the current urgent quality issues. It is cost effective and easy implementable as it starts bottom up from individual group level. However for long lasting information quality management initiatives, the GFIT management leadership will have to be involved at one point.

The most demanding approach:

This approach is both bottom-up and top down therefore, it is focused towards the middle. It requires the involvement of both the desired and most feasible approaches at the same time. If it can be actualized then it can be considered as the most desired approach, as all GF IT stakeholders will equally be involved in improving quality.

Challenge: This approach requires a major change management initiative as it would involve entirely all GF IT stakeholders to make decisions and agreements starting with the top executives, managers, sponsors, teams till individuals. This approach would certainly require more effort in terms of time and human resources since GF IT workers have to also be involved in this project in addition to their daily operations

7.4   Research Conclusions

We conclude that enhancing information quality in GF IT would take three approaches, one being the 'desired' approach, the next is 'most demanding' and the other the most urgent and 'most feasible' approach. It is important to note that the choice between the three approaches will also depend on which information quality maturity level GF IT seeks to attain.

A good suggestion is to start with the most feasible approach and later on adopt the desired approach in this way, GF IT should use the 3 approaches but at different times.

Future work

It is imperative to note that this was a subjective assessment of GF IT and it is advisable that other information quality assessments are carried out at GF IT functional level, department or workgroup level, or process level, e.g., PDAS, BAM, BIM. In some functions, it is pertinent that objective assessments of data in databases are also done according to which information is critical for example; consistent integrity rules should be in all used software applications. An objective assessment of information in GF IT is inevitable.

As explained in chapter 2, section 2.2 this research starts with identification of a problem, diagnosis of problem situation (finding root causes and possible remedies), diagnosis then results into a plan of action in which the remedy is elaborated but it did not go as far as the   'intervention' or implementation which brings about the desired changes and the last stage of 'evaluation' of the new situation. The last two stages are should be considered in future information quality initiatives in Shell GF IT but also by academic researchers.

APPENDICES

APPENDIX 1

1.1 Description of information quality dimensions

Dimensions	Descriptions	Indicators from GF IT interviews
1. Comprehensiveness	Is the scope of information adequate? (not too much nor too little)	We don't have enough information on service specifications or design requirements
2. Accuracy	Is the information precise enough and close enough to reality?	Uncertain about accuracy& reliability of information from external databases ,e.g., PDAS database
3. Clarity	Is the information understandable or Comprehensible to the target group?	HR .Lack of clear definition of 'contractors'
4. Applicability	Can the information be directly applied? Is it useful?	
5. Conciseness	Is the information to the point, void of unnecessary elements?	Lack of details
6. Consistency	Is the information free of contradictions or convention breaks?	Inconsistency in financial caps; caps change year by year
7. Convenience	Does the information provision correspond to the user's needs and habits?	
8. Currency	Is the information up to- date and not obsolete?	Concerned stakeholders should regularly update their information.

Finding the latest version of documents. |
9. Timeliness	Is the information processed and delivered rapidly without delays?	Un centered master data ,untimely information
10. Correctness	Is the information free of distortion, bias, or error?	Having the information aligned to what the project managers say
11. Traceability	Is the background of the information visible (author, date etc.)?	Lack of ownership of data.
12. Interactivity	Can the information process be adapted by the information consumer?	No clear guidance on how to use Document management tools. People not using the defined processes, Tools have many confusing features
13. Accessibility	Is there a continuous and unobstructed way to get to the information?	Difficult to find the latest or most accurate information.
14. Security	Is the information protected against loss or unauthorized access?	
15. Maintainability	Can all of the information be organized and updated on an on-going basis?	No clear structure how to find and store information There is a lot of information online, you can't be sure if it's accurate,
16. Speed	Can the infrastructure match the user's working pace?	Difficult to find the latest or most accurate information.

APPENDIX 2

2.1 Categorization of information quality problems by GFIT function according to (Eppler, 2006)

The researcher identified a total of 47 problems statements mentioned from the interview responses highlighting information quality gaps in GFIT.As shown in below, the problem statements were each subjectively associated to one or more quality dimensions, therefore in some cases one problem statement was linked to two dimensions to which they related to the most.

Function /Role	information quality Problem statements	Causes/Origins	Effects/Results	information quality Dimension	Categorization		
					By Origin	By consequence (Deficiency or problem with the information)	By Management areas
1. Finance Manager ITS & GFIT	Inaccurate Management Information (MI)	Many changes at same time i.e.; Organizational, process and system changes.	Not all processes are stable.	Inaccurate	Targeting	Can't Trust	Media Deficits
	Changing Financial caps	Caps changes year by year	Hard to define strategies	Inconsistency	Authoring	Can't Trust	Content Deficits
		Decisions to sharpen caps unexpectedly	More saving opportunities				
	Processes not fully automated	Processes not fully automated to allow automated reporting	Unmet customer demand Wrong conclusions could be taken.	Timeliness	Infrastructure , Process	Can't find	Media deficit
2.BIM (Business Infrastructure Manager)	Gaps on service development information.		Gaps on service development information.	Incompleteness	Targeting	Can't find	Content deficit
	lack of clear data ownership	Clear lack of ownership of data.	Lost trust by our BSMs in the LOBS that updates will be made correctly.	Traceability	Process	Can't trust & understand,	Content deficit
	Old versions of data			Not-up-to date	Process	Can't find	Media deficit
	Lost trust by BSMs on LOB data			Believability, Credibility	Authoring, Process	Can't trust & understand,	Content deficit
	Minimal use of one trusted source	People do own clean ups, updates	Inaccurate billing information could result into overbilling	Inaccessible,	Infrastructure , Authoring	Can't find	Media deficit
	Individuals keep own personal data			Inaccurate, inconsistent	Targeting	Can't trust	Content deficit
	People do own clean ups, updates	Time consuming to make updates to	Inaccurate demand	Incompleteness	Targeting	Can't find	Content deficit

		centralized information	planning information results into misaligned				
	Lack a good understanding of everything we have	People keep a lot of own personal data.	estimates, planning and budgetary problems.	Incomprehensiveness	Targeting	Can't find	Content deficit
3.IT4IT /PDAS Program Director	Errors of booking costs wrongly against account codes	Costs are booked : To wrong accounts Not booked at all By unknown people	Lots of effort to get accurate information. Mistrust in financial data. Wrong reporting. Being over budget.	Incorrectness	Targeting	Can't understand	Content deficit
	Differences in alignment of individuals' information	PMs keep their own book keeping	Takes time to dig into details of how they come up with those findings.	Inconsistency	Authoring	Can't trust	Content deficit
	Gaps in understanding the financial aspects	Remoteness of the financial section.	Financial misunderstandings.	Incomprehensiveness	Targeting	Can't find	Content deficit
	Irregular access to financial overviews	Lack of financial focal point	Irregular access to financial overviews.	Inaccessibility	Infrastructure	Can't find	Media deficit
	Takes time to dig into details			Timeliness	Infrastructure, Process	Can't find	Media deficit
	Mistrust in financial data.			Incorrectness	Authoring	Can't trust	Content deficit
	Lots of effort to get accurate information.			Inaccurate	Targeting	Can't trust	Content deficit
	Hard to know how they come up with findings			Traceability, Incorrectness	Process, Authoring	Can't trust, understand	Content deficit
	Wrong reporting of financial data			Inaccurate	Targeting	Can't trust	Content deficit
4.HR Manager GF IT	Lots of time spent to clarify information.			Clarity	Process	Can't understand	Content deficit
	Unclear definitions of contractors	unclear definitions of contractors ; Non EP and EP	Lots of time spent to clarify information.	Inconsistency	Authoring	Can't understand	Content deficit
	Not up-to-date employee information	Certain data needs to be kept up-to-date by employees and other	Not up-to-date employee information could result into	Not up-to-date	Authoring	Can't use	Content deficit

		line managers.	Delay in contacting right people.				
	Inaccurate departure window data	Incorrect departure window data	Impacts reliability of succession plans	Inaccurate	Targeting	Can't trust	Content deficit
5.Global Knowledge Manager	Lots of documents, data and we need to know what we have	Information should be seen as an asset ad managed as such		Incomprehensiveness	Targeting	Can't find	Media deficit
	Improve Data ownership	Need for information management culture		Credibility/Traceability	Process	Can't understand	Media deficit
	Improve centralized updates so as to monitor document versions			Consistency	Authoring	Can't	Content deficit
	Guidance for use of tools			Clarity	Targeting	Can't understand	Content deficit
6.Strategy, Assurance & Program Manager	Use of the defined processes		Situation notifications are usually not understood by all stakeholders.	Inconsistency	Authoring	Can't trust	Content deficit
	Need to improve interaction of people			Incompleteness ,interactivity	Targeting	Can't find, use	Content deficit
	Lack of details to base estimates	There is need to improve interaction of people with each other.		Incompleteness	Targeting	Can't find	Content deficit
	Situation notifications are written by technical people			Incomprehensiveness	Targeting	Can't understand	Content deficit
7.BIM Demand Planner	Lack of efficient change management			Un clear	Targeting	Can't understand	Content deficit
	More accurate trend assessment			Conciseness	Authoring	Can't trust	Content deficit
	Improve quality(accuracy) of reports on consumption	Reporting and data is foundational for decision making	Overcharging	Inaccurate	Targeting	Can't trust	Content deficit
8.IRM Compliance & Incidents	Delays to get access rights	it is unclear whom to contact to grant access rights to compliance information	That takes time.	Timeliness	Process	Can't find	Media deficit
	Passing most information	Insufficient use of	passing information	Incompleteness	Targeting	Can't find	Content deficit

	around in e.g. emails	share point to manage document versions.	around in e.g. emails				
	Use of single source of truth			Consistency	Authoring	Can't find	Content deficit
9.GFIT Lead Architect	At times 1 project has different names	different domains like architecture, PM, IRM have different business owners, requirements, budgets and processes and basically drivers	incorrect information flow	Inconsistency	Authoring	Can't trust	Content deficit
	Assign ownership of data to people		Affects having a single source of truth.	Traceability	Process	Can't trust	Media deficit
	Drowning in old information		Drowning in old information.	Inaccessible	Infrastructure, Process	Can't use	Media deficit
	Train people to use tools well	people using the systems are not trained well to use the tools e.g. financials, architectural tools		Un clear	Targeting	Can't understand	Content deficit
10.Personal Assistant	Finding up-to-date information	information overload		Timeliness	Process	Can't use	Media deficit
	Finding the latest version of documents		difficult to find information	Not-up-to-date	Authoring	Can't use	Media deficit
GF IT	No clear structure how to find/ store information	No logical set up of how to find information and at the back end how to store it.		Maintainability	Infrastructure, Process	Can't find	Media deficit
11.P&T lead	No one place to keep data	No one place to keep data so that every other person can find it.	Unclear data definitions	In consistency	Authoring	Can't trust	Content deficit
Architect	Not very clear on data ownership	Unclear data ownership.		Traceability	Process	Can't trust	deficit
		Total of 47 problem statements					

APPENDIX 3
Selection of interviewees by GF IT functions and roles

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