

## Examining Information Quality for e-Governance Services: Towards a Conceptual Model

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**Abstract.** Emerging primarily from the context of system design and development, research in the area of information quality has advanced to address the perception of different stakeholders of business. We attempt to explore quality concerns of information for internet based service environment that is different from static database view. A conceptual model is developed to address the information quality for service based online environments in general and e-governance services in particular. With focused group discussions and follow up interviews, we identify three levels of information quality- representation level, process level, and application level, each having unique objective - soundness, convenience, and value addition respectively that collectively may contribute to the judgment of overall information quality.

**Keywords:** information quality; online services; e-governance services

### 1. Introduction

The concept of information quality (IQ) has been adopted in many academic disciplines of research beyond management, for example, medicine, cartography, history, linguistics and rhetoric etc., all emphasizing upon their domain specific quality parameters which are critical to their area [1]. Therefore, this concept can be considered no more enigmatic to the researchers, at the same time it has not become too mature so that it can prescribe to follow any generic set of methods of research, or to develop generic criteria for measurement, or to address generic issues and challenges concerned with the practice environment. From system centric view to knowledge intensive process view, information can be regarded as a vital element for service based environments. Inadequate research exists that explore the issues information quality research to e-government service delivery. Considering the information quality concerns for service based online environments in general and e-governance services in particular, in this paper we attempt to develop a quality assessment conceptual model by incorporating the existing theoretical and empirical approaches of contemporary research.

### 2. Information Quality: A Review of Literature

A commonly accepted concern about healthy information flow is that it should be conveyed to the appropriate agent, at appropriate place, in appropriate form, with appropriate detail and accuracy, and at appropriate time. This is the fundamental considerations for any information user as well as for the information provider that further can set suitable criteria for the judgment of overall information quality.

Concerns over the issues of information quality have been noticed by the contemporary researchers and practitioners. Madnick et al provides an overview of IQ research and describes a range of topics explored in different practice domains and explains various kinds of methods adopted for the research [2]. The research topics cover many organizational and IT related issues in the following perspectives: impact of IQ in organizational performance with respect of cost, benefit, and operations, organizational changes, and IQ in databases, networks, and information technology etc.

## **2.1. Information: A Product or Service**

For information quality research, information has been viewed primarily as a product during the initial phases of research that advocated due management considerations through design and development of information system, and further to the representation aspects of information products in order to address the requirements of limited set of users for facilitating decision support [3]. This approach was focused upon system centric view of information that considered only intrinsic features of the information system design and deployment. The prime focus was given upon converting the raw data into information products. This approach of research is often acknowledged as data quality research in the literature [3][4][5][6]. The main quality focus has been ‘fitness for use’ and it is typically measured by using objective criteria of data quality such as – accuracy, unambiguous, meaningfulness, and completeness.

In the system centric view of information, while the concerns about user’s needs and complexity of task environment were noticed but not addressed in detail to relate it at the service level factors. Accepting the fact that information is created to cater to the needs of the users in specified domain, service based perspective has emerged and extended its consideration to extrinsic factors such as - variation in consumers’ responses, value perception about information, and their nature of interaction with the information system in the practice environment [7]. The fundamental information quality criteria have been taken as ‘meeting or exceeding consumer’s expectation’ which was initially ‘fitness for use’ as in case of data quality research. Kahn et. al. [8] clearly distinguishes the information quality parameters for both product and service based perspectives, and provides an elaborated framework of quality objectives, quality criteria, and approach of assessment.

## **2.2. Theoretical Approaches to Information Quality**

Here we will discuss two major contributions which are oriented towards deriving quality through information system design and operation. These are also referred as database centric approaches [1].

### **2.2.1. Ontological Approach**

Adopting this perspective, Wand and Wang [6] advocates the notion that the role of information system is to correctly represent the real world (or task environment) as perceived by the user. They underscore the gap between direct observation of a real world and inference about the real world as representation by the system. Such gaps in representation are critical to the user and. These gaps are referred as ‘representation deficiencies’ which can be addressed by matching the level of conformance between direct observation of the real world and its representation through information system. They identified two types of representation deficiencies that invite significant considerations for maintaining information quality: Design Deficiency, and Operational Deficiency. Earlier one is concerned about the information system’s failure to capture the information about the real world states, and the later one is concerned with the errors in data production. Such deficiencies led to the derivation of four distinct measures of information quality: completeness, unambiguous, meaningful, and correctness which are also said intrinsic data quality [9].

### **2.2.2. Semiotic Approach**

This approach is closely related to linguistics, which deals with study of symbols and various associated processes that are involved to assign meanings and values to those symbols. Shanks [10] adopts semiotic approach to information with the fundamental notion that understanding and interpretation of symbols are the central processes to get knowledge. He identified three practical perspectives of information representation at the system interface: a) Language, b) Structure, and c) Content. Language of representation can be formal, semi-formal, or informal depending upon the suitability of domain of representation and stakeholders’ ease of use. Structure relates to the dimensions of information representation and is addressed through data model quality frameworks. Structure may be understood by the way contents are classified, aggregated, and metadata components are created. Contents of the representation are directly associated with the domain of information use. These three perspectives have their due significance in information representation and contribute to final representation quality. Price & Shanks develop this concept further and explain three semiotic levels of information and acknowledge three levels of quality criteria: syntactic level, semantic level, and pragmatic level[7]. At the semantic level, most of the quality criteria were adopted from

the Wand and Wang's data quality framework with suitable modifications. At syntactic and semantic levels, most of the quality aspects were too technical in nature that talks about representational transformation and interpretation transformation (Mapping from external world to IS and reverse mapping of the same). These are meant to be understood by only system designers and data producers of those who are concerned with IS management. Pragmatic level deals with consumer's perception which requires further validation and modifications according to the contextual domain.

### **2.2.3. Limitation of Theoretical Approaches**

The ontological framework, which is also the base of semiotic-semantic level of information quality, is based upon two fundamental assumptions: 1) the observable parts of reality can easily be captured by the human cognitive system, and 2) the captured reality can be represented in the form of information with the help of signs and symbols. Concerns over all kinds of representational deficiencies such as design deficiency, or operational deficiency can be considered only after information is disseminated in some form. However, there is a coherent argument in knowledge management literature that information comes out of existing knowledge staying in the mind, and huge part of the tacit knowledge can't be captured and expressed explicitly [11][12].

Semiotic philosophy also suffers from criticisms because of its focus upon formally established symbols and syntax which are primarily static and contextual in nature. All aspects of reality can't be expressed using existing set of standard signs and symbols. Moreover, this theory doesn't incorporate images, plots, designs, audio, and motion pictures etc. as a part of information which may require developing new set of syntax and linguistic structure to fit into the semiotic framework. In this context, [13] and [14] advocates visual literacy that can bring cognitive consequences such as visual manipulation and aesthetic appreciation to those who are not familiar with standard set of signs and symbols. Furthermore, assigning meaning to a symbol depends mostly upon the individual's perception that is directly associated with his/her socio-cultural background. This may demand an ethnographic foundation to address the events of assigning meaning and use of formal symbols.

### **2.2.4. Empirical Approaches to Information Quality**

There have been few significant efforts towards empirical approaches for information quality assessment [15][16]. We would review few fundamental studies. Wand and Wang [6] have identified 179 adjectives, phrases and terminologies that in some way represent quality attributes in their survey among data consumers. After a systematic filtration, they had identified four main quality dimensions: i) intrinsic quality, ii) representation quality, iii) contextual quality, and iv) accessibility. In another approach, Eppler [1] identified 70 typical information quality criteria from literature, and further reduced them in systematic manner to four dimensions. His model incorporates most of the concerns related to variation in stakeholders (i.e. users' and producers') perception, product and service perspectives, intrinsic and extrinsic considerations etc. as discussed before. They propose four dimensions of information quality: i) relevant information, ii) sound information, iii) optimized process, and iv) reliable infrastructure. The first two levels, relevancy and soundness, consider the content quality parameters, and the last two levels, process and infrastructure, consider the media quality.

### **2.2.5. Information Quality in Internet Based Service Environment**

Internet media is used not only to disseminate or deliver information products to the end users but also to support creation of knowledge intensive processes for creating and transferring the information. Considering this aspect, Eppler [1] demonstrated examples of knowledge intensive view of information processes under service based environments, which is completely different from traditional database view of information, and hence require different approaches for developing quality measures. Therefore, we take a service perspective of information, because it can be relatively more suitable for e-governance service context. Services, can be delivered either in the form of information, for example news, consultant's solution to a business problem, reports, documents, etc, or it can also be delivered by the exchange of information, for example e-marketing, banking, tourism, hospitality, travel and transportation, education, etc. where information about service

products, terms and conditions of use, cost and benefits, etc. about the services reach to the customers through online portals.

Under internet based environment, Knight and Burn [15] explores the issues related to information search and retrieval through search engines and user queries. In the similar context, Naumann and Rolker argue that there are three main sources of information quality [17]: user of information, information, and process of information search retrieval. Chae & Kim [18] explored upon information quality delivered through mobile internet based services. They adapt the framework developed by [6] and propose modifications in their framework to make it suitable for the environment of mobile internets. They have reported four quality dimensions – i) connection quality, ii) content quality, iii) interaction quality, and iv) contextual quality.

### **3. Information Quality in e-Governance web based Services**

According to [19], the relationship of government with recipients of its electronic services may be characterized as government to citizen (G2C), government to business (G2B), government to employees (G2E), and government to government (G2G). In this paper, we consider information quality under G2C services. Quality of G2C services will depend upon not only nature of content representation but also upon the intermediary agents of the service supply chain network, and contractual structure among those agents.

#### **3.1. Distinguishing the service characteristics**

In case of e-governance services, multiple kinds of information concerned with the specific needs of the citizens are presented through the web portals. In G2C service scenario, information is considered as a facilitator of services, and the nature of services are different from prevailing conception of business services. The differences are discussed as follows:

- 1) Not for Profit: G2C services intended to contribute in overall national development for all the sections of the society, as opposed to commercial services that are designed for being sold into competitive markets having characteristic demand patterns, and the bottom-line is to generate profits.
- 2) Publically Accessible: G2C services are designed to be delivered without any discrimination for each and every citizen irrespective of their socio-economic background and culture, as opposed to commercial services which are designed for well categorized market segments, and take into account the customer's purchasing capacity, cultural beliefs, their luxurious needs, and their sustained relationship with the business organization.
- 3) Liability: G2C services are mandatory in nature with a commitment for the public who has the right to access it in all aspects through a standard process.
- 4) Social Needs: G2C services are primarily target primarily to address the social needs of the people as opposed to commercial needs of business.

#### **3.2. Developing Information Quality Criteria for e-Governance Context**

In the context of e-governance, information is considered in the role of facilitating factor for G2C services. The intention is not only to consider information solely as a product but also it acts as a supportive factor for service delivery, which helps information and financial transactions between government and citizens. Another concern is that the information exchange happens in an interactive manner in many cases, where citizens are also required to provide some essential information (such as filling up application forms, submitting documents, etc.) to avail the services. Web based services are offered by different ministries and departments of the government which can sometimes be a complete service or a small part of broader class of physical service, that can be availed through online interface.

##### **3.2.1. Assumptions**

It is presumed that at the intrinsic quality of information such as believability, reputation, etc. are delivered to adequate level to satisfy the requirements, and therefore, these aspects of quality are excluded from the present scope of study in the context where the government is the source of information. This assumption can be removed if sources of quality problems and their interrelations have to be explored.

Another assumption is that availability of adequate IT infrastructure has been either assured by the government, or by the users themselves to have convenient access.

### 3.2.2. Developing an Information Quality Conceptual Model

Citizen centricity is argued to be one of the critical elements for the success, and as a dominant objective of any e-government system [20] that is catered to the need of diverse group of users. Considering user heterogeneity and government’s liability to deliver quality information to all, a focus group discussion and follow up interviews are conducted to identify dominant dimensions of information quality. Respondents were presented with a list of information quality criteria derived from the literature and asked to reflect their perception about its suitability in the e-governance context. It is found that G2C service in e-governance context essentially requires three distinct information based processes for its effectiveness: i) information dissemination in appropriate format ii) extensive information outreach through media infrastructure, and iii) adoption of delivered information into practice by the end-users. Based upon the discussions and interviews, we propose three levels of information quality assessment:

- 1) Representation level: At this level, the expectation is to have a sound representation of information in terms of form, flexibility and consistency at the web interface. We will not consider the process involved in information production and dissemination. We will rather look at design and format of represented information from user’s perspective.
- 2) Process Level: At this level, the objective is to have convenient interaction between the system interface and information consumer through an effective media website design. This level considers the processes (concerned with the users) that facilitate efficient delivery of information to the end-users, or to assist the end-user to access the right information in a timely manner. Systematic accessibility (to web contents), connectivity, interactivity, etc. are of prime consideration.
- 3) Application Level: This level is oriented towards utility perception of information from user’s perspective, and the objective is to have appropriate and useful information that can add value in the decision making, or other activities of end users.

Fig 1 presents a conceptual model of information quality for e-government. The three levels may not be independent of each other but separately contribute to overall information quality. The descriptions of each of these levels in terms of respective objectives are stated as follows:

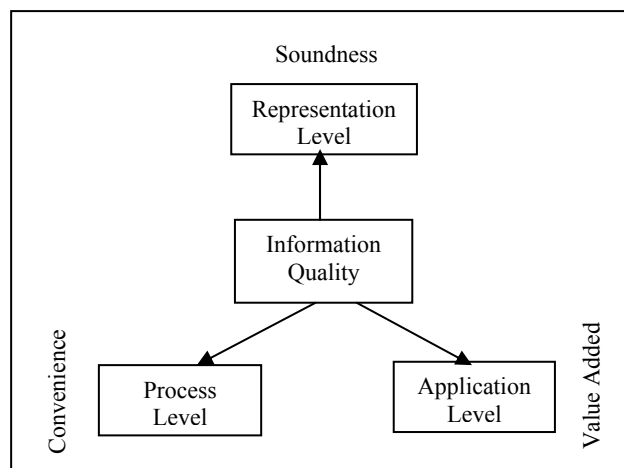


Fig. 1: A Conceptual Model for Information Quality

#### 1) Sound Representation

- a) Form of Representation: At the Representation level, we are considering few specific nature of representation such as form, flexibility, and consistency. Information can be represented in many forms such as text, images, audio, video, animations etc. For textual information, it is essential to have appropriate language with easily understandable vocabulary that is normally used by the concerned community of end-users. For multimedia content, it is essential to ensure image, video and

animation quality. Image quality can be judged upon three common problems – it can be distorted, it can be blurred, and it can be suffering from noise contamination [21]. For assessing video and animation quality, we took three commonly known criteria – high definition video, average quality video, and poor quality video. The judgment about image and video quality is dependent entirely upon the user who is supposed to have viewing experience of wide variety of video clips, pictures and programs of different quality through television, mobile, and internet.

- b) Flexibility of representation: As advocated by Price and Shanks [7], ‘flexibility’ suggests the information representation interface that should be equipped with pre-programmed functions such that it becomes easier for the user to do some manipulation in order to display the information in a user defined customized view. For example, user can select desired themes of representation having different color and image combination or a user can have the option to select specified number of fields to retrieve information from a relational database system. These examples can be referred to display customization and content customization respectively.
- c) Consistency of representation: Two types of consistencies are being considered in the present case – semantic consistency and structural consistency. Stvilia et. al. [22] have adopted this term at two level – intrinsic level and relational level. Since we are not concerned with the intrinsic character of information, therefore only relational level explanation of these terms would be considered as it directly addresses the user’s perspective. Semantic consistency addresses the extent to which same concepts are conveyed by the same set of vocabulary and elements that are suggested by some external standards and recommendations. Structural consistency is defined as the extent to which similar nature of information objects are represented with same structure, format and precision as directed by external standards or guidelines.

## 2) Convenient Process

The process of information access through the online web-interfaces is seriously discussed under web quality literature. Website serves as virtual platform for information dissemination, and the central element is the information that people needs to access through the websites should be always available in the desired form. The critical concern is to ensure availability and smooth delivery of information whenever required. In addition to information access, certain processes also require information supply through the website. Therefore, it is considered as a critical dimension for assessing overall information quality.

- d) Accessibility: ‘Accessibility’ as quality criteria is discussed by most of the researchers with different meanings [11]. Here we define this term in a particular way, which specifically implies accessibility of the appropriate users to the appropriate content on the web portal in an easy and systematic manner. The term ‘systematic’ implies that the user has to follow a systematic procedure, i.e., login to finally get access to the available content. For example, separate spaces can be designed to provide access to different communities such as employee login, agent’s login, citizen login, business login etc. The meaning of easy access implies that citizens should have single portal having web links to access information about various online service spaces. In opposite sense, it can be said that information related to all the citizen services should not be scattered and further left to the user for online searching.
- e) Security/Privacy: This criterion has been identified and adopted by most of the scholars. Security is understood in context of visibility of transaction data by the other parties on the web, while privacy is associated with sharing of personal information to other commercial or advertising websites. Appropriate safeguards should be embedded in the system to protect the sensitive information from unauthorized dissemination.
- f) Interactivity: We define interactivity in two aspects: i) ease of navigation to the information spaces in order to reach to the right information [14], and ii) responsiveness to information input (downloading, or uploading) by the user through the portal. Such processes can suffer from delayed communication from the main server which can further decrease the overall interactivity. The navigation quality measure is defined as the number of clicks that a user makes to reach the appropriate information content. Furthermore, in context of responsiveness, the quality measure can be taken as availability of

working links and buttons. For uploading, there should be availability of appropriate input fields for the query and feedbacks, commenting spaces under the available content, and upload links, etc.

- g) **Connectivity:** This criterion addresses the speed and stability of communication during interaction with the web interface [14]. There are two quality measures to be considered: a) stability of connection, which is critical to the spaces having wireless internet service, and b) promptness, which is the speed at which clicks are communicated and responded by the web portal during information retrieval (e.g., speed of opening a new content page or speed of downloading any file). Stable connection is an essential component of information quality particularly in the case when a user has to provide a significant volume of information continuously for significant duration through the portal (e.g. filing online forms). Stability is also important when the user is getting live streaming of some audio or video content.

### 3) Value Addition

In this dimension, the quality criteria items are taken from ‘contextual quality’ dimension of [9], and ‘relevant’ dimension of [1] with suitable modification for e-government context. This is the most critical dimension where information producers should reflect due concerns. We have taken four major classes

- a) **Understandability:** This criterion considers the familiarity of the user to the knowledge domain of which the information belongs, and the extent to which information is interpretable by the user. There can be cases where people can understand the language and vocabulary, but not the fundamental idea behind the written content. This is a very subjective measure for specific types of information. However, in the case of G2C service related information which addresses the essential needs of the common men, this criterion no longer remains too subjective for the users.
- b) **Level of Detail:** There can be many measures to assess about level of detail of information. These can be found in different names such as comprehensiveness, conciseness, completeness, appropriate amount etc. Comprehensiveness and completeness can be treated as equivalent measure from user’s perception. Similarly, conciseness and appropriate amount can be treated together in similar means. To avoid confusion, we adopt two quality criteria – a) conciseness, and b) completeness for use.
- c) **Currency:** This criterion is a measure against use of obsolete information and the old information can sometimes be treated as inaccurate. However, accuracy is a different criterion of information quality that has already been considered at the representation level (form of representation).
- d) **Applicability:** This value component of quality tends to assess the final judgment of information recipient about use of information in the task settings. It cannot be taken for granted that complete understandable, concise, and current information can always be used by the practitioners. Some information can be irrelevant for use.

Following table summarize all the discussed measures of information quality with their objectives and criteria.

Table 1. Measures of Information Quality for E- Governance Services

<b>Levels of Information Quality</b>		
<i>Representation Level</i>	<i>Process Level</i>	<i>Application Level</i>
Soundness	Convenience	Value addition
Form; Flexibility; Consistency	Accessibility; Security/Privacy Interactivity; Connectivity	Understandability; Level of Detail; Currency; Applicable

## 4. Conclusion

Information can be viewed both as a product and as a service and sometimes both the perspectives are essential for certain kinds of web based services. A conceptual model to evaluate information quality for online service environment in general and for e-governance services in particular is developed by identifying and re-structuring the relevant quality dimensions. Both theoretical and empirical dimensions are considered

and incorporated while developing this model. The quality dimensions acknowledged above can vary in terms of significance and value for various stakeholders of information in different social and business environments. This conceptual model can be used for further survey and evaluation of information quality in a wide range of web based service environments.

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