Understanding user evaluation of Information Quality Dimensions in a digitized world

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Abstract

This paper tries to explore the importance of multiple dimensions of information for measuring information quality from a user's viewpoint. The paper provides a detailed analysis of the nature and importance of different information quality dimensions and how they vary with the context and demographics of the users.

Keywords: Information Quality, Contextual Factors, User Perception, Information Quality Index

INTRODUCTION

Information systems have become an integral part of every organization, whether large or small. These systems play a vital role in data consolidation and analysis and thus impact the quality of decision-making. A number of researchers have proposed different frameworks for successfully measuring and interpreting information quality in different contexts. Deriving the information quality from a user's perspective is beneficial as they closely interact with the system and are more aware of the need and functionality. However, different users of the same data can have significantly different information quality requirements. This paper explores how the perception of information quality varies with the context of the user. Five contextual factors, namely company size, industry of operation, functional area, managerial level of user and type of information system used, were selected and their relationship with information quality attributes has been analysed. This would help in improving the information system design based on the user expectations.

In this paper, the different attributes of information quality, a multi dimensional construct, were explored. The paper starts with a comprehensive literature review in section 2 to shortlist the key dimensions for information quality construct. Section 3 describes the research process, including research model, research questions and key hypotheses that were to be tested. Section 4 describes the methodology which includes instrument development, data collection and analysis. Section 5 discusses the results and findings and Section 6 concludes the paper with the implications and scope of future research.

LITERATURE REVIEW

The problem of insufficient information quality (IQ) is widespread and is often cited as one of the major factors for the failure of information systems (IS). With increasing volumes and complexities of data resources, managing information quality has become an important success factor. In a study of the attitudes of top and middle managers towards a choice between increased information quantity vs. enhanced information quality, a clear preference (nine to one) was expressed for enhanced information quality (Adams 1973). In literature, Information quality has been researched in isolation (Boritz, 2005; Kim, Kishore, & Sanders, 2005), in combination with systems quality (DeLone & McLean, 1992; Nelson, Todd, & Wixom, 2005) and with knowledge management (Wu & Wang, 2006). A lot of research has been carried out in the area of Information management regarding the attributes of Information quality. Nelson et al. (2005) inferred that there are multiple views of information quality, however they focused on the intrinsic, context based, and representational views of information quality as detailed in the figure 1. (Wang and Strong,1996)

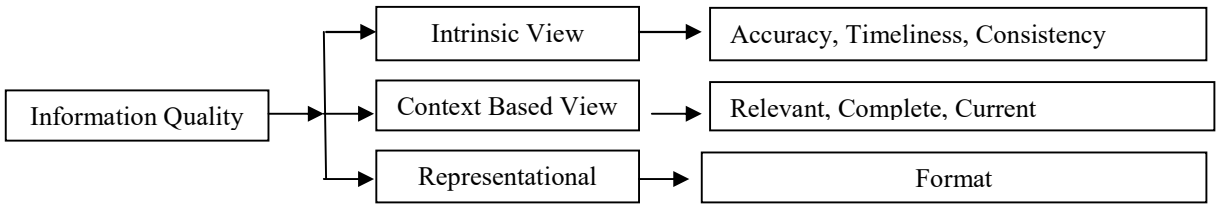

Figure 1: Views of Information Quality Nelson et al. (2005)

However, most of these studies do not include a holistic measure of information quality in a single framework. System analysts have long established the importance of the accuracy dimension of information quality, and hence extensive edit checks and controls have been developed and successfully implemented around it (Martin 1973). IQ studies often mention the importance of trade-offs between IQ attributes (Ballou and Tayi, 1999; Eppler, 2001; Ballou and Pazer, 2003; Fisher et al., 2006).

Taking it forward, the paper is trying to determine the relative importance of various IQ attributes in the mind of the user. This would enable a more effective information system design that is aligned with the user requirements. Also, the role of contextual factors in IQ research is not very clear since majority of the IQ frameworks are more subjective. The paper tried to fill this gap in literature by exploring the role of several contextual factors like company size, managerial level of a user, type of IS, functional area of user and industry of operation on the user perception of IQ dimensions.

Information Quality Attributes

After a comprehensive literature review, seven attributes were selected to represent information quality which is a second order construct that can be operationalized using these attributes. Table 1 list out the definitions of these attributes and their sources in literature.

Table 1: Attribute definitions

Construct	Attributes and Definition	Sources
Information Quality	Completeness refers to the degree to which the system provides all the necessary information	Wang et al (1996), Arazy and Kopak (2011), Price, Neiger and Shanks (2008)
	Accuracy and Reliability refers to the user's perception that the information is correct, stable and repeatable	Delone and McLean (1992), Arazy and Kopak (2011), Price, Neiger and Shanks (2008), Marakkas, 2003
	Format is the user's perception of how well the information is presented	Delone and McLean (1992), Wang et al (1996), Arazy and Kopak (2011), Price,Neiger and Shanks(2008), Marakkas,2003
	Timeliness is the degree to which information is available on time for its intended use and is also up to date	Lucey T (2005), Price, Neiger and Shanks (2008), Wang et al (1996), Delone and McLean(1992), Marakas (2003)
	Relevancy is the degree of match between information being supplied and information required for making a decision.	Marakas (2003), Martin (1981), Wang et al (1996)
	Flexibility denotes the level of output options that the system provides and the level of ease with which the system allows a user to navigate through various options.	Marakas (2003), Price, Neiger and Shanks (2008)
	Consistency denotes the extent to which data are always presented in the same format and are compatible with previous data	Wang and Strong (1996)

Research Questions and Hypothesis

As described earlier, the main aim of the paper is to explore the role of contextual factors on the user perception of IQ attributes. Also, the user importance ratings of these attributes are to be explored. Based on this, following are the main research questions that would be addressed in this paper:

I. Do contextual factors affect the user's perception of Information Quality?
II. What is the relative importance of the selected Information Quality dimensions?
III. What is the overall Information Quality index rating based on the selected IQ attributes?

Based on the research questions, a set of hypotheses were developed that would be tested in this paper. These are described in detail in this section.

i. Effect of Company Size:

Size of the company was defined by the number of employees. Three levels were defined as: 0-500 employees – Small Size firm, 501-1000 employees – Medium Size firm and

Greater than 1000 employees – Large Size firm. The hypotheses to be tested for this contextual factor are:

H_1: The user perception of IQ dimensions is not influenced by the size of the company.

H_2: The user importance rating of IQ dimensions is not influenced by the size of the company.

H_3: The user IQ index rating is not influenced by the size of the company.

ii. Effect of Managerial level:

Managerial level of a user was defined by the years of experience he had. This was also categorised in three levels: 0-5 years – Junior level, 6-10 years – Mid level and Greater than 10 years – High (or Senior) level. The hypotheses to be tested for this contextual factor are:

H_4: The user perception of IQ dimensions is not influenced by the managerial level of the user.

H_5: The user importance rating of IQ dimensions is not influenced by the managerial level of the user.

H_6: The user IQ index rating is not influenced by the managerial level of the user.

iii. Effect of Industry:

Industry of operation was categorised into two fields – Manufacturing industry and Service industry. The hypotheses to be tested for this contextual factor are:

H_7: The user perception of IQ dimensions is not influenced by the industry of operation.

H_8: The user importance rating of IQ dimensions is not influenced by the industry of operation.

H_9: The user IQ index rating is not influenced by the managerial level of the user.

iv. Effect of Functional Area:

The functional areas of users were divided into eight categories – Operations, Finance, Marketing, HR, General Management, Strategy, IT, Any Other. The hypotheses to be tested for this contextual factor are:

H_{10}: The user perception of IQ dimensions is not influenced by the functional area of the user.

H_{11}: The user importance rating of IQ dimensions is not influenced by the functional area of the user.

H_{12}: The user IQ index rating is not influenced by the functional area of the user.

v. Effect of type of information system:

IS Sophistication was defined by the scope and range of the information system used. An IS which operated independently with no external integration (PC based systems) was categorized as a Level 1 basic system. An IS which integrated the cross functional areas of a company (ERP, MIS etc) was categorized as a Level 2 system. An IS that integrated the entire supply chain with participation from external sources (SCM, CRM etc) was categorized as a Level 3 system. The hypotheses to be tested for this contextual factor are:

H_{13}: The user perception of IQ dimensions is not influenced by the type of information system used.
H_{14}: The user importance rating of IQ dimensions is not influenced by the type of information system used.
H_{15}: The user IQ index rating is not influenced by the type of information system used.

METHODOLOGY

Instrument: A detailed questionnaire measuring the attributes of information quality was prepared, taking cues from relevant literature. The items in the questionnaire were presented as Likert-type scales anchored by 1 (*strongly disagree*) to 5 (*strongly agree*). The items were designed to cover both the perception as well as technical data pertaining to the attributes. There were two sections in the questionnaire. Part A measured the perception data of the information quality attributes and their importance ratings and Part B measured the technical data pertaining to information quality. The scale was tested for reliability. Cronbach alpha was 0.892 depicting a high reliability.

Data Collection: The survey was administered amongst executives of managerial level or above who had prior experience in working with different kinds of information systems. A total of 64 responses were collected, out of which three responses were discarded as they were incomplete for data analysis. However, for importance ratings only 32 valid responses could be collected as a number of respondents had little exposure to level 2 and 3 information systems.

DATA ANALYSIS AND RESULTS

The analysis is divided into three phases based on the three research questions as mentioned previously on page 5.

Analysis Phase One

Phase one tested the first research question. The questionnaire measured the information quality of an IS using the perception of the users (Part A) as well as capturing the technical attributes of the system (Part B). The perception part was given a weightage of 0.4 as compared to the technical part whose weightage was 0.6 in measuring the overall score for each of the IQ dimension. The data was analysed using SPSS software to determine the relationships between the various contextual factors and the different dimensions of information quality (H_1, H_4, H_7, H_{10} and H_{13}). Results of ANOVA analysis for checking variations across different contextual factors are detailed in the table below:

Table 2: F and p-Value from ANOVA analysis for IQ dimensions

	Company Size		**Managerial Level**		**Industry**		**Functional Area**		**IS Type**	
	F	p-value	F	p-value	F	p-value	F	p-value	F	p-value
Completeness	2.745	.073*	.392	.677	1.507	.225	1.050	.408	2.015	.143
Acc&Rel	1.392	.257	.103	.902	3.477	.067*	1.447	.207	1.583	.214

Timeliness	.427	.655	1.019	.367	1.240	.270	1.292	.272	.481	.621
Flexibility	1.609	.209	.654	.524	.165	.686	1.136	.355	1.051	.356
Relevance	2.292	.110	2.552	.087*	1.315	.256	.691	.679	3.424	.039**
Consistency	1.277	.287	.137	.873	.006	.940	.342	.931	1.386	.258
Format	.627	.538	.161	.852	6.751	.012**	.961	.469	.625	.539

** $p < 0.05$*

A significant difference was observed between manufacturing and service industry on the Format dimension of information quality (IQ). Also, a significant difference was observed between Level 1 and Level 2 of Information Systems (IS) on the Relevance dimension of information quality (IQ). However, the values are comparable for Level 2 and Level 3 IS. This can be attributed to the fact that as the levels of IS go up, so does the complexity and amount of information. So relevance of information is more critical for Level 2 and Level 3 systems. The graphs below show the difference in means for the above attributes.

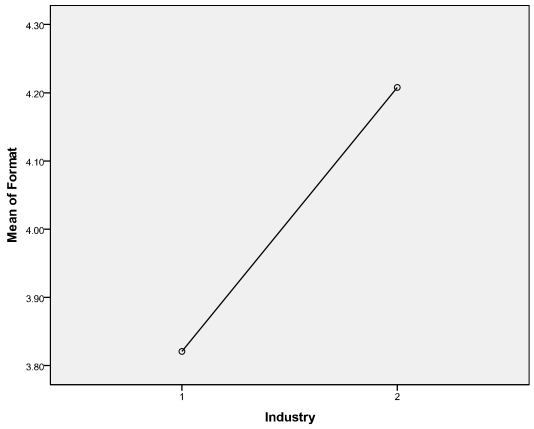

Figure 2: Graph plotting mean of Format dimension for industry types

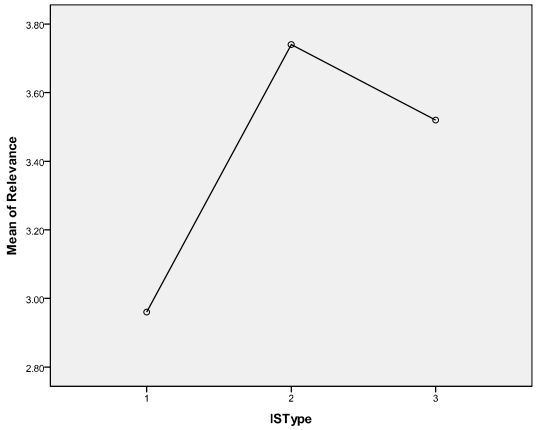

Figure3: Graph plotting mean of Relevance dimension for IS types

Based on the above analysis, table 3 below shows the status of the related hypotheses:

Table 3: Hypotheses Status

Hypotheses	**Status**	**Description**
$H_{1:}$ The user perception of IQ dimensions is not influenced by the size of the company.	Not Rejected	No significant difference was observed of the size of the company on any of the IQ dimensions.
$H_{4:}$ The user perception of IQ dimensions is not influenced by the managerial level of the user	Not Rejected	There is no significant impact of managerial level on any of the IQ dimensions
H_7: The user perception of IQ dimensions is not influenced by the industry of operation.	Rejected	A significant difference was observed between manufacturing and service industry on the Format dimension of information quality (IQ).
H_{10}: The user perception of IQ dimensions is not influenced by the functional area of the user.	Not Rejected	There is no significant impact of functional area of the user on any of the IQ dimensions

H_{13}: The user perception of IQ dimensions is not influenced by the type of information system used.	Rejected	A significant difference was observed between Level 1 and Level 2 of Information Systems (IS) used on the Relevance dimension of information quality (IQ).

Analysis Phase Two

The second phase of analysis tested the second research question. The questionnaire measured the importance of different IQ attributes. It had 30 items corresponding to the seven selected attributes. The users were asked to rate the importance of each of the items on a scale of 1-5, with 1 being the least important and 5 being the most important. A total of 32 valid responses were collected.

Table 4: F and p-Value of ANOVA analysis

	Company Size		**Managerial Level**		**Industry**		**Functional Area**		**IS Type**	
	F	p-value	F	p-value	F	p-value	F	p-value	F	
Completeness	1.767	.189	1.953	.160	.534	.777	.647	.427	3.258	.053*
Acc&Rel	.082	.922	1.631	.213	.683	.665	.083*	.776	2.436	.105
Timeliness	.370	.694	.092	.913	.596	.730	.009**	.927	.074	.929
Flexibility	.683	.513	2.505	.099*	1.443	.238	.081	.777	1.246	.303
Relevance	.443	.646	3.371	.048**	.691	.659	.505	.483	.929	.407
Consistency	2.508	.099*	1.783	.186	1.307	.291	1.832	.186	1.865	.173
Format	.887	.423	1.994	.154	1.057	.414	.119	.733	3.595	.040**

* $p < 0.10$

A significant difference was observed between:

- Middle and high levels of managerial experience on the Relevance dimension
- IS type1 and 2 on the Completeness dimension
- IS type2 and 3 on the Accuracy and Reliability dimension
- IS type 2 and 3 on the Format dimension
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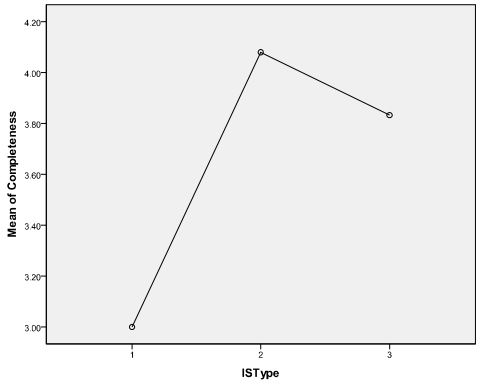

Figure 4: Graph plotting mean of Completeness dimension IS Types

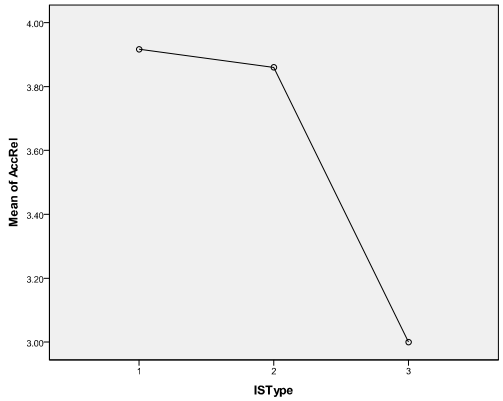

Figure 5: Graph plotting mean of Accuracy for IS Types

The graphs (Figures 4 and 5) depict the means of the above mentioned attributes across the contextual factors. Reasons for the same are discussed in more detail in section 5 on results and discussion.

Based on the above analysis, table 5 below shows the status of the related hypotheses:

Table 5: Hypotheses Status

Hypotheses	Status	Description
$H_{2:}$ The user importance rating of IQ dimensions is not influenced by the size of the company.	Not Rejected	No significant difference was observed of the size of the company on importance ratings of the IQ dimensions.
$H_{5:}$ The user importance rating of IQ dimensions is not influenced by the managerial level of the user	Rejected	A significant difference was observed between middle and high levels of managerial experience on the Relevance dimension of IQ
H_8: The user importance rating of IQ dimensions is not influenced by the industry of operation.	Not Rejected	No significant difference was observed of the industry of operation on importance ratings of the IQ dimensions.
H_{11}: The user importance rating of IQ dimensions is not influenced by the functional area of the user.	Not Rejected	There is no significant impact of functional area of the user on importance ratings of the IQ dimensions.
H_{14}: The user importance rating of IQ dimensions is not influenced by the type of information system used.	Rejected	- A significant difference was observed between IS type1 and 2 on the Completeness dimension of IQ - A significant difference was observed between IS type2 and 3 on the Accuracy and Reliability dimension of IQ - A significant difference was observed between IS type2 and 3 on the Format dimension of IQ

Analysis Phase Three

The third phase tested the third research question. The variation of IQ index ratings across each of the demographic variable was analysed. A significant impact of functional area and type of IS used was found on the IQ index ratings. The graphs below highlight the same.

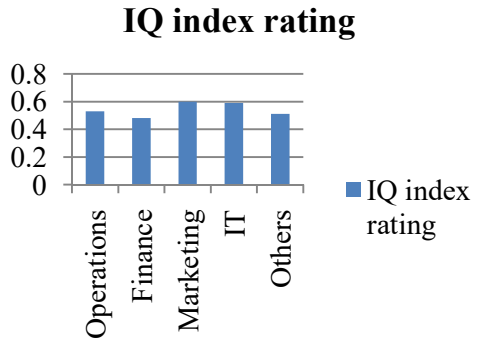

Figure 6: IQ index rating variations by Functional Area

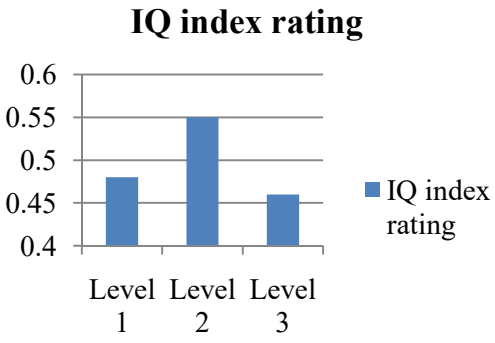

Figure 7: IQ index rating variations by Type of IS used

Based on the above IQ index rating analysis, following table gives an acceptance/rejection status of the concerned hypotheses:

Table 6: Hypotheses Acceptance/Rejection

Hypotheses	Status	Description
$H_{3:}$ The user IQ index rating is not influenced by the size of the company.	Not Rejected	No significant difference was observed of the size of the company on IQ index ratings.
$H_{6:}$ The user IQ index rating is not influenced by the managerial level of the user	Not Rejected	No significant difference was observed between different levels of managerial experience on the IQ index rating
H_9: The user IQ index rating is not influenced by the industry of operation.	Not Rejected	No significant difference was observed of the industry of operation on IQ index ratings.
H_{12}: The user IQ index rating is not influenced by the functional area of the user.	Rejected	There is a significant impact of functional area of the user on IQ index ratings
H_{15}: The user IQ index rating is not influenced by the type of information system used.	Rejected	A significant difference was observed between IS type2 and 3 on the IQ index ratings.

DISCUSSION OF RESULTS AND CONCLUSIONS

A significant difference was observed between manufacturing and service industry on the Format dimension and between Level 1 and Level 2 of Information Systems on the Relevance dimension of IQ ($p<0.05$). Level 1 system is comparatively simpler and less complex than Level 2 systems and handles fewer amounts of data. So selecting and representing the relevant information becomes more important for Level 2 systems. Similar conclusion was drawn by other researchers such as Klein and Calahan, and Dominique and Fehrenbacher (2012).

There was a significant difference in the importance ratings of completeness dimension between executives based on the type of IS used. A type 1 IS is a basic PC based system which contains details of a standalone system. It operates in isolation and contains data pertaining to a particular department only. On the other hand, a type 2 IS connects cross functional departments of a firm and contains information regarding different functional areas. Since the range and volume of information increases as we move from type 1 to type 2 IS, the need for availability of complete information also increases. A type 3 system integrates the external vendors of a firm and contains information from the entire supply chain. The basic elements for accuracy and reliability are built into these system. Thus the focus for these systems now shifts from Accuracy and Reliability to Relevance and Completeness which become the more important parameters. Collecting and managing information for a type 3 system is more complicated than the other types. Hence, more focus is there on operational aspects such as data consistency or availability of relevant information. (Figures 2,3,4, and 5)

Looking at the information quality index, significant differences were observed between perception of information quality, between users of type 1, type 2 and type 3 information systems. As explained above – since the move from stand alone PC systems to organization wide systems causes a large increase in information, the perception of information quality increases. However a move to integrating information from third party systems of vendors and distributors seems to lower the perception of information quality of the system. Finally since the focus of the

systems is largely operational, the perception of information quality is high for operations and marketing, as compared to finance function related managers. (Figures 6 , 7)

In conclusion we may state that the paper explores the variation in perception of information quality dimensions across industries, functional specializations, managerial levels and type of information systems used. However in future, these differences may be explored across a wider range of industries and user contexts, so that the reasons for variation may be better understood.

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