An Information Quality Assessment Methodology: Extended Abstract

Richard Y. Wang
Boston University
School of Management
595 Commonwealth Ave
Boston, MA 02215
Tel: (617) 787-3839
Fax: (617) 787-6365
rwang@bu.edu

Diane M. Strong
Worcester Polytechnic Institute
Management Department
100 Institute Road
Worcester, MA 01609
Tel: (508) 831-5573
Fax: (508) 831-5720
dstrong@wpi.edu

Beverly K. Kahn
Suffolk University
Sawyer School of Management
8 Ashburton Place
Boston, MA 02108
Tel: (617) 573-8642
Fax: (617) 573-8345
bkahn@acad.suffolk.edu

Yang W. Lee
Northeastern University
College of Business Administration
360 Huntington Ave
Boston, MA 02115
Tel: (617) 373-5052
Fax: (617) 373-3166
y.lee@nunet.neu.edu

1. Introduction

Information quality (IQ) has become a critical concern of organizations and an active area of MIS research. The growth of data warehouses and the direct access of information from various sources by managers and information users have increased the need for, and awareness of, high-quality information in organizations. MIS researchers have always considered the quality of information to be important. A survey of the variables used to measure information system success reported IQ as one of the six categories of success commonly employed in MIS research [Delone & McLean, 1992]. Over the last decade, IQ research activities have increased significantly to meet the needs of organizations attempting to measure and improve the quality of information [Ballou & Pazer, 1985; Ballou & Pazer, 1995; Ballou & Tayi, 1989; Madnick & Wang, 1992; Strong, 1997; Strong & Kahn, 1997; Wang, 1996]. In the industrial sector, IQ has been rated regularly as a top concern in data warehousing projects [Brown, 1997; DCI, 1997; Firth & Wang, 1996; Orr, 1998].

Despite a decade of IQ research and practice, only piece-meal, ad hoc techniques are available for measuring, analyzing, and improving IQ in organizations. As a result, organizations are unable to develop comprehensive measures of the quality of their information and to benchmark their IQ against that of other organizations. Without the ability to assess the quality of their information, organizations cannot assess the status of their organizational IQ and monitor their IQ improvements over time. The research challenge is to develop an overall IQ model with an accompanying assessment instrument

for measuring IQ. Furthermore, techniques need to be developed to compare the assessment results against benchmarks and across stakeholders. Such techniques are necessary for prioritizing IQ improvement efforts.

This research is designed to meet these challenges. We develop a methodology called AIMQ (AIM Quality) that provides a rigorous and pragmatic basis for IQ assessments and benchmarks.

2. Overview of the AIMQ Methodology

2.1 Overview of the PSP/IQ Model

The first component of AIMQ is the Product-Service-Performance Model for IQ (PSP/IQ) [Kahn & Strong, 1998; Kahn, Strong, & Wang, 1999]. The PSP/IQ model, shown in Table 1, has four quadrants based on whether improvement involves treating information as a product or a service, and whether improvements can be assessed against a formal specification or customer expectation. The four quadrants capture how well organizations produce *sound* and *useful* information products and deliver *dependable* and *usable* information services to information consumers.

	Conforms to Specifications	**Meets or Exceeds Consumer Expectations**
Product Quality	Sound Information IQ Dimensions: • Free-of-Error • Concise Representation • Completeness • Consistent Representation	Useful Information IQ Dimensions: • Appropriate Amount • Relevancy • Understandability • Interpretability • Objectivity
Service Quality	Dependable Information IQ Dimensions: • Timeliness • Security	Usable Information IQ Dimensions: • Believability • Accessibility • Ease of Operation • Reputation

Table 1: The PSP/IQ Model

2.2 Overview of the IQA Instrument

The second component of AIMQ is an instrument for measuring IQ along the Wang-Strong IQ Dimensions [Wang & Strong, 1996], which is called the IQ Assessment (IQA) Instrument. This instrument can be applied to assess the quality of information in organizations. These assessments can then be analyzed using the PSP/IQ model and associated techniques for assessing IQ.

The development of the IQA Instrument followed standard methods for questionnaire development and testing, see for example [Moore & Benbasat, 1991; Saraph, Benson, & Schroeder, 1989]. A pilot study was performed to test and refine the questionnaire items.

The final questionnaire used 65 IQ assessment items, some demographic questions and space for comments. The scale used in assessing each item ranges from 0 to 10 where 0 is labeled "Not at All" and 10 is labeled "Completely", with the mid-point of 5 labeled "Average." The actual questionnaire items are included in the Appendix, with the Cronbach alpha for each construct.

The full study was based on 261 survey respondents in five organizations. In each organization, there were respondents representing all the information manufacturing roles, i.e., information collectors, information consumers, and IS professionals. All respondents within an organization focused their answers on one set of information of importance to their organization, e.g., patient information in healthcare organizations.

2.3 Overview of IQ Gap Analysis

The third component of AIMQ consists of the IQ Benchmark Gaps analysis technique and the IQ Role Gaps analysis technique. These gap analysis techniques use the PSP/IQ quadrant values as their input. Values for each quadrant of the PSP/IQ model are computed as the mean of the values of its constituent dimensions. These techniques help organizations focus their IQ improvement efforts based on the analysis of their IQ assessments.

IQ Benchmark Gaps compares an organization's IQ assessment to that of a best-practices organization. There are four IQ Benchmark Gaps, one for each quadrant of the PSP/IQ model, which we refer to as the ***Soundness Benchmark Gap***, the ***Dependability Benchmark Gap***, the ***Usefulness Benchmark Gap***, and the ***Usability Benchmark Gap***. When analyzing IQ Benchmark Gaps, three indicators should be considered: size of the gap area, different size gaps at lower and higher percentiles, and different gap patterns by quadrant.

IQ Role Gaps measures the gap between the assessments of different stakeholders of an information manufacturing system. The differences between IS professionals and information consumers are examined. Consumers have an intimate understanding of their tasks and the extent to which the quality of information fits the needs of their tasks. Thus, they assess "fitness for use", the basic definition of quality. IS professionals, on the other hand, attempt to meet consumers' IQ expectations. Their assessments capture the extent to which they believe they have met the quality specifications for the information.

Like the IQ Benchmark Gaps, there are actually four IQ Role Gaps, one per PSP/IQ quadrant. A diagnosis of IQ Role Gaps looks at four indicators: size of the gap, location of the gap, direction of the gap (positive vs. negative), and differences in gaps by quadrant. A large positive gap between the IQ assessments of information consumers and IS professionals would indicate IQ problems, and thus areas on which to focus improvements.

3. Conclusion

Each component of the AIMQ methodology has merit in itself, and makes a research contribution on its own. For example, IQ can be assessed using the validated IQA Instrument and therefore, furthers research in information systems success. The key contribution of the overall research, however, stems from the integration and synthesis of these components. Properly applied in conjunction, they form an effective methodology for assessing information quality in various organizational settings in which decisions must be made to prioritize tasks and allocate resources for IQ improvement. The effectiveness of AIMQ has been demonstrated in the financial, healthcare, and

manufacturing industries. Examples of the application of AIMQ will be presented at the conference.

4. References

[1] Ballou, D. P. & Pazer, H. L. (1985). Process improvement versus enhanced inspection in optimized systems. *International Journal of Production Research,* ***23***(6), pp. 1233-1245.

[2] Ballou, D. P. & Pazer, H. L. (1995). Designing Information Systems to Optimize the Accuracy-Timeliness Tradeoff. *Information Systems Research,* ***6***(1), pp. 51-72.

[3] Ballou, D. P. & Tayi, G. K. (1989). Methodology for Allocating Resources for Data Quality Enhancement. *Communications of the ACM,* ***32***(3), pp. 320-329.

[4] Brown, S. M. (1997). *Preparing Data for the Data Warehouse*. Proceedings of the 1997 Conference on Information Quality, Cambridge, MA. 1997. pp. 291-298.

[5] DCI. (1997). *Data Quality the Top problem*. S5.

[6] Delone, W. H. & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research,* ***3***(1), pp. 60-95.

[7] Firth, C. P. & Wang, R. Y. (1996). *Data Quality Systems: Evaluation and Implementation*. London: Cambridge Market Intelligence Ltd.

[8] Kahn, B. K. & Strong, D. M. (1998). *Product and Service Performance Model for Information Quality: An Update*. Proceedings of the 1998 Conference on Information Quality, Cambridge, MA. 1998. pp. 102-115.

[9] Kahn, B. K., Strong, D. M., & Wang, R. Y. (1999). Information Quality Benchmarks: Product and Service Performance. *Communications of the ACM,* Forthcoming.

[10] Madnick, S. & Wang, R. Y. (1992). *Introduction to Total Data Quality Management (TDQM) Research Program.* (TDQM-92-01) Total Data Quality Management (TDQM) Research Program, MIT Sloan School of Management May 1992.

[11] Moore, G. C. & Benbasat, I. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research,* ***2***(3), pp. 192-222.

[12] Orr, K. (1998). Data Quality and Systems Theory. *Communications of the ACM,* ***41***(2), pp. 66-71.

[13] Saraph, J., Benson, G., & Schroeder, R. (1989). An Instrument for Measuring the Critical Factors of Quality Management. *Decision Sciences,* ***20***(4), pp. 810-829.

[14] Strong, D. M. (1997). IT Process Designs for Improving Information Quality and Reducing Exception Handling: A Simulation Experiment. *Information & Management,* ***31***(5), pp. 251-263.

[15] Strong, D. M. & Kahn, B. K. (1997). *Proceedings of the 1997 Conference on Information Quality* (pp. 372). Cambridge, MA.

[16] Wang, R. Y. (1996). *Proceedings of the 1996 Conference on Information Quality* (pp. 270). Cambridge, MA.

[17] Wang, R. Y. & Strong, D. M. (1996). Beyond Accuracy: What Data Quality Means to Data Consumers. *Journal of Management Information Systems (JMIS), 12*(4), pp. 5-34.

5. Appendix: The Questionnaire Items

All items are measured on a 0 to 10 scale where 0 is not at all and 10 is completely. Items labels with "(R)" are reverse coded.

Accessibility. (4 items, Cronbach's Alpha=.92)
- This information is easily retrievable.
- This information is easily accessible.
- This information is easily obtainable.
- This information is quickly accessible when needed.

Appropriate Amount. (4 items, Cronbach's Alpha=.76)
- This information is of sufficient volume for our needs.
- The amount of information does not match our needs. (R)
- The amount of information is not sufficient for our needs. (R)
- The amount of information is neither too much nor too little.

Believability. (4 items, Cronbach's Alpha=.89)
- This information is believable.
- This information is of doubtful credibility. (R)
- This information is trustworthy.
- This information is credible.

Completeness. (6 items, Cronbach's Alpha=.87)
- This information includes all necessary values.
- This information is incomplete. (R)
- This information is complete.
- This information is sufficiently complete for our needs.
- This information covers the needs of our tasks.
- This information has sufficient breadth and depth for our tasks.

Concise Representation. (4 items, Cronbach's Alpha=.88)
- This information is formatted compactly.
- This information is presented concisely.
- This information is presented in a compact form.
- The representation of this information is compact and concise.

Consistent Representation. (4 items, Cronbach's Alpha=.83)
This information is consistently presented in the same format.
This information is not presented consistently. (R)
This information is presented consistently.
This information is represented in a consistent format.

Ease of Operation. (5 items, Cronbach's Alpha=.85)
This information is easy to manipulate to meet our needs.
This information is easy to aggregate.
This information is difficult to manipulate to meet our needs. (R)
This information is difficult to aggregate. (R)
This information is easy to combine with other information.

Free of Error. (4 items, Cronbach's Alpha=.91)
This information is correct.
This information is incorrect. (R)
This information is accurate.
This information is reliable.

Interpretability. (5 items, Cronbach's Alpha=.77)
It is easy to interpret what this information means.
This information is difficult to interpret. (R)
It is difficult to interpret the coded information. (R)
This information is easily interpretable.
The measurement units for this information are clear.

Objectivity. (4 items, Cronbach's Alpha=.72)
This information was objectively collected.
This information is based on facts.
This information is objective.
This information presents an impartial view.

Relevancy. (4 items, Cronbach's Alpha=.94)
This information is useful to our work.
This information is relevant to our work.
This information is appropriate for our work.
This information is applicable to our work.

Reputation. (4 items, Cronbach's Alpha=.85)
This information has a poor reputation for quality. (R)
This information has a good reputation.
This information has a reputation for quality.
This information comes from good sources.

Security. (4 items, Cronbach's Alpha=.81)
This information is protected against unauthorized access.
This information is not protected with adequate security. (R)
Access to this information is sufficiently restricted.
This information can only be accessed by people who should see it.

Timeliness. (5 items, Cronbach's Alpha=.88)

This information is sufficiently current for our work.
This information is not sufficiently timely. (R)
This information is not sufficiently current for our work. (R)
This information is sufficiently timely.
This information is sufficiently up-to-date for our work.

Understandability. (4 items, Cronbach's Alpha=.90)

This information is easy to understand.
The meaning of this information is difficult to understand. (R)
This information is easy to comprehend.
The meaning of this information is easy to understand.