APPLIED INFORMATION QUALITY: A FRAMEWORK FOR THINKING ABOUT THE QUALITY OF SPECIFIC INFORMATION

JANA BRADLEY, PHD, MLS

ABSTRACT Information quality, considered abstractly, may seem to be a relatively straightforward matter. Information should be accurate, up to date, useful, and attributable to reputable sources. However, determining the quality of a specific piece of information for a specific use is a more complicated process. The concept of *applied information quality* is defined in this paper as a judgment of information quality (1) made by a specific person or persons, (2) in a specific situational context for use of that information, and (3) based on the characteristics of the information. Each of the three elements of the judgment influences its outcome. Information judgments are made by individuals in the context of their discipline and community of practice. The situational context includes the specifics of the context for use of the information, the questions that the information must address, the strategy for locating potentially relevant information, and the body of information that is retrieved and is available for judgment and use. The paper focuses on the third element of a judgment of information quality—the characteristics of the information on which the judgment is based. These characteristics are grouped for discussion under six metaquestions: What is the information item of interest? How was the focal information created and when? Who is involved with the focal information? From what perspective was the information created and why? What relationships does the focal information have to other information—its antecedents, sources, and other related information? What approval, review, or other filtering processes, if any, has the information gone through? Approaches to improving quality judgments can focus on improving the information itself, improving the channels that organize and deliver information, or improving the individual's ability to judge the quality of information for a specific purpose. These are not mutually exclusive and, probably, all should be pursued. Applied judgments of information quality are ultimately the responsibility of the individuals using information; they need to be supported in this professional activity as they are in the other responsibilities of their professional practice.

Dr. Bradley is Assistant Professor, School of Library and Information Science, Indiana University, 755 N. Michigan St., UL1110E, Indianapolis, IN 46202. (E-mail: jbradley@iupui.edu)

INTRODUCTION

Information quality is a conundrum. When we talk in the abstract about information quality, it is easy to develop a list of desirable attributes: information should be accurate, up to date, useful, and attributable to reputable sources. However, when considering the quality of specific items of information and their usefulness in specific situations, complexity arises. Although individuals and groups may have some shared understanding of quality, differences always will exist between groups and between individuals in the same group. Different understandings of quality are demonstrated repeatedly by conflicting "expert reviews" of the same manuscript or research proposal.

Information quality also can be interpreted differently for different situations. Intrinsic quality—however defined—is always important, but relative quality also matters, especially in situations in which information is scarce and decisions must be made.

JUDGMENTS OF INFORMATION QUALITY

This paper presents a framework for thinking about the quality of specific information in specific circumstances—a concept that might be termed *applied information quality*. The applied quality of an item of information can be viewed as a judgment of information quality (1) made by a specific person or persons, (2) in a specific situational context for use of that information, and (3) based on the characteristics of the information.

INDIVIDUALS AS JUDGES OF INFORMATION QUALITY

The concept of applied information quality centers on judgments made by individuals. These individuals are located in what Lave and Wenger term *communities of practice*.¹ Communities of practice are groups of people who work toward broad common goals, share the same work tools and practices, and use the same specialized vocabulary. Any individual's judgment of the quality of information is likely to be in the context of not only the way the individual uses information, but also the patterns of information use among specific communities of practice to which they belong.

SITUATIONAL CONTEXT

In the framework presented here, individuals judge the quality of information in terms of its use in specific situations. Many aspects of the situation in which information is needed affect the perception of quality. Table I suggests a simplified model of situational components for a quality judgment. The context for use of information shapes the information need. Information may be needed for decisions, specific actions, or background understanding. The goals and purposes of

TABLE I Quality Judgments in a Situational Context

-
1. Context for use
 - a. Decision, action, background understanding
 - b. Goals and purposes
 - c. Stakeholders
 - d. Decision processes
 - e. Problem framework
 2. Information questions
 3. Information-seeking strategy
 4. Retrieved body of relevant information
-

the situation affect the information that is relevant. Stakeholders consist of decision makers in a particular situation and other stakeholders who must accept or tolerate the results of the decision. These stakeholders are audiences for the quality judgments that individuals make. Since information is used frequently to defend, support, accept, and reject decisions, credibility of information with stakeholders should be an important factor in judgments of information quality.

The problem framework in a specific situation can be defined as the components of the problem and their relationships to each other. Because different perceptions of key components and relationships undoubtedly exist, arriving at some consensus about the major elements of a problem is not only good decision-making practice, but also is helpful in making information quality judgments. The use of analytic frameworks in the development of guidelines to clinical practice is an excellent example of the power of this approach.² The developers of the *Guide to Community Preventive Services*,³ now in preparation, also are developing logic and analytic frameworks as a means to review evidence and make recommendations. While not every decision situation may call for formal consensus on an analytic model of the problem, some articulation of the main components and relationships will be extremely helpful in the total information-use process.

A second aspect of the situational context for quality judgments is implicit or explicit questions for which information is being sought. Care taken to formulate questions that can be addressed by the type of information that is available publicly can reduce frustration. Information-seeking strategy, the third aspect noted in Table I, is covered by other papers in this issue of the *Journal of Urban Health*. Thoughtful reflection on the questions posed may suggest the disciplines or professions that are likely to be interested in answering those questions, the publication and communication patterns of these people, and the kind of information likely to be available.

The nature of the body of available evidence, the last item in Table I, often conditions judgments of quality about specific pieces of information. The science and art of synthesizing a body of information in a systematic and formal way is beyond the scope of this paper. However, individuals who need to assess the quality of available information in terms of their own needs accomplish an informal synthesis by comparing what is available and making relational judgments. The individual must also decide, in relation to a specific situation, whether less-than-ideal information is better or worse than no information at all.

CHARACTERISTICS OF INFORMATION AS THE BASIS FOR QUALITY JUDGMENTS

Items of information can be described in terms of their characteristics, such as the people responsible for creating and presenting the substantive content, the time and conditions under which the information came into existence, the research methodology producing the results, the background of the expert synthesizing or propounding the information, and the means and format of publication or presentation. Additional characteristics of information are the subject of the information, its theoretical base, or its relation to other sources of information or other versions of the same information. The characteristics of information useful to consider in judgments of applied information quality are the main focus of this paper and are developed in more detail after a discussion of some established approaches to information quality.

APPROACHES TO JUDGMENTS OF INFORMATION QUALITY

Many approaches to judgments of the quality of a specific item of information involve a delegation of the judgment of quality. Instead of judging the quality of the information directly, we rely on the judgment of quality made by others. Examples of delegated quality judgments include relying on peer-reviewed journals, making use of expert syntheses, or focusing on information provided by reputable institutions, organizations, or individuals. A delegated judgment is still a quality judgment, but of some aspect of the context of the information—such as the reputation of the journal in which it was published—rather than the content of the information itself. Table II lists, as examples, some frequently used approaches to quality judgment.

Peer review has been mentioned as a type of delegated judgment. Although the limitations of peer review are well known, it is still a widely accepted yardstick of quality. Reputation is another generic approach to quality judgments that is widely used and is also a delegated judgment. The institution, the organization, or an individual, known through some aspect of reputation, is accepted as a credible judge of the direct quality of information.

TABLE II Some Frequently Used Approaches to Judging Information Quality

Peer review
Reputation and popularity
Familiarity
Methodological rigor
Expert review and selection (transparent criteria)
Criteria-based review and selection (explicit criteria)
Evidence-based medicine
<ul style="list-style-type: none"> • use of the best available evidence for clinical decisions • hierarchies of evidence • processes for assessing types of studies and reports

Another approach to information quality is one used more implicitly than explicitly. We might term this approach the *familiarity factor*, that is, the tendency to find information credible if it fits familiar disciplinary, professional, or problem frameworks. Huge errors have been caused by this approach—Ptolemy versus Copernicus, the explanation of the etiology of ulcers—but it often saves time and produces good results. Unfortunately, if quality judgments are delegated to sources who apply the familiarity factor, new or controversial viewpoints may not be encountered. A major value, and also a major difficulty, of seeking information outside one's discipline or community of practice is being exposed to other, possibly less-familiar, patterns and practices regarding the generation and use of information.

Assessment of methodological rigor and methodological limitations is an approach that combines implicit and explicit criteria. Evaluators may have unstated assumptions about whole types of research that may color an evaluation of the specific methodology of a study. Guidelines and critiques of methodological rigor can best be found within the communities of practice of specific research methods. Critiques of research methodologies from outside a particular research paradigm, such as qualitative critiques of quantitative methods, and *vice versa*, highlight differences in epistemological assumptions—views of how we know what we know—rather than methodological strength and weakness.⁴

Expert review and selection refers to any process by which quality judgments are delegated to experts. Again, individuals who accept an expert's judgment are actually making implicit or explicit quality judgments about the expert, not directly about the information quality. Although experts may use explicit criteria for review and selection, many expert quality judgments are made from implicit criteria.

A related approach can be termed *criteria-based review and selection*. Here, the emphasis is on specific criteria, usually proposed by experts and either applied by them or made available for others to apply. Criteria can sometimes be sufficiently specific to permit an unambiguous application, such as a requirement that information used for promotion and tenure decisions must be published in a peer-reviewed journal. More often, however, the criteria themselves need interpretation by the person judging in order to be applied. For example, in applying the criterion that information be up to date, individuals must use some notion of what up to date means. The working draft white paper, "Criteria for Assessing the Quality of Health Information on the Internet," is an example of criteria-based approaches.⁵

A recently published study of the rating of health information on the Internet, including both expert review and criteria-based review as used here, documents the disparity of the multiple rating systems and questions both the feasibility and the desirability of evaluating health information on the Internet. This article, and the controversy it alludes to concerning evaluation of the more-structured information represented by randomized, controlled trials, illustrates the difficulty of obtaining consensus on criteria of quality.⁶

The approaches to information quality subsumed under "evidence-based medicine" have been extremely influential in raising awareness of the need to use information in health-related decision making. They also have increased understanding that the methods used to create information shape that information and thereby condition what we know. Three general contributions of evidence-based medicine to judgments of information quality are mentioned here.

The broad notion of "integrating individual clinical expertise with the best available external clinical evidence from clinical research,"^{7(p71)} although clearly formulated with clinical decisions in mind, has spread rapidly to many other health-related situations and decisions. Often associated with this general principle is the notion of hierarchies of evidence and the gold standard at the top of the hierarchy. One such example is the hierarchy used by the Task Force in the Clinical Preventive Services.²

A third contribution of evidence-based medicine to quality judgments is the concept of a process for individuals to use in evaluating reports of specific types of research. The articles in the series, "Users' Guide to the Medical Literature," still continuing in the *Journal of the American Medical Association*, are good examples of this approach to quality judgments.

Difficulties in applying evidence-based medicine have been pointed out both within clinical medicine and in disciplines and professional practice outside

TABLE III Characteristics of Information: Overview

What is the information item of interest?
How was the focal information created? When?
Who is involved with the focal information?
From what perspective was the information created? Why?
What relationships does the focal information have to other information: its antecedents, sources, and other related information?
What approval, review, or processes, if any, have operated on the information?

medicine, and the debate about appropriate use continues.* Broadly construed principles of evidence-based medicine—integrating individual experience with the best external evidence, assessing the design and the implementation of research methodologies, and providing guidelines for assessing reports of research—have a major place in the judgment of information quality.

CHARACTERISTICS OF INFORMATION

The remainder of this paper focuses on an analysis of the characteristics of information that can form the basis of judgments of information quality. The purpose of the analysis is to raise awareness of the many attributes of an item of information that can form the basis of a judgment of quality. Judgments of quality typically turn positively or negatively on one or more dominant characteristics that, for the person or people making the judgment, represent quality information. The analysis presented here can be used as a reminder of the many attributes of information that shape its form and that can be used to help understand what the information represents and whether or not it is a fit for a particular situation. Characteristics of information that can form the basis of quality judgments can be grouped around six metaquestions that represented aspects of an item of information (Table III).

WHAT INFORMATION ITEM IS OF INTEREST?

Quality judgments are made about a specific information item or “thing,” which is referred to in this paper as the focal information, meaning whatever information item or thing is currently under consideration. The notion of information as a thing that is capable of informing us comes from Michael Buckland’s analysis of the uses of the word *information*.⁸ He equates an information thing with evidence and suggests that it is fundamentally passive—that it does not *do* anything. Human beings do things with it, such as reasoning, interpreting, or

*See, for example, A. R. Feinstein and R. I. Horwitz, Problems in the “evidence” of “evidence-based medicine,” *Am J Med*, 1997;103:529–535.

judging. Buckland's analysis suggests that the notion of information itself carries with it the idea of a human judgment about the thing's capacity to inform.

We commonly refer to specific text and image things as information, thus attributing to these things the capacity to inform. It is often unclear to which specific referent, or information thing, we are referring as information. When we talk about the quality of "information," we may be referring to a specific semantic meaning, such as a statistic, a conclusion, a definition, or a description of outcomes. We also may be referring to the intellectual object that presents the information, such as a scientific paper, a technical or organizational report, a statistical table, or a Web page. At a still more general level, we can talk about information as the product that makes focal meaning available to the public: a journal, a knowledge base, or an information resource. Table IV presents a typology of various levels of information things. The level of information at which we make a specific quality judgment is not so important in itself, as long as we are aware of what we are judging.

HOW WAS THE FOCAL INFORMATION CREATED, AND WHEN?

The methods or processes by which focal meaning comes into existence shape that meaning. This is true for findings that come into existence as a result of research design and implementation, as well as for expert synthesis of information and other methods of creating new information. Understanding the specific means by which focal information was created, as well as the credibility of those means for an audience of stakeholders, is an important part of judging information quality.

Bias refers to the ways in which methodology skews outcomes. Understanding sources of bias is important for quality judgments. It is useful also to think of all methods decisions—and other decisions involved in generating information—as choices, either conscious or unconscious, that shape outcomes. *Perspective* is a more general word to describe the fact that creations are shaped by their creators. Perspective should not be viewed as an indication of bad information quality, but rather as an inevitable outcome of the creation of information. Looking for

TABLE IV Focal Information Things

Semantic meaning (e.g., specific results, findings, conclusions, statistics, etc.)
Activity, technique, or practice that produced focal meaning (e.g., randomized clinical trial, sampling methodology, nondirective interviewing)
Genre in which meaning is presented (e.g., article, report, data set)
Product in which genre is made publicly available (e.g., book, journal, Web site, knowledge base)

perspectives that shape information, and factoring them into the assessment of the information's usefulness, is part of a thorough quality judgment.

Disciplines and professions have preferences for research methodologies. Presenting a definitive typology of methods of generating information is a major undertaking and well beyond the scope of this paper. One difficulty among many is various levels of granularity at which methods can be described and analyzed. Table V presents, for purposes of example only, some ways of creating information. Descriptions of rigor in these areas can be found in many disciplinary and professional traditions.

The question of when information was generated is important, but often unanswerable. In our current system of print publication, the date of publication usually has to stand for the date of the information, although the actual research or synthesis producing the information may have been done substantially earlier. Information on the World Wide Web often is dated less reliably than is print information.

WHO IS INVOLVED WITH THE FOCAL INFORMATION?

Making quality judgments about the people involved with information is a time-honored method of making a judgment about the information itself. These quality judgments frequently extend to judgments about the credibility of an individual's professional credentials and affiliations and an institution's or company's reputation. In making these judgments, attention should be paid again to the various audiences for the quality judgment in the particular decision situation. How will different audiences perceive the credibility and authority of, for example, physicians, chiropractors, government agencies, associations like the American Heart Association or the American Medical Association, or industries such as pharmaceuticals?

In addition to judging who is involved with information, the roles that they play also can be the focus of a quality judgment. For our well-established print publication systems, roles such as researcher, author, editor, and publisher are well understood. For newer genres of electronic publication, roles have not yet solidified under generally understood and accepted terminology. The term *webmaster* is ubiquitous, but it is unclear, from Web page to Web page, how much content authority this title implies.

FROM WHAT PERSPECTIVE WAS THE INFORMATION CREATED, AND WHY?

Perspective has been mentioned already as a way to consider factors that may condition the shape of information and, therefore, may be important to consider in quality judgments. Looking at the purpose for the creation of focal information

TABLE V Activities that Create Focal Information: Illustrative Typology

Method-driven inquiry

- research paradigms (if you accept these distinctions), such as
 - quantitative
 - qualitative
- types of studies and study designs, such as
 - randomized clinical trials
 - before and after studies
 - case reports or studies
- types of data collection techniques, such as
 - surveys
 - interviews
 - participant observation
- types of data analysis techniques, such as
 - various statistical analytical methods
 - various techniques for analyzing text
- specifics of study implementation

Statistical compilations, such as

- operation definitions
- analytical methods

Expert synthesis, such as

- text
- course materials
- guidelines
- other focal types

Expert opinion, such as

- commentary
- opinion piece
- advocacy piece
- other focal types

Purposive descriptions: descriptions of entities or events developed for a specific purpose, such as

- technical descriptions
- program progress, annual or outcome reports
- organizational descriptions
- infrastructure reports or statistics
- product specifications
- company product profiles

provides a good start for the assessment of perspective. For example, descriptive information provided by an organization with a mission to sell goods or services is bound to have a relationship, at some level, to that ultimate goal. Similarly, information distributed by an association or group is bound to have some connection with that group's mission and, perhaps, world view. Perspective should not be an automatic black mark; every item of information has a perspective that

results from the context of its generation. The judgment task is to assess the way the perspective has shaped the focal information and the implications for a specific situation.

WHAT RELATIONSHIPS DOES THE FOCAL INFORMATION HAVE TO OTHER INFORMATION, SUCH AS ITS ANTECEDENTS, SOURCES, AND OTHER RELATED INFORMATION?

Judging the relationship of focal information to other information is an important part of a critical judgment of information quality. Relationships with other information can be simple, such as a second edition; complex, such as multiple edits of an important document; or both. Even though these relationships exist, discovering them from the piece of focal information is often difficult. Attribution, or the extent to which any focal information thing attributes its sources or antecedents, is often mentioned as a criterion by itself for quality information. In the framework presented by this paper, the existence of attribution and the nature of the attributed relationships are potential characteristics of information to include in one's quality assessment. Attribution traditions exist in the print information system, although they may not necessarily provide all the information about sources that one might want. Attribution of electronic information becomes more complex. On the World Wide Web, for example, it is relatively easy for multiple copies of the same information to be available from different sources with or without the clear attribution or permission of the authors. Figuring out the relationships of documents to other similar documents, and the impact on quality, is compounded also by the ease of transparent modification on the Web and the problem of version identification. Assessing correctly the date when information was authored, already mentioned as a major problem, is compounded on the Web, on which the only dates given—copyright and modification dates—can refer to the page format, not the content.

Determining scope, especially of collections of documents, is also another challenge in making quality judgments about the relationship of focal information to other information. This problem exists in print collections (what universe are the items in an edited book or a library selected from?), but is highly visible on the Web. One must ask: How was a list of "important sites" compiled? How comprehensive was the search? What criteria, either explicit or implicit, were used for inclusion or exclusion?

Probably the most difficult relationship to assess is the place of the focal information in its body of knowledge. Is it in the mainstream? Is it on the cutting edge? Is it an accepted outlier, a member of one of several alternative camps, or an outcast outlier? How current is it? The problem of knowing the date when

information was generated has been mentioned; currency, in this context, involves the interpretation of the date of generation in the context of its body of knowledge. We tend to judge currency by what has been written most recently, but currency of information is really a notion of relative position of content, not solely a temporal measure. How current is the focal information in relationship to what is now being thought and known? Is the focal information "classic"? Classic information may not be current and may no longer be accurate, but it has played an essential role in moving the field to its current position. It is difficult for a newcomer to a field to assess a single focal piece of information in relation to other information in its field. A well-written piece of information will provide background that will help with this assessment. Other pieces of information in the retrieved body of evidence also will be helpful in making relational assessments. Expert syntheses of the field, either written in texts, handbooks, current advances, or review articles or delivered in person, constitute another source of information that is helpful in judging the currency and the relative position of information in its field.

**WHAT APPROVAL, REVIEW, OR OTHER FILTERING PROCESSES
HAS THE INFORMATION ENDURED?**

Peer review, as an approval process mechanism for professional publication, is an excellent example of a filtering process that has gained wide acceptance as a legitimate delegation of quality judgments. Although few other approval processes have such widespread acceptance as peer review, much publicly available information goes through approval and filtering processes of some kind. Such processes include in-house review of reports, cleaning of data in statistical compilations, and informal peer review of materials by colleagues. Review processes, including peer review, are subject to obvious difficulties, such as the perspective and knowledge of the reviewer; however, the fact of a review, and what is known about the type of review, can be useful in making a quality judgment.

APPROACHES TO IMPROVING QUALITY INFORMATION

Approaches to improving quality judgments can focus on improving the information itself, improving the channels that organize and deliver information, or improving the individual's ability to judge the quality of information for a specific purpose. These are not mutually exclusive; all, probably, should be pursued.

If quality judgments are to be based on certain characteristics of the information, then one must be able to identify those characteristics. The problem of inadequate metadata (information that describes the information) is not new to electronic information; many printed reports exist without publisher information

or dates of publication. The problem is worse with electronic information, however. There are many Web pages that do not contain the answers to even the most basic authorship questions. Efforts are under way to improve this situation for Web information in general.

A second approach involves development of more credible units and collections of prejudged information. Having access to prejudged information of many different types speeds up the individual's judgment process, especially if details of the prejudging are available for critical review. Efforts like the *Guide to Community Preventive Services*,³ now being prepared, are exemplary, both for the prejudged information they will provide and for the explicit standards and methodologies that also will be available. Prejudged products of other kinds also can be very helpful—for example, the construction of a county public health Web page that connects to information sources that have been selected based on an assessment of the information needs of the local public health workforce. Regardless of the type of prejudgment project, the important common element should be clarity about who is doing the judging, what characteristics are being judged and by what criteria, and, as far as possible, for what decision-making situations the quality judgments are intended to be useful.

Because judgments of information quality depend on specific situations, individuals who use information, whether prejudged or not, need training, support, and assistance in becoming good judges of information quality. Processes, guidelines, and lists of criteria for specific types of quality judgments are needed as aids to individuals making these judgments. Such guides can focus on specific research methodologies and products, for example, evaluation of meta-analyses or practice guidelines. Typical lifelong learning opportunities, such as articles, symposia, and workshops, can strengthen the ability of individuals to make information quality judgments.

CONCLUSION

The conceptual framework for applied information quality views the quality of any given information as a judgment that is (1) made by a specific person or persons, (2) in a specific situational context for use of that information, and (3) based on the characteristics of the information. This approach places the ultimate responsibility on the individual, either to make a specific judgment or to delegate quality judgments to credible sources. The individual must integrate the information based on experience and on an analysis of the situation at hand. The responsibility of the professional and information infrastructures—and of information professionals—is to simplify access to high-quality information (with the indica-

tors used for the quality judgments clearly articulated) and to support individuals in making decisions of information quality.

REFERENCES

1. Lave J, Wenger E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge, Mass: Cambridge University Press; 1991.
2. Woolf SH. An organized analytic framework for practice guideline development: Using analytic logic as a guide for reviewing evidence, developing recommendations, and explaining the rationale. In McCormick KA, Moore SR, Siegel RA, eds. *Clinical Practice Guideline Development, Methodology Perspectives*. Washington, DC: Agency for Health Care Policy and Research, Public Health Service, US Department of Health and Human Services; November 1994:105–113. HCPR publication 95-0009.
3. US Department of Health and Human Services, US Public Health Services, Task Force on Community Preventive Services. *Guide to Community Preventive Services*. Available at: <http://web.health.gov/communityguide>.
4. Bradley JR, Sutton JB. Reframing the paradigm debate. *Library Q*. 1993;63:405–410.
5. Mitretek Systems, Criteria for assessing the quality of health information on the Internet [working draft white paper]. Edited October 14, 1997. Available at: <http://www.mitretek.org/hiti/showcase/documents/criteria.html>.
6. Jadad AR, Gagliardi A. Rating health information on the Internet. *JAMA*. 1998;279:611–614.
7. Sackett DL, Rosenberg WMC, Muir Gray JA, et al. Evidence-based medicine: What it is and what it isn't. *Br Med J*. 1996;312:71–72.
8. Buckland MK. Information as thing. *J Am Soc Inf Sci*. 1991;42:351–360.