THE MULTIPLE DIMENSIONS OF INFORMATION QUALITY

Information quality occurs along ten dimensions, is defined by the information's customer, and is constantly changing over time. IS managers must understand the dimensions and the dynamic nature of information, quality to effectively use information as a product, as a component of their production processes, and as a vehicle for managerial planning and control.

Sometimes it pays to go back to basics. This is certainly true when talking about information. Most people agree that information is critical to how we live and work and that information, to be effective, must have quality. But what is quality information?

At first, the concept seems obvious. Quality information meets certain recognized criteria such as accuracy, timeliness, relevance, and understandability. We know it when we see it. Yet, despite an intuitive grasp of the term, all of us have presented what we thought was quality information to others, only to find that their opinion differed significantly from our own. If the concept is so obvious, then why do so many people disagree on specifics?

The meaning of information quality lies in how the information is perceived and used by its customer. Although absolute attributes are important, it is the perception of those attributes, now and in the future, that defines information quality. Identifying quality information involves two stages:

1. Highlighting which attributes are important.
2. Determining how these attributes affect the customers in question.

This column discusses ten attributes of information quality and how they can be used as benchmarks to improve the effectiveness of information systems and to develop information quality strategies for all organizations, particularly for those in the information business.

TEN DIMENSIONS OF INFORMATION QUALITY

Relevance
The key component for information quality is whether the information addresses its customer's needs. If not,
that customer will find the information inadequate regardless of how well the information rates along the other nine dimensions. This does not mean that irrelevant information to an information customer is of poor quality. It just indicates that the information is a member of a different information class much in the same way that a luxury car and a sports car are both members of different classes of automobiles. In some cases poor quality information may actually be quite good; what is needed is to educate the information's customer so he or she can understand it and use it.

**Accuracy**
Accurate information reflects the underlying reality. That quality information should be accurate seems obvious. In practice, information used for different purposes requires various levels of accuracy, and it is even possible for information to be too accurate in the sense of being too precise.

Information inaccuracy and related problems occur in many information systems. The problem is well known and is addressed by IS professionals from systems design to implementation to maintenance. Less well understood is that information can be too accurate when its degree of precision exceeds its customer's processing capability. This increases the cost of information systems, strains systems credibility, and even, through the confusion caused, results in misuse or abandonment of the information.

**Timeliness**
Timely information is still current. Implicit in this definition is a dynamic process where new information arises to replace the old. Information has a cycle time that depends on how quickly new information can be processed and communicated to its customer.

Information timeliness goes hand in hand with information accuracy. The concept of what is timely is itself constantly changing and being redefined, because of changes in customer perceptions caused by technology and the competitive environment. Today, time-based competition and the concomitant reduction in operations cycle times has fueled a demand for evergreen information.

**Completeness**
Incomplete information can lead customers astray. An example of this is the old story of blind travelers encountering an elephant in the road with each, after examining a small section, coming to a different conclusion regarding the object's identity. However, complete information for one person may be incomplete for another. For example, the marketing vice-president and the director of research and development for a pharmaceutical company may both be interested in the clinical trials tests for a new drug, but each may require different levels of detail.

Just as information whose precision exceeds a customer's processing capability may be too accurate, information may also be too complete. The classic example is the attorney dumping boxes of material on an adversary's desk, knowing that it will be impossible to unearth the few relevant facts buried within. The danger in business lies in information systems that generate so much information that customers cannot process it all in a timely fashion.

**Coherence**
Coherence is how well the information hangs together and is consistent with itself. Information becomes incoherent through irrelevant details, confusing measures, or ambiguous format that confuses information customers and causes them to not receive or even to reject the information's message. Although information can be genuinely incoherent, incoherent information usually indicates an error in accuracy or timeliness.
Format
Information format refers to how the information is presented to the customer. Two components of information format are its underlying form and its context for interpretation, which is sometimes referred to as its frame.

The appropriate format for information depends on the information's customer and the information's use. For example, an accountant who prefers 20 pages of numbers to a graphical summary may insist on using only multicolor pie charts for a presentation to the senior vice-president of sales.

The context with which we view information also is important. For example, when a company benchmarks its performance against an industry or functional world-class leader, it seeks to give that information context. For years financial analysts have viewed information in context—witness the focus on stock price performance over time, a portfolio manager's performance relative to the S&P 500, or corporate performance versus that of the corporation's industry.

Accessibility
Accessible information is information that can be obtained when needed. Accessibility depends on the customer and even on the specific circumstances for that customer. For information quality to occur, timeliness and accessibility should complement each other. Timely information that is inaccessible or accessible information that is obsolete cannot satisfy an information customer's needs.

Applications of information technology to customer services offer excellent examples of how firms can use quality in information accessibility to obtain competitive advantage. One example is found in the use of 800 numbers by computer software and hardware firms, credit card providers, and mutual funds.

Compatibility
To paraphrase a famous line, no information is an island. Information quality lies not only in the quality of the information itself, but also in how it can be combined with other information and delivered to a customer. This often involves systems working together.

The proper information architecture enhances information quality by making the information suitable for enhanced uses. A quality architecture implies a dynamic structure that can grow with changing customer requirements. This is necessary when companies must leverage their information base to develop new products and services as well as optimize their production and management processes.

Security
Historically, information security has been a stepchild of the information technology revolution. Security often was either added on after IS development was completed or ignored altogether. Two aspects of information security are protecting information from people (logical security) and protecting information from natural disasters (disaster recovery planning). Logical security relies on logical barriers such as passwords, data encryption, and transaction authentication, along with human vigilance. Disaster recovery planning involves protecting information and ensuring that appropriate backup and alternate processing procedures are in place.

The topic of information security has become increasingly visible in recent years. Breaches of information security are a potential Achilles' heel for the entire information technology revolution because information that is not secure cannot be trusted and will not be used to its fullest potential.
Validity
Information has validity when it can be verified as being true and satisfying appropriate standards related to other dimensions such as accuracy, timeliness, completeness, and security. The most common form of verification is auditing information, either as an ongoing practice or as part of a special project. Auditing can uncover mistakes and is an accepted measure of information quality. An obvious example is the corporate financial statement, which to be credible must be audited by an independent party. However, just as quality cannot be inspected into manufactured products, quality cannot be audited into information products:

Validity is a resultant rather than a causal dimension of information quality. Although validity may be high, other crucial dimensions may be low, and overall, the information may be of poor quality. Ultimately, optimizing the design and ongoing operation of the human and technological information system is the road to information quality.

THE MEANING OF QUALITY FOR CUSTOMERS
Information's value lies not in itself but in how it affects its customer. This effect may be passive, such as the customer's reaffirming or changing a intellectual position, or it may be active, such the customer making a decision resulting in an action. Bits of disjointed information are like the brush strokes of a painting that, however well formed, achieve their real meaning only when viewed by an observer. What is important is how the information's customer is affected by the information's picture. This frame of reference is significant because in the age of information technology, we tend to think of information as an end, rather than a means. It isn’t.

Because the information customer is central to this process, those involved with the design of information systems and the subsequent provision of information should understand the meaning of information quality for their customers. This understanding is based on several concepts.

Knowing Information Customers and Suppliers
Knowing the customers and their business needs is a precursor to understanding how those customers define information quality. Businesses must also know their customers if they are to take the customer route to improving information quality by improving their customer's information-processing capabilities. Information suppliers are important because the information they supply affects what can be delivered. In the short term, knowing suppliers may pose a constraint, such as being unable to deliver unit product costs because the production shop does not collect data on matching product volumes. In the long term, knowing suppliers dictates how information suppliers can change their information systems to satisfy customer needs.

Understanding the Meaning of Information Quality
Each customer has a different view of the dimensions of information quality. As these views evolve over time, several key questions must be answered over and over again:

• First, are yesterday's perceptions of quality needs still valid? Five years ago, accuracy and completeness may have been the key factors for an inventory management system. Now, timeliness and format may also be critical.

• Second, how do quality needs translate into technology requirements? The constant stream of new products and new technologies requires framing the technology implementation decision to ensure that fundamental enhancements are separated from bells and whistles.

• Third, do internal information collection, dissemination, and verification procedures measure up to quality
requirements? These procedures often were implemented in customer and technological environments that differed from those of today and may now be too little or too much.

**Evaluating Current Progress**
Progress can be measured by monitoring internal processes and customer perceptions. Some dimensions, such as accuracy and timeliness, can be monitored using standard techniques such as control charts. Benchmarking can also be used to augment internal measurements as well as for monitoring qualitative dimensions such as format and architecture. Because customers constantly redefine information quality, it is especially important for companies in the information product business to constantly reevaluate product positions along the relevant quality dimensions.

**Using Technology Rather Than Being Used By It**
In today's environment, information quality as defined by almost every dimension discussed requires information technology. However, technology can be a double-edged sword: use properly and live by it; use improperly and die by it.

Organizations that have not defined their information quality needs and do not understand how a new product affects their fundamental interests can be led astray. Being unaware of information quality needs may lead either to wasting millions on unnecessary technology or to passing up a breakthrough technology and with it, an opportunity to obtain a competitive advantage by closing a quality gap or redefining a production process.

**INFORMATION STRATEGIES FOR IS MANAGERS**
How the dimensions of information quality translate into business strategy depends on how the information is being used. Companies offering information-based products can use the dimensions of information quality to compete just as manufacturers compete along the dimensions of product quality. This may mean creating market niches based on several dimensions where a company sees an opportunity, such as timeliness, format, and completeness; protecting leadership positions along information quality dimensions where the company is already strong; and even deemphasizing quality along dimensions where customers no longer require it.

Creating new niches is an opportunity for many small companies. Established companies can build on existing strengths by strengthening quality dimensions. When information's role is that of a component in the production process, organizations should identify the key dimensions of information quality and continuously improve on them. For example, in the apparel industry, firms are moving to quick response as an answer to reduce inventories and shorten cycle times. Information timeliness is a critical quality component. Many financial services firms are bundling products together. Here, format and compatibility are two key dimensions. Processing business transactions over the Internet will become commonplace for many businesses. Here, information security may distinguish winning systems from losing ones.

Most organizations have significant investments in using information technology for planning and control. Unfortunately, many of these systems were developed years ago and have evolved independent of changing perceptions of information quality. Some were tailored to meet the needs of long-gone executives; others were designed to move information up the organization even though today's need may be for information to be disseminated across the organization; others responded to market conditions that are now history. To ensure that these IS investments are effective, IS managers should answer several questions:
- Are yesterday’s perceptions of our quality needs still valid? If not, we may be producing the wrong information-based product, missing important opportunities, and spending money on unnecessary quality dimensions.

- How do quality needs translate into technology requirements? Technology investments should be linked with what information quality dimensions are important to ensure the most effective use of scarce financial and human resources.

- Is our technology strategy consistent with our quality needs? Our current hardware and network architecture and software strategies may be technologically current but they may not support what our customers demand along information quality dimensions.

- Do internal information collection, dissemination, and verification procedures measure up to quality requirements? If not, management information flows may lead to an incomplete or erroneous picture of the true situation.

**CONCLUSION**

Managing information quality is a continual process. Products and technologies come and go; high-quality information today may be low-quality information tomorrow. To compete requires a continual focus on definition and follow-up of information systems design and operational processes. The multiple dimensions of information quality can be used to add structure to this inherent complexity. By defining, assessing, modifying, and redefining what information quality is and how it can best be managed, IS managers ensure that information remains the vehicle for, rather than the impediment to, achieving business success.

~~~~~~~

By Holmes Miller

HOLMES MILLER is assistant professor of business at Muhlenberg College in Allentown PA. He has 15 years' experience in operation management and information systems at Chase Manhattan Bank and Union Carbide Corporation.

Copyright of Information Systems Management is the property of Taylor & Francis Ltd and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.