A Model for Delivering Quality Information as Product and Service

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Abstract

Both the product and the service characteristics of information must be considered in delivering quality information to information consumers. Using the quality definitions from the Total Quality Management literature, specifically quality as conformance to specifications and quality as meeting or exceeding customer expectations, and the product and service characteristics of information, we develop the Information Quality Product Service Model. We map the information quality dimensions from our previous research into this model. The Information Quality Product Service Model is useful for explaining how organizations can improve the quality of information delivered to information consumers.

1. Introduction

To deliver high quality information, producers of information need to know what information consumers expect. The information quality (IQ) dimensions developed in our previous research (Wang & Strong, 1996) form a foundation for delivering quality information.

In this paper, we elaborate on these dimensions in terms of the general quality literature, which discusses quality as conformance to specification and quality as exceeding customer expectations. We apply the expertise from the general quality literature and current Total Quality Management (TQM) literature to determine how to deliver high quality information to information consumers. Additionally, we view information as both a product, the conventional view, and as a service.

This research contributes to the IQ field in the following areas:

(1) It presents a two-by-two conceptual model for describing information quality. One dimension views quality as conformance to specifications and as exceeding

customer expectations, whereas the other dimension views quality from its product and service aspects. This model is called the IQ Product-Service Model.

(2) It integrates the sixteen IQ dimensions identified in our previous research into the IQ Product-Service Model.

(3) It describes the application of the IQ Product-Service Model for managing and improving information quality in organizations.

2. Product and Service Information Quality

2.1 Definitions of Quality

Quality is generally defined in the literature as ***fitness for use***. Quality is judged by consumers; they determine whether a product or service is fit for use (Deming, 1986). Fitness for use, as the definition of quality, was introduced by Juran in his 1974 book (Juran, Gryna, & Bingham, 1974). He defines fitness for use as the extent to which a product successfully serves the purposes of the consumer.

While fitness for use captures the essence of quality, it is an overly broad definition; thus it is difficult to measure quality using this definition. Similarly, high quality information is defined as information that is fit for use by information consumers (Wang & Strong, 1996). Measurement of information quality requires further definition and elaboration.

Four general views of quality have been presented in the literature, quality as excellence, quality as value, quality as conformance to specifications, and quality as meeting or exceeding customer expectations (Reeves & Bednar, 1994). While the view of quality has moved from excellence to meeting customer expectations, all of these views of quality are still in use today. Defining quality as excellence is problematic because it is subjective and provides no practical guidance for improving quality. Quality as excellence ignores the potentially high costs of achieving excellence. Defining quality as value captures tradeoffs between excellence and costs, but other attributes of importance to customers, such as understandability and relevancy of the

information, may be ignored. Furthermore, quality as value blends excellence and worth resulting in a hybrid concept of "affordable excellence" (Garvin, 1988). Thus, we focus on the latter two views of quality.

In the recent history of quality management, quality has been most commonly associated with manufactured products. High quality meant that the manufactured product had no defects, that is, it conformed to the product specifications. In this manufacturing view, quality is defined as **conformance to specifications**, sometimes called conformance quality. This is a definition favored by producers. Given specifications for the product or service to be delivered, producers measure quality by how well the product or service meets these specifications (Reeves & Bednar, 1994). The specification is established to ensure that products and services are free of deficiencies that would interfere with their use. Thus, fitness for use could be operationalized as meeting a specification, if the specification was adequately developed. The advantage of this definition is that conformance quality usually can be easily defined and measured.

In contrast to conformance quality, quality has been defined, in the literature, as ***meeting or exceeding customer expectations***. Simply conforming to specifications is not enough, the product or service must meet or exceed what the customers expect from it. Since these customer expectations may change over time, a quality product or service may not remain a quality product or service for long. While this definition may capture the essence of fitness for use, whether quality has been achieved can be difficult to measure.

2.2. Is Information a Product or a Service?

Recent quality literature has distinguished between ***product quality*** and ***service quality***, e.g., (Zeithaml, Berry, & Parasuraman, 1990). Product quality includes dimensions related to the features of the information product. Service quality includes dimensions related to the process of delivering the service, in addition to the quality of

the actual service received. Both product and service quality are important aspects of IQ.

Information has been conceptualized as a product. For example, the information production process can be thought of as a manufacturing process (Ballou, et al., 1997). The traditional view of information quality is product-oriented, as noted by Pitt, Watson, and Kavan, (1995).

Information as a product takes an engineering view. It focuses on the activities needed to put and maintain data in databases. Once the information is stored in a database, it is in the form of an end product. Updating of information values is like product enhancement; updating produces a refined product.

In other aspects, however, information has similarity to a service. Failing to consider the aspects of information as a service misses some important aspects of information quality that are important to information consumers (Pitt, Watson, & Kavan, 1995). Furthermore, information consumers do not clearly distinguish between the quality characteristics of information and the quality characteristics of the hardware and software systems that deliver that information (Strong, Lee, & Wang, 1997). The process of converting data to information has the typical characteristics of a service, e.g., it is often a customized, personal interaction between IS staff and users (Pitt, Watson, & Kavan, 1995). Providing the support, tools, and assistance in this is a traditional role of IS departments.

Information as a service focuses on the activities occurring after information is stored as an end product in a database. These activities form the process of obtaining and using information. Information service quality addresses those latent product attributes that become apparent (manifest) during its use, e.g., whether the information is easily accessible and whether it can easily be aggregated and manipulated.

Providing information to consumers is being thought of in the literature as occurring in two stages. The first stage is the information manufacturing process that produces a database, that is, an information product. The second stage is delivering this

product to the consumer in the form of useful information. Companies are realizing the importance of the second stage for delivering high quality information, see for example the case of Information Resources Inc. (Kovac, Lee, & Pipino, 1997).

Products and services cannot be as neatly compartmentalized as the above discussion assumes (Shostack, 1977). Products are typically assumed to be tangibles, while services are intangibles. Products, however, often have intangible aspects. For example, the automobile industry is assumed to be product manufacturing, while the airline industry is a service industry, but both are delivering transportation (Shostack, 1977). The recent literature on measuring service quality includes a dimension for tangibles, since many services have tangible components (Zeithaml, Berry, & Parasuraman, 1990).

3. A Product and Service Model for Information Quality

To further understand IQ and how to deliver it, we have developed a 2x2 model called the IQ Product-Service Model, as shown in Table 1. The two columns, *Conforms to Specifications* and *Meets or Exceeds Customer Expectations*, are the two primary quality distinctions in the general quality literature (Manz & Stevart, 1997). *Conforms to specifications* captures the view and goals of information producers and manufacturers. The *meets or exceeds customer expectations* column captures the view of information consumers that information quality goes beyond the basic accuracy and accessibility dimensions of quality. The information must be useful and add value to the tasks of information consumers. People involved in product and service design and marketing also tend to take this view of quality.

	Conforms to Specifications	Meets or Exceeds Customer Expectations
Product Quality	Sound Information The characteristics of the information supplied meet IQ standards.	Useful Information The information supplied meets information consumer task needs.
Service Quality	Usable Information The process of converting data into information meets standards.	Effective Information The process of converting data into information exceeds information consumer needs.

Table 1: Aspects of the IQ Product-Service Model

The two rows, *Product Quality* and *Service Quality*, capture the tangible aspects of delivering high quality data in a database and the more intangible aspects of delivering high quality information to consumers. The traditional view of information product quality addresses the tangible measures of accuracy, completeness, and freedom from errors, whereas the service aspects of information quality address the intangible measures of ease of operations, security, and value of the information to consumers. As previously discussed, these two rows represent end points of a spectrum with some hybrid characteristics.

Several examples serve to clarify the four quadrants in the model in Table 1. The *product quality/conforms to specifications* quadrant indicates that information stored in a database meets the standards of being accurate, complete, and free-of-error. For example, a database with 99% accuracy and completeness of inventory information would have high quality for this quadrant. The *product quality/meets customer expectations* quadrant adds the requirement that the information product is useful and relevant to the information needs of information consumers. For example, if information consumers need inventory information broken down by warehouse location, then the inventory information product is only of high quality if this breakdown exists.

The *service quality/conforms to specifications* quadrant indicates that there is a process by which information consumers can acquire the product for their use, i.e., convert data in a database into usable information. For example, if information consumers can easily access and perform operations on the inventory information they need using a query language, then the service specifications for the information product are met. The *service quality/meets customer expectations* quadrant adds the requirement that information consumers can easily obtain the appropriate amount of information that will add value to their tasks. For example, information consumers must be able to use the query language provided to get exactly the inventory information they need to make effective decisions.

4. Elaborating the IQ Product-Service Model

4.1 Dimensions of Information Quality

In our previous research, we determined the IQ dimensions that information consumers perceive as important (Wang & Strong, 1996). The sixteen IQ dimensions, grouped into four higher level categories, are shown in Table 2. The sixteen IQ dimensions capture what is important to information consumers in the information they use. A definition of each IQ dimension is in the Appendix.

IQ Category	IQ Dimensions
Intrinsic	Accuracy, Believability, Objectivity, Reputation of the Source
Contextual	Value-added, Relevancy, Timeliness, Completeness, Amount of data
Representational	Interpretability, Ease of Understanding, Representational consistency, Concise representation
Accessibility	Accessibility, Ease of Operations, Security

Table 2: Categories and Dimensions of Information Quality

The sixteen IQ dimensions are grouped into four IQ categories: *Intrinsic, Contextual, Representational,* and *Accessibility*. To understand the four IQ categories, consider an information consumer who needs information from a library. As a first step to having information that is fit for use, the consumer must be able to access the information, whether through an on-line service or by physically going to the library. Second, the consumer must be able to understand the information. At minimum, this means that

the information is represented in a language understandable to the consumer. Third, the information must be relevant to the information consumer's task. The final concern of the information consumer is whether the information is correct. Thus, information is fit for use by information consumers if it is intrinsically correct, relevant to the consumer's task context, represented in a usable manner, and accessible to the consumer.

4.2 Mapping the IQ Dimensions

The four IQ categories represent the key IQ needs of information consumers. This grouping of IQ dimensions, however, does not necessarily provide insight to the information producers that must deliver IQ. We consider another grouping of these dimensions that may be more useful to information producers. Specifically, we group the dimensions according to whether they can be achieved by conformance to specifications or whether they must be achieved by considering the changing expectations of consumers performing organizational tasks. Information producers, especially those working in a TQM environment understand producing to specifications and the broader needs of the market that go beyond what is in the specifications. We also consider whether each IQ dimension is primarily an aspect of product quality or of service quality. Using our 2x2 model of information quality aspects, we placed each dimension into one (or more) quadrants, as shown in Table 3. Distinguishing IQ dimensions in this way helps information producers understand the requirements for delivering high-quality information.

	Conforms to Specifications	Meets or Exceeds Customer Expectations
Product Quality	Sound Information Free-of-Error Believability Completeness Consistent Representation Timeliness	Useful Information Objectivity Reputation Relevancy Interpretability Understandability
Service Quality	Usable Information Timeliness Consistent Representation Concise Representation Accessibility Ease of Operations Security	Effective Information Value-Added Appropriate Amount

Table 3: IQ Product-Service Model

Sound Information is the threshold or basic characteristics needed to consider information to be of high quality. Dimensions in the *Sound Information* category are tangible and usually measurable. The soundness of information is usually independent of task and decision. An information consumer requires information to be free-of-errors and believable. All information required for a task must be provided, that is be complete. Missing or out-of-date information can lead to incorrect inferences and poor decisions. Consumers need to know the convention used in order to correctly interpret information such as a date field. For example, the date 05/03/98 would be interpreted as May 3, 1998 using American conventions or March 3, 1998 using European conventions. Consistent representation ensures that the consumer knows the convention used so that the date is properly interpreted. A minimum level of interpretability and understandability is achieved in data with a consistent representation.

Useful Information is potentially beneficial to the consumers' task. Dimensions in the *Useful Information* category are task dependent. That is, the consumer can understand and interpret the information product and make valid inferences from it. The information is relevant to the consumers' task and can support decision making.

Information consumers gain greater confidence using information that is objective and has a high reputation.

Usable Information is information that consumers can easily acquire and tailor to their needs. These characteristics cannot be evaluated a priori from the characteristics of data in a database per se. Like any service, information delivery is an event that can only be evaluated after the event occurs. Usable information is provided in time to support the task at hand and is current; that is, the information is timely. In order to use the information, consumers must be able to access it and operate on it. These dimensions are dependent on the computer-based systems in place between the consumer and the stored data providing security, access and the ability to operate on information. Consumers can use the information when it has a consistent and concise representation.

Effective Information provides actual benefits to consumers. These benefits are often intangible and difficult to measure, but are key to delivering high quality information. Dimensions in the *Effective Information* category distinguish one service from another and can only be evaluated from a consumer's point of view based on the task or decision at hand. Information provides added value when the effectiveness of the decision made or task performed is improved as a direct result of the information provided. For example, an online broker service provides effective information if investors, in net, make more money using less of their time than they would by contacting their broker. Investment information can be sound, usable, and useful to investors in making investment decisions without necessarily being effective. To be effective, consumers receive the appropriate amount of information; that is, just enough to make a decision, not an excessive amount that can distract.

5. Applying the IQ Product-Service Model

Our preliminary field experience in applying this model indicates that most organizations focus primarily on the ***soundness*** quadrant (information as a product that conforms to specification), see Table 4. This is consistent with the literature and the reality that information quality is largely the responsibility of the information systems

(IS) department. Compared to the other quadrants, the ***soundness*** aspect of IQ is relatively easy and conceptually straightforward to accomplish. The IS department can establish specifications, in consultation with information consumers, on what information will be stored in databases, how that information should be represented, and how accurate, timely, complete it should be. The IS department can then monitor the processes employed to collect, store, and maintain this database information to ensure conformance to these information product specifications.

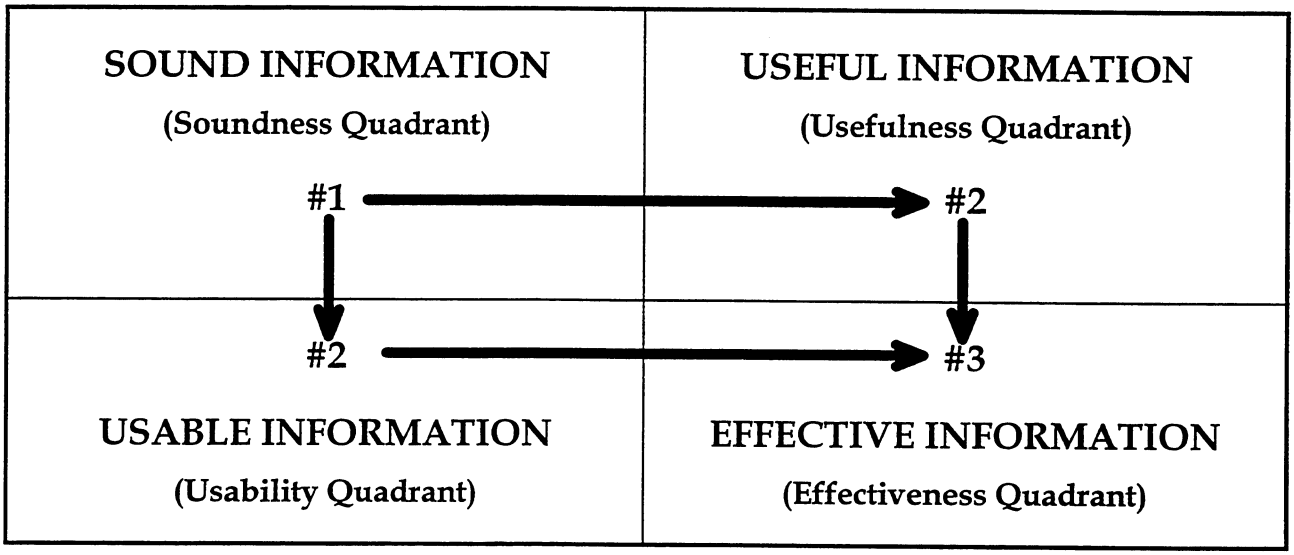

Table 4: Applying the IQ Product-Service Model

In practice, it is reasonable to begin with the ***soundness*** quadrant when initiating an information quality management effort. Commercial methods, tools, and techniques to ensure that information conforms to specification are becoming readily available. For example, most relational database systems implement basic integrity rules that cover many aspects of information *soundness*. Add-on tools, such as the Integrity Analyzer, provide additional support for analyzing and improving the quality of information in relational databases (Wang, et al., 1997b).

As the ***soundness*** aspect of IQ management becomes well-defined and routinely achieved, it is important to move beyond ***soundness*** to ***usefulness*** and ***usability***. In our

field experience, we see organizations moving in parallel to both the *usefulness* and *usability* quadrants.

In moving to the ***usability*** quadrant, organizations are moving beyond the product view of information quality management to the service view. To do this, the IS department must take a service orientation, focusing on the processes of delivering high quality information services to consumers, rather than only delivering a high-quality information product as a database. IS departments are achieving successes in providing easy-to-use information access tools to information consumers. IS needs to select and properly support database management systems, end-user interfaces and relevant tools that empower consumers.

In parallel, organizations are moving into the ***usefulness*** quadrant. In general, moving toward the second column in the model, *meeting or exceeding customer expectations*, is harder to achieve because the target, customer expectations, is both more difficult to define and less stable, than product and service quality specifications in the *soundness* and *usability* quadrants. Customer expectations change over time, as tasks change and general expectations of computing capabilities and services rise.

Achieving success in the *usefulness* quadrant, as well as many aspects of the *usability* quadrant, requires a new approach. Delivering high quality information can no longer be the sole responsibility of the IS department; it requires much coordination between IS departments and information consumers. A partnership between information consumers and providers is established. Thus, we have proposed the concept of an Information Product Manager (IPM) (Wang, et al., 1997a). An IPM serves a role similar to the product or brand manager role in consumer products companies. The IPM is responsible for coordinating the information quality management activities of the IS department and other information producers to meet the needs of information consumers. The IPM also monitors the changing needs of information consumers so that quality improvement efforts serve to meet the rising expectations of information consumers. Organizations such as IRI (Kovac, Lee, & Pipino, 1997) are establishing

some form of IPM position or organization to ensure that their information products and services meet customer expectations.

Ultimately, an information quality management effort must provide actual benefits to consumers. The ***effectiveness*** quadrant can only be achieved after *sound, useful* and *usable* information is delivered. The *effectiveness* quadrant needs to be reached and monitored to ensure that the organization's information is continuously delivered to the consumer which is consistent with the continual improvement component of TQM. This is the challenging and uncharted water of delivering high quality information products and services. The *effectiveness* quadrant is the ultimate goal the IPM is seeking in coordinating all information producers, maintainers, and consumers. More research and practical experience in organizations is needed so that organizations can routinely deliver effective information products and services. Few, if any, organizations can consistently deliver in the *effectiveness* quadrant.

6. Conclusion

We have developed the IQ Product-Service Model, a two-by-two model of information quality. The four quadrants in this model, *sound, usable, useful,* and *effective* information, provide a path by which organizations can move from delivering sound information products into databases to delivering usable, useful, and effective information products and services to information consumers performing tasks and making decisions with this information. More coordination among information producers, maintainers, and consumers is necessary for delivering quality information as product and service. An Information Product Manager can help establish and maintain the necessary coordination.

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Appendix: IQ Dimension Definitions

Free-of-Error: the extent to which information is correct and reliable.

Objectivity: the extent to which information is unbiased, unprejudiced, and impartial.

Reputation: the extent to which information is highly regarded in terms of its source or content.

Believability: the extent to which information is regarded as true and credible.

Relevancy: the extent to which information is applicable and helpful for the task at hand.

Value-Added: the extent to which information is beneficial and provides advantages from its use.

Completeness: the extent to which information is not missing and is of sufficient breadth and depth for the task at hand.

Timeliness: the extent to which the information is sufficiently up-to-date for the task at hand.

Appropriate Amount of Information: the extent to which the volume of information is appropriate for the task at hand.

Interpretability: the extent to which information is in appropriate languages, symbols, and units, and the definitions are clear.

Understandability: the extent to which information is easily comprehended.

Consistent Representation: the extent to which information is presented in the same format.

Concise Representation: the extent to which information is compactly represented.

Ease of Manipulation: the extent to which information is easy to manipulate and apply to different tasks.

Accessibility: the extent to which information is available, or easily and quickly retrievable.

Security: the extent to which access to information is restricted appropriately to maintain its security.