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Quality of IS in Services: Theory of Constructs for Service, Information, and System

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ABSTRACT
In this paper, we investigate the theoretical inter-relationships among three important information systems (IS) quality constructs: information quality, system quality, and service quality. DeLone and McLean formulated information quality and system quality in their 1992 IS Success Model. Following suggestions from later IS service quality studies DeLone and McLean (2003) added service quality to form a triumvirate. Unfortunately, this addition has unintentionally revealed the overall lack of integrated and consistent theorization of the relationships between different IS quality constructs in IS studies to date. To address part of the research gap, we apply a marketing exchange perspective to examine how information quality, system quality, and service quality can be inter-related with each other under different service contexts involving IS. Finally, an integrated IS quality model is proposed for empirical testing. We hope this study can contribute toward coherent theory development of integrating IS quality elements.

Keywords

INTRODUCTION

The quality of information systems, including service, information, and system quality, have been perennially important topics for both IS researchers and practitioners. Early studies in IS had focused on quality evaluation of information technology artifact and its information output (e.g., Feltham 1968; Zmud 1978). DeLone and McLean (1992) developed their IS Success Model (ISM) as a taxonomy of existing IS success measures. This framework is grounded in information communication theory (Mason 1978; Shannon et al. 1949) with information quality and system quality formulated as two quintessential elements.

IS service quality has caught attention of later IS studies (e.g., Kettinger et al. 1994; Pitt et al. 1995). Measures of IS service quality are dominated by SERVQUAL measures (Parasuraman et al. 1988). In their recent update, DeLone and McLean (2003) added service quality to their original 1992 ISM to form a triumvirate together with information quality and system quality. However, such an addition seems not clearly justified with their original information communication theory. In addition, this further uncovered substantial gap in IS quality studies to date, that is, many studies have either ignored service quality or missed information technology (IT) artifacts (Orlikowski et al. 2001) when IS quality is evaluated.

Today, as many businesses go online, IT has served as an important platform for service exchanges between companies and their customers. This kind of IT-enabled service not only changes the landscape of traditional service practices but also challenges our former conceptualization of service and service quality. Even the developers of SERVQUAL have realized that IT has “the potential to alter almost every aspect of business operations” (p. 287) and the original SERVQUAL dimensions should be expanded to consider the quality aspects of IT (Zeithaml et al. 2002). Therefore, we ask: What can be done to create a stronger and coherent theory base for understanding the inter-relationships among IS quality dimensions on service, information, and system?

To address the research question above, the current study starts with a review of existing conceptualization and measurement of quality in general and IS quality in specific. Then, we discuss the development of theoretical relationships of IS quality constructs in two different service contexts. This also involves reconceptualizing IS service and service quality as well as rethinking part of the DeLone and McLean ISM (1992; DeLone et al. 2003). We also provide propositions based on our theoretical discussion. In the final conclusion, we discuss a future agenda for the empirical validation of our theoretical model.
LITERATURE REVIEW

Quality Conceptualization and Measurement

In IS, the concept of “quality” is not well defined (Nelson et al. 2005). In the broader business literature, quality has been conceptualized from different perspectives. Garvin (1984) classified five different approaches used by the academics to define quality: 1. transcendent approach from philosophical perspective, 2. product-based approach from economics perspective, 3. user-based approach from consumer preference perspective, 4. manufacturing-based approach from supply side engineering and production perspective, 5. value-based approach from costs and prices perspective.

Transcendent approach considers quality as a metaphysical concept, which is hard to define and can only be understood through one’s experience (Pirsig 1974). Due to its lack of practicality, it is rarely used by practitioners. Product-based approach views quality as some variable that can be reflected by quantifiable characteristics of a product such as durability (e.g., Leffler 1982). User-based approach considers quality as a consumer-based judgment (Oliver 1997). This approach is commonly used for measuring customer perceived quality in the marketing literature (e.g., Oliver 1997; Rust et al. 2002b). Manufacturing-based approach views quality as an engineering concept that is related to how well and consistently a manufactured product meets its specifications or industrial standards (e.g., Crosby 1979; Deming 1982). One exemplar of conformance measures would be “the proportion of non-defective (conforming units of output produced by the manufacturing/quality control/inspection process)” (Fine 1986, p.1034). According to Garvin (1984), value based approach sees price/cost as an inseparable part in determining the quality of a product. He argued that this approach is hard to apply in practice as it is not well-defined. In another study, Reeves and Bednar (1994) classified the roots of existing quality definitions into four different categories: (1) quality as excellence, (2) quality as value, (3) quality as conformance to specification, and (4) quality as meeting and/or exceeding customer’s expectations. This study shares most classification categories with Garvin’s (1984).

In IS quality research two perspectives are commonly adopted. One is from manufacturing/operation side and the other is from customer/user side (Rust et al. 2002b). From manufacturing side, some IS studies focused on the quality related to system design and implementation (e.g., Boehm et al. 1996; Goel 1985). Other studies have focused on the quality measures from a user or customer perspective (e.g., Baroudi et al. 1988; Wixom et al. 2001). Although manufacturing oriented quality measurement plays an important role in evaluating information system design and development, this study takes a user centered view with a focus on post-production IS quality evaluation.

IS Information quality

DeLone and McLean defined information quality as effectiveness of IS semantic level outputs, which are “primarily in the form of reports” (1992, p.64). Although this conceptualization is somewhere shared across different IS studies, the operation of the construct has been quite different. In early IS studies information quality measures had been used as proxies of other constructs (as shown in the Table 1).

<table>
<thead>
<tr>
<th>Information Quality Measures</th>
<th>Constructs</th>
<th>Studies</th>
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<tr>
<td></td>
<td>Information technique</td>
<td>Swanson (1987)</td>
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<td>Information completeness</td>
<td>Value of information</td>
<td>Gallagher (1974)</td>
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<td></td>
<td>IS efficiencies</td>
<td>Hamilton and Chervany (1981)</td>
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<tr>
<td></td>
<td>Information product</td>
<td>Ives et al (1983)</td>
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Table 1. Examples of Information Quality Measures Used as Proxies of Other Constructs in Early Studies

In recognizing the lack of consensus and parsimonious information quality measurement, Nelson et al (2005) have developed a core set of information quality measures: accuracy, completeness, currency, and format.

In considering how information quality construct should be represented by measures, different measurement models have been chosen. Often, information quality is modeled as a reflective construct in IS studies (e.g., Bailey et al. 1983; Kettringer et al. 1994). Others have used a formative approach to represent information quality with measures such as quantity, format, timeliness, reliability, etc (e.g., Gallagher 1974; Nelson et al. 2005). According to Petter et al (2007), measurement model misspecification can lead to both Type I error and Type II error. In this study we believe a formative or multidimensional measurement model is needed to capture the increasing richness of the content domain of information quality.
IS System quality

Compared with IS information quality, IS system quality has received less attention in IS management literature (Nelson et al. 2005). The measurement of IS system quality involves the performance related measures of hardware, software, and resource utilization (Kriebel et al. 1980). In early IS studies, there was a lack of agreement on what is meant by “system.” Some studies viewed ‘system’ as a generic concept that represents everything related to IS (e.g., Ives et al. 1984; Srinivasan 1985). With this view, information and service components can be considered as part of the system. Often, IS system quality measures have been mixed with measures of different constructs (as shown in the Table 2). Later IS studies tend to link “system” directly to IT artifacts (e.g., DeLone et al. 1992; Wixom et al. 2001). DeLone and McLean (1992) defined system quality as technical level effectiveness of an IS. Alternatively, this construct can be thought of as tapping into the system process in producing and delivering information for users.

<table>
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<tr>
<th>System Quality Measures</th>
<th>Constructs</th>
<th>Studies</th>
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<tr>
<td>Response time</td>
<td>Value of IS</td>
<td>Ahituv (1980)</td>
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<td></td>
<td>Quality of output</td>
<td>Kriebel and Raviv (1980)</td>
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<td>System flexibility</td>
<td>EDP staff and service</td>
<td>Ives et al (1983)</td>
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<td></td>
<td>User satisfaction</td>
<td>Baily and Pearson (1983)</td>
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<tr>
<td>System reliability</td>
<td>User satisfaction</td>
<td>Baily and Pearson (1983)</td>
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<td></td>
<td>Information product</td>
<td>Ives et al (1983)</td>
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Table 2. Examples of System Quality Measures Used as Measures of Other Constructs

Based on over 20 studies of IS system quality studies, Nelson et al (2005) had identified a set of key measures: accessibility, reliability, flexibility, response time, and integration.

Just like the operation of IS information quality construct, system quality construct has been operationalized with either formative measurement model (e.g., McKinney et al. 2002; Wixom et al. 2005) or reflective model (e.g., Chen et al. 2002; Rai et al. 2002) in existing IS studies. In this study we believe a formative or multidimensional measurement model provides more faithful representation of system quality construct given the increasing complexity of IT artifacts today.

IS Service quality

Research on IS service quality has been relatively recent. The context of service is dominated by human delivered support service (e.g., Kettinger et al. 1994; Pitt et al. 1995). The primary instrument used is SERVQUAL. There are a total of 22 items in SERVQUAL representing five different dimensions of service quality including tangible, reliability, responsiveness, assurance, and empathy (Parasuraman et al. 1988).

The validation result of SERVQUAL dimensions has been mixed in IS studies. Some SERVQUAL dimensions (e.g., tangible) do not hold up across different tests (e.g., Kettinger et al. 1994; Van Dyke et al. 1997). Still, there has been a debate on whether SERVQUAL is appropriate for measuring service quality (e.g., Kettinger et al. 1997; Van Dyke et al. 1997). Despite of this debate, some dimensions of SERVQUAL have been proved empirically useful in measuring IS service quality and determining user’s satisfaction (e.g., Kettinger et al 1994; Pitt et al. 1995, Jiang et al 2002). Therefore, in this study, we consider a formative or multidimensional measurement model provides appropriate representation of service quality construct.

Although DeLone and McLean added service quality in their updated IS Success Model (relevant portion the model is shown in Figure 1). Not many extant IS studies have examined service quality in the presence of the original separate IS quality components of information quality and system quality, much more work is needed to better theorize the relationships of information quality, system quality, and service quality to ISM outcomes. Empirical work is also needed to validate the unidimensionality and content, construct, and nomological validity of these three IS quality constructs.
The rise of IT automated service has challenged traditional human delivered service view. One prominent example is Internet technologies that enable virtual businesses such as Amazon, Ebay, and Google. In these cases, “the explosively [sic] growing use of self-service technologies (SSTs)” (Rust et al. 2002a, p. 13-14) has dramatically changed service models. Some of these business have built their service strategies “entirely around Internet access and delivery” (Lovelock et al. 2004, p. 8). Important to note is that the main communications between these service businesses and their customers are powered by responsive systems that require little human involvement. In such cases, capabilities of IT directly become an inseparable part of the service capability perceived by customers. Recognizing the limitation of existing SERVQUAL dimension in capturing the quality of those IT innovated services, even the original developers of SERVQUAL has called for new extended work to investigate what consists of and how to measure IT-enabled service quality (e.g., Zeithaml et al. 2002).

THEORETICAL DEVELOPMENT

With all these, we believe that existing view of IS service quality as an independent component separated from IS information and system quality components is insufficient to capture the quality dynamics in IT-enabled service. What is needed is a stronger conceptual foundation for relationships among these three IS quality components. Given the exchange nature of service (e.g., Bagozzi 1975; Gutek 1995), we believe that marketing exchange theory can guide our initial effort toward theoretical integration of IS quality components.

Reconceptualizing IS Service

To do this, we first need to clearly state what we mean by service. We use service to refer to a series of interactions that occur between customers and service providers in satisfying customer needs. The term has not been standardized in prior service studies (Gutek 1995; Solomon et al. 1985), and this may be part of the reason that the domain has not built a stronger cumulative tradition. Here, interaction is any instance in which two active parties, having the ability to exert influence upon each other, engage in an exchange of direct and indirect values (e.g., Cunningham 1980). Usually, an interaction focuses on the exchange of core benefits (i.e., goods and services for money), information exchange, social exchange, and/or any combination of the three (e.g., Kalafatis 2002).

Traditionally, service exchange has been restricted to human actors, and systems have not been considered to be legitimate service providers in their own right. In short, service systems have been relegated to the role of task-assisting tools. With new information technologies such as e-Learning and training systems, knowledge bases, FAQs and the Internet, VoIP, voice-reading response systems, and the like providing immediate, direct services to customers, the conceptual separation of systems from service needs to change. These technologies not only assist human agents in serving customers, but they can sometimes replace them entirely (Gutek 1995). For customers, expectations regarding service are also shaped by these new technologies (Rust et al. 2002a). Now, with the growth of systems in providing service, we can identify three relevant service exchanges: (1) exchanges between a system and an IS user, (2) exchanges between an IS user and a human IS service agent, and (3) exchanges between IS user and human IS service agent through a system.

Definitions of IS Quality Constructs

With this new view of service and the roles played by IS information and system components, we need consider what consists of quality in those components. In IS literature, quality itself is relatively “ill-defined” (Nelson et al. 2005, p. 201). As we discussed in previous sections, there exist different definitions of quality. We take a customer/user-based view of IS quality constructs. This view also reflects the trend of today’s economy in a shift from a manufacturing oriented to service oriented economy. With this view, the quality of IS components is considered as the capability of those components that benefit IS users in either tangible (e.g., economic values) or intangible ways (e.g., convenience, perceived usefulness, user
satisfaction). This is also consistent with our theory base: exchange theory (e.g., Bagozzi 1975), which states that the exchange taking place includes direct and/or indirect value, through a direct or indirect exchange. By this view, the concept of quality is bounded within exchange context, where value is considered as part quality equation that motivates the repeated exchanges between two parties.

Considering the above view of IS service and our proffered definition of quality, we can now provide definitions of service and the three IS quality components: information quality, system quality and service quality.

- System quality: The capability of information output to benefit users
- Information quality: The capability of an IT artifact to process and deliver information for the benefit of users
- Service: A series of interactions/exchanges between users and providers (human agents or IT artifacts) where the users benefit in both tangible and intangible ways
- Service quality: The capability of a service to benefit users

Next, with a primary focus on intra-organizational IS services and external organizational online IS service, we develop two different service scenarios based on this exchange perspective (Figures 2 and 3). By analyzing these scenarios and their implications, we attempt to elicit the theoretical relationships that exist among IS service quality, information quality, and system quality as defined above.

IS Service Scenario I – Human IS Service for End-User

In the IS human delivered service scenario as depicted in Figure 2, IS support department provides an informational service to satisfy an IS user’s need such as the need to work with and understand an IT artifact (e.g., Bailey et al. 1983; Baroudi et al. 1988). In this case, the human agent is in the IS support department, an organizational subunit that provides direct end-user support services such as training, documentation, and maintenance for satisfying users IS needs (Kettinger et al. 1994). Earlier IS studies (e.g., Schewe 1976; Zmud 1978) of IS information quality and system quality tend to focus on service exchanges between IT artifacts and IS users (the left side of Figure 2). Later studies of IS service quality (e.g., Kettinger et al. 1994; Pitt et al. 1995), however, tend to focus on the other side (the right side) of the exchange, that is, the service exchange between human agents in the IS department and the IS user. Quality constructs have been developed for each side independently, neither taking into consideration the other form of exchange.

From an exchange perspective (Bagozzi 1975), these two sides should not be thought of as entirely independent. The sequence of service activities, as shown in Figure 2, creates IS service through the exchanges carried out by the human agents servicing the customers as well as by the information and system quality of the applications. That is, part of the service support received by an IS user is not through a direct exchange with the IS department but through an indirect exchange embedded in the systems themselves. In this case, we can argue that higher service quality should be reflected in higher system and information quality because the primary service goal of the IS department is to assist end-users in “converting data into information” (Pitt et al. 1995, p. 173). Certainly, one can argue that a very real portion of system and information quality is perceived by users indirectly through the human agency of IS department service. That is, service quality is inextricably tied to information quality and system quality. Yet, logically and contrariwise, both information quality and system quality are quality components that have separate definitions. They capture either the information output characteristics or the system capability of the IT artifact itself (DeLone et al. 1992). Therefore, in this traditional scenario, service quality cannot partake of information quality or system quality measures.
**IS Service Scenario II – Service Provided By IS**

In the not-too-distant future, the overwhelming proportion of service delivery will be carried out through systems rather than human agents. The likely hegemony of this scenario (Figure 3) helps to resolve the apparent dilemma in how we conceptualize and model IS service. Here the provider renders service to its customers primarily through the IS itself. Direct face-to-face interaction between a customer and a human service agent is minimized. Even today many self service technologies that do not call for the direct involvement of human service agents are being used by service organizations (Meuter et al. 2000). Other examples of such services include: online travel services, UPS package tracking services, and online banking services. In those cases, an IS serves as the central medium of exchange between a service provider and its customers. The quality of this exchange medium influences customer satisfaction with the overall service exchange proffered by the service provider (Bagozzi 1975). Therefore, quality resides in the IS itself. It embodies information quality and system quality and these become indispensable components considered by customers when they form perceptions of the overall service quality provided by the service organization. This view is especially relevant to DeLone and McLean’s 2003 model, which, purportedly, was designed to accommodate the ISM to the world of e-Commerce.

**Figure 3. Service Provided Through an IS**

**AN ALTERNATIVE IS QUALITY MODEL AND PROPOSITIONS**

The scenario analysis elaborated here is based on a marketing service exchange perspective. In applying it to DeLone and McLean’s ISM, we propose alternative nomological linkages among three IS quality components, system quality, information quality, and service quality, as well as new paths depicting their impact on the downstream constructs of intention to use, use, and user satisfaction. Clearly, the bulk of this model depends directly on DeLone and McLean’s updated IS Success Model (2003), a model that has yet to be subjected to rigorous empirical testing. Thus, while DeLone and McLean (2003) propose that service quality will impact variables downstream including intention to use, use and user satisfaction, very few studies have tested these relationships (Petter et al. 2006).

**Figure 4. Alternative IS Quality Model**

Based on this alternative IS quality model (Figure 4) and theoretical concepts, we state the following propositions for future empirical testing:

P1: *Information quality has a positive impact on service quality.*
P2: System quality has a positive impact on service quality
P3: Service quality has a positive impact on intention to use /use and user satisfaction.
P4: Intention to use/ use has a reciprocal relationship with user satisfaction.
P5: Information quality has a positive impact on intention to use /use and user satisfaction
P6: System quality has a positive impact on intention to use /use and user satisfaction

CONCLUSION

Through our theoretical discussions of how service, information, and system quality components are related to each other and to ISM outcomes, this research hopefully contributes to a deeper theoretical understanding of IS service quality, system quality, and information quality. In particular, this research attempts to build a long needed theoretical base for IS quality studies. Future research agenda involves empirical validation of this theoretical model of IS quality constructs. The empirical study can be conducted in two phases: (1) instrument development and validation and (2) theory-testing. During the first phase, an appropriately validated instrument from existing measures of IS quality components needs to be developed. In particular, qualitative methods such as expert panel with Q-Sorting methodology can be applied to identify appropriate content domain and test the content validity of IS quality constructs. Then pilot tests can be conducted to test measurement reliability and validities. During the second phase, pilot tests can be conducted to examine construct and nomological validities of these IS quality constructs. Then, full scale tests can be conducted to examine how well IS quality constructs fit in DeLone and McLean’s IS Success Model (2003). The implications of the research should help IS managers see better how various IS qualities can impact customers’ satisfaction and their intentions to use an IS. With this insight, IS managers can develop more effective IS quality management strategy and achieve overall IS success.

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