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Information Quality and System Quality in Online Communities: an Empirical Investigation

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ABSTRACT

As the number of online communities (OCs) continues to increase, it is critical for an OC to satisfy users' needs in order to encourage and retain their voluntary participation and contribution over time. Consistent with the IS Success model, we argue that information quality and system quality are two important antecedents of OC user satisfaction. However, little IS research has systematically examined quality issues and their impacts in the OC context. To bridge the gap, we empirically investigate the impacts of information quality and system quality on user satisfaction in one of the largest travel OCs. Based on the IS quality literature, we develop a measurement model by incorporating different dimensions of information quality and system quality. Given the uniqueness of OCs, this study enriches our understanding of why and how information and system quality matter in an OC. It also provides insights for OC design and management.

Keywords

Online communities, information quality, system quality, user satisfaction.

INTRODUCTION

Due to the advanced Web2.0 technologies, a large number of online communities (OCs) are emerging. MSN has more than 300,000 communities; Google Groups host more than 54,000 forums (Ma and Agarwal, 2007). Consequently, the diversity and intensity of OC competition are rising (Gu, Konana and Rajagopalan, 2007). For an OC to succeed and survive in such a hypercompetitive environment, it has to satisfy users' needs in order to encourage and retain their voluntary participation and contribution (Chen, 2007).

According to the IS Success model, three quality issues are critical in ensuring user satisfaction with an information system (IS) usage: information quality, system quality and service quality (DeLone and McLean, 1992, 2003). However, very few studies have systematically addressed quality issues in an OC setting. It is an important research area, especially given the unique characteristics of OCs compared to a traditional IS, such as user-generated contents, and users' voluntary contribution and interaction. In this study, we investigate information and system quality, and their impacts on OC user satisfaction. We do not focus on service quality because service-related activities (e.g., user training, e-commerce after-sale service) in an OC are rare and much fewer than in a traditional organizational or an e-commerce IS.

In order to confirm that information and system quality matter in terms of user satisfaction with an OC, we need to understand how users evaluate information and system quality in OCs from a multidimensional viewpoint. Specifically, our study intends to answer the following two research questions:

1. How information quality and system quality affect user satisfaction with an OC?
2. What are the key dimensions of information and system quality that are applicable in an OC?

The research gaps we attempt to bridge are twofold. First, although IS quality is a mature research area in the organizational and E-commerce contexts, IS quality research in OCs is sparse and limited. This study is one of the first IS studies that integrate and examine IS quality dimensions in OCs. In addition, we find that most IS research views an OC from a quantitative perspective (e.g., membership size, information volume). Less attention has been paid on the quality aspect. Gu *et al.* (2007) emphasize that future work on quality in OCs could be fruitful. Second, consistent with prior research, we develop and empirically validate a multi-dimensional measurement model for information and system quality in OCs. In particular, we propose a new dimension of information quality (*richness*) and develop new measurement items for a system quality dimension (*interactivity*) to fit the OC context.

Our research focus is the information-intensive OC, defined as "*an IT-supported virtual space for a group of people to access information, encourage topic-specific discussion and disseminate knowledge*" (Butler, 2001; Finholt and Sproull, 1990). In this type of OCs, quality is less understood and worth further investigation (Gu *et al.*, 2007; Jones, Ravid and Rafaeli, 2004)

QUALITY ISSUES IN ONLINE COMMUNITIES

IS researchers have conducted a number of behavioral studies in OCs focusing on user participation behaviors in terms of membership size and information volume. According to this research stream, the value of an OC does not depend purely on the number of users and the amount of information in an OC. Butler (2001) argues that an increase in membership size will affect member retention negatively due to useless information and

undesirable communication activities among users. Gu *et al.* (2007) confirm the trade-off between posting volume and quality in OCs. The value of a discussion board increases with the number of high-quality postings instead of the total number of postings.

Given the influential role of quality in an OC, researchers have revealed why quality is important in OCs. As Butler (1999, 2001) comments, a sustainable OC requires that resources can be transformed into benefits. High information and system quality help users obtain individual benefits in an OC. With high-quality information, users will be connected with those offering superior information resources and get useful information (Constant, Sproull and Kiesler, 1996). With high-quality systems, users will be able to search for information effectively, participate in topic discussion and have social interaction with each other. On the other hand, low-quality OCs place a burden on users to process information, leading to wasted time and efforts. As a result, users may change participation behaviors (e.g., shorter messages or fewer replies) or even end participation (Jones *et al.*, 2004).

The majority of existing IS research investigate OC from a quantitative perspective (e.g., Butler, 2001; Jones *et al.*, 2004). While a few studies have highlighted quality in OCs (Cummings, Butler and Kraut, 2002; Gu *et al.*, 2007), they treat quality as an abstract and aggregated concept. To extend prior research, we believe that it is necessary to explore OC quality issues from a multi-dimensional perspective which will lead to an enriched understanding of these quality concerns in OCs.

RESEARCH FRAMEWORK

In the IS literature, quality has been well understood and examined from three dimensions: information quality, system quality and service quality (DeLone and McLean, 1992, 2003). In this study, we focus on information quality and system quality, but not service quality. Service quality captures the support delivered by the service provider (e.g., IS department, online shopping website). Typical services provided by OCs, such as information search and sharing, have been encompassed in either information quality or system quality.

Information Quality

Information quality focuses on the quality of IS output (Nelson *et al.*, 2005). It is a mature research area in the IS field. Wang and Strong (1996) categorize data quality into four aspects: intrinsic, contextual, representational, accessibility. Strong *et al.* (1997) suggest that information quality should be evaluated by the entire range of concerns, rather than a single perspective to address the needs of information users. Accordingly, it is commonly agreed that information quality is a multi-dimensional concept measured by dimensions such as accuracy, objectivity, usefulness, timeliness, etc. (Kahn, Strong and Wang, 2002; Nelson, Todd and Barbara, 2005). Building on prior research, we propose six dimensions of information quality in the OC context (Table 1).

Dimension	Definition	Reference
Reliability	The extent to which information is regarded as true, believable and credible	McKinney *et al.*, 2002 Wang and Strong, 1996 Wand and Wang, 1996
Objectivity	The extent to which information is unbiased, unprejudiced, and impartial	Kahn *et al.*, 2002 Lee, Strong and Wang, 2002
Usefulness	The extent to which information is beneficial and provides advantages from its use	Kahn *et al.*, 2002 McKinney *et al.*, 2002 Yang *et al.*, 2005
Timeliness	The extent to which information is sufficiently up-to-date for the task at hand	Lee *et al.*, 2002 Lee, 2003-4 Liu and Arnett, 2000
Richness	The extent to which information is enough for fulfilling a specific need	Newly-developed dimension
Format	The extent to which information is presented in a way that is easy to read	Kahn *et al.*, 2002 Lee *et al.*, 2002 Wand and Wang, 1996

Table 1. Dimensions of Information Quality in OCs

System Quality

System quality is another dimension that has been explored in organizational and individual contexts. It represents the user perception of interaction with IT features of the system (Nelson *et al.*, 2005). At the organizational level, researchers have investigated the positive impacts of system quality dimensions such as accessibility, compatibility, reliability on IS implementation (Goodhue and Thompson, 1995; Wixom and Watson, 2001). At the individual level, system quality is evaluated by website design, such as navigation, content organization, security, etc. (e.g., Agarwal and Venkatesh, 2002; McKinney, Yooh, and Zahedi, 2002). Based on previous research, we propose the following dimensions of system quality that are critical to OC users (Table 2). In particular, we redefine the *interactivity* dimension to reflect the OC context (Ma and Agarwal, 2007). McKinney *et al.* (2002) have used *interactivity* (e.g., shopping cart features) in evaluating online shopping websites. However, as an OC has unique characteristic, that is user interaction, the *interactivity* dimension is proposed to capture the quality of system features that facilitate direct user interaction.

Dimension	Definition	Reference
Navigation	The degree to which a user can easily go back and forth between pages of the system	McKinney *et al.*, 2002 Yang, Cai, Zhou and Zhou, 2005
Accessibility	The degree to which a system and the information it contains can be accessed with relatively low effort	Lee *et al.*, 2002 McKinney *et al.*, 2002 Nelson *et al.*, 2005
Appearance	The degree to which the system is visually attractive and appropriate	McKinney *et al.*, 2002 von Dran, Zhang and Small, 1999
Security	The extent to which a user's information is protected and access is restricted	Liu and Arnett, 2005 Yang *et al.*, 2005 Zhang *et al.*, 2000
Interactivity	The degree to which the system can facilitate user	Ma and Agarwal, 2007 McKinney *et al.*, 2002

	interaction in an OC	

Table 2. Dimensions of System Quality in OCs

HYPOTHESES DEVELOPMENT

User satisfaction is an attitude that a user has toward the system (Wixom and Todd, 2005). Information and system quality are the primary antecedents of user satisfaction in the IS literature (DeLone and McLean, 1992, 2003). In this study, we examine this relationship in the context of OCs. The research model is presented in Figure 1.

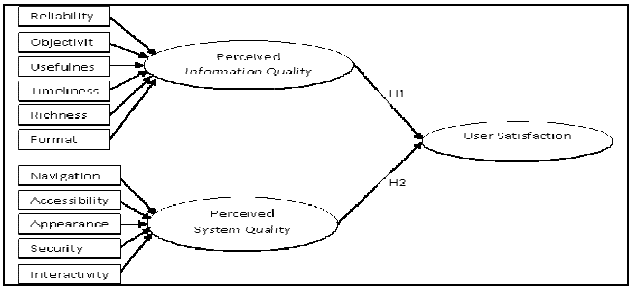

Figure 1. Research Model

In an information-intensive OC, the primary goal for a user is to find useful information. Because information contents are mostly generated by users acting as posters, the goodness of information becomes a concern to other users acting as readers (Ridings, Gefen and Arinze, 2006). It is found that user valuation of an OC mainly depends on the quality of the posts (Gu *et al.*, 2007). In order to satisfy OC users, high-quality information resources are important, because high-quality information is believed to create value to users (Butler, 2001; Sangwan, 2005). In the IS literature, user satisfaction has been well studied and has been found to impact the IS usage intention and behaviors greatly (Wixom and Todd, 2005). Given the severe competition among OCs, if a user is not satisfied with an OC, he can freely decrease his participation or terminate his membership and switch to another OC that can provide better information resources (Gu *et al.*, 2007; Jones *et al.*, 2004). Keeping users satisfied is necessary for the long-term development of an OC, since attracting and retaining users are the two most fundamental issues (Blanchard, 2008). Thus, we hypothesize that:

H1: *Perceived information quality of an OC is positively related to a user's satisfaction with participation experiences in the OC.*

System quality is another important factor to consider in OCs. Since technology needs to serve human needs, an OC is expected to be designed and operated in such a way that helps to satisfy individual needs by providing valuable information and social interaction (Preece and Editor, 2002). Technological tools in navigation and visualization are useful in tracking discussion threads and interactive participation. Rating schemes and filtering techniques influence the quality of user-generated contents (Gu *et al.*, 2007; Preece, 2004). Appropriate system features will also effectively facilitate a certain level of interactivity and knowledge contribution, which reflect the unique characteristics of a successful OC (Jones, 1997; Ma and Agarwal, 2007). When a user believes that he can easily participate in an OC and get individual benefits from participation, he will be satisfied. Thus, we hypothesize that:

H2: *Perceived system quality of an OC is positively related to a user's satisfaction with participation experiences in the OC.*

RESEARCH METHODOLOGY

We employed a web-based survey for data collection. The survey method is appropriate for empirical research on user perception of IS performances (McKinney *et al.*, 2002; Nelson *et al.*, 2005).

Instrument Development

The survey items are measured by a 5-point Likert scale (1-stronly disagree,…,5-strongly agree). We design several reverse-coded items to avoid common method bias (Boyer and Pagell, 2000).

Based on the information quality literature, we develop 6 first-order constructs to form the construct *perceived information quality* (Figure 1). Since each quality dimension represents a portion of the overall quality, it is a second-order formative construct (Law and Wong, 1999; Petter *et al.*, 2007). All these first-order constructs except *richness* are measured by reflective items. *Richness* refers to the degree to which information is enough in terms of both volume and depth and is formative (Lee *et al.*, 2002). Similarly, we draw on the system quality literature to develop *perceived system quality*. We identify 5 first-order constructs of perceived system quality (Figure 1). The items for *interactivity* are newly developed to fit the OC setting that contains more interactive IT features than a regular system or a website (e.g., various methods of interaction; personal profile) (Ma and Agarwal, 2007). As *interactivity* captures different interactive features, it is considered as formative. We adapt validated items for user satisfaction in the IS research (Bhattacherjee, 2001; McKinney *et al.*, 2002).

Survey Administration

We conducted the survey in three stages. First, to ensure face validity, we have asked two OC managers to review the survey for revision. Then, a pilot study was conducted in a sports forum. Finally we launched the formal survey in one of the largest travel communities (Site A). The survey was posted as a sticky link at the top of each forum in Site A. 284 users participated in the survey in two days. Three responses were excluded due to missing data.

DATA ANALYSIS

We used SPSS to screen the dataset (normality, linearity and multicollinearity). Using LISREL, we found that the dataset violated the multivariate normality assumption. SmartPLS 2.0 (Ringle, Wende and Will, 2005), was used to analyze the data, because the data has the normality problem (Chin, 1998; Hsieh, Rai and Kiel., 2008) and the model contains formative constructs (Chin, 1998).

Measurement Model

We assessed reliability and validity for the reflective constructs. Reliability was evaluated by computing AVE, CR (Composite Reliability) and Cronbach's alpha (Hair, Anderson, Tatham and Black, 1998). The general acceptable cut-off values are 0.50, 0.70 and 0.70 respectively (Bagozzi and Yi, 1988; Fornell and Larcker, 1981). Table 3 summarizes the reliability results. Although the Cronbach's alpha of *Timeliness*, *Accessibility* and *Appearance* are slightly lower than 0.70, all the AVEs and CRs are well above the cut-off values, indicating all the items are reliable. Discriminant validity is established because all the squared roots of AVEs are greater than the pairwise correlations between constructs (Fornell and Larcker, 1981). In addition, all the items meet convergent validity, as the factor loading of an item on its designated construct exceeds 0.60 (Chin, Gopal and Salisbury, 1997; Kim and Son 2009). There are no severe cross-loading problems, regarding discriminant validity.

Second-order Construct	First-order Construct	Items	AVE	CR	Cronbach's Alpha
Perceived Information Quality	Reliability	4	0.57	0.84	0.75
	Objectivity	2	0.77	0.87	0.70
	Usefulness	2	0.79	0.88	0.73
	Timeliness	2	0.71	0.83	0.60
	Richness*	3	N.A.	N.A.	N.A.
	Format	4	0.57	0.84	0.74
Perceived System Quality	Navigation	5	0.66	0.91	0.87
	Accessibility	3	0.56	0.79	0.61
	Appearance	3	0.62	0.83	0.69
	Security	3	0.63	0.84	0.71
	Interactivity*	3	N.A.	N.A.	N.A.
User Satisfaction		3	0.90	0.97	0.95

Table 3. Assessment of Internal Consistency and Reliability

Richness and i*nteractivity* are formative. Reliability indices are not reported.

Furthermore, two formative constructs, *richness* and *interactivity,* were validated (Petter, Straub and Rai, 2007). A formative construct is reliable when each item does not highly correlate with other items and there is no multicollinearity problem. Based on the results, the correlation among items is low (0.20~0.34) and multicollinearity VIFs are less than 3.3 (1.1~1.2) (Diamantopoulos and Siguaw, 2006), showing that richness and interactivity are reliable. Construct validity was checked by the item weights, all of which are significant at 1% level, indicating they are also valid.

Structural Model

After validating the measurement model, we examined the structural model (Figure 2). It is found that all the dimensions of information and system quality are significant ($p<0.01$), implying that they are applicable to the OC context. *Reliability* and *format* are the top two dimensions (indicated by the weights) of information quality. *Navigation* is the most important dimension of system quality. Overall, both information and system quality have positive impacts on user satisfaction with Site A, and jointly explain 62.5% of the total variances of user satisfaction.

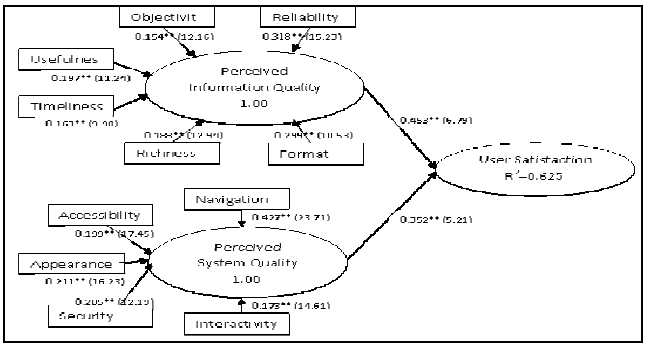

Figure 2. Results of Structural Model

DISCUSSIONS

Summary of Findings

First, we test whether multiple dimensions of information quality are applicable to an OC. Based on our analysis, information *reliability* becomes the primary concern to users. OC users want to get information that they can trust. In a travel OC like Site A, users would like to see comments from real travelers, instead of a person who posts comments simply for commercial purposes. In addition, the *format* of information is also important. With a huge amount of information available online, information should be formatted in a way that is easy to read, so that users can quickly process information for their own purposes (e.g., making traveling plans). It is also interesting to find that *objectivity* is the least important quality dimension. This could be attributed to a unique characteristic of an OC, that is, as users are free to express their own opinions based on their personal experiences, their comments are subject to their own judgments. As a result, OC users care less about information objectivity.

Navigation is rated as the most important system quality dimension. This result is consistent with Jones *et al.*'s (2004) research, which reveals that a huge amount of information may negatively affect humans' information processing capability and incurs processing cost. As a result, it is necessary to design effective navigation features to help users easily identify the information without wasting time and efforts on searching. The study also implies the importance of aesthetic design and privacy protection in an OC. However, the model shows that interactivity is less important. One explanation could be that, in Site A, where the primary goal is to search for useful travel information, social interaction is mostly limited to reading and posting information, compared to social networking OCs (e.g., Facebook and MySpace).

Finally, consistent with prior research (DeLone and McLean, 1992, 2003), we find that information quality and system quality are the two significant antecedents of user satisfaction in an OC. With high-quality information, users are able to use the OC as a valuable information source for making decisions (e.g., traveling). With high-

quality system features, users are able to participate the OC effectively.

Research and Managerial Implications

This study contributes to the IS literature in three ways. Firstly, we bridge the research gap by examining quality issues in OCs and linking them to user satisfaction. Compared with the organizational and e-commerce contexts, an OC has unique characteristics (e.g., user-generated contents, voluntary contribution and social interaction). However, how IS quality research can be applied in the OC context was unknown prior to this study (Gu *et al.*, 2007). Secondly, we develop and empirically test a measurement model for information quality and system quality, based on the multifaceted nature of IS quality literature. Based on data collected from a large popular travel OC, the results provide meaningful insights on the priority of quality concerns from an OC users' perspective. Thirdly, we propose a new dimension, *richness* of information quality, and develop new measurement items for i*nteractivity* of system quality. We hope that these contributions will enrich our understanding of the uniqueness of an OC.

This study also has practical implications for OC managers. Based on the empirical results, OC managers are able to know the major quality concerns. By addressing these concerns, an OC is able to create more individual benefits to users and increase user satisfaction (Butler, 2001). In addition, an OC can address users' quality concerns by improving system design. For example, moderation techniques can filter out useless information and control quality. The navigation tools (e.g., a power search engine; a decision making tool) help users screen information without excessive manual processing. An OC may even use quality to attract new users and "lock-in" current users, given the severe competition among OC (Gu *et al.*, 2007).

Limitations and Future Research

There are several limitations in this study. First, as this study focuses on the development of measures for quality issues in OC, we only proposed two simple relationships between quality and user satisfaction. Future research may explore how quality issues affect other intentional and behavioral constructs in OCs. Second, our focus on information-intensive OCs may limit the generalizability of the results. In particular, data was collected from a single OC. Thus, it is worth examining quality issues in different types of OCs in order to validate our results in a broader context. Third, we propose and validate two formative quality dimensions. More efforts are needed to further validate them theoretically and methodologically.

CONCLUSION

The purpose of this study is to address the important roles of quality issues in OCs, which is a less-understood research topic in the IS field. To this end, we empirically investigate the relationship between information/system quality and user satisfaction in an information-intensive OC. We develop measurement items for quality dimensions, based on the IS quality literature. This study sheds light on OC design and management, and contributes to the better understanding of IS quality in the OC context.

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