



Process quality and collaboration quality on B2B e-commerce

Jengchung Victor Chen and Yawen Chen

*Institute of International Management, National Cheng Kung University,
Tainan, Taiwan, Republic of China, and*

Erik Paolo S. Capistrano

*Institute of International Management, National Cheng Kung University,
Tainan, Taiwan, Republic of China and
College of Business Administration, University of the Philippines,
Quezon City, Philippines*

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Abstract

Purpose – The purpose of this study is to propose two additions to the existing IS success model to influence usefulness and satisfaction, and ultimately customer loyalty. This study posits that process quality and collaboration quality will significantly influence perceptions on satisfaction, since both considerations are expected to improve interactions between the organization and its customers.

Design/methodology/approach – The developed research model was tested in the context of B2B e-commerce users, employing structural equation modelling-partial least square to analyze and test the research hypotheses.

Findings – Results show that adding process and collaboration quality to the model affects the way system, information, and service quality influences usefulness and satisfaction, suggesting a shift in perspectives and priorities when it comes to B2B e-commerce transactions. Furthermore, results show that process and collaboration quality have significant effects on usefulness and satisfaction, reinforcing the objective of using B2B e-commerce systems across supply chain members.

Practical implications – This highlights the importance of improving business processes and enhancing collaboration activities, implying that managers should focus their efforts into enhancing customer service on top of system functionalities and features via B2B to better work with their supply chain partners. However, this study is limited in the context of a Taiwanese supply chain, suggesting that further research consider its applicability in different contexts, culturally and geographically, especially given the fact that B2B e-commerce enables cross-border business operations.

Originality/value – This study also extends the IS success model, especially in the context of B2B e-commerce, by emphasizing behavioural considerations on top of the functional issues present in any information systems.

Keywords IS success model, B2B e-commerce, E-commerce quality, Process quality, Collaboration quality, Electronic commerce, Customer satisfaction

Paper type Research paper

Introduction

Corporate web sites allow corporations and customers to interact with each other, influencing customers' satisfaction and perceived quality (Chang and Chen, 2009; Nelson *et al.*, 2005) and maximizing their loyalty (Ribbink *et al.*, 2004). This research focuses on a specific type of online interaction channel, the business-to-business (B2B) web sites, which generate a significant amount of e-business (Albrecht *et al.*, 2005; Baron *et al.*, 2000; Kim *et al.*, 2003; Xu *et al.*, 2002), and therefore a significant source of customer loyalty. Examples of B2B systems are enterprise resource planning (ERP) and



customer relationship management (CRM) systems where the firm's employees and its suppliers and business buyers transact and interact online (Baron *et al.*, 2000; Kim *et al.*, 2003; Ruiivo *et al.*, 2012; Sternad *et al.*, 2011). This study determines the factors in a B2B system that encourages satisfaction and loyalty from these particular users conducting e-business activities.

Information systems (IS) are developed to aid individuals in performing a task (Petter *et al.*, 2008), but its impact is also often influenced by human, organizational, and environmental factors (Urbach *et al.*, 2010; Sternad *et al.*, 2011), making the creation and management of e-commerce systems more complex (Cullen and Taylor, 2009; Urbach *et al.*, 2010). This is because e-commerce connects users from within and outside the organization. Especially, for B2B e-commerce environments, a higher degree of collaboration between different members of the supply chain is necessary (Cullen and Taylor, 2009; Pereira and Soares, 2007). Customers' satisfaction and employees' efficiency could be achieved when the systems deliver as promised and expected (Tai, 2011; Zeithaml *et al.*, 1996), on both the technical and the user-oriented aspects of B2B e-commerce use. This research proposes an investigation to further examine and analyze how such systems help in delivering as promised and expected its services using the IS success model, reinforced by the concepts of process quality and collaboration quality.

The main purposes of this study are:

- to understand what key IS factors customers perceive as important to B2B web site use that will enable organizations to improve their systems with respect to customer needs and preference; and
- to explore the antecedents necessary to use a B2B web site.

Exploring these antecedents will help identify key quality IS considerations supporting business activities. This study's main contribution is exploring the effects of adding process and collaboration quality into the existing IS success model, proposing that it will further enhance perceptions on perceived usefulness and satisfaction (Chen *et al.*, 2007; Marley *et al.*, 2004), especially in the context of B2B e-commerce. These specific quality dimensions are argued as the ones actually seen and observed more easily by both users and customers (Field *et al.*, 2004; Marley *et al.*, 2004), especially in a B2B scenario (Johnson and Whang, 2002). Since users transact and collaborate with each other using the B2B system, it is argued that the first three quality dimensions are what the B2B system can offer to the users (DeLone and McLean, 2003, 2004), while the additional two dimensions are dependent on customized user interactions (Urbach *et al.*, 2010), which the company can further exploit aside from the system features to further improve perceptions of usefulness, satisfaction, and loyalty. What is unique about B2B interactions is that it requires active participation of the involved entities in some of its functionalities, like having shared work spaces and information flows (Pereira and Soares, 2007), hereby inducing collaboration efforts which are not usually present in other types of e-commerce activities. Hence, since active participation and collaboration efforts are required, attention to the process of such participation and the amount of collaboration needed to achieve active participation is warranted in this study.

This study borrows from marketing, MIS, and operations management literature to argue the importance of process quality and collaboration quality on perceptions of usefulness and satisfaction. Additionally, this study proposes the use of customer loyalty to measure e-commerce success. Similar with process quality and collaboration

quality, this focuses on user attitudes and perceptions (Bhattacharjee, 2001; Chang and Chen, 2009; Flavián *et al.*, 2006) rather than on functional benefits to give a clearer picture of overall success. Focus on these functional benefits derived from technical considerations has been a source of confusion and criticism, questioning whether or not this focus alone gives an adequate picture to fully understand IS success (Cullen and Taylor, 2009), especially in the context of e-commerce. We therefore address this issue by incorporating some factors that are beyond these functional and technical considerations.

Theoretical background and literature review

IS success measurement

E-commerce quality is one of the major considerations used to evaluate usability and perceived usefulness (Dedhia, 2001; Cao *et al.*, 2005; Nelson *et al.*, 2005), with quality assessments based on meeting expectations as the most pervasive consideration (Tai, 2011; Zeithaml *et al.*, 1996). The IS success model (DeLone and McLean, 2003, 2004) assumes that an individual's attitudes and subsequent behaviors are affected by his belief about the system's overall quality and the experience of using the system. The model posits relationships on how information quality, system quality, and service quality each affect perceptions on intentions to use and user satisfaction, which in turn influence perceptions on net benefits (DeLone and McLean, 2004; Petter and McLean, 2009). Furthermore, this model has also been found to be a useful framework for organizing IS success measurements (Petter *et al.*, 2008). In other words, the quality of a system's information, system and service characteristics affects its overall success. Success in this model is measured by usefulness, satisfaction, and net benefits. As such, the development and refinement of the IS success model as a basis for e-commerce quality evaluation presents an opportunity to apply this model in different contexts, one of which is in this study involving B2B web sites. In this case, we propose additional antecedents for perceptions of user satisfaction, separate from the technical considerations of system, information, and service quality. These additional antecedents aim to represent some organizational aspects that potentially play a significant role in further influencing IS success (Urbach *et al.*, 2010; Cullen and Taylor, 2009). Since B2B e-commerce is supposed to build and facilitate relationships between different business entities operating within a supply chain (Cullen and Taylor, 2009), going beyond the technical consideration of the system itself and including some dimensions that can illustrate how B2B e-commerce users interact and work with each other is an important issue to study as well.

This research proposes to extend the model by including two distinct quality dimensions not explicitly covered by the IS success model. These are process quality and collaboration quality. These two additional dimensions are proposed to be added since B2B e-commerce systems are also designed to electronically support existing business processes and facilitate inter-organizational collaboration efforts (Urbach *et al.*, 2010; Cullen and Taylor, 2009), which presently is not covered in the existing dimensions of the IS success model.

Customer loyalty, satisfaction, and usefulness

Net benefits is a construct highly considered to be very broad in nature, not even considering as to whose perspective does net benefits direct to (DeLone and

McLean, 2004; Petter and McLean, 2009; Wang, 2008). In this case, net benefits is measured by customer loyalty, which is critical to business success, especially following the chain of useful-satisfaction-loyalty in marketing literature (Wang, 2008), since we emphasize that it is the users who should enjoy the net benefits of using the B2B system. Several factors impact customer loyalty in the business-to-consumer (B2C) context (Srinivasan *et al.*, 2002; Wolfenbarger and Gilly, 2003), such as web characteristics on use and user satisfaction towards the web site (Dedhia, 2001). When people perceive that the web site will be more useful, there is a greater chance that they are willing to make transactions through the web site, and hence encourage greater loyalty. On the other hand, customer e-satisfaction, largely explained by the variance in e-service quality, also positively and directly influences e-loyalty (Ribbink *et al.*, 2004). We can therefore see here an integration of functionality-oriented, process-oriented, and people-oriented considerations that can all potentially influence customer loyalty, giving us strong reasons to adopt these three measures as the basis to evaluate our adopted e-commerce quality dimensions and to adopt customer loyalty as the final dependent variable in our model instead of net benefits. In other words, the net benefit seen here is measured by the level of customer loyalty acquired due to the use of the B2B e-commerce system. Furthermore, since we are emphasizing more on the behavioral aspects rather than the technical aspects of IS success, customer loyalty serves as a better indicator since loyalty is a behavior-oriented variable (Wang, 2008), whereas net benefits is more technical in nature (DeLone and McLean, 2003, 2004).

Construct definitions and hypothesis development

The IS success model, which is our main theoretical foundation, posits that user perceptions of system quality influence perceptions of usefulness and satisfaction, but measuring these relationship differs depending on the e-commerce context (DeLone and McLean, 2003, 2004). Prior studies also suggested that perceived quality, information quality and service quality are antecedents of overall customer satisfaction (Dedhia, 2001; Urbach *et al.*, 2010).

Specifically, for the B2B context, specific system quality features such as the consistency of interface and ease of use (Rai *et al.*, 2002) and the degree of responsiveness and multi-media capabilities (Cao *et al.*, 2005) are important for system quality to significantly influence perceived usefulness. System quality also reflects usability, availability, reliability, adaptability, and response time (DeLone and McLean, 2003, 2004), which are confirmed to have positive impact of system quality on user satisfaction (Cao *et al.*, 2005; DeLone and McLean, 2003; Rai *et al.*, 2002). In other words, perceptions of system quality, through the specific features as mentioned, should be able to influence user perceptions of usefulness and satisfaction by providing users a wide array of improved system features and characteristics (DeLone and McLean, 2003, 2004) embedded in the B2B system that would make transacting with the company easier, faster, and more convenient (Cao *et al.*, 2005; Rai *et al.*, 2002):

- H1. System quality positively influences usefulness of the B2B e-commerce system.
- H2. System quality positively influences users' overall satisfaction to the B2B e-commerce system.

The IS success model also posits that information quality will influence usefulness and satisfaction (DeLone and McLean, 2003, 2004), especially on web site usefulness and satisfaction (Cao *et al.*, 2005; Field *et al.*, 2004). Specifically, information quality in the context of B2B means the degree of information relevance and accuracy that the system provides to its users (Cao *et al.*, 2005; DeLone and McLean, 2004), which is reflected in the actual contents of the web site. Furthermore, information content quality is the information feature and presentation (Field *et al.*, 2004) in in-house computer systems and in e-commerce systems (Cao *et al.*, 2005). In this sense, the accuracy and relevance of the information contents found within the B2B web site both play vital roles in influencing perceptions of overall satisfaction (Cao *et al.*, 2005; DeLone and McLean, 2004). In other words, the information content provided in the B2B system should immensely address user concerns regarding information search in the aid of whatever decision making process involved. Therefore, the outcome of this information search will determine whether there will be positive or negative effects on user perceptions of usefulness and satisfaction. Therefore, perceptions of information quality, through the aforementioned characteristics of the information searched for and acquired by the users, should be able to influence their perceptions of the system's usefulness and their overall satisfaction of using the system (DeLone and McLean, 2003, 2004) because they were able to acquire the information at their desired level of standards after using the system (Cao *et al.*, 2005; Field *et al.*, 2004):

- H3. Information quality positively influences usefulness of the B2B e-commerce system.
- H4. Information quality positively influences users' overall satisfaction to the B2B e-commerce system.

Service quality refers to the support delivered by the service provider (DeLone and McLean, 2003; Field *et al.*, 2004). It has been widely accepted that service quality directly influences usefulness (Cao *et al.*, 2005; Harris and Goode, 2004) and satisfaction (Cao *et al.*, 2005). Good service quality means quick responsiveness, assurance, reliability and empathy (Liu and Arnett, 2000) that the web site can provide, which is very similar in the B2B context (Cao *et al.*, 2005). As posited by the IS success model, when online customers perceive that their needs have been well served, that is, service quality is deemed high, they find more uses and are more satisfied with the web site (DeLone and McLean, 2003, 2004). Specifically, for B2B transactions, service quality is reflected on the effectiveness of online support capabilities, and on the technical competence (DeLone and McLean, 2004), empathy, and attractiveness of the system towards its users (Cao *et al.*, 2005). In this sense, users' perceptions of service quality, through the specific standards of good service as mentioned, should be able to influence their evaluations of the system's usefulness and their overall satisfaction of using the system (DeLone and McLean, 2003, 2004) because they were able to experience an improved level of service (Cao *et al.*, 2005; Liu and Arnett, 2000) when using the B2B system as compared to not using the system:

- H5. Service quality positively influences usefulness of the B2B e-commerce system.
- H6. Service quality positively influences users' overall satisfaction to the B2B e-commerce system.

We introduce the addition of two constructs proposed to be outside the functional benefits and technical considerations covered by the current IS success model. Considering other factors may prove to be useful in fully understanding IS success (Cullen and Taylor, 2009; Urbach *et al.*, 2010). In this study, we address this concern by incorporating two constructs related to the use of the B2B system. Obviously, the way the B2B system is being used depends on what processes the company has implemented to facilitate transactions and interactions with its trading partners (Marley *et al.*, 2004). Also, the real value of the B2B system can be seen in the amount of collaboration that is being done between and amongst the different companies in the supply chain (Albrecht *et al.*, 2005; Pereira and Soares, 2007). In other words, even without the B2B system, these process and collaboration quality dimensions still exist. Therefore, we argue that these two constructs greatly depend on the users who transact and interact with each other via the B2B system and not entirely on the system itself, hereby setting themselves apart from the information, system, and service quality dimensions.

Process quality covers how the service is actually executed and delivered, shaping customer experiences (Marley *et al.*, 2004), which sets it apart from system quality (Urbach *et al.*, 2010). Furthermore, in managing the B2B system, the facilitation of management support for the system (Cullen and Taylor, 2009) can be argued as part of the business process. Observing process quality, especially in this context, may take the form of the presence of efficient, timely, and accurate information (Chen *et al.*, 2007) and enabling operations to be more flexible and more efficient (Dedhia, 2001; Chen *et al.*, 2007). Therefore, if the process enables improved operations while transacting through the B2B system, then users will find the system to be very useful. On the other hand, customers experience dissatisfaction when a web site has a process failure and poor process design (Marley *et al.*, 2004). Process quality is a very crucial component since customers see the process more clearly than any other web site quality dimension in any e-business transaction (Field *et al.*, 2004; Marley *et al.*, 2004; Urbach *et al.*, 2010), making this dimension a valuable predictor of usefulness and satisfaction. Marley *et al.* (2004) have established in the healthcare industry that process quality does influence patients' perceptions of satisfaction. This presents an opportunity to be tested in the context of IS and e-commerce. In other words, the actual process of conducting B2B e-commerce also plays an equally vital role in the users' perceptions of usefulness and satisfaction, and this is represented by process quality. This means that the better users perceive the process quality is, the more they will use the system and the more they will be satisfied with using it (Urbach *et al.*, 2010):

- H7.* Process quality positively influences usefulness to the B2B e-commerce system.
- H8.* Process quality positively influences users' overall satisfaction to the B2B e-commerce system.

E-commerce technologies have opened the door for better and more efficient collaboration efforts (Johnson and Whang, 2002; Chen *et al.*, 2007; Urbach *et al.*, 2010; Ruivo *et al.*, 2012). Collaboration requires joint and coordinated action between at least two entities (Pereira and Soares, 2007), which means that it requires active participation of these involved entities, unlike service quality wherein it is mostly a one-way relationship between the involved entities. We define collaboration as facilitating better information integration and exchange, decision making, and resource sharing (Johnson and Whang, 2002;

Davidrajuh, 2003; Chen *et al.*, 2007; Urbach *et al.*, 2010), creating shared workplaces and information flows (Pereira and Soares, 2007). This improves usefulness because there are now multiple ways to deal with trading partners. But selecting and evaluating the appropriate systems is also largely based on the duration and type of collaborations to take place (Davidrajuh, 2003; Chen *et al.*, 2007; Ruivo *et al.*, 2012). Interactions between different internal and external applications are key for successful online collaboration (Chen *et al.*, 2007), hereby improving perceptions of usefulness and satisfaction, and therefore achieving greater value (Ruivo *et al.*, 2012). Achieving large sales volumes and value requires collaboration between and amongst the different companies in the same supply chain (Cullen and Taylor, 2009). Furthermore, attaining a working e-collaboration facility is one important reason of investing in a B2B technology in the first place (Albrecht *et al.*, 2005; Pereira and Soares, 2007; Easley *et al.*, 2003). Therefore, aside from the usual web site dimensions posited by the IS success model, another important question is how the B2B system can facilitate better collaboration between organizations as intended in the first place. The actual use of such collaborative systems can influence creativity and decision making, enhancing overall performance (Easley *et al.*, 2003). This means that the better users perceive collaboration quality is, the more they will use the system, and the more they will be satisfied in using it as well (Urbach *et al.*, 2010):

H9. Collaboration quality positively influences usefulness to the B2B e-commerce system.

H10. Collaboration quality positively influences users' overall satisfaction to the B2B e-commerce system.

The IS success model also posits that perceived usefulness affects perceived satisfaction and loyalty (DeLone and McLean, 2003, 2004), especially when comparing actual performance with prior expectations (Cao *et al.*, 2005; Dedhia, 2001; Flavián *et al.*, 2006; Johnson and Whang, 2002; Weiyin *et al.*, 2011). Usefulness further clarifies the issue regarding the use of the system since this reflects how IS patronage (Rai *et al.*, 2002), measured by information search, facilitating customer orders, payments, and service requests, tracking the number of e-commerce site visits, the length of stay, and the number of purchases completed (DeLone and McLean, 2003, 2004), affects net benefits. Furthermore, as previously mentioned, since we are looking at the users' perspective, it is more valuable to look at this from the useful-satisfaction-loyalty perspective (Wang, 2008), further emphasizing the value of usefulness. As they find a web site to be useful, they expect to gain some benefits from using the system, enticing continued use, and encouraging loyalty (Bhattacharjee, 2001; Flavián *et al.*, 2006). When customers find usefulness in using a web site, it will influence directly their behavior (Bhattacharjee, 2001) or indirectly through their attitudes (Dedhia, 2001). In other words, the more users think and perceive that the B2B system is useful, the more that they will use it, and hence cultivating loyalty towards the system:

H11. Usefulness positively influences users' overall satisfaction to the B2B e-commerce system.

H12. Usefulness positively influences customer loyalty to the B2B e-commerce system.

The IS success model posits that satisfaction also influences perceptions on net benefits (DeLone and McLean, 2003, 2004). On the same thread, they will expect to gain some benefits from using the system if they find it satisfactory, hereby encouraging loyalty. This extension of the IS success model is yet another objective and intended contribution. Satisfaction is therefore the evaluation of customers' experience in using the corporate web site, which is considered an important driver of loyalty (Bhattacharjee, 2001). Satisfaction has played a predominant role in acquiring customer loyalty (Anderson and Srinivasan, 2003; Baron *et al.*, 2000; Dedhia, 2001; DeLone and McLean, 2004). When customers are not satisfied, they are likely to search alternatives and hesitate to develop closer business relationships (Anderson and Srinivasan, 2003), stunting the development of loyalty. In other words, to develop and cultivate loyalty towards the B2B system, users should be able to find some satisfaction in using the system. The more a user is satisfied, the more they develop loyalty (see Figure 1 for the overall conceptual model):

H13. User satisfaction positively influences customer loyalty to the B2B e-commerce system.

Research methodology

Sample and data collection

A survey questionnaire using a five-point Likert scale was employed. The company used in this study, a plastics packing materials manufacturer, has been using a corporate-wide system for ten years, which is an ERP system with some elements of CRM integrated into it, to manage their supply chain suppliers and customers. The company produces plastic binding materials used for bulk packaging and is one of the bigger suppliers of these materials in Taiwan. Customers interact with the corporate web site for a variety of activities, thus having the knowledge and experience to evaluate the study variables related to the system (Albrecht *et al.*, 2005; Baron *et al.*, 2000; Cao *et al.*, 2005;

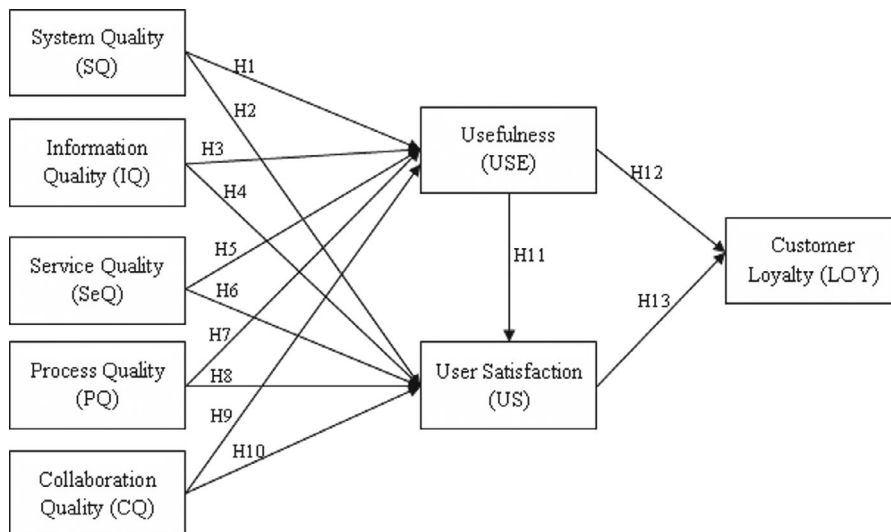


Figure 1.
Conceptual model

Johnson and Whang, 2002; Kim *et al.*, 2003; Xu *et al.*, 2002). B2B networks and infrastructures require the participation of suppliers and buyers (Albrecht *et al.*, 2005; Baron *et al.*, 2000; Kim *et al.*, 2003), especially if the system is integrated across the organization (Simon and Yaya, 2012). The sampling frame was a manufacturing firm's customers who have access to its B2B web site and should have an existing business relationship with the firm for at least three years, possessing some history with the firm; hence there is some familiarity with its process and collaboration activities. These respondents were managers, engineers, purchasers and buyers, or any others who have can access the company's B2B web site, initiate transactions with the company, and to some extent make decisions regarding these B2B transactions and activities, which were essentially the system users (Petter and McLean, 2009). The questionnaires, translated to Chinese, were distributed via online survey and e-mail with the help of the company's sales people who referred to and were randomly selected from the company's customer database. In total, 307 of 380 respondents (80 percent response rate) were used for analysis.

Characteristics of respondents

199 respondents are female. Most of the respondents are in the age between 31 and 40. 64.2 percent of the respondents have a college bachelor degree and 45.3 percent of respondents have work experience from six to ten years. 155 respondents disclosed that they are purchasers and buyers from the firm (Table I).

Measurement results for relevant research variables

There are 69 survey question items adopted from previous literature and reworded to fit the study context: ten items of system quality (Chang and Chen, 2009;

Item	Category	Frequency	Percentage
Gender	Male	108	35.2
	Female	199	64.8
Age	21-30	66	21.5
	31-40	169	55.0
	41-50	72	23.5
Education	Diploma	31	10.1
	Bachelor	197	64.2
	Master	79	25.7
Working experience	<5 years	84	27.4
	6-10 years	139	45.3
	> 10 years	84	27.4
Occupation	Manager	41	13.4
	Purchaser/buyer	155	50.5
	Engineer	52	16.9
	Other	59	19.2
Number of employees	< 100	113	36.9
	101-500	58	18.9
	501-1,000	33	10.7
	1,001-5,000	71	23.1
	> 5,000	32	10.4

Table I.
Respondent
characteristics

Note: *n* = 307

Srinivasan *et al.*, 2002), 16 items of information quality (Ribbink *et al.*, 2004; Srinivasan *et al.*, 2002; Tarafdar and Zhang, 2007), 12 items of service quality (Ribbink *et al.*, 2004; Srinivasan *et al.*, 2002; Wang, 2008), ten items of process quality (Hung *et al.*, 2010; Wolfenbarger and Gilly, 2003), five items of collaboration quality (Benbya *et al.*, 2004; Malhotra *et al.*, 2007), six items of usefulness (Rai *et al.*, 2002), four items of user satisfaction (Chang and Chen, 2009; Srinivasan *et al.*, 2002), and six items of customer loyalty (Zeithaml *et al.*, 1996). Structural equation modeling (SEM) using partial least squares (PLS) via SmartPLS 2.0 statistical software was used for the analysis. Several recent IS studies have used PLS for data analysis, notably in the areas of employee portal use (Urbach *et al.*, 2010), ERP use (Sternad *et al.*, 2011; Ruivo *et al.*, 2012) and systems integration (Simon and Yaya, 2012). Aside from its usefulness in analyzing data with relatively smaller than ideal sample sizes, PLS makes no assumptions regarding the distribution of the variables and ensures optimal prediction accuracy (Fornell and Cha, 1994; Chin, 1998) and is robust against multicollinearity (Cassel *et al.*, 2000). Furthermore, it is very useful when the research model is relatively complex with a large numbers of indicators (Fornell and Bookstein, 1982) and if there is little theory development (Chin, 1998), which in this case is an issue for the two additional constructs in this research's framework.

Validity and reliability tests

Confirmatory factor analysis (CFA) was used to test for validity and reliability. After deletion of items due to low factor loadings ($FL < 0.7$), the results show that each construct has acceptable internal validity and reliability measures of factor loading, AVE, CR, and Cronbach's α (Table II). The correlation matrix also shows acceptable discriminant validity as well (Table III).

Structural equation model

SEM-PLS was used to test the study hypotheses (Figure 2). Model fit indices for the structural model indicate acceptable model-fit measures of R^2 and redundancy values (Table IV).

The structural model revealed that the hypothesized relationships were found to be statistically significant, except for *H1* and *H4*. Hence, the results provide support for 11 of the 13 hypotheses of the study.

Furthermore, since the research model also presents several mediating effects, Sobel test was used to determine the significance of such effects. The results show that all mediation relationships show partial mediation, indicating that usefulness is a partial mediator between each quality dimension and satisfaction, and satisfaction as a partial mediator between usefulness and loyalty (Table V).

Discussions and conclusions

The paths from system quality to usefulness and information quality to user satisfaction were found to be not significant. All the other relationships found in this study pertaining to the IS success model were found to be significant, hereby confirming what past researches (Cao *et al.*, 2005; DeLone and McLean, 2003, 2004; Liu and Arnett, 2000; Rai *et al.*, 2002; Urbach *et al.*, 2010; Wang, 2008) have already discovered and discussed. Additionally, the relationships of usefulness and user satisfaction to customer loyalty were supported. It has been observed that the

Constructs	Code	Question	Mean	SD	Standardized loadings	AVE	CR	Cronbach's α
System quality (SQ)	CI4	The web site's online customer service is easily available	4.16	0.778	0.746	0.657	0.851	0.739
	CI5	I feel that this is a very engaging web site	4.05	0.755	0.835			
Information quality (IQ)	CI6	This web site facilitates two-way communication	4.09	0.753	0.846			
	CU4	I feel that my needs have been met when using the site	4.05	0.744	0.790	0.582	0.874	0.820
	CU5	I believe that this web site is customized to my needs	4.03	0.800	0.734			
	IN4	The site provides sufficient information to enable you to do the tasks	4.22	0.669	0.719			
Service quality (SeQ)	IN5	The site provides helpful information regarding your questions or problems	4.24	0.653	0.788			
	IN6	The web site is a very good source of information	4.18	0.746	0.780			
	CA3	This web site is able to provide service in a timely manner	4.18	0.792	0.749	0.583	0.875	0.821
	CA4	The web site is responsive to any problems that I encounter	3.92	0.785	0.767			
	CA5	I'm able to receive knowledgeable reply from this web site	4.16	0.721	0.736			
	CA7	The web site takes care customers' specific needs	4.13	0.725	0.763			
Process quality (PQ)	CA8	The web site pay attention to customers for each communication	4.12	0.796	0.800			
	RE4	I believe that the web site was reliable	4.27	0.653	0.715	0.610	0.886	0.838
	EF3	The product search results are exactly what I need	4.10	0.664	0.735			
	EF4	I feel that the design of this web site is easy to understand	4.30	0.620	0.858			
	EF5	Using this web site could easily enable me to achieve my purpose	4.25	0.676	0.766			
	EF6	I feel that the web site is easy to use	4.28	0.636	0.820			

(continued)

Constructs	Code	Question	Mean	SD	Standardized loadings	AVE	CR	Cronbach's α
Collaboration quality (CQ)	ES3	The product search results are exactly what I need	4.10	0.664	0.782	0.697	0.873	0.783
	ES4	The web site enables the increased productivity and effective information search	4.30	0.620	0.875			
	ES5	The web site provides presentation of easy information access to accomplish the work	4.25	0.676	0.844			
Usefulness (USE)	US3	Using the web site increases my productivity	4.07	0.692	0.842	0.668	0.889	0.834
	US4	Using the web site makes it easier to do my job	4.18	0.676	0.848			
	US5	The web site supports all the various types of activities to complete the task	4.16	0.717	0.763			
User satisfaction (US)	US6	I found the web site useful	4.20	0.614	0.814	0.614	0.864	0.789
	SA1	I am satisfied with experience in using this web site	3.89	0.616	0.714			
	SA2	This web site is of high quality	4.11	0.793	0.790			
Customer loyalty (CL)	SA3	This online experience is exactly what I needed	4.27	0.747	0.814	0.601	0.857	0.780
	SA4	This web site has worked out as well as I thought it would	4.21	0.748	0.812			
	CL3	Recommend the company to someone who seeks your advice	4.17	0.695	0.782			
	CL4	Encourage friends and relatives to do business with the company	4.06	0.710	0.753			
	CL5	Consider the company your first choice for future purchase	3.94	0.771	0.790			
	CL6	Do more business with company in the next few years	3.96	0.604	0.775			

Table II.

relationships as posited in the IS success model is not always supported (Petter and McLean, 2009). Furthermore, both process quality and collaboration quality to both usefulness and user satisfaction was found to be significant.

Some previous researches have observed differently regarding the effects of system quality on usefulness, arguing that system quality has a more direct effect on specifically system satisfaction (Nelson *et al.*, 2005; Urbach *et al.*, 2010). This posits that satisfaction is an antecedent of usefulness and system quality does not directly affect usefulness. System quality is merely a part of a bigger, more comprehensive dimension called system integration (Saeed and Abdinnour-Helm, 2008). In other words, system quality alone may not be enough to influence perceptions on usefulness. Also, some models posit that information quality influence specifically information satisfaction (Nelson *et al.*, 2005) and usefulness (Rai *et al.*, 2002), instead of user satisfaction as a whole. This research used different considerations to define satisfaction, but focusing on satisfaction based on delivering the expected service (Chang and Chen, 2009; Srinivasan *et al.*, 2002; Zeithaml *et al.*, 1996). These considerations may explain the results found in this study. Practically speaking, customers search through B2B

Table III.
Correlation matrix
with square root of AVE
in the diagonal

	SQ	IQ	SeQ	PQ	CQ	USE	US
SQ	0.835						
IQ	0.575	0.763					
SeQ	0.589	0.641	0.775				
PQ	0.450	0.611	0.605	0.781			
CQ	0.525	0.523	0.571	0.603	0.811		
USE	0.515	0.591	0.623	0.627	0.657	0.764	
US	0.543	0.558	0.612	0.583	0.612	0.603	0.784
LOY	0.511	0.493	0.488	0.525	0.546	0.498	0.544

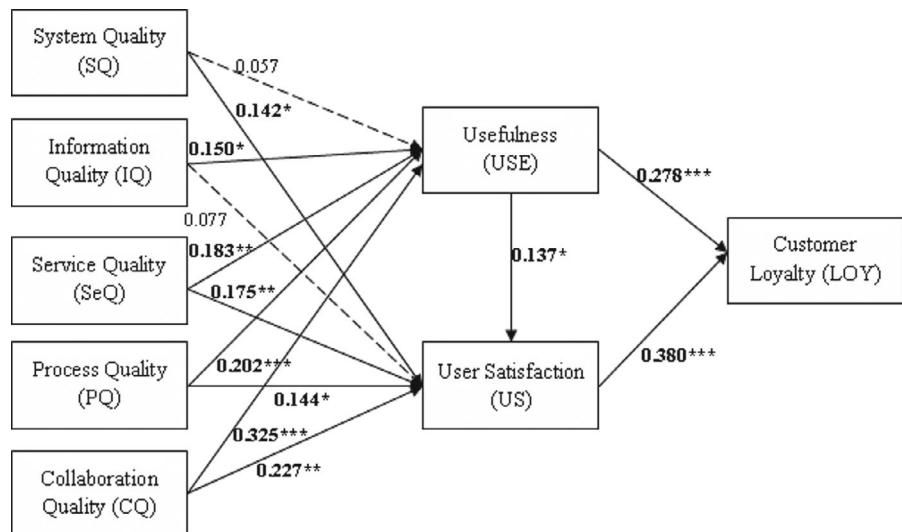


Figure 2.
Structural equation
model-partial least
squares

Note: Significant at: *0.05, **0.0 and ***0.001 levels

Path relationships					
	Path coefficients	SE	t-value	p-value	
(SQ) → (USE)-H1	0.057	0.060	0.944	0.345	
(SQ) → (US)-H2	0.142*	0.067	2.114	0.035	
(IQ) → (USE)-H3	0.150*	0.058	2.569	0.010	
(IQ) → (US)-H4	0.077	0.069	1.121	0.262	
(SeQ) → (USE)-H5	0.183**	0.056	3.217	0.001	
(SeQ) → (US)-H6	0.175**	0.058	3.013	0.002	
(PQ) → (USE)-H7	0.202***	0.060	3.376	> 0.001	
(PQ) → (US)-H8	0.144*	0.062	2.312	0.021	
(CQ) → (USE)-H9	0.325***	0.067	4.825	> 0.001	
(CQ) → (US)-H10	0.227**	0.072	3.114	0.002	
(USE) → (US)-H11	0.137*	0.067	2.020	0.044	
(USE) → (CL)-H12	0.278***	0.058	4.723	> 0.001	
(US) → (CL)-H13	0.380***	0.064	5.928	> 0.001	
Overall fit assessment					
Dependent variables	R ²	Redundancy			
US	0.539	0.141			
USE	0.576	0.217			
CL	0.351	0.162			

Note: Significant at: * < 0.05, ** < 0.01 and *** < 0.001 levels

Table IV.
SEM results

		Beta	SE	t-value	p-value	z-test	p-value
SQ → USE → US	SQ → US	0.318	0.063	5.018	0.000	5.339	0.000
	SQ → USE	0.518	0.058	8.856	0.000		
	USE → US	0.446	0.067	6.693	0.000		
IQ → USE → US	IQ → US	0.304	0.069	4.435	0.000	5.291	0.000
	IQ → USE	0.595	0.062	9.550	0.000		
	USE → US	0.429	0.068	6.361	0.000		
SeQ → USE → US	SeQ → US	0.384	0.064	6.040	0.000	5.123	0.000
	SeQ → USE	0.623	0.055	11.314	0.000		
	USE → US	0.369	0.064	5.747	0.000		
PQ → USE → US	PQ → US	0.338	0.066	5.102	0.000	5.276	0.000
	PQ → USE	0.632	0.056	11.316	0.000		
	USE → US	0.399	0.067	5.961	0.000		
CQ → USE → US	CQ → US	0.390	0.058	6.783	0.000	5.348	0.000
	CQ → USE	0.663	0.054	12.337	0.000		
	USE → US	0.355	0.060	5.937	0.000		
USE → US → LOY	USE → LOY	0.278	0.068	4.070	0.000	5.021	0.000
	USE → US	0.611	0.063	9.722	0.000		
	US → LOY	0.380	0.065	5.862	0.000		

Table V.
Sobel test results for
mediating effects

web sites to look for the correct and useful information that will suit their needs and complete their assigned tasks. Thus, the impact on usefulness has been obtained when the right information is provided, implying that information quality focuses more on usefulness rather than user satisfaction. In addition, customers are equally concerned with whether the B2B web site's system functionalities could expedite the whole process. This implies that system quality focuses more on user satisfaction rather than usefulness.

The results indicate that service quality is the only quality dimension that significantly influence both usefulness and user satisfaction, highlighting the importance of service quality among other quality dimensions (Cao *et al.*, 2005; Harris and Goode, 2004; Tai, 2011). This implies that the quality of service features seems to be an important, if not the most important, factor for customers' use of B2B web sites.

We see here that process quality has a weaker significant influence compared to collaboration quality. Because process quality may be defined in several ways, most notably productivity and/or performance (Davamanirajan *et al.*, 2006), reliability, and efficiency (Hung *et al.*, 2010; Wolfenbarger and Gilly, 2003), there may be some confusion as to how customers actually perceive and understand this dimension (Urbach *et al.*, 2010). And, as initially implied in the earlier results, B2B customers and users may be more interested in the other aspects of quality, especially service quality, and to a lesser degree information and system quality. What is further interesting is collaboration quality, which is shown to have a significant effect. This implies that between discerning between process and collaboration quality, B2B users would be more interested and more discriminating with the latter (Urbach *et al.*, 2010). Practically, B2B systems are established to enable better processes and more efficient collaboration between firms (Baron *et al.*, 2000; Chen *et al.*, 2007; Kim *et al.*, 2003; Xu *et al.*, 2002). In this context, then this implies that indeed, collaboration quality is a very useful and very important predictor of B2B e-commerce success, on top of the web site quality dimensions as posited in the IS success model.

Theoretical and practical implications

Theoretically, we present additional perspectives in measuring e-commerce quality via usefulness, satisfaction, and loyalty. We present other alternatives to measure e-commerce quality (Dedhia, 2001; Urbach *et al.*, 2010), especially in B2B e-commerce (Albrecht *et al.*, 2005). By adding process and collaboration quality, we can have a better theoretical understanding of user behaviors within the B2B network. This addition is important since most B2B e-commerce systems involves integrating several elements in the organization's supply chain (Albrecht *et al.*, 2005; Johnson and Whang, 2002) and involves more organizational levers pertinent to performance (Urbach *et al.*, 2010). In effect, this study makes a contribution to the literature by extending the IS success model and applying it to an important context of B2B e-commerce, which accounts for a significant portion of an organization's e-business activities (Chen *et al.*, 2007; Marley *et al.*, 2004). Furthermore, we open research opportunities to explore how process quality and collaboration quality, two important aspects of B2B e-commerce, can complement web site quality perceptions to enhance perceptions of usefulness, satisfaction, and loyalty. We present a theoretical scenario wherein IS users' perceptions changed, lending some interesting points of discussion regarding which e-commerce quality measures are actually valued by users (Albrecht *et al.*, 2005; Cao *et al.*, 2005; Dedhia, 2001; Johnson and Whang, 2002; Urbach *et al.*, 2010), especially when considered in specific cases and contexts. Additionally, we also present the importance of customer loyalty as opposed to net benefits as the final dependent variable. As opposed to net benefits focusing on the functional aspects (DeLone and McLean, 2003, 2004), customer loyalty focuses more on the attitudes and behaviors formed (Bhattacharjee, 2001; Chang and Chen, 2009; Flavián *et al.*, 2006). We proposed that customer loyalty is a better indication of an e-commerce system performance because this better reflects user

perceptions on overall IS success (Wang, 2008), especially in the context of B2B e-commerce (Baron *et al.*, 2000; Kim *et al.*, 2003), rather than focusing on only its technical aspects typically measured by net benefits.

As for practical implications, this study highlights the very important objective of B2B e-commerce: enhancing collaboration activities with its trading partners (Baron *et al.*, 2000; Kim *et al.*, 2003; Urbach *et al.*, 2010), and improving business process quality (Chen *et al.*, 2007; Dedhia, 2001), which are very integral parts of supply chain operations (Albrecht *et al.*, 2005; Johnson and Whang, 2002). Companies invest a significant amount of resources on a B2B e-commerce system to make the process of interacting and transacting with trading partners within a supply chain significantly much more efficient and cost-effective, and to enhance collaboration efforts between and amongst these trading partners. As such, managers should focus their efforts into enhancing the services they provide to users. This encourages better communication and collaboration efforts, which will increase the usage of the systems in place, since e-commerce as a whole had been found to have such a profound impact in business operations (Johnson and Whang, 2002) and user interactions (Urbach *et al.*, 2010; Easley *et al.*, 2003; Pereira and Soares, 2007). Managers are always burdened by limited resources and must pick the best combination of IS investments. The decisions regarding IS-related investments should be based on which e-commerce quality considerations are the most influential in establishing the desired user behaviors, taking into consideration a whole wide range of issues and considerations, such as process and collaboration-related issues (Chen *et al.*, 2007; Davidrajuh, 2003; Johnson and Whang, 2002), on top of how the web site should be designed and implemented in terms of the technical aspects of system, information, and service quality dimensions. Drawing from this research, managers should prioritize service quality, process quality, and collaboration quality considerations in their B2B e-commerce investments. Furthermore, to completely justify investments in B2B, managers should also consider enhancing information quality and system quality. We emphasize the importance of not just having a good system in place, but also the how can current business processes and collaboration efforts contribute to influencing favorable user perceptions.

Research limitations and future research

Since some of the hypothesized relationships are not supported by our data, there is a need to further explore and test this theoretical framework. Specifically, the relationships posited for system quality to usefulness and information quality to user satisfaction could be investigated further, as the IS success model is not always successful in predicting user behaviors (Petter and McLean, 2009) or establishing the posited relationships (DeLone and McLean, 2004).

The usual limitations surrounding survey method of data collection is acknowledged in this study. Future studies may further test the robustness of this study in different contexts related to e-commerce use, satisfaction, and loyalty. Additionally, since the survey questionnaire was translated to Chinese, limitations surrounding translation issues may also occur, despite the rigorous process of translating and back-translating.

Especially, for organizations with international dealings and operations, domestic and foreign customers and users might have different behaviors in using B2B e-commerce systems. This implies that cultural and locational factors may potentially play a role. Therefore, it will also be worthwhile to investigate the potential resulting differences, especially since B2B technologies enable transnational business operations.

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About the authors

Jengchung Victor Chen is Associate Professor in International Management at National Cheng Kung University, Taiwan, ROC. He holds a Master in Management and Policy (MIS) from State University of New York Stony Brook, Master in Computer Science from Polytechnic Institute, New York University, and a PhD from University of Hawaii. His research interests include telecommunications, e-commerce, privacy, trust and technology, and information service quality.

Yawen Chen obtained International MBA degree from the Institute of International Management, National Cheng Kung University. She has worked as information analyst in manufacturing industry for over ten years. Her research interests include corporate information systems and electronic commerce.

Erik Paolo S. Capistrano is Assistant Professor of Operations Management and Management Information Systems in the College of Business Administration, University of the Philippines, Philippines. He is also an ongoing PhD student of Management Information Systems in the Institute of International Management, National Cheng Kung University, Taiwan. He is a former Project Consultant for Ernst & Young in the Philippines. Professionally, he is an independent business consultant in the Philippines, with past projects with various private, government and non-government firms. His academic research interests include fields in supply chain management, electronic commerce, internet ethics, and project management.