WHY ARE SOCIAL NETWORKING APPLICATIONS SUCCESSFUL? AN EMPIRICAL STUDY OF TWITTER

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Abstract

Social networking applications (SNAs) are among the fastest growing web applications of recent years. In this paper, we propose a causal model to assess the success of SNAs, grounded on DeLone and McLean's updated information system (IS) success model. In addition to their original three dimensions of quality, i.e., system quality, information quality and service quality, we propose that a fourth dimension – networking quality – contributes to SNA success. We empirically examined the proposed research model with a survey of 139 Twitter users. The data validates the significant role of networking quality in determining the focal SNA's success. This study also highlights the overwhelming impact of networking quality on user satisfaction compared to the influence from information quality and service quality. The theoretical and practical implications are discussed.

Keywords: Social Networking Application (SNA), Networking Quality, Information Systems (IS) Success Model, SNA Success Model.

1 INTRODUCTION

Social networking applications (SNAs) have dramatically changed the way in which people communicate and interact with each other. Among the younger generation in particular, SNAs are a popular communication mechanism (Murnan 2006). SNA members often form different groups in order to provide information, emotional support, material aid and social identity (Wellman 2005). Although each SNA has its own mechanisms to help people build social networks and relations with others, all SNAs share the following common characteristics. They are web-based applications that can be used to form a social networking group, enabling people to interact and share information with one another. In the last few years, SNAs have become increasingly popular, as demonstrated by their continuous growth and the richness of information content. Despite the surge of popularity that these SNAs have experienced, research on SNAs has either focused on specific SNA functions or has taken a case study approach into one specific SNA. We should be concerned about the success of SNAs because of their influence on our social lives and their potential to nurture new opportunities in business, education and politics. Therefore, there is a need to establish a formal measurement model to capture the factors that contribute to SNA success.

A large number of studies have described the key elements that contribute to the success of an information system (IS). Among them, DeLone and McLean's (1992, 2003) IS success models (ISSMs) have received considerable attention from academics and practitioners, providing a theoretical foundation for IS research on such topics as knowledge management (e.g. Wu and Wang 2006) and electronic commerce (e.g., Wang 2008). Unlike prior research, we argue that an ISSM related to the social network domain requires conceptual modification given SNAs' social networking characteristics. Specifically, the typical features of SNAs which are distinct from other IS applications include information exchange of short messages and expanding social contacts. These characteristics appear to have contributed to SNAs' success. Thus, the objective of this study is both to conceptualize networking quality and to examine whether networking quality provides a significant and new explanation for the success of SNAs beyond DeLone and McLean's ISSMs.

Following this introduction, we review the literature and summarize our theoretical basis for the proposed SNA success model. We argue that social networking quality is a new dimension that should be included in the ISSM. We next justify the theoretical model in detail. Following a description of the survey method and data analysis, we discuss the findings and make suggestions for future research. We conclude the paper with implications and contributions.

2 LITERATURE REVIEW

2.1 Social Networking Applications

Following Garton et al. (1997), we define a social network application (SNA) as an online platform enabling individual users to interact and interconnect through certain social relationships, such as friendship, co-working or information exchange. The underlying nature of SNAs is similar to traditional social networks formed by means of face-to-face (F2F) conversations, telephone communication or mail interaction. However, this new form of socialization requires the existence of SNAs such as Twitter, where individual users can present themselves, contact friends and access information sources through one specific social network. This form of socialization is popular because of its capability to overcome the time and space limits of traditional networks (Kavanaugh et al. 2005; Lea et al. 2006).

The crux of a SNA's success is its capability to enable interactions between individual users on a mass scale within a connected online network. In order to achieve this capability, SNAs offer the

functionality of identity management (i.e. the representation of one individual actor in the form of a profile in a social network) and enable each user to keep in touch with other members (through the exchange of messages across the social network) (Richter and Koch 2008). Therefore, most social networking researchers consider identity management (Boyd and Heer 2006; Richter and Koch 2008) and information exchange (Bouman et al. 2008; Richter and Koch 2008) to be the key characteristics of SNAs. Specifically, identity management allows the users of a SNA to construct a social identity to present to their counterparts in the focal social network in the form of a personal profile. Information exchange allows connected social actors to exchange information directly (via messages) or indirectly (via photos and blogs) in a semi-structured way (Chou and Chou 2009). Richter and Koch (2008) summarize four other basic functionalities of SNAs, viz.: expert finding (i.e., using expert search as a way to identify knowledge); context awareness (i.e., common context with other people such as common interests, about the same university or company); contact management (i.e., maintenance of the digital personal network by tagging people, allowing access or restricting access to profiles); and network awareness (i.e., the awareness of activities by informing people about one's current status or changes). Typical examples of SNAs with the above six characteristics include Twitter, Facebook and LinkedIn. Overall, Richter and Koch's (2008) conceptual discussion has established a theoretical basis upon which the networking characteristics of SNAs can be further examined.

2.2 DeLone and McLean's IS Success Models

DeLone and McLean's (1992, 2003) ISSMs provide a means of measuring success – a complex dependent variable in IS research. The updated model proposed in 2003 includes six interrelated dimensions of IS success: system quality, information quality, service quality, use, user satisfaction and net benefit (see Figure 1). This model provided a scheme for classifying the multitude of IS success measures and suggested the temporal and causal interdependencies between the six dimensions. Information quality, service quality and system quality should be measured or controlled for, because separately or together they will affect subsequent use and user satisfaction. Use and user satisfaction are closely interrelated in the proposed model. Positive experience with use will lead to greater user satisfaction. Similarly, increased user satisfaction will lead to increased use. As a result of use and user satisfaction, certain net benefits will occur and will in turn influence and reinforce subsequent use and user satisfaction. DeLone and McLean's (1992, 2003) ISSM thus incorporates both *process* and *causal* relationships among the interrelated constructs.

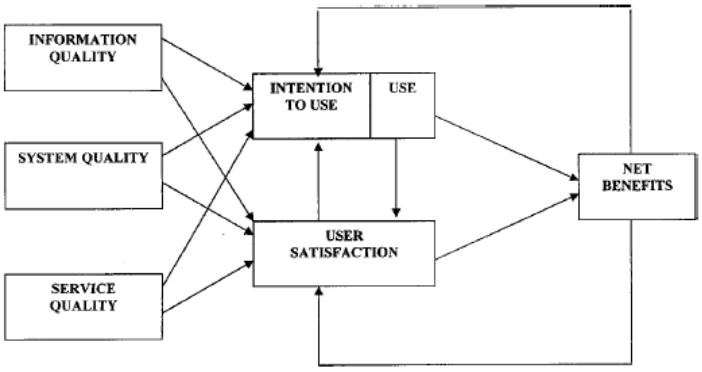

Figure 1. Updated Information Systems Success Model (DeLone and McLean 2003)

Although DeLone and McLean (2003) proposed an updated version of their ISSM, it has only received limited support from empirical studies that tested it in various contexts. Petter et al. (2008) found that tests of the significance of the ISSM constructs received mixed, even contradictory, findings. For example, most studies (e.g. Halawi et al. 2008) provided evidence for the insignificant influence of service quality in the use of ERP systems or KMS. Similarly, Wu and Wang (2008) argued that

service quality is not a good measure for a KMS because it serves as an independent variable rather than an indicator of IS success. Therefore, they dropped service quality from their research model. Wu and Wang (2006) also argued that although system use is a good proxy for IS success, it is not mandatory to model the path between system quality and system use.

Following Petter et al. (2008), we searched for related studies in online databases (e.g., EBSCO, ABI/INFORM, Science Direct and the Web of Knowledge) using the keywords 'information systems success', 'success model', 'success measurement', 'DeLone and McLean', and 'IS effectiveness'. A total of 706 conceptual and empirical papers, published from 2008 to 2010, were identified. We classified 41 studies as 'quantitative empirical research with mixed statistical evidence' on the efficacy of the ISSM in different research contexts. The meta-analytical summary is omitted in this conference paper for brevity, but is available from the authors.

3. THEORETICAL DEVELOPMENT

3.1 Identify the Research Gap and Conceptualize "Networking Quality"

Given the mixed empirical results for the revised ISSM, Petter et al. (2008) called for more empirical research to establish the strength of interrelationships across different contextual boundaries. Considering that the main stream of research on ISSMs focuses on utilitarian IS (such as ERP, KM and e-commerce systems), the need for empirical studies on hedonic IS (such as gaming and social networking) is apparent, especially in the area of social networking (Petter et al. 2008). However, we did not find any studies that apply the ISSM to measure a SNA's performance. Following Petter et al. (2008), we contend that ISSMs should be applicable to the social networking context. System quality of a SNA refers to the application's reliability, ease of use and response time. Service quality of a SNA refers to the overall support delivered by the service provider. Information quality of a SNA captures the completeness, relevance and ease of understanding of web content. While these three dimensions of quality may influence the use of a SNA and user satisfaction, they are not sufficient, since other core elements may also contribute to SNA success. In the context of social networking, the purpose of using SNAs is to expand an individual's social network and to improve the quality of social network lives with broader and stronger online connections with friends, colleagues and collaborators (Garton et al. 1997; Ganley and Lampe 2009). This view of networking has hardly been captured in existing ISSMs, although system quality, information quality and service quality are still relevant to system use and user satisfaction in the context of social networking. As noted by many researchers (e.g. Ganley and Lampe 2009), social capital in terms of information exchanged and the social relationship built in the SNAs is the key indicator and also the driver for people to use a SNA. IT enables the registered members to form many weak ties across different social groups, and strong personal ties with close friends and collaborators by daily update, information provision, emotional support, material aid and social identity (Wellman 2005). From the design perspective, a SNA's social successful networking features include identity management and information exchange, expert finding, context awareness, contact management and network awareness (Richter and Koch 2008). Measuring SNA success requires the above-mentioned dimension of networking quality to be captured. Given this research gap, the purpose of this study is to formalize the above conceptualization of networking quality and to provide empirical evidence on the significance of this construct in the context of social networking.

3.2 Proposing the SNA Success Model

We employ DeLone and McLean's updated ISSM (2003) to measure the success of SNAs, which we term as the SNA success model. Although empirical studies have observed inconsistent results of DeLone and McLean's ISSM (2003) in different research contexts (see Appendices 1 and 2), we expect system quality, information quality and service quality to play an important role in driving

SNA success, and therefore serve as independent variables in the SNA success model. As argued above, the networking features of SNAs are important characteristics that can render a SNA the capability to establish both weak and strong ties among individual users in different social groups within one specific social network such as Twitter or Facebook. We thus propose the conceptual model of SNA success to include this fourth dimension – networking quality – based on the original DeLone and McLean (1992, 2003) IS success model.

A number of alternative approaches to the ISSM's original feedback loop (i.e., the influence of net benefits on user satisfaction and use as shown in Figure 1) have been proposed. Seddon (1997) contended that the mixed process and causal explanation of ISSM introduces confusion. He further argued that system use must precede impacts and benefits. In addition, some scholars (Baroudi et al., 1986; Lee at al., 2009) argue that user satisfaction can cause system use rather than vice versa. As in past empirical studies (e.g., Wang and Liao, 2008; Lee et al., 2009), our research is cross-sectional in nature and therefore we do not measure more than a single usage of SNAs. Given these reasons, the feedback loop of the ISSM has been omitted in the current study.

We depict the whole research model in Figure 2. The definitions of constructs are summarized in Table 1. We provide detailed justifications for the proposed hypotheses in the following sub-sections.

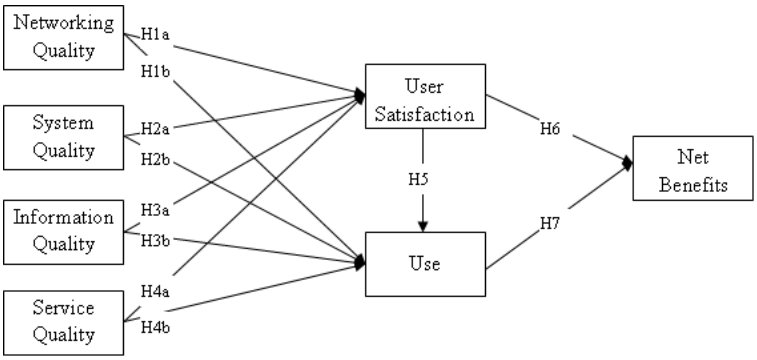

Figure 2. The SNA Success Model

Construct	Definition	Adapted from
Networking Quality	A user's perceived focal SNA's quality of social networking features to information exchange, identify management, contact management, expert search, context awareness, and network awareness	Wellman 2005; Richter and Koch 2008; Garton et al. 1997; Ganley and Lampe 2009
System Quality	A user's perceived focal SNA's quality of technical performance in terms of ease-of-use, stability, user friendliness, and response time	DeLone and McLean 2003; Wu and Wang 2006; Wang 2008
Information Quality	A user's perceived focal SNA's quality of the performance to the extent that the information fits use, is important, helpful, meaningful, practicable and clear	DeLone and McLean 2003; Wu and Wang 2006; Wang 2008
Service Quality	A user's perceived focal SNA's quality of customer service and support to the extent that corresponding administrators or customer service staff provide support when they promise to do, their willingness to help, their knowledge to answer questions and their understanding of users' specific needs	DeLone and McLean 2003; Wu and Wang 2006; Wang 2008
User Satisfaction	The level of satisfaction to the extent that the focal SNA meets the user's social networking needs, as well as a satisfactory level on the focal SNA's efficiency and effectiveness	DeLone and McLean 2003; Wu and Wang 2006; Wang 2008
Use	The use of the focal SNA to make and keep in touch with friends, as well as share information and knowledge	DeLone and McLean 2003; Wu and Wang 2006; Java et al. 2007; Wang 2008
Net Benefits	A user's perceived benefits brought by the focal SNA in	DeLone and McLean 2003; Wu

Construct	Definition	Adapted from
	terms of expanding the user's social networks, acquiring desired knowledge and information, the reduction of time and efforts to exchange information, the quality improvement of the user's social life	and Wang 2006; Java et al. 2007; Wang 2008;

Table 1. Constructs and Definitions

3.3 The Significance of Networking Quality in Measuring SNA Success

A SNA, such as Twitter, focuses on the building and reflecting of social networks or relations among people such as those who share interests and/or activities (Richter and Koch 2008). The provision of quality networking features is one of the major contributors to SNA success. Although each SNA provides a unique set of specific functionalities and characteristics, they all share the same objective of social networking, via the features of identity management and information exchange, expert finding, context awareness, contact management network awareness. The success of the social web is premised on allowing users to connect with others in a traditionally impossible way. Twitter, technically a message routing system (Bouman et al. 2008), connects a global community of friends and strangers by providing a platform for users to influence what is being socialized and talked about around the world. Unlike utilitarian IS applications, SNAs are primarily designed for social purposes with the key characteristic of quality networking. For example, Twitter enables people to keep in touch with their friends, satisfying an inherent human need for social interaction (Thibaut and Kelley 1959). The open and spontaneous interactions that occur on SNAs such as Twitter initiate the process of keeping each other updated, which in turn helps to build trust and reinforce friendship with satisfied experiences (Bouman et al. 2008), leading to a virtuous cycle of SNA usage. We thus hypothesize that:

H1a: A SNA's networking quality is positively associated with user satisfaction.

H1b: A SNA's networking quality is positively associated with SNA use.

3.4 The Significance of System Quality in Measuring SNA Success

System quality is a major system success criterion (DeLone and McLean 1992, 2003). Specifically, system quality refers to system characteristics, focusing on the technical aspect of an information system (DeLone and McLean 2003). It is concerned with whether there are errors in the system, the ease of use, the response time and stability of the system (DeLone and McLean 1992, 2003; Wu and Wang 2006). Similar to the ISSM, the technology acceptance model (Davis et al. 1989) also proposed that system attributes such as system friendliness have a significant impact on a user's satisfaction level. Although these scales of system quality are often used to measure utilitarian IS such as KMS, DSS, and ERP systems, they are also equally applicable to the measure of SNA success, as explained below. SNAs operate by ensuring the rapid relay of messages from millions of online users on a web-based platform or other electronic devices such as iPhones and iPads. Therefore system performance requirements are significant. A SNA needs to be easy to use and offer a swift response time if it is to keep its members and ensure that information content is constantly created. When tens of millions of users are involved concurrently, these SNAs provide an easy way for people to seek contacts, form friendships or coordinate actions. Poor usability and slow response times can discourage customer usage of such SNAs and lead to user dissatisfaction. System technical performance weaknesses will drive users away. We thus hypothesize that:

H2a: A SNA's system quality is positively associated with user satisfaction.

H2b: A SNA's system quality is positively associated with the SNA use.

3.5 The Significance of Information Quality in Measuring SNA Success

Information quality has long been a focus for IS researchers eager to measure system quality (DeLone and McLean 1992, 2003). Unlike previous research, where information quality was primarily measured in the form of reports, in this study we examine to what extent the information exchanged in social networks is updated, meaningful and helpful for users' social lives. Popular SNAs keep users informed with what matters most to them on a daily, hourly or minutely basis, and so help users to discover what might matter to them most in the immediate future. SNA success is related to the user's ability to leverage influence within their social networks, to act as "contactors" and "connectors" between people and information, and in turn build social capital. We argue that the surge of popularity in SNAs is due to the latent capacity to enable users to share information and ideas in a previously impossible way. For example, Twitter was described as enabling "a continuous flow of short updates on your life" (Bouman et al. 2008, p. 13). These SNAs shape users' social networks with intensive targeted information. SNAs allow users to contact the people they know and to access needed information sources. For example, Twitter was a key media channel seen in the wave of popular uprisings across the Middle East from 2009-2011, linking protesters to the outside world. People are assembled by SNAs which provide meaningful information. The more accurate, updated, meaningful and useful the information presented through these SNAs, the more people will be engaged and able to participate, and continue to use these SNAs in their lives. SNAs thus help to satisfy a human need for information. After using these SNAs for some time, SNA members may form a sophisticated social network, which in turn engages the users in a virtuous cycle with satisfied experiences. Therefore, we hypothesize that:

H3a: A SNA's information quality is positively associated with user satisfaction.

H3b: A SNA's information quality is positively associated with the SNA use.

3.6 The Significance of Service Quality in Measuring SNA Success

Service quality refers to the overall support delivered by the SNA service provider (DeLone and McLean 2003). We argue that this dimension is important for a SNA because users are customers, not employees. This dimension of quality measures the service provider's responsiveness and technical competence. Customer satisfaction is based on experience with the service. If a customer is dissatisfied with the service encounter, this will negatively influence the overall product and service quality evaluation (Cronin et al. 2000; Lam et al. 2004). Therefore poor user support will translate into lost customers and sales (DeLone and McLean 2004). SNA success depends on the information generated and exchanged by users. This means that customer support is less important than in other enterprise-wide IS. However, SNAs that provide a better quality of service to users are likely to be more competitive and so outperform other SNA providers. A simple piece of information, such as a phone number or an email address, that can be leveraged to reach the customer service department may help users to solve problems quickly before a situation deteriorates. If SNA users would like to enquire about issues with their own accounts, or communicate with the customer service department by email, the perceived ignorance of the SNA provider or its customer service staff will negatively influence user satisfaction. We thus propose that:

H4a: A SNA's service quality is positively associated with user satisfaction.

H4b: A SNA's service quality is positively associated with the SNA use.

3.7 User Satisfaction, Actual Use and the Net Benefits of SNA

DeLone and McLean (1992, 2003) have suggested close relationships among user satisfaction, actual use and net benefits with a feedback loop in the ISSM (see Figure 2). They also explain that "'use' must precede 'user satisfaction' in a *process* sense, but positive experience with 'use' will lead to

greater 'user satisfaction' in a causal sense. Similarly, increased 'user satisfaction' will lead to increased 'intention to use', and thus 'use'" (DeLone and McLean 2003, p.23). In this study, we establish a conceptual *causal* model, instead of a *process* model, to investigate the success of SNAs. In order to test the loop between use, satisfaction and net benefits in DeLone and McLean's updated ISSM (2003), we propose that user satisfaction leads to the use of SNAs, and subsequently enhances the perceived net benefits of using SNAs. This causal view is consistent with most studies on ISSMs, such as those on electronic commerce (e.g., Wang 2008) and knowledge management (e.g., Wu and Wang 2006), which suggest that user satisfaction leads to the actual usage of a system. Indeed, we argue that user satisfaction is a key element that determines the frequency of SNA use. When a user considers that a SNA can meet his/her social networking needs, it is more likely that the user will continue using the SNA. When the efficiency and effectiveness of the SNA can satisfy the user's requirements, the user will use the SNA more frequently. These arguments are in line with literature that has verified satisfaction as a reliable predictor of reuse (e.g., Cronin et al. 2000; Lam et al. 2004). We therefore hypothesize that:

H5: User satisfaction will positively affect SNA use.

Net benefits are the ultimate outcome measures of IS success in the causal view of an ISSM (see Figure 1). DeLone and McLean suggest that "as a result of the use and user satisfaction, certain net benefits will occur" (DeLone and McLean 2003, p.23). From the user point of view, the net benefits of using SNA involve the expansion of the user's social network and improvements to the quality of social life. This is the fundamental and ultimate design outcome of SNA – strengthening and expanding users' social networks by connecting people in the digital social networking site (Garton et al. 1997; Ganley and Lampe 2009). We contend that user satisfaction is the one of the key determinants influencing users' overall evaluation of the net benefits of using a SNA. Meanwhile, the increased usage of a SNA will expand a user's social networks. Exchanging messages and useful information with friends, co-workers and participants in the same interest groups can increase the bonds among users. The use of SNAs can also enable people to share information with less time and effort. On the other hand, it is very likely that a dissatisfied SNA user neither provides a positive evaluation of a SNA nor appreciates the aforementioned net benefits of the SNA. Consistent with DeLone and McLean (2003), we therefore propose that the use of and satisfaction with a SNA will lead to the user's positive evaluation of the net benefits of using the SNA and test the following hypotheses in the context of SNAs.

H6: User satisfaction will positively affect the net benefits of using the SNA.

H7: The use of a SNA will positively affect the net benefits of using the SNA.

4. METHODOLOGY

Based on the literature, we developed the measures of the constructs in the proposed SNA success model. System quality, information quality, and user satisfaction are measured by the adapted scales from a study about knowledge management success (Wu and Wang 2006) which was based on the original ISSM (DeLone and McLean 1992). Service quality is measured by the scales adapted from the SERVQUAL instrument (Kettinger and Lee 1997). As no existing research has empirically tested networking quality, we first conducted a panel interview with 10 SNA users to obtain their qualitative feedback on the potential measures. In the interview context, Twitter was chosen as the focal site of this research because of its prevalence. Secondly, we matched their qualitative feedback with the identification of SNA functions provided by Richter and Koch (2008) to develop the measures of networking quality. Integrating with the panel discussion and the literature, we finally specified six aspects – identity management, expert search, content management, context awareness, network awareness and information exchange – to measure networking quality. We adapted the ideas of Java et al. (2007) about user intention on Twitter to measure actual Twitter use. For the dependent variable, net benefit, we integrate the panel discussion, the study by Java et al. (2007) and the conceptual

discussion by Richter and Koch (2008) to develop the measures. It covers effective contact keeping, richness of information and easy exchange of information.

As this study includes several newly developed measures, we conducted a pilot study to verify their validity before we proceeded with the large-scale study. We sent the online survey to the members of the Association for Information Systems in early 2010. The participants were asked to indicate their experience and evaluation of Twitter. 30 valid responses were received in one week. We conducted a follow-up discussion with most of the respondents for their qualitative feedback on the measures and the survey. We revised ambiguous questions based on the respondents' suggestions. Appendix 1 documents all measures used in the later formal survey. One of the authors was responsible for recruiting survey respondents from Twitter.com on a voluntary and random basis. She followed the Tweets, published Tweets and sent out invitations to participate in an online survey to Twitter users. Over three weeks, she contacted 556 Twitter users and collected 139 valid responses, yielding a response rate of 25%. We summarize the demographic data in Table 2.

Items	**Options**	**%**	**Items**	**Options**	**%**	**Items**	**Options**	**%**
Gender	Male Female	39.6% 60.4%	Age	0-15 16-26 27-36 37-46 47 +	14.4% 45.3% 20.1% 15.1% 5%	Average Time Spent on Twitter per Day	6+ hours 4-5 hours 2-3 hours 1-2 hours 0-1 hours	15.1% 19.4% 23.0% 22.3% 20.1%
No. of Followers	0-100 101-200 201-300 301-400 400 +	56.7% 16.5% 6.5% 3.6% 20.0%	No. of Followees	0-100 101-200 201-300 301-400 500 +	54.7% 15.8% 7.2% 6.5% 15.8%	Length of Usage	0-1 months 1-6 months 1 year 2 years 3+ years	12.9% 33.8% 38.1% 11.5% 3.6%
Items	**Options**			**%**		**Items**	**Options**	**%**
Education	Junior High School or below Senior High School or Technical School Junior College Bachelor's Degree Master's Degree or above			14.4% 25.2% 8.6% 24.5% 27.3%		Frequency of Visit	Everyday Once a week 2 or 3 times a month Once a month 2 or 3 times a week	75.5% 13.7% 4.3% 1.4% 5.0%
Frequency of Publishing a Tweet	Everyday 2 or 3 times a week Once a week 2 or 3 times a month Once a month Never; I only read others' tweets			65.5% 16.5% 5.0% 2.9% 2.9% 7.2%		Frequency of Receiving a Tweet	Everyday 2 or 3 times a week Once a week 2 or 3 times a month Once a month Never; I only write tweets	60.4% 14.4% 7.2% 7.2% 3.6% 7.2%

Table 2. Demographic Data (n=139)

5 DATA ANALYSIS

5.1 Validating the Measures

We used Statistical Package for the Social Sciences (SPSS) and Smart Partial Least Squares (SPLS) for verifying the measurements, as well as testing the whole model. Convergent and discriminant validity are confirmed by factor analysis (as shown in Appendix 2). Cronbach's alphas of all constructs are above 0.90. The square roots of the Average Variance Extracted (AVE) of all constructs are above 0.80 (diagonal elements of Table 3), ensuring that the AVE for each construct is greater than the squared correlations between constructs. We summarize the detailed analytical results in Table 3.

Constructs	Mean(STD)	Reliability	1	2	3	4	5	6	7
1. System Quality	5.68 (1.23)	0.93	**0.88**						
2. Information Quality	5.50 (1.15)	0.93	0.53	**0.87**					
3. Service Quality	2.26 (2.22)	0.98	0.05	0.03	**0.98**				
4. Networking Quality	5.58 (1.25)	0.94	0.54	0.63	0.07	**0.82**			
5. User Satisfaction	5.41 (1.35)	0.97	0.62	0.58	0.07	0.70	**0.93**		
6. Use	5.71 (1.23)	0.93	0.58	0.56	0.09	0.62	0.72	**0.86**	
7. Net Benefit	5.58 (1.38)	0.95	0.65	0.65	0.02	0.71	0.71	0.74	**0.91**

Table 3. Mean, Standard Deviation, Reliability, Correlations and AVE

Common method bias was tested. Evidence for common method bias exists if one principal factor counts for most of the variance explained (Podsakoff and Organ 1986). Our principal components factor analysis indicates that each principal factor explains roughly equal variance (10.97%~12.83%) (Appendix 2). Second, the correlation matrix (Table 3) shows that the highest inter-construct correlations are below 0.74, while common method bias is usually evidenced by extremely high correlations (r>.90) (Bagozzi et al. 1991). These tests suggest that common method bias is not a serious problem in this study. Collinearity indicators (tolerance values and variance inflation factors) were also calculated and found to be less than the acceptable cut-off points (Amoroso and Cheney 1991; Hair et al. 1995), indicating that the study does not suffer from multicollinearity problems.

5.2 Testing the Research Model

We ran the whole research model using PLS. The results are summarized in Figure 3. The proposed research model received strong support from the data, except H3a, H4a and H4b. The results show that networking quality has a significant impact on user satisfaction (b=0.47, p<0.01) and use (b=0.17, 0.05<p<0.10), thus supporting H1a and H1b. System quality significantly influences user satisfaction (b=0.30, p<0.01) and use (b=0.16, 0.05<p<0.10), thus validating H2a and H2b. The influence of information quality on use is significant (b=0.14, 0.05<p<0.10), thus supporting H3b. The results show that user satisfaction has significant effects on both use (b=0.44, p<0.01) and net benefits (b=0.39, p<0.01), verifying H5 and H6. Together with the contribution from use (H7: b=0.45, p<0.01), the explained variance of net benefits yields 61.3%. The high variances explained to user satisfaction and use are 58.4% and 57.5%, respectively. In sum, the R2 scores for all dependent variables and the high factor loadings yield an adequate goodness-of-fit for the overall research model (Chin 1998).

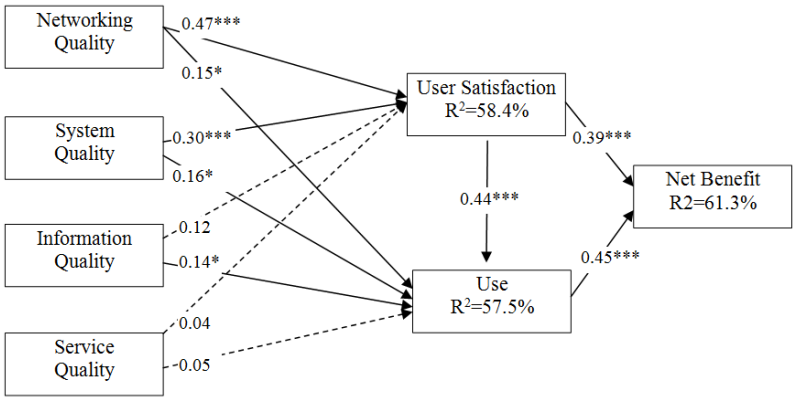

*Fig. 4 PLS Results of structural model (Note: *0.05<p<0.10; **0.01<p<0.05;***p<0.01)*

As networking quality is the focus of this study, we conducted a hierarchical regression analysis focusing on this construct, first excluding networking quality from the research model. Without networking quality, the path from information quality to user satisfaction is significant (b=0.33, p<0.01). When networking quality is included in the whole model, the R2 of user satisfaction is

increased from 46.8% to 58.4%. The extra variance – 11.6% – explained by networking quality in addition to system quality, information quality and service quality is satisfactory. When networking quality is included as an independent variable in the research model, the path from information quality to user satisfaction became insignificant, suggesting the effect of networking quality. This robustness test provides evidence for the insignificant role of information quality on determining user satisfaction.

6. DISCUSSION, FUTURE RESEARCH AND CONCLUSIONS

This research has several key findings. First, we have identified the contribution of the new construct, networking quality, on use and user satisfaction. Its effect is the strongest among all the independent variables determining user satisfaction. Secondly, system quality also plays an important role in use and user satisfaction, while information quality and service quality only have moderate impacts on use and user satisfaction. Such findings further confirm the overwhelming role of networking quality. Over 70% of respondents answered NA (not applicable) to the questions about service quality. For a self-administrated and self-operated SNA, service quality appears not the major issue for evaluating the success of the SNA, highlighting the difference between traditional ISSMs and SNA success model. Last, but not the least, the data suggests that the relationships among user satisfaction, use and net benefit are very healthy. Both use and user satisfaction generate significant levels of net benefit in using the focal SNA. Members of Twitter find that the SNA can enable them to keep in touch with others and exchange information. Net benefit is thus generated.

Theoretically, the dimension of networking quality has extended DeLone and McLean's ISSM (1992, 2003, 2004) by emphasizing the unique and underlying characteristics of SNAs. This study is among the first attempts to conceptualize the underlying characteristics and purpose of designing SNAs, viz., quality networking functionalities. Networking quality concerns the social networking provisions with socialization and swift information exchange, helping SNA members to keep in touch with each other. Empirically speaking, networking quality turns out to have the strongest link with user satisfaction. The results show that Twitter provides a quality social networking platform. Individual members can distribute Tweets by instant messengers, mobile phones, email or the Web, while Twitter's search engine keeps users updated with hot news. These functions contribute to the quality of Twitter. The users are able to keep in touch with friends and exchange information effectively. When developing a social networking website, it is critical to ensure the quality of the networking quality.

Although Twitter is a typical SNA, this study should be replicated with other SNAs such as Facebook, SecondLife and etc, and also cover a broader range of users in terms of demography so as to further verify the generalizablity of the research model. Meanwhile, this study only showed that networking quality is a contributing factor of Twitter's success. Our study has not shown specifically which elements of networking quality contribute more in a SNA's success. Future studies investigating the effects of SNAs can further verify the effectiveness of each element included in the networking quality. So networking quality can be developed into a multidimensional second-order construct in the future, following the method suggested by Lewis et al. (2005). Such interview data can be also analyzed and regarded as the input to the development of the measures, which can enrich and strengthen the rigor of measurement development process.

Practically, the recent surge of SNAs has aroused substantial public interest: users can update their status anywhere, as well as send and receive information globally. SNAs no longer constitute a simple platform for people to form social networks, but also serve as marketing and service tools for various business purposes. This is likely to enhance SNAs' prevalence in the future. We have witnessed the importance of effective social networking in determining a SNA's success. It is always critical to provide easy ways to for SNA users to get to know and keep in touch with other persons with similar interests. With this underlying principle in mind, the design of SNAs will always need to be fine-tuned to accommodate the users' need for quality networking functions. We look forward to more theoretical and practical studies on SNAs, in both social and work contexts.

Appendix 1: Measurement Items

Networking Quality
Scale: Strongly disagree (1) – Strongly agree (7)
(1). Twitter makes it easy for me to create new short message.
(2). Twitter makes it easy for me to present myself. (Drop)
(3). Twitter makes it easy for me to organize my contacts.
(4). Twitter makes it easy for me to get to know people.
(5). Twitter makes it easy for me to have expert/person search.
(6). Twitter makes it easy for me to keep in touch with what others doing and going to do.
(7).Twitter makes it easy for me to share information.
(8). Twitter makes it easy for me to find people with similar interest.

System Quality
Scale: Strongly disagree (1) – Strongly agree (7)
(1). Twitter is easy to use.
(2). Twitter is user friendly.
(3). Twitter is stable.
(4). The response time of Twitter is acceptable.

Information Quality
Scale: Strongly disagree (1) – Strongly agree (7)
(1). The content representation provided by Twitter user is logical.
(2). The information provided by Twitter users is important and helpful for my work and social life.
(3). The information provided by Twitter users is updated, meaningful, and practicable.
(4). The classification or index in Twitter users is clear and unambiguous.

Service Quality
If you never contact the Twitter administrators/customer service by any means (e.g., email, phone), please select "NA". Scale: Not Applicable (NA), Strongly disagree (1) – Strongly agree (7)
(1). Twitter administrator/customer service provides their services at the time they promise to do so.
(2). Twitter administrator/customer service is always willing to help you.
(3). Twitter administrator/customer service has knowledge to answer your questions.
(4). Twitter administrator/customer service understands your specific needs.

User Satisfaction
Scale: Strongly disagree (1) – Strongly agree (7)
(1). I am satisfied that Twitter meets my social networking needs.
(2). I am satisfied with Twitter's efficiency.
(3). I am satisfied with Twitter's effectiveness.
(4). Overall, I am satisfied with Twitter.

Use
Scale: Strongly disagree (1) – Strongly agree (7)
(1). I use Twitter to keep in touch with friends.
(2). I use Twitter to help me record my work in a day. (Drop)
(3). I use Twitter to communicate knowledge and information with friends.
(4). I use Twitter to share my general knowledge.
(5). I use Twitter to share my specific knowledge.
(6). I use Twitter to make new friends.

Net benefit
Scale: Strongly disagree (1) – Strongly agree (7)
(1). Twitter expands my social network.
(2). Twitter helps me acquire desired knowledge and information.
(3). I can share information with less time and less effort.
(4). Twitter improves the quality of my social life.

Appendix 2: The Results of Principal Component Analysis

Component	1	2	3	4	5	6	7
System Quality 1	.051	.162	.168	**.844**	.200	.212	.095
System Quality 2	-.035	.152	.265	**.807**	.279	.071	.155
System Quality 3	.060	.008	.230	**.603**	.173	.323	.383
System Quality 4	.030	.035	.172	**.788**	.086	.226	.243
Information Quality 1	-.076	.250	.167	.184	.119	.071	**.800**
Information Quality 2	.022	.181	.180	.051	.260	.455	**.692**
Information Quality 3	-.027	.252	.038	.232	.190	.227	**.741**
Information Quality 4	.075	.103	.229	.248	.074	.173	**.766**
Service Quality 1	**.980**	.030	.053	-.011	-.002	.000	.016
Service Quality 2	**.986**	.040	-.008	.034	.048	.016	-.010
Service Quality 3	**.971**	-.015	.001	.034	.049	-.002	.013
Service Quality 4	**.990**	.032	.016	-.003	.041	-.008	-.012
Networking Quality 1	.046	**.448**	.400	.356	.082	.282	.244
Networking Quality 3	.071	**.721**	.248	.037	.072	.212	.364
Networking Quality 4	.107	**.680**	.290	.105	.204	.294	.214
Networking Quality 5	.080	**.723**	.230	.016	.209	.171	.275
Networking Quality 6	-.090	**.756**	.200	.297	.174	.284	.107
Networking Quality 7	-.100	**.699**	.114	.413	.187	.326	.028
Networking Quality 8	.113	**.650**	.237	.053	.237	.084	.358
User Satisfaction 1	.041	.253	**.744**	.170	.194	.328	.236
User Satisfaction 2	.030	.218	**.777**	.298	.260	.198	.114
User Satisfaction 3	.052	.256	**.729**	.248	.344	.226	.241
User Satisfaction 4	-.006	.234	**.736**	.318	.284	.237	.168
Use1	-.043	.167	.422	.216	**.509**	.195	.291
Use3	.025	.132	.346	.263	**.733**	.232	.166
Use4	.100	.157	.277	.161	**.802**	.230	.117
Use5	.061	.141	.035	.219	**.849**	.221	.097
Use6	.085	.184	.338	.000	**.563**	.440	.263
Net Benefit 1	-.032	.222	.190	.272	.375	**.711**	.189
Net Benefit 2	.032	.251	.156	.314	.278	**.706**	.255
Net Benefit 3	.009	.241	.248	.252	.280	**.681**	.258
Net Benefit 4	-.036	.226	.376	.221	.222	**.718**	.185
Eigenvalues	**3.96**	**3.96**	**3.79**	**3.66**	**3.63**	**3.56**	**3.51**
Variance Explained Total=81.45%	**12.83**	**12.37**	**11.83**	**11.43**	**11.35**	**11.13**	**10.97**

References

Amoroso, D.L. and Cheney, P.H. (1991) Testing a causal model of end-user application effectiveness. *Journal of Management Information Systems*, 8(1), 63-89.

Bagozzi, R.P., Yi, Y. and Phillips, L.W. (1991) Assessing construct validity in organizational research. *Administrative Science Quarterly*, 36, 421-458.

Baroudi, J.J., Olson, M.H., and Ives, B. (1986) An empirical study of the Impact of user involvement on system usage and information satisfaction. *Communication of the ACM*, 29(3), 232-238.

Bouman, W., Hoogenboom, T., Jansen, R., Schoondorp, M., de Bruin, B. and Huizing, A. (2008) The Realm of Sociality: Notes on the Design of Social Software, PrimaVera Working Paper. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.162.2202&rep=rep1&type=pdf.

Boyd, D.M. and Heer, J.M. (2006) Profiles as conversation: Networked identity performance on Friendster. *Hawaii International Conference on System Sciences*, Kauai, Hawaii, p.1-10, available at http://www.danah.org/papers/HICSS2006.pdf.

Chin, W.W. (1998) Issues and opinion on structural equation modeling, *MIS Quarterly*, 22(1), vii – xvi.

Chou, A.Y. and Chou, D.C. (2009) Information system characteristics and social network software adoption. *Proceedings of the SWDSI conference*, p.335 – 343, http://www.swdsi.org/swdsi2009/Papers/9K02.pdf.

Cronin, J.J., Brady, M.K. and Hult, G.T.M. (2000) Assessing the effects of quality, value, and customer satisfaction on consumer behavioral intentions in service environments. *Journal of Retailing*, 76, 193–218.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.

DeLone, W.H. and McLean, E.R. (1992) Information systems success: The quest for the dependent variable. *Information Systems Research*, 3(1), 60–95.

DeLone, W.H. and McLean, E.R. (2003) The DeLone and McLean model of information system success: A ten-year update. *Journal of Management Information Systems*, 19(4), 9–30.

DeLone, W.H. and McLean, E.R. (2004) Measuring e-commerce success: Applying the DeLone & McLean information systems success model. *International Journal of Electronic Commerce*, 9(1), 31–47.

Ganley, D. and Lampe, C. (2009) The ties that bind: Social network principles in online communities. *Decision Support Systems*, 47(3), 266-274.

Garton, L., Haythornthwaite, C. and Wellman, B. (1997) Studying online social networks. *Journal of Computer-Mediated Communication*, 3(1), http://jcmc.indiana.edu/vol3/issue1/garton.html.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1995) *Multivariate Data Analysis with Readings* (4th ed.), Prentice Hall, Englewood Cliffs, NJ.

Halawi, L.A., McCarthy, R.V. and Aronson, J.E. (2008) An empirical investigation of knowledge-management systems' success. *The Journal of Computer Information Systems*, 48(2), 121–135.

Java, A., Song, X.D., Finin, T. and Tseng, B. (2007) Why we Twitter: Understanding Microblogging Usage and Communities, *Proceedings of the 9th Web KDD and 1st SNA-KDD Workshop on Web Mining and Social Network Analysis.*

Kavanaugh, A., Reese, D. D., Carroll, J. M. and Rosson, M. B. (2005) Weak ties in networked communities. *The Information Society*, 21, 119–131.

Kettinger, W.J. and Lee, C.C. (1997) Pragmatic perspectives on the measurement of information systems service quality. *MIS Quarterly*, 21(2), 223-240.

Lam, S.Y., Shankar, V., Erramilli, M.K. and Murthy, B. (2004) Customer value, satisfaction, loyalty, and switching cost: An illustration from a business-to-business service context. *Journal of the Academy of Marketing Science*, 32, 293–311.

Lea, B., Yu W. and Maguluru, N. (2006) Enhancing business networks using social network based virtual communities. *Industrial Management & Data Systems*, 106(1), 121-138.

Lee, S-Y. T., Kim, H-W., and Gupta, S. (2009) Measuring open source software success. *Omega*, 37, 426-438.

Murnan, C. A. (2006) Expanding communication mechanisms: They're not just e-mailing anymore. *Proceedings of the 34th Annual ACM SIGUCCS Conference on User Services*, 267-272.

Petter, S., DeLone, W., and McLean, E. (2008) Measuring information systems success: Models, dimensions, measures, and interrelationships. *European Journal of Information Systems*, 17(3), 236-263.

Podsakoff, P.M. and Organ, D.W. (1986) Self-reports in organizational research: Problems and prospects. *Journal of Management Information Systems*, 12(2), 531-544.

Richter, A. and Koch, M. (2008) Functions of social networking services. *The Proceeding of the 8th International Conference on the Design of Cooperative Systems*, 87-98.

Seddon, P.B. (1997) A respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research*, 8(3), 240-253.

Thibaut, J.W. and Kelley, H.H. (1959) *The Social Psychology of Groups*, New York: Wiley.

Wang, Y.S. (2008) Assessing e-commerce systems success: A respecification and validation of the DeLone and McLean model of IS success. *Information Systems Journal*, 18(5), 529-557.

Wang, Y.S., and Liao, Y.W. (2008) Assessing eGovernment systems success: A validation of the DeLone and McLean model of information systems success. *Government Information Quarterly*, 25, 717-733.

Wellman, B. (2005) Community: From neighborhood to network. *Communications of the ACM*, 48(10), 53-55.

Wu, J.H. and Wang, Y.M. (2006) Measuring KMS success: A respecification of the DeLone and McLean's model. *Information & Management*, 43(6), 728-739.

Lewis, B. R., Templeton, G. F., and Byrd, T. A., (2005). A methodology for construct development in MIS research. *European Journal of Information Systems*, 14(4), 388-400.