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Fostering the determinants of knowledge sharing in professional virtual communities

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ABSTRACT

Professional virtual communities (PVCs), which are formed on the Internet, are expected to serve the needs of members for communication, information, and knowledge sharing. The executives of organizations should consider PVCs as a new innovation or knowledge pool since members share knowledge. However, many PVCs have failed due to members' low willingness to share knowledge with other members. Thus, there is a need to understand and foster the determinants of members' knowledge sharing behavior in PVCs. This study develops an integrated model designed to investigate and explain the relationships between contextual factors, personal perceptions of knowledge sharing, knowledge sharing behavior, and community loyalty. Empirical data was collected from three PVCs and tested using structural equation modeling (SEM) to verify the fit of the hypothetical model. The results show that trust significantly influences knowledge sharing self-efficacy, perceived relative advantage and perceived compatibility, which in turn positively affect knowledge sharing behavior. Furthermore, the study finds that the norm of reciprocity does not significantly affect knowledge sharing behavior. The results of the study can be used to identify the motivation underlying individuals' knowledge sharing behavior in PVCs. By investigating the impacts of contextual factors and personal perceptions on knowledge sharing behavior, the integrated model better explains behavior than other proposed models. This study might help executives of virtual communities and organizations to manage and promote these determinants of knowledge sharing to stimulate members' willingness to share knowledge and enhance their virtual community loyalty. As only little empirical research has been conducted on the impact of knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility on the individual's knowledge sharing behavior in PVCs, the empirical evidence reported here makes a valuable contribution in this highly important area.

1. Introduction

The internet has led to a proliferation of virtual communities (VCs) all over the world (Fernback, 1999; Hiltz & Wellman, 1997). Exchanging information and knowledge inside VCs has dramatically changed our lives. To be successful in today's competitive workplace, more and more individuals proactively take part in different kinds of VC, especially in professional VCs (PVCs) for knowledge workers that enable them to seek, collect, or even contribute knowledge to improve their capabilities, to absorb advanced insights, and to resolve problems at work. Many organizations have also recognized PVCs as valuable systems for knowledge management and have begun to support the development and growth of PVCs to meet their business needs and objectives (Gongla & Rizzuto, 2001). The executives of organizations should consider PVCs as a new innovation or knowledge pool since members share knowledge (Nambisan & Sawhney, 2007).

Over the past decade, a number of researchers have suggested that VCs (Preece, 2000; Rothaermel & Sugiyama, 2001) and knowledge sharing behaviors are influential to knowledge management success (Chowdhury, 2005; Kankanhalli, Tan, & Wei, 2005; Wasko & Faraj, 2005; Williams, 2001). This importance has led to the investigation of knowledge sharing in VCs by some scholars in an effort to determine what factors are significant to knowledge sharing and knowledge management success (Chiu, Hsu, & Wang, 2006; Hsu, Ju, Yen, & Chang, 2007; Koh & Kim, 2004; Wasko & Faraj, 2005). Most previous studies have focused on either contextual factors and knowledge sharing (Bock & Kim, 2002; Bock, Zmud, Kim, & Lee, 2005; Kankanhalli et al., 2005; Purvis, Sambamurthy, & Zmud, 2001; Wasko & Faraj, 2005) or on personal factors and knowledge sharing (Bock & Kim, 2002; Chiu et al., 2006; Hsu et al., 2007; Kankanhalli

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et al., 2005; Wasko & Faraj, 2005). In this study, we propose an integrated framework to develop a more comprehensive perspective of the relationships between contextual factors, personal perceptions of knowledge sharing, knowledge sharing behavior, and community loyalty, and bring it up-to-date with empirical data from three PVCs.

We investigate how the contextual factors (norm of reciprocity and trust) and personal perceptions of knowledge sharing (knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility) can influence PVC members' willingness to share knowledge with other members and their loyalty to their communities. To get a better understanding of knowledge sharing in PVCs, we examine the relationships between the following four pairs of concepts:

- Contextual factors and knowledge sharing behavior.
- Contextual factors and personal perceptions of knowledge sharing.
- Personal perceptions of knowledge sharing and knowledge sharing behavior.
- Knowledge sharing behavior and community loyalty.

We performed an on-line survey in three PVCs in Taiwan. The empirical data used in the study comprises 350 members, including IS (information science) engineers, programmers, managers, researchers, teachers, students, and other knowledge workers. The research model and hypothesized relationships are empirically tested using the structural equation modeling (SEM) approach, supported by LISREL 8.7 software.

Knowledge-based VCs or organizations need to increase the quality and quantity of new knowledge more rapidly to satisfy the expanding requirements of members. This research has been pursued to assist executives of VCs or organizations to solve some of the difficulties that occur in knowledge management (KM). A universally accepted definition of KM does not yet exist. Many definitions of KM have been proposed in the literature (Nonaka, 1991; Petrash, 1996; Wiig, 1997). Our comprehensive definition of KM is based on Corso, Martini, Paolucci, and Pellegrini (2003). KM in this context is the combination of management systems, organizational mechanisms, information, and communication technologies through which an organization fosters and focuses individual and group behaviors in terms of assimilation and generation, transfer and sharing, capitalization and reuse of knowledge, in tacit or explicit form, that is useful to the organization.

Even with the existence of information systems, knowledge sharing is a difficult challenge for organizations (Argote, Ingram, Levin, & Moreland, 2000; Bakker, Leenders, Garray, Kratzer, & Van Engelen, 2006; Szulanski, 1996). Researchers have noted that knowledge management often fails in fostering knowledge sharing efforts due to its neglect of the willingness of knowledge sharing and the knowledge required for successful knowledge sharing; the omission of important enhancing activities from their knowledge sharing mechanisms; and their often ineffective and inefficient performance of knowledge sharing tasks (Kankanhalli et al., 2005; Pfeffer & Sutton, 1999). In addition to these difficulties, the investigation of knowledge sharing relationships with "personal perceptions of knowledge sharing" such as knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility have not been closely scrutinized to ascertain members' involvement with and contribution to knowledge sharing in VCs. The influence of contextual factors and personal perceptions of knowledge sharing on knowledge sharing behavior and community loyalty is a critical area on which very few studies have been performed. We attempt to illuminate some of KM areas.

2. Theoretical background

2.1. Knowledge sharing and influencing factors

Knowledge sharing is the behavior of an individual dispersing his or her obtained knowledge and information to other colleagues within an organization (Ryu, Ho, & Han, 2003). Knowledge sharing involves a process of communication whereby two or more parties are involved in the transfer of knowledge. Hence, knowledge sharing is defined as a process of communication between two or more participants involving the provision and acquisition of knowledge (Usoro, Sharratt, Tsui, & Shekhar, 2007). Recently, researchers have highlighted the various factors that affect an individual's willingness to share knowledge, such as information and communication technologies, costs and benefits, incentive systems, extrinsic and intrinsic motivation, social capital, social and personal cognition, organization climate, and management championship (Alavi & Leidner 1999; Bock & Kim, 2002; Bock et al., 2005; Chiu et al., 2006; Hsu et al., 2007; Kankanhalli et al., 2005; Koh & Kim, 2004; Orlikowski 1996; Purvis et al., 2001; Wasko & Faraj, 2005). Therefore, we could presume that individuals' behavior for knowledge sharing is affected by the contextual factors and personal perceptions of the knowledge sharing in which they partake in. Social cognitive theory (SCT) (Bandura, 1982, 1986, 1997) is a widely accepted model for validating individual behavior (Compeau & Higgins, 1995). To investigate the knowledge sharing behavior in PVCs, we use SCT to conceptualize a research model for this study. In the SCT model, contextual factors, personal factors, and behavior act as interacting relationships (Wood & Bandura, 1989). This study focuses on the role of contextual factors and personal perceptions on individual behavior.

The norm of reciprocity and trust are treated as two major contextual factors influencing personal perceptions and a member's behavior. Knowledge sharing self-efficacy, perceived relative advantage, and compatibility are seen as predictors of personal factors since they are all considered as the main influences shaping users' behavior (Bandura, 1982, 1986, 1997; Igbaria & Iivari, 1995; Rogers, 2003; Sia, Teo, Tan, & Wei, 2004; Verhoef & Langerak, 2001).

2.2. Contextual factors

According to Davenport and Prusak's (1998) idea of a knowledge market, the norm of reciprocity and trust are two of the most significant factors that drive knowledge sharing. Prior research indicates that knowledge sharing in electronic networks is facilitated by a strong sense of reciprocity – favors given and received – along with a strong sense of fairness (Wasko & Faraj, 2000). Even though exchanges in electronic networks occur through weak ties between strangers, there is evidence of reciprocal supportiveness (Wellman & Gulia, 1999). The norm of reciprocity usually refers to a set of socially accepted rules regarding a transaction in which a party extending a resource to another party obligates the latter to return the favor (Wu et al., 2006), and has been highlighted as a benefit for individuals to engage in social exchange (Blau, 1964). A basic norm of reciprocity is a sense of mutual indebtedness, so that individuals usually reciprocate the benefits they receive from others, ensuring ongoing supportive exchanges (Shumaker & Brownell, 1984). Different from altruism, the norm of reciprocity represents a pattern of behavior where people respond to friendly or hostile actions with similar actions (Fehr & Gachter, 2000). This implies actions that are contingent on rewarding reactions from others and that cease when these expected reactions are not forthcoming (Blau, 1964). The norm of reciprocity can serve as a motivational mechanism for people to contribute to discretionary databases (Connolly & Thorn, 1990). Wasko and Faraj

(2000) suggested that people who share knowledge in online communities believe in reciprocity.

Trust, an implicit set of beliefs that the other party will behave in a dependent manner (Gefen, Karahanna, & Straub, 2003; Kumar, Scheer, & Steenkamp, 1995) and will not take advantage of the situation (Gefen et al., 2003), has been also recognized as an important factor affecting knowledge sharing (Ridings, Gefen, & Arinze, 2002) and as a determinant of the effectiveness of knowledge-sharing activities (Chowdhury, 2005; Williams, 2001). Davenport and Prusak (1998) indicated that trust must be visible; the members of the organization must see people get credit for knowledge sharing. They must directly experience reciprocity. According to Blau (1964), trust creates and maintains exchange relationships, which in turn may lead to sharing knowledge of good quality. Nonaka (1994) indicated that inter-personal trust is important in teams and organizations for creating an atmosphere for knowledge sharing. Trust has been recognized as an important antecedent of IS group performance and it has been found that knowledge sharing is achieved through the mechanisms of mutual trust and influence between these groups (Nelson & Cooprider, 1996). Nahapiet and Ghoshal (1998) suggested that when trust exists between the parties, they are more willing to engage in cooperative interaction.

2.3. Personal perceptions of knowledge sharing

Researchers noted that individual perceived attributes, such as knowledge sharing self-efficacy, perceived relative advantage, and compatibility, influence member knowledge sharing in virtual communities and organizations (Bock & Kim, 2002; Chiu et al., 2006; Hsu et al., 2007; Kankanhalli et al., 2005; Wasko & Faraj, 2005).

Individuals pursuing improved perceptions of competency are motivated by internal self-efficacy-based motivation. Self-efficacy is a form of self-evaluation that influences decisions about what behaviors to undertake, the amount of effort and persistence to put forth when faced with obstacles, and the mastery of the behavior. In general, perceived self-efficacy plays an important role in influencing individuals' motivation and behavior (Bandura, 1982, 1986; Igbaria & Iivari, 1995). For these individuals, the need for a higher level of traits, competency, and values in their important identities spurs them to perform a task. Therefore, people who have high self-efficacy will be more likely to perform related behavior than those with low self-efficacy (Schunk, 1990). This construct has received considerable attention through empirical research in the organizational behavior field (Gist & Mitchell, 1992). More recently, the concept of self-efficacy has been applied to knowledge management to validate the effect of personal efficacy belief in knowledge sharing, i.e. knowledge sharing self-efficacy. For example, in a motivation theory context, research has found that knowledge sharing self-efficacy positively influences the motivation to share knowledge (Hsu et al., 2007; Kankanhalli et al., 2005; Wasko & Faraj, 2005).

Relative advantage refers to the degree to which an innovation provides more benefits than its precursor. Relative advantages are manifested as increased efficiency and effectiveness, economic benefits, and enhanced social status (Rogers, 2003). Moore and Benbasat (1991) found that perceived relative advantage of an innovation is positively related to the rate of adoption. Correspondingly, facilitators of knowledge sharing reported obvious benefits such as reduced communication costs and faster problem-solving capability (Song, 2002). Therefore, when decision makers perceive clear overall personal and organizational benefits of knowledge sharing, they are more likely to facilitate a knowledge-sharing culture in the organization (Kaser & Miles, 2002).

Individuals motivated by a purpose behave in congruity with their value systems. Achieving internalized values and the purpose of the new program or matter is the driving force behind this source of motivation. Gerrard and Cunningham (2003) and Rogers (2003) defined compatibility as the degree to which an innovation is perceived as being consistent with existing values, previous experiences, and potential needs, where existing values involve lives style/habit, work attitude/relevance, and concepts in knowledge sharing; previous experiences include using a computer, the internet, new technology, and knowledge sharing in VCs; and potential needs involve improved job performance, problem-solving capability, innovation, and competitive advantage. Greater compatibility between personal policy and administrative innovation is preferable because it is less uncertain to potential adopters and permits innovation to be interpreted in a more familiar context (Rogers, 2003).

3. Research model

Based on SCT, we may reasonably assume that the contexts of PVCs shaped by the norm of reciprocity and trust should influence personal perceptions and a member's behavior. Fig. 1 shows the research model for this study, which examines the effects that the norm of reciprocity has on knowledge sharing behavior through trust and three personal perceptions. We also examine the relationship knowledge sharing behavior and community loyalty. Each construct involved in the research model and hypotheses are discussed below.

In this study, the definition of the norm of reciprocity is people's salient belief that current knowledge sharing in VCs will lead to a future request for knowledge being met (Davenport & Prusak, 1998). The norm of reciprocity refers to knowledge exchanges that are mutual and perceived by the parties as obligatory and fair. These arguments suggest a positive relationship between reciprocity and the behavior of knowledge sharing by knowledge contributors. Knowledge sharing is encouraged and the tendency to forego the temptation to free-ride suggests that the norm of reciprocity governs online interaction (Constant, Sproull, & Kiesler, 1996; Rheingold, 2000; Wasko & Faraj, 2000; Wellman & Gulia, 1999). According to the social exchange theory (Thibaut & Kelley, 1959), the norm of reciprocity could underline the motivation and commitment of community members to sharing knowledge (Hall, 2001). When there is a strong norm of reciprocity in the collective, knowledge contributors may feel obliged to share their knowledge (Wasko & Faraj, 2005). In such a climate, knowledge contributors are likely to share their knowledge with other members in PVCs; the norm of reciprocity may be a salient motivator for knowledge contributors. Thus, the following hypothesis is proposed:

H1. The norm of reciprocity positively affects members' knowledge sharing behavior in PVCs.

Trust has been studied in a variety of online settings, and results indicate that trust in others' ability, benevolence, and integrity is related to the desire to give and receive information (Ridings et al., 2002) and to improved performance in distributed groups (Jarvenpaa, 1998). In this study, the definition of trust is the degree of belief in good intentions, behaviors, competence, and reliability of members with respect to sharing knowledge in VCs. Different from the norm of reciprocity, trust represents a promise keeping of one party to the action of another party, irrespective of the ability to monitor or control the latter. Blau (1964) indicated that the norm of reciprocity builds trust. Members must directly experience reciprocity to establish trust (Davenport & Prusak, 1998). Further, organizations with generalized reciprocity practices signal benevolent intensions, which foster trust from members (Aselage & Eisenberger, 2003). Norms of reciprocity predisposes individuals to

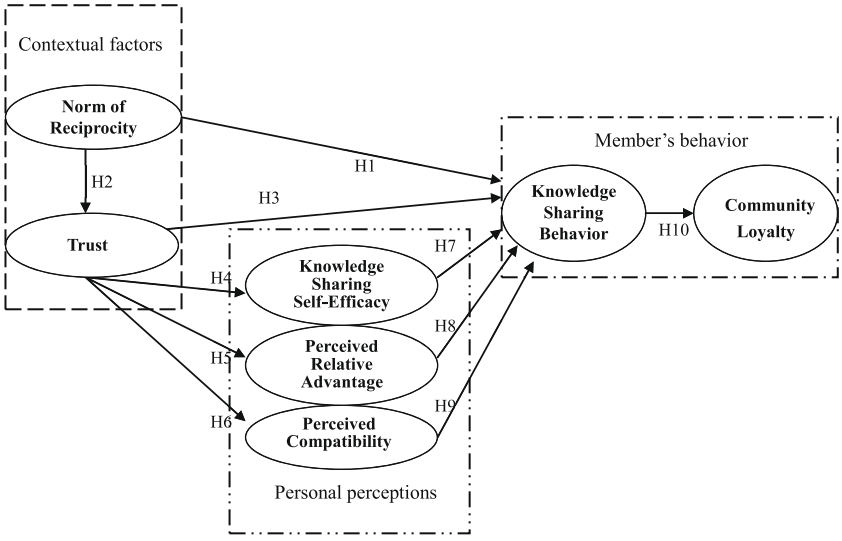

Fig. 1. Research model.

"cooperate, understand, and empathize" rather than to "treat each other as strangers, competitors, or potential enemies". In the early days of a relationship, the norm of reciprocity is tacitly involved in establishing social trust (Newton, 1997). As described above, trust relationships can emerge within virtual communities without any direct social interaction. This may be due to the transparency and visibility of the norm of reciprocity and online knowledge-based assets held in the community's common repositories. Thus, when there is a strong norm of reciprocity in the collective, individuals trust that their knowledge contribution efforts will be reciprocated, thereby rewarding individual efforts and ensuring ongoing contribution. This leads to the hypothesis:

H2. The norm of reciprocity positively affects members' trust in PVCs.

Trust has been defined as employees maintaining reciprocal faith in each other in terms of intention and behaviors (Whitener, 2001). This study focuses on integrity, competence, reliability, benevolence, and reciprocal faith, which refers to an individual's expectation that members will follow a generally accepted set of intentions, values, and benevolence in VCs. When employees have high trust in employee relationships, they become more willing to participate in knowledge-sharing activities (Abrams, Cross, Lesser, & Levin, 2003; Lucas, 2005). Delahaye (2000) found that trust influenced knowledge sharing decisions. Similarly, Corritore, Kracher, and Wiedenbeck (2003) found trust to be a key element of success in an on-line environment. Chowdhury (2005) demonstrated that the presence of trust facilitates complex knowledge sharing. Hence, the present study hypothesizes that trust positively influences personal behavior to facilitate knowledge sharing. The following hypothesis is thus proposed:

H3. Trust positively affects members' knowledge sharing behavior in PVCs.

As mentioned before, this study emphasizes the trust establishment and treats trust as a contextual factor that is crucial to PVCs. Comparing our research model with SCT, trust could be viewed as an environmental factor and knowledge sharing self-efficacy could be viewed as a personal factor. According to SCT, personal factors are influenced by environmental factors. Previous empirical research has also found a causal relationship between trust and self-efficacy (Cheung & Chan, 2000; Pavlou & Fygenson, 2006). Cheung and Chan (2000) used SCT and other theories to examine social cognitive factors in donating money to charity. Hsu et al. (2007) used SCT theory to investigate the effect of identification-based trust on knowledge sharing. Results show that there is a strong and significant direct effect of trust on self-efficacy; trust raises the degree of self-efficacy for donation cognition. According to Lave and Wenger's (1991) theory of situated learning, a new member in a virtual community becomes involved in a transition, over time, from peripheral participation in the VC towards becoming a masterful member. By sharing and developing ideas, by discussing, problem solving, and generally striving to become a more competent member, the community members are able to engage in the mutual development of both their own knowledge and the community's pool of expertise (Usoro et al., 2007). With this ongoing process, members engaged in the development of cooperative and trusting relationships while simultaneously developing knowledge of what it means to be a competent and masterful member (Nahapiet & Ghoshal, 1998). Therefore, the following hypothesis is proposed:

H4. Trust positively affects members' knowledge sharing self-efficacy in PVCs.

Relative advantage is conceptualized as a multidimensional construct that captures the benefits of an innovation on lower costs, savings in time and effort, and a decrease in discomfort (Rogers, 2003). Handfield and Bechteln (2002) indicated that trust occurs in cognitive and affect-based forms. Both forms were also found to enhance coordination by lowering administrative costs. Currall and Judge (1995) proposed that trust enhances the likelihood of resource exchange between trusting parties, decreases transaction costs by reducing the need for actions to protect the interests of either party, decreases the costs of knowledge sharing, and increases the likelihood that newly acquired knowledge can be absorbed and retained. Dyer and Chu (2003) demonstrated that if the suppliers trust the buyers, they are willing to share more work-related information with the buyers. Tsai and Ghoshal (1998) provided empirical evidence that suggests that trust influences resource exchange and combination. Prior studies have provided strong support for the significant relationship between trust and relative advantage.

As mentioned above, the definition of trust in this study focuses on integrity, reliability and good intentions. Trust in the integrity of a virtual community might be thought of as based in part on the compatibility of the community's cultural values with those of the trusting member, the credibility of the community's reputation, and the consistency of the community's members' past behavior such as the extent to which actions are congruent with

words (Usoro et al., 2007). Consistent and reliable past behavior create confidence in future actions. If a member expects that other members' future behavior may lack integrity or unreliably, or is in a manner that is otherwise incongruent with his personal values and potential needs, he or she is unlikely to feel compatible. Conversely, the member is probably more willing to engage in cooperative interaction when expectations of behavioral reliability and perceptions of compatibility are high. These results imply a positive relationship between trust, potential advantages, and compatibility. This leads to the hypotheses:

H5. Trust positively affects members' perceived relative advantage of knowledge sharing in PVCs.

H6. Trust positively affects members' perceived compatibility of knowledge sharing in PVCs.

Self-efficacy is an important concept in social psychology derived from social cognitive theory. It can be defined as beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments (Jashapara & Tai, 2006). In this study, knowledge sharing self-efficacy refers to the confidence in one's ability to provide knowledge that is valuable to others (Kankanhalli et al., 2005). Researchers have found that individuals with high levels of expertise, skills and capabilities are more likely to provide useful advice on computer networks (Constant et al., 1996). Through sharing useful knowledge to the organization, people feel more confident in what they can do (Constant, Kiesler, & Sproull, 1994). This perception of enhanced self-efficacy can motivate employees to contribute their knowledge to others (Bock & Kim, 2002). Hence, this study hypothesizes that knowledge sharing self-efficacy positively influences personal behavior to facilitate knowledge-sharing activities as follows:

H7. Members' knowledge sharing self-efficacy positively affects their knowledge sharing behavior in PVCs.

In this study, perceived relative advantage refers to the knowledge contributor's cognition of likely advantages and benefits that the individual's knowledge sharing behavior will produce and carry to him. Some studies (Andrews, 2002; Zhang & Hiltz, 2003) suggested that individuals share knowledge within virtual communities to enrich their knowledge, to seek support, and to make friends. Butler, Sproull, Kiesler, and Kraut (2002) suggested that the primary reason for individuals to share knowledge is for their benefit in being seen as skilled, knowledgeable, or respected. Consequently, a strong relative advantage of knowledge sharing perceived by knowledge contributors positively influences personal behavior to facilitate knowledge-sharing activities. The following hypothesis is thus proposed:

H8. Members' perceived relative advantage positively affects their knowledge sharing behavior in PVCs.

Perceived compatibility refers to the knowledge contributor's cognition of likely values, needs, and experience that the individual's knowledge sharing behavior is in accordance with his or she original value system. Budman (2003) considers perceived compatibility to be a psychological barrier, and believes that once individuals become comfortable with online transactions, they increase the in usage of other online services. Moreover, a greater fit among components of knowledge sharing is desirable because it can motivate individuals to develop new ideas (Hislop, 2003). Thus, when members in VCs perceive knowledge sharing as compatible with their individual values and needs, they are more likely to be positively predisposed to adopting and promoting it. The following hypothesis is proposed:

H9. Members' perceived compatibility positively affects their knowledge sharing behavior in PVCs.

Behaviors such as sharing knowledge (Abbott, 1988; Butler, 2001), disseminating ideas quickly (Finholt & Sproull, 1990), and providing emotional support (King, 1994; Rice & Love, 1987) are frequently observed in PVCs in the form of extensive postings and viewings by members. Butler (2001) indicated that extensive knowledge postings/viewings or frequent on-line interactions all have the potential to support a higher level of help-giving behaviors and social support. Thus, when members frequently take part in knowledge-sharing activities in PVCs, they are more likely to positively promote PVCs or to invite new potential knowledge contributors. The following hypothesis is proposed:

H10. Member's knowledge sharing behavior positively affects their community loyalty in PVCs.

4. Research methodology

We tested our hypotheses using data surveyed from three maybe famous in Taiwan PVCs. We describe the development of the survey instrument, the data collection procedures, and the validation of the measures in the following subsections.

5.1. Survey procedure: Sample and data collection

An online survey was conducted because the target subjects were individual members of three PVCs. The research model was tested with data from members of Programmer-Club, BlueShop, and Pure C in Taiwan. A banner with a hyperlink connecting to our online survey was posted on the homepage of the Programmer-Club from April 20 to May 31, 2007, on the homepage of the BlueShop from May1 to June 15, 2007, and on the homepage of the Pure C from May 10 to June 30, 2007. Members with knowledge sharing experience were invited to participate in this survey. The three PVCs all provide several useful services and mechanisms for members to share information and knowledge with each other, such as file uploading for sharing, a technical forum, as electronic bulletin board, a special topic group, a chat room, and e-mail services. 383 questionnaires were collected. The exclusion of 33 invalid questionnaires resulted in a total of 350 complete and valid ones for data analysis. Table 1 lists the demographic information of the respondents. To examine the representative of the participating members, we performed MANOVA to compare early respondents with late respondents on all of the variables. The results suggest no significant difference between the early respondents and the late respondents ($p < 0.05$). Furthermore, we conducted several diagnostic tests of common methods bias effects; the results of these tests are reported in the data analysis and results.

5.2. Measurement development

All the measurement items used in the study were adapted from the literature, with minor modifications to ensure contextual consistency. Items used to operationally develop the constructs included in each investigated model were mainly adapted from related theories and previous studies. Items of the norm of reciprocity were developed and adapted from Wasko and Faraj (2000), and Kankanhalli et al. (2005). Items of trust were adapted from Lee and Choi (2003), and Ridings et al. (2002). Items of knowledge sharing self-efficacy were based on Kalman (1999), Compeau and Higgins (1995). Items of perceived relative advantage were based on Moore and Benbasat (1991). Perceived compatibility was assessed with items based on Moore and Benbasat (1991), Nahapiet and Ghoshal (1998), and Tsai and Ghoshal (1998). Knowledge sharing behavior was adapted and based on Davenport and Prusak (1998). Community Loyalty was adapted and based on Koh and Kim (2004), Srinivasan, Anderson, and Kishore (2002), Zeithaml, Berry, and Parasuraman (1996). For all the measures, a seven-point Likert scale was adopted with anchors ranging from strongly disagree (1), neither agree nor disagree(4), to strongly agree (7).

Table 1
Sample characteristics (the number of subjects = 350).

Demographic characteristics		Frequency	Percentage (%)
Gender	Male	252	72
	Female	98	28
Age	<21	18	5
	21–30	112	32
	31–40	136	39
	41–50	53	15
	>50	31	9
Education	High school or below:	25	7
	College (2 years):	67	19
	University:	164	47
	Graduate school	77	22
	PhD	17	5
Working experience	<1 year	24	7
	1–3	32	9
	3–5	57	16
	5–10	123	35
	10–15	66	19
	15–20	28	8
	>20	20	6
Job Title	IS manager:	98	28
	Project manager:	55	16
	Programmer:	24	7
	Software engineer:	11	3
	Hardware engineer:	21	6
	Web application engineer:	43	12
	System engineer:	27	8
	Students:	28	8
	Others:	43	12
Member history	<3 month:	14	4
	3–6 month:	21	6
	6 month–1 year:	42	12
	1 year–2 year:	55	16
	2 year–3 year:	115	33
	Over 3 year:	103	29
Online history	<1 year:	13	4
	1–3 year:	31	9
	3–5 year:	71	20
	5–8 year:	118	34
	8–12 year:	77	22
	Over 12 year:	40	11

To establish content validity, the questionnaire was refined through cautious and rigorous pre-testing. A two-stage pretest of the questionnaire was performed by using 4 experts in the IS area to assess instrument clarity, question wording, ease of understanding and validity, logical consistencies, sequence of items, and contextual relevance. The comments collected from these experts provided a basis for revisions to the construct measures and led to several minor modifications of the wording and the item sequence. Furthermore, a pilot study was conducted involving three professors, 15 Ph.D. candidates, and 20 masters degree candidates who were members of various PVCs. Comments and suggestions on the item contents and structure of the instrument were solicited. The revised questionnaire items used to measure each construct are listed in Appendix A.

5. Data analysis and results

The research model shown in Fig. 1 was analyzed primarily using SEM, supported by LISREL 8.7 software. Numerous researchers have proposed a two-stage model-building process (Anderson & Gerbing, 1988; Hair, Anderson, & Tatham, 1998; Joreskog & Sorbom, 2001; Maruyama, 1998). The first step involves the analysis of the measurement model, while the second step tests the structural relationships among latent constructs. The aim of the two-step approach is to assess the reliability and validity of the measures before their use in the full model.

6.1. Measurement model validation

We applied confirmatory factor analysis (CFA) (Bentler, 1992) to evaluate the properties of the measures addressing latent constructs. Values of skewness and kurtosis for all of the variables analyzed were well below prescribed levels (skewness < 2.0 and kurtosis < 7.0), indicating no significant departures from normality in the data (Yuan, Bentler, & Zhang, 2005). CFA indicated that the final measurement model exhibited strong levels of fit: χ^2/df = 1.555 (χ^2 = 325.09; df = 209), GFI = 0.93, AGFI = 0.90, NFI = 0.96, NNFI = 0.98, CFI = 0.99, and RMSEA = 0.040, as shown in Table 2. All the model-fit indices exceed the respective common acceptance levels indicated by previous research, demonstrating that the measurement model exhibited a fairly good fit with the data collected.

Additionally, the convergent validity of the scales was verified by using the three criteria suggested by Fornell and Larcker (1981): (1) all indicator loadings should be significant and exceed 0.7, (2) construct reliability should exceed 0.7(Hair et al., 1998), and (3) average variance extracted (AVE) by each construct should exceed the variance due to measurement error for that construct (i.e., AVE should exceed 0.50). In Table 3, it can be seen that the CFA results were highly consistent with the relationships expected between the measured items and their respective constructs. All the factor loadings for all items exceed the recommended level of 0.7, and all factor loading are significantly related, via *t*-tests at $p < 0.001$, to their respective constructs. A series of Lagrange multiplier (LM) tests indicated that no items attempted to cross-load on a non-hypothesized construct. These analyses provided sufficient evidence of unidimensionality. Composite reliability (CR) was used to assess the internal consistency of the measurement model. As shown in Table 3, the composite reliability of the constructs ranged from 0.82 to 0.91, and thus all exceeded the generally accepted value of 0.70. In addition, the AVE ranged from 0.60 to 0.76. Hence, all three conditions for convergent validity were met.

Furthermore, the discriminant validity of the scales was assessed using the benchmark suggested by Fornell and Larcker (1981): the square root of the AVE from the construct should be greater than any of the inter-construct correlations. Table 4 lists the correlations among the constructs, with the square root of the AVE on the diagonal. All the diagonal values exceed the correlations between any pair of constructs, providing strong evidence of discriminant validity at the construct level. Evidence of nomological validity was manifested in the inter-correlation matrix, as most of the correlations were in the expected direction and many expected associations were statistically significant (see Table 4). In summary, the measurement model demonstrated adequate and sufficient reliability, convergent validity, discriminant validity, and nomological validity. Finally, we used Harmon's single factor

Table 2
Model fit indices for measurement and structural models.

Model fit indices	Measurement model	Structural model	Recommended value
Chi-square/degree of freedom (χ^2/d.f.)	325.09/209 = 1.555	500.53/220 = 2.275	≤3.00
Goodness-of-fit index (GFI)	0.93	0.90	≥0.90
Adjusted goodness-of-fit index (AGFI)	0.90	0.86	≥0.80
Normed fit index (NFI)	0.96	0.95	≥0.90
Non-normed fit index (NNFI)	0.98	0.96	≥0.90
Comparative fit index (CFI)	0.99	0.97	≥0.90
Root mean square error of approximation (RMSEA)	0.040	0.060	≤0.08

Table 3
Confirmatory factor analysis results of measurement model.

Construct and indicators	Factor loadings	*t*-value	Composite reliability (CR)	Average variance extracted (AVE)
Norm of reciprocity (NR)			0.88	0.71
NR1	0.82	17.65		
NR2	0.86	18.93		
NR3	0.85	18.60		
Trust (TR)			0.90	0.75
TR1	0.82	18.17		
TR2	0.91	21.24		
TR3	0.86	19.58		
Knowledge sharing self-efficacy (KSSE)			0.91	0.76
KSSE1	0.88	20.25		
KSSE2	0.89	20.74		
KSSE3	0.85	19.15		
Perceived relative advantage (PRA)			0.82	0.60
PRA1	0.76	15.48		
PRA2	0.80	16.50		
PRA3	0.76	15.29		
Perceived compatibility (PC)			0.89	0.67
PC1	0.85	19.10		
PC2	0.85	19.03		
PC3	0.78	16.78		
PC4	0.80	17.50		
Knowledge sharing behavior (KSB)			0.87	0.69
KSB1	0.83	18.39		
KSB2	0.84	18.71		
KSB3	0.82	17.95		
Community loyalty (CL)			0.88	0.64
CL1	0.77	16.11		
CL2	0.78	16.49		
CL3	0.82	17.66		
CL4	0.82	17.94		

test (McFarlin & Sweeney, 1992; Sanchez & Brock, 1996) to check common method bias. The single-factor model resulted in $\chi^2(230) = 4269.58$, compared with $\chi^2(209) = 325.09$ for the measurement model, indicating that common method bias was not a serious threat in this study.

5.2. Test of the structural model

As shown in Table 2, all of the model-fit indices of the structural model exceeded their respective common acceptance levels: χ^2 to a degrees of freedom ratio of 2.275 ($\chi^2 = 500.53$; df = 220), GFI = 0.9, AGFI = 0.86, NFI = 0.95, NNFI = 0.96, CFI = 0.97, and RMSEA = 0.060, suggesting that the model fit the data well. The results of hypotheses tests along with the path coefficients and their significance values are shown in Fig. 2. As expected, the norm of reciprocity was strong positively related to trust ($\beta = 0.36$, $p < 0.001$), but it showed no significant influence on knowledge sharing behavior. Consequently, H2 was supported empirically while H1 was not. Trust is positively related to knowledge sharing behavior ($\beta = 0.25$, $p < 0.01$), knowledge sharing self-efficacy ($\beta = 0.51$, $p < 0.001$), perceived relative advantage ($\beta = 0.57$, $p < 0.001$), and perceived compatibility ($\beta = 0.32$, $p < 0.001$). Hence, H3 to H6 were supported. The results also revealed that knowledge sharing self-efficacy ($\beta = 0.26$, $p < 0.001$), perceived relative advantage ($\beta = 0.31$, $p < 0.001$), and perceived compatibility ($\beta = 0.12$, $p < 0.05$) were positively and significantly related to knowledge sharing behavior, providing support for H7 to H9. H10 examined the relationship between knowledge sharing behavior and community loyalty. The results show that knowledge sharing behavior had a strong significant influence on community loyalty ($\beta = 0.33$, $p < 0.001$), providing support for H10.

Table 4
Discriminant validity: Inter-Correlation and AVE.

Construct	Mean	St. Dev.	AVE	NR	TR	KSSE	PRA	PC	KSB	CL
NR	4.23	1.07	0.71	**0.84**						
TR	5.29	1.14	0.75	0.36**	**0.87**					
KSSE	5.10	1.19	0.76	0.19**	0.51**	**0.87**				
PRA	4.73	1.09	0.60	0.21**	0.57**	0.29**	**0.77**			
PC	4.16	0.97	0.67	0.12*	0.32**	0.16*	0.18*	**0.82**		
KSB	5.15	1.06	0.69	0.21**	0.60**	0.50**	0.55**	0.30**	**0.83**	
CL	4.60	0.91	0.64	0.07	0.19*	0.16*	0.18*	0.10*	0.33**	**0.80**

Note: Diagonal elements are the square root of the average variance extracted (AVE). Off-diagonal elements are the correlations among constructs. For discriminant validity, AVE should be larger than squared correlation between any pair of constructs; hence diagonal elements should be larger than off-diagonal elements. *$p < 0.05$; **$p < 0.01$ (two-tailed test).

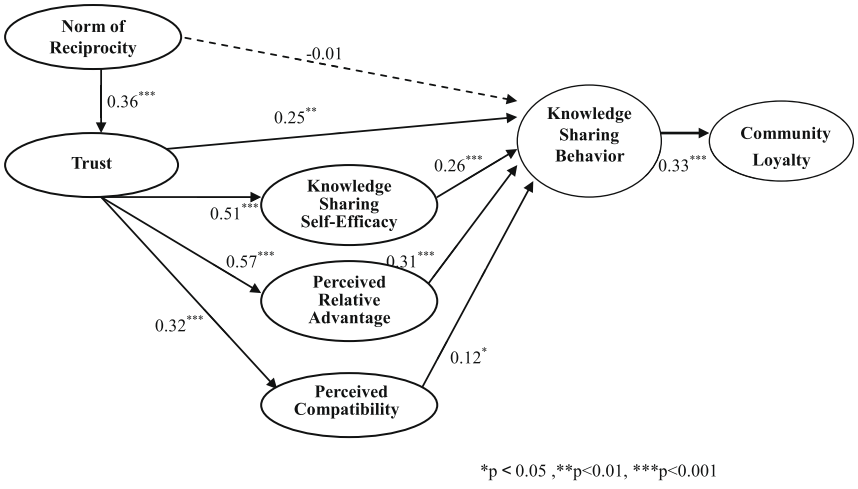

Fig. 2. SEM analysis of research model. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

6. Discussion and conclusion

6.1. Summary of results

This study developed an integrated model designed to investigate and explain the relationships between contextual factors, personal perceptions of knowledge sharing, knowledge sharing behavior, and community loyalty. Our results provide support for the theoretical model and most of our hypotheses, and add to the existing research on the validation of knowledge sharing behavior on PVCs. This study produces four important findings that deserve considerable attention from executives of organizations seeking to build a pool of rich innovation and knowledge, including a comprehensive framework of the determinants to foster members' knowledge sharing behavior.

Firstly, the norm of reciprocity shows a negative and insignificant influence on knowledge sharing behavior. This finding directly contradicts prior research in face-to-face settings, where it is consistently found that reciprocity is critical for sustaining supportive relationships and collective action (Putnam, 1995; Shumaker & Brownell 1984). The result is similar to Wasko and Faraj's (2005) findings that showed that the norm of reciprocity is not a significant predictor of helpfulness of knowledge contribution, but a significant negative predictor of the volume of knowledge contribution in electronic networks. One possible explanation is that online-based interactions may be generalized rather than dyadic, and direct reciprocity is not necessary for sustaining collective action (Wasko & Faraj, 2005). Generalized reciprocity occurs when giving is not reciprocated by the recipient, but by a third party (Ekeh, 1974). In contrast to personal knowledge sharing between two individuals where there is an expectation of direct reciprocity, reciprocity in PVCs may be generalized.

Secondly, according to Blau (1964), the norm of reciprocity builds trust. This study provides supports that the norm of reciprocity is a significant determinant of trust in knowledge sharing. That is, the norm of reciprocity is normative and supportive of knowledge-sharing initiatives in PVCs. Members are more likely to display confidence and reliability in each other's actions in relation to knowledge sharing. Hence, the norm of reciprocity exerts an indirect positive effect on knowledge sharing behavior mediated by trust. Tsai and Ghoshal (1998) found that social interaction had a strong effect on trust in the context of resource exchange and production innovation within an organization.

Thirdly, the results show that knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility significantly and positively influence knowledge sharing behavior. The findings reveal that members, who execute knowledge sharing to be a capable, superior, and compatible means of achieving personal objectives, express a high willingness to share their knowledge. Moreover, as expected, trust enables knowledge sharing and has a direct positive effect on knowledge sharing behavior. On the other hand, trust exerts an indirect positive effect on knowledge sharing behavior mediated by knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility.

Lastly, knowledge sharing behavior may play a vital role underlying community loyalty in reaching a critical mass of community members within a short time, and so brings plentiful knowledge, potential members, and sustainable advantages to PVCs.

6.2. Implications for research

From a theoretical perspective, we have advanced our understanding of the contextual factors behind members' knowledge sharing behavior. Our first finding implies that the norm of reciprocity is an indirect but important influencing factor for knowledge sharing. The norm of reciprocity can motivate members to share knowledge, but it is mediated by trust that leads to a greater effect of knowledge sharing behavior. By identifying facets of the norm of reciprocity and trust as the two key determinants of knowledge sharing behavior, interactive relationships among members of PVCs are characterized as a valuable context for knowledge sharing. The norm of reciprocity falls along a continuum from 'negative reciprocity' to 'generalized reciprocity' (Sahlins, 1972). If expectations of direct reciprocity are not critical to fostering knowledge sharing in PVCs, one potentially interesting area of future research would be to apply multigroup analysis techniques of SEM to examine whether generalized reciprocity is more important than direct reciprocity in knowledge sharing.

Our second finding implies that the personal perceptions of knowledge sharing (knowledge sharing self-efficacy, perceived relative advantage, and compatibility) as mediators of knowledge sharing in professional virtual communities by themselves are sufficient for knowledge sharing behavior. Personal perceptions of knowledge sharing can contribute to knowledge sharing behavior to some extent. These findings conform with and extend prior research (Hsu et al., 2007; Kankanhalli et al., 2005).

Our study examined the effect of contextual factors and personal perceptions on knowledge sharing behavior and the relationship between these factors. The results help explain knowledge sharing behavior in PVCs. However, prior research suggests that a greater level of knowledge sharing may lead to a better development of contextual factors: interactive relationships, mutual trust, identification, and shared vision. According to SCT (Bandura, 1997), determinants influence each other bidirectionally. Hence, such relationships could be tested longitudinally. Future research should look at changes in contextual factors and personal perceptions of knowledge sharing over time and the relationships of those changes with knowledge sharing.

6.3. Implications for practitioners

This study proposes the following suggestions to help practitioners manage or design better PVCs for facilitating members' knowledge sharing behavior. First of all, the results indicate that the norm of reciprocity has an indirect effect through trust on knowledge sharing behavior. From the practitioners' standpoint, the management of PVCs should foster a positive social interaction culture before introducing knowledge-sharing initiatives. Specifically, creating a sharing climate characterized by management support, members involvement, reciprocity, and reward systems in knowledge sharing and the knowledge community is likely to facilitate both management and members to socialize and interact frequently with one another, thus improving trust-building and knowledge-sharing willingness. Managers of PVCs can promote reciprocity by using incentives such as reputable rewards for sharing knowledge. For instance, a unique identity or symbol can be provided to each member to motivate them to contribute to build their own reputations. The BlueShop community web has a creative mechanism by which knowledge receivers can donate value-added points (VP) knowledge contributors as a reward for favors. Acquiring value-added points through contributing knowledge is a visible reputation symbol that motivates knowledge sharing and minimizes free-riders. It also positively encourages a member to reciprocate the benefits that he or she received from other members. The score of value-added points may represent knowledge contributors' professional status, credit, or reputation within the community. Members feel an immediate reward from their contribution and hence increase their sharing (Tiwana & Bush, 2001).

Secondly, the results indicate that trust has both direct and indirect effects on knowledge sharing behavior, implying that trust

plays a critical role in promoting the behavior of knowledge sharing within PVCs. Managers must consider that knowledge sharing can only occur when members are willing to share their knowledge. Trust helps eliminate barriers to knowledge sharing. Without trust, the cooperation required for successful knowledge sharing might not exist. Hence, when promoting knowledge sharing, managers of PVCs should develop solid mechanisms that improve the interactive quality and ties of the relationships among members. For example, the Programmer-Club community web often holds face-to-face seminars, and invites knowledgeable contributors and professional instructors to share their knowledge and experience with members of the community, as a good way of enhancing the social interaction among its members. The Programmer-Club, BlueShop, and Pure C communities also provide personal message boards, chat rooms, technical forums, and blogs as tools for improving online communication and contacts among members. In addition, managers can improve the trust relationships among members by facilitating the norm of reciprocity, sharing vision (experiences), dialoguing, and by confiding personal information in PVCs. For example, Programmer-Club provides a convenient service for members to disclose personal information when registering as a new member and allows the browsing of other members' messages to get more acquainted with them.

Lastly, since knowledge sharing self-efficacy, perceived relative advantage, and compatibility are important predictors of motivation to facilitate knowledge sharing, management of PVCs should provide some facilities, such as on-line training programs, support mechanisms, and guidelines, to increase members' self-efficacy so that members are confident enough to share their knowledge in PVCs. Furthermore, the management of PVCs should actively search for useful information on the benefits of knowledge sharing. For instance, Programmer-Club and BlueShop are successful professional online communities. Their main strategy is to become members of technical alliance programs, receive online advertising, and win awards for excellent virtual communities to enhance their reputation and to meet members' expectations and needs.

6.4. Limitations and future research

Although our findings are useful, there are several limitations to this study, requiring further examination and additional research. First, the results should be interpreted as only explaining knowledge sharing of current knowledge contributors of VCs. Whether the results can be generalized to non-participants or to disaffected participants will require additional research. The sample was collected from Taiwanese PVCs; the research model should be tested further using samples from other countries, since cultural differences among VCs influence member perception of sharing knowledge. Further testing would provide a more robust test of the hypotheses. Second, based on a sample of 350 respondents from three PVCs, it is unclear whether our findings and research model could be generalized to all types of professional virtual communities. The study findings should be verified with more types of VC and a larger sample to increase its generalizability. Further studies can examine other determinants, such as different kinds of knowledge sharer (heavy sharer, medium sharer, light sharer, and free-rider). Different kinds of knowledge sharer may have different influences on the knowledge sharing process.

Appendix A. Scales and measurement items used in the study

Please use the following scale to indicate your extent of agreement about how well each of the following statements is an accurate description of your virtual community. Here, 1 = strongly disagree, 7 = strongly agree.

A.1. Norm of reciprocity (NR)

Definition: People's salient beliefs that current knowledge sharing to VCs would lead to future request for knowledge being met (Davenport & Prusak, 1998).

- I know that other members will help me, so it's obligator and fair to help other members in this virtual community.
- When I share knowledge with other members, I believe that the members in this virtual community would help me if I need it.
- When I share knowledge with other members, I believe that my queries for knowledge will be answered in the future in this virtual community.

A.2. Trust (TR)

Definition: The degree of belief in good intentions, behaviors, competence, and reliability of members with respect to sharing knowledge in VCs (Lee & Choi, 2003; Mishra, 1996).

- Members in this virtual community have reciprocal faith-based and trustworthy relationships.
- Members in this virtual community will not take advantage of others even when a profitable opportunity arises.
- Members in this virtual community always keep promises that they make to one another.

Please use the following scale to indicate your extent of agreement about how well each of the following statements is an accurate description of your perceptions in virtual community. Here, 1 = strongly disagree, 7 = strongly agree.

A.3. Knowledge sharing self-efficacy (KSSE)

Definition: The degree of confidence in member's ability to sharing knowledge that is valuable to the VCs (Constant et al., 1996; Kalman, 1999).

- I have confidence in my ability to provide knowledge that other members in this virtual community consider valuable.
- I have the expertise, experiences, and insights needed to provide knowledge that is valuable for other members in this virtual community.
- I have confidence in responding or adding comments to messages or articles posted by other members in this virtual community.

A.4. Perceived relative advantage (PRA)

Definition: The degree to which encouraging knowledge sharing is perceived to benefit the conduct of members (Moore & Benbasat, 1991).

- Sharing knowledge with members in this virtual community will increase my solving-problem capability.
- Sharing knowledge with members in this virtual community will rapidly absorb and react to new information regarding the area.
- Sharing knowledge with members in this virtual community will help me in my job and improve my performance.

A.5. Perceived compatibility (PC)

Definition: The degree to which encouraging knowledge sharing is perceived to fit the value system and current needs of members (Moore & Benbasat, 1991).

- Sharing knowledge with members in this virtual community is compatible with my values.
- Sharing knowledge with members in this virtual community fits my current needs.
- Sharing knowledge with members in this virtual community is compatible with my previous experiences.
- Sharing knowledge with members in this virtual community fits my work style.

Please use the following scale to indicate your extent of agreement about how well each of the following statements is an accurate description of your behavior. Here, 1 = strongly disagree, 7 = strongly agree.

A.6. Knowledge sharing behavior (KSB)

Definition: The degree to which a member conducts knowledge-sharing activities in VCs (Davenport & Prusak, 1998).

- I frequently participate in knowledge-sharing activities and share my knowledge with others in this virtual community.
- I usually spend a lot of time conducting knowledge-sharing activities in this virtual community.
- When discussing a complicated issue, I am usually involved in the subsequent interactions.

A.7. Community loyalty (CL)

Definition: The degree to which a member promotes the virtual community to get new members to join and talks about the benefits of this VC (Srinivasan et al., 2002; Zeithaml et al., 1988).

- I frequently talk to people about the benefits of our virtual community.
- I usually spend some time providing useful suggestions for our virtual community.
- I often introduce my peers or friends to our virtual community.
- I actively invite my close acquaintances to join our virtual community.

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