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To give or to receive? Factors influencing members' knowledge sharing and community promotion in professional virtual communities

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ABSTRACT

Professional virtual communities (PVCs) bring together geographically dispersed, like-minded people to form a network for knowledge exchange. To promote knowledge sharing, it is important to know why individuals choose to give or to receive knowledge with other community members. We identified factors that were considered influential in increasing community knowledge transfer and examined their impact in PVCs. Data collected from 323 members of two communities were used in our structural equation modeling (SEM). The results suggested that norm of reciprocity, interpersonal trust, knowledge sharing self-efficacy, and perceived relative advantage were significant in affecting knowledge sharing behaviors in PVCs. The knowledge contributing and collecting behaviors were positively related to knowledge utilization. Furthermore, while the collecting behavior had a significant effect on community promotion, the influence of contributing behavior on community promotion was limited.

1. Introduction

The emergence of professional virtual communities (PVCs) has provided a solution, new insights, and mechanisms into knowledge management and sharing in organizations. VCs are groups of people who communicate regularly in an organized manner via a communication medium, such as a bulletin board or a news group. Rapid exchange of information and knowledge through VCs has dramatically changed lifestyles, enhancing individual and organizational learning. Community members share their ideas and thoughts. Individuals take part in PVCs to secure knowledge, resolve problems, improve individual capability, absorb specialized knowledge, and create innovations. Many organizations have recognized PVCs as valuable in their knowledge management and have begun to support their development and growth [1].

The process of knowledge sharing involves members contributing knowledge and seeking knowledge for reuse. Success of PVCs requires knowledge contributors to be amenable to donating their knowledge and be willing to reuse codified knowledge [2]. The same individual can, of course, be a giver or a receiver at different times. The biggest challenge in facilitating a VC is the continuous supply of knowledge from members. It is thus important to know why individuals choose to give or to receive knowledge when they have a choice.

PVC members use virtual meeting places to discuss opportunities for new products and product improvement. Therefore, identifying the critical factors underlying knowledge sharing behavior would help in understanding knowledge sharing. Despite various attempts to examine the behavior of knowledge sharing [3–9], none has adequately explained why individuals choose to give or receive knowledge when they have a choice.

We developed an integrated model to examine the effects of contextual factors, including norm of reciprocity and interpersonal trust, and individual factors, including knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility, on knowledge utilization and community promotion through knowledge sharing. Prior research indicated that knowledge sharing was facilitated by a strong sense of reciprocity and fairness [10]. Interpersonal trust is a key need for effective collaboration [11], and is the salient factor in determining the effectiveness of knowledge-sharing activities. On the other hand, some researchers suggested that individual motivators may affect knowledge contributors' willingness to share knowledge [12]. The expectation of individual benefits will encourage members to share knowledge. Therefore, this research has attempted an integrated model that explores the effectiveness of knowledge sharing from both contextual and personal perspectives. Data collected from 323 members of two PVCs were collected for our study. The analysis used commercially available LISREL 8.7 software.

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2. Theoretical background and hypothesis

2.1. Virtual communities

The VC is concerned with social interaction among its members. We focused on the PVC that consists of people with common interests in specialized fields or subjects for knowledge sharing. They provide a knowledge communication channel allowing sharers to interact via the Internet: a form of computer-mediated communication [13]. However, knowledge management studies have discovered that its availability is no guarantee that knowledge sharing will take place: social interactive issues have significant effect.

2.2. Knowledge sharing and influencing factors

Recently, researchers have defined factors that affect an individual's willingness to share knowledge: its costs and benefits, incentive systems, extrinsic and intrinsic motivation, social capital, social and personal cognition, organization climate, and management championship [14,15]. Most previous studies have focused on either contextual factors or on personal factors in knowledge sharing.

Social Cognitive Theory (SCT) argues that a person's behavior is partially shaped and controlled by the influences of contextual factors and the person's cognition; it states that an individual will take an action that has personal cognition in a social environment.

According to SCT, the question "Why do individuals choose to give to or receive knowledge from other community members?", should be addressed from a perspective of both contextual factors and personal cognition. To investigate the knowledge sharing behavior in PVCs, we used SCT to develop a research model where contextual, personal, and behavioral factors act as interacting determinants that influence one another bidirectionally. We focused on the role of contextual and individual factors influencing personal behavior. Social Exchange Theory explains human behavior in social exchanges, which differ from economic exchanges because the obligations are not clearly specified. In these exchanges, people do others a favor with a general expectation of a future return. Therefore, social exchange assumes the existence of a relatively long-term relationship, as opposed to a one-off exchange. The norm of reciprocity and interpersonal trust are two of the most significant contextual factors that drive knowledge sharing. Its self-efficacy, perceived relative advantage, and compatibility are seen as predictors of personal factors, since they are all considered to be the main influences shaping user behavior [16,17].

In our study, we proposed an integrated framework to develop a more comprehensive perspective of the relationships between contextual factors, personal factors, knowledge sharing behavior, and community promotion, and bring it up-to-date with empirical data from two PVCs. The integrated analytic framework is shown in Fig. 1.

2.3. Norm of reciprocity

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 obligates the latter to return the favor [18], and has been highlighted as a benefit for individuals engaging in social exchange. A basic norm of reciprocity is a sense of mutual indebtedness, so that individuals reciprocate by repaying the benefits they receive from others, ensuring ongoing supportive exchange. Reciprocity can serve as a motivational mechanism to

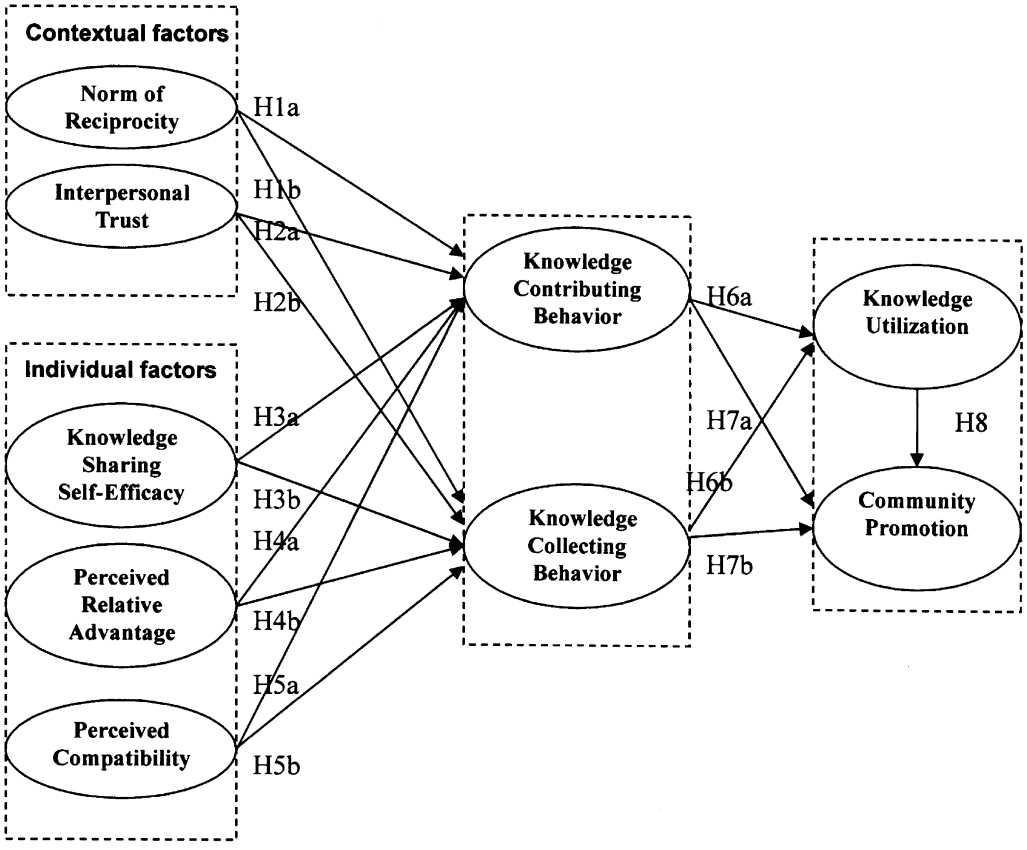

Fig. 1. An integrated framework for examining knowledge sharing.

contribute to discretionary databases. In our study, norm of reciprocity refers to people's salient belief that current knowledge sharing will lead to a future request for knowledge being met.

Generally speaking, participation in VCs is open and voluntary and participants are not acquainted. Knowledge seekers have no control over who responds to their question or its quality. Knowledge contributors have no assurance that those they are helping will ever return the favor. This sharply contrasts with traditional communities of practice and face-to-face knowledge exchanges where people typically know each other and interacts over time, creating expectations of obligation and reciprocity enforceable through social sanctions. The norm of reciprocity represents a pattern of behavior where people respond to friendly or hostile actions with similar actions. Wasko and Faraj suggested that people who share knowledge in online communities believe in reciprocity. In the collective climate, reciprocity is the norm that facilitates the sharing of knowledge. This lead to:

Hypothesis 1a. The norm of reciprocity is positively related to the knowledge contributing behavior of members in PVCs.

Hypothesis 1b. The norm of reciprocity is negatively related to the knowledge collecting behavior of members in PVCs.

2.4. Interpersonal trust

Trust is, of course, a necessity in knowledge sharing on the Internet [19–22]. In general, trust develops when a history of favorable past interactions leads to positive expectations of future interaction. Interpersonal trust in others' abilities, benevolence, and integrity increases the desire to give and receive information, resulting in improved performance of distributed groups; it creates and maintains exchange relationships. Trust is a good predictor of e-commerce adoption [23,24], business cooperative relationships, and performance [25].

In our study, interpersonal trust implies a degree of belief in good intentions, benevolence, competence, and reliability of members who share knowledge in PVCs. It resides in the whole community. Facilitating cooperation and knowledge exchange [26]. Thus, when there is strong interpersonal trust, individuals will liberally exchange, seek, and collect knowledge in VCs. Lee and Choi [27] examined lack of trust among employees as a major barrier in knowledge-sharing activities. When there is high trust in employee relationships, employees become more willing to participate in knowledge-sharing [28]. These arguments lead to:

Hypothesis 2a. Interpersonal trust is positively related to the knowledge contributing behavior of members in PVCs.

Hypothesis 2b. Interpersonal trust is positively related to the knowledge collecting behavior of members in PVCs.

2.5. Knowledge sharing self-efficacy

Individuals attempting to improve others' perception of their competency are motivated by internal self-efficacy, which is a form of self-evaluation that influences a person's decision on behaviors to undertake, the amount of effort and persistence to excel when faced with obstacles, and mastery of the behavior. In general, perceived self-efficacy plays an important role in influencing individuals' motivation and behavior. Therefore, people who have high self-efficacy will be more likely to perform related behaviors than those with low self-efficacy.

Knowledge sharing self-efficacy is one's confidence in an ability to provide knowledge that is valuable to others. In our study, this is the member's self-evaluation and confidence in his or her skills and capabilities to respond to questions posted by other members, and to provide knowledge that is valuable and useful to others. Through sharing useful knowledge, people feel more confident in what they can do. Contributing knowledge to others helps enhance VC users' learning and self-efficacy. Hence:

Hypothesis 3a. Knowledge sharing self-efficacy is positively related to the knowledge contributing behavior of members in PVCs.

Hypothesis 3b. Knowledge sharing self-efficacy is positively related to the knowledge collecting behavior of members in PVCs.

2.6. Perceived relative advantage

Relative advantage is a measure of the degree to which an action provides more benefit than its precursor. It is manifested as increased efficiency and effectiveness, economic benefit, and enhanced social status. In our study, perceived relative advantage is the knowledge contributor's cognition of likely advantages and benefits that knowledge sharing behavior will produce and return to him or her. Its value is positively related to the rate of adoption. Correspondingly, facilitators of knowledge sharing have reported obvious benefits, such as reduced communication costs and faster problem-solving. In general, when decisions makers perceive clear overall personal and organizational benefits of knowledge sharing, they are more likely to encourage a knowledge-sharing culture in the organization. Some studies suggested that individuals would share knowledge within PVCs with a reward of enriching knowledge, seeking support, making friends, etc. They are also seen as skilled, knowledgeable or respected. Furthermore, people who regularly helped others in PVCs seemed to receive help more quickly when they asked for. These arguments lead to:

Hypothesis 4a. Perceived relative advantage is positively related to the knowledge contributing behavior of members in PVCs.

Hypothesis 4b. Perceived relative advantage is positively related to the knowledge collecting behavior of members in PVCs.

2.7. Perceived compatibility

Motivated individuals behave in congruity with their value systems, irrespective of the driving force behind the motivation. Compatibility is the degree to which an innovation fits into the existing values, previous experience, and current needs of potential adopters. In our study, *perceived compatibility* refers to the knowledge contributor's cognition of likely value, need, and experience that his or her knowledge sharing behavior is similar to the original value system. Moreover, greater fit is desirable, because it can motivate individuals to develop new ideas. Thus, members in PVCs perceiving knowledge sharing as compatible with their individual values and needs are more likely to be positively predisposed to adopting and promoting it; leading to:

Hypothesis 5a. Perceived compatibility is positively related to the knowledge contributing behavior of members in PVCs.

Hypothesis 5b. Perceived compatibility is positively related to the knowledge collecting behavior of members in PVCs.

2.8. Knowledge-sharing activity

PVCs can consist of multiple knowledge bases as well as the mechanisms for collection, management, and utilization of the knowledge. However, without a rich, diversified, and renewable

supply of knowledge, they are of limited value. Success requires that knowledge contributors are willing to donate their knowledge and that knowledge seekers are amenable to reusing the codified knowledge. Clearly, effective PVC must receive a continuous supply of knowledge. If a PVC embodies an ideal community process of knowledge contributing and collecting, it will be likely to lead its members to participate as well as to frequently visit the bases. These ideas lead:

Hypothesis 6a. Members' knowledge contributing behavior is positively related to the knowledge utilization from PVCs.

Hypothesis 6b. Members' knowledge collecting behavior is positively related to the knowledge utilization from PVCs.

PVC members can provide valuable knowledge for others or reply to requests from help-seeking members. Knowledge sharing, disseminating ideas quickly, and providing emotional support are frequently observed in a PVC in the form of intensive postings and viewings by its members. Bulter [29] indicated that intensive knowledge postings/viewings or frequent online interactions have the potential to support higher level help-giving behavior and social support. Thus, when members aggressively participate in more knowledge-sharing activities in PVCs, they are more likely to promote PVCs or invite new potential knowledge contributors. Thus:

Hypothesis 7a. Members' knowledge contributing behavior is positively related to the community promotion.

Hypothesis 7b. Members' knowledge collecting behavior is positively related to the community promotion.

According to the Social Cognitive Theory, individuals are more likely to engage in behavior that they expect to result in favorable consequences. Rich content and more personalized services increase the participation of members in VCs. Since various promotional services (e.g., technical forum, expert club, etc.) and events (e.g., seminars, conferences, etc.) by PVCs are frequently available to community members, it is likely that members with a higher level of community participation show a more positive attitude towards their PVC. Eventually, community members are more proactive and aggressive in promoting the PVCs to new knowledge contributors. This leads to:

Hypothesis 8. Members' knowledge utilization from PVCs is positively related to the community promotion.

3. Method and data

3.1. Respondents and procedure

An online (web-based) survey was conducted by sending it to individual members of VCs. Several steps were taken to ensure data validity and reliability by refining and rigorously pre-testing the questionnaire. The questionnaire was pre-tested by four experts in the information system area and five executives in prominent PVCs. The comments collected from these people provided a basis for the revisions of the construct measures and the modifications of the wording and item sequence. Furthermore, two pilot studies were completed. The first was conducted by 73 members in several knowledge discussion forums hosted by PChome Online (www.pchome.com.tw), while the second was completed by several PVCs members, including three professors, 15 PhD candidates, and 20 master degree candidates. These pilot tests were intended to evaluate the relevance of the measurement items to the research variables. Therefore, we used previously validated measurement items wherever possible to help ensure the validity of our survey; multiple-item measures were used for most constructs to enhance content coverage. All of our multiple-item constructs achieved Cronbach alphas of 0.75 or higher, indicating strong internal consistency. In addition, we performed a CFA on the measurement items using the samples of the two pilots. All the factor loadings were significant and had high R^2 values, confirming convergent validity. Comments and suggestions on the item contents and structure of the instrument were solicited.

Two of the largest IT-oriented PVCs in Taiwan were selected for this analysis: the Programmer-Club community (www.programmer-club.com) with 170,000 members and the BlueShop community (www.blueshop.com.tw) with 190,000 members. They both dedicated to sharing knowledge in programming language, databases, technical problems, network skills, and operating systems, and are members of the Microsoft Community Alliance Program. The research model was then tested with data received from members of these PVCs. A banner with a hyperlink to our online survey was posted on the homepage of the Programmer-Club from April 20–May 31, 2007, and on the homepage of the BlueShop from May 1–June 15, 2007. Members of these two PVCs with knowledge sharing experience were invited to support this survey. Twenty randomly selected respondents were offered an incentive in the form of gifts. All respondents were informed that the data collection was part of a research study on knowledge sharing behavior. Additionally, to minimize potential confusion, a definition and description of knowledge sharing was included at the beginning of the questionnaire. A summary of the survey results was also made available to respondents who requested it.

By the time this survey was concluded, 1282 visitors browsed the survey, of which, 354 questionnaires were received. The exclusion of 31 invalid questionnaires resulted in a total of 323 complete surveys for data analysis. Prior research has showed that participants from self-selected samples provider clearer, more complete responses than those who are not volunteers. Of course, the validity of any research methodology relying on volunteers is contingent on their ability and willingness to provide a meaningful response. The counter in our survey website could tally the number of visits and compute the response rate automatically. We deleted incomplete returns even those with only a few items unanswered. The response rate of 27.6% from 323 people was enough to generate statistically reliable estimates on casual paths among constructs.

Non-response bias was evaluated using the usual method: testing for significant differences between early and late respondents, with late respondents being considered surrogate for non-respondents. To examine the representative of the participating members and non-response bias, we performed MANOVA to compare the early 110 respondents with the last 110 respondents on all of the variables. The results suggested no significant differences ($p < 0.05$), indicating that response bias was not present. We also performed MANOVA to compare 209 IT-oriented technical respondents with the other 114 respondents on all variables. The results suggested no significant difference between the respondents of these communities ($p < 0.05$). Detailed descriptive statistics of the respondents' characteristics are shown in Table 1.

3.2. Measures

All the measurement items in the study were adapted from prior research including norm of reciprocity, interpersonal trust, knowledge sharing self-efficacy, perceived relative advantage, perceived compatibility, knowledge-sharing activity (including knowledge contributing and collecting) [30], knowledge utilization, and community promotion [31]. Table 2 lists definitions of the constructs and related literature. For the measures, a seven-point Likert-type scale (ranging from 1 = strongly disagree to

Table 1
Sample characteristics (the number of subjects = 323).

Demographic characteristics		Frequency	Percentage
Gender	Male	266	82%
	Female	57	18%
Age	<21	60	19%
	21–30	103	32%
	31–40	95	29%
	41–50	42	13%
	>50	23	7%
Education	High school or below	33	10%
	College (2 years)	64	20%
	University	140	43%
	Graduate school	72	23%
	PhD	14	4%
Working experience	<1 year	43	13%
	1–3	22	7%
	3–5	41	13%
	5–10	115	36%
	10–15	62	19%
	15–20	27	8%
	>20	13	4%
Job title	IS manager	21	7%
	Project manager	14	4%
	Programmer	44	14%
	Software engineer	38	12%
	Hardware engineer	36	11%
	Web application engineer	27	8%
	System engineer	29	9%
	Students	45	14%
	Others	69	21%
Member history	<3 months	28	8%
	3–6 months	38	12%
	6 months–1 year	42	13%
	1 year–2 years	88	27%
	2 years–3 years	54	17%
	Over 3 years	73	23%
Online history	<1 year	13	4%
	1–3 years	22	7%
	3–5 years	43	13%
	5–8 years	89	28%
	8–12 years	77	24%
	Over 12 years	79	24%

7 = strongly agree) was used. Appendix A lists all survey items used to measure each construct.

4. Data analysis and results

We used a two-step procedure for assessing the reliability and validity of the measures before their use in the full model.

Table 3
Model fit results for measurement and structural models.

Fit index	Measurement model	Structural model	Recommended value
χ^2/d.f.	282/241 = 1.17	334/252 = 1.32	−3.00
GFI	0.94	0.92	−0.90
AGFI	0.93	0.90	−0.90
NFI	0.97	0.96	−0.90
CFI	0.99	0.99	−0.95
SRMR	0.03	0.04	−0.08
RMSEA	0.02	0.03	−0.05

4.1. Analysis of the measurement model

The measurement model was first evaluated and then respecified to generate the 'best fit'. We used LISREL 8.7 to evaluate the properties of the measures, addressing latent constructs via confirmatory factor analysis (CFA). The construct unidimensionality, convergent, and discriminant validity of the candidate items and constructs used in a study were also assessed by employing latent variable constructs. The CFA results indicated that the measurement model fitted the data, χ^2/d.f. = 1.17, GFI = 0.94, AGFI = 0.93, NFI = 0.97, CFI = 0.99, SRMR = 0.03 and RMSEA = 0.02 as shown in Table 3. All the model-fit indices exceed the normal common acceptance levels, demonstrating that the measurement model exhibited a good fit with the data collected.

The convergent validity of the scales was verified by using normal three criteria: that all indicator loadings should be significant and exceed 0.7, that the composite reliability should exceed 0.7, and that the average variance extracted (AVE) by each construct should exceed the variance due to measurement error for that construct (i.e., should exceed 0.50). The CFA results were consistent with the relationships expected between the measured items and their respective constructs. All were significantly related, via *t*-tests, to their respective constructs. The factor loadings for all items except CP1 exceeded the recommended level of 0.7. From Table 4, the composite reliability of the constructs ranging from 0.77 to 0.91 all exceeded the benchmark of 0.7. The AVE ranged from 0.53 to 1. Also, the internal consistency reliability to test unidimensionality was assessed by Cronbach's α. The resulting α values ranged from 0.75 to 0.92 (see Table 4), which were above the acceptable threshold of 0.70. Additionally, we used Partial Least Squares (PLS) Graph Version 3.00 to calculate cross-loadings of latent constructs. There were only four item loadings greater than 0.3 onto other factors. The result indicated a good degree of unidimensionality for each construct. These are shown in Appendix B. thus all the conditions for convergent validity and unidimensionality were met.

The discriminant validity of the scales was assessed by determining that the square root of the AVE from the construct

Table 2
Definitions of constructs.

Construct (abbreviation)	Definition
Norm of reciprocity (NR)	People's salient beliefs that knowledge sharing would lead to future request for knowledge being met
Interpersonal trust (ITR)	The degree of belief in good intentions, benevolence, competence, and reliability of members sharing knowledge in PVCs
Knowledge sharing self-efficacy (KSSE)	The degree of member's self-evaluation and confidence in their skills and capabilities in responding questions posted by others, and to provide knowledge that is valuable and useful
Perceived relative advantage (PRA)	The degree to which encouraging knowledge sharing was perceived to benefit the members
Perceived compatibility (PC)	The degree to which encouraging knowledge sharing was perceived to fit the value system and current needs of members
Knowledge contributing behavior (KCB1)	The quantity of knowledge contributing based on the average volume of a member's active knowledge donating and posting per month
Knowledge collecting behavior (KCB2)	The quantity of knowledge collecting based on the average volume of a member's knowledge collecting and viewing per month
Knowledge utilization (KU)	The degree of usage of knowledge obtained from PVCs
Community promotion (CP)	The degree to which promoting a virtual community is aggressive in inviting new members to join and talk about the benefits of the PVC

Table 4
Confirmatory factor analysis results of the measurement model.

Construct	Internal reliability		Convergent validity	
	Item	Cronbach α	Factor loading (t-value)	CR
Norm of reciprocity	NR1	0.90	0.82 (18.5***)	0.88
	NR2		0.86 (19.9***)	
	NR3		0.85 (19.6***)	
Interpersonal trust	ITR1	0.92	0.82 (19.0***)	0.90
	ITR2		0.91 (22.2***)	
	ITR3		0.87 (20.7***)	
Knowledge sharing self-efficacy	KSSE1	0.88	0.88 (21.4***)	0.91
	KSSE2		0.89 (21.6***)	
	KSSE3		0.85 (20.1***)	
Perceived relative advantage	PRA1	0.86	0.77 (16.3***)	0.82
	PRA2		0.79 (17.0***)	
	PRA3		0.76 (16.2***)	
Perceived compatibility	PC1	0.87	0.85 (20.0***)	0.89
	PC2		0.85 (19.9***)	
	PC3		0.78 (17.6***)	
	PC4		0.81 (18.4***)	
Knowledge contributing behavior	KCB1	n/a	1.00 (27.7***)	n/a
Knowledge collecting behavior	KCB2	n/a	1.00 (27.7***)	n/a
Knowledge utilization	KU1	0.75	0.70 (13.9***)	0.77
	KU2		0.71 (14.1***)	
	KU3		0.76 (15.3***)	
Community promotion	CP1	0.85	0.62 (12.6***)	0.84
	CP2		0.77 (16.7***)	
	CP3		0.80 (17.5***)	
	CP4		0.80 (17.6***)	

Notes: (1) CR = composite reliability; AVE = average variance extracted. (2) See Appendix A for the description of each construct and item.
*** $p < 0.001$.

was greater than the correlation shared between the construct and other constructs in the model. Table 5 shows the correlations among the constructs, with the square root of the AVE on the diagonal. All the diagonal values exceeded the correlations between any pair of constructs, indicating the measure has adequate discriminant validity.

Four correlations of independent variables were above 0.45 (see Table 5), highlighting the need to test strictly for discriminant validity. We therefore adopted another procedure to assess the discriminant validity of the subsets of measures. Within each subset, we examined pairs of constructs in a series of two-factor confirmatory factor models, using LISREL. We ran each model twice, once constraining the correlations between the two constructs to unity and once freeing this parameter. Then a chi-square different test was conducted. The results indicated that the chi-square values were significantly lower for the unconstrained models. In total, 20 models were run, involving 10 pairs of comparison. The chi-square differences were all significant at $p < 0.001$ (see Table 6), which suggested that the constructs exhibited discriminant validity.

In addition we also checked for multicollinearity due to the relatively high correlations among some constructs (e.g., a correlation of 0.57 between PRA and KSSE). The resultant variance inflation factor (VIF) values for all the constructs were acceptable between 1.32 and 1.86. In summary, the measurement model demonstrated adequate and sufficient reliability, unidimensionality, convergent validity, and discriminant validity.

Finally, we conducted a test to assess if common method bias would be problem in interpreting the results. We used Harmon's single factor test, based on the assumption that if the risk of a

Table 5
Discriminant validity: correlations and AVE.

Construct	Mean	St. dev.	AVE	NR	ITR	KSSE	PRA	PC	KCB1	KCB2	KU	CP
NR	4.22	1.09	0.71	**0.84**								
ITR	5.25	1.14	0.75	0.35**	**0.87**							
KSSE	5.04	1.16	0.76	0.25	0.48**	**0.87**						
PRA	4.70	1.08	0.60	0.12*	0.28**	0.57**	**0.77**					
PC	4.13	0.99	0.68	0.34**	0.54**	0.49**	0.33**	**0.82**				
KCB1	3.38	1.45	1.0	0.24**	0.45**	0.52**	0.55**	0.39**	**1.0**			
KCB2	3.89	1.64	1.0	0.16**	0.55**	0.48**	0.58**	0.33**	0.41**	**1.0**		
KU	4.88	0.93	0.53	0.07	0.17**	0.18**	0.20**	0.13*	0.27**	0.23**	**0.73**	
CP	5.22	1.03	0.56	0.08	0.21**	0.20**	0.23**	0.14*	0.25**	0.31**	0.60**	**0.75**

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).

Table 6
Discriminant validity analyses with pairs of constructs.

Pairs of constructs	Constrained model χ^2 (d.f.)	Unconstrained model χ^2 (d.f.)	$\Delta\chi^2$
NR with			
ITR	162 (9)	32.4 (8)	130***
KSSE	183 (9)	28.1 (8)	155***
PRA	204 (9)	34.0 (8)	170***
PC	247 (14)	27.8 (13)	220***
ITR with			
KSSE	154 (9)	25.9 (8)	129***
PRA	175 (9)	28.6 (8)	146***
PC	265 (14)	32.1 (13)	233***
KSSE with			
PRA	192 (9)	35.2 (8)	157***
PC	242 (14)	28.3 (13)	214***
PRA with			
PC	277 (14)	38.7 (13)	239***

***$p < 0.001$.

common method is substantial, a single latent factor will explain most of the covariance among the measures [32]. The single-factor model resulted in $\chi^2(275) = 4655$, compared with $\chi^2(241) = 282$ for the measurement model, indicating that common method bias was not a serious threat in our study.

4.2. Test of the structural model

The causal structure of the hypothesized research model reflecting the assumed linear, causal relationships among the constructs was tested for the model. The LISREL analysis used five exogenous latent constructs (norm of reciprocity, interpersonal trust, knowledge sharing self-efficacy, perceived relative advantage, and perceived compatibility) and four latent endogenous constructs (knowledge contributing behavior, knowledge collecting behavior, knowledge utilization and community promotion). As shown in Table 3, all the model-fit indices exceeded their respective common acceptance levels: χ^2/d.f. = 1.32, GFI = 0.92, AGFI = 0.90, NFI = 0.96, CFI = 0.99, SRMR = 0.04 and RMSEA = 0.03, suggesting that the model fitted the data well. The resulting structural model, together with the path coefficients and their significance values is shown in Fig. 2. Eleven of the fifteen paths exhibited at least a p-value less than 0.05, while the remaining four were not significant at the 0.05 level of significance.

As expected, norm of reciprocity had a negative direct effect on knowledge collecting behavior (path coefficient = −0.11, $p < 0.05$) and no significant influence on knowledge contributing behavior. Thus hypotheses H1b was supported while H1a was not. Interpersonal trust was positively related to knowledge contributing behavior (path coefficient = 0.13, $p < 0.05$), and had a relatively strong positive direct effect on members' knowledge collecting behavior (path coefficient = 0.3, $p < 0.001$). Hence, hypotheses H2a and H2b were supported. Knowledge sharing self-efficacy had a quite strong positive direct effect on knowledge contributing behavior (path coefficient = 0.23, $p < 0.001$), and a positive direct effect on knowledge collecting behavior (path coefficient = 0.16, $p < 0.05$). Hence, hypotheses H3a and H3b were supported. Perceived relative advantage had quite a strong positive direct effect on members' knowledge contributing behavior (path coefficient = 0.32, $p < 0.001$), and on knowledge collecting behavior (path coefficient = 0.36, $p < 0.001$). Hence, hypotheses H4a and H4b were supported. Perceived compatibility had a weak direct effect on knowledge contributing behavior (path coefficient = 0.12, $p < 0.1$) and no significant influence on members' knowledge collecting behavior. Consequently, hypotheses H5a was supported while H5b was not.

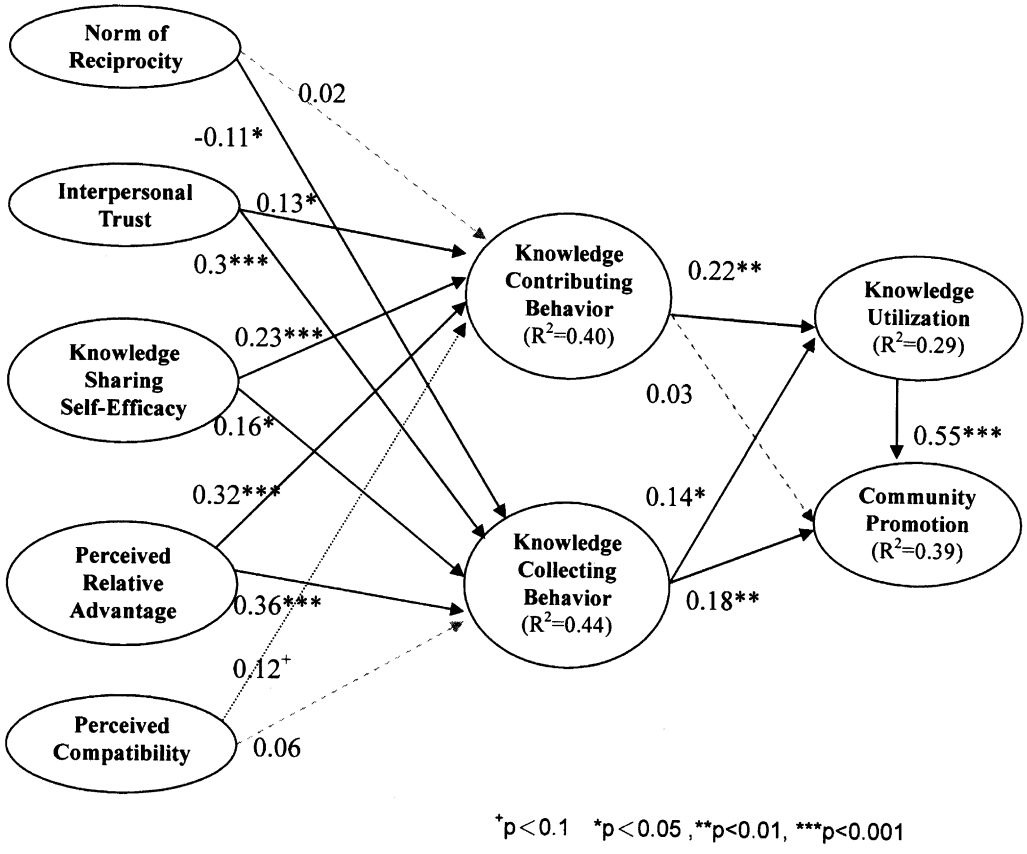

Fig. 2. Results of structural equation model (SEM) analysis.

In terms of H6a and H7a, members' knowledge contributing behavior had a strong direct effect on knowledge utilization (path coefficient = 0.22, $p < 0.01$) and no significant influence on community promotion. Members' knowledge collecting behavior had a significant influence on knowledge utilization (path coefficient = 0.14, $p < 0.05$) and on community promotion (path coefficient = 0.18, $p < 0.01$). Hence, hypotheses H6b and H7b were supported. Our results showed that knowledge utilization had a strong significant influence on community promotion (path coefficient = 0.55, $p < 0.001$), providing support for H8. The explanatory power of the research model was depicted in Fig. 2.

5. Discussion

Our study provided an integrated model examining the influence of both contextual and individual factors on knowledge utilization and community promotion through knowledge sharing. The R^2 values show that contextual factors and individual factors account for 40% of the variance in knowledge contributing behavior and 44% of variance in knowledge collecting behavior. Additionally, the knowledge sharing behaviors (contributing and collecting) account for 29% of the variance in knowledge utilization and 39% in community promotion.

5.1. Contextual factors

Surprisingly, the norm of reciprocity did not show a significant influence on members' knowledge contributing behavior. The norm of reciprocity was found to be significant and has a negative effect on members' knowledge collecting behavior. The PVCs sharply contrast with traditional communities of practice and face-to-face knowledge exchanges.

Interpersonal trust significantly and positively influenced members' knowledge contributing and knowledge collecting behaviors. They also show that trust has a significant effect on the context of resource exchange and production innovation. It was also found to have more influence on members' knowledge collecting than on contributing behavior. Nevertheless, the forming, building and performing of interpersonal trust in PVCs is slower and more fragile than that in organizations, due to a lack of face-to-face settings and close and frequent interactions.

5.2. Individual factors

Knowledge sharing self-efficacy plays a vital role the knowledge-sharing activities. It was found to influence members' knowledge contributing and collecting behaviors; it also had a more pronounced influence on members' knowledge contributing than collecting behavior.

Perceived relative advantage was found to be significant and positively related to both the members' knowledge contributing and collecting behaviors. Furthermore, perceived relative advantage had a rather similar and pronounced effect on members' knowledge contributing and collecting behaviors.

Our model suggested that there were weak relationships between perceived compatibility and members' knowledge contributing and collecting behaviors.

5.3. Knowledge sharing, utilization and community promotion

Our results suggested that the knowledge contributing and collecting behaviors were positively related to knowledge utilization. Furthermore, while the knowledge contributing behavior had a significant effect on community promotion, the influence of members' knowledge contributing behavior on community promotion was limited. An effective and beneficial knowledge collecting activity may thus motivate members to invite their friends to join a PVC. This implies that knowledge contributing has an indirect but critical influence on community promotion through knowledge utilization. Finally, knowledge utilization was found to play a vital role underlying community promotion in reaching a critical mass of community members within a short time, and this brings the benefit of knowledge and network externalities to the PVC.

6. Implications

Previous research has shown that VCs have significant implications for strategic management of knowledge sharing by its members.

The empirical result of our study suggested that both norm of reciprocity and interpersonal trust are significant factors in knowledge utilization and community promotion. Our finding showed that the individual factors (knowledge sharing self-efficacy, perceived relative advantage, and compatibility) should be considered in order to make an appropriate decision for selecting the knowledge-sharing activity as predicators of knowledge utilization and community promotion in PVCs.

For practical applications, the analysis in this study offers a framework of reference for the desire to facilitate knowledge sharing (collecting and contributing), knowledge utilization and community promotion within their organizations and virtual knowledge communities or individuals initiating knowledge-sharing practices. The results also suggest that interpersonal trust plays an important role in knowledge utilization, community promotion and knowledge-sharing activities within PVCs. Interpersonal trust helps eliminate resistance barriers to knowledge sharing, and without interpersonal trust, the cooperation required for successful knowledge sharing might be difficult to attain or nonexistent. For instance, managers can offer programs to enrich knowledge and can organize social interaction to improve members' trust. In addition, managers can should attempt to create better trusting relationships among employees by facilitating norm of reciprocity, sharing vision (experiences), dialoguing and by confiding personal information in organizations or communities, etc. Additionally, since knowledge sharing self-efficacy, perceived relative advantage and compatibility are were found to be important predictors of in motivating to smooth the way knowledge is sharing, top management in organizations should actively provide useful information and cases on the benefits of knowledge sharing. The new information of knowledge sharing programs gathered, together with the successful paradigms for knowledge sharing from other organizations and communities of practice can serve as positive examples of knowledge sharing to employees (members).

7. Limitations

Our research had some limitations. First, the external validity of the results may not extend beyond specially defined and selected samples. The data was collected only at two websites of PVCs in Taiwan. Second, the data presented were cross-sectional. The development of contextual and individual factors leading to knowledge-sharing activity, knowledge utilization and community promotion is an ongoing phenomenon. These influencing factors were measured at a static point rather than as they were developing, thus losing time richness of explanation.

Third, since we simply measured the variable of knowledge utilization and community promotion instead of ultimate outcomes, the direct relationship between the level of knowledge activity and its financial contribution to the PVC or the individual was not explored.

Appendix A. Measurement items used in the study

Norm of reciprocity (NR) (adapted from [12,33])

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

Interpersonal trust (ITR) (adapted from [20,21,27,34,35])

- 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 the profitable opportunity arises.
- Members in this virtual community will always keep the promise that make to one another.

Knowledge sharing self-efficacy (KSSE)

- 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 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.

Perceived relative advantage (PRA)

- 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 be effective in my job and improve my performance.

Perceived compatibility (PC)

- 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.

Knowledge contributing behavior (KCB1)

Average volume of knowledge contributing per month (converted to seven-point scale)

☐ less than 2 times ☐ about 2 to 5 times ☐ about 6 to 10 times ☐ about 11 to15 times

☐ about 16 to 20 times ☐ about 21 to 30 times ☐ more than 30 times

Knowledge collecting behavior (KCB2)

Average volume of knowledge collecting per month (converted to seven-point scale)

☐ less than 5 topics ☐ about 5 to 10 topics ☐ about 11 to 15 topics ☐ about 16 to 20 topics

☐ about 21 to 30 topics ☐ about 31 to 50 topics ☐ more than 50 topics

Knowledge utilization (KU)

- I often use some kind of knowledge which I get from our virtual community to solve problems in my work.
- I frequently use some kind of knowledge which I get from our virtual community to improve professional knowledge level in my expertise area.
- I regularly use some kind of knowledge which I get from our virtual community to handle challenges and changes of the work in the future.

Community promotion (CP) (adapted from [6])

- I frequently talk to people about benefits of our virtual community.
- I usually spend some time to provide useful suggestions to 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.

Appendix B. Item loading and cross-loading

Construct	Items	1	2	3	4	5	6	7
Norm of reciprocity	NR1	**0.83**	0.13	0.08	0.13	0.27	0.13	0.26
	NR2	**0.87**	0.14	0.11	0.15	0.23	0.22	0.29
	NR3	**0.85**	0.13	0.12	0.09	0.19	0.16	0.10
Interpersonal trust	ITR1	0.23	**0.82**	0.20	0.08	0.23	0.11	0.08
	ITR2	0.32	**0.92**	0.04	0.25	0.17	0.17	0.28
	ITR3	0.23	**0.87**	0.26	0.22	0.19	0.11	0.09
Knowledge sharing self-efficacy	KSSE1	0.21	0.20	**0.87**	0.20	0.21	0.13	0.22
	KSSE2	0.11	0.29	**0.90**	0.20	0.11	0.28	0.11
	KSSE3	0.15	0.10	**0.85**	0.31	0.26	0.25	0.16
Perceived relative advantage	PRA1	0.20	0.24	0.30	**0.77**	0.34	0.14	0.16
	PRA2	0.22	0.13	0.31	**0.80**	0.19	0.13	0.11
	PRA3	0.11	0.08	0.21	**0.76**	0.23	0.07	0.25
Perceived compatibility	PC1	0.16	0.12	0.25	0.19	**0.85**	0.08	0.23
	PC2	0.26	0.11	0.20	0.22	**0.86**	0.15	0.19
	PC3	0.19	0.00	0.12	0.18	**0.79**	0.23	0.25
	PC4	0.11	0.13	0.22	0.17	**0.81**	0.27	0.24
Knowledge utilization	KU1	0.07	0.12	0.17	0.12	0.17	**0.71**	0.05
	KU2	0.12	0.13	0.10	0.23	0.17	**0.72**	0.13
	KU3	0.14	0.06	0.20	0.20	0.05	**0.75**	0.20
Community promotion	CP1	0.19	0.11	0.17	0.21	0.12	0.28	**0.63**
	CP2	0.14	0.12	0.13	0.13	0.16	0.13	**0.78**
	CP3	0.21	0.08	0.28	0.14	0.15	0.11	**0.81**
	CP4	0.09	0.20	0.23	0.18	0.04	0.12	**0.81**

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