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Promoting Knowledge Sharing in Virtual Communities of Practice: Effects of the Cooperative Type and Tie Strength

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ABSTRACT

The degree to which people share knowledge has major impacts on the effectiveness of virtual community of practice (VCoP). As an extension to the previous study which investigated the effect of individual cooperative types (cooperator, reciprocator, or free rider) on knowledge sharing, we investigate how much increase in the degree of cooperation will enhance knowledge sharing when there are more knowledge contributors and strong ties exist across the community. We adopt simulation to measure the effect of the cooperative type and tie strength on knowledge sharing. Simulation results reveal that the tie strength positively affects knowledge contribution in VCoP and strongly tied VCoP generates equivalent level of knowledge contribution as that of weakly-tied VCoP with 5% more contributors.

Keywords

Knowledge sharing, virtual communities of practice, tie strength, cooperative type, reciprocity.

INTRODUCTION

In communities of practice (CoP), members share knowledge related to common interests to solve organizational problems and tasks (Constant, Sproull, and Kiesler, 1996; Hiltz, Johnson, and Turoff, 1986; Walther, 1994; Wellman and Gulia, 1999). Rational choice and Nash equilibrium models assume that rational participants can use information from others because generating new knowledge requires time and effort, and rational self-interest choice seeks benefits without incurring costs (Nash, 1950). However, in real world settings interaction and information exchange take place. Three types of cooperative behaviors toward public goods have been identified: cooperators, reciprocators and free riders (Kim, Lee and Olson; 2006; Kurzban and Houser, 2005; Engle-Warnic and Slonim, 2006). Shared knowledge in online communities has been viewed as a type of public good (Cabrera and Cabrera, 2002). The public good dilemma is where free riders will take advantage of publicly provided goods without contributing to the development of these goods, thus resulting in suboptimal outcomes for all (Ostrom, 1998).

Virtual Community of Practice (VCoP) produces a variety of collective knowledge by allowing members to come together in online environment, helping them exchange ideas and coordinate their activities, and providing the kind of identification and feeling of membership found in face-to-face interaction (Brown and Duguid, 2001; Wasko and Faraj, 2005). In the process, however, there are familiar problems of defection, free riding and other forms of disruptive behavior (Sharp, 1997).

This study examines expected knowledge sharing behavior by investigating the effect of knowledge sharing under reasonable assumptions such as weak and strong tie relationships among VCoP members. In the previous study (Kim, Lee, and Olson, 2006), the effects of cooperator fraction; direct and indirect effects (through reciprocators) on knowledge sharing using the reciprocity function were considered .In this study, we expand the first simulation by considering two different tie strengths of the online community (strong tie and weak tie) and the change of its effect on the behaviors of contributors and reciprocators.

PROMOTING KNOWLEDGE SHARING IN VCOP

Three Cooperative Type of VCoP Knowledge Sharing

Knowledge shared in a VCoP can be regarded as a public good. They are non-competitive because multiple people can consume the knowledge at the same time and non-excludable because it is not possible to exclude people who did not pay for the knowledge from consuming them (Cabrera and Cabrera, 2002). As long as people maximize their own utility, no public goods can exist. However, some people make contributions to VCoP knowledge bases regardless of the contributions of

others. Thus, there are people who do not free-ride and these individuals' behaviors are not explained by utility maximization theory (Nash, 1950) or by theory of impure altruism (Andreoni, 1989; 1990).

Two theories could explain this inconsistency. Margolis' theory of altruism (1982) argued that individuals act non-selfishly and are motivated by a concern for group members' welfare. Theory of reciprocity takes the position that individuals choose the level of effort that they most prefer when all other group members are making at least a certain amount of effect in the production of a public good (Sugden, 1984; 2002). Theory of altruism and theory of reciprocity hold that one is never required to contribute more than other people in the group, overcoming the unfairness which arises from free-riding behavior on shared knowledge in VCoP. From these theories on voluntary contribution to public goods, individuals can be categorized as free riders when they always maximize their own utility function by not contributing to other group members, cooperators if they always contribute towards public goods regardless of other's behavior, and reciprocators if they always contribute no more than others contribute.

Reciprocity and Knowledge Sharing

Axelrod (1984) identified three conditions that encourage reciprocity; a) if there is a strong chance of meeting the person again - predictability, b) if the person can be identified, and c) if the person's past behavior is known. Strong tie networks provide an environment fulfilling such conditions. In a strong tie network, people will have more chance of meeting again and they can trace ones past knowledge sharing behavior, which minimizes selfish knowledge sharing behavior. Kankanhalli, Tan, and Wei (2005) found that reciprocity impacts knowledge sharing in electronic knowledge repositories. Cross and Prusak (2003) argued that reciprocity can be used as a payment for knowledge sharing, leading to knowledge sharing behavior. Morrison and Rabellotti (1997) found that firms exchange knowledge exclusively where ties are strong and reciprocity is high. In result, average reciprocity level in strong tie networks is expected to be higher than in weak tie networks and high levels of reciprocity increase knowledge sharing.

Strength of Tie and Reciprocity in VCoP

In the VCoP context, individuals may perceive relationships as weak or strong ties. Empirical evidence has shown that in a weak tie relationship (e.g., anonymous situations) people show less reciprocity and cooperation. McGinn, Thompson and Bazerman (2003) found that face-to-face interaction enhances reciprocity and cooperation in text-based communication. As more sparsely connected by weak ties, larger online social networks (e.g., VCoP) would make normative control more difficult and lead to low contribution behavior compared to offline networks (Wellman et al., 2001). Therefore, the strength of tie in VCoP may be relatively weaker than that in face-to-face CoP and the level of reciprocity of VCoP may also be weaker than that of face-to-face CoP, which may lead to less knowledge sharing in a VCoP than in face-to-face CoP.

Approaches in Promoting Knowledge Sharing in VCoP

In the previous study (Kim, Lee, and Olson, 2006), reciprocity function which explains reciprocators' knowledge sharing behavior patterns was developed based on their positive interactions with cooperators and negative interactions with free riders. As more positive interactions occur, reciprocators share more knowledge. Since most members of VCoP belong to the reciprocator category (Kurzban and Houser, 2005; Engle-Warnic and Slonim, 2006) and this group of people can alter their knowledge sharing behavior unlike cooperators and free-riders (Zeggelink, 1993), we limit our focus on possible implications that may affect this particular group of people. Approaches of increasing reciprocators' positive interactions, resulting in the increase of knowledge sharing are two-fold; increasing cooperators or tie strength. More cooperators will increase the chance for reciprocators to experience positive feedback from them. Reciprocators, then, will increase their knowledge sharing pattern. Strengthened tie of VCoP means that reciprocators (who are altering their behavior pattern based on others) are more affected by the social control mechanism such as the reputation system or feedback system.

RESEARCH METHOD

To investigate how the varying cooperator fraction and reciprocity level affect knowledge sharing in the network, the probability modeling method (simulation) is adopted because simulation provides information on how various types of actors in the social network behave under different conditions such as weak ties and strong ties in VCoP through an imitating process.

Simulation Design

We designed and conducted a simulation examined the effect of tie strength on knowledge sharing. Figure 1 depicts the overall simulation procedure. Following sections discuss the details of simulation design in Figure 1.

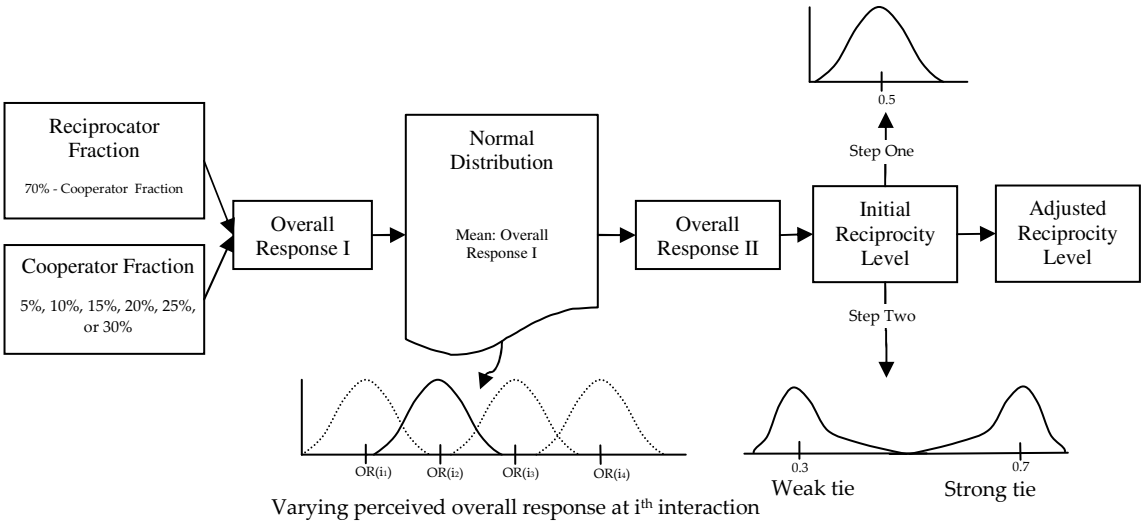


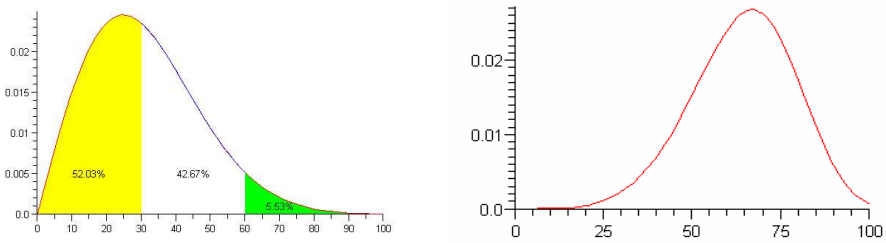
Figure 1. Simulation Design

Perceived Overall Response

In VCoP, people interact with other people by posting questions or looking up some answers they search. For each interaction in VCoP, the overall response people perceive may vary. Reciprocators share knowledge at different rate based upon the perceived overall response, which is represented as reciprocity function. To represent the variation of reciprocators' perceived overall response, we used a probability density function of the normal distribution.

Varying Reciprocity Level

We assume that reciprocators will perceive varying reciprocity levels for each interaction while the overall reciprocity level (in average) is somewhat similar, and that the overall reciprocity level of weak tie is quite lower than that from strong tie. To represent the varying reciprocity level in weakly- and strongly-tied VCoP, two Weibull distributions are used (one is positively skewed for weak ties with α=35, β=2 and the other is negatively skewed one for strong ties with α=70, β=4), as shown in Figure 2. Under this distribution function, weaker reciprocators (between 0 to 30% reciprocity level) takes about half of entire population (52.03%) while moderate reciprocators (between 30% to 60% reciprocity level) takes about 42% of the population. There are only few stronger reciprocators (5.15%) whose reciprocity level ranges from 60% to 100%.



Weak Tie Setting (α=35, β=2) *Strong Tie Setting (α=70, β=4)*

Figure 2. Weibull Probability Distribution

Varying Cooperator Fraction

To understand the effect of cooperator fraction in VCoP, varying combinations of cooperative types (shown in Table 1) are used. As a control group we assume a VCoP without any intervention would have 5% cooperators, 65% reciprocators, and 30% free riders. As experimental groups, we set five possible cooperator policies with varying target fractions of cooperators and reciprocators. Then, we compare the amount of shared knowledge between natural setting and other policies using analysis of variance to check whether the difference of the amount of shared knowledge is statistically significant.

Combination	Cooperators	Reciprocator	Free rider
Natural Setting	5	65	30
Policy1	10	60	30
Policy2	15	55	30
Policy3	20	50	30
Policy4	25	45	30
Policy5	30	40	30

Table 1. Natural Setting and Cooperator Policies (%)

Simulation Result

There are three cooperative types (cooperators, reciprocators, and free-riders) in VCoP. In the simulation of 100 interactions, each cooperative member has a chance to contribute knowledge to VCoP. A cooperator contributes a piece of knowledge to VCoP, while a reciprocator shares partial knowledge based on the perceived reciprocity level[1]. We controlled the cooperator fraction and measured the effect of tie strength on knowledge sharing. As expected, knowledge contribution from cooperators did not change significantly regardless of the tie strength, while reciprocators' knowledge contribution as well as total knowledge contribution is significantly changed between the weak tie setting and the strong tie setting. This result implies that reciprocators make significantly different knowledge contributions when tie strength is changed from weak to strong environment and reciprocators' additional knowledge contribution may increase the total shared knowledge in VCoP. Table 2 summarizes ANOVA of different tie strength on knowledge sharing.

Interaction	*Knowledge Contribution (Cooperator)*			*Knowledge Contribution (Reciprocator)*			*Knowledge Contribution (Total)*		
	F	*Sig.*	*Decision*	*F*	*Sig.*	*Decision*	*F*	*Sig.*	*Decision*
10th	.000	.983	No difference	786.531	.000	Significant	36.391	.000	Significant
20th	.002	.961	No difference	822.516	.000	Significant	36.586	.000	Significant
30th	.003	.954	No difference	1089.603	.000	Significant	41.227	.000	Significant
40th	.006	.938	No difference	1209.899	.000	Significant	42.673	.000	Significant
50th	.009	.923	No difference	1194.831	.000	Significant	42.642	.000	Significant
60th	.009	.925	No difference	1168.504	.000	Significant	41.578	.000	Significant
70th	.008	.928	No difference	1163.915	.000	Significant	41.103	.000	Significant
80th	.008	.929	No difference	1108.979	.000	Significant	40.401	.000	Significant
90th	.009	.927	No difference	1148.489	.000	Significant	40.841	.000	Significant
100th	.010	.922	No difference	1086.481	.000	Significant	39.752	.000	Significant

Table 2. ANOVA Result of Strongly- and Weakly-tied VCoP

[1] Perceived reciprocity level is found through mathematical calculation (Kim, Lee, and Olson; 2006).

Interaction Effect of Cooperator Fraction and Reciprocity Level

We compare the two tie strength groups to see how much the cooperator fraction affects the level of knowledge sharing. To achieve the same level of knowledge sharing, strongly-tied VCoP is supposed to require a smaller fraction of cooperators than weakly tied VCoP since reciprocators will reciprocate at a much higher reciprocity level. From the simulation result, we observed that the same level of knowledge sharing was achieved at different level of tie strength and cooperator fraction, which we named as 'knowledge sharing equivalence. Table 3 shows the result of the knowledge sharing equivalence analysis. In Table 3, we compared the knowledge contribution from cooperators (a), reciprocators (b), and total knowledge contribution (c) between two tie strengths, and between two cooperator fractions. To accomplished these comparisons, we sorted the shared knowledge amount from six different settings (from natural to Policy 5) in an ascending order and compared the values to find where the equivalent knowledge sharing amount is achieved from the strong tie or weak tie setting at which level of the cooperator fraction. Since we ran 100 simulation runs for each cooperator fraction level, we have 100 comparisons for each setting of 5% vs. 10%, 10% vs. 15%, etc.

Equivalent Cooperator Fraction	*Knowledge Contribution from Cooperator (a)*	*Knowledge Contribution from Reciprocator (b)*	*Total Knowledge Contribution (c)*
Strong 5% vs. Weak10% *	0	56	7
Strong10% vs. Weak15% *	2	0	39
Strong15% vs. Weak20% *	6	0	52
Strong20% vs. Weak25% *	6	0	53
Strong25% vs. Weak30% *	6	0	66

Table 3. Result of Knowledge Sharing Equivalence

In the comparison of 5% cooperator fraction in strong tie (SCF5) vs. 10% cooperator fraction in weak tie (WCF10), strong ties helped achieve equivalent knowledge contribution from reciprocators with 5% less cooperator fraction (this occurs 56 times). This means that we have the same amount of shared knowledge with a less cooperator fraction when we increase the tie strength from weak to strong.

In the total knowledge contribution, seven knowledge sharing equivalences (out of 100 comparisons) are found from the comparison of SCF5 vs. WCF10, 39 Type I equivalences from SCF10 vs. WCF15, 52 from SCF15 vs. WCF20, 53 from SCF20 vs. WCF25, and 66 from SCF25 vs. WCF30. These results clearly show that the increment in tie strength has a similar positive effect on knowledge sharing as 5% cooperator fraction increment does. This implies that after achieving 10% of cooperator fraction, if we increase the tie strength from weak to strong, we have about a 50% chance to increase the total knowledge contribution in VCoP (e.g., 39%, 52%, 53%, and 66%, respectively) and this increased amount of shared knowledge is equivalent to that from 5% cooperator fraction increment, implying that strengthening tie in VCoP has equivalent effect of 5% cooperator fraction.

CONCLUSION

Improving knowledge contribution is one of the most fruitful outcomes from VCoP since the members share interest in relevant tasks and most organizational knowledge resides inside its members. Throughout this paper, we investigated knowledge sharing behavior in VCoP through cooperative type and tie strength. We used the reciprocity function which explains reciprocators' knowledge sharing behavior patterns based on their positive interactions with cooperators and negative interactions with free riders. To promote knowledge sharing in VCoP, We tested two approaches of increasing reciprocator's positive interactions; (1) increasing cooperator fraction, and (2) increasing tie strength. Analysis of variance shows that raising the cooperator fraction by 5% will significantly increase total shared knowledge in CoP, not only due to more cooperators, but also due to the higher reciprocity level of reciprocators. Therefore, CoP can benefit by attracting more cooperators into the system where they share more knowledge as well as positively influence reciprocators. We also found that tie strengths positively affect reciprocators' knowledge contribution, which lead to the increase in the total knowledge contribution. One interesting finding is the replacement effect of the tie strength to the cooperator fraction. We found that the increment of tie strength generates an equivalent amount of shared knowledge, and this replacement effect occurs quite often,

roughly 50 percent of the time. Therefore, increasing the tie strength would be a viable alternative to increasing cooperator in VCoP for the purpose of knowledge sharing promotion.

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