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Managerial Knowledge Sharing: The Role of Individual, Interpersonal, and Organizational Factors

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ABSTRACT This paper describes two studies conducted in the People's Republic of China aimed at improving understanding of knowledge sharing among managers. Study 1 found evidence for the role of two individual factors: greed which reduced knowledge sharing, and self-efficacy which increased it. In addition, co-worker collegiality has an indirect influence on knowledge sharing by lowering greed and raising self-efficacy. Study 2 replicated the key findings of Study 1 and also identified the influence of organizational support on knowledge sharing. Organizational support led to higher utilization of information and communication technologies, resulting in more knowledge sharing, especially for explicit as opposed to implicit knowledge.

INTRODUCTION

'Knowledge sharing', or the contributions by individuals to the collective knowledge of an organization (Cabrera and Cabrera, 2002), is increasingly acknowledged as an important research topic. Within an organization, knowledge is often shared among employees in the form of various job-related documents, organizational rules, working procedures, personal experience, and know-how. Knowledge sharing is crucial because it helps organizations promote best practices and reduce redundant learning efforts or 'reinventing the wheel' (Hansen, 2002; McDermott and O'Dell, 2001).

In knowledge-intensive industries, firms cannot compete if their employees guard their insights as personal secrets (Teece, 1998). To succeed in a knowledge economy, organizations need to develop systematic processes to create and leverage knowledge. However, the failure of firms in their effort to promote knowledge sharing has been documented in many cases because employees are reluctant to share their knowledge with others even when knowledge sharing is actively

promoted (e.g., Davenport, De Long, and Beers, 1998). A number of reasons have been given for these failures, such as the influence of organizational culture (Davenport, De Long, and Beers, 1998) or personal concerns of power and self-interest (Jarvenpaa and Staples, 2001). However, these arguments have not been empirically verified, and a coherent account of the factors hindering knowledge sharing is still lacking.

The present article develops a three-level conceptual framework for analysing the antecedents of knowledge-sharing behaviours. It draws upon theories and research in public goods to analyse the effects of individual-level factors as well as drawing upon theories and research in organizational behaviour and knowledge management to analyse the effects of interpersonal and organizational factors. The major objective of the research is to explore what kinds of intrinsic and extrinsic factors can enhance or inhibit knowledge-sharing behaviours within an organization. Hypotheses about the determinants of knowledge sharing among managers were investigated in two studies. Study 1 tested the hypotheses derived from a behavioural model of knowledge sharing. Study 2 extended the model by exploring technology utilization in relation to organizational support for knowledge-sharing behaviours. As we shall see, Study 2 also introduced the distinction between tacit and explicit knowledge into the research model. Overall, the current two studies go beyond past research in modelling the interplay of factors in employees and in the organizational context that determine knowledge sharing.

The research was conducted in China, and given the rising importance of the knowledge economy in China, this research has significant implications for the success of Chinese firms. In fact, Chow, Deng, and Ho (2000) have compared knowledge sharing behaviours in the USA and China. The present research extends this line of enquiry through an in-depth analysis of knowledge-sharing behaviours in a Chinese context.

CONCEPTUAL BACKGROUND – KNOWLEDGE AS A PUBLIC GOOD

A public good is a product or service beneficial to a group that is supplied by the voluntary contributions of its members (e.g., Komorita and Parks, 1994). The problem with public goods is that non-contributors as well as contributors can consume them. Hence, there is a dilemma between self interest and collective interest; if everyone behaves in a manner that maximizes personal gain, everyone is worse off than if everyone maximizes collective gain (Messick and Brewer, 1983). Public goods theories have been applied to management, such as in the analysis of motivation (Spicer, 1985), cooperative behaviour (Aquino and Reed, 1998), and multi-party alliances (Zeng and Chen, 2003), but empirical work based on this perspective is still rare.

Some recent research has conceptualized shared knowledge in organizations from a public goods perspective (Cabrera and Cabrera, 2002; d'Aspremont, Bhattacharya, and Gerard-Varet, 1998). Shared knowledge meets two important public-goods criteria. First, shared knowledge derives exclusively from employees' contributions. Second, employees other than the contributor can use the shared knowledge. In a technology-intensive workplace, knowledge sharing is also often impersonal, as it is increasingly easy for organizational knowledge to be accessed by employees who have no direct relationship with the contributor and who may have contributed nothing themselves.

Given that knowledge can be conceptualized as a public good, the public goods literature provides insights into the determinants of knowledge sharing (e.g., Komorita and Parks, 1994; Rapoport and Eshed-Levy, 1989). For example, public goods experiments indicate that people like to free-ride – taking without giving – because in this way the personal cost is lowered (Yamagishi and Sato, 1986). In the context of knowledge sharing, it is clear that an employee is likely to free-ride on others' knowledge, but if all of the organization's members choose to do so, no knowledge would be available to be shared. A deficient equilibrium state would result, where no one shares knowledge and everyone is worse off.

The Role of Employee Factors in Knowledge Sharing

Considerable research has focused on factors that promote or inhibit the tendency to contribute to a public good. Here two factors that may be proximal determinants of knowledge sharing are identified: greed and self-efficacy (e.g., Chen, Au, and Komorita; 1996). Greed refers to the desire to obtain the best possible outcome for oneself (Kollock, 1998) or the desire to enjoy other people's contributions without cost and is a major reason for non-cooperative behaviours in public goods contributions (see Rapoport and Eshed-Levy, 1989; Yamagishi and Sato, 1986). In the context of knowledge sharing, greed involves the desire to tap into others' valuable knowledge without reciprocation. Social dilemma research has also shown that manipulations that reduce greed result in more cooperative behaviours (see Komorita and Parks, 1994, ch. 3). Correspondingly, we expect that greed will reduce knowledge sharing.

Self-efficacy, the judgement of one's capability to organize and execute a course of action for the attainment of a particular goal (Bandura, 1997), may be another major determinant of knowledge-sharing behaviours. Its positive effect has been documented across a wide range of behaviours. In the public-goods context, self-efficacy involves the perception of one's ability to make useful contributions and the perceived criticality of these contributions to the provision of a public good. In general, perceived self-efficacy can enhance cooperation and reduce free-riding (Chen et al., 1996) as well as promote the sharing of knowledge (Cabrera and Cabrera, 2002).

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The Role of Organizational Context in Knowledge Sharing

Although organizational knowledge sharing resembles a public goods dilemma in many respects, it differs in other respects. In a typical public goods context, participants are treated as equals and are assumed to act more or less independently. In contrast, an organization constitutes a specific context with diverse influences on an employee's knowledge-sharing decisions. This context includes organizational culture, structure, information systems, reward systems, leadership, and interpersonal relationship (Gupta and Govindarajan, 2000). Members of an organization are related to each other both formally and informally in a hierarchical structure, and are subjected to the constant influence of this structure. Thus knowledge sharing, which is influenced by individual factors such as greed and self-efficacy, is also shaped by various organizational forces. For example, in a company that promotes individual and organizational learning, a corporate architecture is likely to be established that facilitates learning and knowledge sharing across the organization (Loermans, 2002). Davenport, De Long, and Beers (1998) emphasized the importance of such an organizational culture and in Taylor and Wright's (2004) research on an innovative culture, the capacity to learn from failure, good information quality, change management, and a predisposition to confront performance indicators, were all predictors of knowledge sharing.

In the present research, we focus on two major aspects of the organizational context. First, the organizational context provides opportunities for employees to interact with each other and individuals have different degrees and nature of interpersonal relationships. Second, organizations have the authority to take steps to achieve specific goals and can provide resources to support or inhibit certain employee actions. Therefore, to further understand knowledge sharing in an organizational context, we consider the concepts of both 'co-worker collegiality' and 'organizational support'.

Co-worker collegiality. Co-worker collegiality refers to the quality of interpersonal relationships and rapport in the workplace. Positive interpersonal relationships are conducive to cooperative choices in public goods dilemmas, including knowledge sharing (e.g., Cabrera and Cabrera, 2002). In the knowledge-sharing context, we propose that the dimensions of interpersonal trust and teamwork are best indicators of co-worker collegiality as these are central to productive interdependent relationships. Specifically, interpersonal trust is a critical social resource that facilitates cooperation and coordinated social interactions (McAllister, 1995). In knowledge sharing, De Long and Fahey (2000) argued that the level of trust among employees in a firm has a significant influence on the amount of knowledge flowing between individuals and from individuals into the firm's databases, best practices, and other records. Roberts (2000) also argued that interpersonal trust reduces the necessity of monitoring others' cooperative behaviours and facilitates informal cooperation.

In knowledge-based organizations, teams are major performing units (Nonaka and Takeuchi, 1995), and good teamwork should contribute to knowledge sharing. Specifically, researchers argued that positive interpersonal interactions can facilitate knowledge sharing (Newell, Scarbrough, and Hislop, 1999) and that promoting a group identity, increasing the frequency of interactions, and enhancing communication are able to facilitate knowledge sharing (Cabrera and Cabrera, 2002). Zeng and Chen (2003) made similar arguments for overcoming the public goods dilemma inherent in a multi-party alliance. These proposed strategies are, in essence, team-building strategies that promote a common identity. In summary, we conclude that teamwork is able to promote communal working relationships characterized by helpfulness and responsibility, thereby facilitating knowledge sharing behaviours (see the review by Jones and George, 1998).

Organizational support. We label the enabling effect of the organizational context on knowledge-sharing behaviour as 'perceived organizational support for knowledge sharing'. This refers to the general perception that an organization cares for the well-being of its employees and values their contributions (Eisenberger, Cummings, Armeli, and Lynch, 1997). We propose three dimensions to index this construct. The first dimension is labelled as 'manager's attitude'. This dimension is supported by the argument that supportive attitudes and actions on the part of managers are a key to the success of knowledge management (Davenport et al., 1998). The second dimension is training, which is widely regarded as vital in implementing knowledge management (e.g., Brand, 1998; Davenport et al., 1998) as it equips people with the vital skills and positive attitudes required for knowledge sharing. The third dimension is sanctions, which are widely used to promote desirable behaviours in organizations and are effective in inducing cooperation in social dilemmas (Messick and Brewer, 1983; Yamagishi and Sato, 1986). Sanctions include both positive and negative measures. To the extent that sharing is rewarded, and hoarding penalized, knowledge sharing should be successful (Bock and Kim, 2002). In fact, firms are well aware of the positive effects of sanctions on knowledge sharing. In the DAOchina (2002) survey of knowledge management in China, 34.6% of the firms considered knowledge-sharing contributions in performance appraisal and compensation decisions.

Hypotheses on Individual-level Factors for Knowledge Sharing

Free-riding is a common problem in knowledge sharing. But if individuals have less greed and possess high self-efficacy about the usefulness of their knowledge, they are more likely to share. This reasoning is stated formally in two hypotheses as follows:

Hypothesis 1. Greed will be negatively associated with knowledge-sharing behaviours.

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Hypothesis 2. Perceived self-efficacy will be positively associated with knowledge-sharing behaviours.

While the relationship between co-worker collegiality and knowledge sharing seems clear, in the absence of relevant research, it is less obvious how co-worker collegiality impacts greed and self-efficacy. The fact that positive co-worker collegiality is characterized by trust, rapport, and mutual support, however, suggests that it should be able to reduce greed. Interpersonal trust, for example, was found to reduce the desire to take advantage of others (De Cremer, 1999; Yamagishi and Sato, 1986). Extrapolating from these findings, interpersonal trust should reduce greed in a knowledge-sharing context. In a similar vein, group cohesiveness is well known to promote pro-social behaviours toward fellow group members. Thus, good teamwork, which emphasizes interdependence, communication, and mutual support, should be able to reduce greed as well.

Positive co-worker collegiality should also be able to elevate self-efficacy because rapport with and support from others, core elements of positive co-worker collegiality, are positively related to self-efficacy (e.g., Dorman, 2000). Furthermore, Maurer, Pierce, and Shore (2002) argued that leader–member exchange should increase self-efficacy because a high-quality exchange facilitates 'learning mastery experiences'. We suggest that positive co-worker collegiality as indexed by interpersonal trust and teamwork should facilitate learning experiences and result in higher self-efficacy. Lastly, in a public goods context, De Cremer and van Vugt (1998) found that while a salient collective identity positively influenced the willingness to contribute to a public good, this was mediated by perceived self-efficacy. This finding suggests that a salient collective identity, a characteristic of a cohesive work team, should enhance people's self-efficacy. In summary, the above analysis suggests the following hypotheses:

Hypothesis 3a. Positive co-worker collegiality will be negatively related to greed in knowledge sharing.

Hypothesis 3b. Positive co-worker collegiality will be positively related to self-efficacy in knowledge sharing.

The beneficial effects of perceived organizational support as indexed by managers' attitude, training, and sanctions on knowledge sharing also seem clear, but its effect on greed and self-efficacy is less obvious. The literature on these links is scanty and we have to gauge their effects by extrapolating from related results. With regard to greed, both Zeng and Chen (2003) and Cabrera and Cabrera (2002) argued that changing the pay-off structure underlying a public goods dilemma dampens the effects of greed. Thus, we believe that perceived organizational support for knowledge sharing can shift the pay-off for sharing in a positive direction. Specifically, training may render knowledge sharing easier and less costly in terms of time

and effort. Managers' attitude along with sanctions can boost the benefits associated with sharing and increase the cost of hoarding.

With regard to self-efficacy, perceived organizational support for knowledge sharing may instill confidence in the perceived usefulness of one's contributions. In fact, Maurer, Pierce, and Shore (2002) concluded in their literature review that supervisory support and the availability of developmental opportunities enhance self-efficacy. Training was also found to boost self-efficacy (Betz, 1986; Lent, Brown, and Hackett, 1994), and we expect the same effect in the context of knowledge sharing (Cabrera and Cabrera, 2002). Lastly, Igbaria, Iivari, and Maragahh (1995) found that top managerial support and attention as well as the availability of resources were associated with higher self-efficacy in the use of computers. In summary, these findings suggest that perceived organizational support should enhance self-efficacy in knowledge sharing. The above discussion suggests the following hypotheses:

Hypothesis 4a. Organizational support for knowledge sharing will be negatively related to greed in knowledge sharing.

Hypothesis 4b. Organizational support for knowledge sharing will be positively related to perceived self-efficacy in knowledge sharing.

One remaining issue that needs discussion is whether or not the effects of co-worker collegiality and perceived organizational support on knowledge sharing are fully mediated by greed and self-efficacy. As discussed above, prior research has consistently shown a positive influence of organizational support and positive co-worker relations on employee outcomes. Hence, we expect a direct effect in addition to an indirect influence through reducing greed and enhancing self-efficacy. Thus, we propose the following two exploratory hypotheses:

Hypothesis 5a. Co-worker collegiality will have both a direct and an indirect effect on knowledge-sharing behaviours.

Hypothesis 5b. Perceived organizational support for knowledge sharing will have both a direct and an indirect effect on knowledge-sharing behaviours.

STUDY 1: METHOD

Sample and Procedures

Respondents were recruited in China from two sources: 350 part-time MBA students in Shanghai and Shenzhen, and 80 middle-level employees from five firms (three in high-tech industries, one in insurance, and one in biotechnology) in Guangzhou, Shenzhen, and Beijing. All respondents had similar backgrounds and were knowledge workers likely to participate in knowledge-sharing activities in their firms.

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The questionnaire distributed to these respondents was part of a research project on knowledge management and participation in the study was voluntary. A total of 246 participants returned the questionnaire (of which 26 were from the firms), resulting in an average response rate of 57% (MBA students, 62.9% and employees, 32.5%). A possible reason for the differential response rate is that the employees took the questionnaires home to complete, which made the collection process more difficult. Twenty-four questionnaires were dropped because of missing data and problematic response patterns, and 14 more were dropped because the respondents were low-level employees, yielding a final sample of 208. Most respondents were from the IT (38.8%), manufacturing (23.4%), and finance and insurance (23.9%) sectors. The size of the companies they worked in ranges from small and medium (100–1000 employees: 40.8%) to large (over 1000: 37.3%). Most respondents were university educated (77.1%), male (71.1 %), and in the 20–39 age group (94.5%).

Measures

Empirical research on knowledge sharing is still in its infancy (e.g., Bock and Kim, 2002; Schulz, 2001), and there are no well-established scales for some of the proposed constructs. Thus, we resorted to a combination of established scales, and items and scales specifically constructed for this survey. The questionnaire contained 119 items, plus 9 items at the end for background information. In a pilot study, 25 respondents answered a draft version. Some items were dropped or revised based on the pilot result. Items measuring multiple dimensions were randomly ordered in each scale in the final version. We have listed the items of all the new scales and modified scales in the Appendix.

We measured the dependent variable, knowledge-sharing behaviours by asking the respondents how frequently they had engaged in eight knowledge-sharing behaviours in the past year. Three of these behaviours were adapted from the 'intention to share knowledge' scale from Bock and Kim (2002). The other five items were constructed for the study.

We used six items to measure self-efficacy for knowledge sharing. Three of them were adapted from Bock and Kim (2002). Three new items were written for the scale. Participants were asked to indicate their agreement to these statements on seven-point Likert-type scales with anchors ranging from '1 = strongly disagree' to '7 = strongly agree'. This format was used for all the scales described below.

Although the effects of greed are well known in the public goods literature (e.g., Brewer and Kramer, 1986; Komorita and Parks, 1994), we were unable to identify a greed scale. We therefore developed a five-item greed scale for knowledge sharing. The response scale for these items ranges from '1 = strongly disagree' to '7 = strongly agree'.

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Perceived organizational support for knowledge sharing was measured using three scales that we constructed to tap perception of the attitude that management expresses, the relevant training provided, and the positive or negative sanctioning keyed to knowledge sharing. The attitude component was measured with seven items. Seven items were developed to measure the training component and six items were used to measure sanction. The response scale for these items ranges from '1 = strongly disagree' to '7 = strongly agree'.

Co-worker collegiality was measured with two scales, focusing on perceptions of co-workers as trustworthy and cooperative. The trust component was measured with the scale of Cook and Wall (1980), which focuses primarily on confidence in the ability of others and faith in their positive intention. Because the items are concerned with both peers and superiors, we adapted the seven items focusing on peers only. The cooperativeness component was measured with the teamwork scale of the Organizational Culture Survey (Glaser, Zamanou, and Hacker, 1987). Seven out of the eight original items were used with some minor adjustment. The response scale for these items ranges from '1 = strongly disagree' to '7 = strongly agree'.

Preliminary Analysis

Eight control variables were included in the survey. Four of them were concerned with organizational characteristics: industry, firm age, firm ownership, and number of employees. The other four were about personal demographic characteristics: gender, age, tenure in the present organization, and education level. Prior to hypothesis testing, hierarchical regression was conducted to test the effects of these control variables on the results. Industry and firm ownership were nominal variables, and both were dummy-coded. Results showed that three of the control variables showed significant effects on the dependent variable: gender, firm age, and number of employees in the firm. These three control variables were included in the main analysis.

The measurement model was tested by comparing the fit of a single-factor model to the fit of a five-factor model (number of latent variables in the model) and that of an eight-factor model (number of scales). Amos, a structural equation modelling package, was used in this analysis (Arbuckle, 1997, Version 4.0). We followed Bollen's (1990) recommendation to rely on multiple indices to evaluate model fit, which included the chi-square statistic, the comparative fit index (CFI), the goodness-of-fit index (GFI), incremental fit index (IFI), and the normed fit index (NFI). We also included RMSEA, which is an indication of the residuals of the predicted parameters from the observed parameters. Furthermore, Carmines and McIver (1981) suggested that a chi-square of two to three times larger than the degree of freedom indicates an acceptable level of model fit, and this ratio was also included.

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The results showed that the single-factor model had a very poor fit (χ^2 = 1539.01, df = 119, χ^2/df = 12.93, GFI = 0.75, CFI = 0.53, IFI = 0.75, NFI = 0.73, RMSEA = 0.24), suggesting that the common method variance problem is not serious. Both the five-factor model (χ^2 = 92.43, df = 44, χ^2/df = 2.10, GFI = 0.93, CFI = 0.97, IFI = 0.97, NFI = 0.95, RMSEA = 0.07) and the eight-factor model (χ^2 = 230.10, df = 91, χ^2/df = 2.53, GFI = 0.88, CFI = 0.97, IFI = 0.97, NFI = 0.95, RMSEA = 0.09) showed a good fit, supporting the measured model hypothesized.

Results on the Hypotheses

The correlation matrix used in the analysis is presented in Table 1, along with the means, standard deviations, and alpha coefficients of all the scales. The correlations between knowledge sharing and the independent variables are in the expected direction.

To reduce the complexity of the model, scales or parcels were used instead of items as indicators for the latent constructs, a common practice in estimating complex models (Hom and Kinicki, 2001; Leung, Su, and Morris, 2001; Yuan, Bentler, and Kano, 1997). For the dependent variable and the two mediators, the original four to eight items were randomly combined into 'parcels', with two or three items in one parcel, and these parcels (G1, G2, SE1, SE2, KS1, KS2 and KS3 in Figure 2) were used as indicators. The control variables were included in the path model to control for their effects.

The predicted model described in Figure 1 was first tested, and the final model was then estimated by excluding the non-significant paths (illustrated by dotted lines), which is presented in Figure 2. The chi-square statistic was significant (χ^2 = 232.76, df = 102, $p < 0.01$), but the χ^2/df ratio was 2.28, suggesting a reasonable fit. The fit indices were acceptable (GFI = 0.89, CFI = 0.92, IFI = 0.92, and NFI = 0.87), and so was RMSEA (0.08).

The results clearly supported Hypotheses 1 and 2. Greed was negatively related to knowledge sharing, while self-efficacy was positively related. Hypotheses 3a and 3b were supported also, with co-worker collegiality having a negative relationship with greed and a positive relationship with self-efficacy. Hypotheses 4a and 4b were not supported because organizational context was related to neither greed nor self-efficacy. Hypotheses 5a and 5b were not supported as co-worker collegiality and organizational support showed no significant direct effect on knowledge sharing.

Discussion of Study 1 Results

These results support the usefulness of a public goods perspective on knowledge sharing. Consistent with the public goods literature, greed suppressed knowledge

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Table 1. Descriptive statistics, reliabilities, and correlations for Study 1[a]

Variables	*Mean*	*s.d.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Sanction	3.72	1.24	(0.84)										
2. Managers' attitude	4.79	1.17	0.62	(0.88)									
3. Training	4.68	1.18	0.74	0.76	(0.92)								
4. Teamwork	5.03	0.95	0.50	0.50	0.62	(0.90)							
5. Trust	4.99	0.88	0.35	0.32	0.48	0.77	(0.84)						
6. Self-efficacy	5.01	0.72	0.21	0.25	0.24	0.37	0.34	(0.70)					
7. Greed	3.11	1.00	−0.12	−0.26	−0.24	−0.30	−0.33	−0.30	(0.81)				
8. Knowledge sharing	5.12	0.79	0.33	0.30	0.27	0.31	0.31	0.37	−0.48	(0.80)			
9. Gender	0.71	0.45	0.08	−0.08	−0.15	0.08	0.15	0.26	−0.09	0.16	(n.a.)		
10. Firm age	3.12	1.05	−0.03	0.08	0.06	−0.07	−0.11	0.01	0.20	−0.13	−0.11	(n.a.)	
11. Number of employees	2.62	1.19	0.04	0.10	0.15	0.00	−0.04	0.07	0.03	0.13	−0.10	0.46	(n.a.)

Notes: [a] $n = 208$. Correlations >0.13 or <−0.13 are significant at $p < 0.05$; those >0.18 or <−0.18 are significant at $p < 0.01$; and those >0.22 or <−0.22 are significant at $p < 0.001$. Cronbach's alphas are shown on the diagonal in parentheses.

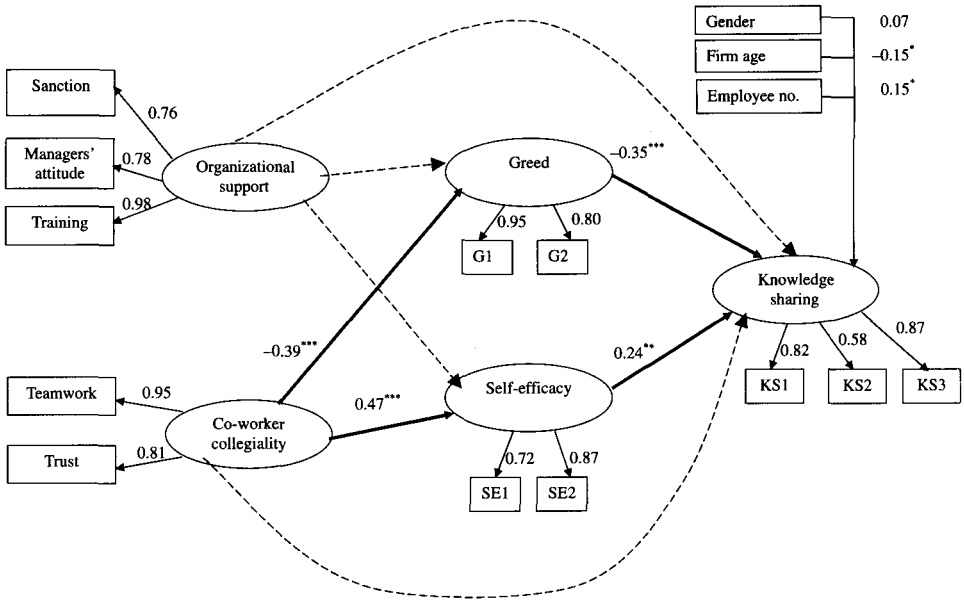

Figure 1. The structural model of knowledge sharing for Study 1[a]

Notes: [a] $n = 208$. Latent variables are shown in ovals and indicators in rectangles, and standardized path coefficients in the final model are shown along the paths. Non-significant structural paths in the original model were excluded and are shown here as dotted arrows. Some indicators are parcels (e.g., SE1 and SE2). The fit statistics are as follows: $\chi^2 = 232.76$, $p < 0.001$, df = 102, $\chi^2/df = 2.28$, GFI = 0.89, CFI = 0.92, IFI = 0.92, NFI = 0.87, and RMSEA = 0.08. This figure does not show covariances among exogenous and control variables, error terms, and disturbances. $^{*}p < 0.05$, $^{**}p < 0.01$, and $^{***}p < 0.001$.

sharing, whereas self-efficacy promoted it. Contrary to expectations, however, perceived organizational support for knowledge sharing was related to neither greed nor self-efficacy. As expected, co-worker collegiality was related to lower greed and higher self-efficacy.

A likely explanation for the null effect of organizational support on greed is that greed may be a deep-seated attitude not easily altered by managerial practices associated with organizational support. With regard to the null effect on self-efficacy, organizational support aims at facilitating and promoting the act of knowledge sharing, but probably does little to actually increase the knowledge of employees. Perhaps self-efficacy is primarily determined by an appraisal of the usefulness of one's knowledge to co-workers and the firm rather than by perceived organizational support.

The lack of direct effects exerted by perceived organizational support and co-worker collegiality on knowledge is interesting but not entirely surprising. As mentioned before, these two hypotheses were exploratory and the full mediation poses no fundamental challenge to our model.

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AN EXTENDED MODEL: THE ROLE OF INFORMATION TECHNOLOGY FOR KNOWLEDGE SHARING

The findings of Study 1 are consistent with previous public goods findings. Nevertheless, the nascent nature of this line of research warrants a replication of the key results. Study 2 seeks to extend previous findings in two important ways. First, Study 1 found that perceived organizational support showed no direct or indirect effect on knowledge sharing. However, perceived organizational support may promote knowledge sharing via other routes not tested in Study 1. One such route is that organizational support may lead to more effective use of information technologies to facilitate knowledge sharing. Second, while Study 1 examined knowledge sharing as a general concept, there may be different processes involved in the sharing of tacit and explicit knowledge, and distinguishing between these two might advance our research. Therefore, Study 2 was designed to examine the relationship between information technologies, knowledge type, and knowledge sharing.

Advances in information technologies have made available a wide range of tools for the convenient storage, retrieval, and communication of knowledge (Bukowitz and Williams, 1999; Davenport and Prusak, 1998; Roberts, 2000). In fact, such technologies are often a prerequisite for successful knowledge management, enabling collaboration among different units and individuals unconstrained by the boundaries of geography and time (McDermott and O'Dell, 2001).

The influence of such technologies on explicit and implicit knowledge, however, may be different. Generally speaking, explicit knowledge is easy to express whereas tacit knowledge is difficult to articulate. Thus, while explicit knowledge is likely to be stored in databases and documents, tacit knowledge is typically stored within individuals (Armbrecht et al., 2001) and communicated via face-to-face contact (Haldin-Herrgard, 2000). Thus, while information technologies should strongly influence the sharing of explicit knowledge, they may have less influence on the sharing of tacit knowledge. This reasoning resulted in the following hypothesis:

Hypothesis 6: The use of information technologies will increase knowledge sharing, and this effect is stronger for explicit than for implicit knowledge.

We further argue that perceived organizational support for knowledge sharing will influence the use of information technologies. The core elements of organizational support such as management support and the availability of training and incentives for knowledge sharing should encourage the use of information technologies for knowledge sharing purposes. This reasoning is summarized in the following hypothesis:

Hypothesis 7. Perceived organizational support will promote the use of information technologies that enable knowledge sharing.

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STUDY 2: METHOD

Sample

A total of 277 part-time students enrolled in an MBA programme in China agreed to participate in the survey. The final sample consisted of 262 cases after deleting cases with missing data or unusual response patterns. Respondents were middle-level employees from a wide range of functional areas and industries, representing a good mix of knowledge workers with diverse backgrounds. Most respondents were from the manufacturing (32.2%) and IT (18.8%) industries. Firm size of these respondents was similar to that of Study 1 (100–1000 employees: 46.1%; over 1000: 30.0%). Almost 100% were under the age of 40 (99.2%) and most were male (69.6%). Because of the admission requirement of China's MBA programmes, the majority of the participants were university educated (95.6%).

Measures and Procedures

Most scales were similar to those used in Study 1. In order to reduce the length of the questionnaire, however, we selected three to four items from each of the original scales. Three new scales were developed for this study to measure explicit knowledge-sharing behaviours, tacit knowledge-sharing behaviours, and information technology utilization. The boundary between explicit and tacit knowledge is fuzzy, and respondents may find it hard to recall how much they have shared each of these two types of knowledge within their firm (Jarvenpaa and Staples, 2001). Thus, in addition to Likert-type items, scenarios were used to capture the tendency to share these two types of knowledge. Such scenarios have been shown to be effective in capturing constructs that were not clearly represented in the minds of respondents (Peng, Nisbett, and Wong, 1997).

Two scenarios were developed based on the contrastive vignette technique (see Jarvenpaa and Staples, 2001), i.e., in each vignette the potential knowledge receiver was described as a possible competitor. This arrangement forced respondents to weigh the social good of sharing against the personal cost (Jarvenpaa and Staples, 2001, p. 164). Respondents were asked to assume that the two fictitious scenarios actually happened in their workplace. The first scenario, adapted from Jarvenpaa and Staples (2001), measured the sharing of explicit knowledge. It described a situation in which a co-worker asked for a set of project documents that the respondent had prepared for a coming presentation in front of senior managers. The borrower would make a presentation on the same topic and was a potential competitor for promotion. Two questions were asked, 'Do you think it is reasonable for him to borrow your documents?' and 'In this situation, would you lend him your documents?' The second scenario, designed to measure the sharing of tacit knowledge, described a situation in which the respondent was transferring a project to a new colleague who was more educated, but with less work experience, and

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who was a potential competitor for an overseas training opportunity. The new colleague asked the respondent to share with him some work experience and introduce him to the respondent's network of business relations. Three questions were asked: 'Do you think his request is reasonable?'; 'In this situation, would you share with him all of your experience?'; and 'Would you help him establish and maintain a good relationship in your business network?' Seven-point scales ranging from '1 = absolutely no' to '7 = absolutely yes' were used for these items. Work experiences and interpersonal relationships often reside in the knowledge holder himself/herself, and are hard to codify into explicit forms. Therefore, the willingness to share personal work experiences and business networks represents a tendency to share tacit knowledge.

In addition to the two scenarios, the respondents were also asked to recall the frequency with which they shared eight types of knowledge with their co-workers. Three types represented explicit knowledge: work reports and work requirements, knowledge about archives or databases, and codifiable knowledge. Five types represented tacit knowledge: stories about one's success or failure in the workplace, interpersonal skills, experience and expertise; where and from whom to obtain solutions, and uncodified job-related skills and know-how. Seven-point scales were used for these scales, with '1 = never' and '7 = very frequently' as end points. An explicit knowledge-sharing scale was formed by combining the two scenario-based items with the relevant Likert items, and a tacit knowledge-sharing scale formed by combining the three scenario-based items and the relevant Likert items.

Information technologies utilization was measured by a list of five information technologies-based channels commonly used in knowledge management (e.g., Almashari, Zairi, and Alathari, 2002; Bock and Kim, 2002), including organizational databases, e-mail and online chat-rooms, webpage or bulletin board systems, electronic document management systems, and specialized knowledge-management software. Usage was measured by seven-point scales, with '1 = never used' to '7 = frequently used' as end points.

A pilot test was conducted with twenty-five part-time MBA students to evaluate the reliability of the new scales and the realism of the scenarios, which was found to be adequate. In the main study, the questionnaires were distributed to eight MBA classes through the instructors, and participation was voluntary. Students who agreed to participate in the survey filled out the questionnaire during the class break.

Results on the Hypotheses

Descriptive statistics are reported in Table 2. The newly developed scales were satisfactory in reliability: explicit knowledge sharing (α = 0.65), tacit knowledge sharing (α = 0.85), and information technologies utilization (α = 0.91). Study 2

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Table 2. Descriptive statistics, reliabilities, and correlations for Study 2[a]

Variables	*Mean*	*s.d.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Sanction	4.07	1.29	(0.84)									
2. Managers' attitude	4.63	1.07	0.55	(0.70)								
3. Training	5.10	0.99	0.62	0.61	(0.75)							
4. Teamwork	5.20	0.76	0.39	0.50	0.54	(0.60)						
5. Trust	4.97	0.98	0.41	0.47	0.44	0.62	(0.81)					
6. Self-efficacy	5.25	0.91	0.15	0.21	0.24	0.27	0.34	(0.78)				
7. Greed	3.28	1.11	0.09	−0.01	−0.18	−0.24	−0.11	−0.16	(0.64)			
8. Information technologies utilization	4.15	1.59	0.31	0.40	0.32	0.28	0.35	0.17	0.01	(0.91)		
9. Explicit knowledge sharing	4.78	0.83	0.14	0.24	0.24	0.25	0.32	0.20	−0.30	0.25	(0.65)	
10. Tacit knowledge sharing	4.87	0.90	0.21	0.32	0.32	0.33	0.42	0.37	−0.27	0.23	0.57	(0.85)

Notes: [a] $n = 262$. Correlations >0.12 or <–0.12 are significant at $p < 0.05$; those >0.16 or <–0.16 are significant at $p < 0.01$; and those >0.20 or <–0.20 are significant at $p < 0.001$. Cronbach's alphas are shown on the diagonal in parentheses. Two control variables, namely, nature of business and type of ownership, were not included here because of their nominal nature.

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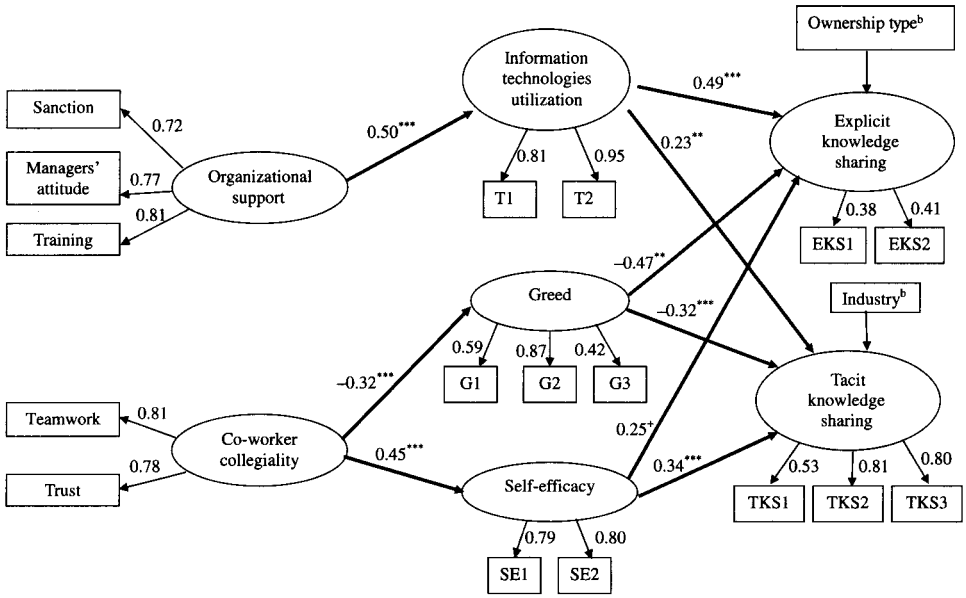

Figure 2. The structural model of knowledge sharing for Study 2[a]

Notes: [a]$n = 262$. Latent variables are shown in ovals and indicators in rectangles, and standardized path loadings are shown along the paths. Some indicators are parcels (e.g., SE1 and SE2). The fit statistics are as follows: $\chi^2 = 422.83$, $p < 0.001$, df = 215, $\chi^2/df = 1.97$, GFI = 0.89, CFI = 0.90, IFI = 0.91, NFI = 0.83, RMSEA = 0.06. This figure does not show covariances among exogenous and control variables, error terms, and disturbances.

[b]Ownership type and industry are control variables, both of which are nominal variables and were dummy coded. Path loadings for the eight dummy variables involved are not presented for the sake of simplicity. $^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

involved ten scales, and a ten-factor model was therefore tested with Amos (Arbuckle, 1997). We also compared the results with those of the one-factor model and the seven-factor model (number of latent variables in the model). The one-factor model showed a very poor fit ($\chi^2 = 2773.06$, df = 464, $\chi^2/df = 5.98$, GFI = 0.60, CFI = 0.80, IFI = 0.80, NFI = 0.76, RMSEA = 0.14). Both the seven-factor model ($\chi^2 = 223.09$, df = 98, $\chi^2/df = 2.28$, GFI = 0.91, CFI = 0.95, IFI = 0.95, NFI = 0.91, RMSEA = 0.07) and the ten-factor model ($\chi^2 = 1063.54$, df = 419, $\chi^2/df = 2.54$, GFI = 0.80, CFI = 0.93, IFI = 0.93, NFI = 0.89, RMSEA = 0.08) showed a good fit, supporting the measurement model we proposed.

After the measurement model was confirmed, the proposed model was evaluated. The chi-squared statistic was significant ($\chi^2 = 422.83$, df = 215, $p < 0.001$), but the χ^2/df ratio was 1.97, indicating a reasonable fit. Fit indices also pointed to a good fit (GFI = 0.89, CFI = 0.90, IFI = 0.91, NFI = 0.83, and RMSEA = 0.06). See Figure 2 for the results.

The paths based on the results of Study 1 were checked for the extent of replication. As expected, greed suppressed the sharing of both explicit and tacit knowledge, while self-efficacy increased sharing of both types of knowledge. Co-worker

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collegiality reduced greed and enhanced self-efficacy. In sum, these paths were consistent with those reported in Study 1.

In support of Hypothesis 6, information technologies utilization increased the sharing of both explicit and implicit knowledge. We tested the two path coefficients with a directional z-test (Hittner, May, and Silver, 2003) to see if information technologies utilization was associated with more sharing in explicit than in implicit knowledge. As predicted, the coefficient for explicit knowledge was significantly larger, $z = 1.69$, $p < 0.05$. Lastly, in support of Hypothesis 7, organizational support for knowledge sharing increased information technologies utilization.

Discussion of Study 2 Results

The major results of Study 1 were confirmed: greed suppressed knowledge sharing, while self-efficacy increased it. These two studies provide strong support for the public goods analysis of knowledge sharing. The results also replicated the negative relationship between co-worker collegiality and greed found in Study 1.

The inclusion of information technologies utilization and the distinction between explicit and tacit knowledge in the knowledge-sharing model is important. The results show that information technologies utilization was related more strongly to the sharing of explicit than to tacit knowledge, supporting the view that information technologies alone are insufficient for successful knowledge management (e.g., Marwick, 2001). To promote the sharing of tacit knowledge, innovative strategies that integrate information technologies-based and face-to-face channels are needed (e.g., Liebowitz, 2002). Lastly, the results confirm the role of organizational support in information technologies utilization. Organizational support appears to promote knowledge sharing through encouraging the use of information technologies.

GENERAL DISCUSSION

These two studies are initial attempts to test a model of knowledge-sharing behaviours that draw ideas from theories in organizational behaviour, knowledge management, and public goods dilemmas. Across the two surveys, the key variables derived from these perspectives showed reliable and expected effects on knowledge sharing. Taken as a whole, these findings suggest that an important way to promote knowledge sharing is to suppress greed and enhance self-efficacy.

We examined the effects of two broad dimensions that may impact greed and self-efficacy: organizational support and co-worker collegiality. Organizational support can be implemented directly through explicit statements, training programmes, and sanctioning systems, while the influence of interpersonal relationships can only be managed through building a collegial culture. Surprisingly, the

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effects of co-worker collegiality were wide-ranging, whereas the effects of organizational support, a focused strategy, were more limited, only impacting information technologies utilization (Study 2).

Cabrera and Cabrera (2002), analysing knowledge sharing from a public goods perspective, developed three broad strategies to promote knowledge sharing. *Restructuring the pay-off function* involves the availability of advanced information technologies, rewards or selective incentives and gain-sharing programmes, and the alignment of human resource policies with participation in knowledge sharing. *Increasing efficacy* includes the provision of feedback to contributors, ensuring a critical mass of participants, the availability of advanced technologies, and training. *Promoting a group identity and personal responsibility* includes the encouragement of communication, creation of knowledge-sharing communities, and publicizing employees' contributions. Their proposals with regard to group identity and the creation of a critical mass overlap with our notion of co-worker collegiality, while their proposed interventions involving incentives, personal responsibilities, the provision of feedback, and training overlap with our notion of perceived organizational support for knowledge sharing. Our results indicate that the first set of interventions is effective, while the second is much less effective than Cabrera and Cabrera expect. We suggest two main reasons for the limited effectiveness of their second group of strategies. First, it is difficult for firms to measure employees' degree of knowledge sharing, so that they cannot always apply sanctions appropriately. Second, immediate task accomplishments often take priority over knowledge sharing, so that perceived management support may have little impact on employees' actions and daily routines.

Information Technologies and Knowledge Sharing

Successful knowledge management seems more attainable because of the rapid advance in information technologies that facilitate knowledge sharing (e.g., Davenport et al., 1998). Our results confirm this view, especially for explicit knowledge. However, the effective sharing of tacit knowledge still remains problematic. Interestingly, our results suggest that old-fashioned camaraderie is able to promote the sharing of tacit knowledge through a positive influence on greed and self-efficacy. In the digital era, there is still no perfect substitute for the motivational effects of human bonding and social connectedness.

At least two interesting theoretical issues are worth pursuing in light of these results. First, a combination of information technologies and traditional communication channels may prove to be more effective than each type alone. Second, such hybrid channels may soon develop with improvements in synchronous multimedia technologies such as video-conferencing. The next generation of information technologies may provide very powerful proxies for face-to-face interactions (e.g., Trethewey and Corman, 2001). Thus, while current information technolo-

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gies may fail to strongly influence the sharing of tacit knowledge, it remains to be seen whether new forms of information technologies can assume a more central role.

Limitations and Directions for Future Research

The two studies reported in this paper have several limitations. First, both studies used primarily part-time MBA students. Although these respondents were full-time, middle-level employees with diverse backgrounds, MBA students might not be representative of the general population of mid-level managers. It is desirable to replicate the results with other samples. A related issue is that although the respondents were knowledge workers, not all of them worked for knowledge-intensive firms, in which knowledge assumes a paramount role. It would be interesting to explore the dynamics of knowledge sharing among employees from such firms.

Second, the two surveys involve self-reported measures, which may be subject to the influence of common method bias. Fortunately, we have presented strong theoretical bases for the predictions, which should reduce the threat of spurious interpretations. For example, it is unlikely that knowledge-sharing behaviour would influence a person's greed or self-efficacy. Furthermore, the highly differentiated pattern of results obtained and its replicability stand against a common-method variance account of the results. Common method could not account for the pattern of results obtained, which involves both significant and non-significant paths, concurs with predictions grounded in well-developed prior theory and research, and replicates well across two different surveys. The results on the measurement models for both studies further alleviated the concern regarding common method. Nevertheless, the newly developed knowledge sharing-related scales are not ideal. Although their development was guided by theoretical considerations and results of pilot studies, the reliability of some scales still needs to be improved. The use of shorter versions of the scales in Study 2 also led to lower reliabilities for some scales. To overcome these concerns, different methodologies, such as experimentation and diverse measures (e.g., peer/supervisory evaluations), should be employed in future research to triangulate these findings and to evaluate the causality posited in the proposed model.

Third, the distinction between explicit and tacit knowledge is well known, but the measurement of these two knowledge types is elusive. We do not claim that our newly constructed scales represent the best measures for these two fuzzy constructs, but they should provide a good staring point for developing better measurement scales in future research. For instance, the scenarios used may be improved to provide more reliable measures of implicit and explicit knowledge sharing.

Fourth, knowledge sharing may take different forms, such as one-to-one (between two people), one to many (e.g., in a meeting within one's department),

and one to all (knowledge stored on the intranet that is accessible to all employees). Our items have included a mixture of modes, and future research may examine whether different processes are associated with different modes of knowledge sharing.

Fifth, the two surveys were conducted in China, which is quickly catching up with developed nations in knowledge management. It is possible that culture may shape the dynamics in knowledge sharing. One distinctive feature of Chinese people is their collectivism, as opposed to the individualism of Westerners (Hofstede, 1980). Earley (1989) found that collectivists were less likely to engage in social loafing in a group than were individualists. Consistent with this finding, Chow, Deng, and Ho (2000) compared the knowledge-sharing behaviours of Chinese and American managers, and found that when the sharing involved a trade-off between self and collective interest, Chinese were more willing to share than were Americans. In addition, Chinese were less willing to share with an outgroup member than were their US counterparts. Based on these findings, can we assume that cultural dynamics only affect the level of sharing, or do they also affect the processes underlying knowledge sharing? In other words, is the behavioural model of knowledge sharing we propose pan-cultural, with culture affecting the levels of the constructs involved, but not their inter-relationships? With regard to cultural differences in the level of sharing, given the collectivistic orientation of Chinese, the effects of co-worker collegiality may be stronger, and the effect of self-efficacy weaker for Chinese than for Americans. Obviously, future cross-cultural studies should examine these speculations.

CONCLUSION

The studies reported in this paper reveal that knowledge-sharing behaviours are influenced by individual, interpersonal and organizational factors. At the individual level, greed reduces knowledge sharing whereas self-efficacy increases it. At the interpersonal level, co-worker collegiality has an indirect influence on knowledge sharing by lowering greed and raising self-efficacy. At the organizational level, organizational support leads to higher utilization of information and communication technologies, resulting in more knowledge sharing, especially for explicit as opposed to implicit knowledge. Some issues are open for future research, including why organizational support shows only limited effect on knowledge-sharing behaviours, and the need for innovative ways to promote the sharing of tacit knowledge.

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APPENDIX: SCALES USED IN THE SURVEYS

Knowledge-sharing Behaviours

1. In daily work, I take the initiative to share my work-related knowledge to my colleagues.
2. I keep my work experience and never share it out with others easily. (R)
3. I share with others useful work experience and know-how.
4. After learning new knowledge useful to work, I promote it to let more people learn it.
5. I never tell others my work expertise unless it is required in the company. (R)
6. In workplace I take out my knowledge to share with more people.
7. I actively use IT sources available in the company to share my knowledge.
8. So long as the other colleagues need it, I always tell whatever I know without any hoarding.

(Note: Items 6, 7, 8 were adapted from Bock and Kim, 2002.)

Self-efficacy

1. The knowledge I share with my colleagues would be very useful to them.
2. My personal expertise will display its value if shared within the company.
3. My limited knowledge, even if shared, will generate little effect within the organization. (R)
4. I am confident that my knowledge sharing would help the organization to achieve its performance objectives.
5. I am confident that my knowledge sharing would improve work processes in the organization.
6. I am confident that my knowledge sharing would increase the productivity in the organization.

(Note: Items 5, 6, 7 were adapted from Bock and Kim, 2002.)

Greed

1. Knowledge is power, so exclusive ownership of knowledge will make me outstanding.
2. Sharing my own knowledge in the company will lead to my loss of competitive advantage.
3. No matter whether I share my knowledge with my colleagues, they are all willing to share with me their expertise, so I do not need to offer my knowledge for sharing.

4. If in knowledge sharing, I teach more than I learn from others, I do not take part in it.
5. It will be wise to learn new knowledge from my co-workers without making my own knowledge public.

The Attitude of Management

1. My manager always behaves as a good example in sharing his knowledge to others.
2. My manager supports me in sharing knowledge with colleagues in other departments.
3. My manager allows me to share my knowledge with my colleagues though it may influence the present job process.
4. My manager tells us how to share my personal knowledge within the organization.
5. My manager often encourages me to share my knowledge by means of interpersonal chats or group meetings.
6. My manager tells us where to find knowledge needed at work.
7. My manager encourages us to provide useful information and knowledge to the company.

Knowledge Sharing-oriented Training

1. It is encouraged in the company that veteran employees should direct the new employees and transfer expertise.
2. The company developed special educational projects to train employees in how to share knowledge better.
3. Through training, the employees learn how to turn personal expertise into expressive and transferable patterns.
4. Through training I got to know how to find information and personnel support needed at work.
5. We learned from company training where to find answers when encountering certain problems at work.
6. Through training the company let us realize that sharing knowledge benefits our career development.
7. When working on some projects, the company gives enough time and support for employees to learn how to share knowledge at work.

Sanctions

1. Those employees who do not share their knowledge with others are usually left out in the cold by their co-workers.

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2. The company will consider the performance of employees' participating in knowledge sharing when making decisions on promotions and salary raises.
3. The company will give praise and promotion for the employees' initiative, knowledge exchange and learning activities.
4. The company has penalty measures for those employees who hoard their knowledge and do not share with others.
5. In the company my efforts on knowledge sharing cannot guarantee my present job.
6. In return, the company rewards knowledge-sharing behaviours.

Trust

1. I believe the help I give to my colleagues will be returned in the future.
2. Many of my personal friends are my colleagues.
3. In a long-term view, getting on well with most colleagues is very important to my career development.
4. Generally speaking, I can trust my colleagues to do as they say they will.
5. My colleagues can be relied upon if I meet with critical incidents.
6. My colleagues and I trust each other.
7. Most conflicts among colleagues in the company are over work issues rather than personal conflicts.

Note: All seven items were adapted from Cook and Wall (1980).

Teamwork

1. People I work with are cooperative and coordinative.
2. People I work with are direct and honest with each other.
3. People I work with accept criticism without becoming defensive.
4. People I work with are good listeners when I encounter any problem.
5. People I work with care for each other.
6. People I work with resolve disagreements cooperatively.
7. People I work with function as a team.

Note: All seven items were adapted from Glaser, Zamanou, and Hacker's (1987).

(R) designates reverse-coded items.

Note: Please contact the first author for the Chinese language version of these scales.

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