The Impact of Peer Mentoring on Organizational Knowledge Creation and Sharing: An Empirical Study in a Software Firm

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AN EMPIRICAL STUDY IN A SOFTWARE FIRM

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Managing organizational knowledge creation and sharing effectively has become an important source of competitive advantage for firms. Peer mentoring is becoming increasingly common and may be an effective way to facilitate knowledge creation and sharing. This article provides an empirical test of the relationship between peer mentoring and knowledge creation and sharing in a high-tech software firm. Results suggested that a peer mentor training course increased perceived levels of peer mentor knowledge and skills. Results also indicated that higher perceived levels of peer mentoring were related to higher perceived levels of knowledge creation and sharing.

Keywords: peer mentoring; knowledge creation and sharing; high-tech firms

Creating and sharing knowledge provides value to organizations and the potential to create competitive advantages (Boisot, 1998; Grant, 1996; Teece, 1998). Firms can increase knowledge creation and sharing through several processes including research and development programs, knowledge sharing directories and databases, sharing best practices between departments companies, training programs, intranets, and other personal and technological means (Boisot, 1998; Stewart, 1997; Szulanski, 1996).

Researchers have argued that mentoring relationships provide a means for firms to share knowledge and build intellectual capital (Allen, Russell, & Maetzke, 1997; Messmer, 1998; Scandura, 1998; Scandura, Tejeda, Werther, & Lankau, 1996). The current mentoring literature emphasizes the antecedents and outcomes of mentoring and focuses primarily on career-related benefits, job satisfaction outcomes, and psychosocial benefits (Scandura, 1998; Turban & Dougherty, 1994). This stream of research has

primarily focused on traditional mentoring relationships between senior and junior managers. However, the recent organizational trends of downsizing and delayering have reduced the number of senior managers in organizations available to be mentors (Eby, 1997). In this situation, newer employees may need to turn to experienced employees on their team who are at the same level in the firm for mentoring. In addition, peers may be more effective at creating and sharing certain kinds of knowledge—especially technical and job-related information.

The mentoring literature has largely ignored the function of information and knowledge sharing, which can play a significant role in the mentoring relationship. This facet of the mentoring relationship has been implicitly argued but not fully explored (cf. Messmer, 1998; Scandura et al., 1996; Swap, Leonard, Shields, & Abrams, 2001). There is no empirical work on the impact of mentoring relationships on knowledge creation and sharing. This article addresses this shortcoming in the following ways: (a) by exploring the role of peer mentoring in firms, (b) by explicitly addressing the role of peer mentoring in knowledge creation and sharing, and (c) by providing an empirical test of the effectiveness of peer mentoring at facilitating knowledge creation and sharing.

KNOWLEDGE-BASED VIEW OF THE FIRM

Organizational knowledge includes all the tacit and explicit knowledge that individuals possess about products, systems, and processes and the explicit knowledge codified in manuals, databases, and information systems (Grant, 1996; Kogut & Zander, 1992; Nahapiet & Ghoshal, 1998; Nonaka & Takeuchi, 1995). The knowledge-based view of the firm (Grant, 1996; Spender, 1996; Teece, 1998) builds on the resource-based view of the firm (Barney, 1991; Penrose, 1959; Wernerfelt, 1984) and argues that knowledge is a central driver of competitive advantage. Knowledge resources are an especially valuable category of resources and meet Barney's (1991) criteria for resources capable of providing sustainable competitive advantages (valuable, rare, inimitable, and nonsubstitutable).

The knowledge-based view provides a solid foundation for the importance of peer mentoring in managing knowledge. Managing organizational knowledge includes the processes of creating knowledge, sharing knowledge, and exploiting knowledge. Peer mentors facilitate the knowledge creation and sharing processes. Exploiting knowledge is accomplished through systems and structures in the firm that convert ideas into new products and services (Boisot, 1998; Crossan, Lane, & White, 1999).

PEER MENTORING

Having established the value of organizational knowledge, we need to examine how mentoring affects organizational knowledge. Mentoring has received significant attention in the organizational literature in the past two decades primarily because of its connection to both job success and career success. Kram's (1985) seminal qualitative study of mentoring, which defined mentoring roles and stages in the mentoring process, stimulated the theoretical and empirical investigation of mentoring in organizations. More than 60 articles have followed Kram's study and explored the following three areas: (a) defining mentoring roles and types (Ensher, Thomas, & Murphy, 2001; Scandura & Viator, 1994); (b) antecedents for mentoring relationships (Aryee, Chay, & Chew, 1996; Ragins & Scandura, 1994); and (c) outcomes of mentoring (Fagenson, 1989; Scandura, 1992). More recently, mentoring has been explored in relation to related organizational behavior literatures, such as leader-member exchange, organizational citizenship behaviors (OCBs), social support, and socialization (McManus & Russell, 1997). These authors suggest that although related to these other areas, mentoring is a distinctive construct that requires further investigation. Allen, McManus, and Russell (1999) built on this argument and suggest that formal peer-mentoring relationships can aid in the socialization of newcomers. Also, Lankau and Scandura (2002) suggested that mentoring can facilitate personal learning.

Although Kram (1985) discussed the significant role that peers play in mentoring each other, little research has focused on peers as mentors. Peer mentoring is becoming increasingly common in organizations, is receiving more attention from scholars, and may offer some unique advantages over traditional mentoring relationships (Allen et al., 1997; Eby, 1997; Ensher et al., 2001). The peer-mentoring literature has developed directly from the traditional (senior-junior manager) mentoring literature, and researchers have argued that peers can provide the same kinds of psychosocial and vocational support (Eby, 1997; Ensher et al., 2001; Kram & Isabella, 1985).

Peer mentoring is an intentional one-on-one relationship between employees at the same or a similar lateral level in the firm that involves a more experienced worker teaching new knowledge and skills and providing encouragement to a less experienced worker (Eby, 1997). Peers can help socialize new employees and help them become effective more quickly (Allen et al., 1999). Much of the knowledge that the peer mentor possesses is tacit and learned from personal experience and from interacting with other employees. Most of the taken-for-granted knowledge of the peer mentor is not recorded in any database, procedure manual, or formal training program.

The pace of change is so rapid in most of the jobs in a software firm that any formalized knowledge is quickly outdated. Therefore, these companies rely on their experienced employees to impart their knowledge to less experienced employees (Eby, 1997).

The main goals of the peer-mentoring relationship are sharing job-related knowledge (transferring job-relevant technical knowledge and skills) and providing psychosocial support (Eby, 1997; Kram, 1985). In this study, we examine primarily the sharing of job-related knowledge.

Peer mentoring is recognized in the education literature as an important source of learning for educators and students, including college faculty (Harnish & Wild, 1993a, 1993b), teachers (Conley, 1995), graduate students (Bollis-Pecci & Walker, 2000; Grant-Vallone & Ensher, 2000), and undergraduate students (Brenden, 1986; Glass & Walter, 2000; Lahman, 1999). Peer mentoring provides an effective way to transfer knowledge and encourage the learner. Peer-mentoring research in the management area has not yet explored the role of peer mentoring in facilitating knowledge creation and sharing. We can learn from the education scholars that peers provide valuable information (Harnish & Wild, 1993a). In organizations, peers are in a unique position to offer job-related and technical information that is critical for successful individual and team performance (Eby, 1997).

Although peer mentoring has not received a significant amount of attention in the management literature, several closely related concepts that support the value of peer mentoring have received more attention. These related concepts include self-managed work teams, organizational citizenship, and socialization.

Self-managed teams are one of the most common types of teams found in organizations (Lawler, Mohrman, & Ledford, 1995) and provide team members with decision-making authority over how the team will accomplish its work (Erez, Lepine, & Elms, 2002). In this type of team, traditional management roles are diffused into the team itself and often increase the performance of the team (O'Connell, Doverspike, & Cober, 2002; Sivasubramaniam, Murray, Avolio, & Jung, 2002). This parallels the peer-mentoring process in which training and knowledge-sharing functions are transferred from supervisors to peers on the team. Although current research on self-managed teams does not explicitly address the knowledge-sharing process, clearly, team members take on greater responsibility for the success of the team, including training, socializing, and securing employee involvement (Spreitzer, Cohen, & Ledford, 1999). This supports the notion that peer mentoring enables teams to be more effective.

Mentoring behaviors have been identified as OCBs, which are discretionary actions that promote organizational effectiveness (Organ, 1988). Peer

mentoring and traditional mentoring fit with the definition of OCBs because they are usually behaviors that are voluntary and not directly rewarded or included in performance evaluations (McManus & Russell, 1997; Tepper & Taylor, 2003). Research on OCBs suggests that employees are willing to give extra effort and go beyond their job requirements when they are committed to the organization, are satisfied with their jobs, are given intrinsically satisfying tasks to do, and/or have supportive or inspirational leaders (Bolino, Turnley, & Bloodgood, 2002). Bolino et al. (2002) also argued that OCBs are linked to increased performance, which suggests that managers should be promoting OCBs including peer mentoring. We would also expect that highly committed and satisfied employees would be willing to be peer mentors and would improve team performance through their mentoring.

Peer mentoring plays a role in the socialization process for new employees. Socialization is the process by which individuals acquire the attitudes, behaviors, and knowledge they need to contribute as an organization member (Van Maanen, & Schein, 1979). Empirical research has highlighted the importance of current employees, especially peers and supervisors, for helping new employees "to acquire information and 'learn the ropes'" (Morrison, 2002, p. 1149). Socialization has been identified as a learning process for new organizational members that helps them acquire the critical information they need to be successful in their new jobs (Ostroff & Kozlowski, 1992). The goal of peer mentoring is to help new employees or team members become effective in their jobs and become contributing team members. Peer mentoring facilitates the transferring of job-related knowledge and supports the socialization of new employees and team members (Eby, 1997).

PEER MENTORING AND KNOWLEDGE

Peer mentoring can be more effective when it creates a more formal and developmental relationship between an experienced worker and a less experienced worker. This type of mentoring relationship facilitates the creation and sharing of knowledge by encouraging the flow of knowledge between workers.

Nonaka and Takeuchi (1995) suggested that the following are the four primary processes for creating knowledge that are based on converting tacit and explicit knowledge: externalization (tacit to explicit), socialization (tacit to tacit), internalization (explicit to tacit), and combination (explicit to explicit). The authors argued that new knowledge is created in each of these four processes. However, they suggested that the externalization and socialization

are the most important processes because they allow "sticky" tacit knowledge to be transferred from one person to another.

Peer mentoring provides an opportunity to externalize knowledge by turning tacit knowledge into explicit knowledge (Nonaka & Takeuchi, 1995). This is a powerful form of knowledge creation and provides a key source of innovation and new ideas in firms. Peer mentors share or externalize knowledge when they take time to organize their thoughts, write them down, and make explicit what they understand implicitly. Mentors can share knowledge of processes (such as accessing the network or how to enter a record in a database), knowledge of people (such as who to contact for help on particular issues), and knowledge of systems (such as how customer feedback is collected and shared in the firm). Some of this knowledge already resides in individuals and is easily accessed, whereas much of this knowledge will be dynamic, newly created, and novel (Nonaka & Takeuchi, 1995).

Workers also bypass the externalization process and share knowledge by demonstrating how to do a particular procedure or solve a particular programming problem through the socialization (tacit-to-tacit knowledge) process (Nonaka & Takeuchi, 1995; Swap et al., 2001). Within software development teams, software engineers often demonstrate how to use a particular software tool to solve a problem. They combine verbal directions with visual demonstrations. Nonaka and Takeuchi (1995) argued that this personal contact between employees is essential to creating new knowledge. Personal contact allows for the creation and sharing of knowledge through the externalization and socialization processes. Peer mentoring accelerates this process by helping mentors organize their thoughts and share relevant, appropriate knowledge in a way that the worker being mentored can learn.

PEER MENTOR TRAINING

Managers can take an active role in facilitating effective peer mentoring through training and motivating mentors (Trautman, 1999). Peer mentor training is one important way to increase workers' ability to mentor their peers. Peer mentor training can provide workers with essential knowledge for effectively mentoring peers. In addition, the training can provide opportunities to practice the mentoring skills in a safe environment and receive immediate feedback. Finally, training can provide workers with the motivation to be good peer mentors by highlighting the following benefits of being a mentor: (a) personal gratification and recognition, (b) new team members come up to speed more quickly, and (c) mentors can complete training more

quickly and return to their work, making them more effective. This leads to the following hypothesis:

> *Hypothesis 1:* Workers who receive peer mentor training will report having higher levels of peer mentoring knowledge and skills than will those who do not receive training.

Because knowledge is a vital source of sustainable competitive advantage, firms may consider how they can effectively manage their knowledge. Peer mentoring provides individual- and group-level tools for fostering the creation and sharing of knowledge. Peer mentoring provides an opportunity to externalize knowledge by turning tacit knowledge into explicit knowledge (Nonaka & Takeuchi, 1995). This is a key form of knowledge creation and provides firms a vital source of innovation and new knowledge. Peer mentors share or externalize knowledge when they take time to organize their thoughts, write them down, and make explicit what they understand implicitly. In this study, we measure individuals' perceptions of their own peer-mentoring skills and their perceptions of knowledge sharing in their teams and their firm. Because these are individual perceptual measures, we are suggesting that individuals who experience their own peer-mentoring skills as stronger will also experience the organization as being more engaged in knowledge sharing. Therefore, we would expect the following:

> *Hypothesis 2:* Higher levels of peer-mentoring knowledge and skills will be associated with higher levels of knowledge creation and sharing.

METHODS

PARTICIPANTS AND SETTING

Data were collected using a Web-based survey from employees of a large software firm located in the Northwest during a 1-day training course. We used a repeated measures design, and training participants were surveyed three times: before, after, and 2 months after the training. The participants represented the major areas of the firm and included software testers, software design engineers, program managers, usability engineers, Web services engineers, and applications and support professionals. Trainees came from the following three hierarchical levels: individual contributor, team lead, and manager. All participants were full-time employees on the main campus. The participants averaged 33 months at the firm, and 84% were men. Of the

participants, 15% had some college, 60% had undergraduate degrees, and 25% had graduate degrees.

Participants in the training received a 1-day training course that covered basic peer-mentoring skills. Of the 107 employees who attended the training, 90 employees filled out the first survey for an initial response rate of 84%. The sample for the study is the 90 participants who attended the peer mentor training and filled out the first survey. Of the 90 who filled out the survey at Time 1 (before the training), 66 filled out the survey at Time 2 (after the training). Of the 66 who filled out the survey at Time 2, 46 filled it out at Time 3 (2 months after the training). We have complete data for 44 participants. The participants filled out a total of 200 surveys. The 90 Time 1 surveys are used for the regression analyses. The 44 participants who filled out all three surveys are used in the repeated measures ANOVA analyses.

To examine the possibility of nonresponse bias, we compared the employees who filled out the survey at Time 2 to the ones who did not and found no significant differences in terms of gender, education, level of management, job description, and time with the firm. In addition, we examined participants' self-perceptions of peer-mentoring knowledge and skills and found no significant difference. Therefore, nonresponse bias does not appear to be a problem for this sample.

We used a within-subjects design and collected data from each participant at three points in time. Participants signed up for the training as a team and were assigned to training dates based on schedule availability. The instructor for all the courses was trained by the developer of the peer mentor training course. The instructor was not informed of the study's hypotheses and conducted all five training courses within a 1-month period. All the training courses covered the same basic peer-mentoring skills including learning styles, learning assessment, how to formalize the mentoring relationship, how to limit and focus on key information, preparing for meetings, and creating an action plan at the end of each meeting. Participants had the opportunity to practice these skills during the training and received learning aids (e.g., meeting plan notepads) to remind them of the basic concepts.

We sent e-mails to participants 1 week before the training requesting that they click on a link to a Web survey and fill out the survey. This survey was designed to form a baseline for all participants and assess their levels of peer mentor knowledge and skills before the training. The employees who attended the training then received another e-mail on the day after the training requesting that they again fill out the Web-based survey after the training. This survey was designed to assess their immediate impressions of the training and to see if their level of understanding of the peer-mentoring concepts

TABLE 1
Descriptive Statistics for Time 1 Variables

	Mean	SD	*1*	*2*	*3*	*4*
1. Time at firm (months)	32.97	30.77	1			
2. Gender (male = 1, female = 0)	.83	.37	.09	1		
3. Peer mentor (Time 1)	3.72	.52	−.03	−.16	1	
4. Knowledge (Time 1)	3.72	.63	−.10	.04	.56	1

NOTE: n = 90. Values greater than .22 are significant at the .05 level.

was higher following the training. Finally, participants were sent an e-mail and asked to fill out a Web-based survey 2 months after the training in order to assess the longer term impact of the training and to see if participants continued to use the peer-mentoring skills.

MEASURES

Data were collected using a self-report Web-based survey. The instrument was composed of 43 items that collected demographic data and the following two individual scales: (a) peer mentoring and (b) knowledge creation and sharing. All scale items used a 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*). Table 1 shows descriptive statistics and intercorrelations. The surveys collected participants' self-perceptions of the following key constructs: peer mentoring knowledge and skills and knowledge creation and sharing.

Peer mentoring. Peer mentoring knowledge and skills were measured using a 14-item scale developed following procedures recommended by DeVellis (1991). Experts including research colleagues, managers, and workers at the firm, and the creator of the peer mentor training course reviewed the items. We then pretested these items on a separate sample of employees and selected 14 items for the final scale based on interitem correlations and factor analyses.

The scale items assess participants' knowledge of the peer-mentoring skills as well as their actual behaviors in terms of using the skills. Examples of items are "I can easily assess what information my coworker already knows," "I prioritize my coworkers' training based on their performance goals," and "Helping a coworker come up to speed more quickly benefits me directly." The 14-item measure had a Cronbach's alpha of .87 at Time 1 ($n =$ 85), .90 at Time 2 ($n = 61$), and .92 at Time 3 ($n = 44$).

TABLE 2
**Scale Items and Reliability for Peer Mentoring
and Knowledge Scales (Time 1)**

	Item Total Correlation
Peer-mentoring knowledge and skills	
1. I feel confident in my ability to communicate my ideas to coworkers.	.58
2. I can easily assess what information my coworker already knows.	.50
3. I feel confident in my ability to assess a coworker's learning style.	.53
4. I can easily identify the main points I want to cover with a coworker.	.55
5. I am able to figure out if my coworker understood my main points.	.62
6. I prioritize my coworkers' training based on their performance goals.	.42
7. I have a formal system in place to manage communication with coworkers.	.30
8. I take time to organize my thoughts before I meet with a coworker.	.54
9. I present the minimum relevant information coworkers need to be productive.	.40
10. I am sensitive to coworkers' learning styles when sharing information.	.56
11. I actively assess whether my coworker understands what I'm presenting.	.74
12. Improving my communication skills makes me more effective at my job.	.55
13. Helping a coworker come up to speed more quickly benefits me directly.	.50
14. I am highly motivated to be a good mentor.	.61
Cronbach's alpha = .87, $n = 85$	
Knowledge creation and sharing	
1. My firm's workers constantly generate new ideas.	.58
2. My firm's workers adapt their work to meet customer requirements.	.54
3. Members of my team actively talk with each other and share knowledge.	.53
4. My team transforms individual knowledge to shared knowledge.	.65
5. Members of my team regularly share knowledge with other teams.	.56
6. My team regularly creates innovative processes.	.69
7. My firm makes constantly updated information available to me.	.63
8. My firm has systems in place that efficiently capture workers' knowledge.	.56
9. My firm is highly committed to research and development.	.50
10. My firm does all it can to launch new products and services.	.67
Cronbach's alpha = .87, $n = 85$	

Knowledge creation and sharing. We constructed a 10-item scale to measure perceptions of knowledge creation and sharing behaviors based on items developed by Bontis (1999); Bontis, Crossan, and Hulland (2002); and Crossan and Hulland (1997). (See Table 2.) Six items assess creating knowledge (e.g., "My firm's workers constantly generate new ideas" and "My firm does all it can to launch new products and services"). Another four items assess sharing knowledge (e.g., "Members of my team actively talk with each other and share knowledge"). The 10-item scale had a Cronbach's alpha of .87 at Time 1, .85 at Time 2, and .88 at Time 3 (see Table 2).

All the scales exceeded the recommended Cronbach's alpha of .70, suggesting reliable scales for peer mentoring and knowledge creation and sharing (DeVellis, 1991). The two main measures in the study—peer mentoring and knowledge creation and sharing—were correlated .56.

Control variables. There is little quantitative empirical work on knowledge creation and sharing to guide our choice of control variables. The mentoring literature provides some guidance for control variables. Past studies have controlled for gender, education level, time at the firm, and functional area (Turban & Dougherty, 1994). We controlled for variables thought to affect the relationship tested in Hypothesis 2 between peer mentoring and knowledge creation and sharing. We also controlled for gender and time at the firm.

Validity. All items were developed for this study with the input of managers at the firm, the peer mentor training course developer, and research colleagues. Items were pretested on a sample at the firm, and feedback was incorporated into the final scales to eliminate redundant questions and clarify wordings.

Nunnally (1978) suggested that internal consistency supports content validity. These scales have high Cronbach alphas, which suggests they are internally consistent and have content validity. In addition, Nunnally suggested that comparing performance on the scale before and after training can indicate content validity, especially if the scores increased after the training. As the results in the next section will confirm, participants' peer mentoring scores increased after the training, which supports content validity. Finally, Nunnally suggested that scales have construct validity if they capture the desired construct. These scales were constructed specifically to capture peer mentoring and knowledge creation and sharing based on the literature and closely related scales (Bontis, 1999; Crossan & Hulland, 1995).

RESULTS

Exploratory data analysis indicated that the scales were normally distributed. There were no significant differences on any variables between participants who responded in Time 1 and Time 2 and those who responded in Time 1 only. Time 3 participants were a subset of Time 2 participants, and a very high percentage of Time 2 participants filled out the survey again at Time 3. Therefore, missing data did not appear to affect the analysis. For the study, 107 employees participated in the training, 90 filled out the first survey, 66

TABLE 3
ANOVA for Impact of Training on Peer Mentoring
at Time 1, Time 2, and Time 3

Source	Sum of Squares	df	Mean Square	F
Between				
Error	18.56	44	.42	
Within	17.62	90		
Training	4.12	2	2.06	13.42***
Linear	2.98	1	2.98	14.65***
Quadratic	1.14	1	1.14	11.00**
Error	13.50	88	.15	
Total	36.18	132		

**p < .01. ***p < .001.

filled out the second survey, and 44 completed the third survey. Therefore, we have a complete set of surveys for 44 employees. Given that the participants were volunteers and no one at their firm knew if they completed the surveys, a 43% response rate for all three surveys seems quite substantial.

We used a repeated measures ANOVA to test the impact of the training on perceptions of peer mentor knowledge and skills. We used hierarchical multiple regression to test the impact of controls (time with the firm and gender) and peer mentoring on perceptions of knowledge creation and sharing. Regression allows us to control for the effects of possible covariates and is robust to violations of the normality assumption.

Hypothesis 1 predicted that peer mentor training would increase perceptions of the level of individuals' peer mentoring knowledge and skills. A repeated measures ANOVA that included Time 1, Time 2, and Time 3 indicated that there was a significant increase in perceptions of peer mentor knowledge and skills, $F(2, 88) = 13.42$, $MS_{error} = 2.06$, $p < .001$, such that peer-mentoring levels were significantly higher after the training (see Table 3). The mean for peer mentoring increased from 3.70 at Time 1 to 4.09 at Time 2 and declined slightly to 4.08 at Time 3. There is a significant linear effect, $F(1, 88) = 14.65$, $MS_{error} = 2.98$, $p < .001$, which suggests that peer-mentoring levels increased over time from Time 1 to Time 3. There is also a significant quadratic effect, $F(1, 88) = 11.00$, $MS_{error} = 1.14$, $p < .01$, suggesting that peer-mentoring levels increased in a curvilinear fashion from Time 1 to Time 3. This suggests that there is a longer term impact to the training and that participants increased their levels of perceptions of peer mentoring knowledge and skills as a result of the training.

TABLE 4
Regression for Impact of Peer Mentoring
on Knowledge Creation and Sharing

	Model 1 (β)	Model 2 (β)
Controls		
Constant	3.72***	.96*
Time at firm	−.002	−.002
Gender	.09	.25
Peer mentoring		.58***
	$R^2 = .01$	$R^2 = .34$
Model summary	$F = .59$	$F = 14.66$***
	$df = 2, 87$	$df = 3, 86$

*$p < .05$. **$p < .01$. ***$p < .001$.

Hypothesis 2 suggests that higher perceived levels of peer mentoring would be associated with higher perceived levels of knowledge creation and sharing behaviors. We tested Hypothesis 2 using hierarchical regression (see Table 4). Model 1 regressed the control variables (time at firm and gender) on knowledge creation and sharing. The overall model does not predict a significant amount of variance in the dependent variable ($R^2 = .01$, $F(2, 87) = .59$, $p > .05$). Model 2 adds peer mentoring into the model, which results in a significant increase in the predictive strength of the model ($\Delta R^2 = .33$, $\Delta F = 42.22$, $p < .001$). Model 2 predicts a significant amount of variance in the dependent variable ($R^2 = .34$, $F(3, 86) = 14.66$, $p < .001$). Peer mentoring is significant and positively correlated with perceptions of knowledge creation and sharing behaviors ($\beta = .58$, $p < .001$), supporting Hypothesis 2. This suggests that higher perceived levels of peer mentoring contributed to higher perceived levels of knowledge creation and sharing behaviors.

DISCUSSION

Relatively little is known about the factors that facilitate organizational knowledge creation and sharing, and even less has been empirically tested. This study provides a beginning empirical test of the relationship between perceptions of peer mentoring and perceptions of the creation and sharing of knowledge. The results suggest that peer mentoring holds promise for increasing organizational knowledge creation and sharing. Results indicate that perceptions of higher levels of peer mentoring are associated with higher perceived levels of knowledge creation and sharing.

The traditional mentoring literature has tangentially explored the link between mentoring and information or knowledge sharing (Scandura, 1998). This study builds on the existing mentoring literature by examining another important form of mentoring, peer mentoring, and analyzing its impact on knowledge creation and sharing. This article provides a theoretical contribution by developing the concept of peer mentoring but also links it to one of its potentially valuable outcomes—facilitating knowledge creation and sharing. This study's results support Hypothesis 2 that peer mentoring may be an effective way to facilitate the creation and sharing of knowledge through its intentional linking of mentors with valuable knowledge with newer, less experienced workers. Although information systems and knowledge systems are one important way to store and share knowledge, the interpersonal nature of peer mentoring provides dynamic, continuous creation and sharing of ideas that networked computers cannot replace.

This study measured individuals' perceptions of their own peer-mentoring skills and their perceptions of knowledge sharing in their teams and at their firm. Although this links multiple levels of analysis, because these are perceptual measures collected from the same individuals, we can make sense of this relationship. In particular, the results indicate that those individuals who experience their own peer-mentoring skills as stronger also experience the organization as being more engaged in knowledge sharing. In addition, although the measure of knowledge creation and sharing explicitly addresses the team and the firm, individuals may think they are describing the entire firm when what they are really describing is the part of the organization to which they are closest. In effect, they are reporting their individual perceptions of knowledge sharing in the team and in the firm and relating that to their perceptions of their own peer-mentoring behaviors.

This study indicates that peer mentor training can help workers learn peer mentoring knowledge and skills. Perceived levels of peer mentoring increase immediately after the training and are still significantly higher 2 months later. This suggests that there may be a longer term impact to peer mentor training and that participants increase their level of peer mentoring knowledge and skills as a result of the training.

LIMITATIONS IN ASSESSING CHANGE

This study suggests that training participants did increase their peer-mentoring knowledge and skills as a result of the training. However, there are several limitations to this finding. First, because this study did not include a control group, we cannot be certain that the effects found in the study were due only to the peer mentor training. Future researchers may want to include

a control group to alleviate this concern. However, because the participants were measured three times using the same instrument, the participants acted as a control for themselves. Second, although we used self-report data, the results suggest that a positive change occurred as a result of the training. Using self-report data is also appropriate when the phenomenon in question is interpersonal and relational in nature, which is precisely what we are trying to measure in this study.

Individuals are the unit of analysis in this study. Participants received the training with other team members, but the changes we are assessing are at the individual level—the individuals' perceptions of their levels of peer-mentoring knowledge and skills and the individuals' perceptions of knowledge creation and sharing. Because the participants received the training as a team, the measures may reflect the effects of team building as well as the specific peer-mentoring knowledge and skills they received in the training.

LIMITATIONS IN ASSESSING THE RELATIONSHIP BETWEEN PEER MENTORING AND KNOWLEDGE

First, the participants are only 107 employees of one high-technology software firm, which limits our ability to generalize the findings to other firms and industries. However, the employees in this firm should have much in common with employees at other software and knowledge-intensive firms. Second, our measures collected workers' perceptions of peer mentoring and knowledge creation and sharing. Future research will need to include archival measures or measures independent of the survey. Third, because all our variables were collected with one instrument, method bias may have inflated the relationships. However, because data were collected at three points in time and the findings were quite robust, these findings appear solid. Furthermore, there is no reason to assume the participants have an implicit theory that there is a relationship between peer mentoring and knowledge creation and sharing (Engle & Lord, 1997). Fourth, all of the scales used in this study were created especially for this study. Consequently, they show promise for construct and content validity but need further validation in future studies. Finally, this study begins to establish a relationship between peer mentoring and knowledge creation and sharing but does not establish a causal relationship. Peer mentoring may lead to higher levels of knowledge creation and sharing or vice versa. They may also feed on each other. Whichever direction the causal arrow points, establishing that there is a relationship between peer mentoring and knowledge is a valuable addition to the literature.

NEED FOR FUTURE RESEARCH

There is a need for theoretical development and additional research methods to test the effectiveness of peer mentoring. Future studies should consider combining qualitative and quantitative methods as well as integrating objective archival measures into the analysis.

Additional scale development is needed for measuring peer-mentoring knowledge and skills as well as knowledge creation and sharing. The scales in this study are new, and although our results indicate that they have acceptable psychometric properties, additional work on validity needs to be done with larger and more diverse samples. Additional work also needs to be done on convergent and divergent validity.

Additional antecedents to effective peer mentoring need to be identified and tested. In addition to the nature of the work itself, the leadership style of the team leader, the company culture, availability of other training, and other factors may affect the effectiveness of peer mentoring. These variables could be included in future research to assess the effectiveness of peer mentoring under different conditions and settings.

Future research needs to identify additional outcomes of effective peer mentoring. Researchers may want to link performance metrics to peer mentoring and knowledge creation and sharing. For example, studies could include peer-mentoring goals in employee evaluations. Performance measures could also be collected from coworkers or supervisors 2 or 3 months after the participants receive peer mentor training to assess the effectiveness of the peer mentoring. Researchers could also examine the differences in performance, turnover, and so forth between participants who receive training as part of a team and those who receive training individually.

Finally, researchers may want to explore obstacles to effectively implementing peer-mentoring programs. Obstacles may include resistance to outside training, employee cynicism, lack of leadership buy in, lack of reward structures for peer-mentoring and knowledge-sharing behaviors, and ineffectively pairing peer mentors with apprentices. Future research needs to explore to what degree these obstacles are present in a firm and how they affect the effectiveness of peer mentoring.

CONCLUSION

Effectively managing the creation and sharing of knowledge can provide firms with a competitive advantage (Grant, 1996; Teece, 1998). Firms can facilitate knowledge creation and sharing by providing their workers with the

appropriate skills and motivation to do so. Peer mentor training provides workers with the knowledge and skills they need to turn their tacit knowledge into explicit knowledge (Nonaka, 1994). Workers are then able to share relevant knowledge with each other.

This study adds to the existing mentoring literature by empirically testing the ability of peer mentoring to increase perceptions of the level of knowledge creation and sharing. It adds to the existing knowledge literature by providing an empirical test of the impact of perceptions of peer mentoring on perceptions of knowledge creation and sharing. The knowledge literature has a strong need for empirical work. This study provides a limited test of the value to a firm of managing knowledge effectively.

REFERENCES

Allen, T. D., McManus, S. E., & Russell, J. E. A. (1999). Newcomer socialization and stress: Formal peer relationships as a source of support. *Journal of Vocational Behavior*, *54*, 453-470.

Allen, T. D., Russell, J. E. A., & Maetzke, S. B. (1997). Formal peer mentoring: Factors related to protégés satisfaction and willingness to mentor others. *Group and Organization Management*, *22*, 488-507.

Aryee, S., Chay, Y. W., & Chew, J. (1996). The motivation to mentor among managerial employees. *Group & Organization Management*, *21*, 261-277.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*, 99-120.

Boisot, M. (1998). *Knowledge assets: Securing competitive advantage in the information economy.* New York: Oxford University Press.

Bolino, M. C., Turnley, W. H., & Bloodgood, J. M. (2002). Citizenship behavior and the creation of social capital in organizations. *Academy of Management Review*, *27*, 505-522.

Bollis-Pecci, T. S., & Walker, K. L. (2000). Peer mentoring perspectives in GTA training: A conceptual road map. *Journal of Graduate Teaching Assistant Development*, *7*, 27-37.

Bontis, N. (1999). *Managing an organizational learning system by aligning stocks and flows of knowledge: An empirical examination of intellectual capital, knowledge management, and business performance.* Unpublished doctoral dissertation, University of Western Ontario.

Bontis, N., Crossan, M. M., & Hulland, J. (2002). Managing an organizational learning system by aligning stocks and flows. *Journal of Management Studies*, *39*, 437-469.

Brenden, M. A. (1986). Pioneering new support systems for non-traditional baccalaureate students: Interactional advising and peer mentoring. *NACADA Journal*, *6*, 77-82.

Conley, S. (1995). Teacher mentoring and peer coaching: A micropolitical interpretation. *Journal of Personnel Evaluation in Education*, *9*, 7-19.

Crossan, M., & Hulland, J. (1995). *Assessing organizational learning: An empirical measurement tool* (Working paper). Ontario: Richard Ivey School of Business, University of Western Ontario.

Crossan, M., & Hulland, J. (1997). *Measuring organizational learning.* Paper presented at the Academy of Management Conference, Boston.

Crossan, M., Lane, H. W., & White, R. E. (1999). An organizational learning framework: From intuition to institution. *Academy of Management Review*, *24*, 522-537.

DeVellis, R. F. (1991). *Scale development: Theory and applications*. Newbury Park, CA: Sage.

Eby, L. T. (1997). Alternative forms of mentoring in changing organizational environments: A conceptual extension of the mentoring literature. *Journal of Vocational Behavior*, *51*, 125-144.

Engle, E. M., & Lord, R. G. (1997). Implicit theories, self-schemas, and leader-member exchange. *Academy of Management Journal*, *40*, 988-1010.

Ensher, E. A., Thomas, C., & Murphy, S. E. (2001). Comparison of traditional, step-ahead, and peer mentoring on proteges' support, satisfaction, and perceptions of career success: A social exchange perspective. *Journal of Business & Psychology*, *15*, 419-438.

Erez, A., Lepine, J. A., & Elms, H. (2002). Effects of rotated leadership and peer evaluation on the functioning and effectiveness of self-managed teams: A quasi-experiment. *Personnel Psychology*, *55*, 929-948.

Fagenson, E. A. (1989). The mentor advantage: Perceived career/job experiences of protégés vs. non-protégés. *Journal of Organizational Behavior*, *10*, 309-320.

Glass, N., & Walter, R. (2000). An experience of peer mentoring with student nurses: Enhancement of personal and professional growth. *Journal of Nursing Education*, *39*, 155-160.

Grant, R. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*, 109-122.

Grant-Vallone, E. J., & Ensher, E. A. (2000). Effects of peer mentoring on types of mentor support, program satisfaction and graduate student stress: A dyadic perspective. *Journal of College Student Development*, *41*, 637-642.

Harnish, D., & Wild, L. A. (1993a). Faculty peer mentoring: A strategy for improving instruction. *Community College Journal*, *64*, 22-27.

Harnish, D., & Wild, L. A. (1993b). Peer mentoring in higher education: A professional development strategy for faculty. *Community College Journal of Research and Practice*, *17*, 271-282.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, *3*, 383-397.

Kram, K. (1985). *Mentoring at work*. Glenview, IL: Scott, Foresman.

Kram, K. E., & Isabella, L. A. (1985). Mentoring alternatives: The role of peer relationships in career development. *Academy of Management Journal*, *28*, 110-132.

Lahman, M. P. (1999). *To what extent does as peer mentoring program aid in student retention?* Paper presented at the annual meeting of the National Communication Association, Chicago.

Lankau, M. J., & Scandura, T. A. (2002). An investigation of personal learning in mentoring relationships: Content, antecedents, and consequences. *Academy of Management Journal*, *45*, 779-790.

Lawler, E. E., III, Mohrman, S.,A., & Ledford, G. E., Jr. (1995). *Creating high performance organizations: Practices and results of employee involvement and total quality management in Fortune 1000 companies.* San Francisco: Jossey-Bass.

McManus, S. E., & Russell, J. E. A. (1997). New directions for mentoring research: An examination of related constructs. *Journal of Vocational Behavior*, *51*, 145-161.

Messmer, M. (1998). Mentoring: Building your company's intellectual capital. *HR Focus*, *15*(9), 11-12.

Morrison, E. W. (2002). Newcomers' relationships: The role of social network ties during socialization. *Academy of Management Journal*, *45*, 1149-1160.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital and the organizational advantage. *Academy of Management Review*, *23*, 242-266.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*, 14-37.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. New York: Oxford University Press.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed). New York: McGraw-Hill.

O'Connell, M. S., Doverspike, D., & Cober, A. B. (2002). Leadership and semiautonomous work team performance: A field study. *Group & Organization Management*, *27*, 50-65.

Organ, D. W. (1988). *Organizational citizenship behavior: The good soldier syndrome*. Lexington, MA: Lexington Books.

Ostroff, C., & Kozlowski, S. W. J. (1992). Organizational socialization as a learning process: The role of information acquisition. *Personnel Psychology*, *45*, 849-974.

Penrose, E. (1959). *The theory of the growth of the firm*. White Plains, NY: M.E. Sharpe.

Ragins, B. R., & Scandura, T. A. (1994). Gender differences in expected outcomes of mentoring relationships. *Academy of Management Journal*, *37*, 957-971.

Scandura, T. A. (1992). Mentorship and career mobility: An empirical investigation. *Journal of Organizational Behavior*, *13*, 169-174.

Scandura, T. A. (1998). Dysfunctional mentoring relationships and outcomes. *Journal of Management*, *24*, 449-468.

Scandura, T. A., Tejeda, M. J., Werther, W. B., & Lankau, M. J. (1996). Perspectives on mentoring (Developing the leaders of tomorrow through mentoring). *Leadership and Organization Development*, *17*, 50-56.

Scandura, T. A., & Viator, R. E. (1994). Mentoring in public accounting firms: An analysis of mentor-protégé relationships, mentorship functions and protégé turnover intentions. *Accounting, Organizations and Society*, *19*, 717-734.

Sivasubramaniam, N., Murray, W. D., Avolio, B. J., & Jung, D. I. (2002). A longitudinal model of the effects of team leadership and group potency on group performance. *Group & Organization Management*, *27*, 66-96.

Spender, J. C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*, *17*, 45-62.

Spreitzer, G. M., Cohen, S. G., & Ledford, G. (1999). Developing effective self-managing work teams in service organizations. *Group & Organization Management*, *24*, 340-366.

Stewart, T. A. (1997). *Intellectual capital: The new wealth of organizations*. New York: Doubleday.

Swap, W., Leonard, D., Shields, M., & Abrams, L. (2001). Using mentoring and storytelling to transfer knowledge in the workplace. *Journal of Information Systems*, *18*, 95-114.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practices within the firm. *Strategic Management Journal*, *17*, 27-43.

Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. *California Management Review*, *40*, 55-79.

Tepper, B. J., & Taylor, E. C. (2003). Relationships among supervisors' and subordinates' procedural justice perceptions and organizational citizenship behaviors. *Academy of Management Journal*, *46*, 97-105.

Trautman, S. (1999). *Technical peer mentoring handbook: The art of sharing what you know with the person working next to you*. Seattle: Solution Strategies, Inc.

Turban, D. B., & Dougherty, T. W. (1994). Role of protégé personality in receipt of mentoring and career success. *Academy of Management Journal*, *37*, 688-702.

Van Maanen, J., & Schein, E. H. (1979). Toward a theory of organizational socialization. In B. Staw (Ed.), *Research in organizational behavior* (Vol. 1, pp. 209-264). Greenwich, CT: JAI.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*, 171-180.

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