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Understanding the Antecedents of Effective Knowledge Management: The Importance of a Knowledge-Centered Culture*

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ABSTRACT

Within the context of knowledge management, little research has been conducted that identifies the antecedents of a knowledge-centered culture—those organizational qualities that encourage knowledge creation and dissemination. In this study, the existing literature on organizational climate, job characteristics, and organizational learning (in the form of cooperative learning theory) are linked with the current thinking and research findings related to knowledge management to develop a theoretical model explaining the relationships among organizational climate, the level of cooperative learning that takes place between knowledge workers, and the resulting level of knowledge created and disseminated as measured by team performance and individual satisfaction levels. The study goes on to empirically test the proposed research model by investigating the climate of organizations, and seeks to understand the linkage between a set of organizational and individual characteristics and knowledge-related activities found in cooperative learning groups and the resulting work outcomes. The hypothesized research model is tested using *LISREL* with data collected from 203 information systems (IS) professionals engaged in systems development activities. The paper concludes with a discussion of the implications the results have for future research and managerial practice.

Subject Areas: Cooperative Learning, Knowledge Creation, Knowledge Management, Knowledge Work, LISREL, Organizational Climate, Organizational Culture, Organizational Learning, Structural Equation Modeling, Systems Development, Team Development, Teams

> *The concept of knowledge management is at once both a simple and complex subject. On the one hand we all have an understanding of our own personal knowledge and how we use it. But managing the development, flow, and application of knowledge on an organizational basis is another matter. The "bandwidth" of the flow of knowledge is based upon trust in both the organization as a whole and the specific individuals with whom we interact. Organizations must deal with this issue by providing a climate of trust built on a culture that embraces and rewards knowledge-sharing in all its manifestations such as learning, mentoring, collaboration, sharing ideas and stories, etc. Imagine the*

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power of an organization that can quickly channel its collective brain-power toward priority issues that arise without a management mandate.

—CIO of a global chemical company internationally recognized for its leadership in knowledge management initiatives

INTRODUCTION

With increased levels of competition in the marketplace, high costs associated with human resources, increases in employee transience, and shortages of qualified knowledge workers, organizations have actively pursued the notion of making more effective use of the knowledge and expertise, that is, the "intellectual capital," that exists within their existing employee base (Alavi & Leidner, 2001; Davenport & Prusak, 1998; Grover & Davenport, 2001). Equally important, Hult, Ketchen, and Nichols (2002) contend that learning from lessons by extracting both successes and failures is an essential cultural element contributing to the emergence of firms' strategic resources, specifically known as cultural competitiveness. For many organizations, this notion of managing knowledge as a corporate resource has been looked to as one of the few foundational weapons that promise to deliver sustainable distinctive competencies in the future. As Grover and Davenport point out, "[knowledge management] is rapidly becoming an integral business function for many organizations as they realize that competitiveness hinges on effective management of intellectual resources" (2001, p. 5). Even so, as the opening excerpt attests, leaders in the practice of knowledge management initiatives continue to struggle with how to develop a "*climate* of trust built on a *culture* that embraces and rewards knowledge-sharing in all its manifestations such as *learning, mentoring, collaboration,* sharing ideas and stories, etc." (emphasis added). Coupled with this practical need is the reality that within the research on knowledge management, relatively little research has been conceptually or empirically conducted that seeks to identify what constitutes a knowledge-centered culture—which key organizational characteristics encourage and facilitate both the *creation* of knowledge (i.e., learning new things) and the *dissemination* of knowledge (i.e., skills transfer or teaching new things to others). On a related note, understanding when (and how) knowledge creation and dissemination is occurring has also proven challenging to researchers. Thus, there are two needs in both academic and practitioner circles that this study hopes to address. First, we empirically investigate the cultural attributes of organizations that may have an effect on knowledge-related activities. Second, we build a case based on the literatures of knowledge management and learning that suggest that the phenomena of cooperative learning may serve as an indicator of the existence of knowledge-related activities such as knowledge creation and knowledge exchange. Finally, it is the goal of the research presented here to seek a better understanding of the linkages between these attributes and individual characteristics related to the development and transfer of knowledge throughout the enterprise, and ultimately, the organization's work products.

BACKGROUND

Many fields within academe (e.g., cognitive psychology, information sciences, educational psychology, etc.) have attempted to better understand the concepts of knowledge creation, storage, and retrieval, knowledge sharing, and knowledge application. Knowledge creation, while interesting by itself, is of limited value if it is not shared among individuals or units in organizations. On the other hand, knowledge sharing is of limited value if the knowledge created is not worth sharing (Schulz, 2001). The value of knowledge increases with its accessibility and the frequency that it is shared within the company (Davenport & Prusak, 1998). Similarly, in the related body of literature of organizational learning, knowledge generation and knowledge sharing are the two major components of the learning process (Huber, 1991; Schulz, 2001).

The Role of Organizational Culture in Knowledge Management

Organizational culture is believed to be the most significant input to effective knowledge management and organizational learning in that corporate culture determines values, beliefs, and work systems that could encourage or impede learning (knowledge creation) as well as knowledge sharing (e.g., Alavi & Leidner, 2001; Gold, Malhotra, & Segars, 2001; Leonard, 1995; Slater & Narver, 1995), and ultimately, decision making (Kettinger & Grover, 1995; Schein, 1985). Therefore, an organization's culture should provide support and incentives as well as encourage knowledge-related activities by creating environments for knowledge exchange and accessibility. It is worth noting that knowledge management is a business practice, not a technology. That is, technology on its own can't make knowledge management successful and, therefore, the most effective knowledge management strategies should aim at strengthening and developing organizational cultures, specifically knowledge-centered cultures or learning cultures (DeTienne & Jackson, 2001; Pitman, 1994). Furthermore, a learning culture has been viewed as evidence of an organization's competitiveness, which, in turn, serves as a strategic resource. Consequently, organizations should develop a learning culture in order to gain a competitive edge in their markets (Hult et al., 2002).

Learning *culture* and learning *climate* are closely related and are usually assumed to have significant impacts on individual, team, and organizational learning (Alavi & Leidner, 2001; Gold et al., 2001; Mikkelsen & Gronhaug, 1999). In general, an organization's climate is thought to be a direct behavioral manifestation of organizational culture, which is a deeper and less consciously held set of cognitions and affective attachments (Schein, 1985; Mikkelsen & Gronhaug, 1999). A climate conducive to learning is expected to influence the rate of organizational learning and, ultimately, organizational performance (Moss-Kanter, 1983; Slater & Narver, 1995). The notion of organizational learning climate pertains to the perceptions that employees have on how work settings either facilitate or hinder learning (Mikkelsen & Gronhaug, 1999; Mikkelsen, Ogaard, & Lovrich, 2000; Slater & Narver, 1995).

The Role of Cooperation in Knowledge Management

Learning and knowledge are inextricably linked in the knowledge management literature. For this research, we have focused on processes related to learning—in our case *cooperative* learning between knowledge workers—to better understand knowledge creation and knowledge transfer. Within the knowledge management literature, the distinction between explicit (formal, systematic, easily codified and communicated) and tacit (highly personal, context specific, difficult to codify and communicate) knowledge has been made (Nonaka, 1991). Nonaka (1991) proposes four basic modes for creating knowledge in any organization: socialization (from tacit to tacit), articulation (from tacit to explicit), combination (from explicit to explicit), and internalization (from explicit to tacit). The socialization mode of knowledge creation, defined as conversion of tacit knowledge to new tacit knowledge among individuals, is learned through observation, imitation, and practice whereby individuals share experience through face-to-face interaction. Nonaka and Takeuchi (1995) have stressed the importance of tacit knowledge and placed great emphasis on establishing conditions that encourage the exchange of tacit knowledge between individuals through a highly interactive social process and direct interaction in a colocated, face-to-face work environment (Cohen, 1998). As will be described later, cooperative learning describes such processes.

With regard to explicit versus tacit knowledge, Hansen, Nohria, and Tierney (1999) have classified an organization's primary approach to knowledge transfer into two distinct strategies: codification and personalization. The codification approach implies that learning is reliant on the utilization of knowledge databases and connecting people with reusable, codified knowledge (Bixler, 2002; Hansen, Nohria, & Tierney, 1999). In contrast, the personalization mode of knowledge transfer relies more on direct interaction between individuals in that the learning occurs through direct collaborative interaction with experts and peers in small groups of people (Bixler, 2002; Hansen et al., 1999; Kogut & Zander, 1992). As such, cooperative learning is much more similar to this latter approach.

The above discussion clearly stresses the importance of socialization, face-to-face relationships, and cooperative interaction among individuals for the purposes of knowledge creation and sharing. More important, bringing knowledgeable people together in a collaborative environment so that knowledge can be shared and enhanced is imperative for knowledge management (Alavi & Leidner, 2001) and organizational learning. Consequently, team orientation is a key characteristic of the organizational learning process (Hult, 1998; Hult, Hurley, Giunipero, & Nichols, 2000; Janz, Wetherbe, Davis, & Noe, 1997; Senge, 1990), and it seems reasonable to assume its importance within the context of knowledge management. This is supported by the perspective that holds that an organization is an institution for integrating the knowledge that resides in individuals and, therefore, a team-based structure is an essential characteristic of organizational structures pertinent to value creation through knowledge utilization (Grant, 1996).

The previous discussion along with previous research suggests that knowledge management and organizational learning are integral to each other (Bixler, 2002; Schulz, 2001). Learning, knowledge creation, and knowledge sharing occur at individual, team, and organizational levels and are the significant contributors to success of organizational learning and organization knowledge management

(Alavi & Leidner, 2001; Grover & Davenport, 2001). Given the importance of socialization among individuals, our study primarily focuses on the learning as well as the knowledge creation and transfer among small groups of people since taking an organization as the unit of analysis would fail to take into account the fact that organizational knowledge is created through the interaction of individuals and, as a result, would provide little guidance on how management can influence the learning process (Grant, 1996; Hedberg, 1981; Lynn, Reilly, & Akgün, 2000).

Team-oriented work environments provide opportunities for employees to learn from colleagues with expertise who are supportive and willing to help one another through working together, sharing information, and watching out for one another (Janz, 1999; Mikkelsen et al., 2000). Similarly, teams play a critical role in a knowledge-creating company such that team members create new ideas through dialogue and discussion (Nonaka, 1991). Teams comprise a communication channel for knowledge seekers and knowledge senders to exchange in knowledge markets, and this exchange behavior in turn leads to superior performance (Guzzo & Dickson, 1996). Such behaviors, in fact, are the primary mechanisms of learning and knowledge management activities. For the research reported here, teams of information systems (IS) professionals involved with the development of IS applications were investigated. This context was believed to be appropriate for investigating knowledge management phenomena for the following reasons:

1. **Teams of IS professionals exhibit different problem-solving behaviors.**
   Novices tend to have limited episodic knowledge and apply fewer heuristics than experienced analysts (Schenk, Vitalari, & Davis, 1998). Given that tacit knowledge consists of heuristics or search rules used to identify problems and solutions (Polanyi, 1966), our study of IS development teams would lend itself to examining the tacit knowledge creation and dissemination through practice among groups of individuals.
2. **The complexity of IS projects mandates a team approach.**
   The complexity and size of information systems and their associated design, development, implementation, and maintenance activities necessitates that groups or teams of people work on them.
3. **The IS context presents ongoing "new knowledge" opportunities.**
   The constant evolution of IS technologies results in IS teams being exposed to new knowledge in the form of new technologies, procedures, tools, etc., and thus epitomizes today's "knowledge work."

The study presented here seeks to make four major contributions. First, we attempt to better understand the mechanisms of knowledge creation and knowledge dissemination, as well as the antecedent conditions that facilitate them. Second, as Cohen (1998) suggests, since most U.S. research to date has focused on processes related to *explicit* knowledge, it is time for more research to focus on *tacit* knowledge processes. By focusing our efforts on cooperative learning processes between members of teams, we hope to illuminate the creation and dissemination of such tacit knowledge. Third, rather than investigating knowledge creation and dissemination through the use of surrogate classroom exercises, we seek understanding of

this real-world issue through field-based research in which true knowledge senders and receivers interact—the type of research repeatedly called for in order to better understand tacit knowledge creation and dissemination (Grant, 1996; Leonard & Sensiper, 1998; Ramesh & Tiwana, 1999). Finally, we attempt to conduct empirical research that seeks to strengthen the logical relationship between climate, organizational learning, and knowledge management. It is our hope that by conducting research built on the firmly established theories associated with organizational climate and cooperative learning, and building the linkages between these concepts and the more recent thinking on knowledge creation and knowledge dissemination, we will not only uncover interesting findings, but will also add to a robust cumulative research tradition and build a case for future interdisciplinary investigation. A hypothesized research model is presented and empirically tested with data collected from teams of IS knowledge workers: 203 IS professionals from 27 system development teams across 13 organizations.

THEORETICAL FOUNDATIONS AND RESEARCH HYPOTHESES

Although we are most interested in knowledge creation and dissemination, it is important for us to (1) seek research conditions that will most likely give rise to the knowledge creation and dissemination processes; (2) understand the environment that helps to foster to these phenomena; and (3) formulate a method (or methods) to verify that the creation or dissemination has occurred. To that end, the proposed research model has its origins in theories relating to organizational learning, organizational climate, and job characteristics.

Organizational learning is defined as the process of improving actions through better knowledge and understanding (Fiol & Lyles, 1985). According to Hult et al. (2000), organizational learning relies on two related different concepts: the process of learning and the structure of the learning organization. Cooperative learning theory (Johnson & Johnson, 1989; Johnson, Johnson, Buckman, & Richards, 1988; Johnson, Johnson, & Holubec, 1989) was selected here as a form of organizational learning that focuses on the learning (i.e., knowledge creation), the sharing (i.e., knowledge dissemination), and ultimately the application of knowledge to realize superior work outcomes.

The literature on organizational climate (e.g., Litwin & Stringer, 1968; Pritchard & Karasick, 1973) suggests that the existence of certain characteristics of the work environment may facilitate and encourage learning processes in terms of knowledge generation and knowledge sharing, as well as knowledge application (Mikkelsen & Gronhaug, 1999; Slater & Narver, 1995).

According to job characteristics theory (Hackman & Lawler, 1971; Hackman & Oldham, 1980; Turner & Lawrence, 1965), increasing levels of autonomy will enhance outcomes of work in terms of work satisfaction and performance (Campion, Medsker, & Higgs, 1993; Henderson & Lee, 1992). In relation to the literature on learning, autonomy is considered an important facilitator of knowledge flow among individuals and units in organizations (Garvin, 1993; Mikkelsen & Gronhaug, 1999; Nonaka, 1991; Schulz, 2001). Autonomy and organizational climate are viewed as related concepts in that they both help to describe organizational culture or the

structure of a learning organization that facilitates knowledge creation as well as knowledge exchange.

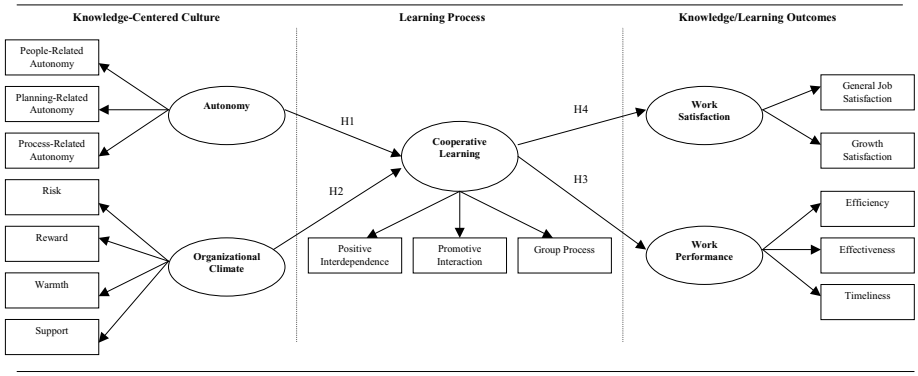
A *knowledge outcome* refers to the process involved in creating value for the recipient of knowledge and ultimately the firm (Grover & Davenport, 2001). For this study, worker satisfaction with his or her job, personal evaluation of work performance, and stakeholder perceptions of team performance (in terms of efficiency, effectiveness, and timeliness) were considered as evidence that knowledge was gained. These measures, rather than "degree of learning," were used in this study for two reasons. First, the value of knowledge gained is difficult to measure directly and tends to be context specific (Cohen, 1998). For example, Hult et al. (2000) used cycle time as an outcome of learning in purchasing process, while Slater and Narver (1995) proposed customer satisfaction, new product success, sales growth, and profitability as outcomes of learning organizations in the context of marketing. Consequently, we felt that the work performance and job satisfaction measures were appropriate for the IS context. Second, we felt that it would be more meaningful to measure newly acquired knowledge when it was actually applied (and thus be observable by the learner or by others) for personal or organizational benefit rather than attempting to measure learning when it actually occurred but was yet to be, if ever, applied.

The proposed model is shown in Figure 1. The model identifies five major constructs and the relationships between them. Organizational climate, operationalized in terms of an organization's supportiveness and posture toward risk taking, as well as the level of autonomy enjoyed by the IS worker, are hypothesized to positively influence cooperative learning, which, in turn, affects work outcomes in terms of work satisfaction and work performance as evaluated by both the worker and external stakeholders.

Cooperative Learning

A "collective mind" is an important characteristic possessed by effective work groups (Weick & Roberts, 1993). To that end, cooperation, coordination, and

Figure 1: Hypothesized research model.



collective approaches to work are all desirable characteristics of knowledge creation, sharing, and the overall learning process—in other words, the socialization mode of tacit-to-tacit knowledge creation and the personalization mode of knowledge transfer (Argote, Gruenfeld, & Naquin, 1999; Bixler, 2002; Gold et al., 2001; Hansen et al., 1999; Kogut & Zander, 1992; Nonaka, 1991). Specifically, a team orientation stressing collaboration and cooperation activities is one of the major antecedents of organizational learning (Hult, 1998; Hult et al., 2000; Janz, 1999).

It has been suggested that learning through application and practice in real work settings is the essential element of tacit knowledge creation (Grant, 1996; Leonard & Sensiper, 1998; Ramesh & Tiwana, 1999). Cooperative learning, one example of organizational learning, embodies this notion of tacit knowledge creation and dissemination and will be the focus of "knowledge activities" for the balance of the paper. Cooperative learning exists when team members work together to maximize their own as well as other team members' performance and learning (Johnson et al., 1989). With cooperative learning, team members work directly together to share and develop tacit knowledge while completing their work. As such, according to cooperative learning theory, certain characteristics are essential for cooperative learning to exist: positive interdependence, promotive interaction, and group process.

Positive interdependence refers to members of a group that are linked in such a way that each member feels that he or she cannot be successful unless all other members of the group are successful. A shared group goal that each group member identifies with and accepts is one way to achieve positive interdependence. In terms of organizational learning, positive interdependence reflects the importance of learning as both individual cognition and group cognition. This is consistent with the literature on knowledge management, which holds that knowledge is created at various levels and transferred within and between levels from individuals, groups, and organizations (Alavi & Leidner, 2001; Grover & Davenport, 2001).

Promotive interaction is defined as the degree to which members of the group identify the individual strengths and weaknesses in the group and seek to assist others in developing the skills necessary for the group to achieve its goals through explaining or teaching. In other words, it refers to the extent to which members of a group interact to educate and encourage each other to accomplish tasks and to promote each other's success. Adequate social skills are a necessary prerequisite for effective promotive interaction, are considered essential types of knowledge for participants in an organization, and equate directly to the "social knowledge" that is inherently created by the collective actions of a group. As a result, it would be reasonable to believe that a high degree of promotive interaction implies a corresponding high degree of social knowledge among participants. These actions are referred to as *norms for communication* between members within a group or between groups (Alavi & Leidner, 2001; Nonaka, 1994). Hence, the degree of learning is dependent on the extent that promotive interaction occurs within the team.

Group process refers to groups periodically assessing (a) those things it has done effectively; (b) those things it has done ineffectively; and (c) the measures the group might take to address the identified weaknesses. Insofar as group process represents a concerted effort to evaluate the performance implications of given

behaviors, it is very much like "double-loop" learning discussed in the literature on organizational learning (Argyris & Schon, 1978), and represents the transition from merely having information to possessing the knowledge as to when it is to be used, for what purpose, and with what expected result.

The Influence of Autonomy on Knowledge Activities (Cooperative Learning)

Autonomy, equivalently referred to as "self-direction," "empowerment," or "self-management," is the extent to which an individual or group of individuals has the freedom, independence, and direction to determine what actions are required and how best to execute them (Henderson & Lee, 1992; Manz, 1992; Manz & Sims, 1980). Research suggests that knowledge workers prefer autonomy to any other job characteristic (Cheney, 1984; Goldstein & Rockart, 1984). Similarly, Nonaka (1991) and Garvin (1993) suggest that self-organizing teams or groups are considered a key success of a knowledge creating company. Within the context of work design and learning, autonomy includes responsibility for such things as the management of work methods, task scheduling, process monitoring, and the assignment of group members to tasks, as well as encouragement for learning and freedom to experiment and take reasonable risks. Autonomy is viewed as a significant dimension of learning climates that facilitate learning among individuals or groups of individuals (Gold et al., 2001; Mikkelsen & Gronhaug, 1999; Slater & Narver, 1995). Furthermore, it is believed that employees should be capable of self-organizing their knowledge as well as communication networks to develop solutions to new or existing problems and to generate or share knowledge (O'Dell & Grayson, 1998).

The findings related to autonomy are consistent with the notion of "localness" as an important cultural factor that may have a positive impact on organizational learning (Hult, 1998; Hult et al., 2000). *Localness* refers to an organizational culture that has a decentralized structure, flexible job responsibility, and extensive lateral communication processes (Burns & Stalker, 1961). Employees in a localized organization are willing to learn and share information cooperatively to achieve organizational effectiveness (Miles & Snow, 1992). In addition, group autonomy shows strong and positive effects on knowledge sharing and this contention supports the view of decentralization as a significant aspect of knowledge exchanges (Schulz, 2001). As a result, we might reasonably expect that the creation and sharing of knowledge through cooperative learning is facilitated and enhanced in a localized or decentralized structure characterized by high levels of autonomy. Thus, the following hypothesis is proposed:

H1: The level of autonomy positively influences the degree to which cooperative learning is present in teams.

Several forms of autonomy are evident in previous research. In this study, we focus on autonomy over planning decisions, autonomy over people decisions, and autonomy over work process decisions. These types of autonomy are characteristic of typical knowledge work activities (Davis, Collins, Eierman, & Nance, 1991)

and we believe they represent relevant aspects that would enhance the cooperative learning process.

The Influence of Organizational Climate on Knowledge Activities (Cooperative Learning)

Organizational culture embodies the deeply held, shared beliefs of an organization and is slow to develop or change over time (Schein, 1985). Kettinger and Grover and others have posited that an organization's culture influences its ability to learn, share information, and make decisions (Kettinger & Grover, 1995; Schein, 1985). Organizational climate is another dimension that is often used as a measure of the shared beliefs of an organization (Litwin & Stringer, 1968; Pritchard & Karasick, 1973). Culture and climate often measure the same phenomenon—organization reward systems, organizational support, and the like—but climate is considered the more visible and adaptive of the two (James & Jones, 1979).

Organizational *climate,* like organizational *culture,* often refers to an organization's value system in terms of risk taking, reward systems, and providing a warm and supportive environment (Litwin & Stringer, 1968). An open and caring climate has been discussed in the learning and knowledge management literature as important organizational attribute that encourage interaction among individuals and, as a result, learning and knowledge exchange (Cohen, 1998; Davenport & Prusak, 1998; Gold et al., 2001). Specifically in learning research, organizational climate is often operationalized as a set of organizational attributes perceived by organizational members that could either facilitate or hamper the learning process and thus influence organizational performance (Mikkelsen & Gronhaug, 1999; Moss-Kanter, 1983). In the present study, we have selected *risk, reward, warmth,* and *support* as the significant dimensions representing organizational climate since each was found to be the most commonly used across numerous earlier organizational climate studies. *Risk* measures the orientation of the organization toward undertaking potentially innovative initiatives with uncertain outcomes. Higher levels indicate that an organization is comfortable with risks and does not penalize workers for taking them. From a knowledge management perspective, an organization's incentive system that encourages risk taking and experimentation would be required to support learning as well as knowledge creation and dissemination (Davenport & Prusak, 1998; Garvin, 1993; Mikkelsen et al., 2000). *Reward* is a measure of how well the organization recognizes employee performance with rewards. *Warmth* is a measure of the friendliness of the atmosphere in the organization. Finally, *support* is a measure of the organization's interest in the welfare of the employee. We believe that the posture of an organization, with regard to risk taking, reward, warmth, and support dimensions, by definition captures most aspects of both openness and caring attributes discussed in knowledge-nurturing organizations (Cohen, 1998; Davenport & Prusak, 1998; Gold et al., 2001).

Although employees might be aware of the significance of the knowledge they generate, they may be less aware of the extent to which they share their knowledge or assist others. Therefore, organizational climates that encourage knowledge generation and sharing by providing supportive environments and such incentives as high-profile rewards and recognition for significant contributions should positively

influence learning among individuals and groups of individuals (Alavi & Leidner, 2001; Mullin, 1996; Trussler, 1998). Conversely, it has been suggested that risk aversion is a major reason for the lack of knowledge application in that punishment for mistakes may hinder knowledge workers from applying their knowledge to realize better performance (Davenport & Prusak, 1998). Thus, risk taking is considered an important dimension of organizational climate in this study.

Finally, it is widely accepted that organizational performance depends more on the ability to turn knowledge into effective action than knowledge itself. Gaps between what people know and what people actually do often exist in organizations (Pfeffer & Sutton, 2000). There may be occasions where organizational members are knowledgeable and willing to share their knowledge with others, yet they do not apply it or act upon it (Alavi & Leidner, 2001). Knowledge generation and sharing is part of the learning process and, therefore, without knowledge application, individuals, groups, and organizations would not be capable of fully taking advantage of the collective knowledge and learning capability to achieve superior performance. It is believed that an organization's overall climate may have an impact on what people actually do (Pritchard & Karasick, 1973). Thus, the following hypothesis relating organizational climate and the level of cooperative learning is submitted:

H2: Organization climate positively influences the degree to which cooperative learning is present in teams.

From Figure 1 it can be seen that an organization with positive levels of organizational climate (i.e., risk, reward, warmth, and support), along with high levels of autonomy, is referred to as a "knowledge-centered culture."

The Influence of Knowledge Activities (Cooperative Learning) on Knowledge Work Outcomes

Work performance and work satisfaction are viewed as outcomes of learning processes such that when knowledge is generated, shared, and applied, improved performance and greater work satisfaction are realized (Mikkelsen & Gronhaug, 1999; Mikkelsen et al., 2000). Such outcomes have been overwhelmingly examined in studies of job characteristics theory (Hackman & Lawler, 1971; Hackman & Oldham, 1980; Turner & Lawrence, 1965). As previously mentioned, work performance and work satisfaction include the notion of knowledge application and realization. Davenport and Prusak (1998) point out that knowing is not the same as doing—that it is meaningless if knowledge and learning are gained, but not applied to generate benefits for an organization.

Performance, for example, exhibiting individual or team achievement, has long been used as an outcome of learning (e.g., Edmondson, 1999; Johnson, Johnson, & Scott, 1978; Slavin, 1991). Cooperative learning theory suggests that if members of a group have interdependent goals, feel individually responsible for the group's performance, help or teach each other the needed skills for work, possess adequate social skills, and periodically evaluate the group's performance, the achievement and productivity of the group will be enhanced. Superior work performance is a result of learning and knowledge application that, in turn, is affected

by organizational climate and other facilitating work characteristics (specifically autonomy for this study).

The term *effectiveness* is often used in descriptions of how individuals or groups of individuals perform. Hackman (1987) explicitly suggests that one element of effectiveness is that work outputs meet expectations of those who review them—such as a supervisor or customer. Consequently, this research solicited stakeholder perceptions (i.e., organizational participants that have a vested interest in the team's work product) as an unbiased source of evidence of work performance. Stakeholder evaluations have the added benefits of reducing the potential for common method variance (Campion et al., 1993). Henderson and Lee (1992) have developed a stakeholder instrument that will be used here to measure stakeholders' perceptions of teams' work performance along the dimensions of *efficiency, effectiveness,* and *timeliness*. *Efficiency* refers to the amount of work the team produces with a given amount of resource inputs. Besides reduced costs, improvement in a company's efficiency is recognized as an outcome of the effective application of knowledge (Davenport & Klahr, 1998). Effectiveness is the degree to which the teams' work product (e.g., a software application) meets users' requirements. Timeliness pertains to the teams' ability to meet scheduled deadlines. Thus, the following hypothesis relating cooperative learning and work performance is proposed:

H3: The level of cooperative learning positively influences work performance.

Work outcomes include not only the quality of the work produced by people, but also the attitudes and feelings people have while producing the work. Work satisfaction is considered another important indication of knowledge utilization and learning that reflects a long-term benefit to an organization. Since knowledge originates with people, organizations suffer significant loss as a result of the departure of knowledgeable workers. A recent survey by European firms revealed that half of companies reported having suffered a significant setback from losing key staff and a loss of income due to the departure of a single employee (Alavi & Leidner, 2001; KPMG Management Consulting, 1998). Therefore, in addition to work performance, work satisfaction is a critical and direct result of learning that should be seriously investigated in a study of learning. Alavi and Leidner (2001) point out that the turnover of knowledge workers is high and one way to keep knowledge inside the firm is to keep employees happy. Because of the increased risk of skill obsolescence, IS workers have an increased exposure to job-related stress (Mak & Sockel, 2001). Consequently, the acquisition of new knowledge on the job would help IS workers in feeling more secure and happy in work.

Work satisfaction in terms of general job and growth satisfaction represents personal outcomes that are as important as work performance (Hackman & Oldham, 1980). *General job satisfaction* is a measure of how satisfied a worker is with the work he or she does. *Growth satisfaction* is a measure of the opportunity for personal learning and growth offered by the work itself. Since IS professionals are believed to be motivated by achievement and growth opportunities (Couger & Zawacki, 1980), growth satisfaction should increase the probability that they would stay with the organization and subsequently would keep their knowledge within

the organization. Given that an individual has a certain need for growth, increasing growth opportunities translate to more growth satisfaction. Since cooperative learning is considered a means for individuals to expand their knowledge and learning ability, their opportunities for growth would be enhanced as their knowledge grows and is applied to produce improved performance. Hence, we hypothesize:

H4: The level of cooperative learning positively influences the job-related satisfaction of IS knowledge workers.

RESEARCH METHODOLOGY

Measures

Organizational climate was measured with 21 survey items adapted from the Litwin and Stringer instrument (1968): 5 items measuring risk, 6 items measuring reward, 5 items measuring warmth, and 5 items measuring support. Autonomy scales were adapted from a previously validated instrument by Beyerlein, Beyerlein, and Richardson (1993). Five items measure people-related autonomy and five items measure planning-related autonomy. A panel of experts with extensive experience in IS system development practices and theory generated a list of possible systems development-related autonomy items. This five-item scale was used to measure autonomy related to IS work processes.

The level of cooperative learning was measured by twenty survey items. A 10-item instrument and a 7-item instrument developed by Johnson et al. (1988) were used to measure the degree of positive interdependence and promotive interaction, respectively, while a 3-item instrument adapted from Campbell and Hallam's (1994) team development survey (TDS) was used to measure group process.

For the work satisfaction construct, nine measurement items from Hackman and Oldham's (1980) job diagnostic survey (JDS) were employed: five items for general job satisfaction and four items for growth satisfaction. To measure teams' work performance, a nine-item stakeholder instrument developed by Henderson and Lee (1992) was used to measure efficiency, effectiveness, and timeliness, with three items for each dimension. The investigators also solicited external stakeholder perceptions as an unbiased source of evidence of work performance. The stakeholders included managers who interacted with teams, end-users who received the teams' work products, and employees and consultants who worked directly with the teams. The stakeholders were chosen to ensure that they were familiar with the team and their work product, yet were not members of the team. This would reduce any biased response from stakeholders who may have been team confederates. A breakdown of individual scales is shown in the Appendix A.

All of the measurement items had either five, six, or seven-point Likert scales as found in the original surveys. Organizational climate, work satisfaction, and work performance were measured in seven-point Likert scales. Two dimensions of cooperative learning—positive interdependence and promotive interaction—were measured in seven-point Likert scales, while group process was measured in six-point Likert scales. Five-point Likert scales were used to measure all dimensions of the autonomy construct. All organizational climate scales as well as scales of

group process and general satisfaction ranged from "strongly agree" to "strongly disagree." The scale ranging from "completely true" to "completely false" was used for positive interdependence and promotive interaction measures. The growth satisfaction scale ranged from "extremely satisfied" to "extremely dissatisfied." The scale ranging from "complete responsibility" to "absolutely no responsibility" was used for autonomy measures, and one ranging from "extremely high" to "extremely low" was used for work performance measures.

Survey Administration

Prior to the survey administration, a pilot administration of the instruments was conducted to ensure reliability, readability, and time requirements. Five MBA teams working on field-based systems development projects and one four-year-old team from industry were selected for the pilot. The readability of all items was satisfactory. The pilot survey responses showed that the survey items had reliability scores above 0.60 (as measured by Cronbach's alpha), indicating an acceptable level of internal consistency (Nunnally, 1967). Due to the satisfaction of the pilot results, all of the items were retained for the actual survey administration.

The research setting comprised information systems organizations that had implemented team projects in systems development environments. Twenty organizations were invited to participate in this research. Follow-up phone interviews were conducted to describe the research and to determine whether the teams' characteristics were consistent with the desired study group, that is, development teams comprised of knowledge workers. As a result, the final sample included 270 team members from 28 teams belonging to 13 organizations across the United States and Canada.

It should be noted that all of the measures were administered to individuals. Our study primarily focused on individual learning and, more specifically, the role of team or individual interaction on individual learning. Therefore, the measures were designed to capture individual attributes. However, since the nature of the IS work used in the study is team oriented, work performance was measured at team level.

Usable surveys were received from 231 team member respondents (85.6%), 27 teams (96.4%), and 114 stakeholders (81.4%). To be considered usable, responses were required from at least three team members and at least three stakeholders in order to insure anonymity among respondents. Over 75% of the team member respondents had college degrees, more than five years of work experience, and over three years' experience in their respective companies. These are precisely the characteristics one might expect to see from knowledge workers—the focus of our research. The majority (51.9%) of the stakeholders were internal customers of the teams, while the rest were management (36.8%), external customer (1.9%), or "other"—suppliers, vendors, nonteam peers, and so on (9.4%).

Analytical Procedures

The data were analyzed using *LISREL,* a software package based on structural equation modeling (SEM) techniques. The SEM approach was used to assess the proposed causal model. The SEM technique allows us to use multiple indicators

to measure constructs and account for measurement errors. Another important advantage is that we can evaluate causal relationships among multiple interested constructs simultaneously (Jöreskog & Sörbom, 1982). Since our model is grounded in existing theoretical foundations and well-validated scales, and since this research attempted to account for the observed covariance (rather than explain the variances or account for variances at the observed and unobserved level—see Fornell & Bookstein, 1982), *LISREL* was used to test the conceptual research model of this study. Likewise deletion was used to handle data missing; as a result, the datasets used for this study had a sample size of 203. Since a sample size of 150 or more is recommended (Anderson & Gerbing, 1988), the sample sizes for our study were considered acceptable.

An assessment of dimensional scales for each of the five constructs was first conducted by using confirmatory factor analysis. Items for each dimensional scale were subjected to scale refinement based on an evaluation of model fits (Jöreskog & Sörbom, 1998). Given that structural equation modeling has no single statistical test of significance for model fit (Schumacker & Lomax, 1996), several goodness-of-fit measures were used to assess the fit of model. The relative chi-square (chi-square/degrees of freedom; χ^2/df), standardized root mean square residual (standardized RMSR), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed fit index (NFI), and comparative fit index (CFI) were used as goodness-of-fit measures. Due to the sensitivity of the chi-square test to sample size, the relative chi-square was used (it should be 3 or less for an acceptable model [Kline, 1998]). Standardized RMSR should not be greater than 0.10 and GFI, AGFI, NFI, and CFI should exceed 0.90 to be acceptable (Segars & Grover, 1993).

The resulting scales are presented in Table 1 along with goodness-of-fit indices. The Cronbach's alpha values for each indicator/dimensional scale also are listed in Table 1 to show evidence of scale reliability. The model fit indices for dimensional scales of organizational climate were slightly below the recommended level, except for the RMSR. Although the AGFI and chi-square/degrees of freedom ratio were below the acceptable level for the work performance construct, the other goodness-of-fit indices were very satisfactory. Overall, according to model fit evaluation recommendations, scales for all constructs were deemed acceptable in quality. Since the Cronbach's alpha values of all indicators or dimensional scales exceed the recommended value of 0.60 (Nunnally, 1967), the scales used in the study are reliable. In addition, when these scales were evaluated together in the overall measurement model discussed below, a satisfactory measurement model was exhibited.

Prior to testing all of the hypotheses or the hypothesized research model, the full measurement model of all constructs was evaluated to demonstrate the quality of the measurement in terms of psychometric properties and overall model fit (Jöreskog & Sörbom, 1996). To eliminate the scale indeterminacy problem, the variance of each construct was fixed to 1.0 in the analysis of the measurement model (Gerbing & Hunter, 1982). The averaged scales of the indicators (dimensions) of all five constructs in the model were used for measurement model analysis and structural model analysis. Following this, all of the proposed hypotheses were tested. The measurement model (loadings and the corresponding error coefficients)

Table 1: Reliabilities of the indicators (dimensional scales) and model fit measures.

Construct/Indicator	Number of Items	Standardized Alpha (Scale Reliability)	χ^2	df	χ^2/df	GFI	AGFI	NFI	CFI	RMSR
Organizational Climate			197.33	59	3.34	0.87	0.80	0.79	0.84	0.07
Risk	4	0.62								
Reward	3	0.75								
Warmth	3	0.69								
Support	3	0.61								
Cooperative Learning			206.01	116	1.78	0.89	0.86	0.82	0.91	0.06
Positive Interdependence	8	0.72								
Promotive Interaction	6	0.85								
Group Process	3	0.65								
Autonomy			113.31	41	2.76	0.91	0.85	0.86	0.90	0.06
People-Related Autonomy	4	0.74								
Planning-Related Autonomy	3	0.80								
Process-Related Autonomy	3	0.67								
Work Satisfaction			52.95	19	2.79	0.94	0.88	0.94	0.96	0.04
General Job Satisfaction	4	0.79								
Growth Satisfaction	4	0.87								
Work Performance			82.19	6	13.70	0.88	0.58	0.94	0.95	0.03
Efficiency	2	0.89								
Effectiveness	2	0.92								
Timeliness	2	0.90								

was fixed when the hypothesized structural model was evaluated in order to avoid possible impacts of measurement-structural interaction on parameter estimation (Anderson & Gerbing, 1988; Burt, 1976). The correlation matrix of all indicators is shown in Appendix B.

The statistical power of the proposed structural model was also evaluated. The power of a model determines the likelihood of drawing the correct conclusion about a false null hypothesis regarding the model fit (MacCallum, Browne, & Sugawara, 1996). Specifically, for the structural equation modeling analysis, the statistical power is referred to as the ability to detect and reject a poor model. According to Chin (1998), the statistical power is very critical in structural equation modeling analyses, but unfortunately, research in the behavioral sciences continues to neglect this part of statistical analyses. Weak statistical power would result in inconclusive findings (Baroudi & Orlikowski, 1989). The current study applied an approach for power testing proposed by MacCallum et al. (1996)—a root mean square error of approximation (RMSEA) to estimate the power of an SEM model. The results of this analysis are discussed in the following section.

RESULTS

Measurement Model

The measurement model with all five constructs was assessed using confirmatory factor analysis (Anderson & Gerbing, 1992). Table 2 presents loadings and the corresponding t-values of indicators in the measurement model. All loadings exceed

Table 2: Factor loadings and t-values of the measurement model.

Construct/Indicator	Factor Loading	t-value
Organizational Climate		
Risk	0.52	7.39
Reward	0.73	11.25
Warmth	0.78	12.37
Support	0.86	14.23
Cooperative Learning		
Positive Interdependence	0.76	11.14
Promotive Interaction	0.59	8.31
Group Process	0.67	9.57
Autonomy		
People-Related Autonomy	0.56	7.72
Planning-Related Autonomy	0.85	12.03
Process-Related Autonomy	0.66	9.21
Work Satisfaction		
General Job Satisfaction	0.85	12.80
Growth Satisfaction	0.80	11.96
Work Performance		
Efficiency	0.90	16.37
Effectiveness	0.90	16.49
Timeliness	0.97	18.53

0.5 and each indicator is significant at 0.05 levels. The measurement model exhibited a good level of model fit. The chi-square/degrees of freedom ratio (175.05/80) is 2.19. The GFI is .90, AGFI is 0.84, NFI is 0.89, CFI is 0.94, and RMSR is 0.05.

The psychometric properties of the five constructs and indicators (dimensional scales) were assessed with respect to convergent validity and discriminant validity (Jöreskog & Sörbom, 1996). The reliability of individual items/indicators, the reliability of the constructs (composite reliability), and the average variance extracted were used as the measures for convergent validity (Bagozzi & Yi, 1988; Chau, 1997; Fornell & Larcker, 1981). To be considered adequate, the individual item reliability should be greater than 0.50 and/or a significant t-value should be observed for each indicator (Bollen, 1989; Jöreskog & Sörbom, 1996). The average variance extracted should be at least 0.5 and the composite reliability should be greater than 0.6 (Bagozzi & Yi, 1988). Table 3 summarizes the three measures of the convergent validity for the model. Only risk, promotive interaction, group process, people-related autonomy, and process-related autonomy had item/indicator reliability below 0.50, but in Table 2 the corresponding t-values were significant for all five. In terms of the average variance extracted, two of the five constructs (cooperative learning and autonomy) were slightly below 0.50. However, the composite reliability exceeded the suggested value of 0.6 for all constructs. Hence, the measurement model seems to possess adequate convergent validity.

Table 3: Test of convergent validity.

Construct/Indicator	Indicator Reliability	Composite Reliability	Average Variance Extracted
Organizational Climate		0.82	0.54
Risk	0.27		
Reward	0.53		
Warmth	0.61		
Support	0.74		
Cooperative Learning		0.72	0.46
Positive Interdependence	0.58		
Promotive Interaction	0.35		
Group Process	0.45		
Autonomy		0.74	0.49
People-Related Autonomy	0.31		
Planning-Related Autonomy	0.72		
Process-Related Autonomy	0.44		
Work Satisfaction		0.81	0.68
General Job Satisfaction	0.72		
Growth Satisfaction	0.64		
Work Performance		0.95	0.85
Efficiency	0.81		
Effectiveness	0.81		
Timeliness	0.94		

Table 4: Test of discriminant validity.

	Organizational Climate	Cooperative Learning	Autonomy	Work Satisfaction	Work Performance
Organizational Climate	*0.54*				
Cooperative Learning	0.31	*0.46*			
Autonomy	0.18	0.29	*0.49*		
Work Satisfaction	0.28	0.48	0.25	*0.68*	
Work Performance	0.0016	0.22	0.03	0.12	*0.85*

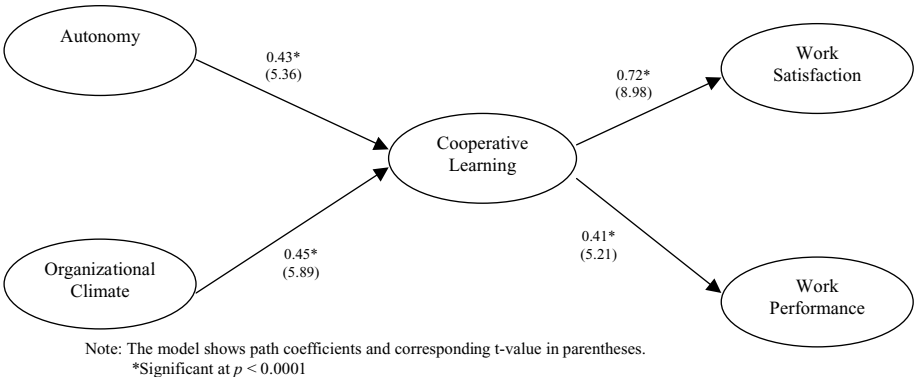
Note: Diagonal elements are the average variance extracted for each of the six constructs. Off-diagonal elements are the squared correlations between constructs.

We used two approaches for evaluating discriminant validity. First, discriminant validity can be assessed by constraining the correlation between any two constructs to 1.0 and then performing a chi-square difference test between the constrained and unconstrained models (Anderson & Gerbing, 1988). When a chi-square value for the constrained model is significantly greater than that of the unconstrained model, discriminant validity is achieved (Bagozzi & Phillips, 1982). According to Anderson and Gerbing (1988), the test should be performed for one pair of constructs at a time. Thus, to evaluate all 5 constructs, 10 separate constrained models were conducted and compared with their corresponding unconstrained model. The chi-square difference between the constrained and unconstrained models always has one degree of freedom; therefore, the chi-square difference should be greater than 3.84 to be considered significant. In this case, the chi-square differences of the 10 pairs of the models were extremely large, ranging from 44.4 to 314.88. This result demonstrates a high degree of discriminant validity for all five constructs. Another approach suggested by Fornell and Larcker (1981) is that discriminant validity is demonstrated when the squared correlation between two constructs is lower than the respective average variance extracted. Table 4 shows the comparison between squared correlations of two constructs (off-diagonal elements) and the average variance extracted for each construct (diagonal elements). Overall, all of the five constructs show evidence of high discriminant validity, even though the squared correlation between cooperative learning and work satisfaction was slightly greater than the average variance extracted of cooperative learning. Therefore, the measurement model exhibited a good level of model fit as well as evidence of convergent validity and discriminant validity. The measures/indicators were then deemed adequate for further analysis of the structural model.

Structural Model

The structural model analysis was conducted to examine the hypothesized relationships among constructs. All indicators were fixed with the loadings and corresponding error coefficients obtained from the measurement model to avoid possible effects of measurement-structural interaction on parameter estimation (Anderson & Gerbing, 1988; Burt, 1976). The results from the structural model used to test the hypothesized research model are shown in Figure 2. The results provided support

Figure 2: The structural model result.



for all of the four hypotheses. All of the path coefficients were statistically significant ($p < 0.0001$) and greater than 0.30, which is considered meaningful (Chin, 1998). The relationship between autonomy and cooperative learning was statistically significant; thus, the level of autonomy over people-related, planning-related, and work-related processes has a positive impact on the degree of cooperative learning in teams (H1 supported). The relationship between organizational climate and cooperative learning was statistically significant (H2 supported). Hence, it is reasonable to conclude that organizational climate in terms of risk, reward, warmth, and support positively influences the degree of cooperative learning evident among members of the teams.

Additionally, the cooperative learning–work performance relationship and the cooperative learning–work satisfaction relationship were statistically significant (H3 and H4 supported). Thus, the level of cooperative learning in the form of positive interdependence, promotive interaction, and group process demonstrated in teams has a positive impact on members' work satisfaction and teams' work performance.

The overall validity of the model results was evaluated with respect to goodness-of-fit indices. The chi-square/degrees of freedom ratio (220.96/111) was 1.99. The GFI is 0.87, AGFI is 0.86, NFI is 0.86, CFI is 0.93, and RMSR is 0.11. The results of goodness-of-fit indices exhibited a moderate but acceptable level of overall model fit and, therefore, provided support to the overall validity of the hypothesized models and hypothesis testing results.

Power Analysis

MacCallum et al. (1996) suggest that samples will often be large enough to lead to rejection of good models via the test of exact fit. Thus the hypothesis test of exact fit is implausible and is not empirically interesting since the result of the test will mean rejection of good models when the sample size is large. With this weakness, the test of close fit should be pursued. A structural model demonstrates a close fit if values

of RMSEA are less than 0.05. Additionally, we should conduct a power test for a close-fit null hypothesis as well as for not-close-fit null hypothesis (MacCallum et al., 1996). In general, the research hypothesis is typically represented by the alternative hypothesis, so that the rejection of the null hypothesis implies support for the research hypothesis. Thus, we would prefer to reject the null hypothesis of not-close-fit in order to support the alternative hypothesis of good fit. On the other hand, failing to reject the null hypothesis of close fit simply suggests that the there is a lack of strong evidence to reject the null hypothesis; it does not imply support for the model.

A *SAS* program provided by MacCallum et al. (1996) was used to test power of our proposed model. For the test of close fit, the null value of RMSEA was 0.05 (null hypothesis is RMSEA $\leq$ 0.05) and the alternative value of RMSEA was 0.08, which are the suggested values by MacCallum et al. (1996). For the test of not-close fit, the null value of RMSEA was 0.05 (null hypothesis is RMSEA $\geq$ 0.05) and the alternative value of RMSEA was 0.01. The degrees of freedom and sample size of the study were 111 and 203, respectively. The alpha used in the test was 0.05. The resulting powers of the proposed structural model were 0.97 for the test of close fit and 0.91 for the test of not-close fit. Hence, the proposed structural model demonstrated very high power, which implies high credibility of our proposed structural model and the test results of all proposed hypotheses.

DISCUSSION

The findings generated from this study have implications for both academicians and managers interested in better understanding the nature of knowledge creation and exchange, as well as better understanding how one might prescriptively facilitate increased levels of knowledge creation, knowledge dissemination, organizational learning, and employee performance and satisfaction. In addition, these findings raises the question of where to go from here.

First, we believe that the research presented here serves as progress in bringing together long-standing theories and well-accepted literature related to organizational climate and organizational learning and linking them with the current research and thinking related to knowledge management. Cooperative learning, when used in conjunction with work outcomes, has proven itself useful as a meaningful theoretical construct to describe and measure the often difficult-to-measure knowledge creation and dissemination. This is especially true when trying to evaluate the presence of highly personalized "tacit-to-tacit" knowledge socialization. Hopefully future investigators will continue to pry at the interprogrammatic overlap of these research streams in search of the synergy and insight that differing perspectives afford.

Second, the robust nature of the proposed research model and the strength of the support for the hypotheses provide support for what has been intuitively hoped for: that effort spent in creating a knowledge-centered culture will be rewarded with higher levels of knowledge-related activities like cooperation and learning. This in turn yields improvements in how workers feel about themselves

and their jobs and how stakeholders view the products of the workers' work efforts.

In terms of future research directions, two issues present themselves. First, one must be aware that cooperative learning and autonomy—two of the main focuses of the research presented here—were predominantly real-time, synchronous, face-to-face phenomena. With the prevalence of information technologies that permit asynchronous, at-a-distance collaboration, we feel that future research needs to address how knowledge creation, dissemination, and learning are affected by a more virtual, technologically "wired" context. Second, learning theories and related constructs need to be further explored for use in knowledge management settings. To speak of tacit and explicit knowledge is one thing; to ascertain whether knowledge (especially tacit knowledge) is being created or disseminated is another, more challenging proposition. It is hoped that other researchers will consider adopting this "learning as evidence of knowledge" perspective in their future knowledge management research activities, and further refine how we in academe conceptualize knowledge-related phenomena in the future.

For practitioners, the results of this study suggest promising avenues for pursuit. This should prove helpful to those business leaders that do not realize the importance of knowledge management, or do not know how to begin in creating a knowledge-centered culture. As a well-known vice president in the academic industry related to one of the researchers, "I believe knowledge management is becoming increasingly important to all organizations. I also feel that many do not realize how important it is and have done little to enhance the organization's ability to improve knowledge management and to gain benefits from doing so." First, and perhaps most importantly, worker performance (and by extension organizational performance) can be improved by encouraging knowledge workers to work in a more cooperative and learning-centric manner. Personal and team-level objectives that heighten the sense of interdependence and encourage promotive interaction behaviors, as well as training and time allocated for the improvement of social skills and group process activities, all will facilitate the emergence of cooperative learning behaviors in work teams.

Perhaps equally as important, the data suggest that cooperative learning may have an even stronger influence on work satisfaction than it does on work performance. Worker satisfaction is a critical concern for organizations attempting to build knowledge and maintain it. Work satisfaction actually represents quality of work life, and through cooperative learning behaviors can only help in increasing employee (and knowledge) retention rates and decreasing costly employee (and knowledge) departure rates.

The research described here also suggests strongly that in order to learn in a cooperative manner, knowledge workers need to be given the freedom–that is, the autonomy–to decide how to work, how to schedule work, and how to assign resources to their work. However, there is a subtle yet sharp double-edged sword operating here. Anecdotal evidence generated through several interviews related to this research suggests that not all knowledge workers appreciate increased levels of autonomy. Upon deeper consideration of these comments coupled with the statistical results of the research presented here, the picture gets a bit clearer. Specifically, the cooperative learning → learning/knowledge outcomes linkage is

influenced strongly by a knowledge-centered culture that includes *both* autonomy and a conducive work climate. In other words, we believe the data presented here strongly suggest that increased levels of autonomy (and thus improved cooperative learning and performance) will be embraced when employees sense high levels of organizational support and warmth and acknowledgment and reward from work well done, as well as low levels of fear of reprisal from failure in taking educated risks.

In determining whether and how much effort to expend in these efforts, managers need to assess the following: (1) To what degree is the work in my organization driven by the need for knowledge (both existing and new)? (2) To what degree is my organization dependent on the knowledge of a relatively few experienced "experts?" and (3) To what degree is the nature of my organization's work dependent on the collective efforts of multiple employees? If the answers to these questions tend to be high in the affirmative direction, it is most likely worthwhile for managers to invest time and effort in creating a knowledge-centered culture and to structure work objectives and incentives to encourage learning in a cooperative manner. The research presented here suggests that the knowledge creation, tacit knowledge dissemination, and resulting job satisfaction may translate to improved work products, higher levels of employee satisfaction, and the second-order benefits of increasing the number of inside experts and higher-knowledge worker retention.

In conclusion, the need for knowledge management begins when knowledge is created and subsequently shared. The empirical research presented here suggests that knowledge creation and dissemination can be facilitated by allowing knowledge workers to have the freedom to exercise authority with their knowledge and by elevating "supportive work climate" beyond buzzword status. [Received: February 27, 2002. Accepted: January 6, 2003.]

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APPENDIX A: MEASUREMENT SCALES

Organizational Climate: Risk

1. Decision making in this organization is too cautious for maximum effectiveness.

2. Our management is willing to take a chance on a good idea.
3. Our business has been built by taking calculated risks at the right time.
4. The philosophy of our management is that in the long run we get ahead fastest by playing it slow, safe, and sure.
5. We have to take some pretty big risks occasionally to keep ahead of the competition in the business we're in.

Organizational Climate: Reward

1. There is not enough reward and recognition given in this organization for doing good work.
2. There is a great deal of criticism in this organization.
3. In this organization people are rewarded in proportion to the excellence of their job performance.
4. We have a promotion system here that helps the best person to rise to the top.
5. In this organization the rewards and encouragements you get usually outweigh the threats and the criticism.
6. If you make a mistake in this organization you will be punished.

Organizational Climate: Warmth

1. A friendly atmosphere prevails among the people in this organization.
2. It's very hard to get to know people in this organization.
3. This organization is characterized by a relaxed, easy-going working climate.
4. There is a lot of warmth in the relationships between management and workers in this organization.
5. People in this organization tend to be cool and aloof toward each other.

Organizational Climate: Support

1. The philosophy of our management emphasizes the human factor, how people feel, etc.
2. Management makes an effort to talk with you about your career aspirations within the organization.
3. When I am on a difficult assignment I can usually count on getting assistance from my boss and coworkers.
4. People in this organization don't really trust each other enough.
5. You don't get much sympathy from higher-ups in this organization if you make a mistake.

Autonomy: People-Related Autonomy

1. Fire members of the team.
2. Determine compensation plans for the team.
3. Conduct peer evaluations.
4. Recruit/hire team members.
5. Handle discipline problems on the team.

Autonomy: Planning-Related Autonomy

1. Develop budgets.
2. Plan the team's work.
3. Set team goals or objectives.
4. Determine the team's training needs.
5. Schedule the team's work.

Autonomy: Process-Related Autonomy

1. Develop system and end-user documentation.
2. Specify which development tools will be used by the team.
3. Determine appropriate system quality and assurance (i.e., testing) procedures.
4. Determine information and application requirements.
5. Specify which development methods will be used by the team.

Cooperative Learning: Positive Interdependence

1. When we work together on our team, we try to make sure everyone on the team learns from each other.
2. When we work together as a team, our job is not finished until everyone on the team has finished his or her job.
3. When we work together on the team, we all receive the same performance evaluation.
4. When we work together on the team, our performance evaluations depend in part on how much all members learn.
5. When we work together on the team, I have to make sure the other members of the team learn if I want to do well on the project.
6. When we work together on our team, we cannot complete a project unless everyone contributes.
7. When we work together on our team, the work is divided up so that everyone has a part and everyone has to share.

8. When we work together on the team, we have to share work material in order to complete the project.
9. When we work together on the team, everyone's ideas are needed if we are going to be successful.
10. When we work together on the team, I have to find out what everyone else knows if I am going to be able to complete my part of the project.

Cooperative Learning: Promotive Interaction

1. On this team I like to share my ideas and work material with other members of the team.
2. On this team I can learn important things from other team members.
3. On this team I like to help my teammates.
4. On this team I like to share my ideas and work materials with my teammates when I think it will help them.
5. On this team it is a good idea for teammates to help each other learn.
6. On this team I like to cooperate with my teammates.
7. Members of my team learn a lot of important things from each other.

Cooperative Learning: Group Process

1. We take the time as a team to examine areas in which we need more skill or experience.
2. We rarely stop to consider how we can work better as a team.
3. We have recently discussed what we did right or wrong on a particular project or job.

Work Satisfaction: General Job Satisfaction

1. Generally speaking, I am very satisfied with this job.
2. I frequently think of quitting this job.
3. I am generally satisfied with the kind of work I do in this job.
4. Most people doing this job are very satisfied with the job.
5. People doing this job often think of quitting.

Work Satisfaction: Growth Satisfaction

1. The amount of personal growth and development I get from doing my job.
2. The feeling of worthwhile accomplishment I get from doing my job.
3. The amount of independent thought and action I can exercise in my job.
4. The amount of challenge in my job.

Work Performance: Efficiency

1. The efficiency of team operations.
2. The team's adherence to budgets.
3. The amount of work the team produces.

Work Performance: Effectiveness

1. Effectiveness of the team's interactions with people outside the team.
2. The quality of work the team produces.
3. The team's ability to meet the goals of the project.

Work Performance: Timeliness

1. The team's adherence to schedules.
2. The team could have done its work faster with the same level of quality.
3. The team met the goals as quickly as possible.

APPENDIX B: CORRELATION MATRIX OF INDICATORS

Indicators	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Risk	1.000														
2. Reward	0.456**	1.000													
3. Warmth	0.346**	0.515**	1.000												
4. Support	0.445**	0.614**	0.707**	1.000											
5. Positive Interdependence	0.182**	0.409**	0.412**	0.361**	1.000										
6. Promotive Interaction	0.161*	0.239**	0.281**	0.241**	0.512**	1.000									
	0.161*	0.239**													
7. Group Process	0.180*	0.305**	0.192**	0.258**	0.475**	0.354**	1.000								
8. People-Related Autonomy	0.134	0.265**	0.108	0.142*	0.234**	0.279**	0.351**	1.000							
9. Planning-Related Autonomy	0.209**	0.392**	0.291**	0.287**	0.320**	0.243**	0.288**	0.484**	1.000						
10. Process-Related Autonomy	0.177*	0.285**	0.131	0.208**	0.264**	0.275**	0.259**	0.326**	0.572**	1.000					
11. General Satisfaction	0.263**	0.428**	0.370**	0.341**	0.453**	0.372**	0.391**	0.255**	0.273**	0.262**	1.000				
12. Growth Satisfaction	0.328**	0.409**	0.288**	0.280**	0.387**	0.257**	0.419**	0.305**	0.401**	0.340**	0.675**	1.000			
13. Efficiency	0.142*	0.105	−0.018	−0.043	0.275**	0.161*	0.314**	0.058	0.057	0.143*	0.269**	0.226**	1.000		
14. Effectiveness	0.101	0.147*	−0.023	0.030	0.262**	0.201**	0.405**	0.114	0.082	0.215**	0.268**	0.182**	0.819**	1.000	
15. Timeliness	0.087	0.120	0.012	−0.003	0.296**	0.217**	0.444**	0.217**	0.112	0.157*	0.303**	0.239**	0.870**	0.874**	1.000

**Correlations are significant at $p < 0.01$
*Correlations are significant at $p < 0.05$

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