Managing Knowledge in Organizations: An Integrative Framework and Review of Emerging Themes

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In this concluding article to the *Management Science* special issue on "Managing Knowledge in Organizations: Creating, Retaining, and Transferring Knowledge," we provide an integrative framework for organizing the literature on knowledge management. The framework has two dimensions. The knowledge management outcomes of knowledge creation, retention, and transfer are represented along one dimension. Properties of the context within which knowledge management occurs are represented on the other dimension. These properties, which affect knowledge management outcomes, can be organized according to whether they are properties of a unit (e.g., individual, group, organization) involved in knowledge management, properties of relationships between units or properties of the knowledge itself. The framework is used to identify where research findings about knowledge management converge and where gaps in our understanding exist. The article discusses mechanisms of knowledge management and how those mechanisms affect a unit's ability to create, retain and transfer knowledge. Emerging themes in the literature on knowledge management are identified. Directions for future research are suggested.

(*Knowledge Management; Organizational Learning; Knowledge Transfer; Innovation; Organizational Memory*)

Introduction

Research on the topics of organizational learning and knowledge management has enjoyed an extended and prosperous history. The importance of these concepts for understanding the coordination of organizational activity can be traced back to the early writings of such influential thinkers as Adam Smith, who described the pin-making example as an illustration of how specialization promoted experience-based learning (Smith 1776/1937); Alfred Marshall, who argued that good ideas are quickly picked up and discussed by others in regional agglomerations (Marshall 1920); and Max Weber, who described the ability of bureaucracies to learn from experience (Weber 1922/1978). It was the Carnegie school, best exemplified by the work of Richard M. Cyert and James G. March (Cyert and March 1963), that transformed these rudimentary and largely anecdotal observations into a formal theory of organizational learning and knowledge management, however. Four decades later, the field is characterized by a wealth of empirical evidence and a wide array of theoretical perspectives.

The highly differentiated nature of organizational learning and knowledge management is a hallmark of the field and is evident in the multitude of disciplinary perspectives brought to bear on the topic. As we noted in the introduction to this special issue, research on organizational learning and knowledge management spans the disciplines of economics, information systems, organizational behavior and

theory, psychology, strategic management, and sociology. This diversity has contributed to the rapid advance of the field by cultivating the simultaneous development of specialized areas of inquiry that investigate different aspects of organizational learning and knowledge management.

The heterogeneity of knowledge management research raises important questions about the degree of integration across disciplines and the extent to which a truly cumulative body of knowledge is emerging. For instance, theoretical foundations of organizational learning and knowledge management range from the psychological emphasis on cognition to the focus of economics on market structure and competition to the sociological orientation toward social structure. As research continues to advance in each of the discipline-based subfields of organizational learning and knowledge management, it becomes increasingly important to consider the extent of integration across these separate traditions. Without addressing the question of integration, we run the risk of propagating a highly fractionated view of organizational learning and knowledge management. Moreover, a limited appreciation of the links across disciplinary perspectives can prove to be inefficient as researchers fail to take advantage of ideas produced in other areas and simply "rediscover" what is known already.

In the remainder of this paper, we address the following questions to assess the state of integration of knowledge accumulated across the different disciplines. Are there points of convergence in the field? If so, do we see stable and consistent findings from one discipline that are replicated or reinforced by findings from other disciplines? Are researchers from different disciplines investigating unrelated aspects of organizational learning and knowledge management or are they treading the same ground? What are the current themes emerging from recent research? Given the size and diversity of the literature, a comprehensive review is beyond the scope of a single paper (for a recent review, see Argote 1999). Instead, we draw on the work appearing in this special issue and other representative work in the field to map the terrain of research on organizational learning and knowledge management. Figure 1 provides such an orienting framework.

The figure represents a summary of our efforts to create a framework for organizing the literature based on the relative positioning of work along two critical dimensions: knowledge management outcomes (knowledge creation, retention, and transfer) and properties of the knowledge management context (properties of units, properties of the relationships between units, and properties of knowledge). The knowledge management outcomes are represented on the vertical axis of Figure 1. Knowledge creation occurs when new knowledge is generated in organizations. Knowledge retention involves embedding knowledge in a repository so that it exhibits some persistence over time. Knowledge transfer is evident when experience acquired in one unit affects another. These outcomes are related. For example, for an organization to transfer knowledge, the knowledge must be retained. Attempts to transfer knowledge can lead to the creation of new knowledge. For example, Song, Almeida, and Wu (2003) show how new knowledge, in the form of patents, is generated when knowledge transfers across organizations through personnel movement.

Despite the diversity of research on knowledge management, theoretical explanations can be organized according to three properties of the context within which knowledge management occurs: Properties of units (e.g., an individual, a group, or an organization), properties of the relationships between units, and properties of the knowledge itself. The context dimension displayed along the horizontal axis of Figure 1 highlights the fact that different theories of knowledge management give causal priority to different contextual properties. For example, some researchers emphasize the properties of the units themselves, such as their absorptive capacity (Cohen and Levinthal 1990). Other researchers, while fully recognizing the importance of properties of the units, emphasize properties of relationships between units, such as the network structure in which the units are embedded (Reagans and McEvily 2003). Still other researchers emphasize the different properties of knowledge, such as tacitness (Nonaka 1991), that promote or inhibit knowledge management.

The framework in Figure 1 can be used to characterize research in the knowledge management literature.

Figure 1   Theoretical Framework for Organizing Research on Organizational Learning and Knowledge Management

Knowledge Management Context
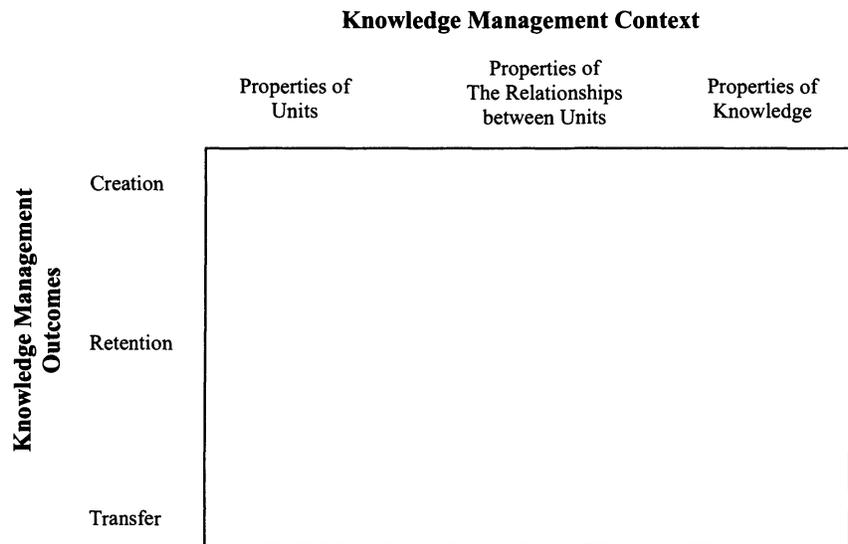
Because many studies in the special issue analyze more than one outcome and more than one contextual variable, we do not place studies in the cells of Figure 1. Rather we discuss relevant findings from each study as we elaborate the framework. The framework can be used to identify points of integration across different traditions and gaps in our understanding of knowledge management. We undertake this integration in the next section.

Knowledge Management Context

Properties of Units

Many explanations of effective knowledge management focus on properties of a particular unit. The unit could be an organization, an individual inside the organization, or a population of organizations. The key driver of effective knowledge management is some characteristic of the unit itself. For example, psychologists and sociologists who study knowledge creation and transfer emphasize status as an important property of units. Status can be a property of an individual, a firm, or even of a piece of intellectual property and is an important predictor of knowledge management outcomes. Thomas-Hunt, Neale, and Odgen (2003) describe the importance of expert status in predicting the kind of information that an individual

shares with a group. Similarly, Borgatti and Cross (2003) demonstrate the importance of expert status in predicting knowledge transfer across individuals. Sine, Shane, and Di Gregorio (2003) also consider the importance of social status and find that knowledge created by a high-status institution is more likely to be licensed than knowledge created by a low-status institution, even when the institution's past performance in licensing is taken into account. Taken together, these studies suggest that status is an important factor that explains knowledge creation, retention and transfer. Status is, of course, not the only property of a unit that facilities knowledge management. Status is highlighted because it illustrates a convergence of findings across disciplines.

Properties of Relationships Between Units

Another tradition gives priority to how units are connected to each other. This tradition is characterized by two approaches. One approach focuses on the dyadic relationship between social units. That relationship can vary along a key set of dimensions, including intensity of connection, communication or contact frequency, and social similarity. Each dimension of the relationship can impact the knowledge management process. For example, two studies in this

special issue focus on the importance of direct relationships for effective knowledge transfer. Uzzi and Lancaster (2003) focus on the strength of connection between a loan officer and an entrepreneur, while Song, Almeida, and Wu (2003) focus on the similarity between scientists. The key outcome is knowledge transfer and the predictor of successful transfer is some quality of the dyadic relationship.

A second approach emphasizes the pattern of connections between multiple units (Rulke and Galaskiewicz 2000). For instance, knowledge flow between two individuals is eased when the individuals are embedded in a dense web of third-party connections (Reagans and McEvily 2003). Moreover, knowledge is more likely to transfer between establishments that are owned by the same parent organization or that are affiliated through the same franchise or chain than across independent organizations (Darr et al. 1995, Baum and Ingram 1998). The structural effect is not limited to interpersonal or ownership connections. The important relationships could be a transactive memory system or consensus about who knows what. Transactive memory systems (Wegner 1986) facilitate knowledge retention (Liang et al. 1995) and knowledge transfer (Borgatti and Cross 2003). Knowledge retention and transfer is even more efficient when group members share a short-hand language (Weber and Camerer 2003).

Properties of Knowledge

Knowledge properties affect the rate at which knowledge is accumulated, how much of it is retained, where it is retained, and how easily it diffuses within and across firm boundaries. Tacit knowledge, or knowledge that is difficult to articulate, is more challenging to transfer than explicit knowledge (Nonaka 1991), and is best transferred through rich communication media such as observation rather than through more explicit media (Nadler et al. 2003). Similarly, knowledge that has not been codified is more difficult to transfer than codified knowledge (Zander and Kogut 1995). Knowledge that is not well-understood or is high in "causal ambiguity" is also harder to transfer than less ambiguous knowledge (Szulanski 1996).

Recent research on knowledge management underscores the importance of several other dimensions of knowledge. One dimension is whether knowledge is perceived as external or internal to the focal unit. Where boundaries are drawn affects the value placed on knowledge and its usefulness. Menon and Pfeffer (2003) show that organizational members are more likely to value knowledge from external, rather than internal, sources, perhaps because such a valuation elevates the members' status. On the other hand, knowledge coming from units perceived to be part of the same organization is more likely to transfer and improve the performance of a focal unit than knowledge coming from external sources (Darr et al. 1995, Kane et al. 2002).

The extent to which knowledge is shared by organizational members or uniquely possessed by a member also affects its transfer. Previous research has shown that knowledge that is uniquely possessed by a member is less likely to be mentioned, repeated, and attended to in group discussion than commonly held knowledge (Stasser and Titus 1985). Thus, groups often fail to make full use of their informational resources because they do not surface information idiosyncratic to particular members. Thomas-Hunt et al. (2003) show that this decision bias depends on the expertise of a group member and the extent to which the member is integrated into the group. Interestingly enough, social isolates with special expertise are more likely to share their unique knowledge than socially connected members with unique expertise.

Another dimension of knowledge that recent research points to is whether knowledge is public or private (Uzzi and Lancaster 2003). Knowledge available in the public domain through standard reports tends to be "hard" information. By contrast, private knowledge, which is not equally available to all or guaranteed by third parties, is "soft" information about unpublished aspects of a firm. Uzzi and Lancaster (2003) show that different types of relationships or ties are suited for transferring private versus public knowledge. Arm's-length ties are better suited for transferring public knowledge, whereas embedded ties are more suitable for transferring private knowledge.

The properties of the knowledge management context identified in Figure 1 summarize how researchers have addressed *what* influences knowledge management outcomes. But what influences an outcome is different from why the outcome occurs. Various mechanisms explain *how* and *why* a particular contextual feature influences learning and knowledge management outcomes. Ability, motivation, and opportunity are three causal mechanisms used to explain why certain contextual features affect knowledge management outcomes. We turn now to a discussion of these causal mechanisms.

Mechanisms of Knowledge Management

Just as successful individual performance depends on an individual's ability, motivation, and opportunities to perform, successful knowledge management also depends on ability, motivation, and opportunity. Properties of the knowledge management context could impact an individual's *ability* to create, retain, or transfer knowledge. Or the context could provide people with the *motives* and incentives to participate in the knowledge management process. Or the context could provide an individual with the *opportunity* to create, retain, or transfer knowledge. Properties of the knowledge management context can operate through more than one causal mechanism. For example, social relationships provide individuals with the opportunity to create, retain, and transfer knowledge. Social relationships also provide individuals with the incentives to participate in the process.

Ability

Ability is an important part of the knowledge management process. Abilities are innate but also can result from training (Nadler et al. 2003). Training in analogical reasoning, for example, increases an individual's ability to transfer knowledge accumulated on one task to a related task (Gick and Holyoak 1983, Thompson et al. 2000). The similarity between the tasks makes that transfer easier (Darr and Kurtzberg 2000). Experience also affects ability. Individuals and organizational units have the capacity to understand

knowledge in areas where they have previous experience because individuals learn, or absorb, knowledge by associating it with what they already know (Cohen and Levinthal 1990). Factors that increase a person's ability to manage knowledge need not be specific to him or her. For example, transactive memory systems (Wegner 1986) and common short-hand languages (Weber and Camerer 2003) are properties of relationships that affect members' ability to create, retain, or transfer knowledge.

Motivation

Rewards and incentives are important components of the knowledge management process. The "not invented here" syndrome in organizations is an example of how rewards can affect knowledge management outcomes. Members of a unit are unlikely to transfer knowledge from other parts of the organization if they are not rewarded for utilizing internal knowledge (Menon and Pfeffer 2003). Social rewards can be just as important as monetary rewards. Strong ties promote the transfer of tacit knowledge (Uzzi 1997) because strong ties are more likely to be governed by the norms of reciprocity. The cooperative norms associated with social cohesion also facilitate knowledge transfer (Reagans and McEvily 2003). Uncooperative behavior damages individuals' reputations, so they are willing to expend extra effort transferring knowledge to protect their social standing.

Opportunity

Ability and extra effort are even more valuable when coupled with opportunity. Effective knowledge management results from providing individuals with the opportunity to create, retain, and transfer knowledge. Those opportunities could result from direct or indirect experience. Experience provides individuals with the opportunity to create knowledge through trial-and-error learning. Interruptions in experience provide opportunities for knowledge transfer (Zellmer-Bruhn 2003).

Organizational relationships influence knowledge management outcomes by providing members the opportunity to learn from each other. Organizations reduce the amount of distance, either physically or psychologically, between people. By reducing that

distance, organizations provide members with the opportunity to learn from each other. Learning by observation is an example of such indirect learning. Instead of accumulating knowledge directly, an individual accumulates knowledge by watching another person perform a task (Nadler et al. 2003). Proximity also provides people with the opportunity to learn who knows what, so members know where to search for relevant knowledge and information (Borgatti and Cross 2003). The transfer of routines, tools, and technology across units within organizations means that members of a recipient unit benefit from knowledge acquired at the first unit (Epple et al. 1996, Winter and Szulanski 2001).

Informal networks serve a similar function. By making knowledge more proximate, informal ties promote vicarious learning. Informal connections allow people to benefit from knowledge accumulated by close contacts and associates (Hansen 1999, McEvily and Zaheer 1999, Reagans and Zuckerman 2001, Uzzi and Lancaster 2003). Those contacts could be inside or outside the organization. Personnel movement across organizations or organizational units also increases the opportunity for one unit to learn from another (Almeida and Kogut 1999, Song et al. 2003).

Emergent Themes

The framework in Figure 1 also highlights several important themes that are emerging on knowledge management in organizations. One theme is the importance of social relations in understanding knowledge creation, retention, and transfer. A second theme is that knowledge management outcomes are affected by the "fit" or congruence between properties of knowledge, properties of units, and properties of relationships between units. The significance of where organizational boundaries are drawn for knowledge transfer is another theme. Work is also emerging on how different types of experience have different effects on learning outcomes. The effect of environmental factors on learning outcomes in firms represents another theme. The importance of embedding organizational knowledge in a repository so that it persists over time is a sixth theme. Each of these

themes is discussed and directions for future research about each theme are suggested.

Significance of Social Relations

Relative to research on how properties of units and properties of knowledge affect outcomes, research on how properties of relationship(s) between units affect learning and knowledge management outcomes is a newer theme. As mentioned previously, research in this area can be organized into two broad categories: Work focusing on the qualities of a given relationship or dyad, and work emphasizing the properties of a social system of relationships (i.e., networks or collective entities).

Research characteristic of the dyadic approach has been primarily directed at understanding how the closeness or strength of a relationship between two parties is related to the effectiveness of knowledge transfer. For instance, Uzzi's (1997) ethnographic study reveals that strong ties develop relationship-specific heuristics that ease the transfer of knowledge. Similarly, Hansen's (1999) study of product development teams indicates that strong ties are conducive to the transfer of complex knowledge, while weak ties aid in the search for new knowledge.

Dyadic research on knowledge transfer could be usefully extended to also consider the effects of tie strength on other properties of the knowledge management context. For instance, in what ways might tie strength affect the creation and retention of knowledge? Future research could also explore how the degree of asymmetry among the members of a dyad affects knowledge management outcomes. Research by Krackhardt (1990) shows that the members of a dyad frequently have differing perceptions of the strength and intensity of their relationship. How might these inconsistencies influence the effectiveness of search, transfer, and related activities?

Beyond tie strength, dyadic research might also consider which other dimensions of relationships affect knowledge management outcomes. For instance, McEvily et al. (2003) argue that the level of trust affects the extent of knowledge disclosure, screening, and sharing between two parties. From this perspective, trust alleviates concerns about knowledge appropriation and misuse. Trust also

reduces apprehension about the veracity of knowledge, thereby diminishing the tendency to question the knowledge's accuracy. An interesting complement to this line of work would be to explore some of the "dysfunctional" or negative aspects of relationships. Similarly, dyadic research could also investigate issues such as the effect of power or conflict on knowledge management outcomes.

Whereas dyadic research on knowledge management focuses on the properties of a single relationship between two individuals or units, other research concentrates on the properties of a set of relationships in a social system. One important line of work emerging in this area is on the structural configuration, or network, of a set of relationships. Properties of an organization's internal social network (Borgatti and Cross 2003, Thomas-Hunt et al. 2003) as well as its network to other firms (Uzzi and Lancaster 2003) affect learning and knowledge transfer.

Although existing research points to the important role of informal networks for effective knowledge transfer, the available empirical evidence on the association between informal social networks and knowledge transfer is limited (see Reagans and McEvily 2003). More research is needed on how informal networks affect the knowledge management process. For instance, are some network configurations more effective at creating and retaining knowledge than others? Moreover, do certain network positions endow the occupants of those positions with differential advantages or liabilities relative to other positions in the network?

In addition to social networks, other properties of social systems have been associated with knowledge management outcomes. For instance, different features of the formal organizational structure, such as the extent to which a firm is integrated (Sorenson 2003) or centralized (Chang and Harrington 2003), are associated with knowledge transfer. Culture is another important social factor. Cultural factors, such as a firm's idiosyncratic conventions and specialized "homemade" language (Weber and Camerer 2003) or its learning orientation and values (Bunderson and Sutcliff, forthcoming, Edmondson 1999), affect knowledge and performance outcomes.

"Fit" of Properties of Contexts

The concept of "fit" or congruence has recurred in many theories in the social and organizational sciences (Burton et al. 2002), including theories of knowledge management (Birkinshaw et al. 2002). Person-job fit predicts outcomes in the stress literature (Edwards 1996). The fit between the organization and characteristics of its task or environment predicts organizational performance in structural contingency theory (Comstock and Scott 1977) and survival in population ecology theory (Hannan and Freeman 1989). Consistent with these perspectives, the emerging literature on knowledge management illustrates that the fit between properties of knowledge, units, relationships, and the environment predicts knowledge management outcomes. For example, Das (2003) demonstrates that the fit between characteristics of a problem confronting an organization and its problem-solving "moves" or approaches predicts performance. Uzzi and Lancaster (2003) show that the fit between the nature of knowledge and the type of tie used to transfer it affects learning outcomes. Sorenson (2003) shows that the fit between the turbulence of the environment and the design of the firm predicts its probability of survival.

These studies find better performance outcomes when components fit or are congruent with each other. More research is needed on the mechanism through which fit affects learning and knowledge management outcomes. For example, does fit affect opportunities to transfer knowledge by making members more aware of other knowledge from which they would benefit? Or does fit affect ability by making the knowledge easier to understand? In addition, research is needed to identify dimensions of fit and to specify a priori when components fit each other and when they do not.

Research is also needed on whether there are conditions under which having dissimilar components that do not fit each other would be more beneficial for learning outcomes. For example, heterogeneous group where members have different backgrounds have been found to be more creative than homogeneous groups where members are similar to each other (e.g., see Lant et al. 1992, Lapre and van Wassenhove 2001, Williams and O'Reilly 1998). In this

volume, Song et al. (2003) find that personnel mobility was more likely to result in interfirm knowledge transfer and the creation of new knowledge at the firm when hired engineers had technological expertise distant from that of the hiring firm. Thus, having and bridging components that do not fit or are different from each other can facilitate the creation of knowledge.

Organizational Boundaries

Current work on knowledge management also illustrates that where organizational boundaries are drawn has important implications for knowledge transfer and subsequent organizational performance. Research has shown that knowledge is more likely to transfer across units that are part of the same organization or superordinate relationship (Darr et al. 1995, Baum and Ingram 1998, Ingram and Simons 2002). Similarly, Zellmer-Bruhn (2003) found that units are more likely to transfer best practices from units that are part of the same organization than from units that belong to a different organization. Song et al. (2003) present evidence that an organization is more likely to benefit from the knowledge of individual scientists when those scientists move to the organization than when they are employed by a different organization. Irwin and Klenow (1994) demonstrate that although knowledge transfers across firms in the semiconductor industry, firms learn three times as much from their own experience as from experience at another firm. Thus, these studies suggest that organizational units are more likely to benefit from internal than external knowledge.

In a somewhat different vein, Menon and Pfeffer (2003) find that organizational members are more likely to value knowledge from external than from internal sources. The researchers suggest that individuals might value external knowledge because they are less familiar with its limitations and because valuing external knowledge would not reduce their own status. The greater value organizational members place on external relative to internal knowledge, does not indicate that external knowledge is more likely to improve organizational performance than internal knowledge. Indeed, the cases Menon and Pfeffer

describe suggest that, by not valuing internal knowledge, the two organizations missed important opportunities to improve their performance.

Being able to bridge knowledge boundaries is an important capability (Reagans and McEvily 2003). Gittleman and Kogut (2003) show that having scientists who are able to bridge two very different knowledge bases—the logic of the scientific community and the logic of patenting—increases firm innovation.

More research is needed on the conditions under which organizational members value internal versus external knowledge and the conditions under which using internal versus external knowledge is more (or less) likely to improve a unit's performance. Further research is also needed on the mechanisms through which organizational boundaries affect knowledge transfer. For example, do boundaries affect member's social identity which in turn affects knowledge transfer (e.g., Kane et al. 2002)? Do boundaries affect the extent to which knowledge is understood and thus affect member's ability to transfer knowledge? Do boundaries affect the rewards members receive and their motivation to transfer knowledge or do boundaries affect member's awareness of knowledge and the opportunities to transfer it?

Nature of Experience

Understanding the effects of different types of experience on learning and knowledge management outcomes is a new direction identified in recent reviews of the organizational learning literature (Argote and Ophir 2002, Ingram 2002, Schulz 2002) that is represented in this special issue. Researchers are taking a more fine-grained view of experience to identify the types of experience that facilitate, impede, or have no effect on learning outcomes. For example, somewhat different or diverse experience appears to be more beneficial for learning than either identical experience or very different experience (Schilling et al. 2003).

Determining how experience interacts with characteristics of the organization is an important current research trend. Whether organizations are specialists or generalists affects their ability to learn from experience. Ingram and Baum (1997) show that specialists that concentrate in a small number of geographic areas are more likely to learn from their own

experience than generalists that operate over a larger area. Similarly, Haunschild and Sullivan (forthcoming) report that specialists learn more from diverse experience than generalists. Sorenson (2003) finds that vertically integrated firms learn more from their experience in turbulent environments than their nonintegrated counterparts.

Nadler et al. (2003) demonstrate that experience observing someone perform a task is more beneficial for subsequent performance than other types of experience, such as that acquired through classroom training. Experience individuals acquire by observing someone perform a task provides opportunities for them to acquire tacit (Nonaka 1991) as well as explicit knowledge. Individuals who learn through observation may not be able to articulate what they learn but are able to transfer the knowledge to a new task.

More research is needed on the mechanisms through which experience affects learning outcomes. For example, do different types of experience provide organizational members with a better understanding of the task and thus, increase their ability to manage knowledge? Work is also needed on the conditions under which experience is most beneficial (or harmful) for learning outcomes. Research is also needed on how experience translates into the development of capabilities at firms (Eisenhardt and Martin 2000).

Environmental Factors
Another theme of current knowledge management research is that environmental factors affect learning outcomes in firms. The turbulence in the environment (Sorenson 2003), the degree of competition (Chang and Harrington 2003) and the proportion of customers with particular characteristics (Lee et al. 2003) affect the success of learning strategies and organizational designs. For example, Lee et al. (2003) find that the "exploration" of new technology is more effective than "exploitation" (March 1991) when the proportion of "power users" (i.e., users who are less attentive to compatibility) is substantial or when a new technology is introduced before a more established one takes off. Sorenson (2003) finds that integrated firms benefit more from their experience than nonintegrated firms in turbulent contexts. Similarly, using a computational model, Chang and Harrington

(2003) find that centralized multiunit firms perform better than decentralized ones when competition is intense.

Understanding "ecologies" of learning (Levitt and March 1988) or how learning by other firms (Ingram 2002) or populations of firms (Miner and Haunschild 1995) can affect a focal firm is an important issue that would benefit from future research. Understanding such interactions would have important implications for the competitive behavior of firms.

Embedding Knowledge
Another theme emerging from the literature is the embedding of knowledge in various reservoirs or repositories. Knowledge can be embedded in individual members, in the organization's rules, routines, cultures, structures and technologies (Levitt and March 1988, Starbuck 1992, McGrath and Argote 2001, Walsh and Ungson 1991). Das (2003) describes how both locating and adapting solutions in the organization's memory are important problem-solving moves used to solve technical support problems. Drawing on work about transactive memory systems or knowledge of who knows what, Borgatti and Cross (2003) show that knowledge of "who knows what" predicts information transfer in organizations.

More research is needed on how knowledge is embedded in an organization's memory and the effect of where knowledge is embedded on performance outcomes. Understanding how transactive memory systems develop and their consequences for group performance is an active research area that would benefit from continued research (e.g., see Faraj and Sproull 2000, Hollingshead 1998, Liang et al. 1995, Lewis forthcoming). Examining the process though which knowledge is embedded in rules and routines and the effect of such embedding on group and organizational outcomes is another important research area that would benefit from additional research (e.g., Cohen and Bacdayan 1994, March et al. 2000). More research is needed on how properties of units, properties of relationships, and properties of knowledge affect whether knowledge persists through time or whether it depreciates (e.g., Benkard 2000, Darr et al. 1995). Whether or not knowledge depreciates has important implications for both operational and strategic decisions of firms (Argote et al. 1990).

Conclusion

The papers in the special issue attest to the vitality and diversity of research on organizational learning and knowledge management. Researchers from different disciplines, using different methods, and studying different contexts are increasing our understanding of managing knowledge in organizations. The reliance on different disciplinary perspectives, different methods, and different empirical contexts helps establish the extent to which findings generalize and to identify the boundary conditions under which they apply.

In spite of the diversity of disciplines, methods and contexts, there is an impressive degree of integration across research traditions. To organize the literature and facilitate the identification of points of convergence, we proposed an integrative framework that highlights knowledge management outcomes and contextual properties as key dimensions. The framework identifies common areas of research according to which contextual properties (of units, relationships, and knowledge) affect knowledge management outcomes (creation, retention, and transfer). We also identify the key causal mechanisms (ability, motivation, and opportunity) that help explain how and why certain contextual properties affect knowledge management outcomes.

Stepping back from the framework in Figure 1, several research trends are evident. Across the rows of the figure, we can see that the majority of papers in this issue focus on knowledge transfer. Thus, there was more research in the bottom row of Figure 1 than in the other two rows. Although there are certainly more opportunities for research on knowledge transfer, knowledge creation, and retention warrant additional attention as well.

Across the columns of Figure 1 we see that research represented in the special issue is more balanced across the columns than across the rows. Our sense, however, is that research on how properties of relationships affect organizational learning and knowledge management is a more recent research trend than research in the other columns. This is a very promising development because relationships are critical when one moves beyond studying individuals to studying social units such as organizations.

The framework in Figure 1 also points to several emerging themes that cut across different research traditions. Social relationships matter for knowledge creation, retention, and transfer. When properties of units, properties of relationships and properties of knowledge fit or are congruent with each other, knowledge retention, and transfer increase. Knowledge creation, by contrast, may be stimulated by a lack of congruence or parts that do not fit together. Experience can be structured to promote learning outcomes in firms. Where boundaries are drawn matters for knowledge creation, retention, and transfer. Features of the external environment affect learning outcomes in firms. And embedding knowledge in transactive memory systems, short-hand languages, routines, technologies, and other knowledge repositories can promote knowledge retention and transfer in firms.

The emerging themes that we have highlighted represent exciting points of convergence and integration across disciplines. We hope that the framework developed here is valuable in integrating the literature and suggesting future research opportunities. We look forward to research that continues to develop the emerging themes and further integrates work across disciplines in order to advance the field of knowledge management.

Acknowledgments

References

Almeida, P., B. Kogut. 1999. Localization of knowledge and the mobility of engineers in regional networks. *Management Sci.* **45** 905–917.

Argote, L. 1999. *Organizational Learning: Creating, Retaining and Transferring Knowledge*. Kluwer, Norwell, MA.

——, L., R. Ophir. 2002. Intraorganizational learning. J. A. C. Baum, ed. *Companion to Organizations*. Blackwell, Oxford, UK, 181–207.

——, S. L. Beckman, D. Epple. 1990. The persistence and transfer of learning in industrial settings. *Management Sci.* **36** 140–154.

Baum, J. A. C., P. Ingram. 1998. Survival-enhancing learning in the Manhattan hotel industry, 1898–1980. *Management Sci.* **44** 996–1016.

Benkard, C. L. 2000. Learning and forgetting: The dynamics of aircraft production. *Amer. Econom. Rev.* **90** 1034–1055.

Birkinshaw, J., R. Nobel, J. Ridderstrale. 2002. Knowledge as a contingent variable: Do the characteristics of knowledge predict the organizational structure? *Organ. Sci.* **13** 274–289.

Borgatti, S. P., R. Cross. 2003. A relational view of information seeking and learning in social networks. *Management Sci.* **49**(4) 432–445.

Bunderson, J. S., K. M. Sutcliff. Management team orientation and business unit performance. *J. Appl. Psych.* Forthcoming.

Burton, R. M., J. Lauridsen, B. Obel. 2002. Return on assets loss from situational and contingency misfits. *Management Sci.* **48** 1461–1485.

Chang, M., J. E. Harrington, Jr. 2003. Multimarket competition, consumer search, and the organizational structure of multi-unit firms. *Management Sci.* **49**(4) 541–552.

Cohen, M. D., P. Bacdayan. 1994. Organizational routines are stored as procedural memory: Evidence from a laboratory study. *Organ. Sci.* **5** 554–568.

Cohen, W. M., D. Levinthal. 1990. Absorptive capacity: A new perspective on learning and innovation. *Admin. Sci. Quart.* **35** 128–152.

Comstock, D. E., W. R. Scott. 1977. Technology and the structure of subunits: Distinguishing individual and workgroup effects. *Admin. Sci. Quart.* **22** 177–202.

Cyert, R. M., J. G. March. 1963. *A Behavioral Theory of the Firm.* Prentice-Hall, Englewood Cliffs, NJ.

Darr, E., L. Argote, D. Epple. 1995. The acquisition, transfer and depreciation of knowledge in service organizations: Productivity in franchises. *Management Sci.* **41** 1750–1762.

Darr, E. D., T. R. Kurtzberg. 2000. An investigation of partner similarity dimensions on knowledge transfer. *Organ. Behavior Human Decision Processes* **82** 28–44.

Das, A. 2003. Knowledge and productivity in technical support work. *Management Sci.* **49**(4) 416–431.

Edmondson, A. 1999. Psychological safety and learning behavior in work teams. *Admin. Sci. Quart.* **44** 350–383.

Edwards, J. R. 1996. An examination of competing versions of the person—environment fit approach to stress. *Acad. Management J.* **39** 292–339.

Eisenhardt, K. M., J. A. Martin. 2000. Dynamic capabilities: What are they? *Strategic Management J.* **21** 1105–1122.

Epple, D., L. Argote, K. Murphy. 1996. An empirical investigation of the micro structure of knowledge acquisition and transfer through learning by doing. *Oper. Res.* **44** 77–86.

Faraj, S., L. Sproull. 2000. Coordinating expertise in software development teams. *Management Sci.* **46** 1554–1568.

Gick, M. L., K. J. Holyoak. 1983. Schema induction and analogical transfer. *Cognitive Psych.* **15** 1–28.

Gittelman, M., B. Kogut. 2003. Does good science lead to valuable knowledge? Biotechnology firms and the evolutionary logic of citation patterns. *Management Sci.* **49**(4) 366–382.

Hannan M. T., J. Freeman. 1989. *Organizational Ecology.* Harvard University Press, Cambridge, MA.

Hansen, M. 1999. The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Admin. Sci. Quart.* **44** 82–111.

Haunschild, P. R., B. N. Sullivan. Learning from complexity: Effects of accident, incident heterogeneity on airline learning. *Admin. Sci. Quart.* Forthcoming.

Hollingshead, A. B. 1998. Group and individual training: The impact of practice on performance. *Small Group Res.* **29** 254–280.

Ingram, P. 2002. Interorganizational learning. J. A. C. Baum, ed. *Companion to Organizations.* Blackwell, Oxford, U.K.

Ingram, P., J. A. C. Baum. 1997. Opportunity and constraint: Organizations' learning from the operating and competitive experience of industries. *Strategic Management J.* **18** 75–98.

Ingram, P., S. Simons. 2002. The transfer of experience in groups of organizations: Implications for performance and competition. *Management Sci.* **48** 1517–1533.

Irwin, D. A., P. J. Klenow. 1994. Learning by doing spillovers in the semiconductor industry. *J. Political Econom.* **102** 1200–1227.

Kane, A., L. Argote, J. L. Levine. 2002. Knowledge transfer between groups via personnel rotation: Effects of social identity and knowledge quality. Presented at the Academy of Management meetings, Denver, CO.

Krackhardt, D. 1990. Assessing the political landscape: Structure, cognition, and power in organizations. *Admin. Sci. Quart.* **35** 342–369.

Lant, T. K., F. J. Milliken, B. Batra. 1992. The role of managerial learning and interpretation in strategic persistence and reorientation: An empirical exploration. *Strategic Management J.* **13** 585–608.

M. A. Lapré, L. N. van Wassenhove. 2001. Creating and transferring knowledge for productivity improvement in factories. *Management Sci.* **47** 1311–1325.

Lee, J., J. Lee, H. Lee. 2003. Exploration and exploitation in the presence of network externalities. *Management Sci.* **49**(4) 553–570.

Levitt, B., J. G. March. 1988. Organizational learning. *Annual Rev. Sociology* **14** 319–340.

Lewis, K. Measuring transactive memory systems in the field: Scale development and validation. *J. Appl. Psych.* Forthcoming.

Liang, D., R. Moreland, L. Argote. 1995. Group versus individual training and group performance: The mediating effects of transactive memory. *Personality Social Psych. Bull.* **21** 384–393.

March, J. G. 1991. Exploration and exploitation in organizational learning. *Organ. Sci.* **2** 71–87.

——, M. Schulz, X. Xhoiu. 2000. *The Dynamics of Rules: Studies of Change in Written Organizational Codes.* Stanford University Press, Stanford, CA.

Marshall, A. 1920. *Principles of Economics: An Introductory Volume.* Macmillan, London, U.K.

McEvily, B., A. Zaheer. 1999. Bridging ties: A source of firm heterogeneity in competitive capabilities. *Strategic Management J.* **20** 1133–1156.

——, V. Peronne, A. Zaheer. 2003. Trust as an organizing principle. *Organ. Sci.* **14** 91–103.

McGrath, J. E., L. Argote. 2001. Group processes in organizational contexts. M. A. Hogg, R. S. Tindale, eds. *Blackwell Handbook of Social Psychology, Vol. 3: Group Processes*. Blackwell, Oxford, UK, 603–627.

Menon, T., J. Pfeffer. 2003. Valuing internal versus external knowledge. *Management Sci.* **49**(4) 497–513.

Miner, A. S., P. R. Haunschild. 1995. Population-level learning. *Res. Organ. Behavior* **17** 115–166.

Nadler, J., L. Thompson, L. Van Boven. 2003. Learning negotiation skills: Four models of knowledge creation and transfer. *Management Sci.* **49**(4) 529–540.

Nonaka, I. 1991. The knowledge-creating company. *Harvard Bus. Rev.* **69** 96–104.

Reagans, R., B. McEvily. 2003. *Network Structure and Knowledge Transfer: The Transfer Problem Revisited.* Working paper, Columbia University, New York.

——, E. W. Zuckerman. 2001. Networks, diversity and performance: The social capital of R&D units. *Organ. Sci.* **12** 502–517.

Rulke, D. L., J. Galaskiewicz. 2000. Distribution of knowledge, group network structure, and group performance. *Management Sci.* **46** 612–625.

Schilling, M. A., P. Vidal, R. Ployhart, A. Marangoni. Learning by doing something else: Variation, relatedness, and organizational learning. *Management Sci.* **49**(1) 39–56.

Schulz, M. 2002. Organizational learning. J. A. C. Baum, ed. *Companion to Organizations*. Blackwell, Oxford, U.K.

Sine, W. D., S. Shane, D. Di Gregorio. 2003. The halo effect and technology licensing: The influence of institutional prestige on the licensing of university inventions. *Management Sci.* **49**(4) 478–496.

Smith, A. 1776/1937. *An Inquiry into the Nature and Causes of The Wealth of Nations*. Edwin Cannan, ed. Random House, New York.

Song, J., P. Almeida, G. Wu. 2003. Learning by hiring: When is mobility more likely to facilitate interfirm knowledge transfer? *Management Sci.* **49**(4) 351–365.

Sorenson, O. 2003. Interdependence and adaptability: Organizational learning and the long-term effect of integration. *Management Sci.* **49**(4) 446–463.

Starbuck, W. H. 1992. Learning by knowledge-intensive firms. *J. Management Stud.* **29** 713–738.

Stasser, G., W. Titus. 1985. Pooling of unshared information in group decision making: Biased information sampling during discussion. *J. Personality Social Psych.* **48** 1467–1478.

Szulanski, G. 1996. Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management J.* **17** 27–43.

——. 2000. The process of knowledge transfer: A diachronic analysis of stickiness. *Organ. Behavior Human Decision Processes* **82** 9–27.

Thomas-Hunt, M. C., T. Y. Ogden, M. A. Neale. 2003. Who's really sharing? Effects of social and expert status on knowledge exchange within groups. *Management Sci.* **49**(4) 464–477.

Thompson, L., D. Gentner, J. Lowenstein. 2000. Avoiding missed opportunities in managerial life: Analogical training more powerful than individual case training. *Organ. Behavior Human Decision Processes* **82** 60–75.

Uzzi, B. 1997. Social structure and competition in interfirm networks: The paradox of embeddedness. *Admin. Sci. Quart.* **42** 35–67.

Uzzi, B., R. Lancaster. 2003. The role of relationships in interfirm knowledge transfer and learning: The case of corporate debt markets. *Management Sci.* **49**(4) 383–399.

Walsh, J. P., G. R. Ungson. 1991. Organizational memory. *Acad. Management Rev.* **16** 57–91.

Weber, M. 1922/1978. *Economy and Society: An Outline of Interpretive Sociology.* G. Roth, C. Wittich, eds. University of California Press, Berkeley, CA.

Weber, R. A., C. F. Camerer. 2003. Cultural conflict and merger failure: An experimental approach. *Management Sci.* **49**(4) 400–415.

Wegner, D. M. 1986. Transactive memory: A contemporary analysis of the group mind. B. Mullen, G. R. Goethals, eds. *Theories of Group Behavior*. Springer-Verlag, New York, 185–205.

Williams, K. Y., C. A. O'Reilly. 1998. Demography and diversity in organizations: A review of forty years of research. *Res. Organ. Behavior* **20** 77–140.

Winter, S. G., G. Szulanski. 2001. Replication as strategy. *Organ. Sci.* **12** 730–743.

Zander, U., B. Kogut. 1995. Knowledge and the speed of the transfer and imitation of organizational capabilities: An empirical test. *Organ. Sci.* **6** 76–92.

Zellmer-Bruhn, M. E. 2003. Interruptive events and team knowledge acquisition. *Management Sci.* **49**(4) 514–528.