



Mechanisms for sharing knowledge in project-based organizations

Wai Fong Boh *

*Nanyang Business School, Nanyang Technological University, S3-B2A-14, Nanyang Avenue,
Singapore 639798, Singapore*

Received 17 February 2006; received in revised form 21 October 2006; accepted 27 October 2006

Abstract

Organizations need to effectively combine and utilize knowledge resources that are distributed amongst the employees and groups in the firm. This paper examines the use of knowledge-sharing mechanisms to leverage the learning, experience and expertise of employees accumulated across projects. I specify a framework that classifies the knowledge-sharing mechanisms used by project-based organizations. Prior research tends to examine only one dimension of knowledge-sharing mechanisms – personalization versus codification. Personalization mechanisms are often assumed to be more ad hoc and informal, and codification mechanisms are assumed to be formal and involve the use of electronic databases. In this paper, personalization versus codification and individualization versus institutionalization are highlighted as two distinct dimensions of knowledge-sharing mechanisms. Individualized knowledge-sharing mechanisms are informal and unstructured, while institutionalized knowledge-sharing mechanisms are formal and embedded in organizational routines and structure. A framework is presented to show how the two dimensions interact. Based on empirical case studies in two project-based organizations, the paper examines if there are suitable configurations of knowledge-sharing mechanisms for organizations with different characteristics. The study contributes to research by providing a more nuanced classification of knowledge-sharing mechanisms, and provides guidance to managers about the types of knowledge-sharing mechanisms that should be adopted based on the size, geographical dispersion and task nature of organizations. © 2006 Elsevier Ltd. All rights reserved.

Keywords: Organizational learning; Project-based organizations; Case studies; Knowledge-sharing mechanisms

* Tel.: +65 6790 6196; fax: +412 6792 2313.
E-mail address: awfboh@ntu.edu.sg.

1. Introduction

In project-based organizations (PBOs), the knowledge, capabilities and resources of the firm are built up through the execution of major projects. Projects are often the major business endeavor and the normal mechanism for executing new business opportunities. Organizing work by projects allow organizations to respond flexibly to changing organizational needs, but PBOs face significant challenges in achieving economies of scale, coordinating cross-project resources, facilitating organization-wide development and promoting organization-wide learning (Hobday, 2000). While it is a misconception to think that there is no learning across projects since there are little commonalities across projects (Cooper, Lyneis, & Bryant, 2002), the challenges in facilitating knowledge sharing across projects are well-recognized (Brusoni, Prencipe, & Pavitt, 2001; Cooper et al., 2002; DeFillippi & Arthur, 1998). The temporary and customized nature of each project makes it difficult for such organizations to learn and build up their knowledge capabilities from one project to another (Meyerson, Weick, & Kramer, 1996). Each project is customized and thus tends to differ from another in several critical aspects. As projects are transient, special effort needs to be invested to glean and improve upon transferable lessons across projects. Employees have the natural incentive to get on with the next project, and are not motivated to dwell on the failures of the past (Cooper et al., 2002). Nevertheless, common problems may be encountered across different projects, and effective sharing of knowledge across projects can reduce the organizational costs of duplicating efforts to invent the same solutions (Goodman & Darr, 1998). Firms that can successfully share knowledge across individuals and projects may find that ideas and experiences in one project can frequently solve the problems of another (Davies & Brady, 2000; Hargadon & Sutton, 1997).

To enable effective sharing of knowledge across projects, knowledge-sharing mechanisms are the means by which individuals access knowledge and information from other projects. This paper focuses on examining the mechanisms that are used to facilitate the sharing of knowledge distributed across individuals in a PBO. Knowledge-sharing mechanisms are defined as the formal and informal mechanisms for sharing, integrating, interpreting and applying know-what, know-how, and know-why embedded in individuals and groups that will aid in the performance of project tasks. This paper presents a framework that classifies different knowledge-sharing mechanisms, and makes propositions about how the size, geographical dispersion and task nature of project-based organizations affect the portfolio of mechanisms suitable for each organization. Based on empirical case studies in two project-based organizations, I then examine if there are suitable configurations of knowledge-sharing mechanisms that organizations should adopt based on their characteristics.

Prior research has highlighted the need to understand the mechanisms that enhance the stocks and flows of learning (Crossan, Lane, & White, 1999). This study contributes to research by providing a more nuanced classification of knowledge-sharing mechanisms. Prior studies tend to examine only one dimension of knowledge-sharing mechanisms – personalization versus codification. Personalization mechanisms are often assumed to be more ad hoc and informal, and codification mechanisms are assumed to be formal and involve the use of electronic databases. In this paper, personalization versus codification and individualization versus institutionalization are highlighted as

two distinct dimensions of knowledge-sharing mechanisms. Individualized knowledge-sharing mechanisms facilitate knowledge sharing at the individual level, and tend to be informal and unstructured; institutionalized knowledge-sharing mechanisms facilitate collective knowledge sharing, and tend to be formal and embedded in organizational routines and structure. This framework provides a systematic way of characterizing the varied set of knowledge-sharing mechanisms adopted by PBOs. In addition, by examining the factors that influence the portfolio of knowledge-sharing mechanisms adopted by different organizations, the study provides guidance to managers about the suitable portfolio of knowledge-sharing mechanisms that should be adopted based on key organizational characteristics.

This paper is structured as follows. The first section introduces the framework to classify knowledge-sharing mechanisms. A distinction is made between personalization versus codification and individualization versus institutionalization as independent dimensions of knowledge-sharing mechanisms. The framework results from interacting the two dimensions. I then make propositions about how organizational characteristics affect the portfolio of knowledge-sharing mechanisms used. Sections four and five describe two case studies conducted in project-based organizations identifying and evaluating the types of knowledge-sharing mechanisms they use. This is followed by a discussion of the usefulness of the proposed framework in identifying a suitable configuration of knowledge-sharing mechanisms based on the characteristics of an organization. The paper concludes with implications and recommendations.

2. A framework for knowledge-sharing mechanisms

As highlighted by [Cabrera and Cabrera \(2002, p. 690\)](#), the “most extended, yet debated” taxonomy of organizational knowledge distinguished two dimensions of knowledge: degree of articulation and degree of aggregation. There are various ways of categorizing the degree of articulation. [Polanyi \(1962\)](#) differentiates between tacit and explicit knowledge, which refers to the ease with which knowledge can be articulated and communicated to others. This classification has been used by many researchers (e.g., [Nonaka, 1994](#); [Spender, 1996](#)). Other researchers differentiate between codified and tacit knowledge (e.g., [Cowan, David, & Foray, 2000](#); [Nonaka, 1994](#); [Saviotti, 1998](#)), which refers to the extent to which knowledge has been articulated and captured in documents and databases. The degree of aggregation distinguishes between individual and collective forms of knowledge, or the extent to which knowledge is held by one person or embedded in the interactions amongst a group of people ([Cabrera & Cabrera, 2002](#); [Nonaka, 1994](#)). Several scholars have examined the interaction between these two dimensions of knowledge ([Lam, 2000](#); [Spender, 1996](#)) to create four types of knowledge: individual-tacit, individual-explicit, collective-explicit, and collective-tacit. [Nonaka \(1994\)](#) have also examined the processes that are involved in converting one knowledge type to another.

Based on these two dimensions of knowledge, I identify two dimensions of knowledge-sharing mechanisms: codification versus personalization, and individualization versus institutionalization. The interaction between these two dimensions results in a framework that generates four classes of knowledge-sharing mechanisms, which relate to the sharing of different types of knowledge identified above ([Lam, 2000](#); [Spender, 1996](#)). Codification versus personalization distinguishes between mechanisms that enable the sharing of

codified knowledge versus tacit knowledge¹. Individualization versus institutionalization distinguishes between mechanisms that enable the sharing of knowledge at the individual level, or at a collective level. I discuss each dimension of the knowledge-sharing mechanisms framework below.

2.1. Codification versus personalization

Organizations can facilitate the sharing of knowledge between individuals by using codification or personalization mechanisms. If knowledge is shared through a codification mechanism, knowledge is carefully codified and stored in databases and documents, where it can be accessed and used easily by employees in the company. If knowledge is shared through a personalization mechanism, it will be closely tied to the person who developed it and shared mainly through direct person-to-person contacts (Hansen, Nohria, & Tierney, 1999). This dimension of knowledge-sharing mechanisms identifies the mechanisms used to facilitate the sharing of tacit versus codified knowledge (Cabrera & Cabrera, 2002; Nonaka, 1994).

Codification can be a good mechanism to store large amounts of knowledge and to create an organizational memory for all employees (Goodman & Darr, 1998). The rise of networked computers has made it possible to codify, store and share certain kinds of knowledge more easily and cheaply than ever before. Adopting the codification strategy, however, is not without costs. Codification mechanisms typically do not provide a rich medium for communication (Daft & Huber, 1987). The richness of a communication medium is determined by bandwidth (the amount of information that can be exchanged between parties in a given time), customization (the degree to which the information can be selected and restructured to cater to specific user needs) and interactivity (the degree to which both parties can engage in repeated exchanges) (Chai, Gregory, & Shi, 2003). The richer the medium for communication, the better it enables the customization of information to suit the context and the more it enables interactions to seek clarification and aid further reinterpretation of the knowledge. Hence, while codification may be an efficient strategy for transmitting a large amount of information, it does not allow interactions and customization of solutions to the knowledge seeker's problems.

Personalization, on the other hand, provides a rich medium for communication, as it is concerned with the use of people as a mechanism for sharing knowledge (Argote, 1999). Individuals are effective carriers of knowledge and information because they are able to restructure information so that it applies to a new context (Allen, 1977). Individuals, in the process of doing their work, generate knowledge that largely remains in their heads and in the memory aids that they create for themselves (Olivera, 2000). Personalization as a knowledge sharing mechanism has the inherent flexibility of transmitting tacit knowledge, and allowing for discussions and sharing interpretations that may lead to the development of new knowledge (Prencipe & Tell, 2001).

¹ Instead of using the tacit–explicit knowledge dimensions used in Spender (1996) and Lam (2000), I use the tacit-codified knowledge dimensions. Codified knowledge is frequently used synonymously with explicit knowledge (e.g., Cowan et al., 2000; Nonaka, 1994; Saviotti, 1998), whereas tacit knowledge here is defined as knowledge associated with experience, and not codified in documents and databases (Spender, 1996).

Personalization, however, may also entail costs and risks to both knowledge seekers and knowledge providers (Borgatti & Cross, 2003). For example, seeking information from others in organizational settings may be perceived by some individuals to involve risks of admitting ignorance on a given topic (Menon & Pfeffer, 2003). Esteem and reputation issues come into play when people seek help from others as they are motivated to maintain positive self-images and so may avoid actions that may threaten their positive sense of self (Borgatti & Cross, 2003). In addition, knowledge sharing via personalization can only take place when the knowledge-seeker is aware of what others know, when he has the ability to access the knowledge provider, and the knowledge provider is willing to actively engage in knowledge-sharing with the knowledge seeker (Cross & Borgatti, 2000).

2.2. Institutionalization versus individualization

Another key dimension in the proposed framework of knowledge-sharing mechanisms is whether the mechanisms are individualized or institutionalized. Based on Van Maanen and Schein (1979), Jones (1986) introduced the institutionalization versus individualization dimension to classify the tactics used by organizations to socialize newcomers into the organization. The institutionalization dimension describes socialization tactics that are collective and formal in terms of the contexts in which organizations provide information to newcomers, while the individualization dimension describes socialization tactics that are individual and informal (Jones, 1986). I use the individualization versus institutionalization labels adopted by Jones (1986) to describe the second dimension of knowledge-sharing mechanisms because these labels encompass both the differentiations between individual versus collective and between informal versus formal aspects of knowledge-sharing mechanisms.

Knowledge sharing can take place at the individual or collective level. Nonaka (1994) identifies four modes of knowledge conversion between tacit and explicit knowledge. While these four modes of knowledge conversion play a key role in knowledge sharing amongst individuals, “the interactions between tacit knowledge and explicit knowledge will tend to become larger in scale and faster in speed as more actors in and around the organization become involved” (Nonaka, 1994, p. 20). This process of knowledge conversion on a wider scale amplifies the ideas and knowledge from individuals to other groups and individuals in the organization, and crystallizes the knowledge as part of the knowledge network in the organization. This transforms individual knowledge to collective knowledge (Nonaka, 1994).

Individualized versus institutionalized knowledge-sharing mechanisms differentiate between mechanisms that are used to support knowledge sharing at the individual level versus the collective level. Individualized mechanisms support knowledge sharing at the individual level. They have limited reach, or there is a limited number of people who are able to access the knowledge (Evans & Wurster, 1997). Individualized mechanisms tend to be based on the random decisions of individuals and are unique to individuals or small groups. These mechanisms also tend to be ad hoc individual level initiatives that are informal (occurring naturally without external intervention) and unstructured (usually ad hoc and unplanned). Institutionalized knowledge-sharing mechanisms support knowledge sharing at the collective level, as they enable the transference of learning and knowledge from an individual to a large number of individuals, by embedding knowledge

sharing capabilities into the structure and routines of an organization. Institutionalized knowledge-sharing mechanisms characterize the use of mechanisms that are formal (established and endorsed by the organization, who have put in place the necessary supporting infrastructure to encourage the use of the mechanism) and structured (pre-defined and embedded in various organizational routines, artifacts, or organizational structure). These mechanisms have a wider reach, or are usually accessible to a large group of individuals in the organization.

Both institutionalized and individualized knowledge-sharing mechanisms have their advantages and limitations. Individualized knowledge-sharing mechanisms allow knowledge sharing to take place using an informal and decentralized approach, where the organization does not dictate the areas for knowledge sharing to take place. This approach encourages a free-flow and unstructured form of knowledge-sharing to take place as and when the need arises (Bhatt, 2001). This increases the responsiveness and flexibility of the organization. Individualized knowledge sharing, however, suffers from problems of scalability. Individualized mechanisms make knowledge sharing serendipitous and reliant on whether employees happen to speak to the right person about their problems and needs at the right time. This becomes an especially significant problem as the organization expands in size and geographical distribution as it becomes much more difficult to search for knowledge embedded in a large group of geographically distributed individuals.

Institutionalized knowledge-sharing mechanisms, on the other hand, provide the opportunity for organizations to increase the probability of useful knowledge sharing and to “push” information and knowledge to others, instead of simply depending on individuals to “pull” knowledge from the right sources. Institutionalized knowledge-sharing mechanisms allow the organization to amplify the knowledge embedded in individuals to the collective level (Nonaka, 1994), so that the knowledge is easily accessible to all employees who need to make use of it. Unlike physical resources that need to be divided amongst all units using the resource, the value of knowledge grows and multiplies when it is shared (Cabrera & Cabrera, 2002). As knowledge is shared in a systematic manner to a wider group of individuals, the knowledge not only becomes embedded in more individuals, synergy is also created in sharing, reusing, discussing and re-interpreting the knowledge (Davenport, De Long, & Beers, 1998). Institutionalized mechanisms, therefore, enable organizations to more effectively exploit the knowledge in the organization, by creating reliability in repeated experiences, and refining knowledge through repeated use and reflections (Holmqvist, 2004; March, 1991). Institutionalized knowledge-sharing mechanisms, however, require organizations to invest a significant amount of time and resources to put in place the supporting infrastructure, systems, routines, rules and procedures, artifacts, and organizational structure and strategy. Moreover, institutionalization of knowledge-sharing mechanisms require the organization to specify areas of focus that have potential for exploitation, thus locking the organization into specific areas of knowledge and pre-defined ways to share knowledge. This reduces the responsiveness and flexibility of the organization.

2.3. Interacting the two dimensions

Interacting the two dimensions of knowledge-sharing mechanisms – codification versus personalization and individualization versus institutionalized – creates a four-quadrant

framework (see Table 1) that can be used to classify various types of knowledge-sharing mechanisms.

Quadrant 1: individualized-personalization mechanisms. Quadrant 1 describes mechanisms that create opportunities for individuals to share knowledge at the individual level in an ad hoc and informal manner. Research has shown the important role of social networks in information sharing (Granovetter, 1982; Krackhardt, 1992) and suggests that social networks contribute to knowledge sharing within organizations (Hansen, 1999). Networks of individuals can be a powerful means of storage and retrieval for the organization's experiential knowledge, given that individuals have a general preference for obtaining information from other people, rather than from documents (Allen, 1977; O'Reilly, 1982). Hence, informal person-to-person interactions often play a significant role in transferring knowledge between individuals. The ability of individuals to make effective use of individualized-personalization mechanisms for knowledge sharing, however, depend on whether individuals have the appropriate knowledge of 'who knows what' in the organization (Moreland & Myaskovsky, 2000), and have access to the individuals who may have the knowledge (Borgatti & Cross, 2003). Increasingly companies are adopting various forms of technology, such as email, and instant messengers, to support knowledge sharing via such individualized-personalization mechanisms (Massey & Montoya-Weiss, 2006). Such technologies are especially useful in enabling individuals to reach across geographical distances to contact one another.

Quadrant 2: individualized-codification mechanisms. Quadrant 2 describes mechanisms where documents and other project artifacts are shared at the individual level, in an informal and ad hoc manner. A key way that project-based organizations can make connections between the problems and potential solutions across time, projects, and geographical boundaries (Hargadon & Sutton, 1997), is to facilitate reuse of the intellectual capital that is produced for one project in another engagement. In the process of completing projects, individuals and groups convert their experiences and learning into various artifacts, including project proposals, project plans, client presentations, client reports, and even lessons learned about what works and what does not for different types of engagements. These different types of intellectual capital codify the experience and learning that the organization has accumulated across different engagements. If an organization can achieve effective reuse of its intellectual capital, it can build upon prior experience and invest in making improvements to the existing intellectual capital instead of wasting effort on reinventing the wheel.

While most researchers recognize the importance of codifying knowledge in various knowledge bases, the general assumption is that such codified knowledge is only accessible if the documentation is stored in an organization-wide database that has good search

Table 1
Framework of knowledge-sharing mechanisms for managing distributed knowledge and expertise in project-based organizations

	Individualized	Institutionalized
Personalization	<i>Quadrant 1: individualized-personalization mechanisms</i>	<i>Quadrant 4: institutionalized-personalization mechanisms</i>
Codification	<i>Quadrant 2: individualized-codification mechanisms</i>	<i>Quadrant 3: institutionalized-codification mechanisms</i>

capabilities. Much of the intellectual capital that are created in the process of completing projects, however, are stored in the hard disks of individual team members, or they are stored in shared spaces that are accessible only to the team members working on the project. A significant amount of the sharing of such intellectual capital may therefore take place through individualized mechanisms where individuals find the right intellectual capital to reuse through personal contacts and their social network. Even when a centralized database is available, individuals sometimes need to ask the right person to locate the relevant documents if the categorization and search facilities are not sufficiently refined (Owen, Burstein, & Mitchell, 2004).

Quadrant 3: institutionalized-codification mechanisms. Quadrant 3 describes codification knowledge-sharing mechanisms that are institutionalized in the routines and structure of the organization. The fundamental idea for this class of knowledge-sharing mechanism is to capture specialist knowledge in knowledge bases that other specialists can access. This mechanism captures individual or group-held knowledge and makes it the wider property of the organization (Earl, 2001). The knowledge-sharing mechanisms in this quadrant are typical of the mechanisms conventionally included in knowledge-management programs, especially those that have significant emphasis on the use of information technology (IT) to create electronic repositories for storing, searching and retrieving the intellectual capital (IC).

Quadrant 4: institutionalized-personalization mechanisms. Quadrant 4 describes personalization knowledge-sharing mechanisms that are institutionalized in the routines and structure of the organization. Organizations need to recognize that individuals play an integral role in the learning and knowledge-sharing processes within the organization. Sharing knowledge based on direct interactions between two individuals offer many advantages over trying to share knowledge by codifying the knowledge and divorcing the knowledge from a specific individual, since people are able to flexibly restructure their knowledge across different tasks. Hence, instead of trying to institutionalize knowledge sharing only by means of codification, organizations can institutionalize mechanisms to facilitate person-to-person knowledge-sharing. This includes institutionalizing an organizational structure such that individuals who have the necessary experience and expertise are available to provide guidance to less experienced professionals (Halverson, 2004), or organizing the work and deploying individual experts in such a way that in the process of completing the project work, the experience and knowledge would naturally be shared amongst the team.

2.4. Contributions and implications of the framework

The above framework contributes to the literature by providing a more nuanced classification of knowledge-sharing mechanisms used by project-based organizations. Prior research has assumed that most knowledge-sharing mechanisms can be classified as either personalization mechanisms or codification mechanisms. Personalization mechanisms are often assumed to be more ad hoc and informal, and codification mechanisms are often assumed to be formal and involve the use of electronic databases (Choi & Lee, 2003). This framework highlights that both codification and personalization mechanisms can be institutionalized. Codification mechanisms are often institutionalized in the form of creating organization-wide repositories or providing access to online discussion archives to share knowledge across geographically dispersed employees. Such mechanisms are potentially

very useful in sharing knowledge across geographically dispersed individuals (Ackerman & McDonald, 1996). Prior work has, however, pointed out that technology solutions to codify knowledge often fall short of organizational goals, as the knowledge individuals need to share with one another is often “tacit and embedded in the context in which it is being used” (Hinds & Pfeffer, 2003, p. 21). Hence, by institutionalizing personalization mechanisms, knowledge can be shared through personalization mechanisms at the collective level. For example, organizations can designate specific individuals as subject-matter experts and provide access to these experts.

Similarly, knowledge sharing through means of codification does not always have to be formal and through the use of a repository, as individuals often exchange codified information informally. For example, individuals may know of another individual who has worked in a similar project in the past, and thus ask for a copy of the project report from that colleague. In fact, some individual may even prefer to share codified knowledge by way of individualized mechanisms, as they would have a better idea of the trustworthiness and credibility of the document source (Sussman & Siegal, 2003).

3. Organizational characteristics and portfolios of mechanisms

In this section, I discuss the key organizational characteristics influencing the portfolio of knowledge-sharing mechanisms that organizations should adopt, based on the framework above. In doing so, I hope to provide insights into the question of what is a suitable configuration of knowledge-sharing mechanisms that a project-based organization should adopt to effectively facilitate knowledge sharing across projects.

3.1. *Use of personalization versus codification mechanisms*

Hansen et al. (1999) highlighted that effective firms excel by predominantly focusing on using either the personalization or codification mechanism for knowledge sharing, and using the other in a supporting role. What determines which set of mechanisms to focus on depend on the task routineness of the organization, or the nature of their business. If an organization provides a standardized product or solution to its client, a codification strategy would leverage the ability to reuse the organization’s knowledge (Scheepers, Venkitachalam, & Gibbs, 2004). Hansen et al. (1999) showed that technical consulting firms, whose task nature tends to be more standardized across projects, benefit more from a codification strategy. This is because the ability to build a reliable, high-quality information system faster and at a better price than others by using work plans, software code, and solutions that have been fine-tuned and proven successful provide more benefits to the customer. On the other hand, strategy consulting firms tend to tackle problems that do not have clear solutions at the outset; hence they benefit more from personalization strategies, which allow them to engage their colleagues in discussions to seek a highly customized solution to each unique problem (Hansen et al., 1999). Hence, I propose that:

P1: Codification knowledge-sharing mechanisms are more suitable for organizations conducting tasks or encountering problems that are more standardized and routine in nature; while personalization knowledge-sharing mechanisms are more suitable for organizations conducting tasks or encountering problems that are more unique in nature.

3.2. Use of individualization versus institutionalization mechanisms

As an organization grows in size and geographical dispersion, they need to facilitate knowledge sharing beyond small, collocated groups. When project-based organizations have employees distributed across different geographical areas, the remote work situation reduces the probability that employees would come into contact with others who may have the relevant experience for them to draw upon. It also reduces the availability of information about “who knows what” for professionals to know whom to approach in order to locate the person with the right experience to share (Finholt, 1993). In a small, collocated organization, individualized mechanisms may serve the knowledge sharing needs of the organization adequately as employees frequently meet each other in the hallways or at cafeterias (Eagle, 2004; Franklin, William, & Johanna, 2003). The small network ensures that it is easy to locate one person who knows what another person is good at. In a large and geographically dispersed organization, it is a challenge to find ways of making the connections between individuals who have the right knowledge to share with one another (Hoopes & Postrel, 1999). The probability of serendipitous encounters drop drastically. It also becomes significantly more difficult to locate individuals with a specific solution to a problem in a large and dispersed organization. Hansen and Nohria (2004, p. 24) refer to this as the “needle-in-a-haystack problem”, noting that “somewhere in the company someone often knows the answer to a problem, but it is nearly impossible to connect the person who has the expertise with the person who needs it.”

The institutionalization of knowledge-sharing mechanisms in quadrants 3 and 4 would help large and geographically dispersed organizations facilitate knowledge sharing across a wider geographical scope, and across a larger group of individuals. By institutionalizing codification mechanisms, the easy storage and transmission of codified knowledge can bridge space and time for large firms that have employees distributed geographically and in different time zones (Goodman & Darr, 1998). By institutionalizing personalization mechanisms, organizational structures and routines are set up such that individuals are no longer restricted to approach only their personal network, and they have access to the knowledge of experts whom they do not necessarily know personally. Hence, I propose:

P2: Institutionalized knowledge-sharing mechanisms are more suitable for large, geographically dispersed organizations; while individualized knowledge-sharing mechanisms are more suitable for small, collocated organizations.

Table 2 summarizes Propositions 1 and 2 into a two-by-two framework, which corresponds to the knowledge-sharing mechanisms framework in Table 1.

Table 2

Framework of knowledge-sharing mechanisms for managing distributed knowledge and expertise in project-based organizations

Nature of work or problems	Size and geographical dispersion	
	Small and collocated	Large and geographically dispersed
Unique	<i>Quadrant 1:</i> most suitable for individualized-personalization mechanisms	<i>Quadrant 4:</i> most suitable for institutionalized-personalization mechanisms
Standardized	<i>Quadrant 2:</i> most suitable for individualized-codification mechanisms	<i>Quadrant 3:</i> most suitable for institutionalized-codification mechanisms

4. Methodology

A case study methodology was chosen to examine whether the above proposed framework is an accurate characterization of knowledge-sharing mechanisms used in project-based organizations to integrate the experience and expertise embedded in individuals and groups. Two case studies were conducted in Research Inc. and Consulting Inc (pseudonyms). Information was gathered regarding the knowledge-sharing mechanisms used in the organizations by conducting interviews, browsing the intranets and observing internal meetings. The research sites were selected because they are both project-based organizations in the business of selling the expertise of their employees and experience of the organization. A positivist approach was adopted for the case study (Mason, 2002). The knowledge-sharing mechanisms used in both organizations and employees' views of the effectiveness of the mechanisms are examined and compared for the two organizations. Based on the characteristics of the organizations, the results of the comparison will then indicate support or lack thereof for the propositions.

Site 1 – Research Inc. Research Inc. conducts projects to do research, consulting, and technical work for other organizations. Its customers include government agencies such as the Department of Education and Census Bureau and private and public companies. Peer organizations in the industry include RAND, American Institutes for Research, Educational Testing Service, SAS, Inc., and Westat. In 2004, Research Inc. had more than 1000 employees distributed in five offices located in Washington DC, Maryland, Massachusetts, and California, and smaller offices in four sites located in California, Georgia, North Carolina and Brazil. The organization created project teams to bid competitively for work in domains such as elementary education, child health, and internet-based information services. Research Inc. is an appropriate setting to study the research problem. As a research and professional service firm, its key resource is the expertise of its employees. Over 80% of the staff are professionals, and over half of these employees have doctorate degrees. Given the importance of knowledge as a resource for the firm, and the wide usage of project teams to supply the complex mix of services required by clients, effective knowledge sharing between individuals and project teams is critical for the organization.

Over a three-week period, the author visited the two largest offices of Research Inc., located in Washington DC and California. The Washington D.C. and California sites have rather distinct characteristics and culture. The Washington DC site (DC site) was the result of the relocation of three Research Inc. offices in the Washington DC, Maryland, Virginia areas to a single location in Washington DC one year prior to the start of this study. Hence, the DC site is relatively big (about 600–700 professionals), and has experienced a significant growth in size over a short period of time. The California site (CAL site) was an office that has been existing since Research Inc. was founded in the mid-1900s. The site, however, has not grown much over the years, and has remained relatively small with a total of about 80 employees. While these two sites are both part of Research Inc. and the knowledge-sharing mechanisms used in the two sites tend to be similar, it is particularly interesting to compare interviewees' perspectives about the effectiveness of the knowledge-sharing mechanisms used in these two sites. To facilitate this comparison, I analyzed the results for these two sites separately.

During the visits to the offices, interviews were conducted with 36 individuals and eight internal meetings were observed, including high-level director meetings, project meetings,

staffing meetings, as well as proposal meetings. The author also browsed the intranet during the visits to understand what types of information and codified knowledge was available on the organization intranet. The interviews were conducted with research directors, project managers, and research associates and analysts. A stratified sampling approach was adopted, ensuring that there was representation from employees at different levels in each site. As Research Inc. does not employ any knowledge-management support staff, except for a group of IT staff (four individuals) who were responsible for the content of the intranet, the only knowledge-management support staff included in the interviews was the IT director responsible for the content of the intranet.

Site 2 – Consulting Inc. Consulting Inc. does technical consulting work for their clients. Examples of organizations in this industry include Accenture, EDS, IBM Global Services, Computer Sciences Corporation, etc. The organization has more than 50,000 employees distributed in many different countries and in different locations within the US. Many consultants work remotely at the clients' office, travel from one office to another, or work at home. Consulting Inc. is an appropriate setting to study the research problem. The organization recognizes the importance of knowledge sharing amongst its consultants and has institutionalized several mechanisms to ensure adequate sharing of knowledge when required.

Compared to Research Inc., Consulting Inc. is a relatively bigger and more geographically dispersed organization. The nature of the jobs undertaken also differs between the two organizations. Research Inc. conducts research work, which tends to be very unstructured and non-routine since repeated tasks (e.g., survey writing) often differ across projects. Consulting Inc., on the other hand, engages in technical consulting. The nature of work conducted by Consulting Inc. is thus relatively more standardized and routine compared to Research Inc.

To collect data in Consulting Inc., the author conducted interviews with 19 individuals in Consulting Inc., and collected extensive information on the knowledge-sharing processes of the organization from the organization intranet. As the consultants in Consulting Inc. work remotely in different cities all over USA, telephone interviews were conducted over a one-month period while the author was based in one of the offices of Consulting Inc. The author also sat in on virtual meetings organized by some knowledge communities, and collected information from a small sample of repositories and communication forums in the organization. Consulting Inc. has institutionalized many knowledge-sharing mechanisms, and information on these mechanisms can be found on their intranet. Hence, a significant amount of information about their knowledge management mechanisms and strategies was collected from the intranet. As Consulting Inc. has a big team of knowledge-management personnel (some full-time, and some part-time), the individuals sampled for the interviews included both knowledge-management personnel as well as project managers and consultants.

The profile of interviewees for Research Inc. and Consulting Inc. is provided in [Table 3](#).

The objective of the data collection exercise was to obtain information about the knowledge-sharing mechanisms used in the two organizations, and to obtain feedback from interviewees about their views on the effectiveness of the mechanisms. Semi-structured interviews were conducted. During the interviews, interviewees were asked to describe the mechanisms they used to share knowledge with others. Interviewees were also probed to elaborate upon specific examples of knowledge sharing or lack of knowledge sharing. The interview protocol is provided in [Appendix A](#). Each interview lasted between

Table 3
Profile of employees interviewed

Description of employees	Number interviewed
<i>Research Inc. – DC site</i>	
Research director	4
Project manager	7
Research associate	10
<i>Research Inc. – CAL site</i>	
Research director	3
Project manager	5
Research associate	7
IT director ^a	1
<i>Consulting Inc.</i>	
Consultant	7
KM staff/manager	6
Project manager	6

^a Research Inc. has only one IT director, and he happens to be housed in the California site.

30 and 60 min. Copious notes were taken during the interviews, and the notes were transcribed within a day. The semi-structured interviews resulted in a rich set of data regarding knowledge-sharing mechanisms.

Data analysis. The data analysis was conducted in four phases. In the first phase, the author used the open-coding technique to code the interview transcripts and other information collected for a comprehensive set of knowledge-sharing mechanisms used by Research Inc. and Consulting Inc. Based on the mechanisms identified in this first round of coding, two additional coders who were blind to the theoretical framework were recruited to recode all the interview documents. This second phase of coding highlighted the text relating to each mechanism. The inter-rater reliability between the two independent coders was good ($\kappa = 86.2$). Based on the results of this phase of coding, some of the categories of knowledge-sharing mechanisms identified in phase 1 were collapsed. No additional knowledge-sharing mechanisms were identified in this second round of coding. The final set of mechanisms identified is listed in Table 4. The coders then conducted a third phase of coding, where the text coded for each type of mechanism was compiled (i.e., each mechanism identified in Table 4 became a unit of analysis). For each type of knowledge-sharing mechanism listed in Table 4, coders then coded the dimensions (personalization versus codification, institutionalize versus individualize). This third phase of coding was to ensure that there was agreement in the classification of the knowledge-sharing mechanisms to different quadrants of the framework. The inter-rater reliability between the two independent coders for the third phase of coding was high ($\kappa = 92.5$). Finally, a fourth phase of coding was conducted to identify the positive and negative statement made with respect to each type of knowledge sharing mechanism. This final phase of coding was conducted in order to evaluate the effectiveness of each knowledge sharing mechanism as perceived by interviewees, and to identify the reasons why interviewees perceived each mechanism to be effective or ineffective. Two independent coders coded the text for each knowledge sharing mechanism resulting from phase 2 of the coding, for positive and negative statements relating to the mechanism. The inter-rater reliability is moderately high ($\kappa = 81.7$). For the above coding

Table 4
Summary of results for coding of positive and negative statements for each knowledge sharing mechanism^a

Code	Mechanisms description	Consulting Inc.		Research Inc.			
				DC		CAL	
		Positive	Negative	Positive	Negative	Positive	Negative
<i>M1</i>	<i>Individualized-personalization</i>						
M1.1	Word of mouth sharing through senior staff			5	1	2	1
M1.2	Personal networks	15	1	15	8	11	3
M1.3	Collaboration tools	3	1				
<i>M2</i>	<i>Individualized-codification</i>						
M2.1	Sharing prior project documents informally	5	3	2	7	4	
M2.2	Manuals written voluntarily			2	3		
<i>M3</i>	<i>Institutionalized-personalization</i>						
M3.1	Meetings among high level staff				1	1	1
M3.2	Project reviews			2	1		
M3.3	One senior person coordinating all staffing needs			2		1	
M3.4	Having a common project director shared across projects			1		1	
M3.5	Cross-staffing across projects			4		2	
M3.6	Setting up a community	13	9	11	6	5	1
M3.7	Support centers	6			2		
M3.8	Staff deployment policies	5	2		4		
<i>M4</i>	<i>Institutionalized-codification</i>						
M4.1	Database	18	9	2	8	1	1
M4.2	Use of templates	6			2		
M4.3	Broadcast emails and forums	3	1	5	5	3	3
M4.4	Expertise directory	5		1	1		2
M4.5	Standardized methodology	7	1				

^a Numbers in the cells refer to the number of interviewees who have provided positive and negative comments about each knowledge sharing mechanism.

exercises, any disagreements between coders were discussed amongst the coders until consensus was reached. Table 4 provides a summary of the results of the final phase of coding.

5. Results – case studies

5.1. Case 1: Research Inc.

Research Inc. has grown very quickly over the past decade, with the number of staff increasing from 494 in 1995 to more than 1000 in 2004. Traditionally, the organization has depended predominantly on individualization and personalization-oriented knowledge-sharing mechanisms. As the organization expanded, however, some of the staff began to realize that many mechanisms for knowledge sharing that had worked in the past would not work if they continued to grow in size and geographical distribution. This was especially the case for the staff at the DC site, as they have grown significantly in size over the past year. The staff at the smaller CAL site, however, felt that the use of such mechanisms had served them well in the past, so they did not see the need to make any changes to help the organization improve knowledge sharing amongst the employees. In the following section, I highlight the key mechanisms used by the DC and CAL sites, and discuss employees' perceptions of the effectiveness of the mechanisms.

5.1.1. *Predominant use of individualized-personalization mechanisms*

Currently, the key mechanisms used for knowledge sharing in Research Inc. are individualized mechanisms predominantly oriented towards personalization. Many interviewees reported that they used word-of-mouth to determine the right individual to approach for knowledge sharing. Many individuals depend on their personal network to find the answers to their questions, or to identify the right people to speak to. One interviewee provided an example:

“We had a project on survey development issues, so we had a discussion about how we were to deal with our limited survey incentive funds. The first person we turned to here was Roger, who is an expert on surveys. Roger will say so and so considered these various options, this person over here has read the literature on survey incentives, why don't you go to him. So you go from person to person, based on what the problem is. You start with the person whom you know is the closest in terms of his expertise and nine out of ten times, they'll refer you to someone.” [Research Director from CAL]

Senior staff and staff with deep institutional knowledge are key sources of referrals and knowledge in Research Inc. One interviewee pointed out:

“I think there are people who have been here for a very long time and they would know things from long ago that you may not know.” [Project Manager from DC]

Research Inc. does not make use of many collaboration tools to enable individuals to gain access to others. The main mode of communication, especially for employees located in geographically separated offices, is through electronic mail and telephone calls. In addition, the organization is investing in setting up video-conferencing capabilities to support greater cross-office collaboration.

DC site: growing dissatisfaction. There is a growing amount of dissatisfaction among the staff in DC about the lack of systematic knowledge sharing amongst the staff. It appears that the growing size of the DC site, due to the recent relocation of three offices into one single location, was one key factor influencing this perspective, as highlighted by one interviewee:

“...when I first got here, we all sort of met in the lunch room at lunch. It was, again, very informal, people will talk, and there’s this whole thing that we’re a family and blah.. but you know... I think we’re not so informal anymore. We’re growing. I don’t know people in the hallways all the time. I’m sure they’re all very interesting people. I just don’t have time to sit down and talk to everybody about what they’re doing. We have the third floor cafeteria now, but its just not the same. We have 300–400 people who share that space. Not sixty...” [Project Manager from DC]

When the organization depends only on individualized personalization processes, they rely significantly on serendipitous encounters between individuals who know one another, or who happen to talk to one another. As an organization grows in size, however, the lack of communication among colleagues who do not but should know one another can become a great challenge (Eagle, 2004). Interviewees in DC complained about the over-reliance on serendipitous encounters that often come too late, and one interviewee provided an illustrative example:

“One of the districts that we’re working with is District A. We’re having a lot of problems collecting data in District A, because the schools in District A are large and problematic with union issues, etc. So While I was at an education conference just last week, I was sitting at lunch with my colleagues, and it turns out we have a huge research study in District A that I didn’t know about. And that we have all these connections in the field in District A. So we started talking, and I go “we’re having these two schools, and we’re having trouble collecting data”. And this person says “oh well at the reception tonight, I will introduce you to the two area coordinators in the district from those areas”, so we all got together, I explained my problem, and now we’re working with them, and they’re helping us to figure it out. If only I had known that, it would have saved me so much time and problems. But its better late than never! But that was a totally random event. That I was at lunch with this person and she mentioned District A, and I said “oh we’re in District A”. “oh you are? What are you doing there?” “collecting data from School A and whatever” “oh, those are the schools I work with” “oh really”... “wow.. that’s really pathetic that we don’t know that”.” [Project Manager from DC]

It was repeatedly pointed out by interviewees that it was not difficult to find information when someone is looking for specific information, but rather that employees do not necessarily know what types of knowledge and information is available to them in the course of their work. Many interviewees pointed out that they often found out after the fact that their work would have been facilitated if they had approached so-and-so for help before they started.

“There’ll be times when you are having a problem with something, and there’s someone in the company who could help you but you don’t know that, and you don’t know who that is, unless someone who’s in your team, or whom you happen to tell

that you're having a hard time dealing with this, and that person knows someone in the company who can share with you their own personal experience, then you're kind of stuck reinventing the wheel." [Research Associate from DC]

In depending on personal networks, there is also a danger that there is a strong tendency for individuals to communicate with others who are most like themselves or who are most likely to agree with them. Over time, individuals may learn to interact selectively to avoid messages and information that might conflict with their established practices and dispositions (Katz, 1982). One interviewee noted:

"I do know that in DC, sometimes, the administrative staff or lower level people will meet with one another or will ask each other first, before asking other senior staff." [Research Associate from CAL]

The increasing need for more systematic knowledge sharing is a view held by across all levels. One research director, for example, pointed out:

"I think that people, when they have a question, there's a number of people they can ask. We can figure out, and we have that information. I think sometimes its difficult for people. That they want everything there, but find that its not as organized as it should be." [Research Director from DC]

Cal site: remains satisfied. In contrast to the DC site, the employees in the smaller California site, with a total of about 80 employees remain satisfied with the informal approach to knowledge sharing – through hallway conversations and by walking over to another person's office to ask for information. This is reflected in the relatively small number of negative comments on the use of personal networks, provided by interviewees in the CAL site, compared to the DC site (see Table 4).

"Our office is so small – I can just stick my head out and say, John, do you know? . . . with the small size of our office, people know what others do . . ." [Research Associate from CAL]

"For example, we're working on translating a survey into Spanish. I'm sure if I hadn't run into someone, I could have just asked around and found someone rather quickly." [Research Associate from CAL]

In a small site, people get to know one another easily, and the frequent conversations with one another make serendipitous encounters come about more frequently.

"So, we often talk to one another to find out what we are doing in other prior projects, and then see if we can adopt or modify their approach for what I am doing." [Project Director for CAL]

The only problem pointed out by interviewees in the CAL site in predominantly using an individualized personalization approach is that depending on personal networks is more difficult for people who are new to the organization, although they note that this can be mitigated by having the guidance of supervisors who can refer them to the right people to approach. One interviewee noted:

"I guess it's harder when you are new. I think it is not an inefficient system for old people, but can be very difficult for new people. But then again, when I was new, I

just asked [my supervisor], and she will tell me who I can ask.” [Research Associate from CAL]

5.1.2. *Institutionalizing personalization mechanisms*

As Research Inc. realizes the need to enable some amount of systematic knowledge sharing, the organization has begun to institutionalize some of its knowledge-sharing mechanisms. For example, the organization recognizes the key role played by the senior staff in brokering knowledge sharing between individuals and project teams. Hence, they provide for staff meetings amongst the senior staff so that they can learn about the projects others at their level are directing, and they can, in turn, disseminate the information to the junior staff who approach them for information. Other meetings, such as the annual meeting for senior staff to discuss the performance evaluations of the junior staff, also sometimes turn out to provide key knowledge-sharing opportunities. Through these meetings, senior staff learn about the strengths and expertise of the junior staff, whom they may not even have met before. Some of the program areas in the organization have a senior staff overseeing all the staffing needs of the program. This provides the senior staff with intimate information of all the researchers in the program area. As a result, s/he can be the key person to broker knowledge sharing opportunities, and s/he is in a good position to know about the capabilities, expertise and availability of the staff they can use to bid on proposals.

Such mechanisms, however, rely significantly on senior staff, and it may be very expensive to rely on knowledge sharing meetings amongst senior staff, as senior staff are paid the highest salaries in the organization. As highlighted by one interviewee:

“We [research directors] used to meet regularly over video conferencing. That was helpful to share knowledge and knowing what we are doing, but it is also very expensive. People got tired of meeting so often. It is also not efficient for the company’s highest paid people to be sitting around. So we all agreed to keep those meetings to the minimum as an as needed basis.” [Research Director from CAL]

The organization also makes use of cross staffing – in certain projects that have the same clients, or that center around a similar topic, the organization ensures that some of the staff work across projects, and in some cases, the organization uses the same project director across projects. This is a good way of ensuring that similar policies are applied across projects (e.g., a similar way of defining variables). Senior staff are sometimes also assigned to review specific projects so that they can help to identify aspects of the project that appear less developed and then point out the right people the project team can approach. Having senior staff review projects, however, may again be expensive, as highlighted by one interviewee:

“If you want some more formal and involved participation that requires action, then you’ll have to figure out a way to support the time of that individual on your project, and that’s when it gets more tricky. Say I have a report, given how this document is structured, it will be a valuable resource to have this someone review it. Then that would probably take a couple of days of that person’s time and you need to figure out a way to support that. Since you’re leveraging senior people, their time is a lot more expensive too.” [Project Manager from DC]

Research Inc. is thus increasingly institutionalizing personalization mechanisms to support knowledge sharing amongst their staff, although the mechanisms tend to rely significantly on senior staff and employees are cognizant of the increased costs for the organization. One other mechanism that Research Inc. is trying to institutionalize, that depends less on senior staff is the setting up of communities. Research Inc. uses communities on a voluntary basis where individuals with similar interests are often invited to brown bag presentations or meetings, thus providing the forum for the discussion of substantive issues in a topic area (e.g., child education) and for the dissemination of information. The activities of these communities, however, appear to be limited to only occasional meetings, and this limited scope of activities appears to restrict the effectiveness of this mechanism in Research Inc. One interviewee reported that the community meetings often depended on the initiative of a few people, and the meetings tended to be dominated by certain people:

“It was more of the senior folks that were dominating the conversation . . . I felt I did not have much to contribute, and since I did not have much background knowledge of the area, and I don’t feel it is appropriate to interrupt the flow of conversation.”
[Research Associate in DC]

5.1.3. *Use of codification mechanisms*

Research Inc. also uses an individualized approach for sharing codified knowledge. When individuals and project teams reuse project documents from prior projects, such as proposals, budgets, and project reports, the documents are usually found through personal networks and referrals. Institutionalized codification-oriented knowledge-sharing mechanisms currently play a minor role in Research Inc. The organization is only in the beginning stages of establishing a database for the staff resumes and project abstracts. Hence, the databases are incomplete and not updated. There are also few “boiler plates” or templates available for frequently repeated tasks and write-ups (e.g., a section in the proposal, which lists the types of capabilities and research projects the organization has engaged in within a particular topic area). While this situation describes knowledge sharing in both the DC and CAL sites, I again observed differences in the extent to which the staff were satisfied with the lack of institutionalized codification mechanisms. This is also reflected in the relative larger number of negative comments relating to lack of database and use of templates in the DC site compared to the CAL site (see [Table 4](#)).

DC site: growing dissatisfaction. Interviewees in DC generally noted their dissatisfaction with the search process for documents using an individualization approach, as it requires considerable time to locate the right document. Interviewees in DC point out that in figuring out whom to ask, and people would often rather start from scratch rather than spend time figuring out who would be the best person to approach. One interviewee noted:

“There’s no one central location where the capability statements are. So you go to your friend.. hey Nancy, remember you worked on that project, do you have anything about that? Oh yeah, sure. Let me look through my files. So she’ll look through her files and send you the capability statement. But if you’re new, you don’t know Nancy worked on that project. You don’t know who to ask to find it. And similarly, I had asked this other person. Hey, we can’t find this capability statement for this thing, do you know who has it.. and you follow the referrals. I cannot tell you

how often.. it probably happens to me twice a week when we're doing proposals. That's the way you do capability statements." [Project Manager from DC]

Interviewees also point out that they frequently produce work which they think will be likely to be useful to others, but find that there is no systematic way to share it with other people:

"There are sometimes when you've done something, then someone says, 'oh, so and so already did that.' And I think 'I wish I had known this, and I wouldn't have wasted my time.' Or I would have been able to incorporate some of their elements into whatever I did. And there's the other side, when I've done something, and I hear someone else doing it and I think that maybe it'll be more efficient if there were some institutional way to make this easily accessible to other folks." [Research Associate from DC]

Even when individuals try to reduce re-invention of the wheel by documenting know-how or procedural knowledge about certain topics by writing manuals on topics such as website maintenance, and large-scale data collection, this was done on an informal basis, with some individuals taking the initiative to write the manual, but not disseminating the manual systematically, and only "passing it around" to individuals who knew of its existence. On the other hand, there are individuals noting how useful it would have been to have some templates and manuals written up for others to readily access:

"Many times, we have people emailing one another asking for broiler plates for different things, like focus groups, or survey, etc. We do use focus groups and surveys all the time. So it will be nice to have more broiler plate like templates, etc. for these." [Project Manager from DC]

Cal site: no complaints. The informal approach of knowledge sharing appear to work more effectively in CAL, as a small and collocated organization where information is freely available and the high density of ties ensures that all knowledge is effectively diffused within the organization. One interviewee noted:

"For the most part, I think it has been reasonably successful to ask around for documents informally. For DC, I don't think we have that, but for here, given we're so small, I think it'll be easier to ask around." [Research Associate from CAL]

Interviewees in CAL, in fact, appeared to dislike the use of technology for institutionalizing codified knowledge. One interviewee, for example, expressed her preference for using her informal network rather than to look up an expertise directory:

"Sometime back, I was looking for someone, and I decided to call someone whom I knew was available. I could have looked at the spreadsheet, and looked at the skills of people, but I may have had to call ten people before I found out who was available, while in this case, I knew I could just call on this one available person." [Project Manager from CAL]

5.1.4. *Summary for Research Inc.*

The difference between the views of employees at the DC site and the CAL site for Research Inc. presents an interesting contrast. Research Inc., as a whole used more of

an individualized personalization approach (complemented with an individualized codification approach) for knowledge sharing. Employees in DC, however, were beginning to see the problems with such an approach given that the occasions of useful knowledge sharing becomes much more serendipitous, and dependent on whether employees “happen to speak to the right person” about their problems and needs “at the right time”. DC interviewees thus see the need to institutionalize mechanisms to increase the probability of useful knowledge sharing, and seek to “push” information and knowledge to others, instead of simply depending on individuals to “pull” knowledge from the right sources. CAL interviewees, due to their smaller size, were able to share knowledge effectively using a predominantly individualized approach. Hence, they did not see the need for institutionalizing knowledge-sharing mechanisms.

5.2. Case 2: *Consulting Inc.*

Given the large size and wide geographical dispersion of Consulting Inc., the organization recognizes that they cannot rely solely on individualized knowledge-sharing mechanisms to effectively share knowledge amongst consultants. Hence, the organization has institutionalized many knowledge-sharing mechanisms. Consulting Inc., however, not only institutionalizes codification mechanisms, such as databases, and archived forums, but they are also aware of the importance of personalized interactions; hence, they have institutionalized several mechanisms to support that.

5.2.1. *Institutionalized personalization mechanisms*

Given that Consulting Inc. is so large and employees often work remotely, they cannot depend on serendipitous encounters for knowledge sharing to take place. They therefore institutionalized several mechanisms to expand the individuals’ network beyond the immediate coworkers in regular and routine contact with the individual, and to provide easy access to experts when required. To do this, the organization deploys experts into positions where they can disseminate knowledge easily to others. For example, Consulting Inc. tries to deploy the right individuals into a project by making use of a tool that details the experience and expertise of each consultant. This ensures that project teams have the right expertise and experience to tap on during the execution of the project.

Consulting Inc. also sets up a help desk using experts with many years of consulting experience. These experienced consultants are assigned to help and advise other consultants on customer engagements when the consultants on the field encounter problems that they cannot solve. These experts actively generate solutions for consultants on the field, and sometimes even help consultants negotiate through the social and political aspects around the issues. Using experts as knowledge bases provides several advantages. First, the experts can provide customized advice for each problem for which they are approached. Second, given the years of experience that these experts have accumulated, they have a wide network of contacts to draw upon. Hence, they can effectively broker knowledge linkages between individuals with problems to other consultants with potential solutions. Third, the experts themselves can benefit from accumulating experience in repeatedly searching for information from their contacts and archives, such that they build up an extensive mental model of who knows what as well as a large set of archives developed from previous interactions with their own client-consultants (Halverson, 2004). One interviewee, for example, noted:

“If consultants are still unable to find the necessary information after talking to people, then they can approach these experts at knowledge point, and these experts will use sources of information that the consultants will not even think of.” [Project Manager]

In addition, the organization relies extensively on the use of communities of practice (Brown & Duguid, 2001) by bringing together individuals who are in a similar practice or have common interests. The organization assigns a group of 15–120 consultants to the core team of each knowledge network, and these core team members are responsible for organizing and managing the activities in that knowledge network. Some knowledge networks are funded by the management, while others have come about as a result of the voluntary efforts of a small group of people. The core team members contribute to these activities voluntarily in their free time. These communities of practice are very useful in providing the group identity and motivation to share knowledge with others in the community. One interviewee provided an example of how he benefited from the community:

“So we sent a message asking a community for help. Within a few days, people have sent me a compilation of the one-to-one mapping. Some people had bits and pieces of it, and others were already doing some work related to it. I chose to use a community because I think it is probably the fastest way.” [Consultant]

Individuals also benefit from increased visibility and reputation, as noted by one interviewee:

“I presented in a conference call and I ended up building a community world wide of people with networking experience and expertise. I was also a core team for the architecture knowledge community. Through these activities, I gained quite a bit of visibility worldwide.” [Project Manager]

Due to the voluntary nature of participation, however, consultants often face problems relating to lack of time and funding, as time spent on these community activities affect their ability to hit utilization targets for their billing hours. Consultants may sometimes even be discouraged from participating by their managers. As noted by one interviewee:

“For me there are no obstacles but I know very well that many people think that it affects their ability to make their utilization targets, also I suspect management discourages it in many areas. Fortunately, my management line supports my involvement. Though I know of other people whose utilization targets prohibit participation.” [Consultant]

5.2.2. *Institutionalized codification mechanisms*

Consulting Inc. institutionalizes several codification-oriented knowledge-sharing mechanisms. Two of the most important codification oriented mechanisms used by Consulting Inc. are highlighted in this section. Given the geographically distributed nature of the firm, the reuse of intellectual capital produced in prior engagements has become a key mechanism for sharing experience across projects. The organization has invested in a centralized repository where individuals would deposit the intellectual capital they have created in the prior projects. In addition, sub-units and communities also have their

own localized repository to facilitate sharing of intellectual capital that are specific to the local practice or to a particular country.

The centralized database mainly serves consultants who help customers to implement and manage IT systems and resources (e.g., in systems development, implementation and support or managing customers' e-business strategy, etc.). The repository provides references of customer projects, as well as customer information to help consultants convince customers that the company has the necessary experience and expertise to provide satisfactory service to the client. The repository also stores prior proposals and engagement work products (e.g., key project deliverables) that consultants can reuse. Each submission to this centralized repository has to be reviewed by the core team in a knowledge network before it is accepted into the repository. Interviewees generally found the repository to be useful, especially if they were working remotely and have few chances to interact with other colleagues working in an area. One interviewee noted:

“Usually, it is hard to communicate with others doing similar type of work in the company, because they are all distributed in different places. I live in the West coast and that can be even more isolating. People in smaller offices have less people, so they have fewer assets developed and shared among one another. So we tend to need to glean a lot of the leading edge work from databases.” [Consultant]

Many consultants do not simply download materials from the repository. They also make use of the repository to identify experts in an area, and they would follow up with the expert to obtain more information or more documents in the area. The repository was therefore effective in bridging individuals even across continents. One interviewee provided an example:

“The authors that I contacted were very forthcoming with their experiences. They were all very willing to talk. There was an individual – Greg, I think, in Europe who had just finished delivering an e-business contract and his customer had asked him to give a presentation on e-business software testing. He readily shared his presentation with me, and the graphics on his slides made up about 30% of the graphics I used in the course. I gave him credit in the course and he got lots of calls from the students following up with him and he got validation about what he was doing, and he also increased his professional network.” [Consultant]

To implement and maintain a knowledge repository, however, is a challenging task. A significant amount of resources is needed to maintain the knowledge repository. One Knowledge Management Specialist recounted the challenges faced in managing the repository:

“First, due to the decentralized way of management, each knowledge network has categorized its intellectual capital (IC) according to what it thinks is the best. However, the IC are meant to be shared across different knowledge networks, but because there is no consistent taxonomy, it may be difficult for people to locate what they need. We are trying to make things more consistent by trying to implement a taxonomy, but it has, unfortunately not received a tremendous amount of support. It is very hard to have to go back and try to re-categorize what has already been there.” [KM Support Staff]

Despite the efforts to maintain the repository, there are still individuals who complain about the difficulties in searching for the relevant document because there are too many documents:

“It’s difficult to find something that meets your needs or what you are searching for. There is too much information that is of little help.” [Consultant]

Prior research has shown that having a shared interpretive schema will significantly help users to reuse knowledge from a knowledge repository (Boh, 2005). To facilitate the sharing of knowledge, Consulting Inc. trains all its consultants in a common methodology for project management. Consulting Inc. defines a set of proprietary methodology or engagement models and frameworks for consultants to make use of in different types of engagement, a common practice amongst consulting firms. The methodology set defined by Consulting Inc. is an encapsulation of the best practices that the organization has observed to work in the experience of conducting hundreds and thousands of engagements. Other than outlining the activities for different types of engagements, there are even frameworks and reference architectures (architecture frameworks that serve as a model for a particular type of system) guiding consultants on how they can help customers to work through their problems. These methodologies influence the work of the consultants via their internalized understanding of the method (Werr & Stjernberg, 2003). After becoming internalized by each consultant, this set of methodology serves as a common language and approach to thinking of problems that can greatly help the sharing of knowledge and experience across projects. Each methodology has a set of templates and checklists that are relatively simple forms of codified knowledge that can be reused across engagements. The internalization of the methodologies thus helps consultants not only in understanding and reusing these simple forms of codified knowledge, but also in encouraging them to make use of more complex work products that result from the implementation of a methodology. One interviewee summarized the impact of the shared interpretive schema very well with the following quote:

“Since the team had all been trained the same way, and since we were all working on an agreed approach towards completing predefined and prototyped deliverables, ramp up speed was greatly reduced, and everyone from [Consulting Inc.] was speaking the same language instantly. [This is] very good for teamwork, and the team appeared to have worked together before in the eyes of the client [even though we haven’t]. In addition, the quality of the deliverables (especially the IT Strategy coming out of the IT Infrastructure analysis) was definitely improved. Project cycle times were reduced. Collectively this all lead to increased customer satisfaction.” [Project Manager]

5.2.3. *Individualized personalization and codification mechanisms*

Although Consulting Inc. places significant emphasis on institutionalized mechanisms for knowledge sharing, consultants still make use of individualized mechanisms, such as word of mouth sharing of information through personal networks. As noted by one interviewee:

“My first choice is always the people that I worked with – the people whom I know I can trust as being very knowledgeable. It is usually much faster to search through people that I know... It is more useful to look for people in my practice mainly

because the domain that they work on is more similar and I know more about the context that they were doing their work on.” [Consultant]

Even though a centralized repository was available, individuals may sometimes choose to tap on their own personal network, especially if they knew who to approach:

“I asked around my Project Management peers – those who report to the same management within my unit, obtained a sample template, and adapted it for my purposes. I went to my peers instead of using the database because I felt that it was faster, given that it was very time-sensitive. I felt that it would be faster to approach my peers because they were working directly in this area.” [Project Manager]

In conducting the study, I observed that it was a norm for people in Consulting Inc. to approach others whom they do not know for knowledge or information, and frequently, these individuals are not even located in the same office as them. This is because Consulting Inc. has invested significantly in collaboration tools such as instant messaging, lotus notes, and other proprietary tools extensively to facilitate communicate between consultants. The use of these collaboration tools are very prevalent, and it is the norm in the organization for consultants to communicate using these collaboration tools, even when they are collocated in the same building.

6. Discussion

In comparing Research Inc. and Consulting Inc., significant differences are observed between these two organizations that affect the portfolio of knowledge-sharing mechanisms adopted by the organizations. First, the two organizations differ significantly in terms of size and geographical dispersion. Research Inc. has about 1000 professional staff distributed in nine geographical locations mostly in the United States, while Consulting Inc. has more than 50,000 professional staff distributed in hundreds of geographical locations globally. Second, the nature of the jobs undertaken also differs between the two organizations. Research Inc. conducts research work, which tends to be very unstructured and non-routine since repeated tasks (e.g., survey writing) often differ across projects. Consulting Inc., on the other hand, engages in technical consulting.

Some observations that distinguish between the knowledge-sharing mechanisms used in Research Inc. and Consulting Inc. can be made from [Table 4](#):

1. Institutionalized codification mechanisms were used more extensively in Consulting Inc. compared to Research Inc.
2. Although Research Inc. uses some institutionalized-personalization mechanisms, the institutionalized-personalization mechanisms adopted by Research Inc. (meetings among senior staff, project reviews, common project director) tend to be less systematic and less scalable than mechanisms adopted by Consulting Inc., which tend to be more systematic and have a wider reach (setting up communities, support centers, and staff deployment policies).
3. Both Consulting Inc. and Research Inc. use individualized mechanisms, although through the interviews, it is observed individualized mechanisms are used in Consulting Inc. generally to tap on existing personal networks and to share knowledge with colleagues within the same unit.

4. There are more negative comments about individualized mechanisms and about the lack of institutionalized mechanisms by interviewees in DC than CAL.

Based on these observations, it appears that the differences in the size and geographical dispersion of the organizations affect the extent to which organizations depend only on the use of individualized knowledge-sharing mechanisms. As Consulting Inc. is much bigger and geographically dispersed, institutionalized mechanisms help them to extend the reach of knowledge-sharing mechanisms for the specific areas of knowledge that they want to exploit. In addition, the contrast in the views of DC and CAL sites in Research Inc. further illustrates that as an organization grows in size, it becomes increasingly more difficult to rely predominantly on individualized knowledge-sharing mechanisms. This provides support for Proposition 2, which states that institutionalize knowledge-sharing mechanisms are more suitable for bigger and more geographically dispersed organizations.

Second, due to the differences in the nature of work between Research Inc. and Consulting Inc., the role of codification mechanisms tends to differ between the two organizations. Research Inc. conducts research projects. Although many research projects follow the same steps – conceptualization, proposal writing, data collection, data analyses, etc. – each research project, even if it is in the same domain, tends to differ significantly from others, given that novel and original contributions to the existing body of work are valued in the field of research. Consulting Inc., on the other hand, engages in technical consulting. The work conducted by Consulting Inc. includes both standardized work like systems implementations, and also less routine tasks like consultation regarding strategic IT management for their clients. Hence, Consulting Inc. engages in a range of both standard and non-standard jobs. In performing standardized work such as implementing the SAP system in Company X, the tasks do not differ much from one project to another. In addition, the clients of consulting firms value a track record and the use of consistent, tried-and-true methodologies that allow them to build upon the best practices of other organizations. Hence, more so than Research Inc., the nature of work in Consulting Inc. discourages re-inventing the wheel, and encourages building upon the experience of prior projects. Hence, Consulting Inc. makes use of more codification mechanisms to share knowledge across projects relative to Research Inc. Personalization mechanisms also play a critical role due to their involvement in a range of both standard and non-standard work. This provides some support for Proposition 1, which states that codification knowledge-sharing mechanisms are more suitable for organizations conducting projects that are more repetitive in nature, while personalization knowledge-sharing mechanisms are more suitable for organizations conducting projects less routine in nature.

6.1. Limitations

This study has some limitations and it raises questions which future research should address. First, this study has only examined two possible factors influencing the suitable portfolio of mechanisms that organizations should adopt – size and geographical dispersion; and nature of work. It is conceivable that there can be other factors influencing the portfolio of knowledge-sharing mechanisms that should be adopted, such as the culture of the organization. Hence, future research could examine other organizational factors that are likely to influence the suitable mechanisms portfolio. Second, this study has only examined the knowledge-sharing mechanisms used in two organizations. Hence, it does not

constitute a valid test of the propositions. Hence, future research can collect data about the knowledge-sharing mechanisms across a bigger group of organizations to test the propositions. It would also be interesting to collect data longitudinally to examine if the suitable portfolio of mechanisms would change as the characteristics of an organization change. Finally, this study made use interview statements from a small sample of individuals within each organization to make evaluations about employees' views of the effectiveness of the knowledge-sharing mechanisms. Future research can adopt a more systematic manner of evaluating the usefulness of each mechanism from a larger pool of employees.

6.2. *Contributions and implications*

While several studies have identified the dimensions of formal versus informal, and codification versus personalization learning mechanisms (e.g. Jordan & Jones, 1997; Nevis, Anthony, & Gould, 1995), none of the prior studies have examined how these two dimensions interact with one another. Many researchers (e.g. Choi & Lee, 2003) assume these two dimensions to be similar to each other, and have not adequately differentiated between these two dimensions. This paper, however, distinguishes between individualization versus institutionalization and personalization versus codification as two distinct and independent dimensions. A framework is provided that identifies how various types of knowledge-sharing mechanisms would be classified in each of the four quadrants representing the interaction of the two dimensions. This study thus contributes to research by providing a more nuanced and systematic classification of knowledge-sharing mechanisms used by project-based organizations. This would enable future researchers to systematically compare across portfolios of knowledge-sharing mechanisms adopted by different project based organizations. The study also provides propositions to guide researchers about key factors affecting a suitable portfolio of knowledge-sharing mechanisms for project-based organizations.

To managers, this study highlights the need to recognize the usefulness of the knowledge-sharing mechanisms that are in quadrant 2 – individualized-codification mechanisms, where individuals exchange codified mechanism through informal and unstructured means, rather than going through a centralized database; and the mechanisms in quadrant 4 – institutionalized-personalization mechanisms, where organizations embed within the organizational structure and routines capabilities for individuals to approach other individuals for knowledge sharing.

The use of institutionalized-personalization mechanisms can help organizations to resolve their dilemma by helping organizations to overcome the limitations of the reach-and-richness trade-off. Institutionalized-personalization mechanisms can increase the reach of knowledge-sharing by creating awareness of the knowledge availability and enabling potential receivers to access potential knowledge sources (Chai et al., 2003). Yet institutionalized-personalization mechanisms can increase the richness of knowledge-sharing since the actual sharing of information is taking place via personalization mechanisms that are capable of transferring a large amount, as well as a variety of information at one time, and allow high interactivity between senders and receivers.

As for individualized-codification mechanisms in Quadrant 2, while they appear to be a rather inefficient way to share knowledge, such knowledge-sharing mechanisms nevertheless play an important role in the knowledge sharing process. A lot of knowledge and information is codified in various artifacts in the organization in the process of completing

project and proposal work, such as project reports and proposals. These artifacts serve as important means to share knowledge (Boh, 2005). Not many organizations have the ability and resources to invest in building electronic databases and allowing employees to easily search these databases. Even if databases do exist, individuals may not be motivated to contribute to the databases (Kankanhalli, Tan, & Wei, 2005). Hence, many potentially useful documents sit in hard disks, or shared spaces accessible only to certain project teams. These documents can still be useful for knowledge sharing if they can be shared through more informal means.

The empirical studies show the usefulness of the framework in evaluating the use of knowledge-sharing mechanisms, and in analyzing the fit of the mechanisms with organizational characteristics. For example, in the case of Research Inc.'s DC site, it is likely more suitable for them to increase the use of institutionalized personalization mechanisms, as they appear to fall between quadrants 1 and 4 in Table 2, but they were using predominantly individualized personalization mechanisms. This may explain why there was increasing dissatisfaction amongst the staff of the DC site in the knowledge-sharing mechanisms currently used in the site. This shows that future research can use the framework to provide a systematic way of characterizing and comparing across the knowledge-sharing mechanisms used in PBOs.

7. Conclusion

This paper contributes to the research in organizational learning and knowledge management by highlighting that knowledge sharing is not only restricted to individualized-personalization mechanisms and institutionalized-codification mechanisms. The paper highlights that knowledge sharing and retention does not necessarily mean having to codify all individual employees' knowledge so that the knowledge will be retained and shared with others in the organization. Instead, another key approach to retain and share knowledge is by ensuring that the knowledge is shared with and diffused amongst other employees in the organization. By institutionalizing various personalization knowledge-sharing mechanisms to help individuals share knowledge with a group of individuals, organizations can ensure that person-to-person knowledge sharing is not simply serendipitous but is more systematic.

The case studies highlight that a different portfolio of knowledge-sharing mechanisms is suitable for organizations with different size, geographical dispersion and job nature. Depending on their characteristics, organizations should therefore use a different portfolio of knowledge-sharing mechanisms. If an organization is large and geographically dispersed, it should probably consider institutionalizing its knowledge-sharing mechanisms. In this case, organization should note that the knowledge-management program implemented can encompass the institutionalization of personalization and/or codification oriented knowledge-sharing mechanisms. The knowledge sharing that takes place in the organization should be pervasive, and not only restricted to the use of repositories and technologies to store and transmit information. Organizations should examine different ways of organizing their work, deploying their personnel, or making use of organizational routines and organizational structure to ensure that systematic knowledge sharing takes place amongst their employees. Other times, however, a knowledge-management program may not even be required if the best approach to share knowledge is through individualized personalization means. This paper therefore provides guidance to organizations in

evaluating a suitable portfolio of knowledge-sharing mechanisms to adopt based on their organizational characteristics.

Acknowledgements

I thank Cecil Chua, Sara Kiesler, Denise Rousseau, Sia Siew Kien, and Daniel Yellin for their help and advice in the development of the paper. An earlier version of this paper was presented at the 2004 International Conference of Knowledge Management in Singapore and at the 2005 Academy of Management Conference in Oahu, Hawaii. Preparation of this essay was supported by NSF Grant ITR IIS-9872996.

Appendix A. Interview protocol

Interview questions:

1. How many years have you been in the organization, what was your experience prior to joining this organization?
2. What is your area of specialization? or What is your expertise and training in? What types of projects are you engaged in?
3. What is your typical role in a project? (Project Manager? Etc.)
4. What types of approaches and mechanisms do you and your colleagues use to share information about projects? In your opinion, which approaches and mechanisms are the most useful?
5. Think about a recent project where you felt you met with a lot of problems, or one you found particularly challenging. Can you identify an incident in this project where sharing knowledge with someone in your project team or outside your project team particularly helped your work.
6. Conversely, can you identify an incident where you think the lack of knowledge sharing adversely affected the project?
7. Are there times when you want to find out about whether prior projects have done similar work, or whether they have faced similar problems before?
 - a. In those times, whom do you typically go to for such information?
 - b. Can you provide examples?
 - c. Have you had trouble obtaining such information before?
 - d. Do you have an example of something someone (or you) did that was an outstanding way to share information?

(*Note.* A customized set of questions was used (sometimes for specific types of mechanisms) when interviewing knowledge management personnel.)

References

- Ackerman, M. S., & McDonald, D. W. (1996). Answer garden 2: Merging organizational memory with collaborative help. Paper presented at the ACM conference on computer-supported cooperative work (CSCW '96).
- Allen, T. J. (1977). *Managing the flow of technology: Technology transfer and the dissemination of technological information within the R&D organization*. Cambridge, MA: MIT Press.

- Argote, L. (1999). *Organizational learning: Creating retaining, and transferring knowledge*. Norwell, MA: Kluwer.
- Bhatt, G. D. (2001). Knowledge management in organizations: Examining the interaction between technologies, techniques and people. *Journal of Knowledge Management*, 5(1), 68–75.
- Boh, W. F. (2005). Reuse of intellectual capital from repositories: A mixed methods study. Paper presented at the academy of management meeting, Honolulu, Hawaii.
- Borgatti, S. P., & Cross, R. (2003). A relational view of information seeking and learning in social networks. *Management Science*, 49(4), 432–445.
- Brown, J. S., & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organization Science*, 12(2), 198–213.
- Brusoni, S., Prencipe, A., & Pavitt, K. (2001). Knowledge specialization, organizational coupling, and the boundaries of the firm: Why do firms know more than they make? *Administrative Science Quarterly*, 46, 597–621.
- Cabrera, A., & Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization Studies*, 23(5), 687–710.
- Chai, K. H., Gregory, M., & Shi, Y. (2003). Bridging islands of knowledge: A framework of knowledge sharing mechanisms. *International Journal of Technology Management*, 25(8), 703–727.
- Choi, B., & Lee, H. (2003). An empirical investigation of KM styles and their effect on corporate performance. *Information and Management*, 40(5), 403–417.
- Cooper, K. G., Lyneis, J. M., & Bryant, B. J. (2002). Learning to learn, from past to future. *International Journal of Project Management*, 20, 213–219.
- Cowan, R., David, P., & Foray, D. (2000). The explicit economics of knowledge codification and tacitness. *Industrial and Corporate Change*, 9(2), 211–253.
- Cross, R., & Borgatti, S. P. (2000). The ties that share: Relational Characteristics that contribute to knowledge flow and organizational learning. Paper presented at the sunbelt social network analysis conference, Vancouver, British Columbia.
- Crossan, M. M., Lane, H. W., & White, R. E. (1999). An organizational learning framework: From intuition to institution. *Academy of Management Review*, 24(3), 522–537.
- Daft, R. L., & Huber, G. (1987). How organizations learn: A communication framework. *Research in the Sociology of Organizations*, 5(2), 1–36.
- Davenport, T. H., De Long, D. W., & Beers, M. C. (1998). Successful knowledge management projects. *Sloan Management Review*, 39(2), 43–57.
- Davies, A., & Brady, T. (2000). Organizational capabilities and learning in complex product systems: towards repeatable solutions. *Research Policy*, 29(7), 931–953.
- DeFillippi, R., & Arthur, M. (1998). Paradox in project-based enterprise: the case of film making. *California Management Review*, 40(2), 125–139.
- Eagle, N. (2004). Can serendipity be planned? *MIT Sloan Management Review*, 46(1), 10–14.
- Earl, M. (2001). Knowledge management strategies: toward a taxonomy. *Journal of Management Information Systems*, 18(1), 215–233.
- Evans, P., & Wurster, T. (1997). Strategy and the new economics of information. *Harvard Business Review*, 75(5), 71–82.
- Finholt, T. A. (1993). Outsiders on the inside: Sharing information through a computer archive. Unpublished doctoral dissertation. Carnegie Mellon University, Pittsburgh.
- Franklin, B., William, S., & Johanna, H. S. (2003). Interaction, identity and collocation: what value is a corporate campus? *Journal of Corporate Real Estate*, 5(4), 344.
- Goodman, P. S., & Darr, E. D. (1998). Computer-aided systems and communities: mechanisms for organizational learning in distributed environments. *MIS Quarterly*, 22(4), 417–440.
- Granovetter, M. S. (1982). The strength of weak ties: A network theory revisited. In P. V. Marsden & N. Lin (Eds.), *Social Structure and Network Analysis* (pp. 105–130). Beverly Hills, CA: Sage.
- Halverson, C. A. (2004). The value of persistence: A study of the creation, ordering and use of conversation archives by a knowledge worker. Paper presented at the 37th annual Hawaii international conference on system sciences (HICSS'04), Big Island, Hawaii.
- Hansen, M. T. (1999). The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44(1), 82–111.
- Hansen, M. T., & Nohria, N. (2004). How to build collaborative advantage. *Mit Sloan Management Review*, 46(1), 22–30.
- Hansen, M. T., Nohria, N., & Tierney, T. (1999). What's your strategy for managing knowledge? *Harvard Business Review*, 77(3), 196–206.

- Hargadon, A., & Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. *Administrative Science Quarterly*, 42(4), 716–749.
- Hinds, P., & Pfeffer, J. (2003). Why organizations don't know what they know: Cognitive and motivational factors affecting the transfer of expertise. In M. Ackerman V. Pipek & V. Wulf (Eds.), *Sharing expertise: Beyond knowledge management* (pp. 1–22). Cambridge, MA: MIT Press.
- Hobday, M. (2000). The project-based organization: an ideal form for managing complex products and systems? *Research Policy*, 29(7), 871–893.
- Holmqvist, M. (2004). Experiential learning processes of exploitation and exploration within and between organizations: An empirical study of product development. *Organization Science*, 15(1), 70–81.
- Hoopes, D. G., & Postrel, S. (1999). Shared knowledge, “glitches,” and product development performance. *Strategic Management Journal*, 20(9), 837–865.
- Jones, G. R. (1986). Socialization tactics, self-efficacy and newcomers' adjustments to organizations. *Academy of Management Journal*, 29(2), 262–279.
- Jordan, J., & Jones, P. (1997). Assessing your company's knowledge management style. *Long Range Planning*, 30(3), 392–398.
- Kankanhalli, A., Tan, B. C. Y., & Wei, K. K. (2005). Contributing knowledge to electronic knowledge repositories: an empirical investigation. *MIS Quarterly*, 29(1), 113–143.
- Katz, R. (1982). The effects of group longevity on project communication and performance. *Administrative Science Quarterly*, 27, 81–104.
- Krackhardt, D. (1992). The strength of strong ties: The importance of philos in organizations. In N. Noria & R. Eccles (Eds.), *Networks and organizations* (pp. 216–239). Boston, MA: Harvard Business School Press.
- Lam, A. (2000). Tacit knowledge, organizational learning and societal institutions: An integrated framework. *Organization Studies*, 21(3), 487–513.
- March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, 2(1), 71–87.
- Mason, J. (2002). *Qualitative researching* (2nd ed.). London, UK: Sage.
- Massey, A. P., & Montoya-Weiss, M. M. (2006). Unraveling the temporal fabric of knowledge conversion: a model of media selection and use. *MIS Quarterly*, 30(1), 99–114.
- Menon, T., & Pfeffer, J. (2003). Valuing internal vs. external knowledge: explaining the preference for outsiders. *Management Science*, 49(4), 497–513.
- Meyerson, D., Weick, K. E., & Kramer, R. M. (1996). Swift trust and temporary groups. In R. M. Kramer & T. R. Tyler (Eds.), *Trust in organizations: Frontiers of theory and research* (pp. 166–195). Thousand Oaks, CA: Sage.
- Moreland, R. L., & Myaskovsky, L. (2000). Exploring the performance benefits of group training: transactive memory or improved communication? *Organizational Behavior and Human Decision Processes*, 82(1), 117–133.
- Nevis, E., Anthony, D., & Gould, J. (1995). Understanding organizations as learning systems. *Sloan Management Review*, 36(3), 73–85.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14–37.
- O'Reilly, C. A. (1982). Variations in decision makers' use of information sources: the impact of quality and accessibility of information. *Academy of Management Journal*, 25, 756–771.
- Olivera, F. (2000). Memory systems in organizations: an empirical investigation of mechanisms for knowledge collection, storage and access. *Journal of Management Studies*, 37(6), 811–832.
- Owen, J., Burstein, F., & Mitchell, S. (2004). Knowledge reuse and transfer in a project management environment. *Journal of Information Technology Cases and Applications*, 6(4), 21–35.
- Polanyi, M. (1962). *Personal knowledge: Toward a post-critical philosophy*. New York: Harper Torchbooks.
- Prencipe, A., & Tell, F. (2001). Inter-project learning: processes and outcomes of knowledge codification in project-based firms. *Research Policy*, 30(9), 1373–1394.
- Saviotti, P. P. (1998). On the dynamics of appropriability, of tacit and of codified knowledge. *Research Policy*, 26(7–8), 843–856.
- Scheepers, R., Venkitachalam, K., & Gibbs, M. R. (2004). Knowledge strategy in organizations: refining the model of Hansen, Nohria and Tierney. *Journal of Strategic Information Systems*, 13(3), 201–222.
- Spender, J. C. (1996). Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal*, 17(Winter Special Issue), 45–62.
- Sussman, S. W., & Siegal, W. S. (2003). Informational influence in organizations: an integrated approach to knowledge adoption. *Information Systems Research*, 14(1), 47–65.

- Van Maanen, J., & Schein, E. H. (1979). Towards a theory of organizational socialization. In Staw, B. M., (Ed.). *Research in organizational behavior* (Vol. 1) (pp. 209–264). Greenwich, CO: JAI Press.
- Werr, A., & Stjernberg, T. (2003). Exploring management consulting firms as knowledge systems. *Organization Studies*, 24(6), 881–908.