Received 12 August 2016
Revised 3 February 2017
Accepted 10 March 2017

Differences between inter- and intra-group dynamics in knowledge transfer processes

Motohiro Nakauchi
School of Business, Aoyama Gakuin University, Tokyo, Japan, and
Mark Washburn and Kenji Klein
California State University, Long Beach, California, USA

Abstract

Purpose – Knowledge transfer (KT) processes are important for building and sustaining competitive advantages and dynamic capabilities. Prior research often treats KT processes as a firm-level capability, assuming knowledge flows uniformly within a firm. The purpose of this paper is to examine whether such a view is too simplistic because it ignores potential differences between inter-group and intra-group KT processes within a firm.

Design/methodology/approach – The authors surveyed 137 software development professionals in a large Japanese electronics firm regarding co-workers who acted as critical sources of useful knowledge and the factors that affected KT within and across internal organizational boundaries. Using regression analysis, the authors test the extent to which factors such as the characteristics of the knowledge, the characteristics of the tie, and the characteristics of the network differentially affect KT within internal organizational boundaries vs across them.

Findings – The authors find that factors such as the accessibility of the knowledge source, network density, and collective teaching all help in transferring knowledge, while knowledge tacitness inhibit such transfers, but that the effect of these properties varies significantly depending on whether KT occurs across group boundaries.

Originality/value – Existing research on KT within firms tends to treat all such transfers as uniform, with little difference between the dynamics of within-group transfer and between-group transfer. This study establishes key differences in KT between and within organizational groups, demonstrating that managers need to consider internal boundaries when deploying tools and strategies for facilitating knowledge flows.

Keywords Knowledge transfer, Managers, Knowledge management, Accessibility, Co-workers, Group boundaries

Paper type Research paper

1. Introduction

The challenges involved in transferring knowledge within an organization are important for both managers and researchers (Argote *et al.*, 2000; Kogut and Zander, 1992). The knowledge-based view of the firm characterizes organizations as communities specializing in knowledge creation and transfer (Kogut and Zander, 1996), which provides a source of competitive advantage (Arrow, 1974; Kogut and Zander, 1992; Kane, 2010). A distinctive feature of this characterization is its focus on social aspects of knowledge; for knowledge to be valuable at an organizational level it must be held and shared across multiple individuals or units within the firm. The processes through which knowledge migrates and evolves through transfer constitute an important capability for firms. Our understanding of such processes has benefited from study through a variety of lenses, including network theory (e.g. Reagans *et al.*, 2004), organizational learning (e.g. Uzzi and Lancaster, 1996), trust (Levin and Cross, 2004), power (Raman and Bharadwaj, 2012), and evolutionary theory (Zander and Kogut, 1995).

Tsai and Ghoshal (1998) proposed modeling knowledge transfer (KT) as a process incorporating social interaction and dyadic trust as antecedents to the production of knowledge conducive to value creation. Hansen (2002) and Reagans and McEvily (2003) extended this understanding through a robust examination of social network structure and

Management Decision
Vol. 55 No. 4, 2017
pp. 766-782

0025-1747
DOI 10.1108/MD-08-2016-0537

the strength of interpersonal connections (tie strength), finding that strong ties and weak ties have differing effects on KT, and these effects vary with overall social network structure. By focusing on network effects, however, these studies omitted important variables such as trust. Levin and Cross (2004) reintroduced trust as a mitigating and moderating factor for explaining the relationship between network structure and transfer of useful knowledge, arguing that examining trust as a mechanism between network structure and successful KT helps explain the inconsistent findings among prior studies of the effect of strong ties on KT.

As the number of factors known to influence KT has expanded, so has understanding of the structure through which KT occurs. Reagans and Zuckerman (2001) emphasize a multi-level network analysis, arguing that the structure of social networks within an organization should be analyzed in terms of two distinct characteristics – the structure of relationships within a given team and the structure of relationships across teams. This view is particularly useful because it spans both individual- and team levels of analysis. Consistent with network theory, individual relations are still treated as dyadic, and the team remains a collection of individual networks. Tsai and Ghoshal (1998) find that high levels of trust at the group level increases willingness to share resources between groups. However, this view assumes a stable and consistent KT process – that all KT occurs through dyadic network relations which can be treated as uniform with little difference between the dynamics of within-group and between-group transfer.

We challenge this assumption and contend that KT across group boundaries in the firm may differ substantially from transfer within a group. We know, for example, that boundaries affect KT. In particular, there is substantial literature on the challenges of transferring knowledge across the external boundary of the firm. Extent research has demonstrated that transferring knowledge across the external boundary of the firm is more difficult than transferring knowledge within the firm (Allen and Cohen, 1969; Darr *et al.*, 1995; Tushman, 1977; Von Hippel, 1987; Zellmer-Bruhn, 2003). Indeed, this insight is central to Kogut and Zander's (1992) knowledge-based view of the firm, which argues that firm boundaries can be explained precisely because knowledge transfers more easily within firm boundaries than in the market or across firm boundaries.

A number of mechanisms to explain this difference have been theorized and demonstrated in the literature. Both Schrader (1991) and Appleyard (1996), for example, argue that knowledge sources are often hesitant to share their knowledge with those from other firms because potential rivalry between the firms could hurt the knowledge source firm's competitive position. Similarly, Kachra and White (2008) found that individuals who possess useful knowledge are less likely to share that knowledge with those outside the firm due to uncertainty about whether the recipients of that knowledge will reciprocate by sharing their own knowledge with the knowledge provider. Eisenhardt (1985) and Ouchi (1979) argue that both social norms and formal rules operating within firms prevent this breakdown of knowledge sharing by ensuring knowledge-sharing reciprocity.

In contrast, Zander and Kogut (1995) argue that the relative ease of KT within firms rather than between firms is a function of shared language and communication codes. This view is supported with empirical evidence from Monteverde (1995), who showed that firms develop their own unique language and vocabulary, what Monteverde referred to as firm-specific dialects, that facilitate KT within, but not across, the boundaries of the firm.

As with boundaries between organizations, there are good reasons to theorize that boundaries internal to the organization also create barriers to effective KT. Cohen and Levinthal (1990) note that an organization's absorptive capacity depends on transfers of knowledge across and within organizational subunits as much as the direct interface between the organization and the external environment. Subunits within an organization, particularly subunits defined by functional department, can differ from each other in

important ways. Because departments respond to different dimensions of the environment and differ in their tasks, they differentiate from each other in terms of knowledge base, goals, formal structure, interpersonal interactions, and even economic performance (Lawrence and Lorsch, 1967). This is the basis for contingency theory, in which "integrative" processes such as KT processes vary with environmental context. Moreover, subunit differences can include the types of information a unit deems useful as well as the approach it takes toward acquiring that information (Szulanski, 1996). Similarly Hansen (1999) pointed out that a subunit with potentially important knowledge may be unwilling to share that knowledge with other subunits for a variety of reasons, including intra-organizational competition or a subunit culture of secrecy. Carlile (2002) notes that knowledge that exists within an organization's subunit is embedded in the subunit's practices. This can be a substantial barrier to internal KT because making sense of and using that knowledge independent of those practices is difficult without some form of translation. And work by Hansen and Løvås (2004) and Monteiro *et al.* (2008) has argued that some organizational subunits become isolated from knowledge flows within the organization and have difficulty participating in KT activities. Any of these factors can influence KT across subunit boundaries, affecting the odds that members of one subunit can acquire useful knowledge from another.

One weakness of this literature on KT across subunits is that it treats that transfer as more difficult than transfer within subunits without empirically demonstrating it. This is a problem because without such evidence we cannot know that such transfer is actually more difficult. Moreover, we have no way of knowing under what conditions KT across internal organizational boundaries is more difficult than within organizational boundaries. As research on KT processes accumulates, the question of whether and how internal organizational boundaries influence transfer becomes particularly salient. Levine and Prietula (2012) note the considerable variation in performance benefits of KT processes. We believe focusing on internal organizational boundaries will further understanding of individual KT mechanisms. Specifically, while prior studies develop theory suggesting why various KT mechanisms work, much of that theory assumes the effects of those mechanisms on KT is essentially uniform. By emphasizing the effects of boundaries within the organization, we contribute to the literature by theorizing and empirically demonstrating that some KT mechanisms can and should perform better depending on whether they are used locally (within a group) or for spanning boundaries within the organization.

We identify multiple mechanisms that facilitate and inhibit KT within a firm, and we test hypotheses for how each mechanism affects KT across subunit boundaries compared to within a subunit. We demonstrate that the efficacy of differing KT mechanisms is contingent on structural aspects of such transfer. By emphasizing organizational boundaries, this study attempts to shift the discussion from simple identification of KT mechanisms to a more dynamic view of knowledge processes, where managers can select transfer mechanisms that are suited to the organizational context and structure organizations in ways that facilitate desirable KT.

2. Research model and hypotheses

Social capital strongly shapes knowledge flows within organizations, as people prefer seeking and acquiring knowledge from other people rather than from documents or digital sources (Allen, 1977). Scholars of KT have examined both the structural and relational characteristics of social capital in making sense of the factors that affect KT in dyadic relationships (Levin and Cross, 2004; Raman and Bharadwaj, 2012). We attempt a more systematic approach by examining five key aspects of KT within an organization: the knowledge itself, the knowledge recipient, the knowledge source, the relationship between

the recipient and the source, and the structure of the network. In total we examine seven factors that capture these five aspects: knowledge tacitness, technical knowledge of the recipient, competence of the knowledge source, accessibility of the knowledge source, collective teaching efforts by the knowledge source, strength of the social tie, and the density of the network surrounding any pair of individuals.

2.1 Knowledge tacitness

Scholars of KT argue that some forms of knowledge are easier to express than others, using the term "tacit" to describe knowledge that is particularly difficult to express or convey. Zander and Kogut (1995) find that the degree to which knowledge is codifiable impacts the speed of KT, and Hansen (1999) proposed that knowledge "tacitness" moderates the effect of network tie strength on KT. Most KT research concurs that the extent to which knowledge is difficult to articulate, or is tacit, impedes its transfer.

While tacitness makes it difficult to transfer knowledge generally, this characteristic is likely particularly true where knowledge must cross group boundaries. Jasimuddin *et al.* (2005), for example, argue that knowledge can seem explicit within one organizational context but behave as though it is tacit when it must cross from one organization to another. We argue for a similar dynamic when knowledge crosses departmental boundaries. Subsystems within organizations are differentiated from each other in various ways, including formal structures, member goal orientation, time orientation, and interpersonal orientation (Lawrence and Lorsch, 1967). Together with the different background experiences and expertise implied by different subunit membership, these factors likely increase difficulty of transferring knowledge that is not explicit and straightforward. Moreover, KT across groups frequently involves fewer opportunities for participants to interact, increasing the difficulty of conveying subtle or nuanced information. Consequently, we expect tacit knowledge to transfer more easily within groups than across them:

H1. The negative association between tacit knowledge properties and KT is larger for transfers across groups than for transfers within groups.

2.2 Recipient technical knowledge

The technical knowledge of knowledge seekers also plays an important role in KT. Such knowledge fosters the acquirer's absorptive capacity, enabling him to understand and make use of new information (Cohen and Levinthal, 1990). When an acquirer lacks relevant technical knowledge, even if providers offer useful information, the acquirer will likely be unable to recognize and exploit the true value of the information. Hence, KT is positively associated with the knowledge seeker's technical knowledge.

For KT across group boundaries, however, technical expertise may be insufficient to create absorptive capacity because the domain of technical expertise the seeker possesses may be group specific and therefore not relevant to absorbing knowledge provided by members of a different technical group. When a provider's technical knowledge differs greatly from the acquirer's knowledge, the acquirer may struggle to understand or evaluate the information provided. Thus, it may be difficult to share information with outside group members, even if the knowledge seeker has a great deal of pre-existing technical expertise:

H2. The positive association between technical knowledge and KT is smaller for transfers between groups than for transfers within groups.

2.3 Knowledge source competence

In addition to characteristics of the knowledge recipient, characteristics of the knowledge source also affect the ease and effectiveness of KT. For example, a knowledge seekers' lack

of faith in the knowledge source's competence can impede knowledge flow (Levin and Cross, 2004). When a knowledge seeker believes the knowledge source is highly capable and has mastery over the relevant knowledge domain, he or she is more likely to accept the information offered. If the knowledge seeker distrusts the competence of the knowledge source, however, he or she is less likely to retain or take action on that knowledge. Put simply, credible knowledge sources are more likely to be taken seriously than dubious ones, and KT is greater when the knowledge seeker perceives the knowledge source as competent.

Group boundaries likely affect the impact of competence perceptions on KT. Like tacit knowledge, accurate perceptions of competence are hard to acquire and may take time to emerge. Working across groups, organization members may interact too infrequently to place much value on their competence assessments. While organization members may make such assessments, those assessments matter less when based on rare or limited interactions. Even if the assessed level is constant, knowledge must transfer across organizational boundaries, creating uncertainty as the knowledge source is from a less known or "novel" domain (Cohen and Levinthal, 1990). Further, competence assessments require depth of understanding of the provider's functional expertise, which is likely less available across groups. Consequently, we expect perceptions of competence to receive less weight for transfers between groups than within them:

H3. The positive association between perception of competence and KT is larger for transfers within groups than for transfers between groups.

2.4 Knowledge source accessibility

Borgatti and Cross (2003) define and measure an individual's accessibility as their willingness and ability to provide information in a timely fashion, as perceived by other individuals in the network. Accessibility measures organizational slack as well as perceptions of the willingness of knowledge holders to take time to interact with a knowledge seeker. In either case, accessibility signals the potential for KT.

While accessibility enables KT generally, we believe accessibility matters more within groups than between them. Accessibility assures timely access to information providers, and this allows an acquirer to speed up product development or problem solving. This effect likely increase the KT within groups because the project completion time is often a key shared performance measure for the same department members. We suggest there is an inherent assumption that members of a group should be more accessible to each other than members of different groups. This creates differences in expectations, where within-group members should be accessible as part of normal operations, while between-group accessibility is viewed as going above the norm. We contend that the difference in expectation correlates to a corresponding difference in the impact of accessibility on KT. As accessibility is perceived as more critical within groups than between groups, it has a larger effect within groups:

H4. The positive association between accessibility and KT is larger for transfers within groups than for transfers between groups.

2.5 Collective teaching efforts

Collective organizational knowledge is important because it compiles stocks of individual knowledge in a process of value creation (Kogut and Zander, 1992), making collective knowledge fundamentally different from simple aggregation of individual knowledge (Zhao and Anand, 2009). Because most job-related knowledge is context dependent (Kogut and Zander, 1992), understanding the context of that knowledge is an important precondition for acquiring and using such knowledge (Zhao and Anand, 2009). Zhao and

Anand (2009), therefore, argue that collective teaching, a process whereby sources of knowledge impart that knowledge by involving knowledge recipients in interactions with those who use it, more effectively ensures that individuals acquire useful knowledge. Thus, in a KT experiment Kane (2010) used a form of collective teaching (participant introduction and linking with a common outcome incentive) to create a superordinate social identity within a group and increase KT. The more a knowledge source encourages a knowledge seeker to engage in cross-functional activities, interactions with clients, and participation in organization-wide events, the more likely that source is to transfer knowledge to those seeking it.

The collective nature of knowledge implies such knowledge is often implicit and embedded within multiple organizational members (Spender, 1996). Because members of a single group likely share understanding of the context in which knowledge is created and used and likely have frequent access to the group members among whom knowledge is dispersed, collective teaching is likely less necessary for KT within a single group. Transfer of knowledge across group boundaries, however, is likely much more difficult because knowledge seekers likely possess less knowledge of the context of the knowledge source and interact less frequently with those individuals within which knowledge is embedded. By congregating for a group discussion, members have the opportunity to reach consensus and reduce outcome uncertainty, which in turn improves the likelihood of successful KT (Raman and Bharadwaj, 2012). Collective teaching, therefore, is more likely to help overcome these barriers to KT:

H5. The positive association between collective teaching and KT is larger for transfers between groups than for transfers within groups.

2.6 Tie strength

The nature of the tie between the source and the recipient also plays a key role in KT. Weaker ties are believed to facilitate transfer of novel information or information useful for innovation because the infrequent contact typical of weaker ties correlates with broader and more diverse networks (Granovetter, 1973), providing individuals access to unique information. Strong ties, on the other hand, may be associated with transfer of more complex knowledge because such ties encourage close and frequent interaction. Hansen (1999) finds that strong ties facilitate transfer of complex and tacit knowledge to a greater extent than weak ties, as complex and tacit knowledge is not easily absorbed and often requires detailed explanation and two-way communication for the receiving party to digest.

While the effects of weaker ties vs stronger ones differ with regard to type of knowledge transmitted, we associate useful knowledge with some level of knowledge complexity. Opportunities to increase process efficiency in ways that save time or reduce costs likely involve incremental improvements based on deep knowledge of local processes. Thus, we believe stronger ties are more likely to facilitate the type of KT most useful to subgroups within an organization. However, we argue that a strong tie between departments, while assessed at the same level of strength as one within a department, is of a different type than a strong tie within a department. This difference results in a differing effect of KT, such that the advantages of strong ties diminish when the ties are between, rather than within departments:

H6. The positive association between tie strength and KT is smaller for transfers between groups than for transfers within groups.

2.7 Network density

The characteristics of the network itself also matter in KT. Network density, the extent to which the social contacts of a given pair of individuals all know each other, creates multiple

redundant ties, allowing information to flow from many sources to accommodate for the complexity of information and increase the likelihood that an information seeker has access to individuals in possession of useful information. Moreover, network density is a general indicator of social cohesion, which likely increases KT by increasing the willingness of individuals to devote time and effort to assisting others (Reagans and McEvily, 2003) while increasing the risk of sanction for failing to do so (Coleman, 1990). If knowledge is highly technical, hard to express, or requires great investment to understand, then a highly dense network of communication should facilitate its transfer.

The main critique of density with respect to KT is that it reduces the number of actors in possession of unique information, thereby reducing opportunities actors have to receive useful knowledge from members of their network. In effect, network density promotes the conversion of knowledge stocks within the network and can also lead to information silos, where members of dense networks are isolated from ideas, ways of thinking, and sources of information outside the network. For example, Hansen *et al.* (2005) and Katz (1982) show that greater network density within a team discourages team members from seeking information in the broader organization. However, the idea that density acts as an impediment within an organization assumes the dense network is itself defined by formal organizational structures such as departments. Under such circumstances, transferring knowledge between groups or department is likely difficult because network density within the group reinforces differences in culture and structure between the groups. However, an individual could have a dense network that spans organizational boundaries, crossing group or department lines. High density could manifest itself as clusters that permeate the formal organization and allow information to travel through multiple channels, allowing higher context communication and enabling more effective information transfer. Here network density would not necessarily lead to a uniform network lacking pockets of unique knowledge. Knowledge that flows throughout the dense network of one department might not flow to the other department because it constitutes a type of knowledge not normally relevant within the other department. However, if that type of knowledge became useful for the other department, network density would facilitate its flow from one department to another. Thus, while density would tend to dampen opportunities for KT within groups due to lack of novel information, it would enable KT between groups by allowing information to travel through multiple channels and allowing higher context communication:

H7. The positive association between density and KT is larger for transfers between groups than for transfers within groups.

3. Methods

3.1 Sample

We surveyed all professional employees associated with software development for multifunctional peripheral (printing) devices in a large Japanese electronics company. The company did not sponsor the research financially. Participants worked on design and development of advanced process software, which required communication with other departments within the company. The company possessed a functional structure, with members of the software development department formally separated from hardware, sales, marketing, and other product line-specific departments. While formal authority rests within the department, projects require cross-departmental communication; consequently the company typically adopts a model of concurrent engineering.

The survey was sent to all 188 professional-level employees in software development in early December of 2010. Senior managers sent three reminders to complete the survey, and collection of data was finalized in mid-January 2011. A total of 137 respondents completed

the survey (response rate 72.9 percent). Our survey included a standard egocentric network survey (Burt, 1992; Wasserman and Faust, 1994), which asked participants to list up to seven co-workers who acted as critical sources of knowledge within the past year and a half. The survey also asked respondents to answer questions related to our variables of interest about each of the reported relationships. Possibly due to the fact that the survey was endorsed by managing supervisors, respondents did complete each measure for each relationship. On average, respondents reported on 4.4 specific relationships. A typical cross-department relationship would be between a software developer and a hardware engineer regarding the desirable improvement of an existing product. This survey technique yielded a total of 609 usable observations.

3.2 Variables

We adapted our survey items from pre-existing scales in the literature. All items were translated into Japanese for data collection. We checked for common method bias using Harman's one-factor test. Multiple factors were detected, and the independent variables included in the model form several factors with eigenvalues higher than 1. These factors accounted for 87.1 percent of the variance, with the first factor capturing 26.7 percent of the total variance. Since no single factor emerged as dominant, common method bias is unlikely to be a serious problem in the data (Podsakoff and Organ, 1986).

3.2.1 Dependent variable. Perceived receipt of useful knowledge comes from Levin and Cross (2004). They define useful knowledge as the "perceived receipt of information […] that has a positive impact on a knowledge seeker's work." They operationalized the variable using eight survey items adapted from Hansen (1999), Hansen and Haas (2001), Keller (1994), and Szulanski (1996). The measure captures the knowledge seeker's perception that a desired project outcome was reached faster or with higher quality than otherwise possible. In operationalizing the measure, the authors merge two broad learning concepts, efficiency and effectiveness. Four items relate to effectiveness (perceived quality, customer satisfaction, overall performance, and value), and four items relate to specific project outcomes in terms of time and budget dedicated to project completion. For example, an outcome item stated, "The information I received from this person made (or is likely to make) the following contribution: shortening the project time." The eight-item scale yields a Cronbach's α of 0.78.

3.2.2 Independent variables. Different department (DD) is a binary variable that is zero when two organization members are from the same department (software development) and one if the co-worker identified was from any other department (e.g. hardware or sales).

Tacit knowledge measures how difficult it is for knowledge to be documented, written, or otherwise codified. We capture this tacit characteristic using three items developed by Hansen (1999): "Was the information sufficiently explained to you in writing (reports, manuals, e-mail, etc.?" "How well documented was the information that you received from this person?" and "What type of information came from this person (1 = reports, manuals documents, self-explanatory software, 4 = half know-how, half documents, 7 = mainly personal practical know-how, tricks of the trade)." The measures yield a Cronbach's α of 0.78.

Technical knowledge: following Obstfeld (2005), we measured technical knowledge with a question that emphasized the respondent's familiarity with his or her area of functional expertise. "I am able to provide knowledge and expertise on advanced technical issues associate with my functional area."

Perceived competence is adapted from Levin and Cross (2004) and captures perceptions prior to seeking information/advice for this project. The two items are "I believe this person approaches his or her job with professionalism and dedication" and "Given his or her track record, I saw no reason to doubt this person's competence and preparation." The Cronbach's α for this measure is 0.91.

Accessibility measures the speed and willingness of contacts to take the time to participate in the KT process. Following Borgatti and Cross (2003, p. 436) we use a single item that states "The extent to which you can access another person's thinking and knowledge is a continuum. At one end of the spectrum are people who do not make themselves available to you quickly enough to help solve your problem. At the other end of the spectrum are those who are willing to engage actively in problem solving within a timely fashion. With this continuum in mind, how would you rate your overall ability to access this person's thinking and knowledge?"

Collective teaching is a revision of Zhao and Anand's (2009) measure of the contacted tie's efforts to connect the respondent to other individuals across formal boundaries within the organization. We adapt six items for this measure including, "This person involved me in his or her meetings with managers," "This person involved me in his or her cross-functional meetings," and "This person involved me in carrying out joint projects with other groups or other departments." The measures yield a Cronbach's α of 0.89.

Tie strength measures the frequency and depth of relationship between two people. Following Reagans and McEvily (2003) we use two items; "How close are you to this person?" and "On average, how often do you talk to the person (in either social or business discussions)?" The measures yield a Cronbach's α of 0.83.

Density measures the extent to which the social contacts of a given pair of individuals all know each other. It is measured using the ratio of the actual number of ties that are present among the contacts of two individuals divided by the maximum number of ties that could be present among those contacts (Burt, 1992; Marsden, 1987).

3.2.3 Control variables. Rank is a binary variable equal to 1 if the respondent is a project manager and zero otherwise. Existing research demonstrates that the rank of individuals affects their propensity to transfer and accept knowledge (Black *et al.*, 2004; Thomas-Hunt *et al.*, 2003). Therefore we control for rank in our analysis.

Tenure is a count of the months of employment. We control for tenure in this analysis because it has been theorized to affect KT, communication and coordination (Reagans and McEvily, 2003; Reagans and Zuckerman, 2001).

Friendship measures willingness to spend free time with the person – getting together for informal social activities such as lunch, dinner, drinks, visiting one another's homes, and so on. Reagans and McEvily (2003) found that the existence of friendship relationships within a network has a separate effect on KT from tie strength and that excluding it from analysis can lead researchers to underestimate the effect of tie strength.

Education level is coded on a scale from 1 to 4 to indicate completion of high school, bachelor's degree, master's degree, or PhD, respectively. To ensure the validity of our technical knowledge variable, we control for the education level of the respondent.

Trustworthiness combines belief that a person can be relied on without fear he or she will take advantage even if the opportunity arises with a belief that the person will keep commitments (adopted from Tsai and Ghoshal, 1998.) Levin and Cross demonstrate that trust has an effect on KT independent of tie strength. Therefore we control for trustworthiness in our model. The Cronbach's α is 0.71.

Expertise overlap incorporates specific reported data regarding respondents' areas of expertise within the organization. Participants were asked to identify both primary and secondary areas of expertise. Expertise overlap is the sum of the cross-product of two individuals' expertise in specific areas across a network tie (see Obstfeld, 2005).

3.3 Analysis

Our study focuses on how KT processes differ in organizations depending on whether knowledge transfers within or between internal organizational groups. We use OLS

regression, interacting all our independent variables with the binary variable DD. Following Aiken and West (1991) we utilize the interaction of the binary (categorical) variable with the independent (continuous) variables to compare differences between two groups – KT relationships within formal structures, and KT relationships across formal structures. Aiken and West (1991, pp. 119-125) interpret the models using the mean value of the continuous variable while treating the binary variables categorically as either 0 or 1. The purpose of including a binary or categorical variable is the ability to compare coefficients between two groups. When the DD variable equals 0, the model coefficients represent independent variables acting within groups (in this case the main effects have values, and the interactions all take the value of 0). When DD equals 1, the joint effect, meaning the sum of the main effect and the interaction effect, creates a separate set of coefficients for the second group. For example, consider the reduced equation:

$$\text{Knowledge transfer} = \beta_0 + \beta_1 \times \text{tacit knowledge} + \beta_2 \times \text{tacit knowledge} \times \text{different department} \quad (1)$$

where DD is a binary categorical variable, with values of either 0 or 1. Tacit knowledge is continuous. When DD equals 0, the function becomes:

$$\text{Knowledge transfer} = \beta_0 + \beta_1 \times \text{tacit knowledge} + \beta_2 \times \text{tacit knowledge} \times (0) \quad (2)$$

$$\text{Knowledge transfer} = \beta_0 + \beta_1 \times \text{tacit knowledge} + (0) \quad (3)$$

Thus, when DD equals 0, which happens when the tie relationship is within a single department, the only coefficient that represents tacit knowledge is β_1.

When DD equals 1, the equation becomes:

$$\text{Knowledge transfer} = \beta_0 + \beta_1 \times \text{tacit knowledge} + \beta_2 \times \text{tacit knowledge} \times (1) \quad (4)$$

$$\text{Knowledge transfer} = \beta_0 + \beta_1 \times \text{tacit knowledge} + \beta_2 \times \text{tacit knowledge} \quad (5)$$

$$\text{Knowledge transfer} = \beta_0 + (\beta_1 + \beta_2) \times \text{tacit knowledge} \quad (6)$$

Thus, when DD equals 1, which happens when the tie relationship is between two departments, the sum of the coefficients ($\beta_1 + \beta_2$) represents tacit knowledge influence. In discussing a continuous-categorical interaction in a multivariate setting (Aiken and West, 1991, Chapter 7, p. 125), the authors' state, "A joint test of *b*4 and *b*5 provides the overall test of statistical significance of the interaction." We employ *F*-tests to compare the main and joint-coefficients. (Note that our final model includes the above operationalization for all the independent variables).

The variable main effects represent the impact of the independent variables on KT processes within-group. When DD equals one, the joint test of the main and interaction variable represents the impact of the independent variable on the KT process between groups (see Aiken and West, 1991, pp. 116-130). Note that the significance of the interaction variable itself is not meaningful, as DD is binary (neither the variable nor the hypotheses represent moderation effects). Finally, we use post-estimation *F*-tests to check whether the main effect (within-group) significantly differs from the joint effect (between groups). Combining both tests in a single regression enables our model to maintain high power, while utilizing demographic control variables uniformly across the organization.

4. Results

Table I presents descriptive statistics and correlations of our variables. Table II presents the full model, with all independent variables having main effects and interactions with the binary variable DD. We include both the significance tests of the individual coefficient (COEF column) and the joint test. Table III takes coefficients from Table II and presents the post-estimation test. The coefficients in the within department column of Table III correspond to the main effects in Table II. The between department coefficients in Table III correspond to the joint values of Table II (interaction with main effect), with significance values correlated with their respective F-tests. The third column of Table III presents post-estimation tests of whether the coefficients differ for KT processes within or between departments (i.e. whether the main and joint-coefficients differ significantly).

We focus on how KT processes vary among and between different groups comprising an organization. Our hypotheses predict that the while the directional impact of our variables will be the same as the main effect of that variable on KT, the magnitude of the impact will differ depending on whether the KT process occurs within or between organizational subgroups. In six of the seven cases, we find evidence that KT processes differ depending on whether knowledge is transferring within or between groups. We find the strongest support for *H3*, that the importance of perceived competence is larger within groups than between groups ($F = 23.15$, $p < 0.001$). There is also support for *H2* and *H7* (technical knowledge and density, $p < 0.01$), and modest support for *H4* (accessibility, $p < 0.05$). Overall, we find fairly broad empirical support for our central argument, that KT processes differ significantly within organizations depending on organizational structure, and that these differences occur in systematic and predictable ways.

5. Discussion and conclusion

This study demonstrates that various factors that influence KT differ in their effects depending on the context across which the transfer occurs. By examining the impact of multiple mechanisms on KT across organizational boundaries, we demonstrate that not all mechanisms transfer knowledge in uniform or predictable ways. Specifically, we demonstrate that inter-group KT processes are distinct from intra-group KT, and that the majority of factors shown to impact KT in prior research only do so for intra-group transfers. This latter finding is consistent with Levine and Prietula's (2012) concern that KT processes may be redundant and their proposition that the marginal benefits of KT vary inversely with organizational support for learning. If managers attempt to simply maximize knowledge flow through all mechanisms, they are likely duplicating effort with only marginal returns. Depicting organizations as multi-level networks of individuals may overstate the role of individual or dyadic relations in KT at the expense of the role of group dynamics. Our results show that group boundaries are an important aspect of KT and suggest that a greater understanding of KT across internal subgroups, departments, or divisions is needed in order to refine our understanding of the key elements of network structure within a firm that affect KT processes.

Such attention to group boundaries can usefully supplement existing research on KT. For example, work on the effect of tie strength at the dyadic level has suggested that both strong ties and weak ties may facilitate KT. A number of papers have tried to explain this complex relationship with moderating factors such as knowledge type (Hansen, 1999; Reagans and McEvily, 2003), trust (Levin and Cross, 2004), and dependency (Hansen, 1999). Our results imply that organizational boundaries also likely function as a key moderating factor. Thus, whether a network variable such as trust or density is useful for KT may depend on whether that transfer requires crossing the boundary of some functional group.

One key exception to our finding that KT processes differed depending on whether transfer was within groups or between them is our result relating to collective teaching.

Table I. Descriptive statistics and correlations

		Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Useful knowledge	4.911	0.821														
2	Rank	0.167	0.374	−0.085													
3	Tenure	4.343	1.080	0.001	0.555												
4	Friendship	1.741	0.861	0.039	−0.187	−0.214											
5	Education	2.630	0.555	0.158	−0.398	−0.510	0.093										
6	Trustworthiness	5.098	1.137	0.273	0.050	0.026	0.074	−0.016									
7	Expertise overlap	4.997	1.460	0.163	−0.105	−0.146	0.120	0.080	0.136								
8	Knowledge tacitness	4.507	1.125	−0.109	0.041	−0.002	−0.013	0.074	−0.071	−0.088							
9	Technical knowledge	5.084	1.114	0.110	0.191	0.188	0.031	−0.100	0.130	−0.040	0.054						
10	Source competence	5.693	1.242	0.290	0.024	0.032	0.046	−0.025	0.592	0.158	−0.038	0.008					
11	Accessibility	5.438	1.473	0.254	0.099	0.046	0.148	−0.038	0.176	0.210	−0.019	0.032	0.129				
12	Collective teaching	3.469	1.463	0.313	−0.220	−0.283	0.229	0.155	0.126	0.201	−0.066	0.067	0.135	0.128			
13	Tie strength	3.048	1.753	−0.092	0.006	0.011	−0.254	0.012	−0.340	−0.324	−0.015	0.054	−0.385	−0.212	−0.163		
14	Density	0.784	0.215	0.054	−0.177	−0.243	0.111	0.082	0.119	0.276	0.009	−0.217	0.156	−0.018	0.143	−0.330	
15	Different department	0.166	0.372	0.035	0.167	0.151	−0.107	−0.132	−0.192	−0.232	0.031	0.117	−0.112	0.074	−0.056	0.163	−0.293

Notes: $N = 609$. Means and standard deviations for variables 7 through 13 are reported unadjusted. Values are mean centered for correlations and subsequent estimations. *P*-values (one-tailed) of 0.01, 0.05, and 0.1 are significant at 0.0935, 0.0667, and 0.052, respectively

Table II. Assessing the transfer of useful knowledge within and between departments

Variables	Coefficient	SE	Joint F-test of interaction and main effect: $F(1, 587)$
Rank	−0.207*	0.096	
Tenure	0.170***	0.036	
Friendship	−0.012	0.036	
Education	0.322***	0.062	
Trustworthiness (benevolence)	0.112**	0.032	
Expertise overlap	0.030	0.022	
Tacit knowledge	−0.071**	0.027	
Technical knowledge	0.076**	0.030	
Perceived competence	0.150***	0.031	
Accessibility	0.101***	0.022	
Collective teaching	0.131***	0.023	
Tie strength	0.056**	0.022	
Density	−0.014	0.171	
Different department (DD)	0.364***	0.092	
Tacit knowledge × DD	0.076	0.079	0.00
Technical knowledge × DD	−0.144*	0.067	1.20
Perceived competence × DD	−0.218**	0.063	0.75
Accessibility × DD	−0.050	0.059	0.83
Collective teaching × DD	0.034	0.056	10.23**
Tie strength × DD	−0.027	0.054	0.36
Density × DD	1.123**	0.364	14.22***
Constant	3.348***	0.277	
R^2	0.324		
n	609		
Adj. $R^2 = 0.300$			

Notes: Different department is binary (1 = between departments, 0 = within departments). *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table III. Differences in the transfer of useful knowledge within and between departments

	Within department (Diff't department = 0)	Between departments (Diff't department = 1)	Significant differences, $F(1, 587)$
Tacit knowledge	−0.071**	0.005	2.58
Technical knowledge	0.076**	−0.068	6.79**
Perceived competence	0.150***	−0.068	23.15***
Accessibility	0.101***	0.051	4.73*
Collective teaching	0.131***	0.165**	2.04
Tie strength	0.056**	0.029	1.62
Density	−0.014	1.109***	6.98**

Notes: In the first column, the significance tests for within department correspond to the main effects tests of Table II ($\beta_0 = 0$); in the second column, the significance tests for between departments correspond to the main effects and interactions tests of Table II ($\beta_0 + \beta_I = 0$); in the third column, the significant difference tests (F-tests) examine differences between the within department and between department coefficients ($\beta_0 = \beta_I$); for more details on model construction, please refer to the analysis section. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

We find that knowledge providers that specifically emphasize inclusiveness – inviting and including knowledge seekers on cross-boundary meetings – in their efforts to transfer knowledge can improve KT regardless of internal boundaries. This finding is important given that most researchers focus on individual knowledge transferred within a dyad or triad rather than focus on knowledge that is collectively held or transferred.

Such lack of attention to collective KT is ironic given widespread recognition that firms that effectively leverage collective knowledge are generally more innovative and competitive than those that do not (Argote, 1999; Levin and Cross, 2004; Wernerfelt, 1984). Zhao and Anand (2009) argue that collective teaching can play an important role in enabling firms to leverage this knowledge as such knowledge tends to be context dependent and often only reveals itself when key elements of that context are present (Kogut and Zander, 1992; Lave and Wenger, 1991). Our results suggest that this collective teaching is particularly useful for transferring such knowledge as it works both for transfer within groups and between.

Tortoriello *et al.* (2012) found that network tie strength aided between-group KT. Specifically, that the negative relation between the boundary and KT diminished as tie strength increased. Our finding that network tie strength facilitates KT between, but not within, groups is both an extension and variation of this work. We did not see a significant connection between tie strength and KT within groups, but we did find a positive relationship between groups. This difference may be due to our inclusion of multiple KT mechanisms beyond network effects. Another potential explanation is that the between-group boundary we examine consists of DDs within an organization, while Tortoriello *et al.* look at different teams within a single R&D department. Regardless, our findings are broadly consistent with theirs, with the unique feature of tie strength being a particularly effective boundary spanning mechanism in KT.

Our study has direct implications for managerial practice. Managers who rely on effective KT must consider internal boundaries when facilitating knowledge flows. Tools and strategies that facilitate knowledge flow in one case may not do so in the other. Thus, managers should be aware of the differences in scope of the KT processes they employ. By emphasizing specific KT mechanisms, managers may be able to create highly effective methods of transmitting knowledge to target audiences.

Moreover, managers should consider ways to encourage collective methods of transferring knowledge, such as collective teaching. By its very nature, however, collective teaching requires firms to open KT processes up to larger groups. Therefore, encouraging collective teaching may require a broader cultural orientation toward openness and collective action than dyadic KTs. While we speculate such a culture would be desirable for both developing and transferring knowledge, we do not wish to over-generalize as our sample is limited to a single large company. With that disclaimer, we believe managers seeking to increase KT would benefit from encouraging a culture of inclusiveness.

Our study has a number of limitations. In the existing literature on KT no two studies treat the actual knowledge transferred in the same way. For example, Tsai and Ghoshal (1998) count major product innovations within business units, while Hansen (2002) examines decreases in project completion time. Levin and Cross (2004) introduce the term useful knowledge as an outcome-focused construct derived from behavioral learning theory (Cyert and March, 1963; Levitt and March, 1988). They codify useful knowledge as a combination of effectiveness and efficiency in project completion as perceived by organization members. This conception improves on earlier work by being more comprehensive, but literature examining behavioral learning emphasizes strong differences between achieving effectiveness and efficiency, treating the two outcomes as divergent and dependent on different organizational structures and processes. Thus, by following Levin and Cross, we risk neglecting that the determinants of successful transfer of knowledge contributing to each of these distinct outcomes may in fact differ.

Overall, this work contributes to the KT literature by demonstrating how multiple factors for facilitating KT vary depending on whether knowledge transfers within or between organizational groups. By focusing on these distinct KT processes, this paper takes initial steps toward building a comprehensive model of KT process by emphasizing the context of KT within those processes.

References

Aiken, L.S. and West, S.G. (1991), *Multiple Regression: Testing and Interpreting Interactions*, Sage Publications, Newbury Park, CA.

Allen, T. (1977), *Managing the Flow of Technology*, MIT Press, Cambridge, MA.

Allen, T.J. and Cohen, S.I. (1969), "Information flow in research and development laboratories", *Administrative Science Quarterly*, Vol. 14 No. 1, pp. 12-19.

Appleyard, M.M. (1996), "How does knowledge flow? Interfirm patterns in the semiconductor industry", *Strategic Management Journal*, Vol. 17 No. S2, pp. 137-154.

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

Argote, L., Ingram, P., Levine, J.M. and Moreland, R.L. (2000), "Knowledge transfer in organizations: learning from the experience of others", *Organizational and Behavior and Human Decision Processes*, Vol. 82 No. 1, pp. 1-8.

Arrow, K.J. (1974), *The Limits of Organization*, W.W. Norton, New York, NY.

Black, L.J., Carlile, P.R. and Repenning, N.P. (2004), "A dynamic theory of expertise and occupational boundaries in new technology implementation: building on Barley's study of CT scanning", *Administrative Science Quarterly*, Vol. 49 No. 4, pp. 572-607.

Borgatti, S. and Cross, R. (2003), "A social network view of organizational learning", *Management Science*, Vol. 49 No. 4, pp. 432-445.

Burt, R. (1992), *Structural Holes: The Social Structure of Competition*, Harvard University Press, Cambridge, MA.

Carlile, P.R. (2002), "A pragmatic view of knowledge and boundaries: boundary objects in new product development", *Organization Science*, Vol. 13 No. 4, pp. 442-455.

Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-152.

Coleman, J.S. (1990), *Foundations of Social Theory*, Belknap, Cambridge, MA.

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

Darr, E.D., Argote, L. and Epple, D. (1995), "The acquisition, transfer, and depreciation of knowledge in service organizations: productivity in franchises", *Management Science*, Vol. 41 No. 11, pp. 1750-1762.

Eisenhardt, K.M. (1985), "Control: organizational and economic approaches", *Management Science*, Vol. 31 No. 2, pp. 134-149.

Granovetter, M. (1973), "The strength of weak ties", *American Journal of Sociology*, Vol. 78 No. 6, pp. 1360-1380.

Hansen, M.T. (1999), "The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits", *Administrative Sciences Quarterly*, Vol. 44 No. 1, pp. 82-111.

Hansen, M.T. (2002), "Knowledge networks: explaining effective knowledge sharing in multiunit companies", *Organization Science*, Vol. 13 No. 3, pp. 232-248.

Hansen, M.T. and Haas, M.R. (2001), "Different knowledge, different benefits: toward a productivity perspective on knowledge sharing in organizations", working paper presented at the annual meeting of the Academy of Management, Washington, DC.

Hansen, M.T. and Løvås, B. (2004), "How do multinational companies leverage technological competencies? Moving from single to interdependent explanations", *Strategic Management Journal*, Vol. 25 Nos 8-9, pp. 801-822.

Hansen, M.T., Mors, M.L. and Løvås, B. (2005), "Knowledge sharing in organizations: multiple networks, multiple phases", *Academy of Management Journal*, Vol. 48 No. 5, pp. 776-793.

Jasimuddin, S.M., Klein, J.H. and Connell, C. (2005), "The paradox of using tacit and explicit knowledge", *Management Decision*, Vol. 43 No. 1, pp. 102-112.

Kachra, A. and White, R.E. (2008), "Know-how transfer: the role of social, economic/competitive, and firm boundary factors", *Strategic Management Journal*, Vol. 29 No. 4, pp. 425-445.

Kane, A. (2010), "Unlocking knowledge transfer potential: knowledge demonstrability and superordinate social identity", *Organization Science*, Vol. 21 No. 3, pp. 643-660.

Katz, R. (1982), "Project communication and performance: an investigation into the effects of group longevity", *Administrative Science Quarterly*, Vol. 27 No. 1, pp. 81-104.

Keller, R.T. (1994), "Technology-information processing fit and the performance of R&D project groups: a test of contingency theory", *Academy of Management Journal*, Vol. 37 No. 1, pp. 167-179.

Kogut, B. and Zander, U. (1992), "Knowledge of the firm, combinative capabilities and the replication of technology", *Organization Science*, Vol. 3 No. 3, pp. 383-397.

Kogut, B. and Zander, U. (1996), "What firms do? Coordination, identity, and learning", *Organization Science*, Vol. 7 No. 5, pp. 502-518.

Lave, J. and Wenger, E. (1991), *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, New York, NY.

Lawrence, P. and Lorsch, J. (1967), "Differentiation and integration in complex organizations", *Administrative Sciences Quarterly*, Vol. 12 No. 1, pp. 1-47.

Levin, D.Z. and Cross, R. (2004), "The strength of weak ties you can trust: the mediating role of trust in effective knowledge transfer", *Management Science*, Vol. 50 No. 11, pp. 1477-1490.

Levine, S.S. and Prietula, M.J. (2012), "How knowledge transfer impacts performance: a multilevel model of benefits and liabilities", *Organization Science*, Vol. 23 No. 6, pp. 1748-1766.

Levitt, B. and March, J.G. (1988), "Organizational learning", *Annual Review of Sociology*, Vol. 14, pp. 319-340.

Marsden, P. (1987), "Core discussion networks of Americans", *American Sociological Review*, Vol. 52 No. 1, pp. 122-131.

Monteiro, L.F., Arvidsson, N. and Birkinshaw, J. (2008), "Knowledge flows within multinational corporations: explaining subsidiary isolation and its performance implications", *Organization Science*, Vol. 19 No. 1, pp. 90-107.

Monteverde, K. (1995), "Technical dialog as an incentive for vertical integration in the semiconductor industry", *Management Science*, Vol. 41 No. 10, pp. 1624-1638.

Obstfeld, D. (2005), "Social networks, the tertius iungens orientation, and involvement in innovation", *Administrative Sciences Quarterly*, Vol. 50 No. 1, pp. 100-130.

Ouchi, W.G. (1979), "A conceptual framework for the design of organizational control mechanisms", *Management Science*, Vol. 25 No. 9, pp. 833-848.

Podsakoff, P. and Organ, D. (1986), "Self-reports in organizational research: problems and prospects", *Journal of Management*, Vol. 12 No. 4, pp. 531-544.

Raman, R. and Bharadwaj, A. (2012), "Power differentials and performative deviation paths in practice transfer: the case of evidence-based medicine", *Organization Science*, Vol. 23 No. 6, pp. 1593-1621.

Reagans, R. and McEvily, B. (2003), "Network structure and knowledge transfer: the effects of cohesion and range", *Administrative Science Quarterly*, Vol. 48 No. 2, pp. 240-267.

Reagans, R. and Zuckerman, E. (2001), "Networks, diversity and performance: the social capital of R&D teams", *Organization Science*, Vol. 12 No. 4, pp. 502-517.

Reagans, R., Zuckerman, E. and McEvily, B. (2004), "How to make the team: social networks vs demography as criteria for designing effective teams", *Administrative Sciences Quarterly*, Vol. 49 No. 1, pp. 101-133.

Schrader, S. (1991), "Informal technology transfer between firms: cooperation through information trading", *Research Policy*, Vol. 20 No. 2, pp. 153-170.

Spender, J.C. (1996), "Making knowledge the basis of a dynamic theory of the firm", *Strategic Management Journal*, Vol. 17 No. S2, pp. 45-62.

Szulanski, G. (1996), "Exploring internal stickiness: impediments to the transfer of best practice within the firm", *Strategic Management Journal*, Vol. 17 No. S2, pp. 27-43.

Thomas-Hunt, M.C., Ogden, T.Y. and Neale, M.A. (2003), "Who's really sharing? Effects of social and expert status on knowledge exchange within groups", *Management Science*, Vol. 49 No. 4, pp. 464-477.

Tortoriello, M., Reagans, R. and McEvily, B. (2012), "Bridging the knowledge gap: the influence of strong ties, network cohesion, and network range on the transfer of knowledge between organizational units", *Organization Science*, Vol. 23 No. 4, pp. 1024-1039.

Tsai, W. and Ghoshal, S. (1998), "Social capital and value creation: the role of intrafirm networks", *Academy of Management Journal*, Vol. 41 No. 4, pp. 464-476.

Tushman, M.L. (1977), "Special boundary roles in the innovation process", *Administrative Science Quarterly*, Vol. 22 No. 4, pp. 587-605.

Uzzi, B. and Lancaster, R. (1996), "The sources and consequences of embeddedness for the economic performance of organizations: the network effect", *American Sociological Review*, Vol. 61 No. 4, pp. 674-698.

Von Hippel, E. (1987), "Cooperation between rivals: informal know-how trading", *Research Policy*, Vol. 16 No. 6, pp. 291-302.

Wasserman, S. and Faust, K. (1994), *Social Network Analysis: Methods and Applications*, Cambridge University Press, New York, NY.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5 No. 2, pp. 171-180.

Zander, U. and Kogut, B. (1995), "Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test", *Organization Science*, Vol. 6 No. 1, pp. 76-92.

Zellmer-Bruhn, M.E. (2003), "Interruptive events and team knowledge acquisition", *Management Science*, Vol. 49 No. 4, pp. 514-528.

Zhao, Z. and Anand, J. (2009), "A multilevel perspective on knowledge transfer: evidence from the Chinese automotive industry", *Strategic Management Journal*, Vol. 30 No. 9, pp. 959-983.

Corresponding author
Mark Washburn can be contacted at: mark.washburn@csulb.edu