Strategic Management Journal
Strat. Mgmt. J., **25**: 801–822 (2004)
Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/smj.413

HOW DO MULTINATIONAL COMPANIES LEVERAGE TECHNOLOGICAL COMPETENCIES? MOVING FROM SINGLE TO INTERDEPENDENT EXPLANATIONS

MORTEN T. HANSEN[1]* and BJØRN LØVÅS[2]
[1] *INSEAD, Fontainebleau, France*
[2] *London Business School, London, U.K.*

This paper explores the relationships among four fundamental determinants of intrafirm competence transfers that have hitherto been analyzed only separately: formal organization structure, informal relations, geographical distance, and relatedness of competencies across subsidiaries. Using a data set consisting of 4840 dyads between new product development teams and subsidiaries that were potential targets for competence transfers in a high-technology multinational company, we find that these determinants interact in surprising ways to explain different patterns of transfers. Results revealed that teams preferred to approach people they knew rather than people who knew related technologies well. They also showed that teams steered away from spatially distant subsidiaries that had related competencies and that the negative effect of large spatial distances could be overcome through established informal relations. These findings indicate that studying one of the determinants separately can yield biased results, as their net effect may change when the moderating effects of the other determinants are considered. Research on synergies, integration, technology transfers, and geographical and cultural differentiation in multinational enterprises therefore needs to be broadened by analyzing multiple determinants of competence transfers. Copyright © 2004 John Wiley & Sons, Ltd.

As competition in a number of global industries is becoming more knowledge- and technology-intensive, the ability of multinational companies to leverage their competencies across dispersed subsidiaries is an increasingly important source of competitive performance (Doz, Santos, and Williamson, 2001). To understand why and how competence transfers occur in multinational companies, much strategic management research has focused on the determinants of such transfers. While one line of research has emphasized that formal organization structure is a fundamental determinant in achieving integration across dispersed subsidiaries (e.g., Galbraith, 1973; Stopford and Wells, 1972), another body of research has stressed the benefits of informal lateral linkages in facilitating competence transfers (e.g., Hedlund, 1986; Bartlett and Ghoshal, 1989; Nohria and Ghoshal, 1997). Research on geography has also found that geographical distance—in the form of spatial, cultural, and national differentiation among employees—can make it difficult to work together and may deter competence transfers (e.g., Kogut and Singh, 1988; Zaheer, 1995). In yet another line of research, scholars have shown that the degree of relatedness in competencies among subsidiaries in a multinational firm may lead to interunit transfers and synergy benefits (e.g., Markides and Williamson, 1994; Rumelt, 1974).

Although these research streams have advanced our understanding significantly, they have

Keywords: international management; synergy; technology transfers; social networks; organizational capabilities
* Correspondence to: Morten T. Hansen, INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, France.
E-mail: morten.hansen@insead.edu

remained largely disconnected, yielding three shortcomings in existing research. First, while there has been a large body of research analyzing whether relatedness in competencies among subsidiaries in a firm leads to synergy benefits, this research has largely ignored the roles of geographical distance and informal linkages (Farjoun, 1998; Hansen, 2002; Ramanujam and Varadarajan, 1989). It is quite possible, however, that these factors moderate the effect of related competencies. In particular, do large spatial distances between subsidiaries deter employees from leveraging related competencies? And do established informal relations steer employees to others whom they know as opposed to others who possess related competencies? If so, these factors may explain why employees do not leverage related competencies across subsidiaries, even if such competencies exist.

Second, although existing research has shown that cultural and national differences may create problems in the acquisition of competencies and cooperation (e.g., Barkema and Vermeulen, 1997; Zaheer, 1995), this line of research has not focused on the extent to which informal and formal mechanisms mitigate this problem in multinational companies. In contrast, existing research on the role of informal and formal organizational mechanisms in enabling knowledge transfers has remained agnostic with respect to geographical distance (e.g., Gupta and Govindarajan, 2000; Nobel and Birkinshaw, 1998). This disconnect between research streams has left an important unanswered question: Does geographical distance, such as spatial distance and cultural differences, prevent a multinational firm from leveraging its competencies across dispersed subsidiaries, or can informal linkages and formal coordination among subsidiaries overcome this problem? If the answer is that spatial distance is an insurmountable obstacle, then one may conclude that multinational companies do not have a unique advantage based on their competencies, because they cannot leverage these across geographically distant subsidiaries.

Third, while some recent research has found that informal lateral linkages appear to be more effective than formal organization mechanisms in leveraging competencies across subsidiaries (e.g., Kim, Park, and Prescott, 2003; Tsai, 2002), there is an incomplete understanding of the potentially dissimilar roles of informal and formal integrative mechanisms in predicting the occurrence of competence transfers. In particular, are informal and formal mechanisms equally effective in leveraging competencies across geographically distant subsidiaries? And are employees more likely to rely on established informal relations or formal organization reporting lines when contacting others to leverage competencies? Answering these questions necessitates analyzing the relationships between informal linkages, formal mechanisms, and geographical distance.

The aim of this paper is to address these shortcomings by analyzing the relationships between formal organization mechanisms, informal relations, geographical distance, and relatedness in competencies. Our overall research question is therefore whether there are important interaction effects between these four fundamental determinants in predicting the occurrence of competence transfers in a multinational firm. We limit our discussion to the global research and development (R&D) function and focus on technological competence transfers between new product development teams situated in a focal subsidiary and other subsidiaries in a multinational firm (cf. Kuemmerle, 1998; Malnight, 1995). While product development teams are likely to differ in the extent to which they need to seek competencies from outside the focal subsidiary, our primary concern in this paper is not whether they decide to acquire competencies but, to the extent that they do, *where* they are likely to go within the company for technological competence transfers, which include the transfer of technical advice and technologies embodied in existing artifacts, such as software or hardware. Our unit of analysis is therefore a *dyad* involving a *focal team* situated in a focal subsidiary and a different subsidiary from which a focal team could potentially acquire technological competencies (i.e., a *target subsidiary*).

THEORY AND HYPOTHESES

Consistent with recent research on multinational and multiunit companies, we conceive of a multinational company as comprising a set of geographically dispersed subsidiaries that are combinations of heterogeneous technological competencies and product-market responsibilities (cf. Galunic and Eisenhardt, 2001; Nohria and Ghoshal, 1997). For a focal product development team that is located in one of the subsidiaries, this heterogeneity in competencies across subsidiaries presents an

opportunity to improve work by leveraging competencies (cf. Ancona and Caldwell, 1992; Clark and Fujimoto, 1991; Eisenhardt and Santos, 2002; Katz and Tushman, 1979), but a team's tendency to engage in intersubsidiary competence transfers may depend on the existence of related competencies, geographical distance, and the presence of informal and formal mechanisms.

Four determinants of technological competence transfers

The relatedness of technological competencies is an important determinant of where in the company a focal project team will search for and acquire competencies (Ramanujam and Varadarajan, 1989). A target subsidiary possesses a related technological competence to the extent that its technologies and technical expertise fall in the same areas as those required by a focal new product development team (cf. Farjoun, 1998; Markides and Williamson, 1994; Rumelt, 1974). For example, a subsidiary that has an expertise in the area of robotics possesses a related competence for a focal team developing a new product that requires robotics technologies.[1] When obtaining competencies, new product development teams should want to match the needs of their project with the type of technological competencies possessed by a target subsidiary. Thus, product development teams should be more likely to engage in a transfer event with a target subsidiary that possesses a related technological competence for a focal project than with a target subsidiary that does not.

Geography also explains why product developers from different subsidiaries in a firm interact to acquire competencies while others do not. By geography, we refer to three dimensions: spatial distance (i.e., miles) between subsidiaries, the extent to which the national cultures of the countries in which subsidiaries are located differ (i.e., cultural distance), and whether interactions take place across national borders. A focal team and a subsidiary may be less likely to interact to the extent that the spatial distance between them is large. The tendency of actors to interact less with increasing spatial distance has been demonstrated in previous research, including studies of intraoffice distances among engineers (Allen, 1977) and partnering patterns among venture capitalists located in different cities (Sorenson and Stuart, 2001). The explanation for this tendency is the accuracy and richness of information transfer, which declines with increasing spatial distance, as well as increasing communication costs with increasing spatial distance, such as travel time and burdensome meetings (cf. Krugman, 1991).

Working relations involving a focal team and target subsidiaries may also become more difficult when they involve employees located in different countries and when there is a large cultural distance, which includes differences in power distance, uncertainty avoidance, masculinity, individualism, and long-term orientation between national cultures (Hofstede, 2001; Kogut and Singh, 1988). With increasing cultural distance and national differences between a focal team and a target subsidiary, the level of comfort and trust is likely to decrease, making it more difficult to work together (Barkema and Vermeulen, 1997). Such differences may act as a deterrent to engaging in transfers (Kedia and Bhagat, 1988) and increase the tendency to interact with others from the same culture and country (cf. Earley and Mosakowski, 2000). A focal team and a subsidiary should therefore be less likely to interact and exchange technological competencies to the extent that they represent different national cultures and countries.

The formal organization structure is another determinant of competence transfers (e.g., Stopford and Wells, 1972; Galbraith, 1973). At the dyadic level, the formal organization links two subsidiaries to the extent that they are formally grouped together and report to the same superior in the organizational hierarchy (cf. Williamson, 1975). Formal groups that comprise two or more subsidiaries thus confer formal proximity that may lead to competence transfers. A formal group may have cooperative rules that direct members to acquire competencies from others in a group (Eisenhardt and Galunic, 2000). There may also be group-based incentives, such as bonuses based on common group performance, that encourage individuals to cooperate across subsidiaries in a formal group (cf. Milgrom and Roberts, 1992). In addition, subsidiaries that belong to the same formal group may have a common identity that leads members within a group to naturally think about leveraging competencies from one another (cf. Brewer, 1979; Katz and Allen,

[1] This relatedness does not guarantee that a subsidiary's competencies will in fact be useful for the focal team but only that they are likely to be so *ex ante*.

1988; Tajfel and Turner, 1986). Extensive within-group communication channels may also make product developers more aware of opportunities for leveraging competencies (Hansen, Nohria, and Tierney, 1999; Katz and Tushman, 1979). All these factors may motivate and enable product development teams to cooperate with others that are part of the same formal group.

Finally, informal cross-subsidiary relations, which we define as continuous work-related informal relations between individuals from two subsidiaries, affect cross-subsidiary competence transfers in a multinational company (Nohria and Ghoshal, 1997; Hansen, 1999). Informal relations are distinct from formal coordinating mechanisms in that they are grounded in norms, habits, and personal reciprocity rather than authority based on a formal hierarchy (cf. Emerson, 1962). These relations imply that the two subsidiaries are embedded in the same social structure and therefore exhibit a higher degree of trust and a higher capacity for information sharing and mutual problem solving than two subsidiaries with no informal relation between them (Granovetter, 1985; Gupta and Govindarajan, 2000; Uzzi, 1997). Because of these benefits, product development team members are more likely to seek technological competencies from other subsidiaries with which they have an established informal relation than from others with whom they do not have established informal relations.

In short, these four determinants affect the tendency for a focal product development team in a subsidiary to transfer technological competencies from a target subsidiary. Stated as a baseline hypothesis:

> *Hypothesis 1: A focal team is more likely to transfer from a target subsidiary (a) that has related competencies than from one that has not, (b) that is geographically close than from one that is distant, (c) if they are formally proximate than if they are not, and (d) if there is an established informal relation between them than if there is not.*

The moderating effect of geographical distance on related competencies

If a team's only concern were to locate subsidiaries that had related competencies, the variable indicating whether a subsidiary possessed related technological competencies for a focal team should predict a transfer event irrespective of geographical distance. Geographical distance, however, may moderate the main effect of related competencies, in two situations. First, if a set of subsidiaries all possess related competencies for a focal team, the team is more likely to transfer from a subsidiary that is located in a facility nearby than from one that is located far away because of the increased search and transfer costs associated with greater spatial distance. Search costs in the form of actual hours spent searching and elapsed days before a useful competence is identified are likely to be higher over greater spatial distance (cf. Sorenson and Stuart, 2001). Although engineers can communicate via e-mail and phone messages, search may also involve phone conversations, which may be difficult to organize if engineers work in different time zones, and long-distance traveling to meet and discuss possible useful technological competencies. Once the team has identified a useful source of technological competencies, the transfer process may involve back-and-forth traveling to adequately absorb the competencies (Leonard-Barton and Sinha, 1993; Teece, 1977). In addition, team members may view the crossing of a national border as an impediment, especially if border crossing involves cumbersome checks upon entering a new country. The focal team may also be deterred to the extent that there is a large cultural distance between the focal team and a subsidiary, as the levels of comfort and trust between the two parties are likely to decrease with increasing cultural distance, making the working relationship more difficult (Kogut and Singh, 1988). These potential burdens associated with increased geographical distance may deter a focal team from interacting with subsidiaries that are geographically distant when other subsidiaries that have related technological competencies are geographically close:

> *Hypothesis 2a: A focal team is more likely to transfer from a target subsidiary with related competencies that is geographically close than from one with related competencies that is geographically distant.*

The second situation in which geographical distance may moderate the main effect of related competencies involves transfer from subsidiaries that have related competencies vs. those that do not. Teams that engage in localized search may first approach subsidiaries that are geographically

close and then broaden their search to more distant subsidiaries (cf. Cyert and March, 1992; Fleming and Sorenson, 2004). As geographical distance increases, however, a focal team's search and transfer costs are likely to increase because of the higher probability of longer travel distances and interactions taking place across different time zones, national borders, and national cultures. When the geographical distance is very large, the perceived search and transfer costs may be sufficiently high to offset the perceived benefits that can be derived from acquiring technological competencies from that subsidiary, deterring the team from attempting to engage in search and transfer over great geographical distance. In such a situation, teams may instead choose to interact with subsidiaries 'close to home' that do not have related competencies but nevertheless may have some useful analogous advice to provide (cf. Hargadon and Sutton, 1997):

Hypothesis 2b: A focal team is more likely to transfer from a target subsidiary without related competencies that is geographically close than from one with related competencies that is geographically distant.

The moderating effects of informal and formal determinants on geographical distance

While greater geographical distance is likely to reduce the chances of a transfer event, an established informal linkage between a focal team and a subsidiary may reduce the search and transfer costs associated with geographical distance.[2] As research on R&D functions in multinational companies has demonstrated, personal relations spanning subsidiaries are effective in integrating R&D personnel who are widely dispersed across country subsidiaries (De Meyer, 1992; Kim *et al*., 2003). Team members may find it easier to contact people who work in a subsidiary many miles away to the extent that they know them or at least know their colleagues. Likewise, the engineers in the target subsidiary may respond favorably to an incoming request from a spatially distant person to the extent that they know the person making the request. In addition, the level of trust and comfort associated with an established informal relation may mitigate the lack of trust and comfort that may result from cross-border interaction and increased cultural distance. Social proximity in the form of established informal relations thus reduces the effect of spatial, national, and cultural differentiation. Thus we predict:

Hypothesis 3: An established informal relation between a focal team and a target subsidiary mitigates the negative effect of geographical distance on the chances of a transfer event between them.

Formal proximity may also integrate subsidiaries that are geographically distant from one another. To the extent that rules, incentives, a common identity, and communication channels that foster cooperation are in place within a formal group, a focal team may feel more motivated and able to connect with subsidiaries that belong to the same formal group, even though they may be located many miles away, in a different country, or are dissimilar culturally. Stated in a hypothesis:

Hypothesis 4: A focal team's location in the same formal group as a target subsidiary mitigates the negative effect of geographical distance on the chances of a transfer event between them.

The moderating effects of informal relations and formal proximity on related competencies

So far we have argued that both informal relations and formal proximity mitigate the main negative effect of geographical distance. These arguments raise the issue of whether the same informal and formal organization mechanisms might moderate the effect of related competencies. There are two situations in which this may occur. In the first and most straightforward situation, two subsidiaries both have related competencies for the team, but only one has an established informal relation with the focal team. In this situation, it is more likely that the team will try to acquire competencies from the subsidiary with which it has an established informal relation than from the one with which no such relation exists. As discussed earlier, established informal relations are associated with trust and a capacity for information sharing and mutual problem solving that should prompt a team to rely

[2] Although spatial distance may reduce the likelihood that a relationship is established in the first place, we are not concerned with the establishment of relations but with how relations interact with spatial distance once they exist.

on them when there is no other difference with respect to related competencies.

The second situation is more complicated: one subsidiary has related competencies but no established relation with the focal team, while another subsidiary has no related competencies, but an established relation exists. There are three reasons why the focal team may choose the subsidiary with an established relation but no related competencies, even though this may appear to be irrational. First, although the subsidiary does not have related competencies for a focal team, an established relation may lead team members, out of habit, to contact the engineers in the subsidiary. They may not know *a priori* that the subsidiary does not possess such competencies, or, if they do know, they may believe that the subsidiary has analogous experiences that can be brought to bear on the project (cf. Hargadon and Sutton, 1997). Established relations thus become taken-for-granted channels through which competencies can be accessed, leading teams to direct their search to subsidiaries they know, regardless of whether they possess particular competencies for the focal project (cf. Ahuja and Katila, 2004; Eisenhardt and Galunic, 2000; Gulati, 1995).

A second reason is that, to save face, team members may feel safer exposing their ignorance and asking for help from others with whom they have an established relation than asking for help from strangers, who may think less of the focal team members as a result. In this way, as research on impression management has shown (Wayne and Liden, 1995), teams seek to manage their impressions on peers in different subsidiaries, an activity that is especially important among employees with a strong professional identity, such as engineers.

Finally, team members may also perceive that established informal relations make the search and transfer processes easier than they would be without such relations. In established relations, they may know the engineers in the subsidiary from past exchanges and thus should know their particular areas of expertise, lowering search costs, and feel comfortable working with them, lowering transfer costs. Thus, although team members choose to acquire competencies from a subsidiary that does not possess related competencies, they may still be behaving rationally, because they believe that the established relation reduces search and transfer costs. Taken together, these three explanations suggest why teams may contact someone they know rather than someone who knows:

Hypothesis 5: A focal team is more likely to transfer from a target subsidiary that does not have related competencies but with which it has an established relation than from one that has related competencies but with which it has no established relation.

Formal proximity may also moderate the main effect of related competencies, in two situations. The most straightforward situation involves possible transfer from two subsidiaries that both possess related competencies for the team, but only one belongs to the same formal group as the focal team. In this situation, a focal team is more likely to transfer from the subsidiary in the same formal group than from the one outside the group, because of coordination, communication activities, and cooperative rules that likely operate within formal groups.

The more complicated situation, however, involves possible transfer from two subsidiaries, one of which has related competencies but is not in the same formal group as the team and one of which does not have related competencies but is in the same formal group as the focal team. The chances of a transfer event occurring within the formal group depend on the intensity of coordination efforts within it. Strict rules and incentive systems stipulating that product developers within the formal group ought to cooperate, a strong common identity among employees within the group, and extensive group-based communication activities may lead to greater motivations and abilities to exchange competencies within the formal group. To the extent that these coordination efforts are intense, the focal team is more likely to transfer from a subsidiary within its formal group than with a subsidiary in another formal group, even though the former subsidiary does not have related competencies but the latter does:

Hypothesis 6: A focal team is more likely to transfer from a target subsidiary in its formal group that does not have related competencies than from one that is not in its formal group but has related competencies.

METHODS AND DATA

Setting and data collection procedures

We tested the hypotheses with data from a large, multinational high-technology company that had sales of more than $5 billion at the time of the study. The company, which is based in the United States, was involved in developing, manufacturing and selling a range of electronics and computing products and systems. At the time of the study, the company was structured into 41 operating subsidiaries that were responsible for product development, manufacturing, and sales. After having negotiated access to the company through three senior corporate R&D managers, we conducted more than 30 preliminary open-ended interviews with R&D managers, engineers, and project managers to better understand the context.

We collected both archival and survey data. There were two surveys: a survey administered to the most senior R&D manager in each of the 41 subsidiaries (with a 100% response rate), asking about intersubsidiary relations and competencies of the subsidiary, and a survey for the project managers of the product development projects included in this study. We developed pilot designs of the two survey instruments and pretested them in 1-hour face-to-face interviews with two R&D managers and five project managers.[3]

To select product development projects to be included in the analysis, we first used the company's databases of projects to identify a list of all projects that the 41 subsidiaries had undertaken in the previous 3 years. We excluded very small projects (i.e., those with fewer than two project engineers) and proposals that had not yet moved from the investigation to the development phase, as these projects were difficult to track. We ended up with a list of 147 projects, and the project managers of 121 of these projects returned their survey, yielding a response rate of 82 percent. We analyzed the response rates but found no significant differences between the final sample and the others in terms of the number of engineers, budget, and age of the projects (as listed in the databases).

[3] During pretests, we determined that project managers could reasonably answer the questions on behalf of the team, although relying on a single respondent for each project team is a limitation in our data.

Table 1. Country locations of the 41 subsidiaries and the 121 project teams

	Subsidiaries		Project teams	
	Number	%	Number	%
U.S.	28	68.3	91	75.2
Canada	2	4.9	1	0.8
Germany	3	7.3	9	7.4
U.K.	3	7.3	9	7.4
France	1	2.4	0	0
South Korea	1	2.4	0	0
Japan	2	4.9	8	6.6
Australia	1	2.4	3	2.5
Total	41	100%	121	100%

The 121 projects took place in 27 of the 41 subsidiaries in the data set.[4] Table 1 depicts the distribution of subsidiaries and projects by country. As the table reveals, the subsidiaries and projects were concentrated in the home country, with 28 of the 41 subsidiaries and 91 of the 121 projects spread across the United States. While the list does not include a large number of countries, the data set allows for a large variance in spatial distance and some variance in cultural distance.

A dyadic approach

Because our hypotheses concern the potential for a transfer event between a focal project team and a target subsidiary, we treated the dyad of a focal team and a target subsidiary as the unit of observation. All our independent variables and the dependent variable pertain to the relational property of the dyads (i.e., using information about both the focal team and the target subsidiary) and not the properties of the individual project team or the target subsidiary.[5] Using this dyadic approach, we created a matrix comprising 4840 observations (i.e., 121 projects times 40 subsidiaries, excluding the focal subsidiary for each project).

This dyadic approach raises an issue of possible non-independence among the observations

[4] Because subsidiaries varied in the extent of their new product development efforts, some of the subsidiaries did not have any product development efforts that met our criteria for inclusion in the study. In addition, project managers in three subsidiaries did not respond to the survey.

[5] Although some product developers did not reside at their subsidiary's main location, most of them, including team members, were located at the main location of a subsidiary, facilitating the computation of dyadic variables.

(Greene, 1993; King and Zeng, 2001). While this issue is not salient in our data set, as we include dyadic variables that incorporate relational properties, we nevertheless wanted to address this potential problem in our model specifications. Guided by prior research analyzing dyads, we approached this issue in two ways (cf. Gulati, 1995; Sorenson and Stuart, 2001). First, as our primary approach, we used a conditional fixed-effects logistic regression analysis as implemented in STATA in which we specified the fixed effect for the focal subsidiary. This procedure conditions on the total number of events and groups together subsidiaries with the same number of events (e.g., it assumes that two subsidiaries that each received two transfers have the same baseline probability of receiving competencies). Because of the conditional effect, this approach excludes from the analysis five subsidiaries in our data set that did not receive any transfers, reducing the number of observations to 4360.

As a second approach, to verify the first, we also implemented a matched-pair sample approach that has been used by prior researchers studying dyads (e.g., Sorenson and Stuart, 2001). In this approach, we matched the observations with a transfer event (i.e., 87) with a randomly generated set of observations drawn from the set of non-event observations. Following the guidelines set by King and Zeng (2001), we chose a conservative number of matched dyads, which we set to twice the amount of events (i.e., 174 observations). Thus, this data set of 261 dyads does not rely on the full data set, thereby reducing the number of observations that are potentially non-independent. We used this model specification to verify the results from our conditional fixed-effect logit model.[6] Because both approaches produced similar results for the main independent variables, we report only the results from our primary approach.

Dependent and independent variables

Dyadic transfer event

The dependent variable is whether a transfer event occurred between a focal project team located in the focal subsidiary and one of the other 40 subsidiaries (i.e., the target subsidiaries). To construct a measure of the transfer of technological competencies, the project manager was asked to indicate the percentages of a project's total hardware and software and the percentage of the project's total technical know-how and information that came from other subsidiaries. He or she was also prompted to indicate which subsidiary the transfer involved, using a list of 40 subsidiaries (the focal subsidiary was excluded from the list, as we were only interested in cross-subsidiary transfers).

Project managers frequently maintained log files tracking the sources of the code and hardware components and were thus in a position to readily answer this question. While it was more difficult for them to track the sources of technical advice, they were most likely aware of significant transfers, as they had to approve any travel costs involved and any compensation given for time spent by engineers in other subsidiaries. Thus, while project managers would not necessarily notice very brief *ad hoc* informal exchanges of advice (e.g., a phone call between an engineer on the project and another engineer in a target subsidiary), they would be aware of substantial transfers. Because we were interested in analyzing whether a transfer event occurred in a dyad, we dichotomized the dependent variable, which was set to '1' if the project manager reported a transfer from another specified subsidiary, and '0' otherwise. In all, 54 of the 121 project teams experienced between one or three transfer events, with a total of 87 such events.

Spatial distance in a dyad

We measured spatial distance as the number of direct air miles between the city where the office of the project team was located and the city of the target subsidiary in the dyad (*Miles (log)*). We logged this measure, as individuals most likely do not perceive that the burdens of travel increase linearly with air miles. For example, a 5000-mile air flight to a target subsidiary is most likely not perceived as five times more burdensome than a 1000-mile air flight, because some of the time-consuming activities of air travel, such as waiting time at airports, do not vary by the length of travel. The shortest dyadic distance was 0 (i.e., located on the same site), and the longest was 10,512 miles (between Edinburgh, Scotland, and

[6] Because this approach may produce underestimates of variables that predict a transfer event, we implemented a relogit procedure in STATA that corrects for this bias by adjusting the coefficient estimates, as recommended by King and Zeng (2001) and implemented by Sorenson and Stuart (2001).

Melbourne, Australia), with a median value of 1072 miles.

Different countries in a dyad

We recorded whether the office of the focal project team and the location of the target subsidiary were located in different countries (*International*). Of all the dyads, 48.3 percent crossed national borders.

Cultural distance in a dyad

We constructed a cultural distance measure based on the cultural indices developed by Hofstede (2001), who conceptualized differences among national cultures in terms of five national attributes: power distance between individuals in the society, tendency toward uncertainty avoidance, emphasis on masculinity, focus on individualism, and emphasis on long-term orientation. We followed prior measures developed by Kogut and Singh (1988) and Barkema and Vermeulen (1997), and computed the differences in these attributes between pairs of relevant countries. We then calculated the Euclidean distance, as follows (*Cultural distance*):

$$\mathrm{CD}_j = \sqrt{\Sigma_{i=1,2,3,4,5}\ ((I_{ij} - I_{in})^2 / V_i)}$$

where CD_j is the cultural distance between the focal team and a target subsidiary, I_{ij} is the index for the ith cultural dimension for the jth country in which the target subsidiary is located, n is the country of the focal team and subsidiary, and V_i is the variance of the index of the ith cultural dimension across all countries in our sample. This measure essentially assigns to a subsidiary the national cultural characteristics of the country in which it is located and then computes the distance between the focal and target subsidiaries in a dyad. We set both measures to zero if the dyad did not cross national borders. Among the international dyads, the smallest cultural distance was between subsidiaries and teams from Australia and the United States (i.e., a score of 0.4), while the largest distance was between subsidiaries and teams from Korea and Scotland (i.e., a score of 4.9), with a mean value of 0.95.

Existence of related competencies in a dyad

To measure whether a target subsidiary possessed technological competencies that were related to the focal project team, our first step involved working with the three senior corporate R&D managers to generate a list of 22 technological competencies in which one or more subsidiaries had developed a particular competence. Examples of competencies include digital signal processing, quartz/cesium resonance, fault diagnostics, and device physics. As a second step, we submitted a questionnaire to the R&D managers of each of the 41 subsidiaries, asking them to indicate their particular technological competencies on the list. The three senior corporate R&D managers then verified whether the responses made sense. In the third step, we asked the project managers of the 121 projects to indicate, from the same list, which technological competencies the project required. Thus, through this procedure, we obtained information on the competencies that existed in the subsidiaries and what competencies the project required. As a final step, we then constructed a dyadic variable that took a value of 1 if there was a match between at least one competence listed by the target subsidiary and the focal team, and zero otherwise (*Related competencies*). For example, this variable would take a value of 1 if the project required expertise in digital signal processing and the target subsidiary had reported that it possessed a particular competence in digital signal processing. Of the 4840 dyads, 42 percent were coded as having related competencies. To analyze interaction effects, we interacted this variable by multiplying it with the international variable (*International* $*$ *Competence*), miles (*Miles* $*$ *Competence*), cultural distance (*Cultural distance* $*$ *Competence*), and the informal relation and formal proximity variables.

Established informal relation in a dyad

During the preliminary interviews, several engineers and managers explained how a relationship between two subsidiaries functioned: A group of engineers in a subsidiary typically maintained an informal regular contact with a group of engineers in a target subsidiary, and a project team would use such contacts to obtain technological competencies. Several times, people described these relations in terms such as 'we normally work with those units over there.' These types of contacts had been institutionalized in that they were regularly occurring patterns of activities between groups of people from different subsidiaries. They were common knowledge in that most product developers

seemed to know about their existence and how to use them, and we were told that a main responsibility of a subsidiary's managers was to provide these contacts for their project teams, should the need arise. Because of the saliency of these relations in the company, we decided to focus exclusively on them, although it may be more appropriate to study other types of lateral linkages in different settings.

We obtained information on these regularly occurring intersubsidiary contacts through the network survey to the R&D managers, who were asked: 'Over the past 2 years, are there any units [subsidiaries] from whom your unit [subsidiary] regularly sought technical and/or market-related input?' The question was followed by a list of the 41 subsidiaries included in the study, and the manager indicated on the list the relevant subsidiaries. We then merged the project data with the subsidiary network data by assigning a subsidiary's network relations to its projects that were included in this study.

It was important to verify that an informal relation existed *prior* to the start of a project because our theoretical arguments assume that a project team uses *established* pre-existing intersubsidiary relations to acquire competencies. Following established procedures in network research (e.g., Podolny and Baron, 1997), we asked the R&D manager how many years each of these reported relations had been in existence and then only included relations that had existed *prior* to the start of a focal product development project (*Informal relation*). Of all the dyads, 12 percent had an informal relation. To test the interaction effects, we interacted this variable with the international variable (*International* $*$ *Informal relation*), miles (*Miles* $*$ *Informal relation*), cultural distance (*Cultural distance* $*$ *Informal relation*) and related competencies (*Competence* $*$ *Informal relation*).

Finally, because prior research has shown that the strength of informal cross-unit relations matters for knowledge transfers (e.g., Hansen, 1999), we also included a control variable that indicates the strength of each intersubsidiary relation. Using 7-point scales, we asked the R&D managers how frequently the engineers from the two subsidiaries interacted (with anchors of 'once a day' to 'once every 3 months') and how close the working relationships had been (with anchors of 'very close, practically like being in the same work group' to 'distant, like an arm's length delivery of the input'). We reverse-scored the items and took the average of the two items, which have a correlation of 0.83 (*Strength of relation*).

Formal proximity in a dyad

We used the two hierarchical levels in the company to construct a measure of formal proximity. First, the 41 subsidiaries had been structured into five broad *business groups*, each of which had a vice president and a small staff that coordinated the efforts across the subsidiaries within the business group. Second, several subsidiaries were grouped into *divisions* with between two and four subsidiaries in them. Sixteen out of the 41 subsidiaries were grouped into a division, while the remaining 25 were not. A subsidiary manager could therefore report directly to a division manager, who in turn reported directly to a business group vice president (see Figure 1 for a partial diagram of this organization structure). Thus, two subsidiaries could have a common hierarchical point of integration at one of three possible levels: by reporting to the President's office at the very top of the organization (i.e., the least proximate formal integrative point), as exemplified by subsidiaries A and E in Figure 1; by belonging to the same business group, as illustrated by subsidiaries A and C in Figure 1; and by reporting to the same divisional manager (i.e., the most proximate formal group), as exemplified by subsidiaries A and B in Figure 1. We constructed a three-level measure of formal proximity: 0, only integrated at the top; 1, integrated at the business group level; and 2, integrated at the division level (*Formal proximity*). Of all the dyads, 72 percent were at level 0, 25 percent at level 1, and the remaining 3 percent at level 2. We also used an alternative measure denoting whether the focal team and the target subsidiary were in the same business group (with a score of 1) or not (a score of 0). To test the hypothesized effects, we interacted the formal proximity variable with the international dimension (*International* $*$ *Formal proximity*), miles (*Miles* $*$ *Formal proximity*), cultural distance (*Cultural distance* $*$ *Formal proximity*), and related competencies (*Competence* $*$ *Formal proximity*).

Project control variables

While our theory focuses on *where* a project team would acquire competencies, we nevertheless wanted to control for a project's propensity to

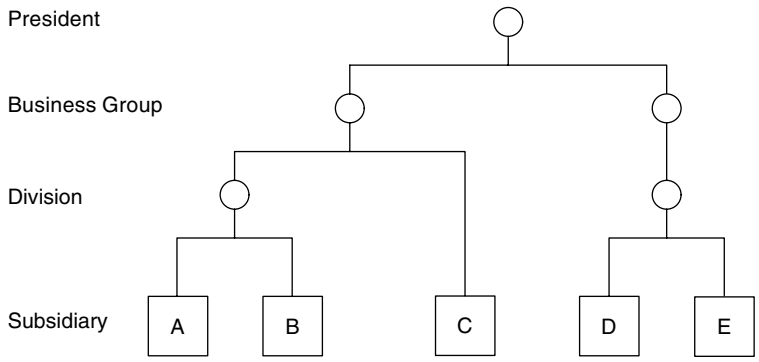

Figure 1. Diagram of levels in the formal organization

seek competencies from other subsidiaries in the first place. We used three project-level variables to control for this propensity. First, we constructed a variable by asking the project manager to indicate the percentage of the project's total software and hardware that came from the focal subsidiary (*Existing ware*). Assuming that a team would first use what its own subsidiary had already developed, this measure indicates the need to acquire new competencies from elsewhere: if projects could reuse their own technologies, they should have less need to seek technological competencies elsewhere. Second, we also entered a control variable measuring the size of the project. Larger projects may have had a higher propensity to seek competencies from other places, as they may have had higher needs or more personnel available to seek competencies. We used the initial budget (in $000) as an indicator of the project's size and logged this measure (*Budget*). Third, we controlled for a project's overall opportunities for acquiring competencies from other subsidiaries. We measured the number of the competencies on the pre-developed list of 22 competencies that the project manager reported that the project required (*No. competencies required*). The higher the number of competencies required on this list, the more likely that other subsidiaries could provide opportunities for competence transfers to the focal team, increasing the propensity for the project to seek competencies from other subsidiaries in the first place.

RESULTS

The descriptive statistics are reported in Table 2. We subtracted the mean from the independent variables to avoid high correlations with the interactions terms.[7]

Main effects

The variables testing the main effects of the four determinants are entered sequentially in Models 2–5 in Table 3. First, as shown in Model 2, the related competencies variable is positive and significant, indicating that the probability of a transfer increases substantially when the target subsidiary possesses related competencies. Second, as seen in Model 3, the coefficient estimate for the log of miles is significant and negative, while the results pertaining to the country effect and cultural distance are not significant (and these results hold in models in which each distance variable is entered separately). That is, as the spatial distance increases between a project team and a target subsidiary, the probability of a transfer between them decreases.

Third, the effect for formal proximity is shown in Model 4 and is positive and significant, implying that teams and subsidiaries that are formally proximate are more likely to engage in a transfer than dyads that do not have such formal integration. Fourth, the effects for informal relations are entered in Model 5. Both the presence of a relation in a dyad and the strength of that relation are positive and significant.

In short, when viewed separately, there is support for the main effects of related competencies,

[7] We computed variance inflation factors to assess if our models had any multicollinearity problems. No variable had a VIF factor higher than 5, which is well below the recommended threshold of 10, indicating that there are no major multicollinearity concerns (Neter, Wasserman, and Kutner, 1990).

Table 2. Descriptive statistics (n = 4840)

Variables	Mean	s.d.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Existing ware	0.45	0.31	0.00	1.00																				
2. Budget	6.75	1.07	4.50	10.72	−0.26																			
3. No. competencies required	3.06	1.40	0.00	9.00	−0.09	0.26																		
4. Related competencies[1]	0.00	0.49	−0.42	0.58	−0.03	0.08	0.30																	
5. International[1]	0.00	0.50	−0.48	0.52	−0.03	0.03	0.10	0.06																
6. Miles (log)[1]	0.00	2.34	−6.88	2.38	0.00	0.01	0.03	−0.05	0.61															
7. Cultural distance[1]	0.00	1.43	−0.95	3.95	0.02	0.09	0.04	0.02	0.69	0.45														
8. Formal proximity[1]	0.00	0.53	−0.31	1.69	−0.03	−0.01	0.01	0.10	−0.08	−0.29	−0.06													
9. Informal relation[1]	0.00	0.33	−0.12	0.88	0.01	0.06	0.06	0.12	−0.02	−0.22	0.02	0.36												
10. Strength of relation	0.55	1.56	0.00	7.00	−0.02	0.05	0.06	0.15	−0.04	−0.27	−0.01	0.49	0.81											
11. International ∗ Competence	0.01	0.25	−0.28	0.30	−0.01	−0.01	−0.05	0.02	0.00	0.09	−0.02	−0.03	−0.05	−0.05										
12. Miles ∗ Competence	−0.06	1.20	−3.99	2.89	−0.01	0.01	−0.03	−0.02	0.09	0.24	0.05	−0.12	−0.09	−0.13	0.62									
13. Cultural distance ∗ Competence	0.01	0.70	−1.66	2.08	0.00	−0.02	−0.03	0.01	−0.02	0.05	−0.02	−0.03	−0.04	−0.03	0.68	0.45								
14. International ∗ Informal relation	−0.00	0.16	−0.42	0.45	0.00	−0.01	−0.03	−0.05	−0.00	0.18	0.03	−0.21	−0.05	−0.16	0.11	0.14	0.07							
15. Miles ∗ Informal relation	−0.16	1.17	−6.05	2.09	0.01	−0.03	−0.04	−0.06	0.12	0.39	0.10	−0.36	−0.33	−0.47	0.10	0.22	0.07	0.67						
16. Cultural distance ∗ Informal relation	0.01	0.50	−0.83	3.15	0.01	0.02	−0.02	−0.03	0.03	0.14	0.07	−0.17	0.04	−0.13	0.07	0.09	0.07	0.71	0.48					
17. International ∗ Formal proximity	−0.02	0.26	−0.81	0.87	0.01	−0.03	−0.05	−0.03	−0.01	0.23	−0.01	−0.14	−0.21	−0.25	0.10	0.15	0.06	0.35	0.40	0.19				
18. Miles ∗ Formal proximity	−0.36	1.94	−11.60	4.01	0.04	−0.04	−0.06	−0.08	0.14	0.49	0.10	−0.36	−0.35	−0.49	0.11	0.25	0.07	0.40	0.71	0.25	0.67			
19. Cultural distance ∗ Formal proximity	−0.04	0.67	−1.60	2.46	−0.01	−0.04	−0.02	−0.04	−0.01	0.17	−0.10	−0.17	−0.21	−0.22	0.06	0.11	0.08	0.22	0.30	0.18	0.70	0.51		
20. Competence ∗ Informal relation	0.02	0.17	−0.37	0.51	−0.01	0.02	0.02	0.04	−0.05	−0.09	−0.03	0.18	0.26	0.29	−0.04	−0.22	0.01	−0.05	−0.15	−0.06	−0.02	−0.14	−0.03	
21. Competence ∗ Formal Proximity	0.03	0.27	−0.71	0.98	−0.02	0.04	0.05	0.03	−0.03	−0.12	−0.03	0.18	0.18	0.23	−0.09	−0.31	−0.07	−0.03	−0.15	−0.03	−0.00	−0.19	−0.07	0.39

[1)] Mean value subtracted.

Table 3. Results from Conditional Fixed-effects Logistic Regression Analysis of Dyadic Transfer Events

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Existing ware	−1.74(0.52)***	−1.79(0.53)***	−1.75(0.53)***	−1.77(0.54)***	−1.86(0.55)***	−1.82(0.56)***	−1.84(0.56)***	−1.83(0.56)***
Budget	0.12(0.13)	0.11(0.13)	0.12(0.13)	0.13(0.13)	0.17(0.14)	0.19(0.14)	0.19(0.14)	0.19(0.14)
No. competencies required	0.07(0.09)	−0.11(0.10)	−0.11(0.10)	−0.10(0.10)	−0.06(0.10)	−0.07(0.11)	−0.07(0.11)	−0.07(0.11)
Related competencies		1.66(0.27)***	1.60(0.28)***	1.50(0.28)***	1.36(0.29)***	1.18(0.30)***	1.10(0.32)***	1.01(0.33)***
International			0.49(0.47)	0.23(0.48)	−0.30(0.51)	−0.40(0.55)	0.97(0.84)	0.99(0.85)
Miles (log)			−0.19(0.05)***	−0.07(0.06)	0.03(0.06)	0.13(0.09)	−0.21(0.12)*	−0.25(0.18)**
Cultural distance			−0.08(0.16)	−0.08(0.16)	0.04(0.16)	−0.02(0.17)	0.10(0.20)	0.10(0.20)
Formal proximity				0.94(0.19)***	−0.13(0.24)	−0.11(0.24)	−0.12(0.24)	0.03(0.26)
Informal relation					2.10(0.45)***	2.14(0.45)***	2.52(0.50)***	2.46(0.50)***
Strength of relation					0.21(0.09)**	0.20(0.09)**	0.24(0.09)***	0.27(0.09)***
International ∗ Competence						0.44(0.90)	0.48(0.94)	0.49(0.97)
Miles ∗ Competence						−0.27(0.14)*	−0.27(0.14)*	−0.31(0.15)**
Cultural distance ∗ Competence						0.25(0.24)	0.24(0.24)	0.30(0.25)
International ∗ Informal relation							−2.26(1.01)**	−2.15(1.08)**
Miles ∗ Informal relation							0.57(0.13)***	0.46(0.14)***
Cultural distance ∗ Informal relation							−0.29(0.23)	−0.25(0.24)
International ∗ Formal proximity								−0.09(0.70)
Miles ∗ Formal proximity								0.16(0.09)*
Cultural distance ∗ Formal proximity								−0.05(0.20)
Chi-square (d.f.)†		44.6(1)***	61.6(4)***	84.6(5)***	196.6(7)***	201.8(10)***	224.0(13)***	230.2(16)***

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. N = 4360. No. of groups = 22. Two-tailed tests for variables; standard errors are in parentheses. †Compared with Model 1.

spatial distance, formal proximity, and informal relations, confirming much prior research on these dimensions and lending support to Hypothesis 1. Model 5 in Table 3, however, reveals two interesting changes in the main effects. First, the main effect for spatial distance is no longer significant, suggesting that when the formal and informal mechanisms are controlled for, there is no overall negative effect of spatial distance. As revealed in subsequent models, however, spatial distance interacts with other variables to explain competence transfers. Second, when the informal relation variable is entered in Model 5, the effect of formal proximity is no longer significant. As the subsequent analysis of interaction variables reveals, however, formal proximity interacts with other determinants to predict transfer events.

Geographical distance and related competencies

Models 6–8 in Table 3 include the three interaction effects combining geographical distance and the existence of related competencies in a subsidiary. The interaction effect including related competencies and whether the dyad crosses national borders is insignificant, as is the interaction effect including related competencies and cultural distance. In contrast, the interaction term involving miles and related competencies (*Miles* ∗ *Competence*) is negative and significant throughout the models. That is, the probability of a transfer event *decreases* as the spatial distance increases between the focal team and a target subsidiary that has related competencies. To evaluate the combined effect of these results, we plotted the estimates for the interaction term and the main effects of miles and related competencies, as shown in Figure 2.[8] When the target subsidiary has related competencies (i.e., the upper line in Figure 2), the probability of a transfer event between a focal project and a subsidiary that has related competencies decreases as the number of miles between them increases. This result supports Hypothesis 2a.

Figure 2 also plots the effects when the target subsidiary has no related competencies (lower line in the figure). The probabilities in this situation are considerably lower than the other line in Figure 2 for all values of spatial distance, but some probabilities are higher in the lower line than in the upper line. Specifically, when the focal project team and the target subsidiary are located on the *same* site (i.e., mean-deviated miles is −6.88), the probability of a transfer event occurring between them is 0.60 when the target subsidiary does not possess related competencies (as seen from the lower line). In contrast, as seen from the upper line, when the subsidiary does possess related competencies but is located farthest away (i.e., mean-deviated miles is 2.37 or 10,512 miles), the

[8] Using estimates from Model 8 in Table 3 and holding other variables constant at their mean value, the equation for the plots is: Prob. $= 1/(1 + e^{-[\text{miles}*(-0.25-0.31*\text{competence})+1.01*\text{related competencies}]})$. Because the dummy variable for related competencies is mean-deviated, it takes on negative (−0.42) and positive (0.58) values instead of 0 and 1.

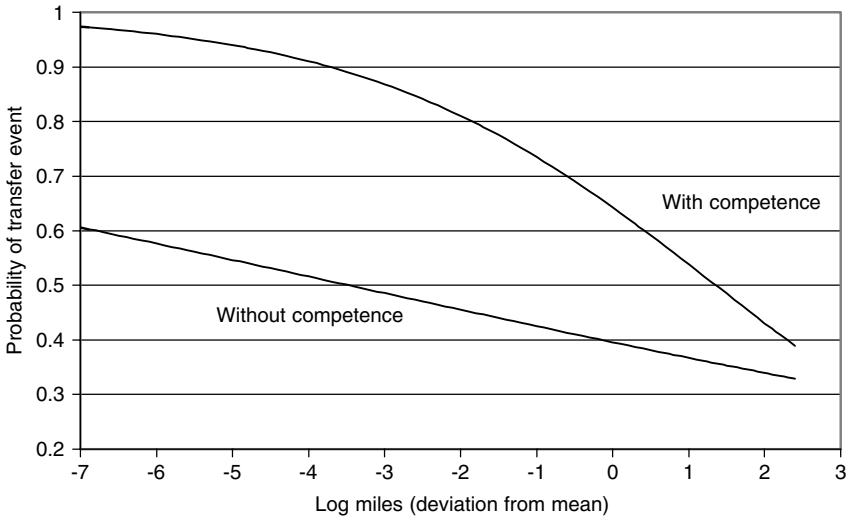

Figure 2. Plot of the interaction effects of related competencies and miles on probability of a transfer event in a dyad

probability of a transfer event is 0.39, which is considerably lower than a probability of 0.60. The turning point occurs when mean-deviated miles is 0.40 (i.e., the distance between the focal team and the subsidiary is 1450 miles), beyond which the focal team is more likely to transfer from a target subsidiary that is close but has no related competencies than from a subsidiary that is very far away but has related competencies. In our data set, 47.8 percent of all dyad observations had a spatial distance of more than 1450 miles, including distances between Europe and the United States, Europe and Asia, and the West and East Coasts in the United States. In short, these results support Hypothesis 2b.

Geographical distance, informal relations, and formal proximity

Model 7 in Table 3 depicts the results involving the interaction effects for geographical distance and informal relations. The interaction effect including the presence of an informal relation and cultural distance is not significant, but the effect for international and informal relation is significant and negative, which is in the opposite direction from what we had predicted. We investigated this result further by partitioning the variables into four dummy variables but found no significant effect for the dummy variables involving the international dimension.[9] The interaction effect involving spatial distance and informal relations (*Miles* ∗ *Informal relation*) is positive and significant in Model 7, indicating that, with an increase in spatial distance in the dyad, the presence of an informal relation increases the likelihood of a transfer event in the dyad. Thus, informal relations mitigate the main negative effect of spatial distance, confirming Hypothesis 3.

Model 8 in Table 3 adds the moderating effects of formal proximity on geographical distance. While the interaction effects involving an international dyad or cultural distance are not significant, the interaction effect involving spatial distance and formal proximity (*Miles* ∗ *Formal proximity*) is positive and significant. That is, with increasing spatial distance between the focal team and a target subsidiary, an increase in formal proximity between them enhances the probability of a transfer event between them, lending support to Hypothesis 4.

Figure 3 shows the moderating effects of informal relations and formal proximity on spatial distance, using the effects obtained in Model 8 in Table 3.[10] The line indicated as 'none' plots the effect of having no formal or informal integrative mechanisms, revealing a negative effect on the probability of a transfer in a dyad as the spatial distance increases between a focal team and a subsidiary. The two lines 'Formal 1' and 'Formal 2' indicate the presence of a common business group (i.e., the least proximate form of hierarchical integration) and a common division (i.e., the most proximate form of hierarchical integration), respectively. As revealed by the plots in Figure 3, the negative effect of miles is mitigated (but not overcome) by these two levels of formal proximity, but an informal relation is sufficient to turn the main negative effect of miles into a positive effect. In short, these results confirm Hypotheses 3 and 4.

Related competencies, informal relations, and formal proximity

Model 1 in Table 4 depicts the results for the interaction term involving related competencies and informal relations. This effect is significant and negative. The combined coefficient estimate for the two main effects (*Related competencies* and *Informal relation*) and the interaction effect (*Competence* ∗ *Informal relation*) is 0.84 when there were related competencies but no informal relation in the dyad. This coefficient estimate increases to 2.26, however, when there were no related competencies but an informal relation in

[9] Specifically, we created three dummy variables to test the movement from a baseline of 'national with no relation' to any other combination: one in which 1 indicates the existence of an informal relation in a national dyad (showing a significant and positive effect), another dummy variable in which 1 indicates the existence of an informal relation in an international dyad (a significant and positive effect), and a third dummy variable in which 1 indicates an international dyad with no relation (no significant effect). Thus, regardless of whether the dyad is national or international, moving to any state that has an informal relation has a positive and significant effect. This suggests that there is no overwhelming effect for the international variable in our data.

[10] The equation for plotting the lines is: Prob. $= 1/(1 + e^{-[\text{miles}*(-0.25+0.16*\text{formal}+0.46*\text{informal})+0.03*\text{formal}+2.46*\text{informal}]})$. Because the variables are mean-deviated, we have used the mean-deviated variable scales to plot the results. For informal relations, those are −0.12 (no) and 0.88 (yes), while for formal proximity they are −0.31 (i.e., only organization president is common integration point), 0.685 (formal 1, i.e., same business group in dyad), and 1.69 (formal 2, i.e., same division in the dyad).

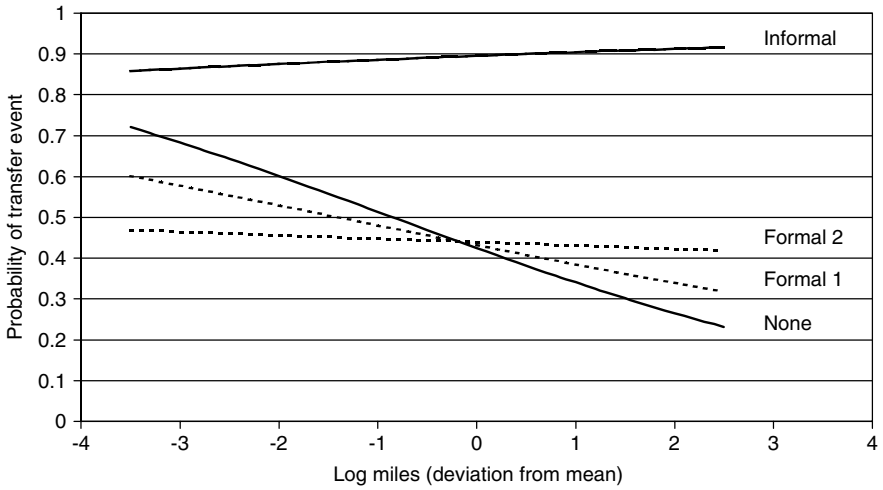

Figure 3. Plot of the interaction effects of informal relations, formal groups and miles on probability of a transfer event in a dyad. Note: 'None" refers to a dyad with no established relation and a formal proximity value of 0; 'Formal 1' denotes the same business group in a dyad; 'Formal 2' denotes the same division in a dyad (the most proximate form); and 'Informal' refers to the presence of an established informal relation in a dyad

the dyad, suggesting that teams were *more likely* to transfer in a situation with no related competencies but an informal relation than in a situation with related competences but no informal relation.[11]

To investigate this result further, we created an alternative specification that categorizes the dyads according to the four possible combinations: 'no relation but related competence' (as the omitted baseline specification), 'both relation and competence,' 'relation but no competence,' and 'neither relation nor competence.' As shown in Model 2 in Table 4 and depicted in Figure 4(a), moving from the baseline combination of 'no relation but competence' to 'both relation and competence' substantially increased the probability of a transfer event (i.e., coefficient = 2.51). Also, moving to a situation in which there was neither a relation nor a related competence significantly reduced the probability of a transfer (−2.46). However, the results reveal a positive effect of moving from the baseline of 'no relation but related competence' to a situation in which there was a relation but the subsidiary had no related competencies for the project (1.54). It appears that the teams went to those with whom they had relations, irrespective of whether they had related competencies for the project. This result lends support to Hypothesis 5.

Model 3 in Table 4 reports the result for the moderating effect of formal proximity as stated in Hypothesis 6. The interaction effect is not significant, but breaking out the interaction effect into four possible combinations produces some interesting results. Model 4 in Table 4 includes the effects from this alternative specification, using three dummy variables based on one dimension of the formal proximity variable—whether the team and the subsidiary in the dyad belonged to the same business group.[12] As shown in Model 4 in Table 4 and depicted in Figure 4(b), there is a *negative* effect of −0.93 of moving from a situation of 'not the same business group but related competence in the dyad' (i.e., the omitted baseline specification) to a situation in which there is a common business group but the target subsidiary has *no* related competencies (i.e., the 'same group but no competence' variable). This result indicates that teams are less likely to transfer competencies from a subsidiary that is in the same business group but has no related competencies than it is from a

[11] Because the two variables are mean-deviated, the two equations for the estimates are computed as follows:

Coefficient estimate (related competencies, no informal relation) $= 1.88 * 0.58 + 2.87 * -0.12 - 1.42 * 0.58 * -0.12 = 0.84$;

Coefficient estimate (no related competencies, informal relation) $= 1.88 * -0.42 + 2.87 * 0.88 - 1.42 * -0.42 * 0.88 = 2.26$.

[12] We used this variable because it is dichotomous and correlates 0.92 with the continuous formal proximity variable, which does not lend itself to this dichotomization of the variables.

Table 4. Results from Conditional Fixed-effects Logistic Regression Analysis of Transfer Events

	Model 1	Model 2	Model 3	Model 4
Existing ware	−1.82 (0.56)***	−1.85 (0.55)***	−1.82 (0.56)***	−1.85 (0.55)***
Budget	0.19 (0.14)	0.16 (0.14)	0.19 (0.14)	0.18 (0.14)
No. competencies required	−0.07 (0.11)	−0.07 (0.10)	−0.07 (0.11)	−0.07 (0.10)
Related competencies	1.88 (0.59)***		1.87 (0.59)***	
International	0.93 (0.90)	−0.29 (0.50)	0.92 (0.90)	−0.38 (0.51)
Miles (log)	−0.21 (0.12)*	0.02 (0.06)	−0.22 (0.13)*	0.06 (0.06)
Cultural distance	0.08 (0.21)	0.04 (0.16)	0.08 (0.21)	0.05 (0.16)
Formal proximity	0.05 (0.26)	0.13 (0.21)	0.01 (0.29)	
Informal relation	2.87 (0.57)***		2.86 (0.57)***	2.12 (0.44)***
Strength of relation	0.27 (0.09)***		0.27 (0.09)***	0.16 (0.08)*
International ∗ Competence	0.26 (1.00)		0.28 (1.00)	
Miles ∗ Competence	−0.30 (0.15)**		−0.29 (0.15)*	
Cultural distance ∗ Competence	0.27 (0.26)		0.27 (0.26)	
International ∗ Informal relation	−1.96 (1.10)*		−1.94 (1.10)*	
Miles ∗ Informal relation	0.39 (0.14)***		0.39 (0.14)***	
Cultural distance ∗ Informal relation	−0.22 (0.25)		−0.22 (0.25)	
International ∗ Formal proximity	0.02 (0.70)		−0.03 (0.73)	
Miles ∗ Formal proximity	0.16 (0.09)*		0.16 (0.10)*	
Cultural distance ∗ Formal proximity	−0.06 (0.20)		−0.06 (0.20)	
Competence ∗ Informal relation	−1.42 (0.70)**		−1.45 (0.74)**	
Competence ∗ Formal proximity			0.12 (0.47)	
Alternative specifications:				
Relation and competence		2.51 (0.32)***		
Relation but no competence		1.54 (0.37)***		
Neither relation nor competence		−2.46 (0.63)***		
Same group and competence				0.56 (0.32)*
Same group but no competence				−0.93 (0.47)**
Neither same group nor competence				−1.20 (0.37)***
Chi-square (d.f.)†	234.4(17)***	197.0(7)***	234.5(18)***	199.4(8)***

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. N = 4360. No. of groups = 22. Two-tailed tests for variables; standard errors are in parentheses.
†Compared with Model 1 in Table 3.

subsidiary that is not in the same business group but has related competencies. This result contradicts Hypothesis 6 and is the opposite of what the results revealed for informal relations: while informal relations led teams to engage in transfers with subsidiaries without related competencies, formal proximity did not reveal this effect.[13] This is a highly unexpected result.

In addition to the lack of support for Hypothesis 6, there was no support for the posited cultural distance and country effects in our data set. Two issues pertaining to our context could explain this lack of results. First, only a relatively small number of countries were represented in our data, reducing the variance in cultural distance and the possibility that this variable would explain transfer events. Second, we studied transfers between engineers in a company that had a strong R&D culture. It is possible that this organizational culture was more salient than national differences and thus 'overrode' a possible national cultural effect. Data sets with larger variances in these two variables may therefore yield different results.

[13] To investigate the relationship between informal relations and formal proximity further, we performed an additional analysis not reported here. We created four dummy variables for various combinations of these two variables and used a baseline that denotes a common business group between the focal team and the subsidiary but no relation between them (i.e., formal only). Results showed that moving from the baseline to a situation of 'neither formal nor informal' has a significant negative effect on the probability of a transfer, indicating that formal proximity has a significant effect on the probability of a transfer when there are no informal relations. This result clarifies the result found in Model 5 in Table 3, where the main effect for formal proximity turned insignificant once the informal relation variables were added.

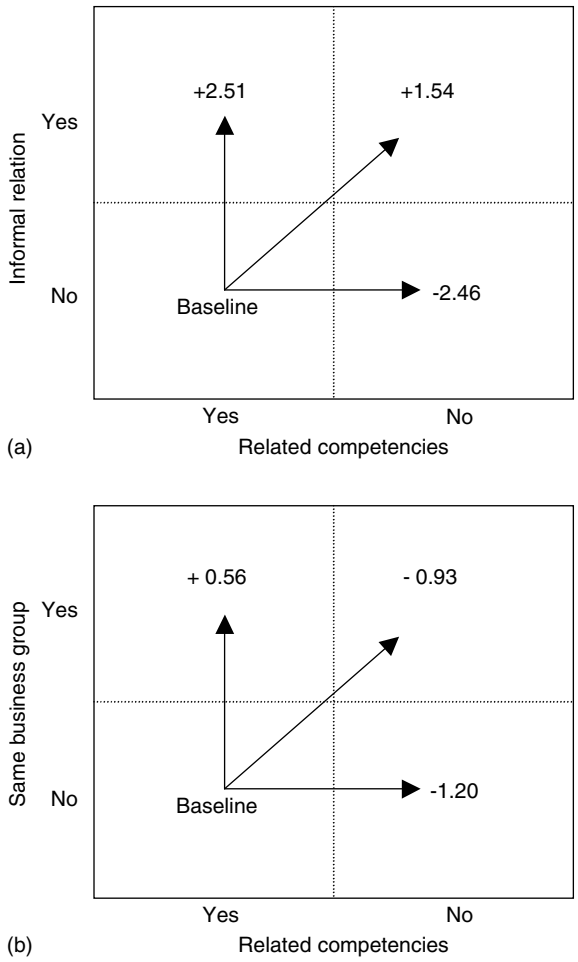

Figure 4. Coefficient estimate effects for various combinations of informal relations, formal business groupings, and related competencies. Note: Figure 4(a) is based on Model 2 in Table 4; Figure 4(b) is based on Model 4 in Table 4

DISCUSSION

In summary, all hypotheses except one were supported. As predicted in Hypothesis 1, the main effects of the four determinants of technological competence transfers were positive and significant when viewed separately: a focal team was more likely to transfer from a target subsidiary to the extent that the subsidiary had related competencies, was spatially close, had a prior relationship with the focal team, and belonged to the same formal subgroup as the team. These results confirm much prior research that has analyzed one of the determinants of transfers separately from the others. However, the results also revealed several significant interaction effects that altered the net effects of these determinants. As predicted in Hypothesis 2, large spatial distances between subsidiaries deterred employees from leveraging related competencies. The negative main effect of spatial distance on the occurrence of a transfer event was, in turn, mitigated if the focal team and a target subsidiary belonged to the same formal group and overcome if they had a prior informal relation, confirming Hypotheses 3 and 4. Interestingly, the informal and formal organizational mechanisms revealed different moderating effects on the existence of related competencies: while informal relations led teams to engage in transfers with subsidiaries *without* related competencies, formal proximity did not. These results confirmed Hypothesis 5 but not Hypothesis 6.

These findings address the three shortcomings in existing research that we noted in the introduction to the paper: the tendency in the literature on synergies in diversified firms to ignore the roles of spatial distance and informal relations; the lack of research that examines how informal and formal integrative mechanisms may overcome a negative effect of geographical distance; and the largely unexplored comparison between formal and informal mechanisms in facilitating competence transfers. Our results suggest several important implications for research in these areas.

Challenging the construct of related competencies

The literature on synergy benefits based on relatedness in competencies has largely ignored two important explanations for why the relatedness construct does not explain synergy benefits better (Ramanujam and Varadarajan, 1989). First, studies have not considered the moderating effect of spatial distance between subsidiaries in a multiunit firm, but our results showed that large spatial distances reduced the tendency for focal teams to transfer from subsidiaries that had related competencies, to the point that large spatial distances overrode the effect of related competencies. When spatial distances are large, the notion of relatedness may simply fade as an explanatory factor.

Second, synergy studies have also ignored the possibility that units in a firm are more likely to connect with other units whose employees they know than with units that possess related competencies. This behavior may not be surprising, as

product development teams are often encouraged to develop strong cross-functional and cross-unit relations (e.g., Clark and Fujimoto, 1991; Eisenhardt and Tabrizi, 1995), but these established patterns of interactions can become cemented and constrain search for related competencies elsewhere (cf. Ahuja and Katila, 2004; Henderson and Clark, 1990). If such behavior is prevalent in a firm, the relatedness construct may only partially explain the flow of competencies.

One implication of our findings is therefore that the explanatory power of the construct of related competencies is not as powerful as first envisioned (e.g., Rumelt, 1974). Perhaps the problem with the notion of related competencies does not concern the noted empirical imprecision of relatedness measures (Farjoun, 1998; Ramanujam and Varadarajan, 1989), but the limited explanatory power of this construct in explaining technological competence transfers in multinational firms that are characterized by large spatial distances and many horizontal informal relationships between subsidiaries. While we only studied one multinational firm and thus cannot easily generalize across firms, our findings suggest that research on synergies in diversified firms need to be broadened beyond the relatedness construct to consider other reasons why competencies are leveraged in a firm. Subsequent research can readily use a large sample of firms to test the hypothesis that the constructs of spatial distance and network relations among subsidiaries overwhelm the effect of relatedness in competencies in explaining the occurrence of transfers and the resultant firm-level performance.

Are large geographical distances an insurmountable obstacle?

Our results pertaining to geographical distance have implications not only for research on synergy but also for research on the use of informal and formal integrative mechanisms and for the notion of firm-wide learning as a source of competitive advantage in multinational firms (Doz *et al*., 2001; Nohria and Ghoshal, 1997). In the introduction, we raised the issue of whether geographical distances in the form of spatial, cultural, and national differentiation present an insurmountable obstacle to leveraging widely dispersed competencies in a multinational enterprise. Our results suggest that this is not the case: the presence of informal relations among subsidiaries offset the negative main effect of spatial distance on the leveraging of technological competencies, whereas formal proximity nearly offset the negative effect of spatial distance (as shown in Figure 3). These findings indicate that problems associated with leveraging competencies across large spatial distances can be managed through the use of informal and formal organizational mechanisms. To our knowledge, ours is the first study that empirically demonstrates this effect.

The finding that spatial distance problems can be overcome or mitigated by formal and informal integrative mechanisms has implications for research into whether multinational firms that participate in regional technology clusters around the world can benefit from spillovers from such clusters and thereby gain a firm-wide competitive advantage (Almeida and Kogut, 1999; Jaffe, Trajtenberg, and Henderson, 1993). Our results suggest that such firm-wide learning benefits are not automatic: without formal and informal integrative mechanisms, task units such as new product development teams are unlikely to leverage competencies from subsidiaries that are situated in spatially distant technology clusters, thereby preventing the firm from taking full advantage of its participation in regional technology clusters (cf. Feinberg and Gupta, 2004; Florida, 1997; Serapio, Dalton, and Yoshida, 2000). An emerging hypothesis that can be tested with a large sample of firms is therefore that increased firm-level performance requires both the participation of a firm in local technology clusters *and* the presence of internal formal and informal integrative mechanisms. Cluster participation without internal mechanisms, or internal mechanisms without cluster participation, is unlikely to lead to substantial firm-level performance.

Different effects of formal and informal integrative mechanisms

In the introduction to the paper, we posed the question of whether informal and formal mechanisms had different effects on the occurrence of competence transfers in multinational firms. Our results suggest that they do. Consistent with recent research on this topic in multinationals, we found that informal relations were a more potent integrator than formal proximity (e.g., Kim *et al*., 2003; Nohria and Ghoshal, 1997; Tsai, 2002). One indication is that the positive main effect of formal proximity on the probability of a transfer event

became insignificant once the informal relationship variable was added to the model (see Models 4 and 5 in Table 3). Also, as noted above, informal relations were more effective than formal proximity in overcoming the negative effect of large spatial distances. The pervasive effects of informal relations stand out in our results. In fact, there were only a few contrasting situations when the presence of established informal relations did not lead to a higher probability of transfer.[14]

Moreover, our results also revealed another interesting contrast between informal and formal integrative mechanisms that have not been explicated by existing research: while informal relationships steered teams to subsidiaries without related competencies, a team was not more likely to contact a subsidiary without related competencies just because they belonged to the same formal subgroup. These different results suggest an unintended consequence of informal relations that is not associated with formal proximity.

However, whether the tendency of relying on informal relationships as opposed to relying on subsidiaries with related competencies lead to poor performance is unclear. On one hand, informal relations that lead task units to subsidiaries that do not possess related technological competencies may reduce task unit performance to the extent that task units obtain inferior knowledge (cf. Gargiulo and Benassi, 2000). This possibility suggests a potential 'dark-side' effect of established informal relations that provides an alternative explanation to the positive role of informal relations that is often noted by research on lateral informal linkages in multinational companies (e.g., Bartlett and Ghoshal, 1989; Birkinshaw, Nobel, and Ridderstrale, 2002; Nohria and Ghoshal, 1997).

On the other hand, connections to subsidiaries that do not possess related competencies may offer unexpected benefits. While such subsidiaries may not possess the most directly relevant knowledge for a project team, working with them may lead to the discovery of unexpected benefits such as novel combinations of existing technologies (Graebner, 2004). Thus, it is quite possible that a seemingly irrational behavior of relying on informal relations as opposed to relying on subsidiaries with related competencies may in fact lead to innovative and high-performing teams. Because we did not study the performance implications of relying on informal relations, however, we could not disentangle whether it was detrimental or beneficial for teams to rely on those they knew as opposed to those with related competencies. While our study is one of the first to study the relationships among the four main determinants of competence transfers, subsequent research needs to study the associated performance implications of these findings.

[14] For example, the probability of a transfer was *higher* when there was *no* informal relation but related competencies and small spatial distance in the dyad, than when there was an informal relation but no related competencies and large spatial distance in the dyad.

CONCLUSION

This study was motivated by the observation that various lines of research that focus on the determinants of technological competence transfers in multinational enterprises have remained largely disconnected and have thus yielded incomplete and potentially biased results. To address this shortcoming, we posed the research question of whether there are important interaction effects between four fundamental determinants of technological competence transfers—i.e., between related competencies, geographical distance, formal proximity, and informal relations. The main finding of this study is that the effect of each of these four fundamental determinants of technological competence transfers depends to a large extent on the state of each of the other determinants. In particular, our results revealed that informal relations and large spatial distances between subsidiaries were relatively more important than the presence of related competencies in explaining the occurrence of technological competence transfers. While large spatial distances deterred competence transfers, however, both formal and informal integrative mechanisms mitigated this tendency. These findings challenge the premise that different determinants of technological competence transfers operate independently of one another and indicate the need for approaches that examine interdependencies among them. To advance research on this topic, studies need to shed the past tendency of analyzing one determinant to the exclusion of others and pursue approaches that integrate the various literatures on synergies, geography, informal relations, and formal structure.

ACKNOWLEDGEMENTS

We thank the guest editors of the special issue on the Global Acquisition, Leverage and Protection of Technological Competencies, two anonymous reviewers, Olav Sorenson, William Simpson, and the seminar participants at London Business School, INSEAD, and the *Strategic Management Journal* conference in Pittsburgh for helpful comments. Research support from the Division of Research at Harvard Business School is greatly acknowledged.

REFERENCES

Ahuja G, Katila R. 2004. Where do resources come from? The role of idiosyncratic situations. *Strategic Management Journal*, Special Issue **25**(8–9): 887–907.

Allen TJ. 1977. *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information Within the R&D Organization*. MIT Press: Cambridge, MA.

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

Ancona DG, Caldwell DF. 1992. Bridging the boundary: external activity and performance in organizational teams. *Administrative Science Quarterly* **37**: 634–665.

Barkema HG, Vermeulen F. 1997. What differences in the cultural backgrounds of partners are detrimental for international joint ventures? *Journal of International Business Studies* **28**: 845–865.

Bartlett CA, Ghoshal S. 1989. *Managing Across Borders: The Transnational Solution*. Harvard Business School Press: Boston, MA.

Birkinshaw J, Nobel R, Ridderstrale J. 2002. Knowledge as a contingency variable: do the characteristics of knowledge predict organization structure? *Organization Science* **13**: 274–290.

Brewer MB. 1979. Ingroup bias in the minimal intergroup situation: a cognitive motivational analysis. *Psychological Bulletin* **86**: 307–324.

Clark KB, Fujimoto T. 1991. *Product Development Performance: Strategy, Organization, and Management in the World Auto Industry*. Harvard Business School Press: Boston, MA.

Cyert RM, March JG. 1992. *A Behavioral Theory of the Firm* (2nd edn). Blackwell Business: Cambridge, MA.

De Meyer A. 1992. Management of international R&D operations. In *Technology Management and International Business*, Granstrand O, Hakanson L, Sjolander S (eds). Wiley: New York; 163–179.

Doz Y, Santos J, Williamson P. 2001. *From Global to Metanational: How Companies Win in the Knowledge Economy*. Harvard Business School Press: Boston, MA.

Earley PC, Mosakowski E. 2000. Creating hybrid team cultures: an empirical test of transnational team functioning. *Academy of Management Journal* **43**: 26–50.

Eisenhardt KM, Galunic CD. 2000. Coevolving: at last, a way to make synergies work. *Harvard Business Review* **78**(1): 91–101.

Eisenhardt KM, Santos FM. 2002. Knowledge-based view: a new theory of strategy? In *Handbook of Strategy and Management*, Pettigrew A, Thomas H, Whittington R (eds). Sage: London; 139–164.

Eisenhardt KM, Tabrizi BN. 1995. Accelerating adaptive processes: product innovation in the global computer industry. *Administrative Science Quarterly* **40**: 84–111.

Emerson RM. 1962. Power–dependence relations. *American Sociological Review* **27**: 31–41.

Farjoun M. 1998. The independent and joint effects of the skills and spatial bases of relatedness in diversification. *Strategic Management Journal* **19**(7): 611–630.

Feinberg SE, Gupta AK. 2004. Knowledge spillovers and the assignment of R&D responsibilities to foreign subsidiaries. *Strategic Management Journal*, Special Issue **25**(8–9): 823–845.

Fleming L, Sorenson O. 2004. Science as a map in technological search. *Strategic Management Journal* **25**(8–9): 909–928.

Florida R. 1997. The globalization of R&D: results of a survey of foreign-affiliated R&D laboratories in the USA. *Research Policy* **26**: 85–103.

Galbraith JR. 1973. *Designing Complex Organizations*. Addison-Wesley: Reading, MA.

Galunic CD, Eisenhardt KM. 2001. Architectural innovation and modular corporate forms. *Academy of Management Journal* **44**: 1229–1249.

Gargiulo M, Benassi M. 2000. Trapped in your own net? Network cohesion, structural holes, and the adaptations of social capital. *Organization Science* **11**: 183–201.

Graebner M. 2004. Momentum and serendipity: how acquired leaders create value in the integration of technology firms. *Strategic Management Journal*, Special Issue **25**(8–9): 751–777.

Granovetter M. 1985. Economic action and social structure: the problem of embeddedness. *American Journal of Sociology* **91**: 481–510.

Greene WH. 1993. *Econometric Analysis.* (2nd edn). Macmillan: New York.

Gulati R. 1995. Social structure and alliance formation patterns: a longitudinal analysis. *Administrative Science Quarterly* **40**: 619–652.

Gupta AK, Govindarajan V. 2000. Knowledge flows within multinational corporations. *Strategic Management Journal* **21**(14): 473–496.

Hansen MT. 1999. The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly* **44**: 82–111.

Hansen MT. 2002. Knowledge networks: explaining effective knowledge sharing in multiunit companies. *Organization Science* **13**: 232–249.

Hansen MT, Nohria N, Tierney T. 1999. What's your strategy for managing knowledge? *Harvard Business Review* **77**(2): 106–116.

Hargadon A, Sutton RI. 1997. Technology brokering and innovation in a product development firm. *Administrative Science Quarterly* **42**: 716–749.

Hedlund G. 1986. The hypermodern MNC: a heterarchy? *Human Resource Management* **25**(1): 9–35.

Henderson RM, Clark KB. 1990. Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly* **35**: 9–30.

Hofstede G. 2001. *Culture's Consequences: Comparing Values, Behaviors, Institutions and Organizations Across Nations*, 2nd edn. Sage: Thousand Oaks, CA.

Jaffe AB, Trajtenberg M, Henderson R. 1993. Geographical localization of knowledge spillovers from patent citations. *Quarterly Journal of Economics* **108**: 577–598.

Katz R, Allen TJ. 1988. Investigating the not invented here (NIH) syndrome: a look at the performance, tenure, and communication patterns of 50 R&D project groups. In *Readings in the Management of Innovation* (2nd edn), Tushman ML, Moore WL (eds). Ballinger/Harper & Row: New York; 293–309.

Katz R, Tushman M. 1979. Communication patterns, project performance, and task characteristics: an empirical evaluation and integration in an R&D setting. *Management Science* **23**: 139–162.

Kedia BL, Bhagat RS. 1988. Cultural constraints on transfer of technology across nations: implications for research in international and comparative management. *Academy of Management Review* **13**: 559–571.

Kim K, Park JH, Prescott J. 2003. The global integration of business functions: a study of multinational businesses in integrated global industries. *Journal of International Business Studies* **34**: 327–344.

King G, Zeng L. 2001. Logistic regression in rare events data. *Political Analysis* **9**: 137–163.

Kogut B, Singh H. 1988. The effect of national culture on the choice of entry mode. *Journal of International Business Studies* **19**: 411–433.

Kuemmerle W. 1998. Optimal scale for research and development in foreign environments: an investigation into size and performance of research and development laboratories abroad. *Research Policy* **27**: 111–126.

Krugman P. 1991. Increasing returns and economic geography. *Journal of Political Economy* **99**: 483–499.

Leonard-Barton D, Sinha DK. 1993. Developer–user interaction and user satisfaction in internal technology transfer. *Academy of Management Journal* **36**: 1125–1139.

Malnight T. 1995. Globalization of an ethnocentric firm: an evolutionary perspective. *Strategic Management Journal* **16**(2): 119–141.

Markides C, Williamson P. 1994. Related diversification, core competencies and corporate performance. *Strategic Management Journal*, Summer Special Issue **15**: 149–167.

Milgrom PR, Roberts J. 1992. *Economics, Organization, and Management*. Prentice-Hall: Englewood Cliffs, NJ.

Neter J, Wasserman W, Kutner MH. 1990. *Applied Linear Statistical Models* (3rd edn). Irwin: Homewood, IL.

Nobel R, Birkinshaw J. 1998. Innovation in multinational corporations: control and communication patterns in international R&D. *Strategic Management Journal* **19**(5): 479–497.

Nohria N, Ghoshal S. 1997. *The Differentiated Network: Organizing Multinational Corporations for Value Creation*. Jossey-Bass: San Francisco, CA.

Podolny J, Baron J. 1997. Resources and relationships: social networks and mobility in the workplace. *American Sociological Review* **62**: 673–693.

Ramanujam V, Varadarajan P. 1989. Research on corporate diversification: a synthesis. *Strategic Management Journal* **10**(6): 523–551.

Rumelt R. 1974. *Strategy, Structure, and Economic Performance*. Harvard University Press: Boston, MA.

Serapio M, Dalton D, Yoshida PG. 2000. Globalization of R&D enters new stage as firms learn to integrate technology operations on world scale. *Research Technology Management* **43**: 2–5.

Sorenson O, Stuart TE. 2001. Syndication networks and the spatial distribution of venture capital investments. *American Journal of Sociology* **106**: 1546–1588.

Stopford J, Wells LT. 1972. *Managing Multinational Enterprise: Organization of the Firm and Ownership of the Subsidiaries*. Basic Books: New York.

Tajfel H, Turner JC. 1986. The social identity theory of intergroup behavior. In *Psychology of Intergroup Relations* (2nd edn), Worchel S, Austin WG (eds). Nelson Hall: Chicago, IL; 7–24.

Teece DJ. 1977. Technology transfer by multinational firms: the resource cost of transferring technological know-how. *Economic Journal* **87**: 242–261.

Tsai W. 2002. Social structure of 'coopetition' within a multiunit organization: coordination, competition, and intraorganizational knowledge sharing. *Organization Science* **13**: 179–190.

Uzzi B. 1997. Social structure and competition in interfirm networks: the paradox of embeddedness. *Administrative Science Quarterly* **42**: 35–67.

Wayne SJ, Liden RC. 1995. Effects of impression management on performance ratings: a longitudinal study. *Academy of Management Journal* **38**: 232–260.

Williamson OE. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications: A Study in the Economics of Internal Organization*. Free Press: New York.

Zaheer S. 1995. Overcoming the liability of foreignness. *Academy of Management Journal* **38**: 341–364.

