Organization Science
Vol. 18, No. 4, July–August 2007, pp. 595–612
ISSN 1047-7039 | EISSN 1526-5455 | 07 | 1804 | 0595
informs®
DOI 10.1287/orsc.1070.0263

Expertise and Collaboration in the Geographically Dispersed Organization

Wai Fong Boh
Nanyang Business School, Nanyang Technological University, Nanyang Avenue, Singapore 639798, awfboh@ntu.edu.sg

Yuqing Ren
Carlson School of Management, University of Minnesota, Minneapolis, Minnesota 55455, yren@andrew.cmu.edu

Sara Kiesler
Human Computer Interaction Institute, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, Pennsylvania 15213, kiesler@cs.cmu.edu

Robert Bussjaeger
American Institutes for Research, 1000 Thomas Jefferson Street, NW, Washington, D.C. 20007-3835, bbussjaeger@air.org

The knowledge-based view of the firm has led to greater theoretical interest in how organizations integrate knowledge resources embedded in their employees' expertise. We examine the knowledge-integration problem in geographically dispersed professional organizations in which experts work in project teams. From consideration of coordination costs and local ties, we argue that (1) the organization will develop specialized expertise within local sites, (2) managers avoid crossing geographic boundaries to staff a project unless bringing on a distant expert helps meet customer requirements, (3) cross-site connections help less-needed members participate in dispersed projects, and (4) dispersed projects that have a better match of expertise generate higher net earnings. We tested these hypotheses using archival data and interviews in a geographically dispersed professional service organization. We examined how managers staffed 493 local and dispersed projects over a five-year period, and the financial outcomes of these projects. Managers created dispersed projects comparatively rarely; they did so when scarce expertise from other sites was needed to match customers' project requirements. Dispersed projects garnered higher net earnings than local projects when there was a better match of scarce expertise to project requirements. However, a curvilinear relationship was observed, such that a very high percentage of dispersed experts on a project increased coordination costs and reduced net earnings. Our study extends the knowledge-based view by showing how considerations of coordination costs and social ties affect knowledge integration in the geographically dispersed organization. The study also shows, empirically, the managerial trade-offs that encourage or discourage dispersed collaboration.

Key words: knowledge-based view; virtual teams; expertise management; project teams

Introduction

From the knowledge-based view of the firm (Empson 2001, Grant 1996b, Lowendahl et al. 2001), integrating the expertise of employees is an important process in knowledge organizations. Organizational success depends not just on individual employees' expertise, but also on how the organization combines their expertise and deploys people in teams (Grant 1996a, b; Teece 1998). Nordhaug and Gronhaug (1994, p. 92) argue that a knowledge organization's distinctive capability rests on its ability to collaboratively blend specialists from its "competence portfolio" to perform better than competitors do. In this article, we argue that project team staffing is a critical function for achieving knowledge integration and strategic advantage in professional and technical services organizations, a sector of the economy that is especially dependent on expertise and collaborative teams (Maister 1993).

The knowledge-based view is not a formal theory, but an emerging set of ideas about organizational knowledge (Priem and Butler 2001). Grant (1996a) and Kogut and Zander (1992) have argued that specialized knowledge embedded in people is the organization's most important asset. Typically, many kinds of experts need to be included on a team to meet project requirements and satisfy customer needs. This argument does not account for how expertise is likely to be distributed across sites in a dispersed organization, influencing the costs and net returns of dispersed and local projects. The argument also does not account for the influence of coordination costs and local ties in project team staffing decisions.

In this article, we suggest a theoretical approach to understanding staffing of project teams in the geographically dispersed professional organization. Our approach accounts for organizational dispersion, returns to expertise, and the costs and benefits of collaboration across sites. We develop theoretical arguments about managers' decisions regarding expertise utilization when organizations are geographically dispersed, and we test these ideas using data from one professional service organization. In doing so, we contribute to the knowledge-based view a nuanced and predictive account of knowledge integration in organizations.

Theoretical Argument

From the knowledge-based view, professional service organizations can achieve competitive advantage by recruiting top experts from the organization to create uniquely capable teams. However, project team staffing can be complicated significantly if the organization is dispersed across different geographical sites, a common scenario as organizations have increased their pool of expertise through acquisitions, mergers, and offices opened in new market areas. Dispersion creates barriers to collaboration across sites. These barriers are associated with the coordination problems involved in dispersed collaboration and with the power of local ties and sparseness of cross-site connections.

Coordination Costs. The costs of coordinating work over distance may be a disincentive for managers to obtain the best match of expertise to project requirements. Distance reduces opportunities for spontaneous, informal talk (Allen 1977) and increases the likelihood of time zone separation (Espinosa and Carmel 2004). Compared with local project teams, projects with members at different sites struggle to foster a collegial social environment (Kraut et al. 2002, Nardi and Whittaker 2002), build common ground (Clark and Brennan 1991), maintain awareness (Weisband 2002), focus on the project (Kanfer 1990), and make rapid adjustments to surprises (Olson and Olson 2000). Allen's (1977) rule of thumb is that coworkers should work no more than 30 meters apart, beyond which collaboration declines precipitously (see Kraut et al. 1990).

Computer and telecommunications technology can be used to facilitate resource sharing and communication across distance (May and Carter 2001). Managers can use flexible work arrangements in which experts work on the project at a distance, using technology to communicate (Majchrzak et al. 2004). Doing so potentially makes it possible to achieve an optimal mix of expertise. Nonetheless, technology has proved to be an imperfect substitute for collocation. Many projects with dispersed members get bogged down with delays (Espinosa and Carmel 2004, Herbsleb and Mockus 2003), misunderstandings (Cramton 2001, Hinds and Bailey 2003), site rivalries (Armstrong and Cole 2002), free riding (Weisband 2002), distractions from local site priorities (Mark et al. 1999), inconsistent procedures across sites (Curtis et al. 1988), and inability to share information (Hinds and Mortensen 2005). In addition, if the project involves a greater percentage of dispersed members or more sites, more coordination is required and costs will increase (Cummings and Kiesler 2005, Lee-Kelley 2002, Mark 2005).

Social Ties. Another barrier to dispersed collaboration may be that these work arrangements must overcome the pull of local ties. Managers want to cover their own people and employees want to please their immediate managers. Local coworkers are more likely to be friends than distant coworkers are. Local coworkers are more likely than distant coworkers to know what others know, lowering search costs to locate and recruit required experts (see Brandon and Hollingshead 2004, Liang et al. 1995). At the same time, ties across sites are likely to be sparse. In these cases, managers face high search and team assignment costs because they do not have an intimate knowledge of employees at other sites (Finholt et al. 2002). Technology solutions have been proposed to help managers locate the right expertise (Maybury et al. 2003) and to codify information about people that is not easily accessible (e.g., Ackerman 1994). However, as Hinds and Pfeffer (2003, p. 21) point out, the information needed is often "tacit and embedded in the context in which it is being used."

Barriers to dispersed collaboration can outweigh the advantages of creating project teams composed of an optimal group of experts. We therefore need new theoretical arguments to predict how managers resolve this dilemma and the organizational implications of their decisions.

Hypotheses

Dispersion of Expertise Across Sites. Professional service organizations typically have a pool of experts in various specializations across the organization from which managers can draw to compete for new business and satisfy customer needs. From the knowledge-based view, one might infer that managers will draw on the organization's large pool of experts to match team expertise to their projects' requirements. This inference, however, does not take into account the coordination costs and pull of local ties, which will discourage local managers from dispersed collaboration and will encourage their use of local expertise. Local managers are thus likely to develop a pool of local experts and develop specialized services that meet local market needs. For example, a California site of an education consultancy might build competence in California state education practice. In this manner, site managers will tend to recruit professionals who have the expertise that their sites frequently require.

By developing local expertise and local customers, each site will achieve congruence between the knowledge of its employees and the site's products and services. Over time, local specialization will grow and encourage more business with site-specific customers. Growing specialization will increase the stability and predictability of readily available capabilities (Lepak and Snell 1999). At the organizational level, a differentiated expertise structure is likely to unfold whereby each site has a group of experts who specialize in areas that are different from the experts at other sites. We thus hypothesize:

Hypothesis 1 (H1). *The distribution of expertise across sites in geographically dispersed professional service organizations will not be random. Instead, each site will tend to employ professionals who specialize in the expertise areas that meet the requirements of the local market.*

Matching Project Requirements Through Local and Dispersed Projects. Local specialization represents a disincentive to collaboration across sites because, however good experts at other sites might be, managers already have a stable pool of local expertise well adapted to the project requirements of local customers. Moreover, with managers' desire to avoid coordination costs and with employees' local social ties, managers are unlikely to draw on staff from other sites when they can staff their project teams with local experts who meet project requirements. Local experts have frequently used expertise well adapted to local conditions and markets. Thus, following from H1, we hypothesize:

Hypothesis 2 (H2). *Managers will create dispersed projects when they need expertise to match project requirements and this expertise is unavailable locally, that is, when it is not frequently used locally.*

Role of Cross-Site Connections in Dispersed Projects. Expertise is not the only consideration in project staffing. Professionals might request projects because they are interested in the project topic, want to learn a new skill, want greater exposure to a certain area of work, or need coverage for additional hours. If these employees do join distant projects, they start developing relationships or cross-site connections with coworkers at distant sites (Cummings 2004, Walther 2002). These cross-site connections, serving as information bridges across sites (Granovetter 1973), can aid people's search for the new projects (Even-Shoshan and Gilad 1999) and help those who want to advertise their knowledge and interest in new areas of work (Nahapiet and Ghoshal 1998). When vacancies occur on projects, cross-site connnections may help managers fill these positions with people from other sites.

We argue that cross-site connections will have a different influence on staffing for team members whose expertise matches project requirements, as compared with members whose expertise does not match project requirements. If potential project team members have expertise required by a dispersed project, their scarce and valuable expertise will be salient to managers searching for someone who fulfills this need through mechanisms that organizations use to keep track of employees' expertise (e.g., through discussion amongst top managers or expertise databases). Hence, their cross-site connections will not be necessary to enable their participation in the project. By contrast, if potential project team members do not have expertise required, particularly if they do not have scarce and valuable expertise and prefer to work on a collaborative project for reasons such as personal interest or career development, then their cross-site connections should be very critical to gaining such an opportunity. We thus hypothesize:

Hypothesis 3 (H3). *Dispersed projects, as compared with local projects, will have more cross-site connections for project team members whose expertise does not match project requirements.*

Note that this hypothesis contrasts with a simpler derivation from the social network literature, that individuals' cross-site connections will increase their likelihood of being placed on dispersed collaborative projects. Rather, we predict individual cross-site connections will positively predict dispersed project participation only for individuals who do not have the expertise required by the project.

Outcomes of Team Staffing Decisions. From the knowledge-based view, staffing projects to achieve a good match of project members' expertise with project requirements represents effective knowledge integration. The better the match is, the better managers can compete for more profitable, more comprehensive, or bigger projects, or they can negotiate a better price for their projects (e.g., Becker 2001). We amend this view and argue that, to account for the difficulties of dispersed collaboration, there will be differences between the net earnings of local versus dispersed projects that are able to achieve a good match of expertise with requirements.

A local project with a good match of team members' expertise with project requirements is comparatively easy to achieve, because such projects typically reflect the local demands that the expertise distribution of local firms has evolved to meet. By contrast, a dispersed project with a unique mix of expertise may represent creative use of human capital and capture the potential synergy of the configuration of expertise, thus increasing its value and price (Hitt et al. 2001). Customers value teams with elite experts whose knowledge and skills match their projects' requirements (Miner et al. 1994). The difficulties and complexity in integrating different types of specialized knowledge within a single project make it difficult for other organizations to imitate and offer similar configurations of expertise. Hence, we expect that managers' decisions to make use of scarce experts from other sites will be rewarded with better net earnings for the project.

There is also a selection bias in choosing to use experts from other sites on a project. Managers will do so mainly when they believe the value of these projects offsets their coordination costs. Thus, the opportunity to win a bid for a large and valuable project should increase the likelihood that managers will collaborate with other sites to match project requirements, either by enlisting other sites' staff members on the project to obtain desirable expertise or by releasing a valued staff member to work on a project at another site.

For these reasons, we expect that the rewards from matching expertise to project requirements will be greater in dispersed projects than in local projects.

Hypothesis 4 (H4). *Controlling for their size, dispersed projects that have a better match of expertise to project requirements will bring in higher net earnings than will local projects that have expertise matching project requirements.*

Study

We studied expertise distribution and utilization in a geographically dispersed professional service organization. We examined project staffing decisions for 493 projects over a five-year period, and the outcomes of these decisions. We supplemented our quantitative analysis with interviews with five site managers and four groups of senior professionals who frequently served as project managers.

Organizational Context

American Institutes for Research (AIR) is a not-for-profit organization that carries out applied research, consulting, and technical services. AIR's customers include U.S. federal agencies such as the Department of Education and the Census Bureau, state governments, private and public companies, and foreign governments. Its competitors and sometime-partners include MITRE, RAND, Educational Testing Service, SAS, Inc., Research Triangle Institute, Westat, and others. From 1996 to 2000, the period of our study, AIR employed 1,028 employees at seven major and two small sites. Project teams, each managed from an AIR site, performed work for customers. During the period of our study and through publication of this article, AIR grew vigorously and was financially successful.

AIR is an appropriate setting for this study because, as do other professional service organizations, AIR regards expertise as one of its fundamental assets. Before AIR can do project work, it must sell its expertise to its customers in a highly competitive business environment. On average, the organization wins about half of its project bids. The ability of AIR to win projects, and in turn to keep its staff employed and to earn fees to expand the organization, depends on its ability to staff project teams with members who have the expertise customers want for their projects. In short, AIR must not only have excellent knowledge resources, but it must also ensure that it effectively utilizes and integrates these resources through appropriate deployment of expertise on project bids and project work.

In 1996, the company had recently expanded through acquisitions from its original three major sites to six, and the question arose as to how best to take strategic advantage of this expansion. Top management at AIR started taking steps to increase collaboration across sites. Ultimately, the CEO of the company became a driving force for collaboration across programs and geographic locations; this practice continues today.

At AIR, collaboration across sites required managers to recruit employees from other sites for their projects and to give assent for their employees to work on distant projects at other sites. Professionals at AIR typically do not relocate to serve on a project run by another site; they work on the project from a distance. Prior to 1996, there were few cross-site collaborations. The compensation and bonuses for site managers were tied to their own sites' revenue growth, net earnings, and indirect costs. Revenues and profits were assigned to the site managing each project. If a site used employees from another site, the focal site owned all net earnings resulting from the project, whereas the home office of those distant team members would be paid only for the hours these employees worked, based on a standard rate. Although managers could recover the direct costs of sending their employees to work on other sites' projects, they would lose their services on local projects that brought in higher net earnings.

To improve collaboration, the CEO changed the incentives for dispersed project work. He and other top managers instituted a new accounting system whereby sites shared the profits for collaboration; the CEO also changed the incentive structure for managerial promotion. Although site managers were still rewarded for growing revenues at their own sites, they also got credit for the contributions they made to other sites' growth. Collaboration across sites grew over the period of the study.

Team Staffing Process. To form project teams, AIR managers used a mix of centralized and decentralized processes. Site and project team managers discussed the expertise needed to bid on a project. After forming a core group of experts for the project in a top-down manner, the project manager at the lead site chose the rest of the project team. Project managers brought individuals onto projects based on their expertise, availability, and interests. Professionals also approached project managers about their interest in a project. Very large projects engaged the interest of top management, as well.

Most managers had been with the organization for a long time. Site and project managers had a rich institutional knowledge of AIR and a good top-down view of the capabilities and expertise of AIR professionals. They mainly used informal mechanisms to locate experts. Senior staff had frequent meetings and learned who had expertise in which domains and specialties through performance evaluation exercises. Some sites tried to create expertise directories in a spreadsheet, but most managers and professionals used their personal networks.

Technology. Unlike some high-technology companies, AIR did not have cutting-edge technology to facilitate dispersed collaboration. Throughout the period of this study, most AIR staff depended on travel, e-mail, facsimiles, long-distance phone calls, and audio-conferencing to collaborate at a distance. Video-conferencing facilities existed, but were unpopular. Top management did not consider technology and technology integration to be an essential solution to organizational issues (see Grudin 1988). Each site used a different local area network. Shared folders existed only for employees within the same site, and no sophisticated collaboration technologies such as team rooms or application sharing were available for cross-site collaboration.

Variables and Coding

Project Member Expertise. The AIR website described types of domain expertise as the nine key program areas of the organization: education, children's mental health, early childhood, employment equity, health, individual and organizational performance, social marketing and communications, community development, and usability engineering. The authors also identified methodological expertise areas described on the website and in project abstracts: training, program assessment and evaluation, surveys and measurements, statistical analysis, database construction and management, and interviewing and ethnomethodology. Methodologies specific to only one domain area were omitted and considered part of the domain expertise. The distinction between domain and methodological expertise was made frequently in interviews and in managers' spreadsheets of personnel expertise. Appendix A provides detailed descriptions for domain and methodological expertise.

To obtain information about the distribution of expertise in the organization (H1), we gave the six site managers a list of all professional-level employees who had worked at their sites in the previous five years. Site directors rated the expertise of 345 professionals who worked during 1996–2000 (97% of the total). Of these, 291 worked on the 494 projects in our sample. We asked site managers to designate whether each person on the list was an expert and what types of expertise that person had. The questions were open-ended, but the answers provided could be mapped clearly to the types of expertise we identified. For one of the sites, the manager and a person in upper-level management were surveyed about the expertise of research staff; their judgments agreed on 73.33% of the individuals they rated. For the sake of consistency across sites, where there was a discrepancy in this case, we used the ratings of the site manager. We also checked managers' ratings against expertise information about individuals on the company website. There were no discrepancies.

Each professional's specialized expertise, if any, was coded zero or one in each of the nine domain and six methodological categories. People with both types of expertise were coded as one on both variables. Our questionnaire asked site managers to identify only the experts in their sites. Among all the professionals (virtually all with advanced degrees), 25% were not rated as an expert in any category.

Project Requirements. We coded the expertise requirements of projects from archived project abstracts. Project abstracts were drawn from customer specifications or requests for proposals and were sometimes revised before the project began. In our coding, if the abstract said that a database would be developed, then we coded the project as requiring database expertise. The first and second authors coded a random sample of 200 abstracts independently. The interrater reliability Kappa statistic was 80%. After resolving differences through discussion, the first author coded the rest of the abstracts. Each project could have up to nine domain expertise requirements and up to five methodological expertise requirements.

Match of Project Member Expertise with Project Requirements. Every project has a theoretically ideal number of experts in each area to match its requirements. Our data did not allow us to specify this ideal because project abstracts never enumerated experts needed. Instead, we used a proxy for the match of project member expertise with project requirements, that is, the total number of experts whose expertise matched expertise requirements articulated in project abstracts. Our proxy assumes two things: (1) Experts are valuable and the more experts on a project whose expertise matches expertise mentioned in the abstract, the better the project expertise requirements are satisfied, and (2) experts added to the project beyond the ideal number of experts for each type of expertise add to the attractiveness of the project to the client or, if not, will be cut from the budget and omitted in the project.

The matched-domain experts variable represents the number of domain experts whose expertise is mentioned in the abstract as a requirement. For example, if a project abstract said the project requires expertise in education, then the number of education domain experts on the project was counted toward the project's total matched domain experts. This variable ranged from 0 to 58. The matched methodological experts variable, ranging from 0 to 38, represents the number of methodological experts on a project whose expertise is mentioned in the abstract as a requirement. Only 15% of project teams had members coded as both domain and methodological experts, and in half of these projects only one person was coded that way.

Cross-Site Connections. To examine the effects of cross-site connections in dispersed projects (H3), we constructed two cross-site connections variables—one of matched experts and one of unmatched experts. The cross-site connections for each member working on a project starting in year t were constructed based on the person's collaboration history from year 1996 (the start of our data collection) to year $t-1$. Projects that started in 1996 (95 projects) did not have any work history collaborations data available and were excluded from all the analyses that included cross-site connection variables. The variable, cross-site connections of matched experts, was defined as the average number of other sites that project members with matched expertise had worked with in the past, normalized by the total number of connections a person could have had with all the other sites. The cross-site work history network of unmatched experts was defined as the average number of other sites that project members without matched expertise had worked with in the past, normalized by the total number of connections a person could have had with all the other sites.

Dispersed (vs. Local) Project. To examine the factors affecting the probability that a project will be dispersed (H2 and H3) and to examine the differences in the net earnings of dispersed versus local projects (H4), we defined a dichotomous variable whereby a project was defined as dispersed if at least one project member's home site differed from the site where the project was managed.[1] This distinction enables us to examine managers' decisions to recruit outside the site for a better match of expertise with requirements (H2), or for professionals' personal reasons (H3), and to compare the financial performance of local projects and dispersed projects (H4). We also examined whether the percentage of dispersed project team members had implications for coordination costs and the financial performance of dispersed projects. Doing this allowed us to test whether the organization sustained benefits from better utilization of expertise for dispersed projects as it brought more dispersed experts into a project.

Project Net Earnings. We defined project net earnings as AIR itself did, that is, as the net of project revenue over project expenses, including all labor costs and overhead cost allocations.

Project Size. Project size is the number of people who worked on the project. Sensitivity tests conducted using number of person-months to operationalize project size gave the same results.

Other Control Variables. We controlled for unmatched project expertise by defining a variable that counts the number of categories of expertise requirements that were not matched to member expertise. We also controlled for the effects of project members' dispersed project experience, measured as the average number of dispersed projects members of a project had participated in prior to the start of the project (whether previous projects were owned by the local or another site). The dispersed project experience variable was differentiated for those experts who had expertise matched with project requirements, and those without expertise required by the project. In addition, we included dummy variables to control for the type of contract, because contract type affects the fees the organization can charge. We also controlled for site, because unmeasured factors associated with any specific site could affect its propensity to engage in dispersed projects. Finally, we controlled for the start year of each project to control for trends or unexpected events in the year that each project was started.

Results

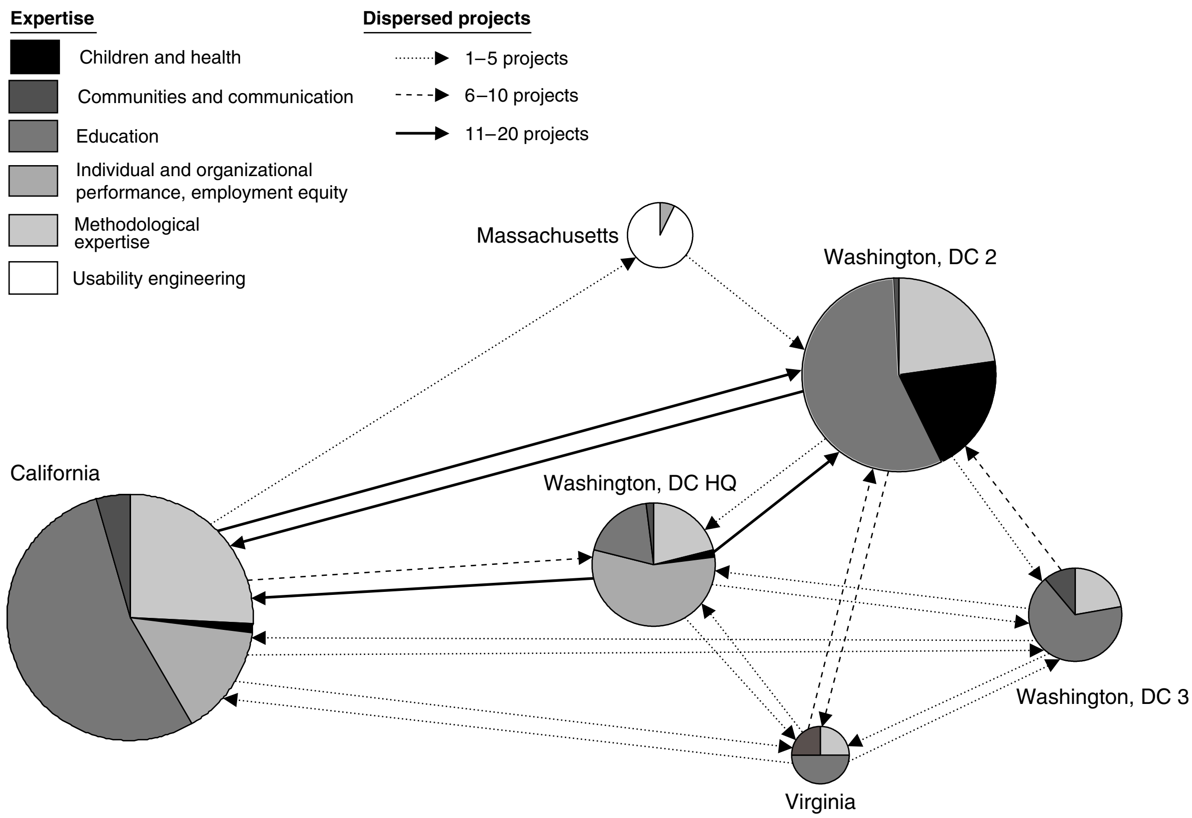
We present our results in three sections. We first examine H1, regarding the distribution of expertise across sites. We next turn to H2 and H3, evaluating the likelihood that projects will be dispersed under various conditions, and then to H4, on outcomes of expertise utilization decisions in dispersed and local projects.

Organization Expertise Structure

H1 asserts that geographically dispersed professional service organizations will tend to concentrate frequently used specialties within sites. We analyzed data from six major sites of AIR, located in Washington, D.C. (three sites), Virginia, Massachusetts, and California. The most proximate sites were 0.4 miles apart, more than Allen's (1977) 30 meters rule of thumb. Figure 1 illustrates the expertise structure of the organization, showing how domain and methodological expertise was distributed across all six sites in 2000. Methodological experts were employed at five of the six sites, but domain experts dominated methodological experts at each site. This imbalance reflected customers' project requirements. Of the 493 projects, 279 projects (57%) required domain expertise only, 177 (36%) required both domain and methodological expertise, 24 (5%) required methodological expertise only, and 13 (3%) required uncoded expertise, such as management of art collections.

To test for H1, we conducted four chi-square tests to examine the distribution of expertise across sites for both domain and methodological expertise. First, we tested to see if domain and methodological experts were randomly distributed across sites. Then we tested whether the distribution of domain and methodological experts matched the expected distribution of expertise based on requirements for expertise at each site. We found domain

Figure 1 Sites, Distribution of Expertise, and Intraorganizational Collaboration Across Sites at AIR, 2000



Notes. Each circle represents a site, its size approximately proportionate to the number of professionals. The pie chart within each circle shows the proportion of domain and methodological expertise (those with both types of expertise counted twice). Slices in each pie chart reflect the percentage of each type of expertise at each site. To increase readability of this chart, all methodological expertise types are collapsed into a methodological expertise category. Also, smaller domain areas—children's mental health and early childhood and health—are collapsed into the children and health category; and social marketing and communications and community are collapsed into a communities and communication category. Each arrow to a focal site from a source site represents the number of dispersed projects owned by the focal site that drew on at least one professional employed by the source site.

experts were not randomly distributed across sites ($\chi^2 = 469.95$, $df = 40$,[2] $p < 0.001$), but rather that the distribution of domain experts matched the requirements for domain expertise across different sites[3] ($\chi^2 = 51.54$, $df = 40$, $p > 0.10$). Thus, a nonrandom domain expertise structure existed across sites. On the other hand, methodological experts were randomly distributed across sites ($\chi^2 = 3.46$, $df = 5$, $p > 0.10$) rather than according to the methodological expertise requirements of each site ($\chi^2 = 33.48$, $df = 5$, $p < 0.001$). Overall, the expertise structure reflected the more frequently used type of expertise in the organization—domain expertise. Domain expertise was not distributed randomly across sites but was available locally to meet the domain expertise needs of local clients. This finding supports H1. Methodological expertise, comparatively, was scarce locally and was infrequently used at each site.

Overview of Project Data

The six sites ran 805 projects from 1996 to 2000, of which 494 (62%) were sufficiently documented in AIR archives to test hypotheses. Omitted projects lacked information about project requirements and started in earlier years, when managers were not required to record project abstracts. The projects in the sample were otherwise not different from those omitted. Most projects lasted two or more years. To test H2–H4, we assembled a study data set containing information about the employees who had worked on these 494 projects for the years 1996 through 2000, and the financial and work records associated with their projects. We conducted analyses at the project level, pooling across years. We omitted one outlier project because it had extremely high net earnings and biased the data to favor our hypotheses. Table 1 displays means, standard deviations, and correlations among all variables in our sample. Dispersed projects at AIR grew in number over the five years in our study, from 41 projects in 1996 to 67 projects in 2000. Nonetheless, dispersed projects remained a minority of projects, just 12.6% of all projects. Table 2 summarizes differences between local and dispersed projects. As shown in the tables, dispersed projects were more likely to reflect a better match of expertise with project requirements, were larger, had higher net earnings, and had members with more cross-site connections.

Table 1 Descriptive Statistics and Correlations of Project-Level Main Variables

Variables	Mean	S.D.	*N*	1	2	3	4	5	6	7	8	9	10
1. Dispersed (vs. local) project	0.13	0.33	493										
2. Project net earnings (dollars)	14,588	70,813	493	0.36**									
3. Matched methodological experts	1.03	4.09	493	0.44**	0.74**								
4. Matched domain experts	2.67	5.90	493	0.20**	0.55**	0.62**							
5. Unmatched methodological project expertise	0.38	0.68	493	0.10*	−0.03	−0.04	−0.07						
6. Unmatched domain project expertise	0.29	0.49	493	0.09^{+}	−0.06	−0.06	−0.16**	0.11*					
7. Project size: no. of project members	6.72	12.73	493	0.52**	0.67**	0.66**	0.48**	0.06	−0.04				
8. Dispersed project experience for matched experts	2.77	2.71	398	0.18**	0.05	0.15**	0.00	0.06	0.01	0.10^{+}			
9. Dispersed project experience for unmatched experts	1.29	2.80	398	0.16**	0.01	0.04	−0.11*	0.23**	0.19**	0.05	−0.23**		
10. Cross-site connections for matched experts	0.31	0.32	398	0.15**	0.11*	0.11*	0.17***	−0.09^{+}	−0.04	0.19**	0.30**	−0.24**	
11. Cross-site connections for unmatched experts	0.11	0.22	398	0.26**	0.07	0.08	−0.09^{+}	0.28**	0.10*	0.16**	−0.20**	0.63**	−0.18**

$^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Project Team Staffing

To test H2 and H3, we used logistic regression analysis to examine the factors that influenced the probability that a project at AIR would be dispersed. The dependent variable is whether a project was dispersed or local.[4] Table 3 reports coefficient estimates for our logistic analysis. Model 1 in Table 3 includes only our control variables. The model is statistically significant ($\chi^2 = 162.87$, $p < 0.01$) with a pseudo R^2 of 0.53, and it shows that larger projects are more likely to be dispersed ($\beta = 0.132$, $p < 0.01$). Model 2 examines the effect of matching experts to projects' expertise requirements. Model 2 provides a statistically significant improvement over Model 1 ($\chi^2 = 21.68$, $p < 0.01$), and the pseudo R^2 increases to 0.59. We added the cross-site connections variables last into the regression analyses in Model 3 because the lack of historical work history information for 1996 projects reduced the number of observations from 493 to 398. Model 3 provides a statistically significant improvement over Model 2 ($\chi^2 = 7.43$, $p < 0.01$). The Hosmer and Lemeshow goodness-of-fit test (Hosmer and Lemeshow 1989) shows that both Models 2 and 3 are adequate models for the case of a binary response model.

Table 2 Profiles of Local and Dispersed Projects

Variables	Local projects	Dispersed projects
Number projects in sample	431	62
Cross-site connections	0.38 (0.37)	0.61 (0.26)
Matched methodological experts	0.35 (1.62)	5.77 (9.51)
Matched domain experts	2.21 (4.21)	5.84 (12.02)
Unmatched methodological project expertise	0.36 (0.66)	0.56 (0.78)
Unmatched domain project expertise	0.20 (0.43)	0.15 (0.40)
Project size: number of project members	4.22 (5.28)	24.05 (27.57)
Project net earnings (dollars)	\$4,937 (14,813)	\$81,678 (183,480)
Project nonlabor cost	\$43,075 (124,666)	\$881,880 (1,881,373)

Note. Standard deviations are presented in parentheses.

H2 states that managers tend to create dispersed projects when they need scarce expertise that is not frequently used locally. If H2 is supported, then the match of scarce or infrequently used experts (methodological experts) will be positively and significantly related to the use of dispersed projects, whereas the match of frequently used experts (domain experts) will be negatively and significantly related to the use of dispersed projects. The results for Model 2 show that projects with greater utilization of matched methodological expertise tended to be dispersed ($\beta = 0.195$, $p < 0.05$), whereas projects with greater utilization of matched domain expertise tended to be local ($\beta = -0.168$, $p < 0.01$). Hence, these results provide support for H2.

H3 states that dispersed projects, as compared with local projects, will have project team members with more cross-site connections for project team members whose expertise does not match project requirements. If this hypothesis is supported, then only the cross-site connections of unmatched experts will be positively and significantly related to the use of dispersed project. The results of Model 3 show that projects whose

Table 3 Logistic Regression Predicting the Likelihood a Project Will Be Dispersed

	Model 1	Model 2	Model 3
Project size: number of project members	0.132** (0.021)	0.176** (0.033)	0.139** (0.036)
Matched methodological experts		0.195* (0.072)	0.168* (0.082)
Matched domain experts		−0.168** (0.047)	−0.117* (0.050)
Unmatched methodological project expertise		0.102 (0.262)	0.098 (0.281)
Unmatched domain project expertise		0.274 (0.374)	0.467 (0.412)
Dispersed project experience for matched experts			0.087 (0.107)
Dispersed project experience for unmatched experts			0.011 (0.098)
Cross-site connections for matched experts			1.281 (0.967)
Cross-site connections for unmatched experts			2.032+ (1.140)
Maximum rescaled *R*-square	0.53	0.59	0.58
Chi-square likelihood ratio	162.87	184.55	152.63
−2 Loglikelihood	210.08	188.40	163.41
Deviation (Δ dev)		21.68**	7.43**
N	493	493	398

Notes. (1) The pseudo *R*-square statistic displayed is based on the generalized coefficient of determination (Cox and Snell 1989, pp. 208–209). (2) We included dummy variables to control for contract type, start year of projects, and site that owns the project. All control variables were not significant in the final model (Model 3); "Cost plus fixed-fee contracts" ($\beta = 0.960$, $p < 0.05$) and contracts owned by the California site ($\beta = -1.290$, $p < 0.05$) were significant in Model 2. The results of these dummy variables were not included in this table. (3) Deviation between Model 3 and Model 2 is calculated based on the difference of −2 Loglikelihood between Model 2 with 398 observations and Model 3. (4) Standard errors of beta coefficients are presented in parentheses.
$^+p < 0.1$, $^*p < 0.05$, $^{**}p < 0.01$

unmatched experts had more extensive cross-site connections tended to be dispersed ($\beta = 2.032$, $p < 0.10$), whereas the cross-site connections for matched experts were not significantly associated with the use of dispersed projects ($\beta = 1.281$, $p > 0.10$). These results provide support for H3. The experience of members with matched and unmatched expertise working on previous dispersed projects, included as controls, was not significantly associated with dispersed projects.

Net Earnings of Dispersed and Local Projects

To test H4, which examines the outcomes of expertise utilization decisions in local and dispersed projects, we used ordinary least squares to estimate hierarchical models with project net earnings as the dependent variable.[5] The results are presented in Table 4.

The baseline model with only the control variables (Model 1) indicates that project size significantly improved the net earnings of a project. Model 2 includes the set of variables showing the extent to which members' expertise matched project expertise requirements. The model R^2 improved significantly with the inclusion of the expertise variables ($\Delta R^2 = 0.18$, $p < 0.01$). In Model 3 we added the interactions of the expertise variables and the dispersed project variable, and the model provided a significant improvement in R^2 over Model 2 ($\Delta R^2 = 0.05$, $p < 0.01$). Model 3, however, suffers from multicollinearity because of the high correlation between the interaction terms and the main effects of matched methodological and domain experts. To check the robustness of the Model 3 results, we repeated the analyses separately for local project teams ($N = 431$) and dispersed project teams ($N = 62$). These analyses are shown in Models 4 and 5 of Table 4, respectively.

H4 states that, controlling for project size, dispersed projects that have a better match of expertise to project requirements will bring in higher net earnings than will local projects that have experts matching project requirements. The coefficient results of the interaction terms in Model 3 show that dispersed projects utilizing more methodological experts required by the project brought in higher project net earnings than did local projects with a similar number of matched methodological experts ($\beta = 0.145$, $p < 0.01$). These results were confirmed by the robustness check conducted using Models 4 and 5. A t-test showed that the coefficients of methodological match in Models 4 and 5 were significantly different ($t = 2.99$, $p < 0.01$). A better match of methodological expertise was significantly associated with higher net earnings in dispersed projects, but a better match of methodological expertise was unrelated to the project net

Table 4 OLS Regression Predicting Project Net Earnings

	Dispersed and local projects								Dispersed projects only			
	Model 1		Model 2		Model 3		Local projects		Model 5		Model 6	
Project size: number of project members	0.052**	(0.006)	0.023*	(0.011)	0.023*	(0.010)	0.004	(0.005)	0.028**	(0.010)	0.015	(0.014)
Dispersed project	0.076	(0.190)	−0.144	(0.145)	−0.192	(0.138)						
Matched methodological experts			0.124*	(0.048)	−0.010	(0.016)	−0.014	(0.012)	0.109**	(0.041)	0.120**	(0.039)
Matched domain experts			0.024	(0.019)	0.023+	(0.013)	0.034**	(0.006)	0.057+	(0.030)	0.060*	(0.030)
Unmatched methodological project expertise			0.016	(0.045)	0.009	(0.041)	0.002	(0.009)	−0.040	(0.214)	−0.003	(0.227)
Unmatched domain project expertise			0.110+	(0.066)	0.072*	(0.035)	0.018	(0.013)	0.598	(0.398)	0.519	(0.359)
Dispersed project × matched methodological experts					0.145**	(0.046)						
Dispersed project × matched domain experts					0.017	(0.031)						
Percent dispersed											1.794	(1.105)
Percent dispersed squared											−0.588*	(0.278)
Model F	30.45**		48.69**		53.97**		27.65**		7.64**		7.16**	
R-square	0.47		0.65		0.70		0.52		0.73		0.75	
R-square change			0.18		0.05							
F test for incremental contribution			60.94**		39.33**							
N	493		493		493		431		62		62	

Notes. (1) Dependent variable—YTD profit has been standardized. (2) We included dummy variables to control for contract type, start year of projects, and site that owns the project. For Model 3, "Cost plus fixed-fee contracts" ($\beta = 0.30$, $p < 0.05$), projects owned by the WashingtonDC3 site ($\beta = 0.49$, $p < 0.05$) and projects starting in year 1999 ($\beta = -0.26$, $p < 0.05$) and in year 1997 ($\beta = -0.24$, $p < 0.05$) were significant. The results of these dummy variables were not included in this table. (3) Virginia had just two projects, one dispersed and one local, causing perfect collinearity in Models 4 and 5, and was excluded from these models. (4) The matched methodological expertise and matched domain expertise variables were centered for Models 2 and 3. (5) Standard errors of beta coefficients are presented in parentheses.

$^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$.

earnings of local projects.[6] Hence, H4 is supported for methodological expertise.

For domain expertise, the results of Model 3 show that projects with a better match of domain experts with project requirements brought in significantly higher project net earnings ($\beta = 0.023$, $p < 0.10$), and the effects did not differ significantly between dispersed and local projects ($\beta = 0.017$, $p > 0.10$). A comparison of the coefficients of domain match in Models 4 and 5 showed that they were not significantly different ($t = 0.75$, $p > 0.10$), thus confirming these results. Figures 2(a) and 2(b) summarize these different relationships, showing that projects with higher net earnings were dispersed projects whose teams included methodological experts matched to project requirements.

Our results show that despite the coordination costs of dispersed projects, there are positive returns to using dispersed projects if scarce expertise has been utilized to match requirements in dispersed projects. As projects become more dispersed, however, coordination can be increasingly difficult. The question that arises is whether organizations are able to sustain the benefits as the projects become increasingly more dispersed. For the dispersed projects, we examined the impact of the amount of dispersion on project net earnings, where the amount of dispersion is defined as the percentage of dispersed (nonlocal) team members. Prior researchers typically have compared local projects with dispersed projects, but some prior work suggests that the more dispersed members a team has, the more coordination difficulties the team faces (Herbsleb and Mockus 2003). In the case of AIR, we considered that a higher percentage of dispersed members would increase the costs of travel, communications, and the probability of delays and interpersonal difficulties. Projects with more dispersed members also might involve subgroups in different sites that need to be coordinated (Mark 2005). If that is so, higher project coordination costs might reduce the benefits of including dispersed experts. To investigate this possibility, we added a quadratic term to examine whether the expertise utilization benefits from using dispersed projects were similar for dispersed project teams with a lower or higher percentage of dispersed members. Model 6 in Table 4 provides the results of the analysis.

Comparing the coefficients of matched methodological and domain experts for Models 5 and 6 in Table 4, we see that changing the operationalization of dispersed projects from binary to the percentage of dispersed members did

Figure 2(a) Relationship Between the Match of Methodological Expertise with Project Requirements and Project Net Earnings in Local and Dispersed Projects

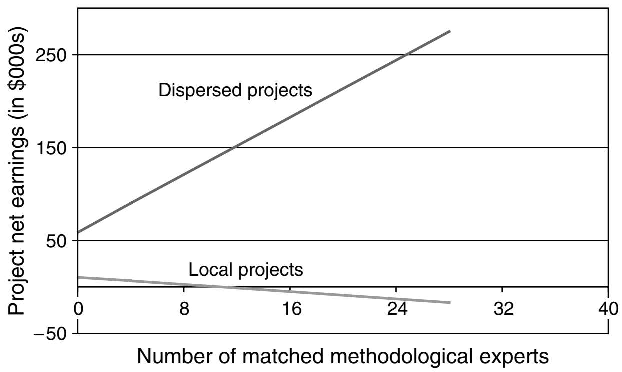


Figure 2(b) Relationship Between the Match of Domain Expertise with Project Requirements and Project Net Earnings in Local and Dispersed Projects

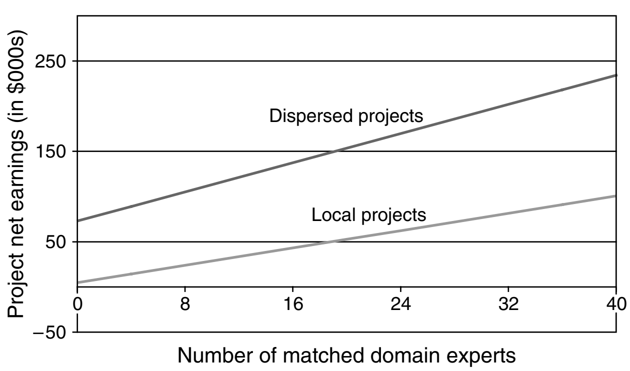


Figure 3(a) Marginal Increase in Project Net Revenue with Increasing Expertise Match in Dispersed Projects

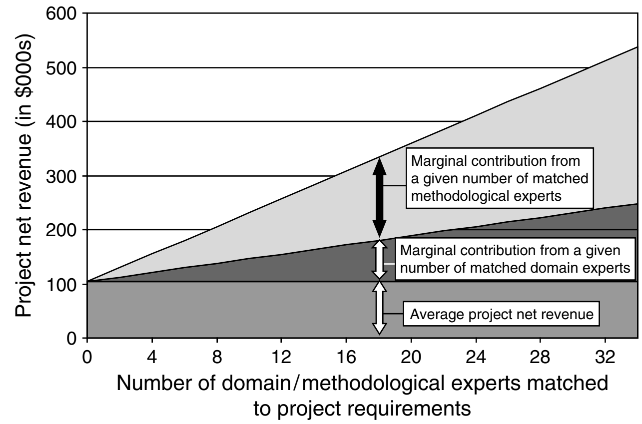
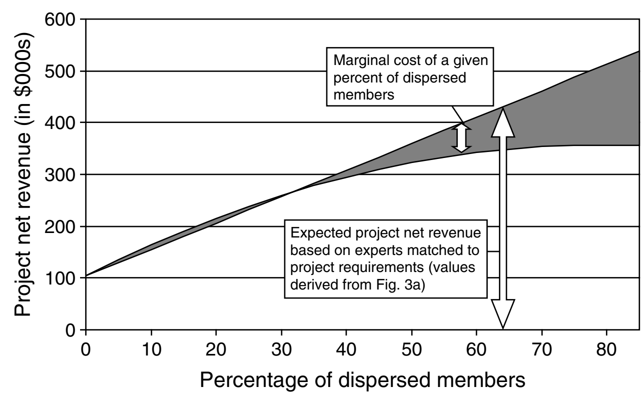


Figure 3(b) Marginal Decrease in Project Net Revenue with Increasing Percentage of Dispersed Members in Dispersed Projects



not result in significant changes for the coefficient of matched methodological and domain expertise. Model 6 shows that the squared percent dispersion term has a negative and significant relationship with project net earnings ($\beta = -0.588$, $p < 0.05$), controlling for project size. This finding reflects the fact that projects with the highest percentage of dispersed members had significantly lower net earnings than would be expected based on a configuration of expertise matched to project requirements.

Figures 3(a) and 3(b) summarize these results. Figure 3(a) shows the marginal benefit of adding domain and methodological experts to dispersed projects. Figure 3(b) shows the marginal changes in net earnings (from the expected net earnings based on the number of domain and methodological experts matched to project requirements) from adding a higher percentage of dispersed members. For example, if AIR had a project with 10 matched domain experts and 4 matched methodological experts and was 40% dispersed, Figure 3(a) indicates that the matched domain experts, on average, brought in $150,000 project net earnings, and that the matched methodological experts contributed an additional $60,000. From Figure 3(b), we see that the 40% dispersion marginally decreased net earnings by $10,000.

We conducted some additional analyses to investigate whether high coordination costs accounted for the reduced net earnings of projects with a high percentage of dispersed members. Nonlabor costs are about 50% of AIR's project costs. Included in nonlabor costs are fringe benefits, overhead expenses, travel expenses, and costs for activities before projects begin. We consider these nonlabor costs to be a proxy for the coordination cost of projects. As nonlabor costs rise, they reflect the additional expenses incurred for travel, long-distance calls, increased technology expenses, and other project management costs that may result from the use of dispersed teams. We found that the nonlabor costs (normalized by the total number of project members) for dispersed projects were significantly higher than those for local projects ($t = 3.83$, $p < 0.001$). The five projects with more than 15 dispersed team members (30%–50% dispersion) also had somewhat higher nonlabor costs than did other dispersed projects ($t = 1.93$, $p < 0.10$). Moreover, this group drew on dispersed members from three to six different sites.[7] Thus we see that projects with a high percentage of dispersed members may incur such high coordination costs that the returns from drawing on dispersed project team members to match project requirements are insufficient.

Discussion

In the knowledge-based view of the firm, organizations that can draw on diverse knowledge competencies from across the organization can better integrate their knowledge resources and have a strategic competitive advantage over organizations that do not collaborate across sites. This argument emphasizes the benefits of drawing from a large pool of geographically dispersed experts, but fails to account for the organizational conditions influencing when managers will create collaborations to utilize geographically dispersed expertise, and the outcomes of those decisions. We developed new theoretical arguments and empirical observations to understand expertise utilization in geographically dispersed professional service organizations.

Consistent with our arguments, we found that sites specialize in the areas of expertise most frequently required by their local customers (H1). Our finding implies a managerial perception that dispersed projects are costly, and a strong managerial preference for local projects. Our interviews support these assumptions. All interviewees said dispersed projects incurred high coordination costs (nine interviews). They particularly mentioned communication problems and lack of awareness (six interviews):

> One [factor] is cost, and collaborating across sites increases your costs significantly ... one of the major people on this project lives in [city 2,800 miles away] so she has to fly in so we can all meet. That's really expensive. Phone calls, video conferences—I mean, they all add up, the amount of time you have to spend really talking through things where you could walk down the hall and have these communications. (Project Manager B)

> [Dispersed project work] can be difficult, because when things start to go wrong, you catch it a lot later than you would if it was going wrong in your own office. It's harder to see things going on, and when you do, it's harder to figure out exactly where the problem is and where to fix it .... (Project Manager D)

Site and project managers staffed most of their projects with frequently used local domain experts. Our interviewees' strong preference for local projects (nine interviews) sometimes conflicted with the desire for experts who could help win the project bid:

> If there's a skill set that I need, I'm probably still more likely to try to fill it within this office, especially if someone's available ... and I'd like to make sure that the staff are covered .... The real question becomes how much of a better fit does someone have to be in another site to make up for the inconvenience of not being right here. (Project Manager A)

> How much incremental expertise are you getting to make it worthwhile to do it? Because under any circumstances, it's always going to be less convenient to have to, you know, walk 10 minutes down the street or wait till 11:00 to make a phone call versus if I know that all I have to do is walk around the corner and there's the person, and so you do it [a dispersed project] because of some benefit that can be had in terms of making your project better. (Project Manager C)

The interviews provided further support for our hypothesis (H2) that project managers would only consider experts from other sites for their projects if they did not have the expertise available locally. For example:

> What usually drags me to another office is if there's some sort of gap. Either expertise ... some expertise we just don't have here, or some labor need—some key people. (Project Manager E)

Also consistent with the quantitative analyses, interviewees mentioned that methodologists were most likely to be highly sought-after for dispersed projects (six interviews):

> Some are very high fluent statisticians who like to play this role and are approached frequently. (Site Manager C)

These most desirable people were comparatively scarce, leading to competition for their time:

> My boss managed to get one of our best social statisticians into a planning meeting, but it never went anywhere. There was no follow through ... Why? The statistician was busy—he was a very good guy. I suspect the request was not made very clear ... and the guy had a ton of other things to attend to. (Project Manager C)

Employees sometimes wanted to join dispersed projects, as reflected in this comment: "People get exposed to projects they wouldn't in the local office. It helps people's expertise and professional development" (Project Manager A). In H3, we argued that when professionals did not have the expertise required by a project, their cross-site connections would influence their ability to join a dispersed project. Interviewees provided further support for this idea (six interviews):

> If you have relationships with people, they're willing to bend their back for you. ... I guess a lot of it is just the personal relationships you have with people. Whether people you're working with have an interest in what you're doing and having the opportunity to make those relationships .... (Research Associate B)

> I call my friend and ask them about the opportunities in their office. That's provided you know someone in the office. That's limiting if you don't know someone. (Project Manager I)

In H4, we argued that, considering coordination costs, creating dispersed projects only when they represent a good match of scarce expertise to project requirements will result in high net earnings. We found that this outcome occurred in the case of scarce methodological expertise and was not true of cases when more frequently used domain expertise was matched. Dispersed projects with a good match of scarce methodological expertise attained even higher net earnings than local projects with a similar match. Our interviews provided support that this finding reflected a pattern of decision making that took into consideration the costs and advantages of forming dispersed projects. Managers typically required a project's value to be high and local talent unavailable before forming a dispersed project.

> [It's] largely dependent on the sort of profile and attention the project is getting. I think [with] a higher profile, more important project, I have better access to some people [at other sites] ... [compared to a] small, low-profile project. (Project Manager G)

> [If] it's a multiyear, large-scale project and it's gonna be coverage for many years, it's the person's area ... you know it's much more likely to be able to get that person. (Project Manager D)

The above comments suggest that managers weigh the value of forming dispersed projects and generally prefer local projects. They will collaborate across sites and create dispersed projects primarily to obtain needed scarce expertise, particularly when they anticipate that doing so will be unusually profitable. Cross-site connections play a key role in helping professionals without scarce expertise win a place in dispersed projects they desire, but those connections do not play a significant role in placing professionals who are recruited based on their expertise in dispersed projects. In this manner, managers who use dispersed projects to appropriately tap scarce expertise will see significant benefits, despite the coordination costs involved.

However, project net earnings can be affected negatively as projects involve a higher percentage of dispersed members. Our results indicate that when project dispersion climbs to 30%–50% of the members (depending on project size), dispersion exacts coordination costs that are not fully offset by the returns from having a dispersed project well matched to project requirements. These results imply that the coordination costs can increase exponentially as projects become more dispersed. At some point, the addition of another dispersed scarce expert no longer provides sufficient benefits to offset the increased coordination costs. Hence, managers need to balance the need to search for the best expert from all over the organization against the additional coordination cost that would be entailed for the project.

Alternative Explanations, Limitations, and Boundary Conditions

Alternative Explanations. A potential alternative explanation of the higher influence on net earnings of matched methodological experts in dispersed projects is that methodological experts command a market premium. To rule out this explanation, we conducted sensitivity tests using the total number of methodological and domain experts on the project as independent variables instead of the number of methodological and domain experts whose expertise matched project requirements. We found that the number of domain experts had a positive and significant impact on net earnings, but the number of methodological experts did not, nor did the interaction of the number of methodological experts with dispersed (versus local) project.

Another concern may be that projects were not independent observations, because of the overlap in membership of individuals across the projects. To address this concern, we identified distinct groups of projects, comprised of projects having a high degree of overlapping membership with each other.[8] We included a dummy variable to represent the effect of the project's membership in each group. We identified 56 such groups and added 55 dummy variables to our equations to test for the effects of controlling for overlapping membership between projects. The results were unchanged.

Limitations. One methodological limitation of this study is that our operationalization of individuals' expertise was a binary variable that did not provide information about the depth of expertise of each individual or of unmeasured kinds of expertise, such as social competence. Future research should explore levels of individuals' expertise and other kinds of expertise to obtain a more in-depth understanding of the selection process for projects.

We also studied only one outcome variable—project net earnings. Other outcomes of interest might be project members' satisfaction; customer satisfaction; winning future work; organizational visibility; entry into new markets; social outcomes, such as keeping people employed; and social impact. A few interviewees said that AIR sometimes conducted projects at a loss to enter a new market or to establish relationships with a new client. Exploring other outcomes and outcome trade-offs would be a useful direction for future research.

Another limitation is that the organizational context of this company, such as its modest use of computer technologies and extensive government contracting may have driven some of our results. Although our analyses of differences within the organization speak to the validity of the hypotheses, without replication in other organizations we can only speculate as to the generalizability of our results. Thus, for example, it is possible that the reasons for dispersed projects at AIR or the internal processes for managing these projects would not be observed in for-profit organizations where cost minimization rather than expertise utilization is the primary reason for remote work. We note, however, that thus far the literature on coordination costs of remote project work is fairly consistent across a wide range of not-for-profit and for-profit large and small organizations doing different kinds of work, including Boeing, Shell Oil, Lucent, small student groups, and many others.

We attempted to assess the extent to which organizational factors might have affected our results by examining if a restructuring at AIR resulted in any changes in the use of dispersed collaboration. In 2002, management reorganized AIR by program areas (that is, domain areas) rather than by sites. This restructuring meant that a single program director oversaw all the projects and staff within the same domain area across all the sites. As a result, managers held more cross-site meetings at the program area level and had a greater awareness of the projects and staff capabilities across sites. The percentage of dispersed projects tripled to 38.8% after the restructuring, compared with the 1996–2000 period (12.6%), suggesting that organizational restructuring facilitated collaboration. Nevertheless, the comparative differences between dispersed and local projects for both project size and total revenue were similar for projects that began before and after the restructuring; dispersed projects were still used only when projects had high contract value. This finding and discussions with managers suggested that the strategies for selecting members for dispersed projects did not change after restructuring; hence, changes in organizational factors such as management structure did not result in changes in our key findings.

Boundary Conditions. We believe that our findings will apply in professional and technical services organizations that depend heavily on the expertise of their staff, and also when different specialized experts need to work together. Although we studied a not-for-profit (primarily) government contractor organization, AIR holds, in common with most other professional and technical services organizations, a high concern with ensuring sufficient staff utilization, business growth, and net revenues. AIR puts a premium on expertise utilization, as do many other organizations such as consulting and software development firms and the research and development and product development functions of large organizations.

Our theory differentiated between expertise that is frequently and infrequently used across sites. That is, different sites will tend to specialize in different domains. Some expertise tends to be more frequently used at each site, and this expertise tends to be locally available, whereas less frequently used expertise tends to be distributed across the organization. We have only tested this idea in one organization, but we believe that local specialization is a phenomenon that can be found in many organizations. Some organizations are structured by different functional areas (e.g., all marketing staff are local in the marketing office, and all accounting staff are local in the finance department office). Other organizations structure themselves around product expertise. Maybury et al. (2003), for example, studied MITRE, a large not-for-profit organization that also organized itself by domain and methodological expertise. We believe that results of this study will be applicable to organizations that tend to have sites specializing in different knowledge domains.

Finally, a key premise of our theory is that the perceived costs of dispersed collaboration pose a significant barrier to forming dispersed project teams. The perceived costs of dispersed collaboration may depend on the type of technology available to facilitate collaboration at a distance and the incentive structure of the firm. In the case of AIR, technology use played a limited role in reducing coordination difficulties. The CEO instituted an incentive structure neutral to dispersed collaboration. These contextual factors help explain why the perceived cost of dispersed collaboration was particularly salient. In some other organizations, the perceived cost of dispersed collaboration may be less significant. Nonetheless, there is ample evidence of the difficulties of working at a distance and of using technology to share knowledge in organizations ranging from the traditional industrial steel mill to high-powered consultant networks (Pipek et al. 2003). This evidence indicates that the preference for collocation may not be unique to organizations like AIR.

Contributions

Our approach accounts for three aspects of collaboration not yet addressed in knowledge-based theory. First, we address the distribution of organizational knowledge, especially the development of local specialization and frequently used expertise, which renders cross-site collaboration unnecessary much of the time. Second, we acknowledge barriers to cross-site collaboration involving coordination costs and local ties and explore how they influence managerial decisions about forming dispersed projects. Third, we predict the conditions under which cross-site collaboration is expected to result in positive net returns.

Our work joins recent research that has begun to examine how theories considering the costs of utilizing resources can complement the knowledge-based view (e.g., Lepak and Snell 1999, Schilling and Steensma 2002). We have added to this literature by showing how theoretical arguments invoking coordination costs and the role of social ties help to illuminate both the organization of expertise within sites, the utilization of dispersed expertise across sites, and how the distribution of expertise and managerial decisions result in returns to collaboration. Our study implies that there is room for future research to further extend the knowledge-based view of the firm by examining how managerial decision making is related to integrating knowledge in organizations.

This study also contributes to the knowledge-based view of the firm through its detailed examination of the concept of expertise utilization and through our operationalization and measurement of different expertise resources in a professional and technical services organization. Priem and Butler (2001, p. 33) have argued that "the processes through which particular resources provide competitive advantage remain in a black box. We do not know, for example, how the resources generate sustainable rents." By defining and measuring domain and methodology expertise, we were able to show in far more detail than in previous work how expertise resources provide competitive advantage to the professional services organization through an appropriate match of expertise resources to customer needs. We believe our study counters the high level of abstraction found in much knowledge-based view research (Priem and Butler 2001).

We also contribute to the literature on the management and outcomes of distributed work. To our knowledge, this study is the first to show how expertise is organized in the geographically dispersed professional service organization, how team staffing decisions result in dispersed projects, and the financial outcomes of those decisions. Our findings suggest that decision makers take the anticipated difficulties of geographically dispersed work into account when they initiate dispersed projects, and they create dispersed work arrangements when projects are valuable and large, justifying the associated difficulties. These findings imply that researchers should pay attention to the context in which dispersed work occurs, and to the considerations managers and participants have for engaging in dispersed projects, rather than only comparing dispersed work with local work.

Conclusion

The knowledge-based view of the firm emphasizes the importance of how organizations utilize knowledge to improve their strategic advantage. We extended the knowledge-based view theoretically and empirically. Our results suggest that the geographical dispersion of an organization dramatically affects how it develops and utilizes organizational expertise. Managers develop a pool of local staff that serves most customers' needs. This specialization results in internal incentives and local ties that are barriers to cross-site collaboration. Managers collaborate across sites and create dispersed projects primarily to obtain needed scarce expertise, particularly when they anticipate that doing so will be unusually profitable. Professionals with scarce expertise win places on dispersed projects regardless of their social ties, whereas professionals without scarce expertise can use cross-site connections to join dispersed projects.

The consequences of this pattern of decision making in the organization we studied were mostly good. Overall, dispersed projects with a good match of scarce expertise to project requirements attained high net earnings. These benefits, however, became unsustainable when projects became too dispersed. The additional benefits from bringing in a scarce expert from another site were insufficient to offset the additional coordination costs arising from adding another dispersed team member. These results imply that managers need to balance the need to search for the best expert from across the organization against the additional coordination costs entailed.

Acknowledgments

This research was supported by National Science Foundation Grants IIS-9872996 and IIS-0325047. The authors thank Robert Kraut, in whose class this project started, Jeffrey Roberts, who participated in the class project, and colleagues who commented on revisions: Pamela Hinds, James Herbsleb, Denise Rousseau, Lee Sproull, Suzanne Weisband, and Sandra Slaughter. The authors also thank the associate editor, Andrea Hollingshead, and the anonymous reviewers for their advice in the development of the paper, and Sol Pelavin, Robert Bussjaeger, and employees at the American Institutes for Research for their help and participation.

Appendix A. Domain and Methodological Expertise Codes

Number of experts	Domain expertise	Description of knowledge and skill
149	Education	Education research and services in areas such as literacy, education finance, educational technology, test development, school reform, professional education, international educational programs, and disability
9	Children's mental health	Research and services in children's mental health, children's drug and alcohol abuse, and children involved in the juvenile justice system.
18	Early childhood	Research and services in child development, child care, and early childhood education
13	Employment equity and discrimination	Technical support in court cases involving allegations of age, gender, race, or national origin discrimination
44	Individual and organizational performance	Research, technical services, software development, and other support in management, organizational process, human resources, personnel selection and measurement, and security

Appendix A (cont'd.)

Number of experts	Domain expertise	Description of knowledge and skill
4	Health	Research and services in health services, medical technology, and public health programs and research
7	Community	Research and services in community development, profiling, measuring, and building community
2	Social marketing and communications	Marketing services and products in social services, health, education, and science
15	Usability engineering	Usability engineering services, human factors research, user interface design, and usability testing of products, technology, and services
14	Training	Training, technical assistance, design and production of training materials, management or operation of technical assistance centers
6	Program assessment and evaluation	Empirical analysis and evaluation of the effectiveness or impact of programs or policies
8	Surveys and measurement	Development, validation, and implementation of surveys and other empirical forms of measurement
43	Statistical analysis	Statistical analyses of data
6	Database construction and management	Construction of databases by extracting information either from already existing computerized information systems or directly from paper source documents
4	Interviewing and ethnomethodology	Conducting interviews and making observations in context

Endnotes

[1]We also examined whether our results would differ if we defined dispersion at the metropolitan area instead of at the building level (e.g., a project of a Washington, D.C. site with the California site is a dispersed one, but not a project between two Washington, D.C. sites). The results were unchanged.

[2]Degrees of freedom for chi-square is calculated based on the formula (Number of domain categories $-$ 1) $*$ (Number of sites $-$ 1) $= (9-1)*(6-1) = 40$.

[3]The proportion of domain experts available in each site corresponds to the proportion of projects requiring different types of domain expertise in each site.

[4]A tobit analysis where the percentage of project members dispersed is used as the dependent variable provides similar results.

[5]To test for simultaneity between project net earnings and the propensity for a project to be dispersed, we conducted a Hausman specification error test by regressing all exogenous variables on the project net earnings and then using the predicted values and the residual values from the first regression to predict project dispersion. The coefficient of the residual value is insignificant ($p = 0.192$), indicating low simultaneity between the expertise match variables and the dispersed project variable.

[6]An inspection of residual plots of the ordinary least squares (OLS) regression model for Models 1–5 revealed somewhat larger dispersion for higher values of the dependent variable, which violates the OLS assumption that error terms have uniform variance and are not correlated with one another. A White test for heteroskedasticity (White 1980) was also significant ($p < 0.001$), showing that there is heteroskedasticity in the residuals. To correct for the problem of heteroskedasticity, we used White's heteroskedasticity-consistent variances to test for the significance of each coefficient. The models were also inspected for multicollinearity using the condition index and the variance inflation factors. All the models in Table 4 except Model 3 have variance inflation factors less than 4 and condition index no more than 11, suggesting no significant multicollinearity (Belsley et al. 1980).

[7]We repeated the analysis for Model 6 in Table 4 by using the number of sites involved in the dispersed project to measure the extent of project dispersedness. The dispersedness variables using this operationalization were not significant. Adding the number of sites as a control variable in Model 6 also did not change the results.

[8]We identified distinct groups of projects by examining the extent to which each pair of projects had the same members, using the clique identification technique and structural equivalence blocking technique in UCINET (Krackhardt 1999, Wasserman and Faust 1994).

References

Ackerman, M. 1994. Augmenting the organizational memory: A field study of Answer Garden. J. B. Smith, F. D. Smith, T. W. Malone, eds. *Proc. ACM Conf. Comput. Support. Coop. Work* (*CSCW'94*), ACM Press, Chapel Hill, NC, 243–252.

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

Armstrong, D. J., P. Cole. 2002. Managing distances and differences in geographically distributed work groups. P. Hinds, S. Kiesler, eds. *Distributed Work*. MIT Press, Cambridge, MA, 167–186.

Becker, M. C. 2001. Managing dispersed knowledge: Organizational problems, managerial strategies and their effectiveness. *J. Management Stud.* **38**(7) 1037–1051.

Belsley, D., E. Kuh, R. Welsch. 1980. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. John Wiley, New York.

Brandon, D. P., A. B. Hollingshead. 2004. Transactive memory systems in organizations: Matching tasks, expertise, and people. *Organ. Sci.* **15**(6) 633–644.

Clark, H., S. Brennan. 1991. Grounding in communication. L. B. Resnick, J. M. Levine, S. D. Teasley, eds. *Perspectives on Socially Shared Cognition*. APA Books, Washington, D.C., 127–149.

Cox, D. R., E. J. Snell. 1989. *The Analysis of Binary Data*, 2nd ed. Chapman and Hall, London, UK.

Cramton, C. D. 2001. The mutual knowledge problem and its consequences in geographically dispersed teams. *Organ. Sci.* **12** 346–371.

Cummings, J. N. 2004. Work groups, structural diversity, and knowledge sharing in a global organization. *Management Sci.* **50**(3) 352–364.

Cummings, J. N., S. Kiesler. 2005. Collaborative research across disciplinary and organizational boundaries. *Soc. Stud. Sci.* **35**(5) 703–722.

Curtis, B., H. Krasner, N. Iscoe. 1988. A field study of the software design process for large systems. *Comm. ACM* **31** 1268–1287.

Empson, L. 2001. Introduction: Knowledge management in professional service firms. *Human Relations* **54**(7) 811–817.

Espinosa, J. A., A. Carmel. 2004. The effect of time separation on coordination costs in global software teams: A dyad model. *Proc. 37th Hawaii Internet Conf. System Sci.,* IEEE.

Even-Shoshan, M., T. Gilad. 1999. Network your way to better recruitment. *Workforce* **78**(6) 106–113.

Finholt, T. A., L. Sproull, S. Kiesler. 2002. Outsiders on the inside: Sharing know-how across space and time. P. Hinds, S. Kiesler, eds. *Distributed Work*. MIT Press, Cambridge, MA.

Granovetter, M. 1973. The strength of weak ties. *Amer. J. Sociol.* **78** 1360–1380.

Grant, R. M. 1996a. Prospering in dynamically competitive environments: Organizational capability as knowledge integration. *Organ. Sci.* **7**(4) 375–387.

Grant, R. M. 1996b. Toward a knowledge-based theory of the firm. *Strategic Management J.* **17**(Winter Special Issue) 109–122.

Grudin, J. 1988. Why CSCW applications fail: Problems in the design and evaluation of organizational interfaces. *Proc. ACM Conf. Comput. Support. Coop.* ACM Press, New York, 85–93.

Herbsleb, J. D., A. Mockus. 2003. An empirical study of speed and communication in globally distributed software development. *IEEE Trans. Software Engrg.* **29**(3) 1–14.

Hinds, P., D. Bailey. 2003. Out of sight, out of sync: Understanding conflict in distributed teams: An empirical investigation. *Organ. Sci.* **14**(6) 615–632.

Hinds, P., M. Mortensen. 2005. Understanding conflict in geographically distributed teams: The moderating effects of shared identity, shared context, and spontaneous communication. *Organ. Sci.* **16**(3) 290–307.

Hinds, P., J. Pfeffer. 2003. Why organizations don't "know what they know:" Cognitive and motivational factors affecting the transfer of expertise. M. Ackerman, V. Pipek, V. Wulf, eds. *Sharing Expertise: Beyond Knowledge Management*. MIT Press, Cambridge, MA, 1–22.

Hitt, M. A., L. Bierman, K. Shimizu, R. Kochhar. 2001. Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective. *Acad. Management J.* **44**(1) 13–28.

Hosmer, D. W., Jr., S. Lemeshow. 1989. *Applied Logistic Regression*. John Wiley & Sons, Inc., New York.

Kanfer, R. 1990. Motivation theory and industrial/organizational psychology. M. D. Dunnette, L. Hough, eds. *Handbook of Industrial and Organizational Psychology*. Vol. 1. Consulting Psychologists Press, Palo Alto, CA, 75–170.

Kogut, B., U. Zander. 1992. Knowledge of the firm, combinative capabilities and the replication of technology. *Organ. Sci.* **3**(3) 383–397.

Krackhardt, D. 1999. The ties that torture: Simmelian tie analysis in organizations. *Res. Sociol. Organ.* **16** 183–210.

Kraut, R. E., C. Egido, J. Galegher. 1990. Patterns of contact and communication in scientific research collaboration. J. Galegher, R. E. Kraut, C. Egido, eds. *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work*. Erlbaum Associates, Hillsdale, NJ, 149–171.

Kraut, R. E., S. R. Fussell, S. E. Brennan, J. Siegel. 2002. Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. P. Hinds, S. Kiesler, eds. *Distributed Work*. MIT Press, Cambridge, MA, 137–162.

Lee-Kelley, L. 2002. Situational leadership: Managing the virtual project team. *J. Management Development* **21**(5/6) 461–476.

Lepak, D., S. Snell. 1999. The human resource architecture: Toward a theory of human capital allocation and development. *Acad. Management Rev.* **24**(1) 31–48.

Liang, D. W., R. Moreland, L. Argote. 1995. Group versus individual training and group performance: The mediating role of transactive memory. *Perspect. Soc. Psych. B* **21** 384–393.

Lowendahl, B. R., O. Revang, S. M. Fosstenlokken. 2001. Knowledge and value creation in professional service firms: A framework for analysis. *Humam Relations* **54**(7) 911–931.

Maister, D. H. 1993. *Managing the Professional Service Firm.* The Free Press, New York.

Majchrzak, A., A. Malhotra, J. Stamps, J. Lipnack. 2004. Can absence make a team grow stronger? *Harvard Bus. Rev.* **82**(5) 131–155.

Mark, G. 2005. Large-scale distributed collaboration: Tension in a new interaction order. *Proc. Soc. Informatics Workshop*, Irvine, CA. http://crito.uci.edu/2/si/resources.asp.

Mark, G., J. Grudin, S. E. Poltrock. 1999. Meeting at the desktop: An empirical study of virtually collocated teams. S. Bodker, M. King, M. K. Schmidt, eds. *Proc. 6th Eur. Conf. Comput. Support. Coop. Work.* Kluwer Academic Publishers, Dordrecht, Netherlands, 159–178.

May, A., C. Carter. 2001. A case study of virtual team working in the European automotive industry. *Internet J. Indust. Ergonomics* **27**(3) 171–186.

Maybury, M., R. D'Amore, D. House. 2003. Automated discovery and mapping of expertise. M. Ackerman, V. Pipek, V. Wulf, eds. *Sharing Expertise: Beyond Knowledge Management*. MIT Press, Cambridge, MA.

Miner, J. B., D. P. Crane, R. J. Vandenberg. 1994. Congruence and fit in professional role motivation theory. *Organ. Sci.* **5**(1) 86–87.

Nahapiet, J., S. Ghoshal. 1998. Social capital, intellectual capital, and the organizational advantage. *Acad. Management Rev.* **23**(2) 242–266.

Nardi, B. A., S. Whittaker. 2002. The place of face-to-face communication in distributed work. P. Hinds, S. Kiesler, eds. *Distributed Work*. MIT Press, Cambridge, MA, 83–112.

Nordhaug, O., K. Gronhaug. 1994. Competences as resources in firms. *Internet J. Human Resource Management* **5** 89–106.

Olson, G. M., J. S. Olson. 2000. Distance matters. *Human-Comput. Interaction* **15** 139–178.

Pipek, V., J. Hinrichs, V. Wulf. 2003. Sharing expertise: Challenges for technical support. M. Ackerman, V. Pipek, V. Wulf, eds. *Sharing Expertise: Beyond Knowledge Management*. MIT Press, Cambridge, MA, 111–136.

Priem, R. L., J. E. Butler. 2001. Is the resource-based "view" a useful perspective for strategic management research? *Acad. Management Rev.* **26**(1) 22–40.

Schilling, M. A., H. K. Steensma. 2002. Disentangling the theories of firm boundaries: A path model and empirical test. *Organ. Sci.* **13**(4) 387–401.

Teece, D. J. 1998. Capturing value from knowledge assets: The new economy, markets for know-how and intangible assets. *California Management Rev.* **40**(3) 55–79.

Walther, J. B. 2002. Time effects in computer-mediated groups: Past, present, and future. P. Hinds, S. Kiesler, eds. *Distributed Work*. MIT Press, Cambridge, MA, 235–257.

Wasserman, S., K. Faust. 1994. *Social Network Analysis: Methods and Applications*. Cambridge University Press, Cambridge, UK.

Weisband, S. 2002. Maintaining awareness in distributed team collaboration: Implications for leadership and performance. P. Hinds, S. Kiesler, eds. *Distributed Work*. MIT Press, Cambridge, MA, 311–334.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* **48**(4) 817–838.