

More Than an Answer: Information Relationships for Actionable Knowledge

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Research on information processing, managerial cognition, and social networks demonstrates that people rely on other people for information. However, this work has not specified how seeking information from others results in actionable knowledge—knowledge directed at making progress on relatively short-term projects. This research employs both qualitative and quantitative methods to investigate how personal sources of information contribute to actionable knowledge. Our qualitative study found that people cultivate different kinds of information relationships that are the source of 5 components of actionable knowledge: (1) solutions (both know-what and know-how), (2) referrals (pointers to other people or databases), (3) problem reformulation, (4) validation, and (5) legitimation. Our quantitative study revealed that, while source expertise predicted receipt of these components of actionable knowledge, so too did expertise of the seeker and features of the relationship between the seeker and source. We draw implications from these findings for the study of social capital and organizational learning.

Key words: information; knowledge; problem solving; relationships

I had done a decent amount of work in related areas but not on these specific issues in billing and not in telecom. So there was some stuff I knew about our service line, but a lot I did not about the industry or the specific organization we were in. While you can pick some of this up by scanning trade publications or looking through slide decks in [the knowledge management system] there is only so much this can tell you. Time is tight and until you spend a lot of time in an area, you don't necessarily know what the important points are. So you have to rely on other people to help you get to the right information, to help you ignore what's not relevant, and to just brainstorm with you in ensuring that you are on the right track and maybe where some political traps are that you need to avoid.

—*Manager in Management Consulting Practice*

In knowledge-intensive work such as professional services or software development, people must solve complex problems with short time horizons. Because projects are often ill-defined, problem solving requires more than simply finding a correct answer. It typically entails defining relevant dimensions of a problem space, crafting a solution that is both feasible and appropriate for the social context where it will be introduced, and convincing others of the correctness of a proposed course of action. Information search and problem solving in these situations is directed toward acquiring or creating *actionable knowledge*, which we define as knowledge that leads to immediate progress on a current assignment or project. The concept, *actionable*

knowledge, represents a pragmatic view of knowledge creation and application toward specific ends (Carlile 2002, Dewey 1938/1949).

Both qualitative and quantitative research predicts that the manager in our opening vignette would, indeed, turn to colleagues in the pursuit of actionable knowledge. Less clear is what transpires in such interactions. Two schools of research offer different perspectives on how such interactions lead to actionable knowledge. A knowledge transfer perspective focuses on knowledge abstracted from a particular setting and moved from one person to another for use in a different context. For example, research on knowledge transfer in organizations has focused on cognitive, social, and organizational impediments to the movement of knowledge from one part of an organization to another (Argote 1999, pp. 143–182; Szulanski 1996). Research on networks and relationships has focused either on relational characteristics associated with effective knowledge transfer (Levin and Cross 2003, Hansen 1999) or on how network structure affects diffusion of information (Allen 1977, Burt 1992, Rogers 1995). In general, knowledge transfer research views learning as a process of acquiring and putting to use information or knowledge that has been abstracted from one setting and moved to another.

In contrast, a constructivist perspective suggests knowledge cannot easily be transferred out of context (e.g., Elkjaer 2003, Lave and Wenger 1991, Weick and Westley 1996). Rather, actionable knowledge is heavily conditioned by history and the environment in which

it is created. From this perspective, information seekers do more than obtain “answers” from experts; they “construct their understanding out of a wide range of materials that include ambient social and physical circumstances and the histories and social relations of the people involved” (Brown and Duguid 1991, p. 47). In general, research taking a situated or constructivist perspective turns away from transfer models of abstract and decontextualized knowledge and toward a view of learning as located in a particular physical and social context.

These two views characterize actionable knowledge differently. The transfer perspective is concerned with movement of information or knowledge. As a result, problem solving and the creation of actionable knowledge focuses on obtaining “correct” solutions. The situated or constructivist perspective suggests that a “correct” solution is only part of actionable knowledge. Thus, while people might obtain solutions from others, sometimes information-seeking interactions might also lead people to think about their problems differently (Orr 1996, Tyre and von Hippel 1997). In this view, problem solving may help generate feasible solutions, but may also help people frame problems in ways consonant with group values (Cook and Yanow 1993, Wenger 1998). Information seeking might also yield affirming feedback that bolsters confidence and the ability to introduce solutions in a specific social context (Blau 1986, p. 32; Lave and Wenger 1991, pp. 79–84). Informed from a situated perspective, it seems that an objectively “correct” solution is only part of actionable knowledge. Yet, we know little regarding how actionable knowledge is created through interaction with others.

Both transfer and constructivist perspectives identify interpersonal relationships as central to finding information and generating actionable knowledge (Allen 1977, pp. 182–228; Lave and Wenger 1991, pp. 27–42; Rogers 1995, pp. 284–289). However, we know little about important features of relationships within which these interactions occur. Social network analysis provides tools to understand characteristics of information relationships and to model antecedents and outcomes of such relationships in ways that ethnographic accounts cannot accomplish. However, to date, the social network literature has focused primarily on structural properties of networks (Adler and Kwon 2002, Burt 2000, Monge and Contractor 2000). Traditionally network research has assumed that relationships can be appropriated for different purposes (e.g., friends can be sought for work-related information), and so it is unnecessary to distinguish between kinds of ties or specify content in networks (Adler and Kwon 2002). Yet, the constructivist perspective calls into question the assumption of interchangeable relationships. It suggests that some people are likely to know more than others about values in a specific context that make certain solutions more appealing and acceptable than others. Similarly, some

relationships, marked by history, are likely to be more helpful than others.

This paper is about information relationships in organizations—how they are cultivated, maintained, and used to create actionable knowledge. In two studies, we identify and assess dimensions of actionable knowledge and the information relationships that help to produce it. The first, qualitative, study develops the concepts of information relationships and actionable knowledge based on managers’ descriptions of how they solve complex problems under tight deadlines. We began this phase of our research with an agnostic stance toward the nature of information relationships. We were prepared to learn that informants viewed actionable knowledge as unidimensional “answers”; we were equally prepared to learn that they viewed answers as only one part of actionable knowledge. Similarly, we were prepared to learn that informants cultivated generalized, interchangeable, information relationships that provided the entirety of actionable knowledge; we were equally prepared to learn that information relationships were more specialized. The second, quantitative, study builds on findings from the first study by assessing how attributes of the knowledge seeker, knowledge source, and the relationship between the two predict actionable knowledge.

Study 1: Information Relationships as a Source of Actionable Knowledge

Setting and Informants

We conducted a qualitative interview study within the business consulting practice of a Big Five accounting firm in 1999–2000. We interviewed 40 managers from 12 offices throughout the United States. We chose this hierarchical level because managers in the firm made most of the decisions regarding problem definition and solution trajectory in consulting engagements. All respondents had significant client project responsibilities that required them to be effective and efficient at generating pragmatic solutions to move the engagements forward. We interviewed equal numbers of men and women, given possible gender differences in information-seeking networks (Ibarra 1992, 1995). Our goal was to understand how these managers construct actionable knowledge.

Interviews and Analysis

We used an iterative data collection process to identify and successively refine themes emerging from the interviews (Maxwell 1996, pp. 63–66). After each of the first 10 interviews, the first author annotated a transcript of the audio recording and interview notes with questions and emerging themes. These annotations were included as probes in the next 10 interviews. The first 20 informants were then recontacted by telephone and asked additional questions. Then, the final 20 interviews

were conducted with the refined probes over a subsequent 2-week period.

The two-hour to three-hour interviews used in-depth and semistructured questioning techniques to encourage informants to reflect on their own experiences (Patton 1987, pp. 108–143; Marshall and Rossman 1998, pp. 80–82). We first asked informants to describe a consulting engagement they had been involved in during the previous six months that held significance for their career. (Informants had typically worked on one to three such projects in the previous six months.) We encouraged them to focus on information important in the project and the sources of this information. After eliciting this description, we then followed a two-step process common in egocentric network studies¹ (Scott 1990, pp. 72–79; Wasserman and Faust 1994, pp. 42–43). First, we asked informants to write down the names of all the people they consulted for information or advice during the project. Then, informants selected the three people from the list whom they considered to be the most important information sources. The remainder of the interview asked the informant to describe one or more scenarios from the project in which each of the three people played an important role and to describe characteristics of each relationship. We employed four probes to help informants amplify their descriptions. First, we simply asked for further details and examples. Second, we asked for specific ways that a person helped the informant create useful knowledge. Third, we asked the informant to describe and reflect upon the relationship he or she had with the information source. Finally, we asked the informant to reconsider the scenario and add any additional thoughts that might have come to mind as a result of the probes. Throughout this process, we asked informants to describe specific behaviors, names, and dates, when possible, to help guard against memory errors (Dougherty 1992).

The first author transcribed and coded the interviews using typical content and thematic analysis procedures (Weber 1990, pp. 15–40; Miles and Huberman 1994, pp. 55–66). In this process, we focused on each informant's description of how interacting with another person resulted in the creation and use of knowledge. Coded transcripts were assessed for interrater reliability by an independent coder. Inter-coder reliability was estimated by correlation between codes and initially reflected 0.85 agreement. Inconsistencies were discussed and revisions made based on clarifying terminology specific to consulting and the firm under study. With these inconsistencies resolved, the final correlation between raters was 0.96. Remaining inconsistencies were not considered as evidence in the analysis. The data presented below include both frequency distributions of commonly occurring themes and verbatim illustrative quotations from respondents. Each quotation is followed by an alphanumeric code indicating the identity of the respondent.

The frequency distributions are based on an N of 40 when they describe informants; they are based on an N of 120 (40 respondents times 3 information relationships for each respondent) when they describe information relationships.

Findings

When asked to describe sources of information important to the successful completion of their project, 85% of the managers immediately and spontaneously named one or more specific people. We had thought managers might frequently report relying upon computerized “knowledge repositories,” which the firm was heavily promoting at that time. Because they almost never mentioned these or other impersonal sources, the remainder of this paper focuses only on people as information sources. As one manager said, “I mean the whole game is just being the person that can get the client what they need with [the Firm's] resources behind you. This almost always seems to mean knowing who knows what and figuring out a way to bring them to your client's issue” (R6). Very few of the named people were simply organizationally designated “experts”; most were described as partners in information relationships.

Information Relationships. Information relationships were diverse in terms of both formal and informal characteristics. Thirty-six percent of relationships were with hierarchical superiors who often participated in meetings and distribution lists that provided them with information not available to our informants. Superiors also frequently set standards by which a project and informant would be evaluated, and so were valuable for problem framing and prioritization discussions. Solutions often came to our informants via boundary spanning relationships across technical domains (26% of relationships) and occasionally outside the organization (10% of relationships). Yet, while formal structure conditioned search for actionable knowledge, informal aspects of relationships were also important. For example, informants often had trouble obtaining useful information from experts in the absence of a preexisting relationship that compelled these people to return calls or engage in a helpful manner. Similarly, informants were reluctant to trust advice offered by someone they did not know well.

Informants described their most valuable relationships as having deepened when commonalities outside of work were discovered. Whether these connections were educational background, intellectual interests, families, housing, sports and hobbies, or some form of philosophical outlook, they were consistently identified as major milestones in developing productive information relationships. For example, one manager indicated:

I think our relationship really got going because we went to the same university, which is the University of Florida. We also had similar interests. I think one day on his

bookshelf I saw a book that he had not read and I had and I recommended that he do it. So there is a mutual intellectual interest there We also have a very similar family life. He has a child older than my son, but there is a similarity there . . . all of these things I think begin to improve our relationship, making it more accessible, more helpful, more timely . . . (R4).

Connections on a personal level made relationships feel safer, and thus in many ways, more functional in solving problems. When asked to subjectively rate their information relationships in terms of safety, informants indicated: 66 High Safety, 50 Medium Safety, and 4 Low Safety. In the safer relationships, informants felt more able to “ask dumb questions” to explore areas that they knew little about. Not only did the personal connection broaden the knowledge domains, people were willing to ask questions about, but these connections also seemed to promote a sense of creativity and exploration in the interactions. In safer relationships, informants were more willing to take risks with their ideas and potentially go astray a little.

Alan is always looking for the positive spin on something. I mean even if he thinks that is crap and if he really thought that, he would always, always find something positive or he would say “Well I think we might be a little off track on that and here’s why,” and then say why and of course there is learning that comes from that. He would still make sure I did the right thing, but do it in a way that left me dignity (R16).

Connections on a personal front also helped ensure that people were accessible and willing to engage in productive problem solving. Only 3% of information relationships were rated as low in willingness to engage, and these were people who were valued only for answers to very precise questions. “Engaging” in problem solving was not a lengthy process. Informants described it as a simple two-step process in which the information source first understood the problem as experienced by the knowledge seeker and then shaped his or her knowledge to the problem. This process could occur in a two-minute hallway conversation, but was a behavior distinguished by willingness to think with—as opposed to dump information on—a person.

It’s not a lot of time that makes the difference. We don’t sit in a conference room for hours on end. It’s the fact that he listens and then responds in a way that is helpful to me. And despite how good he is, he is very careful not to overload you with information. I guess it seems like he makes sure that what he is saying is relevant to you and fits your need (R20).

Informants cultivated and maintained their information relationships over time. These actions ensured that information sources would continue to be accessible as well as informed on new knowledge or skills developed since the last interaction. Informing others of

newly acquired expertise was particularly important in interactions with superiors who decided whether and how a person might be involved in future projects.

With Dave . . . once the project ended there was really no reason for me to e-mail him or voice mail him and I guess I didn’t feel comfortable doing that, especially knowing how busy he is. What I will do with Dave is . . . if I see him on the fourth floor, we will talk and sometimes I will just take a walk down to the fourth floor and wander by his office to see if he is around—just to look for a way to maintain the relationship. Not formally, very informally just to see what he is up to . . . and more importantly tell him what I have been doing (R8).

Proactive sharing of information or opportunities was an important maintenance behavior that, to some degree, hinged on a norm of reciprocity. Implicit in most people’s decision to either forward information or involve another person in a project was a calculation about the amount that the other person had contributed back to the relationship. Reciprocity was important in ensuring the ongoing functioning of an informational relationship.

To be honest, I’m questioning how much I want to put into Seth going forward. He was great on that project, but recently [he] has chewed up a lot of my time on several smaller things that did not come through. I guess I will probably try and stay in touch, but as I think about it, I am definitely becoming less responsive and I guess this in and of itself will likely diminish the odds of us doing something together again (R39).

Finally, most informants said that maintaining relationships did not require frequent interaction so long as quality exchanges occurred when people did interact. Quality connections typically entailed catching up on a personal basis (in terms of commonalities from the past or gossip on third-party relationships the two people had in common) as well as on a professional level (in terms of updating on projects others had been working on and discussions of general career issues).

. . . and that is typically how most of our interactions tend to go. I maybe see him once every three to four weeks. And it’ll be a lot of energy, a lot of depth all at once and then you know nothing for three to four weeks. But that is fine. I know he is out there and will help if I need it. There really isn’t a need for tons of e-mail or phone calls. Just to connect well when we do see each other (R25).

Components of Actionable Knowledge. In the view of our managers, actionable knowledge was not unidimensional. Our informants consistently described receiving some combination of 5 components of actionable knowledge from people they sought out for information: (1) solutions (both know-what and know-how), (2) referrals (pointers to databases or other people), (3) problem reformulation, (4) validation, and (5) legitimization.

Solutions. Fifty-seven percent of information sources provided information that helped generate solutions for an important project. In describing solutions received, informants differentiated declarative knowledge (knowledge of facts about something) from procedural knowledge (knowledge of how to do something). Only 13% of the information sources that yielded solutions provided explicit, declarative knowledge. In each of these cases, the problem domain itself was well defined. For example, one informant recounted how facts provided by a source were valuable because the client's request for a proposal required the informant to address 33 detailed technical questions:

The people issuing the RFP [request for proposal] were ex-consultants themselves and knew the games that we play in making ourselves appear as experts. They gave us an incredibly precise listing of questions that required us to really show whether we knew our stuff. In a sense, this was a blessing because half the time you are shooting in the dark because the client does not know what they really need. But it was also a curse in that it required me to answer the damn things correctly and quickly. So [information source] really came through with the details and specific technical dimensions they were questioning us on. If we had not been incredibly precise in the RFP, we wouldn't have made it (R19).

This level of problem specificity was uncommon, however. Usually, problems were more ambiguous so that informants had to establish relevant problem dimensions and persuade themselves and others that these dimensions should be addressed with a specific solution. In these cases, information about steps that a manager should take or tools and methodologies that could be employed to develop a solution were useful. Eighty-seven percent of the information sources valued for providing solutions provided procedural knowledge that helped turn theoretical principles or abstract knowledge into action.

At [Client X] we had access to background information and, you know, lots of case studies and approaches that were really well written up. We had no experience in the practice though of actually applying it on an engagement. So what was specifically useful to me was to talk with Terry who knew what we were trying to achieve at [Client X]...to help me work some of this accessible content into a workable approach. What I needed to know was: How might we apply this, given that we have not done it before? That was my key question. Rather than what do I need to know about this subject matter (R28).

Referrals. Not all information sources yielded solutions directly; some provided pointers to other people with requisite expertise or pointers to specific information in a database. Forty-five percent of the information sources provided referrals, which helped informants efficiently locate relevant expertise or reusable work products. One informant estimated that weeks of time were

saved by such a referral provided by a team member early in a project.

It was critical that Laura was also able to bring to bear some work she had done in other projects. You know, she was able to say we could tap into this person who did something just like this over here or I can steal the code he wrote for this client and use it here. She had a lot of ideas of how to pull in her existing network [of information relationships] to much more quickly get our stuff up and running (R34).

Seventy percent of the information sources valued for referrals provided pointers to other people. These people also often went beyond providing the name of a referral to making actual introductions for our informants. In these cases, the information source's personal relationship with the third party often encouraged that person to provide information to our respondent.

Problem Reformulation. People also valued information sources for their ability to help define or re-define problem dimensions. Forty-five percent of the information sources were valued for their ability to shape the informant's problem. Such sources often prompted informants to think more broadly about a problem or to attend to dimensions that the informant had not considered. These sources were valued for their ability to listen to a description of a complex scenario and abstract out important points. One manager recounted how a person he turned to was consistently helpful in ensuring that he was addressing the correct aspects of a problem.

She can dig into a complex mess of issues and pull out relevant problems. To me I really respect that. We often just try to throw a methodology at client situations and are often only half-heartedly successful and this often reinforces our own ignorance as we do not ever learn the importance of attacking the right organizational issue rather than all of them in whatever methodology we are using. She is not like that at all (R21).

Sources were also valued for pointing out consequences of planned actions and for their ability to anticipate issues and concerns likely to appear in the future. In describing how one source suggested that potentially inflammatory findings be presented, an informant summarized:

I often miss the dynamics in a situation that will affect people. I don't know why, but it has bitten me before and so is something I am increasingly cognizant of...[that's why] I continue to go back to her for advice...(R2).

Validation. Informants also reported valuing interactions with other people who helped them develop confidence in their solutions or plans. Forty-nine percent of the information sources helped validate the manager's plans by bolstering the informant's confidence in his or her ideas, and allowing him or her to introduce these ideas persuasively in other contexts. For example, one

informant described a scenario in which she was developing a marketing strategy for a high-technology company. Though she was well versed in marketing, she was less expert in her client's technology or industry. As a result, she relied heavily on one person to validate her plans and ideas prior to proposing them to a particularly difficult client.

...the other times I tended to turn to him for help was when I had a problem that I had a solution for and I just wanted him to validate it. You just want someone important to say yeah, you are thinking along the right lines (R17).

Informants typically sought validation at critical junctures of a project, such as before proposing an approach to a superior or delivering a final presentation to a client. Most informants felt that validation improved the effectiveness with which they presented their ideas. Furthermore, validation also yielded an efficiency benefit: once informants were assured that their thinking was sound, they did not continue to collect and analyze additional information. Validation shows how seeking information from others affects not only knowledge creation, but also its effective deployment. The ability to get an answer (even a correct one) is only the first step in actionable knowledge. The next step almost always requires one to convince people (whether a client, boss, teammate, or oneself) of one's thinking. This step is often supported by seeking validation from others.

Legitimation. Ninety-five percent of the informants described using the fact that they had discussed their ideas with an influential person to bolster their proposals in a different context. Thirty-six percent of information sources were valued for legitimation that accrued from the interaction. Like validation, legitimation was valuable at important project junctures, such as when persuading a client to implement a proposed solution. Legitimation also reduced the amount of work required to substantiate a solution with objective information alone, thereby providing an efficiency benefit. One informant described a meeting with two influential people in which she planned to propose a technical platform for a client intranet project. Before entering the meeting, she expected she would need to spend several more weeks analyzing competing technologies to gain support for her recommendation. However, she was surprised by the extent to which a prior substantive conversation with the client's chief information officer (CIO) precluded this work.

In conversations with the two heads of the e-commerce initiative, the fact that I had covered my plan with [the CIO] and [the CIO] bought into it—they were like “Oh, great. We have the buy in of IT, we don't need to worry about that and you know, [the CIO] understands the web so we are sure that there are some good ideas there” (R9).

Legitimation helped informants to speed the process of securing agreement with their plans by giving superiors and even team members a sense of comfort in the efficacy of a proposed solution. Informants also used legitimating contacts to help obtain approval for a course of action in an efficient fashion.

...I mean, what is a partner [but a] figurehead. It is kind of like the Wizard of Oz. There is Oz, the almighty Oz, and I am kind of like standing behind the curtain going God I hope [the client] does not see me. A partner might not know what the hell the subject is from a content standpoint, but they have the title, they have been around the block, and they are usually good at interpersonal relationships. Playing a role is what they are all about.... The title, years of experience, all that is what you put in front of the client (R36).

Discussion

Our informants described and differentiated various components of actionable knowledge, which we have identified as solutions, referrals, problem reformulation, validation, and legitimation. Ninety-five percent of them said that they received all 5 components of actionable knowledge from their three most important personal contacts. Although informants often received more than one component of actionable knowledge from one source, there were no generalist relationships that conferred all 5 components—the most any one relationship provided was three. These findings suggest a multidimensional framework for what has often been considered to be a unidimensional advice network in social network research or as a single component in research on information processing, managerial cognition, and knowledge transfer.

In addition, the quality of relationships upon which people draw for some components of actionable knowledge appears to be richer than others. When the problem domain was well defined and knowledge seekers knew what they were looking for, they were likely to turn to whomever they felt might have the right answer. Similarly, for legitimation, where the value of reaching out to a specific person accrues in part from the ability to tell others about the interaction rather than what is learned, relationships did not have to be particularly close. However, for referrals, problem reformulation and validation, the information relationship was characterized by greater intimacy, perhaps because each of these components entailed some element of risk for the knowledge seeker. At a minimum, respondents risked wasting time finding out that a document or person to which one was referred was irrelevant. At the extreme, allowing another person to influence one's thinking via problem reformulation or one's action via validation puts the trajectory of a project into that person's hands. Our informants all indicated that relationships relied on for these purposes were richer along both professional and personal dimensions.

These findings also suggest that effective information relationships themselves are situated—situated not within the context of the immediate client engagement but within a context of previous interactions, shared history, and (sometimes) connections outside of work. The second study begins to investigate characteristics of these situated relationships.

Study 2: Determinants of Actionable Knowledge

Theory and Hypotheses

A dyadic model of knowledge seeking should include characteristics of the knowledge seeker, the knowledge source, and the relationship between the seeker and the source. Prior research on seeker characteristics has investigated gender (Ibarra 1992), job roles or job categories (Pentland 1992, Shah 1998), and task expertise (Day and Lord 1992). Prior research on source characteristics has investigated source expertise (O'Reilly 1982) and hierarchical position (Morrison 1993). Prior research on relational characteristics has focused on tie strength (Granovetter 1973, Hansen 1999), trust (Tsai and Ghoshal 1998, Levin and Cross forthcoming), and homophily (McPherson et al. 2001). Most research has focused on characteristics of either the seeker, or the source, or the relationship, not on all three simultaneously.

The primary purpose of this study was to simultaneously model characteristics of the knowledge seeker, source, and relationship between the parties as determinants of the 5 components of actionable knowledge. This approach allows us to assess the relative importance of different characteristics of the dyad members and the relationship within the same analytic framework. We know that relationships in organizational settings are established in part through relative position in formal structure (Lincoln 1982) and in part through repeated interaction and social psychological processes (Weick 1979, pp. 89–117). However, little research has investigated both formal and informal aspects of relationships in the same study (for exceptions, see Brass 1984, Stevenson and Gilly 1991). Thus, a second purpose of this study was to better understand how both formal and informal characteristics of relationships predict receipt of actionable knowledge.

A knowledge seeker's task-relevant expertise should affect how information is attended to and processed (e.g., Johnson-Laird 1983, pp. 126–145; Starbuck and Milliken 1988). In particular, a seeker's expertise should play a role in the components of actionable knowledge dealing with ill-structured parts of problems (Voss and Post 1988). Task-relevant expertise is not necessarily critical to obtaining solutions to well-defined problems because in such cases, information correctness can be determined in comparison to the problem frame.

Similarly, task-relevant expertise, on its own, should not necessarily improve one's ability to obtain legitimation via contact with a well-regarded information source. However, expertise should enable information seekers to better act on referrals by helping to screen out pointers to irrelevant information. Expertise should also benefit problem reformulation as the seeker will be more likely to attend to only those dimensions of a problem that experience suggests are important. Finally, expertise should benefit validation by helping to weed out platitudes offered by well-intended, but ill-informed colleagues. Stated formally:

HYPOTHESIS 1. Information seeker expertise will be positively related to receipt of referrals, problem reformulation, and validation.

Perceived source expertise is likely to be positively related to receipt of all components of actionable knowledge. Research on transactive memory and distributed cognition suggests the importance of understanding “who knows what” as a precondition to seeking out people for information (Hutchins 1995, Moreland et al. 1996). Social network research also suggests that a precursor to seeking information from someone is a belief that the expertise of that person is relevant to a given problem or opportunity (Borgatti and Cross 2003). As a result, we can anticipate perceived source expertise to influence who is sought out for solutions, referrals, and problem reformulation. Validation, if it is to be believed and affirming to a knowledge seeker, is likely to be derived from someone perceived to have relevant expertise. And it is likely that a source's ability to provide legitimation is related to reputation and a group's recognition of that person's expertise in a given problem domain. Stated formally:

HYPOTHESIS 2. Information source expertise will be positively related to receipt of solutions, referrals, problem reformulation, validation, and legitimation.

However, simply knowing that someone has relevant expertise is not all that is required to obtain useful information from that person. At a minimum, acquiring information from someone requires his or her cooperation, which is a function of the relationship that one has with that person. We expect that both formal and informal relationships between a seeker and a source of information will affect receipt of the 5 components of actionable knowledge.

External boundary spanning has long been known to influence how information enters organizations (Tushman and Scanlan 1981). Information also often comes from other units within the same organization but outside of one's group, thus spanning functional boundaries (e.g., Allen 1977, pp. 155–161; Hinds and Kiesler 1995). As a result, we would expect boundary spanning relations to be conduits of solutions. However, referrals, problem reformulation and validation are more likely to come from within one's group. People sought out for

these components of actionable knowledge must be willing to cognitively engage with the information seeker, which is more likely to occur when the two parties share common goals and perspectives. We would not necessarily expect legitimation to be consistently and directly related to relative boundary position. Stated formally:

HYPOTHESIS 3A. Ties spanning organizational boundaries will be positively related to receipt of solutions.

HYPOTHESIS 3B. Ties inside of one's unit will be positively related to receipt of referrals, problem reformulation, and validation.

Hierarchy is also likely to affect knowledge seeking, but possibly in contradictory ways. Superiors often have access to information not available to lower levels, which should make them valuable sources of both solutions and referrals. Further, by virtue of their formal position, superiors are more likely to be able to validate plans and be a source of legitimation. However, a person moving up the hierarchy often becomes less engaged in and knowledgeable of daily work. Thus, we might expect superiors to be less desirable sources of problem reformulation. In contrast, research on situated learning shows that people rely on accessible and knowledgeable peers for "problem solving" (e.g., Lave and Wenger 1991, pp. 27–38). This ethnographic work suggests that people will turn to peers for solutions, referrals, and problem reformulation. Yet, peers are likely to have access to similar solutions and referrals; consequently, they should not be particularly valuable for those types of knowledge. Their comparative advantage comes from their experience with similar situations, which should make them specifically valuable for problem reformulation. Stated formally:

HYPOTHESIS 4A. Ties to those higher in the hierarchy will be positively related to receipt of solutions, referrals, validation, and legitimation.

HYPOTHESIS 4B. Ties to those at the same hierarchical level will be positively related to receipt of problem reformulation.

In addition to relationship features established by relative position in the formal structure, interpersonal features of relationships are also likely to influence receipt of the 5 components of actionable knowledge. Granovetter (1973) argued that weak ties provide information seekers with nonredundant information. Hansen (1999) found that weak ties supported the exchange of simple, explicit information, while strong ties were necessary for transfer of complex, tacit knowledge. Two predictions can be made in relation to the 5 components of actionable knowledge. First, weak-tie relations should be important for the receipt of solutions, because they allow knowledge seekers to bridge into socially

distant pockets of a network for nonredundant information. However, we do not suggest that weak ties predict receipt of referrals as our qualitative evidence suggested that taking action on reference knowledge requires a seeker to sufficiently trust a source to expend time and effort pursuing their recommendations—trust in a stranger that is not necessarily likely to exist despite a weak tie's potential to be a rich source of nonredundant information. In contrast, strong-tie relations should be important for problem reformulation and validation, because these exchanges require greater investment of a source's time and effort (Krackhardt 1992). We would not necessarily expect legitimation to be directly related to tie strength alone. Stated formally:

HYPOTHESIS 5A. Weak ties will be positively related to receipt of solutions.

HYPOTHESIS 5B. Strong ties will be positively related to receipt of problem reformulation and validation.

Study 1 highlighted the importance of an information source's willingness to cognitively engage with the seeker and the seeker's problem; this attribute has also been noted in other empirical work (e.g., Pentland 1992). A source's willingness to cognitively engage should be important for receipt of three of the components of actionable knowledge: referrals, problem reformulation, and validation. To provide an actionable referral, the source must understand the information seeker's problem. Helping a seeker frame a problem or validate a course of action also should require an information seeker to address and possibly shape nuances of the problem space as experienced by the seeker. However, we would not necessarily expect solutions for well-defined problem domains to require active engagement with a knowledge source. Similarly, legitimation, which accrues as a product of a source's standing in a specific context, should not necessarily require a source to engage. Stated formally:

HYPOTHESIS 6. Relationships with sources who are willing to cognitively engage will be positively related to receipt of referrals, problem reformulation, and validation.

The degree of "safety" that exists between two people should also affect learning that occurs via receipt of the components of actionable knowledge (Edmondson 1999). Asking for information makes a person vulnerable. Further, defensive behaviors can knowingly and unknowingly block learning (Argyris and Schon 1996, pp. 101–107). Thus, the degree of perceived safety in a relationship is likely to influence the extent to which seekers will be forthcoming about their lack of knowledge and open to learning. While we would not necessarily expect safety to be important for solutions or referrals, we would anticipate it to matter for problem reformulation and validation. Both require one to expose

a lack of knowledge in ways that seeking solutions or referrals do not. As with engagement though, we would not necessarily expect that the ability to obtain legitimation is directly related to a sense of safety in the relationship. Stated formally:

HYPOTHESIS 7. *Relationships characterized as safe will be positively related to problem reformulation and validation.*

Taken together, these hypotheses suggest different patterns of determinants for each of the components of actionable knowledge. For solutions, sources with expertise who travel in entirely different information circles are likely to be most valuable because they provide access to the greatest scope of nonredundant information. For referrals, sources with expertise who know the seeker's context but have a broader perspective are likely to be most valuable. For problem reformulation, sources with expertise who are close to the seeker organizationally and psychologically are likely to be most valuable because reformulation often entails the greatest degree of cognitive and emotional effort for both members of the relationship. For validation, sources with expertise who are psychologically close but organizationally superior should be most valuable because developing validation is likely to entail some degree of risk on the part of the seeker and some degree of organizational clout on the part of the source. And finally, for legitimation, sources who are expert and hierarchically superior are likely to be most valuable.

Methodology

Design, Setting, and Sample. To investigate the hypotheses enumerated above, we used a stratified sample survey design to administer a two-part questionnaire within three different offices of the same Big Five business consulting practice from Study 1. We randomly selected 13 consultants, 13 senior consultants, and 14 managers from each of 3 offices to receive our survey. The managing partner of the office sent out a personalized e-mail requesting that these people complete the survey and also sent out follow-up e-mails to nonrespondents. Out of 120 possible respondents, 118 completed the survey for a response rate of 98.3%. Respondent characteristics can be found in Table 1.

Data Collection. We used standard egocentric network survey techniques in a two-part questionnaire to measure characteristics of the knowledge seeker (respondent), knowledge source, relationship between the two parties, and components of actionable knowledge received. In Part 1, we first used a standard name generator/interpreter methodology to identify people whom the respondents relied on for information (Scott 1990, pp. 72–79). We requested:

Table 1 Respondent Characteristics

| | Number | % |
|---------------------------|-------------|------|
| Hierarchical level | | |
| Manager | 41 | 34.7 |
| Senior consultant | 39 | 33.1 |
| Staff consultant | 38 | 32.2 |
| Mean time in organization | 37.1 months | |
| Standard deviation | (44.5) | |
| Mean time in industry | 38.1 months | |
| Standard deviation | (21.2) | |
| Gender | | |
| Female | 51 | 43.2 |
| Male | 67 | 56.8 |
| Education | | |
| High school graduate | 4 | 3.4 |
| College | 51 | 43.2 |
| Masters | 60 | 50.8 |
| Doctorate | 3 | 2.6 |

Consider a project that you have been involved with in the past six months that you feel holds significance for your career. Considering the full cycle of your involvement in this project, please write down the names of people who you turned to for information or advice. Feel free to include people in this list who are either employees or not employees of [the firm] (e.g., customers, suppliers, friends in other organizations, etc.).

We gave respondents 20 blank lines to list people they relied on for information or advice. The mean number of names recalled was 7.9 (s.d. = 4.01; min = 3; max = 15). We then instructed:

From the list above, please name below the five people (if you listed that many) who you believe were most helpful in providing information or advice necessary to get your work done. Please order these people in terms of their importance in helping you to successfully complete your work on this project—with one being most important and five being least important.

In the remainder of Part 1, we asked specific questions about these five people and their relationships with the respondent. In Part 2, which respondents received one week later, we asked them to characterize the components of actionable knowledge respondents received from these people. We split the questionnaire into two parts to reduce respondent fatigue and to separate responses to the independent and outcome variables to reduce common method variance (Doty and Glick 1998).

Measures

Independent Variables. Independent variables characterized the source, seeker, and relationship between the two. We used measures from previous research for expertise and tie strength (Hansen 1999).

We first assessed bivariate item correlations to ensure that individual items were more highly correlated with those measuring the same construct and less with those measuring other constructs. Unfortunately, the items

Table 2 Principal Components Analysis Varimax Rotation

| | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|-----------------------|-------------|-------------|-------------|-------------|
| Safety1 | 0.74 | −0.03 | −0.12 | 0.17 |
| Safety2 | 0.75 | 0.04 | 0.16 | 0.15 |
| Engage1 | 0.81 | −0.04 | 0.16 | 0.06 |
| Engage 2 | 0.80 | 0.05 | 0.21 | 0.05 |
| Seeker Expertise1 | −0.07 | 0.76 | 0.09 | −0.12 |
| Seeker Expertise2 | 0.01 | 0.74 | 0.15 | 0.10 |
| Seeker Expertise3 | 0.09 | 0.84 | 0.06 | −0.03 |
| Source Expertise1 | 0.19 | 0.03 | 0.90 | −0.04 |
| Source Expertise2 | 0.13 | −0.03 | 0.90 | 0.06 |
| Tie Strength1 | 0.04 | −0.09 | −0.05 | 0.91 |
| Tie Strength2 | 0.13 | 0.16 | 0.08 | 0.86 |
| Eigenvalue | 3.089 | 1.877 | 1.590 | 1.056 |
| % Variance | 28.1% | 17.1% | 15.2% | 11.2% |
| % Variance cumulative | 28.1% | 45.2% | 60.3% | 71.5% |

measuring *safety* were highly correlated with several other variables in the analysis. Further, those items had a Cronbach's alpha of only 0.488. Finally, as seen in Table 2, a principal components analysis (with a varimax orthogonal rotation) revealed that the safety items loaded on the same factor as the engage items. Thus, items measuring *safety* were removed from further analysis. A principal components analysis of the remaining items (with a varimax orthogonal rotation) yielded four factors that cumulatively accounted for 77.1% of the variance in the data. Items all loaded cleanly on the appropriate component, with loadings well above the 0.3 benchmark (Hair et al. 1996, p. 387). The reliability coefficient for each scale exceeded the recommended 0.7 benchmark (Nunnally 1978).

Dependent Variables. The dependent variables in this study were the 5 components of actionable knowledge emerging from Study 1, each measured with a single item. Even though single-item measures can be problematic, in a review of empirical evidence, Marsden (1990) concluded that single-item network measures can be effective when they use recognition methods and ask about behaviors over time. We took several steps to increase reliability and validity of the dependent measures. First, we asked about specific behaviors (Freeman et al. 1987). Second, we pretested the measures with 14 consultants from a separate organization. A focus group debriefing with 12 of these respondents suggested that people were interpreting items correctly. Finally, the first author randomly selected 20 of the 118 respondents to interview after they had completed the survey. These interviews assessed respondents' general understanding of the items and required them to describe scenarios in which they received the component of actionable knowledge from a person they had named in the survey. In only 6 out of 100 scenarios (20 respondents times 5 components of actionable knowledge), did respondents categorize a component differently than we

would have. In three cases, respondents reported receiving *solutions* that we would have coded as *referrals*; in one case, a respondent reported *problem reformulation* that we would have coded as a *solution*; and in two cases, respondents reported *validation* that we coded as *legitimation*.

Analyses

We conducted preliminary analyses of variance to check for differences in information seeking across organizational location or consulting practice. Multiple analysis of variance showed no significant differences associated with respondent's office location or consulting practice across all components of actionable knowledge and all sources. Accordingly, we pooled data across offices and practices.

Descriptive statistics and bivariate correlations can be found in Table 3. All correlations are significant among the five dependent variables (i.e., the 5 components of actionable knowledge), ranging from a high of 0.50 between *solutions* and *referrals* to a low of 0.21 between *problem reformulation* and *legitimation*. While statistically significant, these correlations are lower than those in other network studies that have investigated multiple relationships in social networks (e.g., Ibarra and Andrews 1993). Moreover, the postsurvey interviews made it clear that respondents view these components as distinct. Thus, we interpret significant intercorrelations as a sign that respondents obtain more than one component of actionable knowledge from one person. Significant correlations among the independent variables primarily occurred in categorical variables, where inclusion in one category would necessarily mean a negative correlation with another.

We analyzed the data using hierarchical linear modeling (HLM) (Hoffman 1997, Kreft and De Leeuw 1998, Raudenbush and Bryk 2002, Snijders and Bosker 1999) with the statistical package HLM 5 (Raudenbush et al. 2001). Because HLM does not rest on the assumption of independence in observations that is a cornerstone of typical regression procedures, it is particularly well suited to egocentric network data that are inherently nested (Hoffman et al. 2000). In such data, independent variables composed of source characteristics and relationship characteristics are nested "within" each respondent (van Duijn et al. 1999, Wellman and Frank 2001). HLM allows a researcher to partition the variance between these two levels. First, a "Level 1" model estimates the relationship between independent and dependent variables within the subject in a manner equivalent to OLS regression. In this case, characteristics of information sources (e.g., perceived source expertise) and relationships (e.g., relative hierarchical position) predict receipt of each of the 5 components of actionable knowledge. The intercept and slope estimates

Table 3 Means, Standard Deviations, Reliabilities, and Bivariate Correlations

| | Mean | Standard deviation | Reliability | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|--------------------------|------|--------------------|-------------|--------|--------|--------|--------|--------|---------|-------|---------|---------|--------|---------|---------|-------|--------|----|
| 1. Solutions | 5.9 | 1.32 | | | | | | | | | | | | | | | | |
| 2. Referrals | 5.4 | 1.80 | | 0.50** | | | | | | | | | | | | | | |
| 3. Problem reformulation | 5.5 | 1.84 | | 0.23** | 0.32** | | | | | | | | | | | | | |
| 4. Validation | 5.8 | 1.70 | | 0.25** | 0.30** | 0.34** | | | | | | | | | | | | |
| 5. Legitimation | 5.4 | 1.69 | | 0.32** | 0.39** | 0.21** | 0.45** | | | | | | | | | | | |
| 6. Seeker title | 2.0 | 0.82 | | −0.02 | −0.11* | 0.01 | 0.03 | −0.03 | | | | | | | | | | |
| 7. Seeker tenure | 37.1 | 44.5 | | 0.05 | 0.01 | −0.02 | 0.03 | 0.03 | 0.36** | | | | | | | | | |
| 8. Seeker education | 3.5 | 0.60 | | −0.09 | −0.13 | 0.07 | −0.01 | −0.10 | 0.54** | 0.09 | | | | | | | | |
| 9. Seeker expertise | 3.9 | 1.59 | 0.773 | −0.06 | 0.03 | 0.15** | 0.10* | 0.01 | 0.34** | 0.08 | 0.36** | | | | | | | |
| 10. Source expertise | 6.2 | 1.07 | 0.842 | 0.43** | 0.37** | 0.20** | 0.28** | 0.37** | −0.06 | 0.09 | −0.09 | −0.02 | | | | | | |
| 11. Out group | 0.4 | 0.49 | | 0.07 | 0.02 | −0.10* | −0.10* | 0.01 | 0.18** | 0.04 | 0.06 | 0.05 | −0.05 | | | | | |
| 12. Hierarchy higher | 0.4 | 0.49 | | 0.13** | 0.12* | 0.09 | 0.11* | 0.10 | −0.42** | −0.09 | −0.29** | −0.23** | 0.14** | −0.18** | | | | |
| 13. Hierarchy even | 0.2 | 0.42 | | −0.05 | −0.04 | 0.07 | −0.08 | −0.11* | 0.14** | 0.08 | 0.15** | 0.07 | −0.04 | −0.10* | −0.44** | | | |
| 14. Tie strength | 3.2 | 1.94 | 0.756 | −0.11* | 0.02 | 0.21** | 0.18** | 0.01 | 0.04 | 0.09 | 0.05 | 0.12* | −0.03 | −0.11* | 0.05 | 0.02 | | |
| 15. Engage | 5.9 | 1.08 | 0.771 | 0.20** | 0.26** | 0.41** | 0.29** | 0.10 | −0.07 | −0.02 | −0.01 | 0.03 | 0.34** | 0.07 | 0.15** | −0.06 | 0.24** | |

* = 0.05, ** = 0.01.

in the “Level 1” model then become dependent variables that are regressed against “Level 2” independent variables, i.e., respondent characteristics. The “Level 2” equation models variance across respondents and can provide evidence of cross-level interaction affects.

Results

Predicting Information Benefits. We first employed our “Level 1” independent variables (source and relationship characteristics) to predict dependent variables at the same level (receipt of *solutions*, *referrals*, *problem reformulation*, *validation*, and *legitimation*). Initially, we fit a model using fixed effects across all independent variables and then allowed the intercept and relational measures to vary across respondents on source expertise (our Level 2 variable) (Heck and Thomas 2000, p. 60; van Duijn et al. 1999). Analytically, three steps are required in building our model. First, we must establish that sufficient between-respondent variance exists to warrant use of hierarchical linear modeling. A one-way analysis of variance with random effects model allows us to partition variance in our dependent variables into “within” and “between” respondent components. The intraclass correlation coefficient measures the proportion of variance that resides between respondents (Raudenbush and Bryk 2002, p. 24), which, in this case, was 27.0% for *solutions*, 43.9% for *referrals*, 28.3% for *problem reformulation*, 40.3% for *validation*, and 29.2% for *legitimation*. A chi-squared test on the residual variance indicates whether the Level 2 “between” variance is significantly different from zero. In this case, the tests for *solutions* (217.67, 117, $p < 0.000$), *referrals* (358.66,

117, $p < 0.000$), *problem reformulation* (223.37, 117, $p < 0.000$), *validation* (326.05, 117, $p < 0.000$), and *legitimation* (224.72, 117, $p < 0.000$) rejected the null hypothesis of no systematic variance between respondents.

With these preconditions established, we moved on to an “Intercept-as-Outcome” model based on complete Level 2 data only (Raudenbush and Bryk 2002, pp. 80–85). Our theoretical interest lay with assessing the effect of a seeker’s expertise on his or her ability to acquire the components of actionable knowledge. Thus, we modeled the Level 1 regression intercept as the dependent variable and the seeker’s expertise as the independent variable. Centering decisions can influence the interpretation of Level 2 intercept and slope models (Hoffman and Gavin 1998). With grand-mean centering, the variance in the intercept term reflects the adjusted between-respondent variance in the outcome measure after controlling for predictors in the Level 2 model (Snijders and Bosker 1999, p. 81). As our interest lay in understanding the role of seeker characteristics after accounting for Level 1 source and relational characteristics, we chose to employ grand-mean centering.

Hypothesis Tests. Regressions summarized in Table 4 test the hypotheses. We found full support for Hypothesis 1 on the role of seeker expertise. That is, seekers’ task-relevant expertise improved receipt of *referrals* ($p < 0.05$), *problem reformulation* ($p < 0.01$), and *validation* ($p < 0.01$). Substantial, but not complete, support was found for Hypothesis 2 (people obtain all informational benefits from those with greater task-relevant knowledge). Perceived source expertise

Table 4 Seeker, Source, and Relationship Characteristics Predicting Receipt of Actionable Knowledge

| | Solutions | Referrals | Problem reformulation | Validation | Legitimation |
|--------------------------------|----------------------|---------------------|-----------------------|---------------------|---------------------|
| Intercept | 5.967*** | 5.412*** | 5.490*** | 5.799*** | 5.451*** |
| Seeker expertise | −0.021 (0.054) | 0.134* (0.059) | 0.191** (0.064) | 0.159* (0.080) | 0.038 (0.079) |
| Perceived source expertise | 0.465*** (0.105) | 0.462*** (0.122) | 0.129 (0.102) | 0.334*** (0.099) | 0.536*** (0.095) |
| Formal relationships | | | | | |
| Boundary spanning out group | 0.332* (0.150) | 0.175 (0.157) | −0.016 (0.167) | −0.219 (0.161) | 0.073 (0.172) |
| Relative hierarchy (to seeker) | | | | | |
| Higher | 0.422*** (0.126) | 0.442*** (0.177) | 0.407 (0.237) | 0.279* (0.137) | 0.184* (0.087) |
| Even | 0.114 (0.156) | 0.127 (0.338) | 0.284* (0.126) | −0.226 (0.211) | −0.296 (0.241) |
| Informal relationships | | | | | |
| Tie strength | −0.173*** (0.036) | 0.042 (0.046) | 0.192*** (0.050) | 0.133** (0.042) | −0.001 (0.043) |
| Engage | 0.109 (0.105) | 0.278** (0.112) | 0.549*** (0.112) | 0.258* (0.117) | −0.057 (0.123) |
| R-squared | 26.9% | 25.9% | 21.9% | 19.6% | 29.8% |

Notes. Coefficients are unstandardized. Standard errors are in parentheses.

* = 0.05, ** = 0.01, *** = 0.001.

was significant for *solutions*, *referrals*, *validation*, and *legitimation* ($p < 0.001$), but not for *problem reformulation*.

When we tested hypotheses about formal relationships, we found partial support for the effect of *boundary spanning* and full support for the effect of *hierarchical position*. Support was found for Hypothesis 3a (people obtain *solutions* from those outside of their group) ($p < 0.05$). No statistical support was found for Hypothesis 3b (people obtain *referrals*, *problem reformulation*, and *validation* from those within their group). Hypothesis 4a received full support: hierarchical superiors were considered important for receipt of *solutions* ($p < 0.001$), *referrals* ($p < 0.001$), *validation* ($p < 0.05$), and *legitimation* ($p < 0.05$). Hypothesis 4b (people rely on those at the same hierarchical level for *problem reformulation*) also received full support ($p < 0.05$).

When we tested hypotheses about informal relationships, Hypothesis 5a (people rely on *weak ties* for *solutions*) received full support ($p < 0.001$). Hypothesis 5b also received full support: respondents reported relying on *strong ties* for *problem reformulation* ($p < 0.001$) and *validation* ($p < 0.01$). Hypothesis 6 (people rely on those willing to *engage* in problem solving for *referrals*, *problem reformulation*, and *validation*) also received full support for *referrals* ($p < 0.01$), *problem reformulation* ($p < 0.001$), and *validation* ($p < 0.05$).

Discussion

We undertook this work to better understand pragmatic problem solving in professional settings. To this end, we introduced and explored the concepts of actionable knowledge and information relationships. We found 5 components of actionable knowledge that play unique roles in solving important problems at work. Solutions, referrals, and problem reformulation involve problem framing and resolution, whereas validation and legitimation involve search and solution implementation. These components also seem to contribute in different ways to a knowledge seeker's performance. Solutions, referrals, and problem reformulation can be central to the effectiveness of a plan or course of action. Referrals, validation, and legitimation can improve the efficiency with which search is conducted and plans implemented. From a social network perspective, these components were derived from different people, suggesting that information networks are not unidimensional (Burt 2000, p. 385). Our qualitative work (Study 1) indicated that 95% of informants obtained all components of actionable knowledge from their information relationships, yet no more than three components ever came from one person. Our quantitative results (Study 2) indicated that the components of actionable knowledge come from relationships with different attributes.

We modeled determinants of actionable knowledge in terms of characteristics of the seeker, source, and relationship between the two. Perceived source expertise was important in predicting receipt of four components of actionable knowledge, but not problem reformulation. What mattered for problem reformulation was tie strength and the willingness of a source to engage in problem solving. The postsurvey interviews suggested that sources for problem reformulation did not have to be problem domain experts, instead, they were valued for their ability to point out important dimensions of problems and consequences of potential actions. We also found that seeker expertise plays an important role in the receipt of referrals, problem reformulation, and validation. For components of actionable knowledge dealing with ill-structured problems, knowing something improves one's ability to engage productively with others.

Characteristics of the relationship between the knowledge seeker and source also influenced who was sought out for the 5 components of actionable knowledge. Given calls for research to assess how formal organization shapes informal relations (Tichy 1981, Salancik 1995, Adler and Kwon 2002), two findings were significant. First, as we anticipated from previous research, boundary-spanning relations yield solutions. Second, hierarchy also affected knowledge seeking. Hierarchical superiors were valued for solutions, referrals, validation, and legitimation. Postsurvey interviews confirmed that hierarchical superiors interact in different information environments than those lower in the hierarchy. Further, hierarchical position conveys authority, enabling one to be an effective source of validation and legitimation. Respondents turned to peers only for problem reformulation. Because people at the same hierarchical level were often dispersed on different projects, their knowledge of specific content appeared to be weaker than their ability to engage in general problem solving.

Informal characteristics of relationships also predicted receipt of actionable knowledge. First, tie strength varied predictably in relation to the 5 components. Weak ties were important for solutions, presumably because they bridged into subnetworks containing nonredundant information (e.g., Granovetter 1973; Burt 1992, p. 116). In contrast, strong ties mattered for problem reformulation and validation, components that require willingness of a source to exert effort on the behalf of a knowledge seeker. Together, these findings suggest the need for a richer understanding of information relationships in studies of social networks. Strong ties probably shape how people think about problems, and thus seek additional information, an important complement to a weak tie's ability to yield nonredundant information.

In addition to tie strength, source willingness to cognitively engage in problem solving predicted receipt of

referrals, problem reformulation, and validation. Willingness of a source to actively think *with* the seeker is important to one's ability to assimilate and use new knowledge when a problem is not well defined. Szulanski (1996) has suggested that limited "absorptive capacity" of the recipient and an "arduous relationship" impede knowledge transfer. Our findings extend this work and suggest that learning is affected in part by existing knowledge, but also by specific relational characteristics and source behaviors that enhance or hinder one's ability to learn from another.

Of course, this study has limitations that should be noted. Generalizability is limited because the study was conducted within only one organization. We attempted to mitigate local biases by sampling across multiple offices. Nevertheless, different national, occupational or organizational cultures could engender different types of information relationships. Moreover, our study is characterized by common methods variance, because both dependent and independent variables were measured by self-report. This was a deliberate choice because a knowledge seeker is the best, and perhaps the only, judge of the usefulness of knowledge received from a particular source. We did, however, separate the surveys assessing the dependent and independent variables by a week in time to reduce any potential common methods bias, according to the recommendation of Doty and Glick (1998).

Our study is also limited in that it assesses the creation of actionable knowledge from a one-sided and retrospective perspective, whereas ethnographic work demonstrates that problem spaces and solutions are established and change dynamically in interaction with people and the environment (Brown and Duguid 1991). Thus, our view of actionable knowledge is constrained to ways that interpersonal interactions facilitate its creation; our view of information relationships is constrained to characteristics associated with components of actionable knowledge. Yet, while these constraints limit our understanding of how actionable knowledge is created and how information relationships are initiated and sustained, our work does begin to illuminate the role these processes play in complex problem solving.

We hope future research will consider how information relationships affect learning and performance. Traditionally, social network research has considered the link between information acquisition and performance almost exclusively in structural terms. In this perspective, individual social capital derives from network structure with little regard for differences in relationships within the network: A relationship's value to a person is determined by its incremental effect on the network's structural ability to yield nonredundant information (Burt 2000, pp. 353–355). Our findings suggest an alternative or possibly complementary link to performance. Components of actionable knowledge

play different roles in a knowledge worker's ability to frame problems or opportunities, generate solutions, and convince others of the correctness of a given course of action efficiently. Further research could uncover how actionable knowledge benefits different dimensions of performance such as effectiveness, efficiency, and innovation. In fact, it is possible that structural holes provide benefit from an ability to derive a balance of the components of actionable knowledge as opposed to their ability to offer access to nonredundant information. Future research should illuminate how network structure and content affect different dimensions of performance.

This work also suggests that situated learning can be understood at a collective level of analysis. In his review, Elkjaer (2003, p. 43) states that a social view of learning "changes the locus of the learning process from that of the mind of the individual to the participation patterns of individual members of organizations in which learning takes place." Ironically, work on situated learning has focused almost exclusively on how social context shapes individual learning. For example, the primary job of a learner is to become a practitioner via legitimate peripheral participation (Lave and Wenger 1991), a process principally focused on how established members "educate" those on the periphery. This perspective does not tell us much about what, if anything, effective groups learn *from* their peripheral members. Might they play an important role in introducing solution or reference knowledge, while more central members do more in the way of validation and legitimation? In short, social network analysis applied to components of actionable knowledge may allow us to determine not only the distribution of expertise in a group, but also who learns what from whom, how rapidly, and how faithfully.

This collective view of learning could be extended to assess learning biases of an entire network. For example, a social network perspective applied to actionable knowledge can enrich our understanding of absorptive capacity. Though Cohen and Levinthal (1990) suggested a need to study communication links to understand absorptive capacity, inquiry has focused on existing knowledge and routines (Zahra and George 2002). Applying network analytic techniques to components of actionable knowledge can allow researchers to model more precisely whose knowledge is disproportionately important in a group. For example, we can anticipate that people central in a legitimation or problem formulation network are disproportionately important to a group's ability to recognize and act on opportunities. Alternatively, the situated learning concept of legitimate peripheral participation suggests that ties are arrayed in a core-periphery pattern in which a group of experienced members are tightly connected in the center with less connectivity amongst more peripheral members. This pattern is highly effective in rapidly diffusing information from the center of the network. However

is this an effective array of relations to solve ambiguous problems? Research on temporary teams suggests that a core-periphery pattern may be negatively related to performance in more ambiguous settings (Cummings and Cross 2003). In such settings, lateral connectivity in a network may allow an entire group to leverage its collective expertise more effectively. Alternatively, subgroups, particularly in problem reformulation and legitimation networks, may allow for different interpretations to emerge in ways that a core-periphery structure would squelch. The answers are not clear, but the opportunities for discovery are rich for scholars at the intersection of these bodies of work.

Finally, our work holds importance for managers in two respects. First, recent advice has suggested that leaders should turn to their personal network for technical, political, and personal counsel (Ciampa and Watkins 1999, pp. 253–256) as well as consider their personal networks in terms of size, structure, composition, and focus (Baker 2000, pp. 27–67). Our work offers different insight by suggesting not only types of advice that one may seek, but also relationship investments that must be made to yield various components of actionable knowledge.

Second, our work suggests ways that managers can promote knowledge creation and sharing in their organizations. A recent study indicated that demand for knowledge management technologies will grow 41% annually from \$2.3 billion in 2000 to \$12.7 billion in 2005 (Dyer 2001). Traditionally, these investments have been made in technologies and procedures to create repositories that capture and share codified knowledge (Ruggles 1998, Davenport et al. 1998). Our work emphasizes the importance of social networks as a source of actionable knowledge. Technologies such as collaborative spaces and expertise locators can facilitate knowledge sharing among employees. Yet, other, perhaps less obvious, opportunities to promote collaboration exist in organizational structure, planning processes, work management practices, human resource policies, and culture (Cross et al. 2002). If the goal is to promote the effectiveness with which knowledge is created and shared, we hope that practitioners will consider a wide range of options in this pursuit.

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Endnote

¹The term “egocentric network” refers to a focal individual, called “ego,” and the set of contacts named by ego, who are called “alters.”

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