

## A bird's-eye view: Using social network analysis to improve knowledge creation and sharing

*A significant yet often overlooked component of people's information environments is composed of the relationships that they use to acquire information and knowledge. Social network analysis (SNA) allows managers to visualize and understand the myriad of relationships that can either facilitate or impede knowledge creation and transfer.*

*In research conducted by the IBM Institute for Knowledge-Based Organizations, we discovered four different relationship dimensions which are important for effective learning. By analyzing and applying these dimensions to important groups of people within an organization, we can improve knowledge creation and sharing.*



*By Rob Cross, Andrew Parker and Stephen P. Borgatti*

# Social network analysis

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## An increasingly common scenario ...

“So the call came in late on Thursday afternoon and right away, I wished I hadn’t answered the phone. We had received a last-second opportunity to bid on a sizable piece of work that the partner on the other end of the line really wanted to pursue. Unfortunately, I had little experience in the subject matter but happened to be the one with availability at the time. I had no clue how to even begin looking for relevant methodologies or case examples, so my first move was to tap into my network to find some relevant info and leads to other people or databases. And in fact, I relied pretty heavily on this group of people over the next couple of days. For example, Seth was great for pointing me to other people and relevant information, Paul provided ideas on the technical content of the project while Jeff really helped in showing me how to frame the client’s issues in ways that we could sell. He also helped navigate and get buy-in from the client, given his knowledge of their operations and politics. And somehow in this process, we managed to pull it off ... I mean the whole game is just being the person that can get the client what they need with the company’s resources behind you. This almost always seems to mean knowing who knows what and figuring out a way to bring their knowledge to bear on your client’s issue. Knowing who to turn to for what is ultimately the key to doing what you need to do quickly so you can go home to your family.”

We live in fascinating, yet uncertain and often disconcerting times, as less and less time is available for us to grow comfortable in our own knowledge while at work.<sup>1</sup> Even within narrow technical specialties, it is becoming more and more difficult just to stay current. For example, witness today’s medical profession where, despite an unparalleled formal education, doctors are frequently “taught” by their patients, who have more time to review massive amounts of data related to their specific medical concern. Further, as we move into a knowledge-intensive economy, only rarely does any one person have sufficient knowledge to solve increasingly ambiguous and complex problems.

The opening vignette is representative of stories frequently heard when managers and executives are asked to recount how they obtained information critical to the success of an important project. Perhaps both the ambiguity of the initial problem posed as well as the way the manager resolved the problem resonates with your own experience. This person was successful, not solely as a result of his own knowledge, but rather as a product of being able to find and apply relevant information efficiently. And of notable importance is the role that his network played in helping him locate knowledge in a timely fashion.

The IBM Institute for Knowledge-Based Organizations found this scenario to be increasingly common. Usually, when thinking of where people go for information, databases or other sources of information, such as policy and procedure manuals come to mind. However, a significant, yet often overlooked component of people's information environments are composed of the relationships that they use for information and knowledge capture.<sup>2</sup> One study demonstrated that people are roughly five times more likely to turn to friends or colleagues for answers than other sources of information such as a database or file cabinet.<sup>3</sup> Our own research with 40 managers revealed that 85 percent claimed to receive knowledge critical to the successful completion of an important project from other people. Although these managers did employ the organization's knowledge base, it was often only to supplement knowledge they had acquired from other people. This, despite the fact that their organization had a leading-edge technical platform and institutionalized practices for capturing, screening and archiving codified knowledge.

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In short, *who* you know has a significant impact on *what* you come to know. Many people we work with have discovered the importance of attending to the human element in knowledge-management programs and are initiating various programs to facilitate knowledge creation and use. Although we can design programs to enhance organizational learning, knowledge transfer or innovation, it is often difficult to understand the impact of such interventions. We have found social network analysis (SNA) – a set of tools for mapping important knowledge relationships between people or departments – to be particularly helpful for improving collaboration, knowledge creation and knowledge transfer in organizational settings.

In management, growth of the social network discipline has been aided by three important developments in the business world: Firstly, is the discovery of the importance of the informal structure within an organization, that coexists with the formal structure of an organization. Even in the most bureaucratic organizations, individuals have always interacted with each other in a myriad of ways not specified by the organization chart. Secondly, is the shift in the late 20th century to an organizational model that is flatter, more flexible, team-oriented and more reliant on knowledge assets. With this shift to more-organic, network-like structures, comes a need to understand how these structures work and how to manage them. Thirdly, is the rapid growth in close cooperative relationships across organizational boundaries – outsourcing, joint ventures, alliances, multiorganizational project work, and so on. Virtual organizations generate a host of new management issues about how to manage work in the absence of strict reporting relationships.

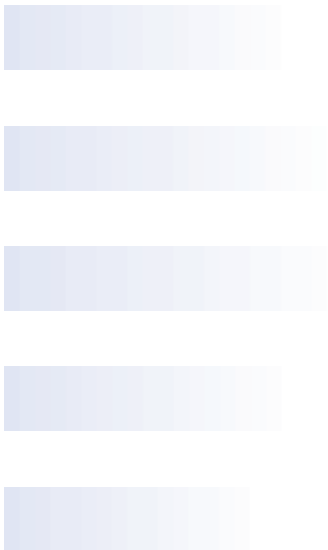
In this context, network analysis shows considerable promise for helping organizations handle a number of classic situations, including:

- Leader selection – Who is central in the trust and respect network?
- Task force selection – How do we put together a team that is maximally connected throughout the organization?
- Mergers and acquisition – It's not just two cultures merging, it's two separate networks.

### **Social network analysis and knowledge**

Social network analysis allows managers to visualize and understand the myriad of relationships that can either facilitate or impede knowledge creation and transfer. How does information flow within an organization? To whom do people turn for advice? Have subgroups emerged that are not sharing what they know as effectively as they should? These are questions that can often be answered through analysis of a social network diagram – a map of individuals and the social ties that link them together. The key feature of these diagrams lies with in the pattern of relationships displayed and the relative position of individuals (or groups) to each other.

For example, the IBM Institute for Knowledge-Based Organizations conducted an SNA of executives in the exploration and production division of a large petroleum organization. This group was in the midst of implementing a distributed technology to help transfer knowledge across drilling initiatives. They were also interested in assessing their ability to create and share knowledge as a group. As a result, we were asked to conduct a SNA of information flow among the top 20 executives within the exploration and production division. As can be seen in Figure 1, this analysis revealed a striking contrast between the group's formal and informal structure.



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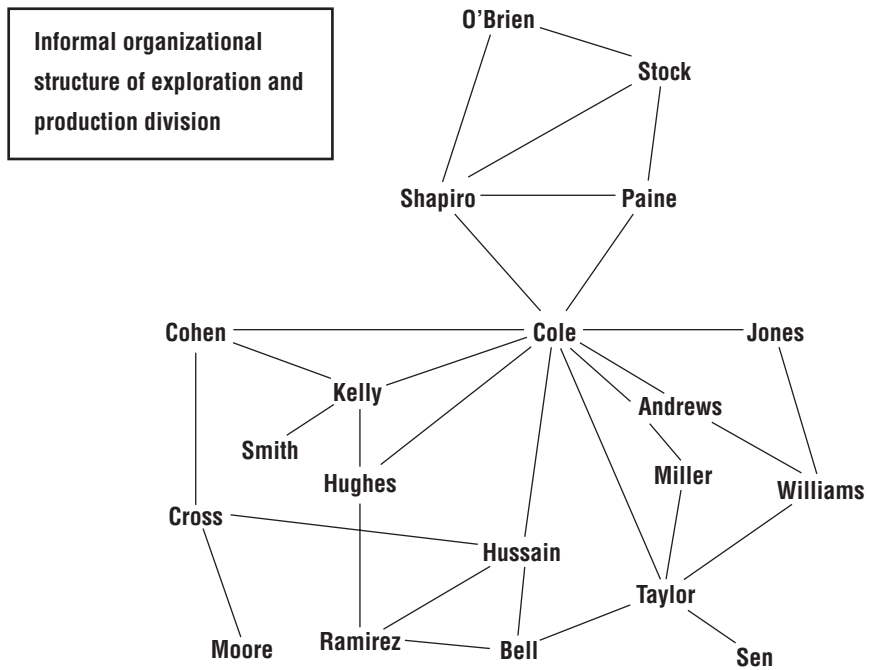
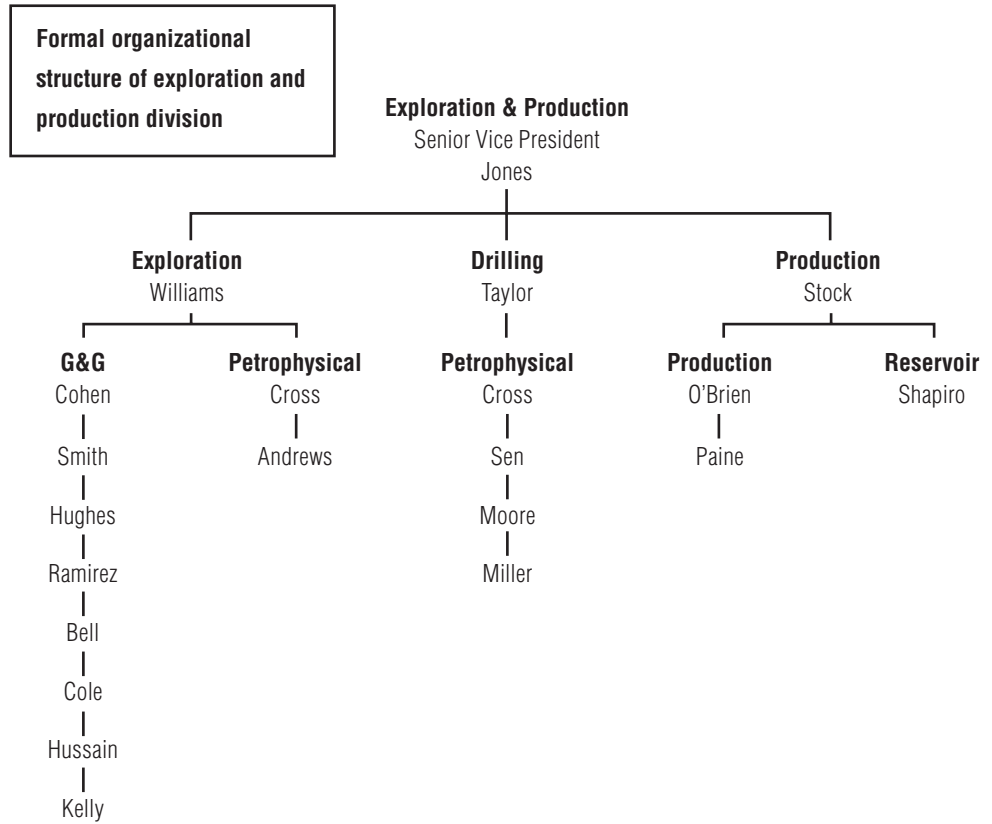
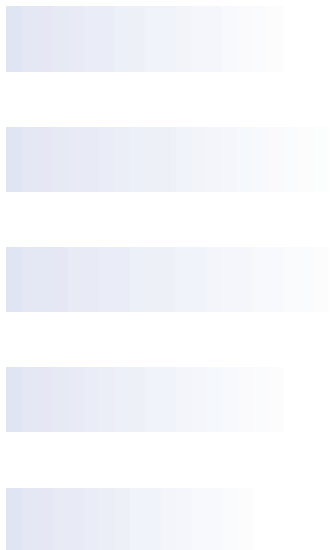


Figure 1: Formal vs. informal structure in a petroleum organization.<sup>4</sup>

Three important points emerged quickly for this group in relation to sharing information and effectively leveraging collective expertise. First, the SNA identified mid-level managers that were critical, in terms of information flow within the group. A particular surprise came from the very central role that Cole played in terms of both overall information flow within the group and being the only point of contact between members of the production division and the rest of the network. A facilitated session with this executive team revealed that over time, Cole's reputation for expertise and responsiveness had resulted in his becoming a critical source for all sorts of information. Through no fault of his own, the number of informational requests he received and the number of projects in which he was involved grew excessively, which not only caused him stress but also frequently slowed the group down as a whole because Cole had become a bottleneck.

As a result, a central intervention that came from this analysis was to reallocate many of the informational requests that were coming to Cole to other members in the group. Simply categorizing various informational requests that Cole received and then allocating ownership of these informational or decision domains to other executives served to both unburden Cole and make the overall network more responsive and robust.

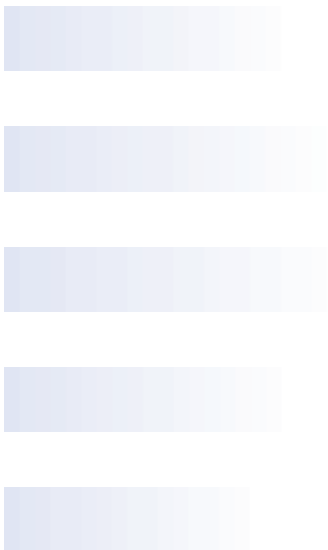
Just as importantly, the SNA helped to identify highly peripheral people who essentially represented untapped expertise and thus, underutilized resources for the group. In particular, it became apparent that many of the senior people had become too removed from the day-to-day operations of this group. For example, Figure 1 reveals that the most-senior person (Jones) was one of the most peripheral in the informal network. This is a common finding: As people move higher within an organization, their work begins to entail more administrative tasks, which makes them both less accessible and knowledgeable about the daily work of their subordinates. In this case, our debrief session indicated that Jones had become too removed from the group and his lack of responsiveness frequently held the entire network back when important decisions needed to be made. Fortunately, the social network diagram helped to make a potentially difficult conversation with this executive nonconfrontational and resulted in more of his time being committed back to the group.



Finally, the SNA also demonstrated the extent to which the production division (the subgroup on the top of the diagram) had become separated from the overall network. Several months prior to this analysis, these people had been physically moved to a different floor in the building. Upon reviewing the network diagram, many of the executives realized that this physical separation had resulted in the loss of a lot of the serendipitous meetings that occurred when they were separated. In this case, the executives decided that they needed to introduce more structured meetings to compensate for this recent loss of unplanned communication. They also adopted an instant messaging system to promote communication.

Analysis of social network diagrams helps determine the extent to which certain people are central to the effective functioning of a network, regardless of whether or not divisive subgroups in a network exist or what the overall connection of a given network is. Things to look for in SNA:

- Bottlenecks – Central nodes that provide the only connection between different parts of the network.
- Number of links – Insufficient or excessive links between departments that must coordinate effectively.
- Average distance – Degrees of separation connecting all pairs of nodes in the group. Short distances transmit information accurately and in a timely way, while long distances transmit slowly and can distort the information.
- Isolation – People that are not integrated well into a group and therefore, represent both untapped skills and a high likelihood of turnover.
- Highly expert people – Not being utilized appropriately.
- Organizational subgroups or cliques – Can develop their own subcultures and negative attitudes toward other groups.



### A knowledge-based network

In our research, we learned that it was important to look at social networks from more than a simple communication or information-flow perspective. The interventions we find effective in improving specific networks of people often have more to do with helping groups know what the others know and ensuring safety and access among people. With this realization, we began to focus less on communication and more on the knowledge-based dimensions of relationships that make them useful in sharing and creating knowledge. Specifically, we interviewed 40 managers about key relationships on which they relied for information or advice. We found that four dimensions tended to be critical for a relationship to be effective, in terms of knowledge creation and use:

- Knowing what someone knows
- Gaining timely access to that person
- Creating viable knowledge through cognitive engagement
- Learning from a safe relationship.

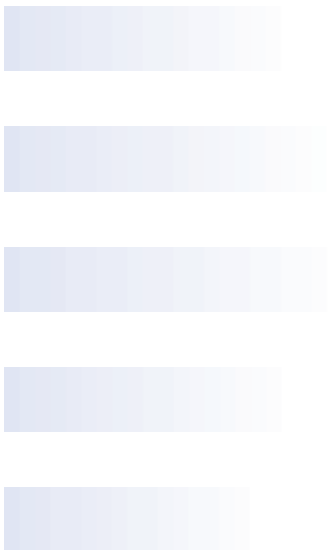
*Knowing what someone knows.* In deciding whether or not to seek out an individual for information or advice, a person must have some perception of the relevance of the other person's knowledge, skills and abilities in relation to the current problem. Although this perception might be wrong or biased by a variety of factors, it is still the basis for deciding to whom to turn for information or advice on a given problem. Thus, understanding how well members of a group know each others' knowledge skills and abilities is a first step to understanding how effective they are in terms of knowledge sharing and creation.

*Gaining timely access to that person.* Simply believing someone has relevant knowledge does not necessarily result in a contact facilitating knowledge creation. Gaining access to that person's thinking in a sufficiently timely fashion is requisite as well. To some extent, access is a product of the social fabric of an organization and influenced by power inhering in positions of formal authority or informal structure.<sup>5</sup> Access is also influenced by the physical and technical environment, as impediments to people being able to connect dramatically reduces the likelihood of their being consulted. For example, Tom Allen's work poignantly demonstrates the striking relationship between physical proximity and likelihood of collaboration in a knowledge-intensive environment.<sup>6</sup> Thus, a second dimension of importance is to assess the extent to which people have access to each other's thinking.



*Creating viable knowledge through cognitive engagement.* Of course, access alone does not ensure effective knowledge transfer or creation. One way people can distinguish themselves from a file cabinet or database in terms of knowledge transfer and creation is by actively helping other people think through problems they are trying to solve. In turning to others for information or advice, people who are willing to first understand the other person's issue and then actively shape their knowledge to the problem are more helpful in terms of knowledge creation. This often stands in stark contrast to those people who simply dump information without taking the time to actively engage in problem solving. As one manager we interviewed stated: "I have been around people who give you a quick spiel because they think they are smart and that by throwing some framework or angle up they can quickly wow you and get out of the hard work of solving a problem. Mike, for all his other responsibilities and stature is not like that. He helps you think about a problem." Thus, a third dimension of importance to assessing networks is in the extent to which people will actively engage with others in helping them solve problems.

*Learning from a safe relationship.* Finally, relationships have properties that affect the degree of learning or creativity emerging from interactions. When a person asks another person for information, they inherently become vulnerable because "help seeking implies incompetence and dependence, and therefore is related to powerlessness."<sup>7</sup> To ask for information is to give power to someone – trust that this power will not be employed against you is an important precursor to deciding to engage with someone. One's trust in another shapes the extent to which they will be forthcoming about their lack of knowledge and helps reduce defensive behaviors that can knowingly and unknowingly block learning, at both the individual and group levels.<sup>8</sup> Further, relationships characterized by a degree of safety or trust also provide room for exploration or creativity in interaction.<sup>9</sup> Relationships characterized as safe or secure improve knowledge creation by allowing room for creativity and learning. As a result, safety is a dimension of importance to analyze in investigating a network's knowledge creation and sharing potential.

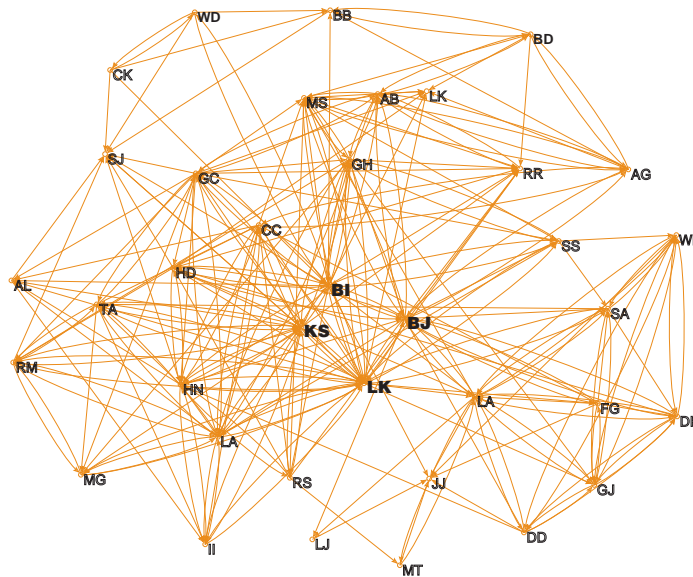


### A network view of knowledge relationships

By applying these dimensions to important groups of people within an organization, we can better analyze and intervene in critical points of knowledge creation and sharing. The four key dimensions can be viewed separately to illustrate different aspects of a network, but they can also be examined cumulatively. For example, it can be very illuminating to look at how the network of relationships changes, based on the specific relationship being mapped (that is, knowledge, access, engagement or safety). Further, it can also be instructive to analyze how the pattern of relationships changes when we multiply these relationships together. For example, IBM analyzed these four dimensions across a group of 37 Information Scientists in a large pharmaceutical firm. The objectives were to:

- Analyze their understanding of each other's knowledge, skills, and abilities to evaluate the overall cohesion of the group (see Figure 2) – the “know” network.
- Identify the central people in their network to understand which skills and knowledge are most influential in this group in terms of knowledge creation and use.
- Assess those that are not well connected in the network, because these people probably represent underutilized assets.
- Analyze the network to highlight ties between people who support all four dimensions of a knowledge sharing relationship (see Figure 3) – the Know × Access × Engage × Safety Network.

The most-central people in the “know” network were LK, BJ, KS and BI.

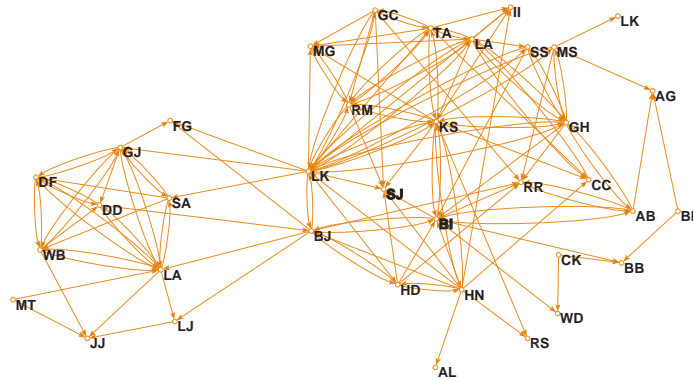


**Figure 2: Knowing what someone knows is only half the battle.**

*Source: IBM Institute for Knowledge-Based Organizations.*

The first thing to note about this network, in general, is that it is cohesive—in other words, there are no subgroups which are split off from the larger group. This is often a healthy sign in networks, because factions that have become separated from the overall network often represent untapped human resources and, in worst-case scenarios, can reflect political problems. The most-central people in the “know” network were LK, BJ, KS and BI. In contrast, there are various people around the edges of the network who have only three or four connections. These are the people who represent underutilized knowledge for this group.

Finally, when we look across all four dimensions (see Figure 3), six people (LK, BI, KS, LA, RR and SJ, in order of importance) emerged as central to this group. They were not the same group of people as we found in the “know” network analysis. LK has remained the most-influential person in the group and we have added LA, RR and SJ to this list. Now, BJ no longer remains a central member of this group, most likely because BJ was the head of the group and, due to time constraints, was not always accessible to everyone.



**Figure 3. Network as viewed across all four dimensions.**

*Source: IBM Institute for Knowledge-Based Organizations.*

It is also interesting to note that in the bottom left of Figure 3 is a subgroup of 10 people who have become almost completely separated from the main network. Without the relationship to LK and BJ, this subgroup would be largely disconnected from the main network. The existence of such a subgroup implies an inefficiency in knowledge utilization: members of the subgroup are not utilizing the expertise of the main group, and conversely. In solving problems, both groups could be drawing on a larger pool of talent.

By looking at the network with four dimensions, it is possible to determine which factor is the most common impediment to knowledge sharing (for example, is it knowing what we know, being accessible to each other, and so on?). Once this factor is identified, it is possible to target interventions in order to improve overall collaboration.

### Improving a network's capacity for knowledge creation and transfer

Social network analysis provides a set of tools and a way of representing networks that afford certain interventions not possible through standard cultural surveys or snowball interviewing techniques. For example, while culture surveys may indicate that the organizational climate does not support knowledge sharing, SNA is a more detailed analysis, specifically pointing to who shares knowledge with whom. More importantly, this increase in precision offers specific ways to influence a network's ability to create and share knowledge. The following section lists several interventions we have found helpful in promoting the collaborative ability of a network.

Social network analysis maps take on a life of their own when they represent your own relationships with your colleagues. Simply asking people to spend five minutes, either on their own or in groups of two or three, to identify what they “see” in the map, the structural issues impeding or facilitating group effectiveness, and the performance implications for the group is an extremely effective intervention.

*Linking technologies.* Although certainly not a cure all, there are various opportunities to employ distributed technologies to help connect people. Many organizations have recently begun to leverage online communities of practice and other divergent forums to allow individuals to engage relevant experts with a problem. These divergent forums allow employees to pose “Does anybody know?” kinds of questions to a group of relevant experts. Such forums are often very effective in bringing the collective intellect of a community to bear on a given problem, if an organization has found some way to reward sharing behavior. For example, at Buckman Laboratories, the National Sales Manager in Australia was scheduled to submit a bid to a major paper mill that wanted one company to supply products for both machine hygiene and alkaline fine paper. Unfortunately, the National Sales Manager had limited experience with alkaline fine paper. In order to get some assistance, the manager decided to post his question on the intranet forum. Within 48 hours, 36 detailed responses were posted from other Buckman employees around the world. The responses from the other employees allowed him to prepare a successful presentation, which ultimately awarded the bid to his company.<sup>10</sup>

However, there are often problem scenarios in knowledge-based work where there is no clearly defined question or problem – as in the beginning of a project. In these settings, individuals need to be able to contact specific others within organizations. It is in response to this need that many organizations are developing corporate “yellow pages” or skill profiles of employees. For example, at Microsoft® they have constructed a database of core competencies for all their employees within the information systems group. “The project objective is to improve the matching of employees to jobs and work teams.”<sup>11</sup>

*Multidimensionality of knowledge.* It is easy to analyze a group and find that its members are often not communicating effectively, but simply proposing that communication needs to be better does not help the group understand how to make communication more effective. By analyzing the four aspects of relationships underlying effective information flow—knowledge, access, engagement and safety (see Table 1)—we can offer precise technical and social “interventions” to improve a network’s ability to share and create knowledge, without necessarily requiring more meetings.

Aspects	Objectives	Technical interventions	Social interventions
<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Increase awareness of who knows what and who is working on what within the company</li> </ul>	<ul style="list-style-type: none"> <li>• Skill profiling system</li> <li>• Corporate yellow pages</li> </ul>	<ul style="list-style-type: none"> <li>• Communities of practice</li> <li>• Thematic help desks manned by knowledge-area specialists</li> <li>• Knowledge fairs</li> </ul>
<b>Access</b>	<ul style="list-style-type: none"> <li>• Add speed of access to knowledge sharing</li> <li>• Target accessibility as a critical behavior</li> </ul>	<ul style="list-style-type: none"> <li>• E-mail</li> <li>• Cell phones</li> </ul>	<ul style="list-style-type: none"> <li>• Peer feedback forums</li> <li>• Periodic SNA</li> </ul>
<b>Engagement</b>	<ul style="list-style-type: none"> <li>• Increase ease of interaction, add a dimension to more-conventional communication that engages people</li> <li>• Enhanced performance</li> <li>• Increased awareness of skills, abilities and knowledge of co-workers</li> </ul>	<ul style="list-style-type: none"> <li>• Synchronous technologies (such as Lotus® Sametime® or AOL Instant Messenger)</li> <li>• White boarding applications</li> <li>• Video conferencing</li> </ul>	<ul style="list-style-type: none"> <li>• Peer reviews</li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>• Allow safe relationships to develop over time</li> <li>• Increase visibility of relationships that are not safe so they can be discussed by the group</li> </ul>	<ul style="list-style-type: none"> <li>• Any form of communication technology used throughout the company</li> </ul>	<ul style="list-style-type: none"> <li>• Face-to-face interactions such as work sessions or “brown bag” lunches</li> <li>• SNA</li> </ul>

**Table 1. Multidimensionality of knowledge.**

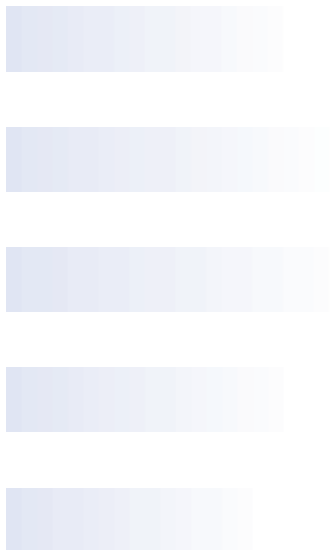
### Conclusion

A critical resource embedded within organizations is the knowledge that highly skilled workers bring to work on a day-to-day basis. However, aside from human resource policies targeted at the attraction, development and retention of skilled knowledge workers, there has been little effort put into systematic ways of leveraging knowledge that is embedded in people and relationships. Given the extent to which people rely on their own knowledge and the knowledge of their contacts to solve problems, this is a significant shortcoming. Social network analysis allows us to understand how a given network of people create and share knowledge, helping us to move beyond this approach.

By offering specific dimensions of importance on which to assess these networks, we have made the application of SNA more useful in many ways. If we only look at an advice network and find that there are not many ties existing in an important community, the bulk of our recommendations are going to entail various forms of additional meetings – not something most organizations desire. However, if we break up this network into the dimensions of knowledge, access, safety and engagement, we have a more-precise view of how to help this network.

At IBM, we would welcome the opportunity to help your business analyze, build and strengthen its social networks. Our SNA consultants can pinpoint potential bottlenecks, underutilizations, misutilizations and hindrances and suggest alternative strategies. If you would like to explore how we might put our experience and creativity to work for you, please contact us at [bva@us.ibm.com](mailto:bva@us.ibm.com). To browse through other resources for business executives, we invite you to visit:

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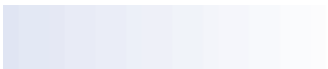
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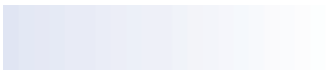
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### Footnotes

<sup>1</sup> Vaill, 1989; Handy, 1994.

<sup>2</sup> Granovetter, 1973; Burt, 1987 and 1992; Rogers, 1995; Szulanski, 1996; Shah, 1998.

<sup>3</sup> Allen, 1977.

<sup>4</sup> Names have been changed at the request of the company.

<sup>5</sup> Astley & Sachdeva, 1984; Burkhardt & Brass, 1990; Ibarra & Andrews, 1993.

<sup>6</sup> Allen, 1977.

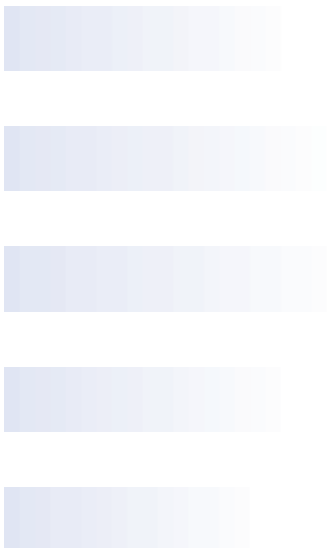
<sup>7</sup> Lee, 1997: p. 336.

<sup>8</sup> Argyris, 1982; Argyris & Schon, 1996; Edmondson, 1996.

<sup>9</sup> Amabile, 1988; Csikszentmihalyi, 1988; Woodman, Sawyer & Griffin, 1993.

<sup>10</sup> Fulmer, 1999.

<sup>11</sup> Davenport & Prusak, 1998.





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05-02  
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