Searching for Answers: Knowledge Sourcing Strategies

Maria Christina Binz-Scharf
City College of New York
mbinzscharf@ccny.cuny.edu

David Lazer
Harvard University
david_lazer@harvard.edu

ABSTRACT

It is well documented that individuals use their contacts to access the knowledge they require in order to get their job done. What is less studied is the variety of search strategies individuals follow when trying to access knowledge. For example, when do individuals turn to reference sources, such as the Internet or the library, when do they post queries en masse to a listserv, and when do they contact particular other individuals? In particular, what determines the *sequence* in which individuals access these knowledge sources? In order to address these questions, we are conducting a case study of a community of forensic scientists who are members of the state forensic DNA laboratories from around the United States. These labs are involved in analyzing crime scene evidence, typing samples from convicts, and administering the database of samples collected from casework and convicts. Because of the complexity and continuous evolution of the technology, members of the system depend on each others' experience and expertise and are constantly seeking to augment their knowledge. Preliminary analysis supports a number of propositions: (1) There is a substantial variation of knowledge sourcing strategies from individual to individual. Some individuals immediately contact peers; others will only consult references and, at most, close confidantes. (2) The sequence of knowledge sourcing is contingent on the nature of the problem as well as on an individual's personality. (3) Individuals predominantly reach outside their organization to source knowledge; either because they believe that the required knowledge is not available within the organization, or for fear of exposing themselves.

Keywords:

Communities of practice; decision making (incl. problem solving); case study

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INTRODUCTION

Workers in knowledge-intensive domains need to have constant access to other experts and to relevant reference sources. There has been ample research highlighting the role of human to human sharing of knowledge (e.g., Borgatti & Cross, 2003; Hansen, 1999, 2002). There have also been recent efforts at examining the flow of information among human and non-human sources (Carley, 2003; Krackhardt & Carley, 2003). There has been little to no research on the *sequence* with which people attempt to access knowledge from which sources. Given a menu of possibilities, in what order will people look? What are the systematic patterns across people, and what individual-level, question-level, and network-level affect the order of knowledge seeking?

This issue has become more important with the development of information and communication technologies (ICT) that have facilitated access to human and non-human sources of information and knowledge — e.g., Google facilitates access to a vast array of reference materials on the web as well as identification of individuals with expertise, e-mail facilitates focused and asynchronous questions and answers, listservers and web-based forums allow posting of questions to a large number of people.

Of course, the technology simply creates the outer bounds of what is possible — simply because it is possible for me to have spoken to someone from a distant location today does not mean that I have. There are numerous societal, institutional, individual, and situational factors that limit the use of these technologies (Fountain, 2001; Huber, 1990; Orlikowski & Yates, 1994; Zuboff, 1988). Therefore, there is a need to understand how the particular features of technologies (new and old) interplay with how people tap into different sources of knowledge, why they ask and answer questions the way they do, and where and how technology is helpful in

improving knowledge sharing. In particular, in this paper, we focus on the following fundamental question: What search strategies do individuals adopt when seeking to acquire knowledge, and what determines the sequence of their search? That is, where and how do people look for answers?

This paper is an initial conceptual exploration of these issues, supplemented by data from the early stages of a research project examining knowledge sharing among public DNA labs in the US. Below we briefly summarize the salient features of this community. Because of the exploratory and inductive nature of the paper, we then discuss our methodology, finally turning to a discussion of knowledge sourcing and sequencing in part informed by these data.

A COMMUNITY OF FORENSIC SCIENTISTS

We explore these issues by studying a particular knowledge-intensive and geographically dispersed community — that of DNA labs involved in the analysis of crime scene samples. The use of DNA in the criminal justice system has grown exponentially in the last decade (Lazer, 2004), and this growth combined with the rapidly changing technology has created a particular need for inter-organizational knowledge sharing among the approximately 170 government labs scattered across the country involved in forensic DNA analysis. The knowledge-sharing issues are particularly acute because of the decentralized nature of the US government—many of these labs have just a handful of DNA analysts. In contrast, in the UK, which has a slightly larger database than the US, forensic analysis is done by a single organization.

The knowledge-intensive nature of the work, combined with the manageable, closed universe, make this community an ideal laboratory for studying the impact of information technology on knowledge sharing in a geographically dispersed community.

Our objective is to do a case analysis of this community, and develop a theoretical framework in part based on these data. In the next section we summarize our data collection efforts.

METHODOLOGY

When the subject of inquiry is a social phenomenon for which little or no theory exists, one way to cover that ground is to inductively generate new theory (Glaser & Strauss, 1967). This approach seems particularly appropriate to understand the processes and mechanisms of knowledge sharing among DNA forensic scientists at this early stage of the inquiry. We therefore chose to conduct a qualitative study aiming at generating theory that grows out of the knowledge sharing activities occurring in the setting under inquiry (Emerson, Fretz, & Shaw, 1995).

Data Collection

We selected the respondents for this study through purposeful sampling (Yin, 1994) according to the professional roles held by members of the community. Each state government laboratory employs one individual who is responsible for the administration of the state DNA database, a system provided by the Federal Bureau of Investigation called CODIS (COmbined DNA Indexing System), bringing the size of the core community to 50 members (one per US state). This method of sampling allows for comparability between the respondents, and at the same time incorporates the range of different realities that characterize the various US state governments.

So far, we have conducted 13 semi-structured, open-ended interviews lasting between 30 minutes and two hours each with the CODIS administrators of state DNA databases. The interviews were guided by the following list of questions:

Description of work function and work environment. This set of questions is aimed at identifying organizational contingency factors such as the hierarchical relationships the respondent is embedded in and the proximity to peers within the lab;

Description of knowledge required for the job. Questions address the areas of expertise and the types of knowledge required, such as technical or legal knowledge, advice, or opinions;

Habitual knowledge sources. Description of the most commonly used knowledge sources for the identified types of required knowledge, media and venues used, and difficulties in retrieving this knowledge;

Engagement in the community. Description of behavior when approached with a question, in particular motivation to set aside time to answer questions from colleagues and peers, content of questions, reasons for answering certain questions rather than others.

Data Analysis

We transcribed and content analyzed all interviews using the qualitative research software package NUD*IST (QSR N6 [NUD*IST], 2002). Miles and Huberman (1994) point to two methods of creating codes. The first one mirrors essentially the grounded theory approach originally advocated by Glaser and Strauss (1967). The second method is to create a provisional start list of codes in the very early stages of the fieldwork (Strauss & Corbin, 1990). That list comes from the conceptual framework, list of research questions, hypotheses, problem areas and/or key variables that the researcher brings to the study. The latter method, which we have chosen to use in this study, has the advantage of bringing some structure into the coding process, as opposed to the completely unstructured (and consequently time-consuming and error-prone) process described by Glaser and Strauss.

Coding scheme. We have developed a coding scheme from the data we have gathered so far, a simplified version of which is shown in figure 1. Naturally, the scheme will be adapted as our data pool grows. We divided our initial coding into two main categories: Setting/context and activities/process. The *setting/context* category was constructed with the intention to capture accounts of the perceived reporting structure in the laboratories, e.g. whether individuals in the laboratories respect or bypass the chain of command, and what the role of the supervisor in the decision-making process is. The core subcategories of setting/context address are aspects of culture, including the general workplace climate (open or closed doors? nice colleagues?), the predominant knowledge sharing practices at the organizational level, and the sense of belonging to a group as well as the perception of boundaries ("them versus us") at the community level. The category also covers facts about the laboratory, such as size, location, workspace, and general office characteristics.

Insert Figure 1 about here

In order to examine how and where individuals search for answers, we constructed the *activities/process* category. Here we recorded the interviewees' accounts of the online, offline, and human sources they use when searching for answers, the content (technical, legal, etc.) and the type (opinion, advice, confirmation, etc.) of information sought, as well as their rationale for choosing and sequencing their sources. Furthermore, this category includes references to interaction behavior, aimed at capturing aspects such as the individual's personality, motivation and willingness to share knowledge with others, and the means of communication employed in the interaction. Finally, we coded for personal challenges relating to the search process, e.g. difficulties in accessing information, feeling left alone, insecurities, and fear of failure.

THEORETICAL FRAMEWORK

How do individuals acquire the knowledge they need to get their job done? Research on knowledge sharing shows that not all information and knowledge required to pursue an organization's goals is readily available within the organizational boundaries (Anand, Glick, & Manz, 2002; Grant, 1996; Spender & Grant, 1996). Therefore, members of an organization often rely on knowledge from external third parties (Anand et al., 2002). One popular source for tapping into external knowledge is that of online communities of professionals who share similar occupations and have experience in similar fields. In recent years, these so-called communities of practice (Brown & Duguid, 2000; Lave & Wenger, 1991; Wenger, 1998) have gained ever-increasing attention by scholars and practitioners alike. For the purpose of this paper, we refer to communities of practice in a broad sense, defining them as a set of loosely coupled relationships that serve as bridges across formal organizational boundaries. They emerge from connections practitioners establish among each other to share common practices and to support the knowledge flows within their community (Brown et al., 2000; Brown & Duguid, 2001). The actors in the community are geographically dispersed and therefore may not know each other. Their activities are monitored with the support of technology, such as community platforms or e-mail lists. Moreover, informal meetings at conferences or professional trainings enhance the knowledge sharing processes. In these — mostly self-organized — informal communities knowledge sharing is on a voluntary basis, and so is the extent of engagement in sharing activities and the amount of individual engagement.

In our study, the members of the community are geographically dispersed professionals who are each formally affiliated with a specific crime lab anywhere in the US, and who have

similar skills and occupational positions within their organizational settings. These complementary skills and techniques might contribute to a mutual feeling of being part of a community of DNA forensic scientists. Within this informal community, knowledge is shared across time, space and organizational boundaries in different forms, such as innovative techniques and interpretations based on prior experience. Even though members of this loosely coupled informal network of professionals have a lot in common, they tend to create innovative techniques and routines independently from each other, which are then shared across the formal organizational context.

The individual embeddedness of each community member affects their engagement in knowledge sharing activities within the community (Uzzi & Lancaster, 2003). [1] A highly engaged individual from our study attributes his embeddedness to the size of the community:

> *"[T]he forensics field is a very small field; there isn't really a humungous number of forensic scientists. I probably know half of them on a first-name basis, and would probably recognize the faces of almost everybody who [administers] the databases. With a small community like that information transfer really helps."*

It therefore appears that the level of engagement in the community is related to (1) an individual's pre-existing reputation (those who are known to be experts may need to guard those reputations, but then they may be allowed some "free passes"); and (2) an individual's embeddedness within the community (those individuals who anticipate that their professional future lies in this community may be reluctant to reveal ignorance).

Factors that determine the amount and quality of knowledge sharing within the community include norms (e.g., how accepting is the community of "naïve questions"), trust, and

[1] We do not necessarily refer to embeddedness in the network sense (e.g., Uzzi, 1999), but rather to a more general notion of embeddedness — i.e., the extent to which an individual is "stuck" within a community. So, an individual who has few relationships within a community, but anticipates spending their entire life there would be considered "embedded."

the obligation the community feels to answer the questions. A shared understanding of the community norms raises the commitment to the shared goals and needs of the community members and their individual perception of how they themselves are embedded within the community (Nahapiet & Ghoshal, 1998).

In the following section, we examine the knowledge sourcing strategies of community members at the individual level.

Knowledge Sourcing

In the knowledge-based view of the organization (Grant, 1996; Spender 1996), knowledge is viewed as a scarce resource, and its creation and use is what determines the competitive advantage of an organization. Knowledge is different from information in that knowledge requires interpretation in order to be acquired, which generally occurs through a learning process (Nonaka, 1994). We refer to the process of an individual's demand of - and subsequent search for - knowledge as *knowledge sourcing*, thus extending Gray and Meister's definition of the term as "the extent to which individuals intentionally access each other's expertise, experience, insights, and opinions" (Gray & Meister, 2004:821) [2] to include any source an individual might access, even if the source is not another individual.

Below, we discuss several types of knowledge sources, possible reasons for choosing them, and related search behaviors.

Types of knowledge sources. Knowledge resides in a variety of sources. As mentioned above, knowledge can reside within or outside an organization's boundaries. It can be acquired through an interaction between humans (generally through a learning process) or by processing

[2] The term knowledge sourcing is used differently by scholars in other fields. For example, students of Research & Development refer to knowledge sourcing as an effort by multinational corporations to gain access to local knowledge (e.g., Chen & Lin, 2004), and researchers in the field of decision support systems use knowledge sourcing to describe heuristics performed by software agents (E.g., Vahidov & Kersten, 2004).

data and facts from non-human sources; for example, by looking up references or doing a Google search. Finally, knowledge can be shared through a variety of media, which can be classified into two major types: (1) Online media, such as the Internet, listservers, and e-mail; and (2) offline media, such as print publications and face-to-face communication. Each of these sources of knowledge has different implications for interaction, and the choice of each source is conditioned by individual considerations (see table 1). For example, print publications could be preferred to e-mail or phone calls when an individual wishes to remain anonymous; a listserver or e-mail might be chosen for reasons of convenience in that these media do not require the synchronous presence of another person to answer a question.

Insert Table 1 about here

As for the process of knowledge sourcing, Gray and Meister (2004) suggest classifying knowledge sourcing by the number of actors involved, namely one-to-one, one-to-many, or many-to-many. They distinguish between *dyadic knowledge sourcing*, which refers to a single knowledge seeker engaging in dialogue with an individual source, *published knowledge sourcing*, where many knowledge seekers can benefit from the codification of the knowledge of one source, and *group knowledge sourcing*, which involves knowledge exchange in a setting containing multiple individuals (Gray & Meister, 2004).

Human versus non-human sources. One potential obstacle to seeking information from human sources is that the query itself poses a potential reputational challenge to the poster because it reveals ignorance or might make the impression of exploiting the community's

knowledge instead of investing one's own time first. Thus, for example, one interviewee highlighted their thorough use of non-human sources so as to not reveal her ignorance:[3]

> *"I'd probably go online. I would also read papers, and then if I didn't necessarily find what I was looking for I think probably at that point if I were able to connect with people at meetings, I would just come out and say, 'Gee I'm having a problem with such and such. Can you help me with it?'"*

Another potential downside of seeking knowledge from human sources is given by the reciprocal commitments such a request might entail, where an answered question might require actions that are more costly in the future than the costs of simply looking up some reference sources in the present.

Human versus human sources. There is ample research that indicates that a variety of dyadic factors affect the probability that one person will seek information from another, including strength of ties (Granovetter, 1973; Hansen, 1999), and similarity (McPherson, Smith-Lovin, & Cook, 2001). Research shows that individuals tend to ask friends and experts for advice (see Granovetter, 1973; Krackhardt & Hanson, 1993; Nelson, Bloomfield, Hales, & Libby, 2001), and professionals rely on their communities of peers when it comes to specialized knowledge (Cross, Parker, Prusak, & Borgatti, 2001; Orlikowski, 2002), where reputation for expertise plays a part in the choice, as exemplified in this account:

> *"[I] rely on places that are very good at researching what is in the community or in the business world. The Royal Canadian Mounted Police are wonderful. Before they implement something they check the computer industry, all these different industries before they make a decision. So I rely – I've got a relationship with them that I enjoy. And I call them and ask, 'Have you heard of anything like this?'"*

In general, the choice of a source over another is determined by prior knowledge, where the perceived credibility, or trustworthiness of a source is the strongest predictor for choosing it

[3] We would note that anonymity (although atypical) can also be created in human to human interactions—e.g., through anonymous postings.

(Kerstetter & Cho, 2004). Applied to the choice among human sources, individuals will likely seek the advice of somebody with an established reputation in the field of knowledge sought.

Synchronous versus asynchronous sources. In seminal research on information sharing over e-mail, Sproull and Kiesler (1986) found that much of the information conveyed through e-mail was information that would not have been conveyed through another medium, due to status equalization and uninhibited behavior. In particular, asynchronous communication offers major advantages with respect to costs to both the sender (it can be sent any time) and the receiver (it can be replied to when convenient). As one individual stated during the pilot study:

> *"Obviously it depends a little bit on what kind of question it is. A lot of times though I've got to tell you that the [listserver] thing is just the fastest. It takes no time at all and you've sent it to a couple of hundred people."*

Asynchronous communication allows, at low cost, rapid access to the knowledge of many people. From a social communication point of view, e-mail thus does not simply speed up the exchange of information but leads to the exchange of new information as well.

Interactions with type of knowledge sought. The search strategy will in part be contingent on the type of knowledge sought. For example, McGrath (2001) highlights how particular searches are contingent on what is being searched for. The search strategy can also determine what the knowledge seeker will learn as a result of the search (Vandenbosch & Higgins, 1996). Students in the library sciences have analyzed the patterns of how professionals search for information. They found that the behavior of knowledge seekers is determined by the professionals' work roles, associated tasks, and the characteristics of information needs; and that awareness, sources, and outcomes affect information seeking (Ellis & Haugan, 1997; Leckie, Pettigrew, & Sylvain, 1996). One respondent in our study stated,

> *"Sometimes I'll call or sometimes I'll email, like I had a hit with [a state] that I needed to have verified, so I just emailed [the CODIS administrator of that state], because I didn't, I mean it wasn't anything that was worth a phone call*

over. But if we have technical questions we use each other as resources for those."

This suggests that there is not going to be a single strategy for knowledge sourcing, but that the strategy will be deeply contingent on what questions the individual has.

Knowledge sequencing. There has been little examination of the sequencing of source choices: e.g., why do some individuals in a particular situation spend days searching for references to answer a question on their own, while someone else posts a question to a listserver, and yet another person with another question calls someone they know for the answer? The choice of the first source individuals turn to could be an indicator for related factors such as personality, self-consciousness, or ease of access. Furthermore, the choice of the first source might be related to a positive experience with this source (Gavetti & Levinthal, 2000), therefore pushing the knowledge seeker to start his/her search there again next time a similar question arises. Vandenbosch and Higgins (1996) propose that learning through information acquisition is influenced by an individual's mental model. It could thus be assumed that an individual's mental model also influences the sequencing of source choices.

DISCUSSION

This is, of course, very much work in progress. However, we believe that it points the way to analyses that will have great practical importance. There is a systemic imperative that individuals find the information they need, and at low cost to the individual and the system. There is no reason to expect that the systemic rules will naturally yield anything approaching something that is functional. For example, as others have found (??), individuals will more likely seek answers from those with whom they are friends than those who are competent. Further, the fear of revealing ignorance has the potential for discouraging human to human

knowledge seeking when it would be (systemically) welfare increasing. The individual above that indicates that they would virtually exhaust non-human sources before they sought information from a human source may well be spending days to solve a problem that an expert could solve for her in minutes. Even assuming the expert's time is much more valuable than hers, this is probably a poor use of resources. The prescriptive question then becomes how to manipulate the systemic rules so that such mis-allocations of resources do not occur?

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TABLE 1

Classification of Knowledge Sources

Source	Interaction features	Considerations for choice
Search engines	• anonymous	• Quality control through linking process
Professional websites	• anonymous	• Established practice • Helpful for directed search
Listserver	• one-to-many • asynchronous	• Fast answers because of large n • Prestige vs. embarrassment
E-mail	• one-to-one • asynchronous	• Pre-existing relationship important • Easy to evade
Print publications	• anonymous	• Peer-reviewed • Relatively hard to search
Phone	• one-to-one • synchronous	• Pre-existing relationship important • Relatively easy to evade
Face-to-face	• one-to-one • synchronous	• Pre-existing relationship important • Very difficult to evade

FIGURE 1

Simplified Coding Scheme