Workplace Connectors as Facilitators for Work

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1. Introduction

Through a wide range of information technologies information workers are continuing to expand their circle of contacts. In tandem, research is also focusing more and more on the role that both face-to-face and distributed interactions play in accomplishing work. Though some empirical studies have illustrated the importance of informal interaction and networks in establishing collaborations (e.g. Nardi et al., 2002; Whittaker, Isaacs, et al., 1997), there is still a need for more *in situ* research to understand how different types of interactions support group work.

Various constructs have been used to characterize different types of workplace interactions. Over the last decade much attention has been directed to the notion of community of practice (Brown & Duguid, 1991; Wenger, 1998; Wenger et al., 2002) which explains how people are part of a professional community and slowly become acculturated into a specific work practice or profession. Wenger applied the concept to explain how claims processors learn from each other, moving inwards to the core of the community where seasoned veterans of the organization are situated.

Aside from communities of practice (CoPs), other social constructs have been used as well (e.g., networks, knots, coalitions and teams) that attempt to explain how and why people interact—see Nardi et al.'s (2002) work for a review. Indeed, many of these concepts overlap, and it is difficult sometimes to discern what sets one apart from another. As a case in point, Nardi et al. describe the difficulties in discerning between knots, ephemeral collections of people and artifacts and their own theory of *intensional* social networks. Moreover, theories are often promulgated as being flexible enough to account for newer phenomenon, further occluding

Presented at the 3rd International Conference on Communities and Technologies, Michigan State University, East Lansing, Michigan, June 28-30, 2007

Published in Steinfield, Pentland, Ackerman, and Contractor (eds.), Communities and Technologies 2007: Proceedings of the Third Communities and Technologies Conference, Michigan State University, 2007, London: Springer, 131-150.

perceived benefits of one theory over another. For example, while CoPs was originally presented as an alternative to the traditional teacher-student model of learning (Lave & Wenger, 1991), it has been expanded considerably as a model for virtual as well as cross-organizational learning (Wenger et al., 2002).

Recognizing that socially grounded work can occur in many forms, we are interested in understanding what types of contexts exist in the workplace that lead people to form multiple forms of social interaction. For example, an individual might regularly interact with others face-to-face in the same collocated business unit. As members of the same department, they may share a common identity and provide mutual support. Other types of relationships in the workplace may be associated with other social properties that are shared among the interactants. For example, at the same workplace one can interact with others in the same organization who are in different business units. Social networks may be formed with others outside of the company. One may also be a member of more formalized communities in the workplace, such as CoPs where shared goals are important. Similarly, one's private life communities consisting of friends and family may also be a part of the workplace. Perlow (1998) has written about how the borders of work life and home life are often blurred. We maintain that these various types of workplace relationships offer different functions for people and have different salient social properties that influence work.

Membership in various types of social arrangements involves maintenance work. Communities not only provide support to its members but people also must contribute to the community to insure its continuation and their status as members (McMillan & Chavis, 1986). Interacting and maintaining membership in multiple types of social structures in the workplace therefore involves work that is above and beyond the visible work of producing identifiable and measurable task results.

2. Moving beyond communities of practice in the workplace

The notion of formal CoPs has gained much attention in recent years. The increasing popularization of knowledge management and organizational sciences in general has fostered a movement towards cross-organizational sharing. Through explicit procedures and policies, companies seek to nurture an environment conducive to knowledge sharing in order to reduce redundancy and the loss of so-called *tacit knowledge* (Nonaka & Takeuchi,

1996) when employees leave a corporation. A popular way of implementing such a strategy is through the sponsorship of formal communities of practice. Various works in literature are specifically aimed at teaching one how to create and integrate these communities in the organizational (Wenger et al., 2002) and technological levels (Kim, 2000) of workplaces.

Indeed, the view now that knowledge management techniques will improve an organization is indicative of an overall trend to reconcile rational and natural perspectives of organizational strategies (Scott, 1998). The rational perspective emphasizes the formalized structures put in place through processes and procedures. On the other hand, the natural perspective emphasizes the informal nature of relationships that inevitably arise due to multiple motivations. The notion of formal communities attempts to impose rationality to a usually natural phenomenon. The hope is that formal policies will bring about increased informal interactions with a more focused lens toward achieving the organization's goals.

However, formal CoPs is just one type of social arrangement in the workplace. Through ethnographic investigations and grounded theory (Strauss & Corbin, 1990), we have shifted our focus of understanding work from a perspective of CoPs to rather a more basic starting point of investigating the different kinds of contexts that lead social arrangements to form. We believe that by understanding better the commonalities or affinities that facilitate the creation of these different social structures, we can better learn how people accomplish everyday work.

We have elected to term these commonalities *connectors*. We believe connectors, defined by the Oxford American Dictionary as something *that links two or more things together,* nicely conveys the notion of the shared contextual experience that serves as a basis for linking people together into a social configuration. These connectors are what drive, in both overtly intentional and subtle ways, workers to form social arrangements such as formal CoPs, informal communities, or social networks. We intend for this paper to be a first step in identifying the types of connectors that exist to bind people together in the workplace.

The initial impetus of our study was to investigate the community work lives of people in a high-tech corporation. The company is currently in the process of advocating and rolling out formal communities. We discovered though that we had the opportunity to compare workers' participation in these formal communities with other types of social interactions. Our interest was in discovering what current types of contexts exist in the company to connect people and the role each type of social structure plays for the employee. Our larger research interest is in understanding how

these various social structures in the workplace facilitate people in accomplishing their day-to-day work.

The purpose of our paper is twofold. First, our goal is through ethnographic observations to identify the different types of connectors, or common contexts that link people together, that exist in the workplace. Our second goal is to investigate the extent to which people switch among these different social entities throughout the workday. We are interested in people's patterns of social engagement and how they distribute their time among these different social entities. González and Mark (2004) found that people's workday consists of continually switching between projects. We also expect that people continually switch among different social structures. If so, we expect that people must invest effort in managing these different social arrangements, such as maintaining identity or influencing the community.

3. The Field Site

Our field site is a large corporation, Lovelace Corporation[1], headquartered on the U.S. west coast with offices also distributed across the U.S. The corporation serves in an advisory role by providing expertise on scientific and technical issues for its customers.

Our data collection methods follow the ethnographic tradition. Our goal was to get a snapshot of a person's daily work life. To capture this egocentric viewpoint, it necessitates that one becomes fully entrenched in the informant's own cultural setting. Furthermore, discerning "social activity" itself is a difficult task in that the boundaries between social structures are not clearly defined. Formal communities in the modern organization have been aggressively advocated by knowledge management practitioners through activities in various forms called CoPs, communities of interest, topic groups or committees. While these communities may be easier to delineate as they are organizationally specified, informal communities or other kinds of social arrangements that every worker has nurtured are an important part of work life that can only be seen by stepping in their shoes. As such, we felt that diary studies or surveys would be ill suited for a deep analysis of interaction in the workplace.

Observations were conducted through a *shadowing* method. Shadowing is an intense form of observation in which the researcher observes and follows the informant whenever possible. The researcher carried a notepad

[1] A pseudonym.

and would record and timestamp the informant's activities. As much as possible, the researcher would sit directly behind the informant to fully observe the informant's focus of attention, e.g. a computer screen or papers on the desk. The key data points that were recorded were an activity's start/end times, artifacts utilized (e.g., PDA, cell phone or stationary), person(s) (if any) interacted with, goal of the activity and relevant quotes. We made it clear that the informant could at anytime ask the researcher to temporarily leave to return at a later time, or ask the researcher to stop taking notes whenever they felt uncomfortable with a certain event being recorded. The researcher remained as unobtrusive as possible, and informants were asked to act as they normally would. Whenever something unclear would arise during the shadowing sessions, the observer would typically reserve questions until the end of the day.

In total, ten informants were recruited and shadowed, resulting in approximately 290 hours of recorded shadowing sessions. Informants were recruited by email from an initial pool suggested by our contact at Lovelace. We then used a snowball sampling technique to recruit other potential informants. Lovelace also has an internal directory service which was used to find and contact potential subjects. After an email contact, the researcher spent 15 minutes in a face-to-face conversation detailing the goals and methods of the study. An initial half day shadowing session was done so that the informant would get used to having a shadow, and so that the observer would get acclimated to the informant's environment. At the end of this half-day, an interview was conducted to ascertain what regular interactions they participated in. This half-day was then followed by three full days of observations; the observer would meet the informant as he or she came into work and end the session once their work day was over.

Studies in "identifying" communities in the workplace have taken different approaches. Andriessen (2005) uncovers several "archetypes" of knowledge communities by scrutinizing nine case studies of organizations. From his analysis, key dimensions were realized and then applied to the case studies. This method is advantageous in that it compares a wide range of different organizational settings; however, it is a study which relies solely on third-hand accounts of organizational behavior. We believe a study that seeks to uncover types of communities or social arrangements in the workplace needs a deep, ethnographic inquiry into an organization's culture. Quan-Haase and Wellman (2005) take an approach similar to ours in that they do observations of an employee for one full workday. However, their focus was on how the availability of instant interaction technologies has shaped trust in communities. Moreover, understanding the social structures that a person experiences necessitates an

understanding of that worker's work life. We therefore felt one day would not be enough to get fully acclimated to each informant's particular working habits and environments.

Our technique closely follows that of other researchers who have used this shadowing and measuring technique to identify employees' different activities in the workplace (González & Mark, 2004; Mark & González, 2005; Perlow, 1999; Sproull, 1984). However, in contrast, our data collection methods are more geared towards collecting both the specific intent as well as the participants of an activity.

4. Coding Interactions

Our next challenge was to develop a coding scheme that could characterize the connectors that led to the informants' social arrangements. We used the technique of grounded theory (Strauss & Corbin, 1990) where we derived conceptual categories for the distinguishable activities carried about by the informant. Based on this, and guided by the notion of mutual influence of McMillan and Chavis (1986), we developed a coding scheme to identify different social structures that the individual is involved in.

Social structures in the workplace influence the worker in various ways. They can be viewed as a medium through which one conducts work. Work at Lovelace is not performed within a vacuum, but as researchers in the field of social studies of science elaborate for scientific work (Callon, 1996), work is conducted within a social medium. If an information worker is, for example, designing a new project plan for their business unit, they are working within a social medium surrounded by others in their business unit who may have given input to this plan and who will be affected by this plan. Working with the knowledge that they are within a social medium can have either positive or negative motivational consequences. For example, a positive atmosphere in an open office environment where people chat and share humor through their cubicle walls can motivate people to work hard. Conversely, a negative atmosphere can de-motivate people. As a medium, communities, or more broadly any social structures, facilitate work (positive or negative). For example, an informal community of business managers might facilitate decision-making for a member who faces a similar problem that had previously been discussed in the group.

When coding for social structure, we insisted that there be at least two people involved. The involvement may be face-to-face, or technology mediated (e.g. instant messaging or email). In this sense, the notion of a

social structure as a medium is analogous to Wenger's (1998) concept of community participation: *I will not say that a computer "participates" in a community of practice, even though it may be part of that practice and play an active role in getting certain things done...In this regard, what I take to characterize participation is the possibility of mutual recognition.* This type of coding is in contrast to actor network theory (Callon, 1996; Latour, 1992) in that working with artifacts (e.g., receiving events from artifacts or inputting information into artifacts) does not, from the informant's point of view, constitute interaction with a community.

The motivation for following this scheme is that associating an artifact with a community or social structure is problematic. While specialized artifacts such as departmental forms or laboratories can be seen as belonging to a specific community (or communities), artifacts are multifaceted in that they cross boundaries (Star & Griesemer, 1989). Community work from an "artifact's perspective" is highly contextual.

Our coding scheme seeks to capture the notion of a social structure as an entity that is facilitating work. This facilitation allows one to accomplish their work while at the same time reinforcing and reaffirming a person's own *membership* in a particular social structure (Dourish & Button, 1998).

5. Criteria for Community Membership

To identify different social structures we turned to social properties associated with communities because we believed that these properties are general ones that could apply to a range of formal and informal types of social structures. The problem of defining community is one that has been revisited many times. Psychologists McMillan and Chavis (1986) defined and operationalized *sense of community* (SOC). Since then, various measures (predominantly through survey instruments) of SOC have been employed (Chavis et al., 1986; MacQueen et al., 2001). In IT-related fields such as CSCW and HCI, research on online and virtual communities has also defined communities within the backdrop of IT (Preece, 2000; Roberts, 1998; Whittaker, Swanson, et al., 1997) Many of these definitions in fact overlap (e.g. common ground and support appear in one form or the other with most definitions). Using these community definitions as a springboard, we have refined the dimensions which define social structures to be applicable to the workplace as follows:

Shared Goal. Does the informant share with other members a common goal, interest, need or activity members that provides the primary reason for belonging to the social arrangement?

Reputation. How much do the perceptions and opinions of other members matter to the informant?

Common Ground. Does the informant have implicitly and explicitly shared experiences, behaviors and discourse with the other members?

Identity. Does the informant place importance on being identified or associated with this social group?

Support. Does the informant feel that the social arrangement provides support such as help or advice from others? For example, sharing expertise or information is a type of valued support.

Influence. Does the informant feel that his or her opinion matters? Does the informant have the ability to influence or shape his or her group or community? For example, can one improve the community?

In our coding scheme, we considered that these six dimensions must be present for an informant to be considered a participant of a particular social structure. In going through all the recorded activities, we asked these questions as a litmus test to determine whether the activity was involved with a unique social entity. It is important to note here that this litmus test is something that only someone who has become familiar with an informant's particular interaction patterns and environment would be able to meaningfully answer. By becoming ingrained in the corporate environment of Lovelace, the ethnographer becomes an "expert" of a culture and the informant's work life. Only then can the observer readily glean of which communities an informant is actually a member.

6. Results

We discovered that people were continually switching interactions between various social entities throughout the workday. In this section we will explain the types of connectors that linked people together as well as the extent to which people switched interactions.

6.1 Connectors in the Workplace

We found that connectors (commonalities) among people in these different social groups could be characterized and could serve to delineate different social entities. In general, connectors could be *organizationally determined,* based on organizational boundaries, *formal,* where links among people were formally determined by the organization, and *informal,* where links were formed in a bottom-up approach. Specifically, we

identified the following and describe what their function was for the informants. Table 1 summarizes the informants we shadowed, with the total percent time of interactions with each type of connector, described below.

Table 1. Percentage of time informants spent in each connector type

Job Position	Work Home	Company	Common Workrole	Social	Private	Professional	Formal CoP	Other	Unknown
Library Man.	49.52	26.55	0.16	--	3.28	2.39	12.89	3.39	1.81
General Man.	48.36	28.51	6.56	2.69	2.00	--	--	0.83	11.05
Sr. Proj. Lead.	50.47	8.54	--	0.39	0.93	--	38.86	0.23	0.59
Business Assoc	54.76	29.62	1.10	0.10	6.81	--	--	2.00	5.60
Business Man.	38.75	16.98	34.92	--	3.64	--	1.44	1.16	3.13
Scientist	53.62	32.24	0.95	--	8.08	1.91	--	2.12	1.09
Semi-retired Eng.	74.28	16.94	0.35	--	0.41	--	0.49	7.4	0.13
Eng. Intern	47.58	1.00	28.83	--	18.54	--	--	3.7	0.34
Proj. Lead.	38.68	8.51	--	0.83	11.16	--	37.50	0.37	2.95
KM Staff	27.19	27.61	--	--	14.62	--	28.65	--	1.93

Work Home Connectors. These are organizationally determined linkages and exist within a person's business unit. Though membership in such communities has an external criterion for belonging (e.g. as a member of the Alpha department), social properties may be important to different degrees with others in one's business unit. For example, the semi-retired engineer who spent 74.28% of his interactions in the work home was *the* expert of a specialized software tool. This was valuable only to a specific subset of the engineer's department. Work home is a hotbed of informal interactions because of the close physical proximity of its members.

Work home connectors facilitate a strong sense of identity for its members. For example, upon first meeting people, informants would often exchange business cards. The first things informants noted was what department others were in. Many people have a preconceived notion of how certain departments work and their own "tricks of the trade" to interact effectively with those departments. Thus, there is a strong association of a particular department with work features and with identity.

Company Connectors. The second most common type of connector was the entire organization. As with the work home, this type of connector creates social entities that are organizationally determined (its borders define who belongs). People experience a shared identity as employees of Lovelace; since Lovelace's "product" is in providing first-class expert advice, reputation is especially important to maintain company-wide. People with primarily service-oriented work roles (benefiting members inside Lovelace) tended to spend the most time through these company connectors. Librarians often interact with a select "set" of clients company

wide (26.55% of their interactions) established over time (some people always prefer a certain librarian when asking for assistance).

Interaction is often conducted remotely. One problem we encountered was that interactions with different departments often brought to light different standards and conventions (Mark, 2002). The business manager, who spent nearly 17% of his interactions in company-wide interactions, was responsible for people on the east and west coast. Each coast interpreted field names on common forms differently. Sometimes only one coast was aware of a certain company-wide policy and did their paperwork incorrectly until the other coast pointed it out. Company connectors are especially necessary for those in managerial positions—certain roles "envelope" a larger range of communities. The general manager spends 28.51% in interactions with his subdivisions, whereas a scientist is primarily only responsible in his or her subdivision. Furthermore, junior employees such as the engineering intern are just in the nascent stages of forming company connectors (1% of their interactions).

Formal Community Connectors. These are connectors that have been formally created and sponsored by the company through its knowledge management division. This includes formal CoPs initiated by the company with the intent of encouraging cross-departmental knowledge sharing. Formal communities are still in the incipient stages in the company. The most obvious indicator of Lovelace's push for communities is its advocacy of a content management system to support them, CM[2]. CM is intended to be a comprehensive solution for the corporation's collaborative storage needs. In addition to replacing shared drives, it supports discussion forums and meeting management utilities. By creating a standard "template" folder structure for communities, the knowledge management staff hopes to encourage people to form communities that utilize CM.

While the knowledge management staff, project leader and librarian play a large role in maintaining and advocating the use of formal community tools and policies, those who have not been explicitly "chosen" as champions for formal communities did not use the content management system as rigorously. One issue was that CM's initial roll-out faced technical problems and was subsequently viewed as unstable. The association of CM with CoPs may have turned people away from the very organizational policies meant to encourage knowledge sharing. Another issue is in the formal community's legitimacy. People are unsure whether they can properly "bill" their managers for time spent doing community work, as Lotus adopters faced in Orlikowki's (1992) study. Recent stability improvements and explicit announcements from upper

[2] A pseudonym.

management has lessened the initial bad impression people had of the system. Our results thus seem to confirm Alatta's (2003) conjecture that grouping employees by their informal communication networks leads to something more akin to CoPs, rather than the formalized communities that Lovelace sponsors. The informants were skeptical of artificially created connectors that do not conform to a natural process of social production.

Professional Connectors. Communities and networks formed by these informal connectors allow members to develop, enhance or share professional skills. For example, one community helps foster unix-like tools within the organization. This allows members to use alternative open source email clients or calendaring systems. The librarian spends only 2.39% of interactions in the Librarian Association, yet identifies with it, receives support, influences other users, is concerned with maintaining her reputation, and has common ground with other librarians in the field.

The informants' goals for participating in these communities are to increase their "worth" to the organization and also expand their job opportunities. Being part of a professional community is especially important for those whose reputation is defined by their professional "clout." For example, the scientist spent only 1.91% of interactions with professional organizations but did so to keep on the forefront of the latest research news and activities.

Social Connectors. These are informal connectors within the company that emphasize social interaction, often around a common hobby or belief. Examples of connectors of Lovelace employees include a company drama club and scrapbook club. Members of these communities span the company; and the primary activity is sharing a social experience.

Within the company, social connectors provide a way for employees to expand their social networks. Religious organizations were also examples of social communities at Lovelace. The project leader shadowed often commented on how a person with who he just interacted was part of a religious organization, or part of a certain social group. Belonging to social communities sponsored by the company enables people to acquire a legitimacy to speak with people they normally would not. Furthermore, people utilize social connections gained from these social communities to accomplish their work. For example, the project leader drew on people she knew from her scrapbook club to help her accomplish tasks meant for her home unit. Social communities can also allow one to "jump" levels in the hierarchy, asking advice from a senior executive with whom many others might normally be hesitant.

Less organized forms of social connectors took the form of baseball simulations, pitting virtual teams' stats against each other. While high up

in the ladder, a general manager maintained ties to the people in different departments with who he had long ago started the virtual baseball league.

Private Connectors. These are informal linkages with people outside the company such as family and friends. Wenger (1998) described identity as an innate part of a worker that cannot be simply turned off or on: they certainly do not cease to be parents because they are at work. At times people talked about their kids at Lovelace; and more generally, the tidbits of conversation they interweave with their exchanges of work-related information continually reflect their participation in other practices. Indeed, while private connector interaction constitutes a relatively small percentage compared to other social groups, activities where the private community is the main topic do exist. For instance, the scientist at Lovelace always made sure to call her husband once she arrived at work. The project leader mentioned after a particularly long day that she "missed her husband," and called him (11.16% of her interactions were private).

However, another important portion of private social groups is in simply enabling people to get personal tasks done during the work day. The business manager (3.64%) made use of his little free time to call the mechanic to check up on his wife's car in the shop. He performed an action for someone who was a member in his private community: his wife. Similarly, after a particularly long period of debugging, the Senior Project Leader called his wife.

Interaction with private connectors was often done through alternative media. For example, private email was usually done through webmail. Phone calls were often done through the informant's cell phone. The intern (18.54% of the time) made extensive use of instant messaging with friends and family. This separation of company and private media perhaps allows people to more easily manage their communities and keep them from overtly intersecting each other. Thus, personal communities constitute an important component of work life by enabling people to maintain their personal identity while in the workplace. It is interesting to note that *everyone* had private communities that they tapped into during work days.

Common Work Role Connectors. These connectors bind people together through employees' common work role or rank within the organization. Common work role groups provide an important way to share knowledge and common experience related to the work role. For instance, the business manager met with other managers in the same building (34.92% of the time) regularly since they were intimate with the facility issues in the building. Employees of the same rank share a common skill set and experience and many experienced the same career ladder path. The engineering intern consulted with other engineering interns 28.83% of the

time, even if they were from different disciplines. The scientist lamented that she was isolated from the rest of the engineers while sitting at her computer. As a result, she would walk over to a building at least once a week where there were engineers and sit down at an empty desk there. Though she did not explicitly set up appointments, she knew that the *chances* of encountering fellow engineers there was greater. Should an idea pop up, it would be trivial to walk to the next door to speak with individuals who share her work role (she did 0.95% of the time). Common work roles are an important vehicle for sharing specialized knowledge.

Thus, throughout the workday, people quickly tap into an arsenal of connectors to get work done in social settings. Connectors allow us to examine what different commonalities spur people to interact with various communities, networks or groups whose membership often overlap.

6.2 Switching Interactions in the Workplace

Once we identified different types of connectors we next turned to analyzing how often people switched interaction contexts based on timing activities in observations. Table 2 lists average times spent *per interaction* in the cells for different social arrangements throughout the workday. For example, the F2F/Work Home cell refers to the average time a face-to-face interaction lasted with people linked through their work home.

If we do not count time spent in formal meetings (since meeting length is usually beyond the informants' control) then we found that the informants averaged about a quarter of their day (1 hr. 52 min.) interacting in various social arrangements. However, the average time for each interaction is quite fleeting (1 min. 56 sec. on average). The results confirm our expectation that people rapidly switch interactions.

We found that people spent the majority of time in interactions with people related by their work home connectors (about 34% of their non-formal "meeting" interactions). This result highlights the importance of the influence that the work home has on the individual, and correspondingly, the influence that the individual contributes to their work home. Company connectors take up 11% of non-formal meeting interactions. A small proportion of non-formal meeting interactions occurs through formal connectors (about 6%). However, most of this time can be attributed to people whose work roles officially promote formal CoPs as opposed to workers intended to benefit from such communities (e.g. see the business manager and engineer in Table 1).

Table 2. Connectors & Interaction Type: Avg. Time/Interaction (h:m:s) (sd)

Interaction Type	Work Home	Company	Common Workrole	Social	Private	Professional
F2F[1]	0:02:36 (0:06:03)	0:02:43 (0:05:26)	0:03:10 (0:04:44)	0:01:00 (0:00:50)	0:01:11 (0:00:35)	—
Email	0:01:12 (0:01:43)	0:00:59 (0:01:23)	0:01:19 (0:02:10)	0:00:36 (0:00:38)	0:01:22 (0:02:22)	0:01:26 (0:00:59)
IM	0:00:30 (0:00:31)	0:02:44 (0:03:40)	0:00:41 (0:00:46)	—	0:00:48 (0:01:04)	—
Meeting	0:31:36 (0:24:35)	0:28:31 (0:35:20)	0:28:20 (0:37:15)	0:27:35 (0:00:00)	01:28:03 (00:22:00)	—
Paper[2]	0:01:32 (0:01:40)	0:01:28 (0:01:33)	—	—	00:01:05 (0:01:45)	0:01:06 (0:00:24)
Phone[3]	0:02:46 (0:03:47)	0:02:30 (0:03:20)	0:04:09 (0:03:09)	0:02:44 (0:01:58)	0:02:42 (0:02:18)	—
CM	0:02:02 (0:02:47)	0:03:44 (0:04:57)	—	—	—	—
All types but "Meeting"	0:02:05 (0:04:36)	0:01:40 (0:03:05)	0:02:09 (0:03:27)	0:1:06 (0:01:15)	0:01:52 (0:02:15)	0:01:25 (0:00:57)
% all interactions	**33.9**	**10.74**	**2.52**	**0.28**	**3.98**	**0.44**
All media	0:02:50 (0:07:30)	0:03:02 (0:10:16)	0:04:54 (0:14:31)	0:02:15 (0:05:39)	0:02:47 (0:09:18)	0:01:25 (0:00:57)
% all interactions	**46.95**	**20.55**	**6.42**	**0.60**	**6.00**	**0.44**

[1] In contrast to meetings, face-to-face interactions are not planned in advance.

[2] Paper based media that include faxes, "where-you-were-out" notes and internal postal mail.

[3] Includes cell phones as well as PDAs will cell phone functionality.

Interaction Type	Formal CoP	Other[4]	Unknown[5]	Avg. time/ interaction	Avg. time/day[6]	% all interactions
F2F	0:04:47 (0:14:51)	0:04:16 (0:03:56)	0:01:31 (0:02:20)	**0:02:41 (0:06:32)**	**0:52:27 (0:45:01)**	**28.40**
Email	0:00:47 (0:00:54)	0:01:23 (0:01:52)	0:00:57 (0:01:23)	**0:01:06 (0:01:35)**	**0:25:00 (0:28:19)**	**13.98**
IM	0:00:41 (0:00:47)	—	0:00:05 (0:00:00)	**0:00:48 (0:01:12)**	**0:01:20 (0:04:03)**	**0.74**
Meeting	0:41:27 (0:16:49)	—	1:43:02 (0:00:00)	**0:33:47 (0:30:25)**	**1:10:33 (1:26:45)**	**38.35**
Paper	—	0:00:57 (0:00:15)	0:00:18 (0:00:21)	**0:01:27 (0:01:35)**	**0:02:55 (0:06:51)**	**1.60**
Phone	0:01:54 (0:02:10)	0:03:40 (0:02:48)	0:02:45 (0:03:52)	**0:02:39 (0:03:15)**	**0:25:36 (0:28:35)**	**14.11**
CM	0:02:10 (0:02:28)	—	0:00:25 (0:00:31)	**0:02:10 (0:02:52)**	**0:05:08 (0:14:08)**	**2.82**
All types but "Meeting"	0:01:53 (0:06:30)	0:02:01 (0:02:29)	0:01:33 (0:02:34)	**0:01:56 (0:04:14)**	**1:52:29 (1:33:15)**	**61.65**
% all interactions	**5.68**	**1.67**	**2.44**			
All media	0:04:19 (0:12:05)	0:02:01 (0:02:29)	0:02:17 (0:09:00)	**0:03:02 (0:09:06)**	**3:03:03 (2:29:44)**	**100**
% all interactions	**13.76**	**1.67**	**3.62**			

[4] Interactions with identifiable people, but did not meet our criteria for connector coding.

[5] Interactions with unidentifiable people, either due to researcher error or the informant's wish.

[6] Average disregards connectors that have no interactions through a certain media (marked by "—").

Though a small proportion of work time, both common work role and private connectors constitute an important portion of the workday. Interestingly, more time is spent on private connectors that often go beyond company boundaries, rather than on social connectors that tend to stay within the corporation. This may point to the fact that while people see social activities as best left for non-work hours, private lives are an integral part that cannot be separated from work lives.

Looking at the interaction types, we see that aside from meetings, face to face interactions make up a significant percentage of interactions (28.40%). Though the proportion of the day spent on email and phone are roughly equal, phone interactions last twice as long as email on average. IM and paper average less than 2% of interactions. Interestingly the informants averaged less than 3% of interactions using the company promoted CM system .

Finally, several interesting points arise when we analyze the interplay between interaction type and connector. Work home is the connector where people spend the largest proportion of their day in interactions but spend the shortest amount of time in face-to-face interactions. This may indicate that technology is well distributed (and easily attainable) in the work home. There is also a longer face-to-face interaction in connector types where people spend a small proportion of their day. Informants may feel that when the opportunity to interact through these connectors arises, they take full advantage of it by utilizing richer communication media, and spending longer durations. IM is used in most communities and networks and is used in short snippets compared to email or F2F. Meetings, when they exist, take up an inordinate amount of time in all contexts. Some interaction contexts have a total (or almost total) absence of certain media technologies. This may be indicative of whether others are accessible through the technology, e.g. using the company intranet. It could also mean that people have certain habits with technology communication, such as preferring to use email or phone with private communities.

7. Discussion

Brown and Duguid (1991) discuss how actual work departs from canonical descriptions of work practice. Our results show how work is enacted not through canonical formal CoPs but rather through a variety of social structures: informal communities, groups, and networks that continually change throughout the workday.

7.1 Formal and Informal Connectors

Our study suggests that the majority of work in the workplace is done through connectors that are organizationally determined. This is thus the principal *opportunity* through which knowledge can be shared. In contrast, most informants spent only a small proportion of their day interacting through formal connectors established and promoted by the organization. In formal communities where people deliberately meet to share knowledge, knowledge is exchanged outside of their work context, whereas knowledge exchanged especially in the work home is embedded in the work context. This result suggests that formal communities might be designed to avoid recontextualizing knowledge.

Some researchers have discovered that much knowledge sharing occurs through personal networks in the organization (Nardi et al., 2002). We did not make a distinction between work conducted through personal networks, or as part of organizationally determined teams. To a large extent the role of these social entities is blurred. Some members on project teams primarily exchange formal results related to the project while others form networks for exchanging a wider array of informal information. Similarly, some informants formed what could be called personal networks with only a certain subset of people in their own department. The exchange of information in the organization is a complex web of networks, organizationally determined relationships and other types of communities that exert continual influence on people throughout the workday.

7.2 Connectors as a Unit of Analysis

Following Lave and Wenger's (1991) notion of "legitimate peripheral participation" in communities, we have tried in this paper to understand the different sources of learning in the workplace through identifying *what makes different types of social entities exist*. Contrary to the notion of a single work identity, our results suggest instead that people negotiate multiple identities, as well as multiple goals, reputations, influence, and common ground as they move in and out of different communities and networks throughout the workday.

Our unit of analysis, *connectors*, shares similarities with the notion of legitimate peripheral participation. Like legitimacy, connectors often come in the form of shared interests or experiences. And, likewise, connectors allow one to begin the trajectory towards the "core" of a community. However, connectors are not intimately tied to the theory of CoPs. What we have gleaned from our ethnographic investigations is that CoPs do

exist, but so do many other social configurations. Instead, we posit that connectors necessarily moves the focus away from seeing legitimacy as an enabler for CoP building, to an enabler for a variety of social configurations, of which CoPs are just one. Furthermore, connectors allow us to understand how it is that a variety of social configurations are maintained and navigated by different commonalities—not necessarily just to maintain CoPs, but other forms such as social networks or knots. Connectors are not a means to an end, but rather a separate unit of analysis worthy of study.

The term connector may also bring to mind the techniques used in social network analysis. In the classic sense, social networks are formed by "ties" between actors. Algorithms that utilize metrics such as social cohesion (Bruggeman, 2007) exist to automatically determine what subset of actors form a "community." While ties and connectors do indeed link people together, connectors is a relationship not always easily quantifiable into a numeric "strength." Though connectors may have different strengths (e.g. people may have a strong bond through professional connectors), what we wish to convey, from an egocentric viewpoint, is a link that is constantly changing, disappearing in and out, to facilitate a person's work. Connectors essentially give one multiple hats to wear. As events change, people will use the connector most appropriate to facilitate their work.

Geertz (1994) describes that as long as the group exists so does one's identity as a member of the group. In the workplace people maintain multiple types of identities. Yet especially when people switch so rapidly between groups, boundaries can be fuzzy and identities can become blurred. Our study suggests that identity is intimately tied with the connectors that continually change and are contextual in the workplace. One identifies with one's work role when the reference group involves others of a common work role, or as an Alpha department employee when the frame of reference is the work home.

We believe that our study can help in understanding the larger picture of how work is fragmented and what its impact is on information workers. Not only does work consist of multiple projects but also of multiple communities, groups and networks. Maintaining and switching different identities is the invisible work that people engage in at the workplace.

Limitations of the Study

Our study has several limitations. To perform effective "shadowing" of informants, the observer cannot be a source of interruptions. We thus kept clarification questions for the end of the day or for the post-interviews. Another limitation is that our observations are limited to one fieldsite. This

is also true of a number of workplace studies (Orlikowski, 1992; Perlow, 1999; Sproull, 1984). It is very possible that factors unique to the organization affect the type of communities we observed. For example, social communities (drama clubs, scrapbook clubs) seem to not be common practice in many organizations. We would need to investigate other organizations to understand more completely how organizational factors affect the types of communities that exist.

We also only observed a limited number of people. This is a higher number observed than other in-depth workplace studies (Sproull, 1984). We therefore cannot claim that our sample represents a wide range of information workers. We believe though that the types of connectors we observed at Lovelace are not atypical of large-scale distributed organizations.

8. Conclusions and Future Work

Our results have shown that multiple types of communities, groups and networks influence people in the workplace. We have introduced *connectors* as a unit of analysis to characterize how work is done in multiple contexts. The seven distinct classes of connectors were derived through using a grounded theory approach on ethnographic observations. The connectors we have introduced can provide a useful framework for investigating how and why people navigate between multiple formal and informal communities in their work life. These results are consistent with other ethnographic studies which show that people are involved in multiple activities that they constantly move in and out of in the workplace.

Our future research will build upon our data set by conducting comprehensive post-interviews with our informants regarding their community behaviors. More specifically, we wish to cull from our informants their perspectives on what connectors do for them at work and what specific benefits can be derived from them. The variety of connectors we discovered are largely prevalent to some degree for each of the informants. The communities which an informant participates in reveals a rich tapestry of interaction patterns that belies the traditional view that IT has made people more isolated (McPherson et al., 2006; Putnam, 1995).

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