Computers, Networks and Work

Electronic interactions differ significantly from face-to-face exchanges. As a result, computer networks will profoundly affect the structure of organizations and the conduct of work

by Lee Sproull and Sara Kiesler

Although the world may be evolving into a global village, most people still lead local lives at work. They spend the majority of their time in one physical location and talk predominantly to their immediate coworkers, clients and customers. They participate in only a few workplace groups; their primary work group, perhaps a committee or task force and possibly an informal social group.

Some people, however, already experience a far more cosmopolitan future because they work in organizations that have extensive computer networks. Such individuals can communicate with people around the world as easily as they talk with someone in the next office. They can hold involved group discussions about company policy, new product design, hiring plans or last night's ball game without ever meeting other group members.

The networked organization differs from the conventional workplace with respect to both time and space. Computer-based communication is extremely fast in comparison with telephone or postal services, denigrated as "snail mail" by electronic mail converts. People can send a message to the other side of the globe in minutes; each message can be directed to one person or to many people. Networks can also essentially make time stand still. Electronic messages can be held indefinitely in computer memory. People can read or reread their messages at any time, copy them, change them or forward them.

Managers are often attracted to networks by the promise of faster communication and greater efficiency. In our view, the real potential of network communication has less to do with such matters than with influencing the overall work environment and the capabilities of employees. Managers can use networks to foster new kinds of task structures and reporting relationships. They can use networks to change the conventional patterns of who talks to whom and who knows what.

The capabilities that accompany networks raise significant questions for managers and for social scientists studying work organizations. Can people really work closely with one another when their only contact is through a computer? If employees interact through telecommuting, teleconferencing and electronic group discussions, what holds the organization together? Networking permits almost unlimited access to data and to other people. Where will management draw the line on freedom of access? What will the organization of the future look like?

We and various colleagues are working to understand how computer networks can affect the nature of work and relationships between managers and employees. What we are learning may help people to exploit better the opportunities that networks offer and to avoid or mitigate the potential pitfalls of networked organizations.

Our research relies on two approaches. Some questions can be studied through laboratory experiments. For instance, how do small groups respond emotionally to different forms of communication? Other questions, particularly those concerning organizational change, require field studies in actual organizations that have been routinely using computer networks. Data describing how hundreds of thousands of people currently use network communications can help predict how other people will work in the future as computer-based communications become more prevalent. Drawing on field studies and experiments, researchers gradually construct a body of evidence on how work and organizations are changing as network technology becomes more widely used. The process may sound straightforward, but in reality it is often full of exciting twists. People use technology in surprising ways, and effects often show up that contradict both theoretical predictions and managerial expectations.

One major surprise emerged as soon as the first large-scale computer network, known as the ARPANET, was begun in the late 1960s. The ARPANET was developed for the Advanced Research Projects Agency (ARPA), a part of the U.S. Department of Defense. ARPANET was intended to link computer scientists at universities and other research institutions to distant computers, thereby permitting efficient access to machines unavailable at the home institutions. A facility called electronic mail, which enabled researchers

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ISOLATED EMPLOYEES, such as a night watchman, benefit in particular from computer network links. Networks can create a web of social connections that stretch across time and that exist independently of an employee's physical location or hierarchical position. Because of the lack of social cues, people communicating electronically tend to talk more freely than they would in person. Networks potentially permit broader access to information and more democratic structures than are now found in most organizations. Exploiting that potential will force managers to grapple with issues of responsibility and control.
Global communication is possible using computer networks and electronic mail, as illustrated by the behavior of Sue Jones, a composite based on a number of workers studied by the authors. On a typical day, one sends and receives from 25 to 100 pieces of electronic mail that cover both business and social topics. The map of the links made during the course of the day, highlighting those associated with one of her working groups, shows how a message quickly resolved via electronic communication. Networks permit ongoing cooperation among coworkers who are physically located in very different corners of the globe.

to communicate with one another, was considered a minor additional feature of the network.

Yet electronic mail rapidly became one of the most popular features of the ARPANET. Computer scientists around the country used ARPANET to exchange ideas spontaneously and casually. Graduate students discussed problems and shared skills with professors and other students without regard to their physical location. Heads of research projects used electronic mail to coordinate activities with project members and to stay in touch with other research teams and funding agencies. A network community quickly formed, filled with friends and collaborators who rarely, if ever, met in person. Although some administrators objected to electronic mail because they did not consider it a legitimate use of computer time, demand grew sharply for more and better network connections.

Since then, many organizations have adopted internal networks that link anywhere from a few to a few thousand employees. Some of these organizational networks have also been connected to the Internet, the successor to ARPANET. Electronic mail has continued to be one of the most popular features of these computer networks.

Anyone who has a computer account on a networked system can use electronic mail software to communicate with other users on the network. Electronic mail transmits messages to a recipient's electronic "mailbox." The sender can send a message simultaneously to several mailboxes by sending the message to a group name or to a distribution list. Electronic bulletin boards and electronic conferences are common variants of group electronic mail; they too have names to identify their topical audience. Bulletin boards post messages in chronological order as they are received. Computer conferences arrange messages by topic and display grouped messages together.

The computer communications technology in most networked organizations today is fairly similar, but there exist large differences in people's actual communication behavior that stem from policy choices made by management. In some networked organizations, electronic mail access is easy and open. Most employees have networked terminals or computers on their desks, and anyone can send mail to anyone else. Electronic mail costs are considered part of general overhead expenses and are not charged to employees or to their departments. In the open-network organizations we have studied, people typically send and receive between 25
and 100 messages a day and belong to between 10 and 50 electronic groups. These &QEs hold across job categories, hierarchical position, age and even amount of computer experience.

In other networked organizations, managers have chosen to access or charge costs directly to users, leading to much lower usage rates. Paul Schreiber, a Newsday columnist, describes how his own organization changed from an open-access network to a limited access one. Management apparently believed that reporters were spending too much time sending electronic mail; management therefore had the newspaper's electronic mail software modified so that reporters could still receive mail but could no longer send it. Editors, on the other hand, could still send electronic mail to everyone. Clearly, technology by itself does not 1pel change. Management choices and policies are equally ineluent.

But even organizations that have open access, anticipating the effect of networks on communication has proved no easy task. Some of the &st researchers to study computer networks communications thought the technology would improve group decision making to over face-to-face discussion because computer messages were plain text. They reasoned that electronic discussions would be more pure and lectua, and so decision making would be less affected by people's social skills and personal idiosyncracies.

Research has revealed a more complicated picture. In an electronic exchange, the social and contextual cues that usually regulate in luence group dynamics are missing or attenuated. Electronic messages lack in or mation about job titles, social importance, hierarchical position, race, age and appearance. The context also is poorly defined because formal and casual exchanges look essentially the same. People may have outside information about senders, receivers and situations, but few cues exist in the computer interaction itself to remind people of that.

In a series of experiments at Caltech, we compared how small groups make decisions using computer conferences, electronic mail and face-to-face discussion [see illusraion below]. Using a network induced the participants to talk more frequently and more equally. Instead of one or two people doing most of the talking, as happens in many face-to-face groups, everyone had a more equal say. Furthermore, networked groups generated more proposals for action than did traditional ones.

Open, free range of discourse has a dark side. The increased democracy as sociated with electronic interactions in our experiments interfered with decision making. We observed that tree personal groups took approximately four times as long to reach a decision electronically as they did face-to-face in one case, a group never succeeded in reaching consensus, and we were ultimately forced to terminate the experiment. Making it possible for people to interject another slowed discussion making and two ceased communication as a few members tried to dominate control of the network. We also found that people tended to express extreme opinions and vented anger more openly in an electronic face-on than when they sat together and talked. Computer scientists using the ARPANET have called this phenomenon 'la ing'.

We discovered that electronic communication can influence the effects of people's status. Social or ob position normally is a powerful regulator of group interaction. Group members typ

LABORATORY STUDIES reveal some ways in which networks affect how people work together. Ninety-four groups of subjects in five experiments were told to reach consensus decisions on several questions. Each group made some decisions electronically (through one or two network modes) and others face-to-face. When networked, all groups took longer to make a decision (a). On the other hand, they enjoyed more equal participation (b) and proposed more ideas (c). The electronic modes of discussion seemed to encourage "flaming," impassioned self-expression (d).

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erarches have advanced alter
native exp anations for the open
ness and democracy of electron
tic talk. One hypothesis is that peo
talk more openly on a computer than when they are
face-to-face. Another hypothesis holds that text messages require strong lan
gage to get a point across; this hy
thesis explains laming but not the
reduction of social status di&ences. The most pro-
ving exp anation of the behavior of networked indivi
duals is that when cues about so-
text are absent or weak, people ignore
the so a situation and cease to wor
about how others evaluate them.
Hence, they deco less time and e*ort to
posing and social ceties, and they
may be more honest.

Researchers have demonstrated de-
creased social post ing in st dies that ask
people to describe their own beha
or in one of our experTs, peo
were asked to complete a self eval-
uation questio a ire either by pencil
and paper or via electron c mail. hose
randomly assigned to reply e*ectu-
cally reported signi cantly more unde-
sirable social behaviors, such as legal
drug use or petty crimes. John Greist
and Is colleagues at the University of
Wisconsin found similar decreases in
posting when they asked medical histo-
ries from clinical patients. People who
responded to a computerized patient
history interview revealed more social
and physical undesirability
than those who answered the same
questions asked by a physician.

These st dies show that people are
reluctant to reveal more about under-
sirable symptoms and behavior to a
computer, but are these reports more
true? An investigation of alcohol
consumption conducted by Josh C.
Waterton and John C. Du* y of the Uni-
versity of Edinburgh suggests an a+ r
ative answer. In traditional surveys,
people report drinking only about one
half as much alcohol as alcohol sales
gues would suggest. Waterton and
Du* y compared computer interviews
with personal interviews in a survey of
alcohol consY ption. Pe o e who were
randomly assigned to answer the com-
puter survey reported higher alcohol
consumption than those who talked to
the human interviewer. The computer
derived reports of consY ption extrap-
olated more accurately to actual alcohol
sales than did the face-to-face reports.

These and other controlled studies of electron c talk suggest that such
com u cation is relatively imperson-
al, yet paradoxically, it can make peo-
ple feel more comfortable about talk

ically defer to those who have higher
status and tend to follow their direc
tion. Members’ speech and demeanor
be one another form a t the presence of
people who have high status. Higher
status people, in turn, talk more and
influence group discussion more than do lower-status people.

Given that electronic conversations attenuate contextual cues, we expected
that the exact of stat s differences with
in a group should be reduced. In an experimen conducted with Vitaly Du
brovsk of Clark University and Be
heruz Set na of Lamar University, we
asked groups conta ng high and low
status members to make decisions both
by electronic and face to face. The
results confirmed that the proportion of
tA and I of higher status people
decreases when group members
communicate by electronic mai .

Is this a good stat e of a* airs? When
higher status members have ex press
more democracy could improve
decision ma&. If higher status members
tly are better qua ed to make
decisions, however, the results of con-
sensus decisions may be less good.

Shoshanah Zab of Harvard Busi
ness School documented reduced ef-
efts of status on a computer confer-
ence system in one group. People who
regarded themselves as physically un
attractive reported feeling more live-
ly and consistent when they expressed
themselves over the network. Others
who had soft voices or small stature re-
ported that they no longer had to s r g
ple to be taken serious y in a meeting.
Working the night shift, it used to be that I would hear about promotions a ter they happened, though I had a right to be included in the discussion. Now I have a say the decision makes.

Organizations are traditionally built around two key concepts: hierarchy and decomposition of goals and tasks and the stability of employee relations. Over time, in the fully networked organization that may become increasingly complex in the future, task structures may become more flexible and dynamic. Hierarchies will not disappear, but they will be augmented by distributed lattices of interaction.

In today's organization executive's general level of working people have never met. Allocating resources to projects and assigning credit and blame for performance will become more complex. People will often belong to many different groups and will be able to reach out across the network to acquire resources through management intervention or perhaps even without management knowledge.

A recent case in mathematics research is at the nature of what may be ahead. Mathematicians at Bell Communications Research (Bellcore) and at Digital Equipment sought to factor a large, theoretically intereting number known as the 9th Fermat number. They broadcast a message on the Internet to researchers in universities, government laboratories and corporations asking them to test their project. The severa hundred researchers who volunteered to help received via a computer e-mail software a piece of the problem to solve; they also reprinted their solutions through electronic mail.

After results from all the volunteers were compiled, the message announced the 416 results of the project contained a charming ad.

We'd like to thank everyone who contributed computing cycles to this project, but I can't: we only have records of the person at each site who in stalled and managed the code. If you helped us, we'd be delighted to hear from you; please send us your name as you would like it to appear in the final version of the paper. (Broadcast message from Mark S. Manasse, June 15, 1990.)

Networking in most organizations today is limited to data communication, often or even on a network. Application such as electronic data in

exchange, electron c 6 nds answer or remote access on process g. Most organi zations have not yet begun to connect the opportunites and the times a orderd by convention the employ ees to our networks.

Among those that have managers have responded to a variety of ways to changes that affect the authority and control. Some managers have installed networks or system reas and used the potentials or more robust changes. Some have resisted who can send mail or have e mail down as electronic discussion groups. Others have encouraged using the network or broadening participation on involving more people in the design and management processes. The last year's push remained onlly down and through the organization and also provide the new managerial issues.

A democrat organization requires competent, co op erative people. It is essential is new ways of alIating credit. It increases un prod uctivity, but also for producer ideas of personal growth. Managers will have to come up to new ends of work and cent eves and organizational structures to handle these changes.

The technology of electronic mail is changing rapidly. Electronic mail that is cudes graphs, pictures, sound and video will eventually ally become widely available. These advances will make it possible to reintroduce some of the so-calculated cues absent, cut or electronic communication. The number and size of electronic groups will expand and demand notust on how he technology net or ge oder block assume on how managers see the system presents or transm the structure orork.

FURTHER READINGS


Today telecommunications is becoming the business relations and one decisive factor in production. This is especially true since the international borders are more global in communication.
A partner with the right attitude is needed. And a partner with the right phone number is needed. A partner with the right attitude is needed.
In 1990, ELEK M, with a turnover of about 47 billion DM (US $26 billion) and 250,000 employees, 'overtook' Europe's largest telecommunications company, has ended its link with the governmental postal monopoly itself in a $50 million transaction.

GOING IT ALONE

TELEK M has established a new, set of competition-oriented guidelines: market-oriented performance, new products, and services at a reasonable price and commercially-oriented motivation of employees. Typical of TELEK M's strategy of offering service with high consumer appeal and low costs, fiber optics down to the subscriber level have been introduced. TELEK M now confronts the challenge of converting itself from a technology-driven public corporation into a consumer-oriented corporation.

While protecting its core telephone service and network, ELEK M has been forging strategic alliances with other network operators seeking partners in other industries and expanding abroad. As a result, the firm aims to strengthen its domestic competitive position, internationalize its operations, and also meet the enormous task of modernizing the telephone network in the year 2000. The result is that Germany's East is moving to a new telecommunications network.

A SOPHISTICATED INFRASTRUCTURE FOR EASTERN GERMANY

TELEK M faces a unique challenge here: network capacity is inadequate (70% of all exchanges are from twenty-five to sixty years old); equipment is antiquated and unreliable. The firm's TEK M 2000 program foresees investment in the short and long term. By 1991, each of the five new federal states will meet state of the art world telephone standards. In 1991, DM 5.5 billion will be spent on network expansion.

The master plan of DM 55 billion makes TELEK M Germany's largest capital investor eastward. By 1994, competition in the east will be similar to that in the rest of Germany.
IN INCREASINGLY COMPETITIVE MARKETS, TELEKOM COOPERATES WITH INTERNATIONAL PARTNERS

The Commission of the European Community has predicted that the telecom share of EC wide GNP will double from 1984 to about the same level in 1999. In the decade’s end TELEKOM is responding with joint ventures with its European neighbors: a new high-capacity optical fiber link across the Atlantic (Sea) in 1992, the first direct link to Germany), a new electronic data transmission service (EDI) in Europe and a system to help deliver electronic brochures to European agents.

Germany is strategically placed for multinational expansion in Europe, its attractiveness enhanced by reunification of Eastern Europe with the Soviet Union, Czechoslovakia and Poland. The firm’s guiding principle is to open these markets for European businesses. A example: the Czechoslovakian firm Modacom, a mobile data transmission service, is expanding from Eastern Europe to Warsaw, Prague and Budapest.

TELEKOM IS COMMITTED TO A LEADING ROLE IN TELECOMMUNICATIONS RESEARCH

TELEKOM is a leading national telecommunications research organization, a spin-off of the East Germany’s mobile telephone and data services network (EMT) at the University of Technology, Munich.

20 et works a to som 16 countries. Established to provide a high-capacity optical fiber link across Europe, the company aims to develop a suitable expansion strategy, to receive research by linking projects in the success of member states and to ensure that results are used in the expansion of the European network. TELEKOM has installed 1,020 million kilometers of fiber optic cables at the subscriber level. By 1990, TELEKOM had installed 1,020 million kilometers of fiber optic cables. In the series of pilot projects called Telekom in 1990, a design and a network architecture for future networks is being developed. The company is also involved in a series of pilot projects (called CADE) launched in 1990).

TELEKOM’S FUTURE LOOKS BRIGHT

TELEKOM confronts a difficult in its history. And yet, the firm is secure that it will be able to achieve high tech solutions wherever feasible, according to its goals. A new project, the Transatlantic Internet, will allow the creation of a sophisticated communications network in the eastern part of the world. The project will be carried out by a multinational team of companies based in Germany, where the company is active as a major player in the telecommunications market.