

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 co-workers, 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 mes-

sage 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.

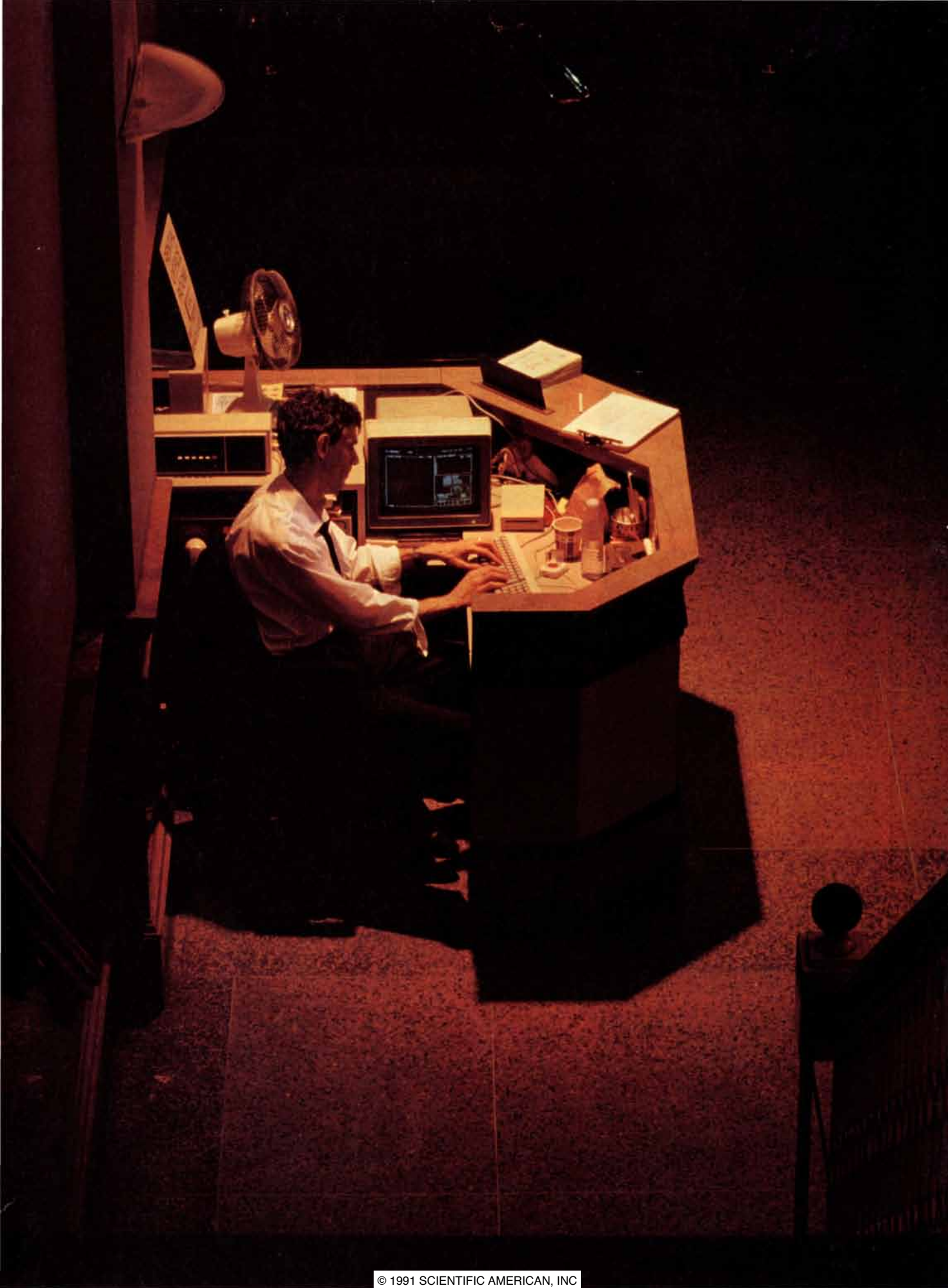
Our research relies on two approaches. Some questions can be studied through laboratory experiments. For instance, how do small groups respond emotionally to different forms of communication? Other questions, particu-

larly 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

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.

LEE SPROULL and SARA KIESLER have spent more than a decade studying established electronic mail communities to learn about how they change patterns of communication within organizations. Sproull received a Ph.D. in social science from Stanford University in 1977. Until this year she was a professor of social sciences and sociology at Carnegie Mellon University. She is now a professor of management at Boston University's School of Management. Kiesler completed a Ph.D. in social psychology at Ohio State University in 1965. In 1979 she joined the faculty of Carnegie Mellon University, where she is a professor of social sciences and social psychology, as well as a member of the university's robotics institute.



How People Work via Electronic Mail

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, Jones sends and receives from 25 to 100 pieces of electronic mail that cover both business and social topics. The maps record the links made during the course of the day, highlighting those associated with one of her working groups; the computer screens show the messages she sends to and receives from that working group. In this case, a potential crisis in the pricing of a new product is quickly resolved via electronic communication. Networks permit close, ongoing cooperation among co-workers who are physically located in very different corners of the globe.

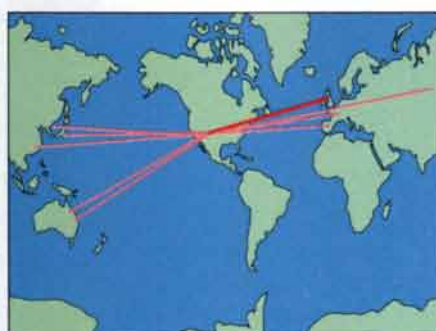


Time: 7:55 am
To: Product Dev. Group
From: Ising
Subject: Marketing Results in HI Guys. It's a gorgeous day here in Tokyo for a change (rain all last week). The whole document will be coming by email this pm. Sorry, but according to the report, the competition is pricing its product several \$\$ lower than we expected.
Lee



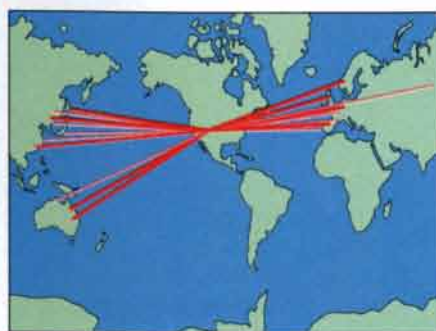
Time: 9:10 am
To: Product Dev. Group
From: jwp@ AP Supplies
Re: Marketing results

We in Singapore can get you a package that will look ok & much cheaper.
John



Time: 10:05 am
To: Product Dev. Group
From: "Pete Wilson"
Re: Marketing results

John,
Thank you for your suggestion but I cannot tolerate any slippage in the schedule.
--Pete Wilson



Time: 11:00 am
To: Product Dev. Group
From: "Sue"
Subject: hey, no problem Hello group, I checked. We CAN use John's idea for cheaper packaging. Moreover its a good sell-- biodegradable...!! The schedule is at minimal risk.
Sue

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 topic or 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 groups hold across job categories, hierarchical position, age and even amount of computer experience.

In other networked organizations, managers have chosen to let access to charge costs directly to users, leading to much lower usage rates. Paul Schreier, 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 depending on much time sending electronic mail; management therefore had the newspaper's electronic mail software modified so that reporters could still receive it, but could no longer send it. Editors, on the other hand, could still send electronic mail to everyone. Clearly, technology by itself does not help change management choices and policies are equally influential.

But even organizations that have open access anticipate the effect of networks on communication has proved to be easy to ask. Some of the best researchers to study computer network communications thought the technology would improve group decision

making, a 7 ng over face-to-face discussion because computer messages were plain text. They reasoned that electronic discussions would be more pure, more direct, and more decision making would be less affected by people's social skills and personal idiosyncracies.

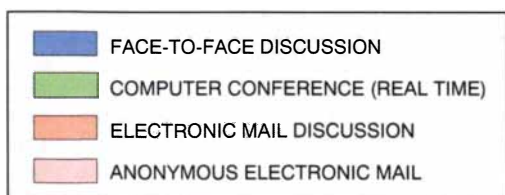
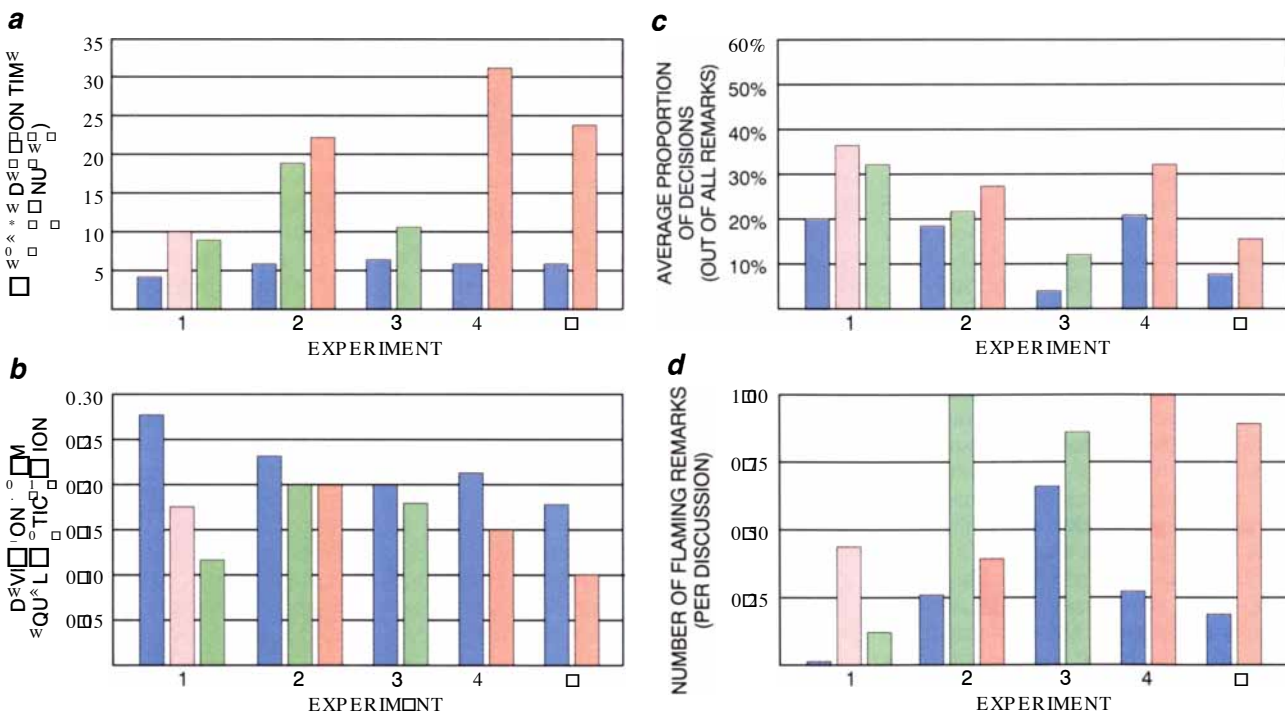
Research has revealed a more complicated picture. In an electronic context, change in the social and contextual cues that usually regulate and influence group behavior are missing or attenuated. Electronic messages lack information regarding job titles, social importance, hierarchical position, race, 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 knowledge.

In a series of experiments at Caltech, Leonard diversity, we compared how small groups make decisions using computer conferences, electronic mail and face-to-face discussion (see illustration below). Using a network induced the participants to talk more freely and more equally. Instead of one or two people doing most of the talking, as

it happens, many face-to-face groups, everyone had a more equal say. Furthermore, networked groups generated more proposals for action than did traditional ones.

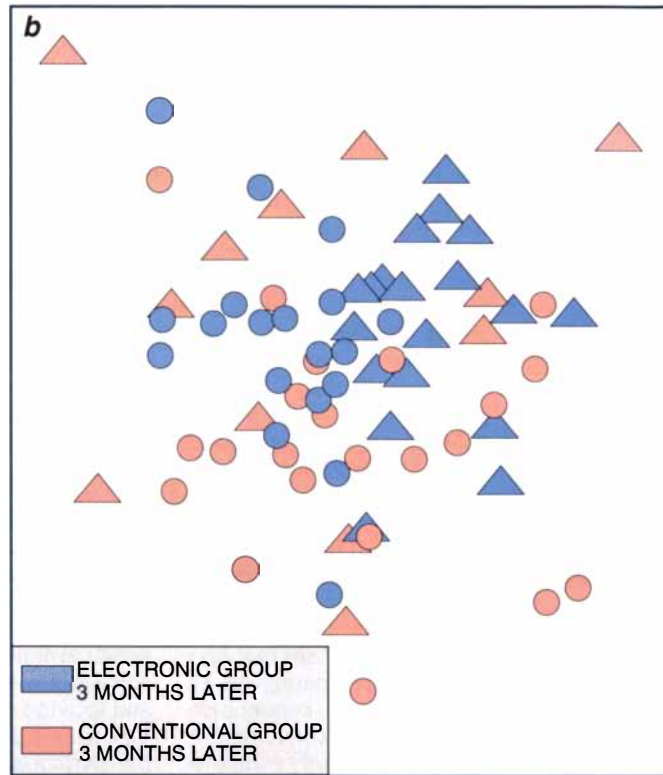
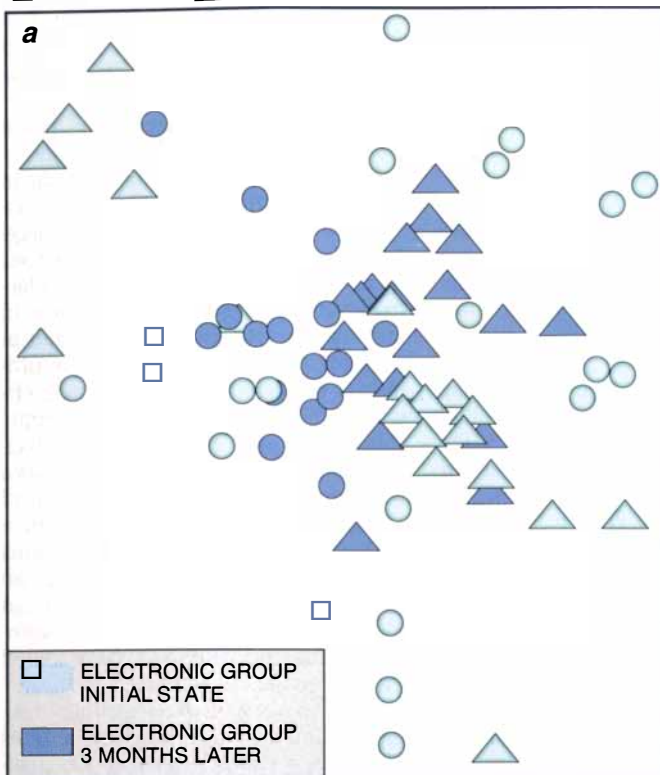
Open, free, and anonymous discourse has a dark side. The increased democracy associated with electronic interactions in our experiments interfered with decision making. We observed that in free person groups took approximately four times as long to reach a decision electronically as they did face-to-face. In one case, a group never succeeded in reaching consensus and gave up. It immediately forced to terminate the experiment. Making it possible for people to interrupt one another lowered decision making and increased nondecision. 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-to-face than when they sat together and talked. Computer scientists using the ARPANET have called this phenomenon flaming.

We discovered that electronic communication can influence the effects of people's status. Social hierarchy position formally has power (regulator of group interaction). Group members typi-



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).

□ EMPLOYEE △ RETIREE



ically defer to those who have higher status and tend to follow their direction. Members' speech and demeanor become more formal in 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 effect of status differences within a group should also be reduced. In an experiment conducted with Vitaly Dubrovskiy of Clarkson University and Behruz Setoona of Lamar University, we asked groups containing high- and low-status members to make decisions both by electronic mail and face-to-face. The results confirmed that the proportion of talk and influence of higher-status people decreased when group members communicated by electronic mail.

Is this a good state of affairs? When higher-status members have less expertise, more democracy could improve decision making. If higher-status members truly are better qualified to make decisions, however, the results of consensus decisions may be less good.

Shoshanah Zuboff of Harvard Business School documented reduced effects of status on a computer conference system in one firm. People who regarded themselves as physically unattractive reported feeling more lively and confident when they expressed themselves over the network. Others

who had soft voices or small stature reported that they no longer had to struggle to be taken seriously in a meeting.

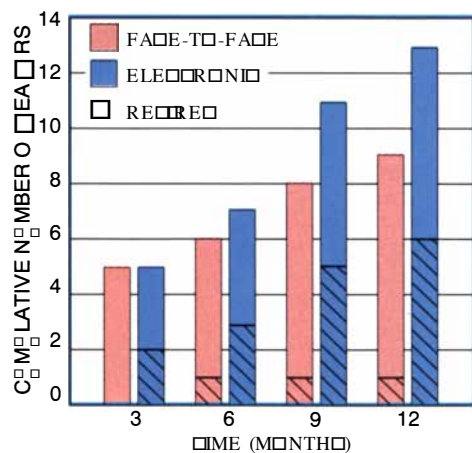
Researchers have advanced alternative explanations for the openness and democracy of electronic talk. One hypothesis is that people who like to use computers are childish or usually, but this hypothesis does not explain experimental results showing that the same people talk more openly on a computer than when they are face-to-face. Another hypothesis holds that text messages require strong language to get a point across; this hypothesis explains flaming but not the reduction of social and status differences. The most promising explanation of the behavior of networked individuals is that when cues about social context are absent or weak, people ignore the social situation and cease to worry about how others evaluate them. Hence, they devote less time and effort to posturing and social niceties, and they may be more honest.

Researchers have demonstrated decreased social posturing in studies that ask people to describe their own behavior. In one of our experiments, people were asked to complete a self-evaluation questionnaire either by pencil and paper or via electronic mail. Those randomly assigned to reply electronically reported significantly more undesirable social behaviors, such as illegal

drug use or petty crimes. John Greist and his colleagues at the University of Wisconsin found similar decreases in posturing when taking medical histories from clinical patients. People who responded to a computerized patient history interview revealed more socially and physically undesirable behavior than did those who answered the same questions asked by a physician.

These studies show that people are likely to reveal more about undesirable symptoms and behavior to a computer, but are these reports more truthful? An investigation of alcohol consumption conducted by Jennifer J. Waterton and John C. Dwyer of the University of Edinburgh suggests an affirmative answer. In traditional surveys, people report drinking only about one-half as much alcohol as alcohol sales figures would suggest. Waterton and Dwyer compared computer interviews with personal interviews in a survey of alcohol consumption. People who were randomly assigned to answer the computer survey reported higher alcohol consumption than those who talked to the human interviewer. The computer-derived reports of consumption extrapolated more accurately to actual alcohol sales than did the face-to-face reports.

These and other controlled studies of electronic talk suggest that such communication is relatively impersonal, yet paradoxically, it can make people feel more comfortable about talking



DYNAMIC GROUP STRUCTURES emerge when people converse electronically. These charts depict the behavior of two study groups, each containing a mix of employees and retired workers. One group worked in person, the other over a network. Members having the most information and social contacts appear near the center of the charts. Over time, the electronic group becomes more socially cohesive (a). Chart b compares the electronic group with the conventional group three months into the project and shows that retirees in particular become better integrated in the electronic group. Networks also encouraged more people to take on leadership roles (c).

ing. People are leery and more playful in electronic discussions. They also express more opinions and ideas and become more emotional.

Because of these behavioral differences, organizational differences in electronic group applications. Nobody had anticipated computer capabilities. The group's ability to work together and coordinate is a key factor in the success of the group. The group's ability to work together and coordinate is a key factor in the success of the group. The group's ability to work together and coordinate is a key factor in the success of the group.

Just as the dynamics of electronic communication are different from those of face-to-face communication, the dynamics of electronic group work are different from those of face-to-face group work. People in a face-to-face group are likely to be working on a common project or task, and they are likely to be working on a common project or task. People in a face-to-face group are likely to be working on a common project or task, and they are likely to be working on a common project or task. People in a face-to-face group are likely to be working on a common project or task, and they are likely to be working on a common project or task.

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ber, however, and in the relationship between people who do not know each other personally.

Employees who are organized into a community of electronic work can be seen in the electronic group who are members of the community. For example, Reid, a 37-year-old man, is a member of the community. Reid is a member of the community, and he is a member of the community. Reid is a member of the community, and he is a member of the community.

Networked communities can be seen in the workplace. The networked community is a community of electronic work. The networked community is a community of electronic work. The networked community is a community of electronic work. The networked community is a community of electronic work.

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The challenge of communication made possible by e-work may be both equally and also alter the relationship between employees and their organization. The

Research on the effects of community on the health of workers is limited. However, a number of studies have shown that community-based interventions can be effective in reducing the health risks of workers. For example, a study of the effects of a community-based intervention on the health of workers in the garment industry in Bangladesh found that the intervention was effective in reducing the prevalence of respiratory symptoms and improving the health of workers. Another study of the effects of a community-based intervention on the health of workers in the garment industry in Bangladesh found that the intervention was effective in reducing the prevalence of respiratory symptoms and improving the health of workers. These findings suggest that community-based interventions can be effective in reducing the health risks of workers and improving their health.



initiated questions and answers about company products and services) over a one-year period; the greater the usage, the larger the circle. Workers in distant or isolated offices, where local expertise is relatively limited, made the most use of the information provided through the network.

"Working the night shift, it used to be that I would hear about promotions after they happened, though I had a right to be included in the discussion. Now I have a say in the decision making."

Organizations are traditionally built around two key concepts: hierarchical decomposition of goals and tasks and the stability of employee relationships over time. In the fully networked organization that may become increasingly common in the future, task structures may be much more flexible and dynamic. Hierarchy will not vanish, but it will be augmented by distributed lattices of interconnections.

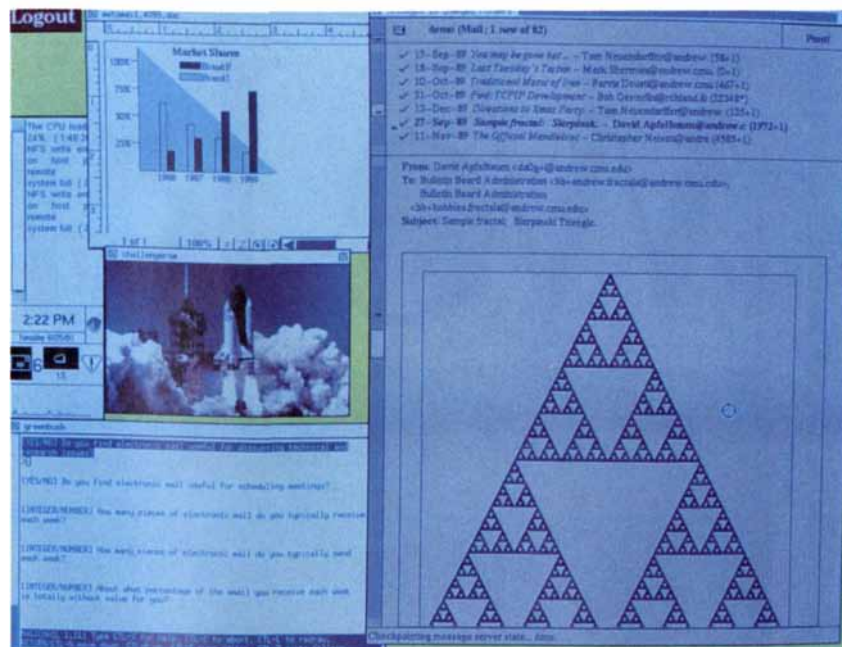
In today's organizations executives generally know whom they manage and manage whom they know. In the future, however, managers of some electronic project groups will face the challenge of working with people they have never met. Allocating resources to projects and assigning credit and blame for performance 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 without management intervention or perhaps even without management knowledge.

A recent case in mathematics research hints at the nature of what may lie ahead. Mathematicians at Bell Communications Research (Bellcore) and at Digital Equipment sought to factor a large, theoretically interesting number known as the 9th Fermat number. They broadcast a message on the Internet to recruit researchers from universities, government laboratories and corporations to assist them in their project. The several hundred researchers who volunteered to help received a electronic mail software and a piece of the problem to solve; they also returned their solutions through electronic mail.

After results from all the volunteers were combined, the message announcing the final results of the project contained a charming addition:

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 installed 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 communications, often for economic or financial applications such as electronic data in-



ADVANCED ELECTRONIC MAIL, such as this experimental setup at Bellcore, will make it possible to transmit graphics, animation, self-contained computer programs and audio recordings. Such features will broaden the applications for networked communication. They may also restore some of the social cues now absent from electronic mail and thereby modify the behavior of its users.

terchange, electronic funds transfer or remote transaction processing. Most organizations have not yet begun to confront the opportunities and challenges afforded by connecting the employees through networks.

Among those that have, managers have responded in a variety of ways to changes that affect the authority and control. Some managers have stalled networks for efficiency reasons but ignored the potential for more profound changes. Some have resisted who can send mail or have shut down electronic discussion groups. Others have encouraged using the network for broadening participation and involving more people in the decision-making process. The last actions push responsibility down and through the organization and also produce their own managerial issues.

A democratic organization requires competent, committed, responsible employees. It requires new ways of allocating credit. It increases unpredictability, both for creative ideas and for appropriate behavior. Managers will have to come up with new kinds of worker incentives and organizational structures to handle these changes.

The technology of networks is changing rapidly. Electronic mail that includes graphics, pictures, sound and video will eventually become widely available. These advances will make it possible to reintroduce some of the so-

cial context cues absent from current electronic communication. Even so, electronic interactions will never duplicate those conducted face-to-face.

As more people have ready access to network communications, the number and size of electronic groups will expand dramatically. It is up to management to make and share connections. The organization of the future will depend significantly not just on how the technology of networking evolves but also on how managers see the opportunities it presents for transforming the structure of work.

FURTHER READING

WHAT DO COPIES DO? James Rule and Paul Attewell in *Social Problems*, Vol. 36, No. 3, pages 225-241; June 1989.

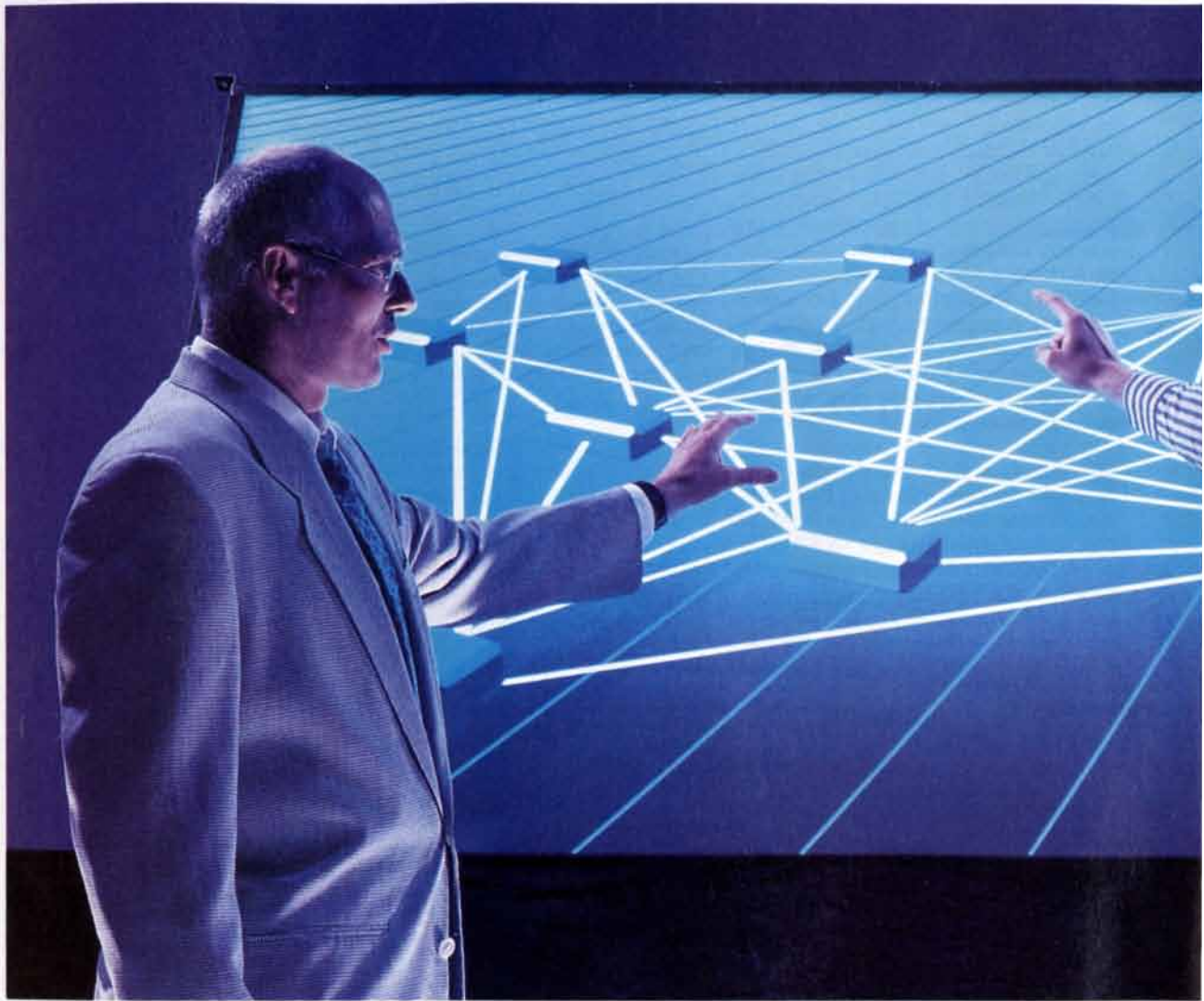
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Germany **LEKOM:**

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In 1990, TELEKOM with a turnover of about 47 billion DM (US \$26 billion) and 250,000 employees became Europe's largest telecommunications company. It ended its link with the governmental postal monopoly itself in business for 500 years.

Going it alone, TELEKOM has established a new set of competitive oriented guidelines: market-oriented performance, new products and services at a

reasonable price and commercially-oriented motivation of all employees—typical of TELEKOM's strategy of offering service with high consumer appeal and low cost—fiber optics down to the subscriber level. The so-called "Fiber to the Home" project. TELEKOM 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 business, TELEKOM has been forging strategic alliances with other network operators, seeking partners in other industries and expanding abroad. Simultaneously, the firm aims to strengthen its domestic competitive position internationally to respond to its customers' globalization and also meet the enormous task of modernizing the telecommunication structure of what was East Germany.

A SOPHISTICATED INFRASTRUCTURE FOR EASTERN GERMANY

TELEKOM 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 TELEKOM 2000 program foresees investment in the short, medium and long term so that by 1991, each of the five new federal states will meet state-of-the-art world telecom standards. In 1991, DM 5.5 billion will be spent on doubling in 1992. Overall spending on construction, equipment and assembly in the east is foreseen to reach DM 20 billion.

The master plan of DM 55 billion makes TELEKOM Germany's largest capital investor east or west. Its infusion of capital and expertise translates

g **Telekom**

to seven million new telephones, about 360,000 business and private fax lines, 50,000 DatexP lines, type C and D cellular telephone networks serving 300,000 users and 70,000 new public telephones.

Results have come quickly. The past July, more than 100,000 additional telephone lines within the new federal states and to western Germany came on line, ending the era of constant busy signals. A new digital overlay network increased available lines fourfold and eight digital main exchanges and digital multipoint exchanges were phased into service. By the end of this year, every business that has applied for a telephone is expected to be hooked up; half a million new telephones will have been installed. In one year, that figure will reach one million.

Further to eliminate blockages in the east, type C cellular networks will connect virtually the entire country by year's end. Transmission among all German business centers will also soon come online: called "Citytronic," the mobile paging system's receiver displays up to 80 characters and digits. TELEKOM's latest two-way paging service, "Chekker" (using the burst broadcasting mode) was enthusiastically received when introduced this year in important eastern German commercial centers.

TELEKOM 2000's further phases will see text and data communication services, video conferencing and a BTX videotext capability rapidly expanded from major cities like Berlin, Leipzig and Dresden to all five eastern states.

In an interim phase, until replacement of the analog network with a digital network will "overlay" the existing infrastructure. To smooth business use in this transition, companies will have access to satellite-based systems. For different such transmission services are already at work for both telephone and data use.

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 just under three percent in 1984 to about seven percent by 1999. Over the telecom revenues, worldwide, should rise from US \$392 billion (1990) to US \$865 billion by this decade's end. TELEKOM is responding with joint ventures with its European neighbors: a new high-capacity optical fiber link across the Atlantic (in service 1992, the first direct link to Germany), a new electro-optical data interchange service (EDI) in Europe and a system to help develop electronic brochures and catalogs to European travel agents.

Germany is strategically situated for multiple relations settling up in Europe, its attractiveness enhanced by reunification options such as one-stop shopping, single billing and network management are concepts being brought into play, in part with partners like British Telecom. With in the past year TELEKOM has upgraded its international presence by opening offices in Tokyo, New York, London, Paris and Brussels. Components and equipment are increasingly being procured abroad: two examples are digital mobile radio and intelligent networks.

Furthermore, TELEKOM is actively pursuing market opportunities in the Soviet Union, Czechoslovakia and Poland. The firm's guiding principle is to open these markets for European businesses. An example: Orange Europe Line (TEL) — this fiber link runs from Frankfurt to Warsaw, Prague and Budapest and is scheduled to go into service by the end of 1993.

TELEKOM IS COMMITTED TO A LEADING ROLE IN TELECOMMUNICATIONS RESEARCH

TELEKOM is grounded in technological innovation, concentrating on specialization and differentiation of products and services. Two examples of introduction of this year of the cellular network and "Modacom," a mobile data transmission service.

An important role has been undertaken in Eurescom, at Heidelberg (the first European telecommunications body based in Germany), a research organization founded by 20 network operators

to form 16 countries. Established to foster a coordinated network across Europe, Eurescom aims to develop a suitable expansion strategy, to foster research by linking projects underway in existing communities maintained by members and to generate initiatives in order to demonstrate the viability of research results. As networks expand using common standards, customers are better served and operational costs lowered.

TELEKOM's own Research Department in Darmstadt and Berlin is working in semiconductor technologies, the use of digital switches and the use of optical fiber cables. One key thrust is to lower the cost of optical fiber at the subscriber level. By 1990, TELEKOM had installed 1.02 million kilometers of optical fiber in trunk and local networks. The cost for use of fiber optics is for TELEKOM a perfect technology compatible with existing networks, once the cost of installation and feeding-in of the lasers is taken into account. A new phase must have a high fail-safe protection of faults and cable interruptions and allow upgrade of broadband services. Currently, TELEKOM is testing specific optical fiber network architectures for distribution in a series of pilot projects (called EPAC) launched in 1990, designed to evaluate broadband distribution services, analogue telephone and switchable telecommunications services. Cost saving measures can begin as soon as standardization of components and interfaces with the switching equipment, split into core and wavelength allocation are established.

TELEKOM'S FUTURE LOOKS BRIGHT

TELEKOM confronts a difficult situation in its history. And yet, the firm is secure that it can overcome high-tech solutions wherever feasible, it is continuing edge research, a commitment to international collaborations will allow it successfully to meet increased competition at home and abroad. A strong will to allow the creation of a sophisticated communication network in eastern Germany. TELEKOM's secret management team's successful track record speaks for the company's future as a major corporate player in the expanding, and evermore challenging global telecommunications market.