

lems. Experts can maintain publicly accessible files of questions they have received and answers they have provided. In this way people with questions can first check the archives to see if their question has already been asked by someone else and answered by an expert.

Tandem maintains archives of reply files from both does-anybody-know? questions and questions directed to experts. While each archive is equally and easily accessible to everyone, people access the does-anybody-know? archive much more frequently than they access the experts' archive. We doubt if this behavior means that Tandem employees generally do not value formal expertise. Rather we think it means that they have many procedures for accessing formal expertise, whereas they have no other easy way to access the experiences of anybody—employees worldwide who answer a does-anybody-know? question. This archive does not represent authoritative or authorized answers. It represents a slice of experience or opinions that employees could sample in no other way.

7.3 Conclusion

Many people would argue that if you implement the kinds of procedures described in this chapter, you can wind up with more communications, more impositions on people, and more unfocused projects initiated that go unfinished. Any time there is intense communication, there also will be more information than people can use and, in the short term for the individual, some wasted time and effort. The evidence thus far suggests some valuable compensations for the individual and for the organization. Electronic communication can make routine procedures more efficient and more humane, reducing the need for redundant information exchange. It also can expand the scale and scope of informal communication, which is necessary for coordination and for maintaining ties among disparate people and subunits.

There is another advantage. An old Chinese proverb says, "If we don't change direction, we'll end up where we're headed." Information procedures using paper technology typically move prespecified categories of information among preidentified groups of people. Computers can improve the efficiency of these old procedures as demonstrated in transaction processing systems, database systems, and management information systems. They also make it possible to have procedures for exchanging unspecified kinds of information among unspecified people. These new

procedures are especially appropriate when organizations and activities within them are large and internally diversified, when internal or external change is great, and whenever nonroutine events create a need for new ways of thinking, acting, and organizing.

In the 1960s people speculated that large time-sharing computer systems would overturn familiar organizational structures or patterned relationships among people and subunits. Conventional channels of authority and processes of decision making would be replaced by something else. Relationships among subunits would change. Jobs would be transformed. Technophiles dreamed about increased rationality and efficiency. Technophobes had nightmares about Big Brother. As it turned out, neither the dreams nor the nightmares were realized (Simon 1973; Weizenbaum 1976; March and Sproull 1990). Mainframe computerization did lead to the creation of computer centers and information systems departments (McFarlan and McKenney 1983; King 1983). There may have been small reductions in the number of clerical workers and a slight decrease in centralization associated with increasing computerization (Whisler 1970; Pfeffer and Leblebici 1977), but by and large, computing technology has not yet led to widespread changes in how work is organized.

By contrast, three other technologies have had profound effects on the structure of modern organizations: the telephone, the railroad, and office paperwork technologies. It is useful to keep them in mind as a standard of comparison when thinking about the potential for computing technology to change organizational structure.

Managers must be in touch with the production process. Before telephony, they worked at production sites. With telephony, managers could locate their offices several miles away from a production site and still be in immediate touch with it. In a place like Pittsburgh, this meant that managers no longer had to work at the mills. They could move their offices downtown (and upwind), away from the dirt and noise of the factory or mill. The telephone made possible the (literally) white-collar manager and

the separation between production and administration. At the same time long-distance telephony made possible the creation of national markets in stocks and commodities (Aronson 1971).

The railroad led to the vertical integration of asset-specific firms. Consider the meat packing industry. With long-distance railroads and refrigerated railroad cars, local butchers in Chicago could expand and consolidate their operations. They built new organizational structures with livestock ranches in the West and Southwest, slaughter houses in the Midwest, and retailers in the East. The railroad also made possible the mass distribution of commodities and consumer goods supported by particular administrative structures. As Alfred Chandler (1977:209) noted, "All these mass marketing enterprises had the same internal administrative structure. Their buying and selling organizations, by using the railroads, the telegraph, the steamship, and improved postal services, coordinated the flow of agricultural crops and finished goods from a great number of individual producers to an even larger number of individual consumers. By means of such administrative coordination, the new mass marketers reduced the number of transactions involved in the flow of goods, increased the speed and regularity of that flow, and so lowered costs and improved the productivity of the American distribution system."

Office paperwork technologies enabled the growth of administrative systems and the back office. Until the end of the nineteenth century, organizations stored their correspondence in piles, laying one piece of paper on top of the previous one until the pile got too high and then beginning a new pile. Some organizations stored these piles in stackable letter boxes, perhaps stipulating separate boxes for internal documents and external correspondence or giving very large customers their own box. Finding something that had been stored was difficult and inefficient (Yates 1982). The introduction of vertical filing systems made it possible to store and access efficiently much larger volumes of paperwork. This development combined with new copying technology, such as carbon paper and mimeograph, to enable the growth of back office support for transactions.

The telephone, railroad, and office paperwork technologies enabled sweeping changes in the number and nature of communication links that organizations and their employees had with one another. These linkages then could become formalized and regularized in new patterned relationships or structures. Compared to these large-scale technologically supported changes, structural changes associated with computing up to now have

been puny indeed. Recent developments in computer networks and computer-mediated communication suggest that more substantial structural change may be possible. The foundation will be computer networks: telecommunications transport and data networks that reach throughout the organization and beyond it to customers or clients and suppliers. (Voice and video networks are additional components of network infrastructure, but they are beyond the scope of this book.) Computer networks will let organizations create new organizational structures or links between processes and groups and will let organizations rapidly reconfigure structures. Some links will be relatively formalized as in electronic data interchange for fixed-format data on such matters as order processing or engineering designs. And others will be relatively informal and personalized as in electronic mail. Computer networks will let organizations experiment with new structures in ways heretofore impossible.

This chapter reviews three such possibilities. One is increasing organizational interdependence; the second is solving the out-of-sight, out-of-mind problem; the third is creating dynamic structures. The first focuses on relationships between organizations and the second and third on relationships within organizations. The general process of creating links by regularizing communication is common across all three topics. The evidence in this chapter comes almost entirely from case experiences. There has been almost no systematic empirical research on changing organizational structures through electronic communication because the processes are just beginning.

8.1 Increasing Organizational Interdependence

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To extend John Donne, no organization is an island. Every organization is interdependent with others. Manufacturing organizations depend on suppliers for raw materials and completed subassemblies. Sales and service organizations depend on customers or clients to buy their products or services. From any one organization's perspective (organization A), the best relationship is one in which it can have a continual presence in the other organization (organization B). A would like to capture B's attention and form mutually interdependent relationships with B. A would like to see B's employees behave as though they were employees of A without, of course, expecting a paycheck from A. With electronic communication, these conditions can be approximated.

Although this book emphasizes relatively unstructured human communication via computer, we begin by considering more stylized communications via electronic data interchange (EDI). Using network communications and precise formatting rules, organizations can exchange routine information rapidly and efficiently. EDI is widely used in order processing in various industries. A customer can transmit an order for goods through EDI from the customer's computer into a supplier's computer. There the order triggers other computer programs to generate one or more of the following: packing list, shipping order, invoice, inventory charge, or customer profile. The shipping order and invoice may be transmitted by EDI back to the customer and, when coupled with receipt of goods notification, may trigger payment authorization within the customer's computer system.

EDI, like many other computer-based communications technologies, was originally envisioned and is still often thought of as a way to speed up preexisting manual processes. It eliminates duplicate keypunching of the same information into both customer and supplier computers. It substantially reduces the transmission delays of sending order information via postal mail. American Hospital Supply (AHS), an early exemplar of EDI, demonstrates how the process can work. AHS distributes medical supplies to hospitals around the country. A few years ago it began installing direct-order terminals in hospital medical supply rooms. When hospital employees noticed that supplies of particular items were dwindling, they could enter restocking orders directly into the AHS system, which guaranteed 24-hour order delivery. In effect, hospital employees became part-time sales and order clerks for AHS using electronic communication.

Manufacturers also are now coming to rely on EDI. Just-in-time (JIT) manufacturing reduces the lead time required to obtain components from suppliers by, in part, increasing the communications bandwidth between a manufacturer (organization A) and its suppliers (organization B). An automobile assembly plant procures components, such as tires, upholstered seats, and windshields, from other organizations. With JIT, components for the day's assembly run are ordered through EDI a day or two in advance. Organization A uses a direct terminal connection into organization B to print out the orders for B to fill. Organization B's employees take those orders off the screen or printer and begin filling them, either through drawing down their own stock or through producing then and there what is needed.

We have seen that electronic mail does more than simply speed up existing work; so too does EDI. The second-order effects are more related to changing patterns of attention, social contact, and interdependencies than they are to speeding up information flow. EDI can cause organizations to focus attention on their internal procedures in new ways. For example, when Gillette opened EDI links with some of its biggest customers in the retail food distribution industry, it discovered anomalies in its internal pricing procedures.¹ Prior to EDI, Gillette sales representatives were able to offer promotional pricing discounts with some degree of discretion to their favored customers. With EDI, all price allocations were made by a centralized pricing routine. When formerly favored customers began complaining about missing their discounts, the company discovered that EDI meant more than accelerating information flow. It meant changing the social relationships between sales representatives and customers, and it led the company to rethink its entire discount pricing policy.

EDI can also help companies discover new businesses. Foremost-McKesson pharmaceuticals, like AHS, uses terminals located in their customers' pharmacies to maintain on-line inventories of customers' stock. They provide automatic stock replenishing when stock drops below a certain level. The employees of organization B (the pharmacists) become, in effect, sales and order clerks for organization A (Foremost-McKesson). But Foremost-McKesson uses the electronic connection for another purpose as well. Many pharmacy customers apply for third-party reimbursement of prescription costs. Foremost-McKesson uses information keyed in by its customers (pharmacists) at the time of a sale not only to maintain inventory records but also to prepare and submit third-party reimbursement requests for its customers' customers. It expanded its focus of attention from pharmaceutical supply information to third-party reimbursement information. Pharmacists can offer reimbursement requests as an attractive benefit to their customers and Foremost-McKesson gets into a new business. In terms of interdependence, the customers of organization B are encouraging it to buy from organization A.

The value of computer-supported connections in changing the focus of attention and creating new relationships between companies can be assessed by the concept of switching costs. If electronic connections between A and B would make it more expensive for B to obtain the identical product by switching to a different supplier, then A has increased the

switching costs for B. Increased switching costs are a sign that free market relationships between organizations have been replaced by different relationships or different structures. But isn't this an unstable situation? Won't company A's competitors also find ways to increase switching costs?

American Airlines offers a case in point. The first on-line airline reservations system, which was run by American, always displayed American flights as a first response to any query. Travel agents using this system effectively became part-time reservations clerks for that airline. But other airlines recognized the inherent competitive advantage the system gave American, and forced an end to that practice. Tom Malone, a professor at MIT, suggests that strategies like these for organizational interpenetration are fundamentally unstable (Malone 1987). Competitors of organization A will argue, as in the case of the American reservation system, that the interpenetration induced by the technology offers an unfair competitive advantage and operates in restraint of trade. It is too soon to tell if Malone's analysis is correct. If so, we may still see organizations using computer-based communication systems to catch the attention of potential customers or suppliers. If not, and in the meantime, computer-based communication is creating new means of organization interpenetration.

The concept of switching costs typically employs an economic perspective. Unfair competitive advantage and restraint of trade are measured in economic terms. The remedy is to make economic switching costs equal for all by allowing all equal access to the technology. But switching costs can also be assessed in psychological terms, particularly when EDI is coupled with electronic mail to provide links among people, as well as links among computer processes. In this view, even if economic costs are equivalent, if people from different organizations have developed satisfying personalized relationships with one another, they will be reluctant to forego those relationships by switching to another supplier.

E. I. du Pont de Nemours and Co. understands the concept of psychological switching costs. It offers electronic connections to over eight hundred of its customers and suppliers, links for both data and electronic mail. As vice-president R.E. Cairns, Jr., sees it:

If you're a company that we're dealing with and we have your engineers dealing with our engineers on electronic mail and they've established a relationship and they know each other, it's different than just working through the purchasing agents. If John [our competitor, figuratively speaking] comes in with a penny a pound decrease in price or a nickel a pound, okay? The cost for you to switch to him in the past would have been just that. Now you have to switch your engineers.

Who are they going to contact? How is the relationship going to be developed? How are the partnerships going to be enhanced? Because we're really talking about greater partnerships between companies these days. And so by doing that, switching costs will increase. (Mead 1990:68)

The psychological links can also be strengthened by pleasurable interactions that have nothing ostensibly to do with work. In the travel industry, hotels and car rental companies are continually trying to catch the attention of travel agents so that the agents will recommend and use their services rather than those of their competitors. Within the on-line reservations systems, heavily used by travel agencies, there are few obvious cues to differentiate one company and its services from another. Some hotels and car rental firms, recognizing this, have added popular extracurricular messages to their system files. Thus, for instance, a travel agent who wants to read his or her horoscope or the daily soap opera summary selects a particular hotel chain from the system and within that hotel chain's directory pulls up the daily horoscope or soap opera file. The transaction has nothing overtly to do with work, but it keeps the name of one hotel chain (rather than its competitors) on the agent's screen. (And it suggests an additional function for extracurricular messages beyond those discussed in chapter 5.)

Psychological links can also be strengthened by the perception of receiving special treatment. The strength of EDI is in regularizing relationships. But even in such regularized interactions as order processing, exceptions occur. A customer, for instance, may need to return ordered goods. Black and Decker illustrates how electronic order processing can be coupled with electronic mail to give customers special assistance. Black and Decker's power tools division sells a wide range of construction and home maintenance products to hardware distributors and retailers. At times, a customer in California might have a surplus of a certain product and return it to Black and Decker for credit. Meanwhile in New York another customer might require that product. If buyer and seller can be matched, the goods are shipped directly from California to New York rather than being reprocessed through Black and Decker's inventories. In the past, sales representatives and managers depended on postal mail to try to engineer such swaps. Only 10 percent of the requests for buyers were satisfied in this way, with the remaining 90 percent of excess goods returned to inventory.

Black and Decker recently installed a computer-based communication system for its 260 sales representatives and managers used for order entry,

product line shortage reports, and managerial communications (Meyer and Boone 1987:84-86). The system also has an on-line swap shop. When a customer wants to return goods, an electronic message is sent to the swap shop coordinator. If the request cannot be matched with a buyer, an electronic notice is sent to the entire sales force. Requests are now resolved in fewer than 48 hours, and the swap rate has risen from 10 percent to 80 percent. Local governments in western Pennsylvania use a similar electronic swap shop to exchange information about such items as needed fire engines or surplus snow plows.

In a highly competitive market, insufficient buffering against regional fluctuations in customer requests represented a significant loss of profits and a significant opportunity for computer-based communications technology. Black and Decker could have improved its own inventory system, but given its manufacturing realities, the savings would have been small. Instead it gained a significant marketing advantage by helping remote customers manage their inventories at the same time it helped its remote sales managers manage theirs.

Electronic linkages between organizations will substantially increase in the future. They will undoubtedly reduce processing time and cost for many routine transactions. Their more important effects, however, are likely to be found in how they change the focus of attention, social contact patterns, and interdependencies among organizations. We cannot predict the particular form that these changes will take, but organizations that see more than efficiency benefits will be best positioned to capitalize on them.

8.2 Solving the "Out of Sight, Out of Mind" Problem

(1) We're All in This Together

In large organizations, geographically separated subunits may need to work together. If left to their own devices, however, each experiences subunit drift, the tendency to develop parochial views and to drift in idiosyncratic directions. From the organization's perspective, the best situation is one in which subunits A and B keep each other continually in mind. But with geographic separation, it is difficult for each unit to keep the other continually in mind and therefore also to keep their common goals in mind. People naturally attend to what is close at hand and ignore what isn't (Kiesler and Sproull 1982). Importance isn't perfectly correlated with proximity, though, and remote communications are essential even in

highly decentralized organizations. Yet they can be difficult. For instance, the director of European operations for an automated testing equipment firm claims that if he were to stay in touch by telephone with his firm's U.S. divisions, corporate headquarters, and subsidiaries, he would be on the telephone constantly. Because he can't do this and because of time zone and language differences, it is easy to lose touch with physically distant people and operations.

Organizations use a variety of ways to keep people in touch. Members of one subunit may travel extensively to the other. They may schedule routine conference calls. Some organizations have experimented with video conferencing.² All of these methods are better than nothing, but none includes informal mundane contact—the exchange of everyday experiences that people in the same setting can't help but do. In fact, the unnaturalness of these methods may exacerbate differences across subunits rather than reduce them. The coffee pot, the telephone, and electronic mail share the advantage of encouraging informal conversation and gossip about ongoing events, but electronic mail is the only one of these three to allow such conversations to take place both asynchronously and at a distance.³

Computer-based communication technology alleviates some of the routine communication problems, but it also has a more subtle impact on what is in the manager's mind. In a neighborhood, people recognize one another and share common context and mundane events on a frequent basis. As a result of this interchange, people come to identify with the collective group and find common interests with other group members. The telephone extended peoples' psychological neighborhood in the first half of the twentieth century by letting people share common context and mundane events independent of physical proximity (Aronson 1971). Computer-based communication may allow people to extend their organizational neighborhood in much the same way.⁴ As the European manager described above noted, "Japan is now on electronic mail and it's like we found them again!" (Meyer and Boone 1987:220).

Austek, a small custom computer chip manufacturer, has its main offices in Adelaide, Australia, and a substantial sales organization located in Silicon Valley, California. The president of Austek commutes between Adelaide and California, spending two or three weeks in each location before returning to the other. He is not fond of travel but takes on this schedule because his presence in both locations reminds employees that

they're all working for the same company. Austek uses electronic mail to the same end. In addition to one-to-one mail and group mail, Austek uses one electronic bulletin board for the company's daily events that people in both sites read. On any day, in addition to announcements of seminars, special meetings, or visitors, it might include a message that strawberries will be served with tea in the commons room at 4 P.M. or nachos will be served with beer in the courtyard at 5 P.M. A newcomer to the organization thought he could save money by forbidding the cross-posting of "irrelevant" messages, arguing that no one in California would want to know what was being served with tea in Australia and no one in Australia would want to know what was being served with beer in California. The president of Austek disagreed with this analysis, arguing that it was important for people in each site to be reminded every day of the existence of the other site. "Irrelevant" messages, which took only a few seconds to scan, were an almost subliminal reminder of the other site.

Even more extreme subunit separation exists when one company (A) acquires another (B), which is to continue its own business. In this case the acquired company must retain enough autonomy to continue doing well what it did before it was acquired. At the same time, each firm must begin exchanging information with the other, and each must come to believe B is part of A. When Tandem acquired three smaller companies in 1988, its first postacquisition act was to put each of the three companies on the Tandem electronic mail system. Electronic mail provided easy information access between Tandem and each of its acquisitions, which were located in different parts of the country. In the terms of chapter 2, electronic mail reduced the transaction time for exchanging information between Tandem and its acquisitions. And it did more than that. It helped employees in each company begin to "meet" people in the other company—to know their names and what they do. With this information, employees in each company could develop a sense of whom to contact for specific information to solve a particular problem. Furthermore, by joining electronic distribution lists or special interest groups, employees of the acquired companies could "watch" Tandem employees by reading group messages. The president of Tandem hoped this would serve as a socialization experience, helping the acquired employees learn about Tandem employees and norms. Precisely what they learned was never measured, but surely any acquired employee who read group mail did begin to learn the "Tandem way." In most acquisitions, formal mechanisms are established to educate each

company about the other. Ordinary employees are likely to be a bit skeptical of information disseminated by these mechanisms. They are likely to take more seriously information that they glean from “ordinary” people—regular mail system participants—who are not paid to convey that information. It is the process of attributing greater sincerity to people who have insufficient external justification for their actions.

Computer-based communication can usefully counter the tendencies of subunit drift, exhibited when subunits are not closely linked to one another. Although it does not substitute for face-to-face communication, it can keep people reminded of one another so that every new face-to-face meeting is not a meeting of strangers but a meeting of neighbors.

(2) Connections through Copying

Drift can occur not only when people or groups are geographically separated but also when they are too busy with their own concerns to inform and keep informed about others. A product marketing manager for Telecom Canada had to interact with his staff of eight people, along with the engineering department building the product, public relations, the legal staff, and others. Although he could not be everywhere, he had good insight into what everyone was doing because he was being copied on communications that, without electronic mail, would have taken place in private telephone calls or face-to-face meetings that he could not attend. Were it not for the electronic mail system, he would have found out about these communications only when his staff reported to him—if they had time and remembered to do so (Caswell 1988).

Electronic mail not only increased what the manager knew about his subordinates' doings, but it also increased his knowledgeability about related activities in other departments. The manager was responsible for marketing the new product, but his engineering counterpart was responsible for building it. Each had staffs of equal size, along with responsibilities and problems of similar magnitude. The two managers had to coordinate their work closely but had to spend most of their time on their separate tasks. Yet both were kept apprised of the other's doings through electronic mail. Both parties were copied on messages that related to anything associated with joint coordination and were often included on marginally related problems. Instead of communications flowing only up the hierarchy, they often flowed from subordinates of one manager to both higher-

level managers simultaneously. This increased the probability that the two managers would talk about problems or capitalize on opportunities that involved both of them.

Connections through copying can create problems as well as opportunities. Subordinates who habitually copy their superiors on messages may “copy up” problems they should resolve themselves. In one company with an active electronic mail system, mid-level managers complained that they were sucked into everybody else’s problems by being copied on irrelevant messages. A trivial message might be copied to more than one manager or could be sent by more than one subordinate or might even be sent to many people, perhaps to the entire company via a broadcast message. It is much harder to ignore problems that have been publicized than problems that are kept private.

The desirability of copying up depends on how close to the firing line management wants to be (McLaren 1982). If people know about only their assigned tasks, they will be less distracted by outside events. On the other hand, they may miss opportunities to become better informed about and contribute to the larger context in which their tasks are situated. Other considerations equal, our choice would be for more connections through copying, but ultimately it is a dilemma with no single right answer.

8.3 Dynamic Structures

All organizations have some form of hierarchy, but all hierarchies are not created equal. Some organizations, such as those in some R&D firms, are so fluid that it is not even obvious which hierarchical level is the superior one. Other organizations, often disparagingly termed bureaucracies, have clear lines of control and a firm sense of which subunit is responsible for which activity. Two merits of bureaucracy are that work and job responsibilities are rationalized and that behavior is buffered from the whims and idiosyncrasies of individuals. The same features are its demerits. When activities are rigidly specified, how does the organization do something new? How does a manager exert leadership? One way to allow for flexibility without eliminating stability is to create temporary dynamic structures, such as ad hoc groups and teams. These can be thought of as soft structures, sets of systematic and patterned relationships that emerge, evolve, and disappear over time.

(1) **Electronic Groups at Work**

Modern organizations are generally structured to locate routinely interdependent activities in close proximity. While this strategy increases the efficiency of routine behavior, it can disadvantage organizations facing nonroutine problems and opportunities that cut across conventional structures and boundaries. Electronic groups may help organizations create more flexible structures so that the experience and expertise of employees can be mustered wherever it is needed.

Electronic task groups can have larger, more complex, and more fluid structures than their face-to-face counterparts. The Rand experiment on electronic task forces showed that both retiree task forces created subcommittees, but the task force with electronic communication created more of them. Both task forces assigned members to subcommittees: the task force without electronic communication assigned each person to only one subcommittee; the task force with electronic communication had people on more than one subcommittee. Not only were there more subcommittees in the task force with electronic communication, but also they were organized more complexly in an overlapping matrix structure. New subcommittees were added during the course of that task force's work. And indeed the group decided to continue meeting even after the official one-year life span of the committee had ended. Electronic communication helped the structure of the one task force to grow and change as its task evolved.

The software development teams first described in chapter 2 also used electronic communication to create useful subgroup structures. Using one-to-one mail, project managers and chief programmers created two-person crisis management groups that kept on top of the ever-changing project requirements and personnel shifts. Using the all-group distribution lists, project managers and chief programmers kept all other team members informed of changes. In this fashion electronic communication technology helped the teams create in-groups without out-groups.

All complex organizations experience conflicts between organizational subunits. For instance, it is not uncommon for marketing departments to vie with R&D departments over control of projects. The department that has less control exhibits hostility toward the favored group, which acts defensively. This divisiveness could be reduced by the multiple group memberships that electronic mail technology permits. Members of the marketing and development departments who belong to DLs that span

interests in both places—Consumer Research, for instance—act as “link pins” who can promote cooperation and solidarity between the separate departments.

(2) A Structure for Every Task

Organizations have formal subunit structures—blunt instruments for delicate and complex tasks. General-purpose structures are not often the best for any particular task, but over many tasks, they are good enough. One conceivable alternative—designing a separate special-purpose structure for every task—is infeasible in most cases. Computer-based communication may make it more feasible for some tasks by allowing people who are physically located at one place to participate in multiple electronic task groups.

When a complex organizational task involves more than one subunit, a change made by one subunit can have ramifications for others. Consider the design task for a new automobile. Subassemblies, such as window handles or chassis, are designed by different teams and are subject to common design goals and constraints. Once component designs have been set, any further change in one of them must be accompanied by proper notification to those in charge of all other component designs that could be affected by the change. That is the process in theory. In practice people or units can be inadvertently dropped out of the loop or not notified of changes that affect them. Such oversights then lead to delays downstream when incompatibilities or conflicts are discovered. This problem could be eased if all the relevant parties spent all their time watching for changes in other components that might affect their own. If they did that, though, they wouldn't have the time to do their own jobs.

All the relevant parties do attend to some common stimuli, however. The most important are the design document and the project budget. We can envision an “intelligent document” in the future—one that knows, whenever a change is made to it, which other people need to see that change. The document thus has embedded within it a representation of the organization structure relevant to that task. Whenever a change is made to the document by one party, all the affected parties are automatically notified of the change via electronic communication. If necessary, all recipients could be required to return an electronic acknowledgment of the change. Every document may have a slightly different structure associated with it, but that

is fine. In this view, employees no longer work in one structure and carry out a variety of tasks. Instead they work in as many different structures as they have tasks.

8.4 Conclusion

Organizations are just beginning to experiment with using computer-based communication technology to create new interorganizational linkages, to solve the out-of-sight, out-of-mind problem, and to create dynamic structures. Organizations first need to gain experience with and be comfortable with electronic groups and changing information procedures before they attempt electronic restructuring. We have very little evidence about electronic restructuring because such attempts are just getting underway. Their long-term effects, though, may be profound.

So will be the management challenges. Imagine the difficulty of trying to hire someone who will work in ten different soft structures. How do you manage and evaluate such a person? Where will such a person's loyalties be? How do you think about the organization chart when it may look different for every employee and for every day of the week? The bookkeeping won't be too complicated. If the structures are electronic, there can be computer support for allocating effort to different budgets and maintaining running records of progress across structures. Organization charts can be displayed dynamically on-line. The real challenge will be to the human imagination to envision and invent new ways of working in these structures.)

An organization making new connections does not merely add new behaviors to an unchanging base. Rather, the process is a transforming one, leading to and reinforcing fundamental changes in how people work, interact, and think. We have documented some of the potentially transforming changes in interaction and work. Here we briefly suggest how people in networked organizations can come to think in transformed ways about three important topics: the relationship of an employee to his or her organization, the nature of organizational structure, and the nature of management.

In conventional organizations employees typically work within one discrete and identifiable work unit. Their relationship to that unit is strong, whereas their relationship to the larger organization is weak. In our vision of a networked organization, employees can come to be thought of and think of themselves as employees of the larger organization. When they share information with unknown colleagues located in distant places and work in electronic groups whose members are drawn from many subunits, their mental maps of the organization become more elaborate and well informed. Their identities and loyalties also are likely to be more influenced by the larger organization. In the past, organizational cosmopolitanism—a broad view of an organization's goals and processes—has been mostly the province of senior management. Our vision makes it possible to think of extending cosmopolitanism throughout the networked organization.

The organization chart is a useful way to display patterned relationships among subunits in conventional organizations. It reflects two properties that define conventional views of structure: stability of relationships over time and hierarchical decomposition of goals and tasks. In our vision of a networked organization, people are simultaneously linked to and buffered

from numerous others in multiple groups; groups or subunits are also simultaneously linked to and buffered from one another. The concept of structure as a static, or even stable, set of relationships gives way to a concept of soft structures, as dynamic and flexible relationships emerge and evolve. In our vision of a networked organization, an organization chart would be obsolete before it could be printed and distributed. Moreover, even if it were theoretically possible to capture a picture of structure at any point in time, to record it would require an enormously wide piece of paper because hierarchical decomposition gives way to distributed lattices of interconnections.

In conventional organizations managers know whom they manage and manage whom they know. The concept of management will require substantial revision when people work in multiple groups, when groups are composed of members who collaborate only electronically, and when soft structures emerge without management directive. We do not prophesy the demise of management, but our ideas about management will certainly change. Rather than know intimately each worker and each job under their personal supervision, managers will become strategists who coordinate a variety of workers and situations. The morale of some managers will be much higher because of their varied responsibilities and experience. The morale of others will suffer. Hence one cannot just impose new structuring arrangements and new kinds of management without considering the qualities and attributes of the employees one has or can have.

A recent event in mathematical research suggests some of the challenges. Two mathematicians employed by Bell Communications Research and Digital Equipment Corporation used electronic mail to recruit several hundred researchers from companies, universities, and government labs around the world. They asked them to work on solving a large and important mathematical problem, one with practical implications for cryptography. Researchers who volunteered to help were sent a piece of the problem and returned their solutions by electronic mail. All of the partial solutions were then used to construct the final solution. The electronic message announcing the final results contained a charming admission: the two mathematicians who organized the work and constructed the final solution from the pieces returned to them did not even know the names of all of the people who helped them:

We'd like to thank everyone who contributed computing cycles to this project, but I can't: we only have records of the person