Organizational Trends

Introduction

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THIS SECTION DEALS WITH TWO of my favorite topics: people and organizations, and how each interacts with and shapes the other. A number of years ago, a friend shared with me a thought germane to this discussion. We live life forward and understand it backward. We often leap into the fray of everyday life and become deeply enmeshed in everyday problems. Only later, after living the experience and reflecting on it, do we understand the significance of these experiences, what we did, and the intelligibility of the process. As a case in point, as I was rereading the 2020 Vision papers, I was struck when I remembered the thoughts expressed by Peter Drucker more than a generation ago about what he termed the *knowledge worker*. These ideas, which now seem prophetic, noted the emergence of the knowledge worker who, by his or her own expertise and specialized information, contributed in a unique way to the manufacturing or service process, yet who might not have any direct control over the institution's people or resources. Drucker saw then what we in retrospect now recognize as the emergence of the knowledge worker who contributes, coordinates, and creates information and communicates that information in various ways and to various levels of the organization, irrespective of formal pathways of control or hierarchy. He predicted very accurately how this worker would reshape organizations and how information would assume an even more important role as we made the transition to the information age. Current developments are fulfilling his promise.

Those of us who deal in information are almost overwhelmed by opportunity and challenges in a field becoming ever more competitive. Ten, twenty, or thirty years ago, archivists, librarians, and a few other information professionals played in a field that was relatively deserted. As information has assumed a much more critical role in every process and the computer has allowed individuals to handle, manipulate,

and communicate information at speeds undreamed of by previous generations, individuals and institutions have flooded into the information field.

To be competitive, even to survive, archivists must carefully reevaluate their approach to information. While continuing to recognize the importance of information in its more traditional forms, we must understand how information and institutions are shaping and reshaping one another, how rapid communications are accelerating this process, and how institutions are changing as the result of a better educated and more autonomous work force.

Archivists have the opportunity to influence, as we never have had before, how information is created, shaped, and preserved; how accessible it will be; and how it will be used. The real challenge to us as archivists, information professionals, and managers is to understand the direction organizations are taking, to assess the impact of technology, and to ensure that archival requirements are integrated into the systems and processes. If we do not do this, these considerations will be left solely in the control of the technologists.

This section addresses current organizational trends, but I am struck by a thought that is germane to all of the 2020 Vision sections: the questions we raise today are more important than the answers we may arrive at. As we move into the future, the questions, if they address fundamental issues, will change more slowly than the answers we may reach at at any one time. If these sessions raise more questions than they answer, it will be a success; perhaps fewer answers will not be a disappointment.

Organizational Trends

Organizational Trends and Electronic Media: Work in Progress

TORA K. BIKSON

Abstract: Organizations are experiencing rapid and widespread growth in the use of information and communication technologies, with associated changes in the ways work is organized and carried out. These changes—apparent in trends toward greater flexibility, denser connectivity, broadened participation, more team work, and more permeable boundaries—have yet to appear in formal policies, procedures, organization charts, and reporting relationships. Given the inherent synergies between networked media and the design of work, all prescriptions for future organizational forms should be viewed with skepticism. Rather, organizational decision makers should give greatest attention to understanding and managing open-ended change processes. Further, as these processes unfold, they should exploit the capabilities of new technologies to document and store information about emerging organizational forms and functions. Besides serving the needs traditionally filled by records and archives, such information can provide the material for organizational memory and organizational learning.

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THIS PAPER IS SUBTITLED "Work in Progress" to reflect both the state of social science knowledge and the state of organizations right now. Both are trying to incorporate and understand the roles of new electronic technologies. In the 1990s, most large U.S. organizations in the private and public sectors will make distributed computing power available to individuals while embedding it in a shared information infrastructure. Like Ronald Weissman's article in this issue, this overview emphasizes the remainder of the 1990s. It is possible to be reasonably confident about projections up through the year 2000; but, for reasons to be discussed later, projecting to the year 2020 poses problems for organizational researchers even as it poses problems for technology experts.

At present, organizations and social science researchers have done a better job of understanding how individuals can make use of powerful stand-alone tools than they have of learning how to develop effectively shared information infrastructures. Such infrastructures, for the purposes of this paper, are taken to include not only the networks that allow us to communicate with remote databases or remote colleagues but also the systems and devices that connect us with local area networks and let our applications communicate directly with one another. While many organizations have begun to implement these kinds of shared, integrated information environments, the latter half of the 1990s should find them in general use, for two important reasons: the push of technology and the pull of demand.

Technology and Demand

Technology push. The first reason can be described as a technology "push." Weissman's paper provides compelling examples of improvements in price: performance ratios for computing. Computer technology has become less expensive but more powerful, better, faster, smaller, and so on; communication technologies are exhibiting similar advances. Having begun at least two decades ago, such changes are likely to continue throughout the 1990s and beyond. They are the enabling force behind the widespread diffusion of networked computer based tools at the level of individual workstations.[1]

A new technical impetus comes from the progress now being made toward technologies for shared work. Weissman refers to collaborative tools, for which the current acronym is CSCW (computer supported cooperative work). Many disciplines—including computer science, cognitive science, social psychology, engineering, and information systems departments of business schools—are now engaged in research in this domain. What unites their efforts is a focus on the need for tools that facilitate shared tasks and operations.[2] Not surprisingly, the significant work of organizations is rarely done by individuals acting on their own but rather comprises multiperson efforts.

Complementing the transition to computer supported cooperative work is progress toward open systems environments, also

[1] Lawrence Tessler, "Networked Computing in the 1990s," *Scientific American* 265 (September 1991): 86–93.

[2] Research on computer supported cooperative work began to emerge as a distinctive field of study in the latter half of the 1980s. Because it is inherently interdisciplinary, the research it generates is widely dispersed in journal literature. The best sources for collected material in this field are edited volumes. See, for instance, Jolene Galegher, Robert Kraut, and Carmen Egido, eds., *Intellectual Teamwork* (Hillsdale, N.J.: Erlbaum, 1990); Margarethe Olson, ed., *Technological Support for Work Group Collaboration* (Hillsdale, N.J.: Erlbaum, 1989); and Irene Greif, *Computer-Supported Cooperative Work* (San Mateo, Calif.: Morgan Kaufmann, 1988). See also the Proceedings of the Conference on Computer Supported Cooperative Work (New York: Association for Computing Machinery, 1986, 1988, 1990 and 1992). A carefully annotated bibliography of readings in this field is available in Saul Greenberg, "An Annotated Bibliography of Computer Supported Cooperative Work," *SIGCHI Bulletin* 23 (July 1991): 29–62.

briefly mentioned by Weissman; the most notable achievement in this area is the Open Systems Interconnection (OSI) reference model. While CSCW research explores how small collaborative task groups can make better use of electronic media, the OSI movement is pursuing ways in which geographically dispersed individuals and organizations can be more transparently interconnected. The development of open international standards is an attempt to provide interoperability between organizations or between different units of large organizations, even if they are in different parts of the world and use quite different hardware and software.[3] Technology push, accompanied by efforts to support networked interactions at local and global levels, is one of the reasons why the long-predicted information revolution in organizations should become a reality in the 1990s.[4]

Demand pull. The second reason concerns what can be called demand "pull," which reflects strong organizational incentives to deploy these technologies more effectively. It has been alleged for some time that we have entered a postindustrial economy; yet information is regarded as "the last great unmanaged resource" of twentieth-century organizations, as Weissman and others suggest.[5] For example, a great deal of any organization's information today resides in individual workstations, undocumented, unscheduled, and stored according to idiosyncratic filing schemes.[6] In principle, the information is retrievable, but it is unclear whether anyone besides the original creator of the information could in fact retrieve and reuse it (and even whether that individual could find it again within, for example, a year of its creation). Given that information resources are thought to be of critical importance in the postindustrial economy,[7] the consequences of their mismanagement (or nonmanagement) could be severe and costly over time.

Information work constitutes an increasingly large proportion of organizations' activities and costs. Bureau of Labor Statistics data indicate that the number of white-collar jobs in U.S. industry has grown dramatically over the past few decades. By now, jobs in the service sector account for 77 percent of all employment.[8] Even within manufacturing firms, estimates are that 65 to 75 percent of the labor is value-added

[3] An excellent source of information about the Open Systems Interconnection reference model for nontechnical readers is available from the Advisory Committee for the Coordination of Information Systems (ACCIS), *Strategic Issues for Electronic Records Management: Towards Open System Interconnection* (New York: United Nations, 1992). The volume also provides citations to relevant technical documents. See also the discussion in A. S. Tanenbau, *Computer Networks,* 2nd ed. (Englewood Cliffs, N.J.: Prentice Hall, 1988), 14–34.

[4] R. I. Benjamin and J. Blount, "Critical IT Issues: The Next 10 Years," *Sloan Management Review* 33 (1992): 7–20.

[5] See Weissman's article in this issue. See also "IS/21: Creating Information Services for the 21st Century," a research report on chief information officer responses to I/S issues, planning, and trends, based on results of the third annual Coopers & Lybrand/Datamation CIO Survey (prepared by Coopers & Lybrand, January 1991).

[6] T. K. Bikson and E. J. Frinking, *Preserving the Present* (The Hague: Sdu Publishers, 1993). See also Richard E. Barry, "Getting It Right: Managing Organizations in a Runaway Electronic Age," in *Information Handling in Offices and Archives,* edited by Angelika Menne-Haritz (New York: Saur, 1993), 27–55.

[7] See, for example, J. Y. Bakos and M. E. Treacy, "Information Technology and Corporate Strategy: A Research Perspective," *MIS Quarterly* (June 1986): 107–19; J. S. Brown, "Research That Reinvents the Corporation," *Harvard Business Review* (January–February 1991): 102–11; Claudio Ciborra, *Teams, Markets and Systems* (Cambridge: Cambridge University Press, 1993); G. P. Huber, "The Nature and Design of Post-Industrial Organizations," *Management Science* 30, no. 8 (1984): 928–51; P. G. W. Keen, *Shaping the Future* (Boston: Harvard Business School Press, 1991); P. A. Strassman, *Information Payoff* (New York: Free Press, 1985); and R. E. Walton, *Up and Running* (Boston: Harvard Business School Press, 1989).

[8] G. Silvestri and J. Lukasiewics, "Occupational Employment Projections," *Monthly Labor Review* (November, 1991): 65 (table 1).

information work rather than goods-producing work.[9] Needs to streamline such work, decrease costs, and improve bottom-line performance are driving organizations to exploit electronic media in new ways. In the past, the information and service sectors of the U.S. economy were largely protected from interstate as well as international competition. But regulatory constraints on such interchange have been relaxed, in part to allow institutions to take advantage of the boundary-spanning capabilities of these new media. At the same time, decreased regulation exposes these sectors to new competitive pressures.[10] The challenges presented by a more dynamic and globally interdependent economic environment have only intensified the demands for improved performance. Organizations hope that these demands can in part be met through better use of advanced information and communication technologies.[11]

The intersection. The sections that follow examine what the intersection of technology push and demand pull means for organized work in the near term (i.e., to about the year 2000), based on findings from recent social science research. The longer-term implications of these new ways of working for organizational design and management are then discussed. Finally, although there is no certainty about the nature of the organization of the future, this paper nonetheless attempts to draw some conclusions and make some recommendations related to organizational trends and new electronic media.

The focus here is on organizational trends associated with the use of computer-based information and communication technologies for white-collar (or information-intensive) work. It does not consider electronic technologies used, for instance, to control production processes (e.g., numerically controlled manufacturing tools) or to handle point-of-sale transactions (e.g., bar-code readers for registering retail prices). The discussion draws on a growing body of research on electronic media as used within organizations by intact work units.[12] In particular, it relies most heavily on recent RAND research carried out in both private and public sector organizations whose activities are national or international in scope.

Five Organizational Trends

The union of the abilities to create, access, interact with, store, display and disseminate information by means of linked individual workstations provides the basis for profound changes in the way organizations work. These changes will, for ease of presentation, be described in terms of five trends, but their separation is arbitrary, and their synergy is the real foundation for new forms of work. Already present in organizations, these trends are technologically enabled but not technologically

[9] J. Brian Quinn, *Intelligent Enterprise* (New York: Free Press, 1992).

[10] National Research Council, *Information Technology in the Service Society: A Twenty-First Century Lever* (Washington, D.C.: National Academy Press, 1993).

[11] Paul Attewell, "Information Technology and the Productivity Paradox," in *Understanding the Productivity Paradox: Organizational Linkages,* edited by Douglas H. Harris (Washington, D.C.: National Academy Press, forthcoming).

[12] The RAND research on information technology in organizations referenced throughout this paper defines *work groups* in terms of primary work subsystems, borrowing from sociotechnical systems analysis literature (see, for example, E. L. Trist, "The Sociotechnical Perspective," in *Perspectives on Organization, Design and Behavior,* edited by A. H. Van de Ven and W. F. Joyce (New York: Wiley and Sons, 1981). So construed, work groups comprise a number of individuals whose work is united by output and/or work flow; they thus form a bounded, complex whole, whether or not they are designated as a formally distinct unit on an organization chart. This definition is explained in more detail in T. K. Bikson, " A Response to Attewell and Rule," in *The Information Systems Research Challenge: Survey Research Methods,* edited by K. Kraemer (Cambridge, Mass.: Harvard Business School Press, 1991), 323–36.

determined. Each is illustrated with some research-based examples.

Greater speed and flexibility. Greater speed and flexibility in information- and communication-intensive tasks is perhaps the most apparent trend. It is manifest both within workstations (as information moves from application to application) and between workstations (as information moves from person to person in collaborative work). In both processes, there is a close intermingling of the substantive and technical context of tasks. For instance, "biocomputing" is a field of specialization that combines expertise in computing with expertise in another field; a recent National Research Council report provides several similar examples.[13] Even where no such formalized specialties are involved, many people who use computers for information work find that their tasks and their tools have become almost inextricably combined.

One result, according to an employee in a globally oriented business services firm taking part in a RAND study, is that "there is a sense in which we don't really ever sell the same product twice"; rather, preparing and delivering these services in an electronic environment permits tailoring them to suit customers' needs.[14] What enables this union of tasks and tools is the modularity and tailorability of applications, allowing individuals with domain expertise who are not trained as programmers to modify the software they use so it better conforms to the work at hand. Consequently, a new information product or service can be produced and disseminated much faster.

Changes in the speed with which information work can be accomplished are usually illustrated with very impressive examples. Today the National Research and Education Network (NREN) allows information to be communicated at the rate of 45 million bits per second; this means that the entire collected works of Shakespeare could be transmitted in four seconds. A fiber-optic network would allow information to be communicated at rates of 100 million to nearly 2.5 billion bits per second; at the middle of the range, the complete Shakespeare could be transmitted in a quarter of a second.[15] While informative, such examples are hard to interpret in relation to routine computer-supported information work in organizations.

More instructive about the speed and flexibility of information use in day-to-day work are data collected in an internal RAND study of electronic mail (e-mail) flows. During the summer of 1991, RAND logged e-mail activity for a six-week period, retaining message-header information for analysis.[16] Collectively, this organization of about five hundred researchers and five hundred support or administrative staff sent

[13] See also National Research Council, *Computing Professionals: Changing Needs for the 1990s* (Washington, D.C.: National Academy Press, 1993); and T. K. Bikson, B. A. Gutek, and D. A. Mankin, *Implementing Computerized Procedures in Office Settings: Influences and Outcomes* (Santa Monica, Calif.: RAND R-3077-NSF, 1987).

[14] T. K. Bikson and S. A. Law, *Global Preparedness and Human Resources: College and Corporate Perspectives* (Santa Monica, Calif.: RAND MR-139-CPC/IET, 1993); National Research Council, *Information Technology in the Service Sector.*

[15] Benjamin and Blount, "Critical IT Issues."

[16] To preserve the privacy of e-mail users, data were collected in the following way. The logging program first stripped out subject lines and message bodies. It then looked up senders and recipients in the directory database, recording such characteristics as job category and department. Last, it removed the names of senders and receivers, replacing them with arbitrarily generated but unique numeric codes. The result was a database with information about volumes and patterns of messaging at a detailed level but with no ability to associate the data with identifiable individuals. Variants of these procedures are described in more detail in J. D. Eveland and T. K. Bikson, "Evolving Electronic Communication Networks: An Empirical Assessment," *Office: Technology and People* 3 (1987): 103–28; and in T. K. Bikson and J. D. Eveland, "The Interplay of Work Group Structures and Computer Support," in Galegher, Kraut, and Egido, eds., *Intellectual Teamwork*, 245–90.

Table 1. Cumulative Distribution of Response Times for 31,277 Replies (hours or days from time of receipt)

Hours from Receipt		Days from Receipt	
.25	4,183	1	25,466
.5	6,844	2	27,307
1.0	9,853	3	28,630
*1.5	12,066	4	29,970
2.0	13,608	6	29,970
**4.0	17,205	8	30,290
8.0	19,897	10	30,512
12.0	20,957	15	31,277

*mean time to reply
**median time to reply

nearly 75,000 e-mail messages. Interestingly, that number of sent messages translated into well over 200,000 messages received during the same period—a reflection of the ease of sending the same message to multiple recipients.[17] More surprising, however, was the rate at which people responded to electronically received information. Of the 75,000 original messages, over 30,000 were replies. To get at the pace of e-mail interaction, we subtracted the time of message receipt from the time of response in the header data for replies. The results are shown in table 1.

While the range is substantial—in part a reflection of the fact that some message recipients were on vacation during the period—the average time to reply is just an hour and a half, and over half of all replies are received within four hours. In comparison to the flow of internal correspondence, this is a pace of truly dizzying speed. And, given that 70 percent of phone calls fail to reach their targets on the first try, it may be that e-mail represents a faster rate of completed interactions than does the telephone.[18] One more point is also worth noting. The data in table 1 show that over 10 percent of all replies are received within the first fifteen minutes, suggesting the very rapid rate at which exchanges can occur in day-to-day information work. They also suggest that those who wait until the next working day to reply may have little substantive influence on the discussion because a sizable majority of the replies are already available.

Whereas table 1 relates chiefly to speed, figure 1 reflects the flexibility provided by e-mail. Also drawn from an internal study of RAND's use of e-mail, it reflects percentage of messages sent by the time of day when they were sent: the broken line represents messages sent by individuals in RAND's Washington, D.C., office, and the solid line represents messages sent by those in the California office; for ease of comparison, all are displayed against Pacific standard time on the abcissa.[19]

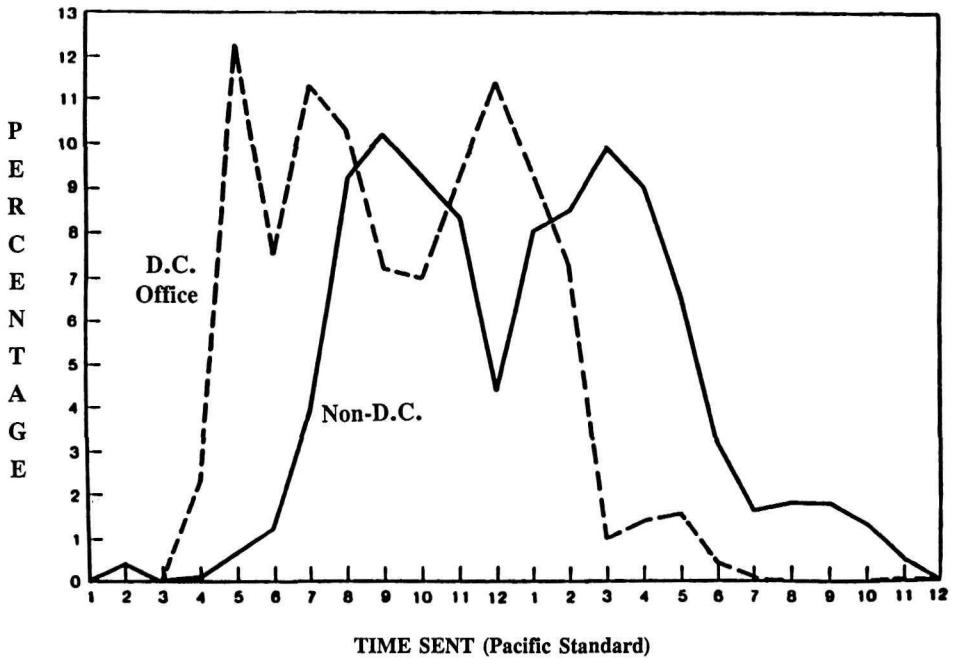
Patterns of message sending throughout the day reveal, first, that people are able to tailor their information-related activity to the demands of their own schedule; the asynchronous nature of e-mail allows them to engage in collaborative work before the standard business day begins or after it ends. In the California office, for instance, about 30 percent of all messages are sent before 8:00 a.m. or after 5:00 p.m. The ability to collaborate asynchronously is even more important for geographically dispersed groups. Comparison of the broken and solid

[17] That the number of messages received exceeds the number of messages sent, sometimes by a considerable margin, is a frequent finding in research on e-mail use in organizations. See, for example, Robert Kraut and Paul Attewell, "Electronic Mail and Organizational Knowledge: Media Use in a Global Corporation," unpublished manuscript, 1993; T. K. Bikson and S. A. Law, "Electronic Mail Use at the World Bank: Messages from Users," *The Information Society* 9, no. 2 (1993): 9–124; and Bikson and Eveland, "The Interplay of Work Group Structures and Computer Support."

[18] D. C. Gurlet, "The Ascom Message Manager (AMM)—A System That Integrates Voicemail and Faxmail," *Ascom Technical Review* 2 (1990): 16–20.

[19] Eveland and Bikson, "Evolving Electronic Communication Networks."

Figure 1. Time Constraints and Messaging



lines in figure 1, for instance, indicates that peak morning messaging activity occurs in the Washington office well before most Californians have begun their workday. When West Coast employees arrive at work, there are many messages waiting to be answered; but the Washington staff is out to lunch during peak morning messaging activity in California (the afternoon shows similar asynchronous effects). In this way, many more iterations of budgets or revisions of memos and the like can occur during any given day, which in part helps explain the growing volume and pace of information work.

Moreover, an examination of message sending by time of day within a time zone by individuals in different job categories suggested that, given an asynchronous medium, individuals distribute their interactions differently over the day according to occupational demands, personal preferences, and other factors.[20] New electronic media, then, are used to overcome schedule constraints on communication with individuals in the next office as well as in another time zone to do collaborative work that closely mingles substantive knowledge with technical fluency.

Denser connectivity. The second clear trend, in addition to greater speed and flexibility of information work in organizations, is denser connectivity. Local area networks are being connected to organizationwide networks that have gateways to external networks (e.g., Bitnet), which are, in turn, interconnected (e.g., via the Internet). The number of individuals who can

[20] T. K. Bikson, J. D. Eveland, and B. A. Gutek, "Flexible Interactive Technologies for Multi-Person Tasks: Current Problems and Future Prospects," in Olson, ed., *Technological Support for Work Group Collaboration,* 89–112.

engage in direct point-to-point interaction with one another has grown dramatically in recent years and will continue to grow. By 1993, for instance, Internet host computers numbered 1,180,548, and the number of users was reported to be over five million; steep growth in the number of both hosts and users is projected through at least the year 2000.[21]

Not only do more people have the capability to interact, but these capabilities are increasingly being actualized. The more individuals one can interact with electronically in a communication community, the more useful the medium becomes. This, in turn, stimulates even more demand for access. Or, as a recent *American Archivist* article expressed it, "computing becomes more useful the more it is used,"[22] which is why an organization's system capacity usually reaches the saturation point well before it was predicted to, given prior usage trends.

Advances in critical-mass theory have helped to explain this phenomenon. Initial work on the diffusion of innovations assumed that early adopters of a new technology would undergo greatest risk but, if successful, would achieve the greatest benefits.[23] Until others caught up with them, the individuals and organizations that first embraced the new technology would have a competitive edge. At the point at which a critical mass of others had also acquired the technology, it was thought no longer to provide a special advantage. That theory was revised, however, to take into account interdependent technologies—cases in which the benefits to one user are contingent on the behavior of other users of the same technology.[24] E-mail is such a technology:

> If a user is still bound to the telephone, paper mail, paper documents, paper files, and paper memos, then computation remains an infrequently used tool that does not integrate with the rest of the environment. When electronic mail (e-mail) begins to replace telephone and paper messages and when machine-readable electronic documents and files begin to replace paper, the user's working context is integrated in new ways.[25]

In a 1988 study of e-mail use in United Nations organizations, we learned that the agencies who were early adopters of this technology conceptualized it as an independent innovation; cost issues plus friendliness of the interface were cited as the most important criteria in choosing the sys-

[21] A. M. Rutkowski, "State of the Internet," presentation to the first Internet Society Conference, San Francisco, 1993. Interestingly, these figures, gathered in May 1993, are already out of date. In July 1993, the Network Information Systems Center of SRI International reported results of its Internet Domain Survey, which attempts to discover every host on the network by doing a complete search of the Domain Name System (see Internet message from Mark Lottor, 29 July 1993 and the pub/zone directory on ftp.nisc.sri.com). The mid-July 1993 survey results found 1,776,000 hosts on the network—a dramatic increase over the figures reported above and a 79 percent increase over the calendar year since mid-July of 1992. Further, by the latest estimate from Matrix Information and Directory Services, Inc., posted as an Internet message from John Quarterman on 15 November 1993, there are now about fifteen million Internet users. All such figures should be regarded as still snapshots of a fast-moving situation.

[22] Avra Michelson and Jeff Rothenberg, "Scholarly Communication and Information Technology," *American Archivist* 55 (Spring 1992): 248.

[23] E. M. Rogers, *The Diffusion of Innovations* (New York: Free Press, 1983).

[24] M. Lynne Markus, "Toward a 'Critical Mass' Theory of Interactive Media: Universal Access, Interdependence, and Diffusion," *Communications Research* 14, no. 5 (1990): 491–511. See also M. Lynne Markus and Terry Connolly, "Why CSCW Applications Fail: Problems in the Adoption of Interdependent Work Tools," *Proceedings of the Conference on Computer Supported Cooperative Work, Los Angeles CA, October 1990* (New York: Association for Computing Machinery, 1990), 371–80; and Kraut and Attewell, "Electronic Mail and Organizational Knowledge."

[25] Michelson and Rothenberg, "Scholarly Communication and Information Technology," 248.

Table 2. Daily Volume of E-mail Use

	Average	Range
1991 (n = 13)		
Messages sent	1,668	5 – 20,050
Messages received	1,695	5 – 20,100
1988 (n = 13)		
Messages sent	149	2 – 1,500
Messages received	148	2 – 1,500

Note: *The number of organizations using e-mail in 1991 and 1988 is 21 and 18, respectively. The reduced number of organizations represented in this table reflects that several agencies are unable to estimate amounts of e-mail sent and received.*

tem. In contrast, later adopters viewed connectivity with other United Nations agencies plus integration with other applications as key criteria.[26]

In a 1991 follow-up to that study, United Nations member agencies were again surveyed about their daily volume of e-mail use. Table 2 summarizes messaging activity for both 1988 and 1991.[27] Although 88 percent of the organizations reported using e-mail in 1991 and 64 percent in 1988, only 13 were able to estimate their daily volume of message traffic. For those able to report levels of use in both years, as table 2 shows, volume had increased tenfold on average.[28] Such growth should persist throughout the decade, for the reasons stated earlier.

Similar dynamics can be expected to drive the demand for multimedia communications in the near future. Currently, in organizations that have both voice mail (v-mail) and e-mail, a frequent request from users is for media integration. In a study assessing comparative use of e-mail, v-mail, and fax, for instance, one respondent said:

> Place all v-mail automatically into e-mail. I want to see all my messages on my computer. I want fax capability from my computer. I want voice to e-mail and e-mail to voice from my computer. Make my computer the complete origin and destination point. . . . I want document scanning ability added to my computer e-mail to replace fax and photocopying.[29]

As Weissman makes clear, integrated multimedia capabilities are on the near-term technical horizon, and pieces of the solution are already in place in some organizations. Because these are interdependent technologies, their benefits will not be fully evident until multimedia systems are in use throughout the communication community. In the meantime, the chief advantages to early adopters may derive not so much from the capability to disseminate mixed-media information but rather from alleviating the need to manage several different commu-

[26] T. K. Bikson and L. Schieber, *Relationships Between Electronic Information Media and Records Management Practices: Results of a Survey of United Nations Organizations* (Geneva: Advisory Commission on the Coordination of Information Systems, ACCIS 89/018[e], 1989; also available as RAND Reprint N-3150-RC).

[27] T. K. Bikson and S. A. Law, "Electronic Information Media and Records Management Methods: A Survey of Practices in United Nations Organizations," *The Information Society* 9, no. 2 (1993): 125–44.

[28] Bikson and Law, "Electronic Information Media and Records Management Methods"; See also Bikson and Law, "Electronic Mail Use at the World Bank: Messages from Users." In table 2 above, the organization reporting highest levels of e-mail use in both 1988 and 1991 was the World Bank. As the 1988 data were being prepared for the 1989 publication (see note 26, above), participating organizations were provided with a draft manuscript to review. At that time, the World Bank contacted us to say they believed there was an error in the data because their own e-mail volume exceeded the highest level in the reported range. We sent back a copy of the data the bank had originally supplied for their verification. As it turned out, our 1988 report was correct; but World Bank e-mail use had grown very rapidly, more than doubling between the time of data collection and report publication (cf. Internet growth, reported in note 21 above).

[29] Lynne Markus, T. K. Bikson, M. El-Shinnawy, and L. L. Soe, "Fragments of Your Communication: Email, Vmail, and Fax," *The Information Society* 8, no. 3 (1992): 223.

nication channels separately as a recipient. The second trend, then, should be interpreted as meaning denser connectivity between people, between applications, and between media.

Flatter hierarchies, broader participation. A third trend in evidence is flatter hierarchies and broader de facto involvement of their members in significant roles as organizations come to rely on networked electronic media. In his article in this issue, Weissman describes a new distributed computing paradigm quite different from older mainframe environments in which access to information resources was centrally and rigidly controlled. It is important to note, however, that distributed computing arrangements do not of themselves lead to overall decentralization in organizations. For instance, it would be possible to introduce software-based filters making it difficult or impossible to store a file on a shared server unless the file is indexed in a particular way and associated with proper descriptors. More generally, organizations can impose rules that recreate rigidities once regarded as a necessary evil of mainframe systems; and the same technologies that permit elimination of some levels of hierarchy also enable close supervision of the lower by the higher ones.[30] In fact, in the organizations we have studied, some functions have tended to become more centralized (e.g., payroll processing) while others have become more decentralized (e.g., information technology applications development).[31]

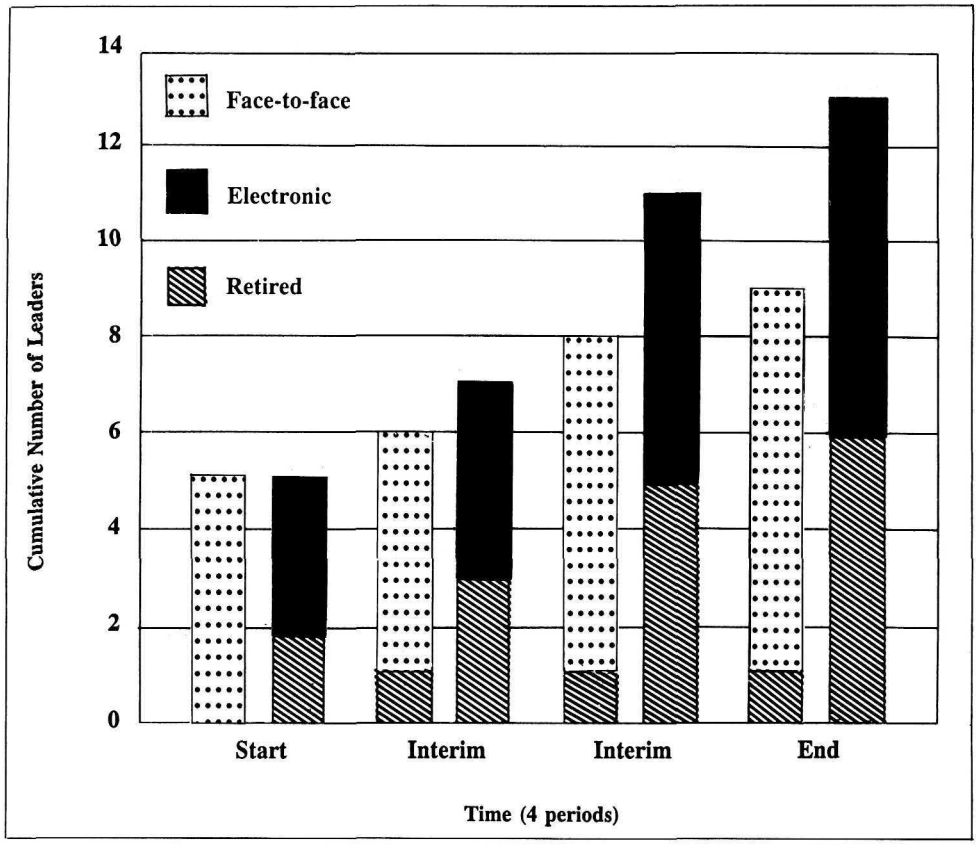
With these caveats in view, it nonetheless appears that electronically networked task groups exhibit greater de facto participation in decision making, task leadership, and other roles that are often linked to status (e.g., formal position, gender, and age). This result, sometimes referred to as the *equalization effect,* has been reported in a number of laboratory experiments as well as in case studies of organizations using electronic media.[32] Both types of research have been criticized—laboratory experiments for the artificiality of the settings and case studies for the nonrepresentativeness of the sites. Consequently, we undertook a year-long field experiment that involved two task forces, each working toward the same goal: to prepare a white paper on the transition to retirement in today's retirement environment. The task forces were equal in size and composed of managers and professionals similar in age; half the members were retired and half were eligible to retire but had not yet done so. One task force was provided with standard assistance for collaborative work—secretarial support for arranging meetings, typing and duplicating minutes and memos, doing mailings; reimbursement for telephone calls and parking fees at meeting sites; and the like. The members of the other task force were provided with networked microcomputers, a standard Unix e-mail system, other office applications (word processing, spreadsheet, and database management), and a half-day training session. None had worked with a microcomputer or used e-mail be-

[30] Bikson and Frinking, *Preserving the Present.* See also Jonathon Trevor, Tom Rodden, and Gordon Blain, "COLA: A Lightweight Platform for CSCW," in *Proceedings of the Third European Conference on Computer Supported Cooperative Work—ECSCW 93,* edited by G. de Michelis, C. Simone, and K. Schmidt (Boston: Kluwer Academic Publishers, 1993), 15–30.

[31] C. Stasz, T. K. Bikson, J. D. Eveland, and B. Mittman, *Information Technology in the US Forest Service: An Assessment of Late Stage Implementation* (Santa Monica, Calif.: RAND R-3908-USDAFS, 1990). See also National Research Council, *Information Technology in the Service Society.*

[32] V. J. Dubrovsky, S. Kiesler, and B. N. Sethna, "The Equalization Phenomenon: Status Effects in Computer-Mediated and Face-to-Face Decision Making Groups," *Human-Computer Interaction* 6 (1991): 119–46; L. Sproull and S. Kiesler, "Computers, Networks and Work," *Scientific American* 265 (September 1991): 116–23; and Howard Rheingold, "The Great Equalizer," *Whole Earth Review* (Summer 1991): 5–11.

Figure 2. De Facto Leaders in Electronic and Standard Work Groups



fore. Participants were randomly assigned to either the standard or electronic group.[33]

Data about task and social participation were collected at the start and end of the experiment and at two interim points during the year. Figure 2 shows the cumulative number of de facto leaders over that period for each group.[34]

Significant statistical differences emerged

[33] T. K. Bikson, J. Goodchilds, L. Huddy, J. D. Eveland, and S. Schneider, *Networked Information Technology and the Transition to Retirement: A Field Experiment* (Santa Monica, Calif.: RAND R-3690-MF, 1991).

[34] To permit a detailed mapping of the "social space" of each task force, the research team collected information about the number of other group members with whom each participant had been in contact, noting both the nature and medium of the interactions reported. From these sociometric data, we were able to derive such characteristics as the integrativeness of each task force (based on the proportion of others with whom a given individual was in contact), its centralization (the extent to which interaction paths are routed through a small number of individuals), and so on. The data in figure 2 reflect de facto leadership patterns based on sociometric data. For purposes of this analysis, we defined a *leadership cadre* as the five individuals who were most central in the contact network at each point in time. Across the four time periods, then, there were a total of twenty possible leadership slots. As figure 2 shows, a greater number of different individuals occupied leadership positions over the year in the electronic task force than in the standard task force; further, de facto leadership was much more evenly distributed among retirees and employees in

between the electronic and standard task forces with respect to participation. In the electronic group, participation was more evenly distributed among members, and at varied times during the work year, different individuals assumed more responsibility when task force needs meshed with their skills and schedules. Not only did the electronic task force engender more de facto leaders, it also exhibited greater social cohesion. Further, its retired members were able to play strong central roles; in the standard task force, in contrast, retired members had peripheral status throughout the period of work. Results from this project strongly corroborate the main conclusions drawn from laboratory experiments and case studies: new electronic media can help overcome not only barriers of space and time but also constraints on group involvement typically imposed by status.

It is important to emphasize that new electronic media are not automatically empowering, nor do organizations necessarily strive to become more egalitarian through their use. Rather, while networked technologies make such outcomes possible, they are consequences of organizations' perceived performance needs related to information work (see earlier discussion). In particular, organizations are pushing decision making and responsibility to lower levels of the hierarchy because that seems to be the only way to take advantage of the speed, flexibility, customizability, and connectivity afforded by the new media. As a department head for a technical services firm participating in one study of global competitiveness noted, "Entry-level people used to have to know how to do what they were told. Now they have to be able to make decisions."[35]

Government agencies have arrived at similar positions in response to pressures to reduce costs, decrease turnaround times, and improve public satisfaction with government performance.[36] Meeting these demands on information work in either public or private sector organizations, then, involves providing individuals with advanced electronic media and with the authority to use those resources along with their substantive knowledge to get their jobs done in the ways they judge to be most effective.

More teamwork. The tendency to rely more on teams to get work accomplished is closely related to the trend of flatter hierarchies and broader participation. Activities that are project- or process-oriented are becoming a major organizing principle. In contrast to standing hierarchical units, teams are likely to cross functional or departmental lines and to be relatively self-managing. Further, teams are reconfigurable over time on the basis of an organization's needs, and individual employees may belong to more than one team.

A team-based approach to work is not new. Research and development (R&D) firms, and even R&D divisions of more traditionally structured firms, have long relied on this mode of work management.[37] In the late 1980s, however, teamwork was being touted as a generally viable way of accomplishing the missions of organiza-

the electronic group. These analyses were corroborated by correlation and regression analyses indicating that in the standard task force, leadership at one point in time was highly associated with leadership at another point in time; in the electronic task force, these statistical predictions did not hold. For a more detailed explanation of data, derived variables and analysis techniques, see T. K. Bikson, et al., *Networked Information Technology.*

[35] Bikson and Law, *Global Preparedness and Human Resources,* 20.

[36] Bikson and Frinking, *Preserving the Present.* See also C. Stasz, T. K. Bikson, and J. D. Eveland, *Assessing Benefits of the US Forest Service's Geographic Information System: Research Design* (Santa Monica, Calif.: RAND N-3245-USDAFS, 1991).

[37] See, for example, L. G. Tornatzky and M. Fleischer, *The Processes of Technological Innovation* (Lexington, Mass.: Lexington Books, 1990); and L. G. Tornatzky et al., *The Process of Technological Innovation: Reviewing the Literature* (Washington, D.C.: National Science Foundation, 1983).

tions, as these samples from the literature suggest:

The Team as Hero . . . . (Reich)
Business Teams Becoming a Way of Life (Johansen)
Task-focused Teams . . . . (Drucker)
Adhocracies . . . . (Malone, et al.)
. . . More Broadly-based, Reconfigurable Collaborations (Bikson et al.)
Groups That Work (Hackman)[38]

Current social science research, moreover, indicates that this is not just a business press fad; rather, organizations are in fact increasingly turning to teams to get their work done. Networked technologies in general and groupware in particular are facilitating the shift. But the incentive for change appears to be the need to streamline business processes while retaining a work force that is competent to respond to business demands. The geographic and temporal flexibility afforded by electronic media enable work teams to be location independent and yet locally responsive.

This theme was frequently mentioned in the sixteen firms that participated in a recent RAND study of the effects of globalization. For instance, a human resource specialist in one business services firm told us, "We want to be able to put together the best team for the client's problem, drawing on the right kinds of expertise, regardless of where the people happen to be." A similar point was made in relation to medical decision making: "You cannot afford to have an expert in a very rare kidney disease on your team, just in case you might need him or her someday. . . . The technology allows you to have experts available electronically."[39] As is evident, having all types of expertise in the membership of standing units in all locations would be wastefully redundant and costly; but not having these specialized competencies on hand when they are important incurs other risks. Given the appropriate supporting technology, teams can be dynamically composed in response to situation-specific needs in a timely and effective way. In a manner analogous to flexible manufacturing techniques, then, teams supported by electronic media permit the just-in-time delivery of knowledge resources.

Structuring work around self-managing teams whose members come from diverse units is much more feasible in organizations that have flattened their hierarchies and empowered their employees to act in autonomous ways. In part, this is what enables teams to cope with uncertain and changing task environments more effectively than their fixed bureaucratically managed counterparts can.[40] It should be noted, however, that in these more horizontal organizations employees have to do much more independent schedule juggling and time management. With access to electronic media becoming more ubiquitous (because, for instance, employees may take portable computers with them on travel or have networked connections via modem from home to the office), they are able to keep up with the work of the diverse team efforts in which they may be involved, wherever they may be located; and new technology developments can only boost this

[38] Adapted from the following sources: Robert Reich, "The Team as Hero," *Harvard Business Review* (May–June 1987): 77–83; Robert Johansen, *Groupware—Computer Support for Business Teams* (New York: Free Press, 1988); Peter Drucker, "The Coming of the New Organization," *Harvard Business Review* (January–February 1988): 45–54; T. W. Malone, J. Yates, and R. I. Benjamin, "Electronic Markets and Electronic Hierarchies," *Communications of the ACM* 30, no. 6 (1987); Bikson, Eveland, and Gutek, "Flexible Interactive Technologies for Multi-Person Tasks"; J. R. Hackman, *Groups That Work* (San Francisco: Jossy Bass, 1990).

[39] Bikson and Law, *Global Preparedness and Human Resources,* 15; Paul Strassman, "Conversations with Paul Strassman," *Organizational Dynamics* 14, no. 42 (1985): 19–34.

[40] Hackman, *Teams That Work;* and Ciborra, *Teams, Markets and Systems.*

trend. Consequently, employees may find themselves overbooked, committing themselves to schedules that an old-style hierarchical management would not have attempted to impose and that spatio-temporal constraints on collaborative work would have precluded. Research findings suggest that with comparatively pervasive access to new electronic media, people in self-managing team situations are working harder and working longer hours—but these changes are usually not formally reflected in changed titles or salaries.[41]

Greater boundary permeability. As the preceeding discussion has indicated, electronic information and communication media make boundaries more permeable, both within organizations (between units) and between organizations. Work teams can cross internal unit boundaries even when the units are in geographically disparate divisions of an organization. How this happens is illustrated by the U.S. Forest Service, as it internalized networked electronic tools over time. At three different points, quite different views of the system emerged.[42]

1. *The system is the interface.* Initial perceptions in 1985 of the agency-wide information infrastructure focused on the interface—how easy or difficult it was to access and use the functionality it provided.
2. *The system is the network.* In a follow-up assessment of the technology in 1989, we found that users scarcely noticed the interface; rather, perceptions of the system turned on its reach—where the network allowed users to go.
3. *The system is the database.* By 1991, at the time of RAND's third study of the Forest Service, the emphasis had changed again. The network had become fairly transparent; the key concern was the kind of information the network made available, whether it was on a file server three doors down the hall or three time zones away. Forest Service users, in fact, did not particularly want to have to know where databases were located. Rather, they wanted to know about content, accuracy, and timeliness.

Another example of boundary permeability comes from a study of firms' responses to increasing global competition. In the past, one technical services firm participating in the study had had a geography-based structure. The international headquarters was in the United States, where its North American branch headquarters was also located; other branches of the organization were its European division, its Asian division, and its South American division. Each regional division reported to the international headquarters. A strategic planning effort in the late 1980s resulted in a new organizational structure that made geographic boundaries irrelevant. The vice

[41] Alexia Martin, research results from the Groupware Outlook Project, an ongoing effort at Institute For The Future, Menlo Park, Calif.; Bikson and Eveland, "The Interplay of Work Group Structures and Computer Support"; T. K. Bikson and B. A. Gutek, "The Impact of Information Technology on Jobs," unpublished paper presented to the Academy of Management annual meeting, Annaheim, Calif., 1988; T. K. Bikson, "Cognitive Press in Computer Mediated Work," in *Social, Ergonomic and Stress Aspects of Work with Computers,* edited by G. Salvendy, S. L. Sauter, and J. J. Hurrell, Jr. (Amsterdam: Elsevier, 1987), 353–64; T. K. Bikson, "Understanding the Implementation of Office Technology," in *Technology and the Transformation of White Collar Work,* edited by Robert Kraut (Hillsdale, N.J.: Erlbaum, 1986).

[42] T. K. Bikson, J. D. Eveland, and C. Stasz, "Plus Ca Change, Plus Ca Change: A Long Term Look at One Technological Innovation," forthcoming. See also Stasz, Bikson, and Eveland, *Assessing Benefits of the US Forest Service's Geographic Information System;* Stasz, Bikson, Eveland, and Mittman, *Information Technology in the US Forest Service: An Assessment of Late Stage Implementation;* and C. Stasz, T. K. Bikson, and N. Shapiro, *Assessing the Forest Service's Implementation of an Agency-Wide Information System: An Exploratory Study* (Santa Monica, Calif.: RAND N-2463-USFS, 1986).

president for strategic planning described it this way: "We are moving to a domain-based organization. Instead of being organized geographically, with reporting to country or region managers, employees will report to a business domain manager."[43]

Boundary permeability enabled by electronic media is more than an individual's ability to overcome space and time constraints to collaborate with remote colleagues. Rather, networked information and communication technologies permit entire firms or government agencies to reconsider traditional boundaries and invent new organizational forms. Such technologies allow boundaries between organizations to become more permeable. Classic success cases—required reading in many business schools—have involved the linking of customer and provider firms via networked computers in ways that influenced whole industries. American Hospital Supply, which linked pharmacies directly to its order departments, and American Airlines' Sabre system, which linked flight schedules and reservations systems directly to travel agencies, are two early instances.[44]

Technologies that embed the tools for specific tasks and operations in networked electronic infrastructures spanning both internal and external organizational boundaries serve, in turn, as the basis for restructuring efforts.[45] Information-based work can be taken apart and reconfigured to generate new task structures and linkages; in the process, organizations make decisions about which operations they should perform internally and which might better be purchased or contracted from an external supplier.[46] Ross Perot's presidential candidacy, for instance, drew attention to EDS (Electronic Data Services), a company created to carry out data processing functions formerly handled internally by firms. Networks make it easy to have these tasks done by an outside firm specializing in them, even when fast turnaround is required. It is important to note, moreover, that private-sector firms as well as government agencies engage in such "outsourcing." As this trend continues, whole industries are likely to be reorganized.

Finally, via new electronic media, activities can be distributed between humans and computers on a scale not ever possible before. Two recent events provide particularly compelling examples, both involving what Weissman has called *brute force computing.* The first case involved taking advantage of underutilized computing capacity in organizations to carry out huge computing tasks (e.g., factoring 100-digit integers). In reporting on this effort, its designers said:

> They made use of electronic mail networks for the distribution of the [factoring] programs and for interprocessor communication. Even during the initial stage of this experiment, machines all over the United States and at various places in Europe and Australia contributed 15 percent of the total factorization effort. At all the sites where the program is running, the authors only use cycles that

[43] Bikson and Law, *Global Preparedness and Human Resources,* 15.

[44] Max Hopper, "Rattling SABRE—New Ways to Compete on Information," *Harvard Business Review* 68, no. 3 (1990): 118–25; "Harvard Case Notes, American Hospital Supply Corp. (A) The ASAP System," in *HBS Case Services* (Cambridge, Mass.: Harvard Business School, 1986).

[45] T. H. Davenport, *Process Innovation: Reengineering Work Through Information Technology* (Cambridge, Mass.: Harvard Business School Press, 1993); T. H. Davenport and J. E. Short, "The New Industrial Engineering: Information Technology and Business Process Redesign," *Sloan Management Review* (Summer 1990): 11–17; M. Hammer, "Reengineering Work: Don't Automate, Obliterate," *Harvard Business Review* 68 no. 4, (1990): 104–12.

[46] National Research Council, *Information Technology in the Service Society;* Bikson and Frinking, *Preserving the Present.*

> would otherwise have been idle. This shows that the enormous computational task of factoring 100 digit integers with the current algorithms can be completed almost for free.[47]

The other example has to do with the calculation of the ninth Fermat number. Mathematicians and logicians had long believed it was calculable because it could not be demonstrated to be noncalculable, but it required so much in the way of human and computer resources that it had never been attempted. Then researchers at Bellcore developed a program to parse the calculation, putting out an Internet call for organizations and scientists willing to collaborate on the problem. Parts of the problem were distributed and the results reassembled on their return; all the pieces fit, and the ninth Fermat number was indeed calculated in a relatively short time. Interestingly, when a paper representing this effort was prepared for publication, a question about participants arose:

> 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.[48]

These kinds of large-scale self-generated task groups uniting computers and humans across internal and external boundaries are evidence of work forms unprecedented in organizational literature. Although they may raise new and serious questions about provenance for archivists, they generate equally fundamental questions for social science researchers attempting to prefigure the twenty-first century organization.

Longer-Term Implications

It should be apparent by now that the widespread trends just reviewed are not independent. Rather, they reflect different ways of examining what are better regarded as complex synergistic changes across organizations as they incorporate electronic information and communication media. Taken together, these changes are diminishing the roles of place, time, and hierarchy in the structure and management of work processes. The question that arises next concerns what will stand in their stead. What are the longer term implications of these trends for organizational design in the twenty-first century? Whether approached from the viewpoint of organizational research or information technology research, this remains an unanswered question.

Organizational research perspective. From the perspective of organizational research, there are a great many de facto changes in work design, roles, and reporting structures that have yet to be recognized formally. For example, changes in organizational charts and job descriptions lag well behind actual behavior. Contrary to what is often alleged, employees themselves are not particularly unwilling or unable to do new tasks, or to do old tasks in new ways, using new computer-based tools. Rather, resistance to change is observed more in the organization than in the employees.[49]

It is further widely acknowledged that,

[47] A. K. Lenstra and M. S. Manasse, "Factoring by Electronic Mail," in *Proceedings of the Conference on Advances in Cryptology (EUROCRYPT '93)* (Berlin: Springer Verlag, 1990), 355–71.

[48] Mark Manasse of Bell Communications Research (bellcore.com), Internet broadcast message on 15 June 1990, reprinted in *Scientific American* 265 (September 1991): 123.

[49] Bikson, "Understanding the Implementation of Office Technology", see also Bikson, Gutek, and Mankin, *Implementing Computerized Procedures in Office Settings.*

in general, organizations have not done a good job of managing changes related to new electronic media.[50] In many cases, corporate management has left decisions to technical experts who are not necessarily knowledgeable about the strategy and structure of the organization as a whole. Moreover, it is a recently popular idea that organizations need "re-engineering," as restructuring efforts are often called. But there are no well-developed and validated models, nor even an accumulating body of precedents, on which to rely for designing and managing new organizational forms to take advantage of the unique characteristics of new electronic media. Put more clearly, "There are no rules of thumb for the electronic road."[51]

In the meantime, the broad distribution of capabilities to access information, solve problems, take action, and communicate is leading researchers to revisit organizational theory. For example, hierarchically structured bureaucracies were believed to be required for the coordination of complex multiperson tasks. But new electronic media might provide alternative avenues to such levels of coordination by enabling markets to serve as the coordination mechanism, by permitting relatively self-managing teams to form in relation to specific opportunities, by supporting work organized by shared interests or objectives, by designing rules of work flow into software, and so on.[52]

Knowledge and ability can now be very widely shared among people, and between people and machines, in the course of organized work. However, nothing in extant social psychological research or theory provides a basis for understanding group behavior on a scale comparable to the size of the group that calculated the ninth Fermat number, or for comprehending the division of intellectual labor between people and computers.[53] Currently there is no shared vocabulary, agreed conceptual framework, or established model for understanding and managing such work. Instead, new forms of work are posing new theoretical questions that behavioral and social scientists need to address. For these kinds of reasons, organizational researchers are not able to make well-grounded predictions about where new organizational designs are heading.

Technology research perspective. From the vantage point of technology research, the picture is similarly fuzzy, although for different reasons. There is widespread agreement that information and communication technology are the foundation of postindustrial organizations. But how information systems or information technology functions should be structured and managed in such organizations, and the roles they should play in transforming them, are matters of considerable debate.

First of all, while electronic information and communication are critical resources of today's organizations, they have escaped policy recognition and guidance. Thus, although considerable effort is expended in making decisions about hardware and software, far less attention is given to defining the status of the resulting electronic information—retaining, updating, documenting, ensuring appropriate access to, and

[50] National Research Council, *Information Technology in the Service Society.* See also Bikson, Gutek, and Mankin, *Implementing Computerized Procedures in Office Settings;* and D. A. Mankin, T. K. Bikson, B. A. Gutek, and C. Stasz, "Managing Technological Change: The Process is Key," *Datamation* 34, no. 18 (1988): 68–80.

[51] John McDonald, "Archives and Cooperation in the Information Age," paper presented to the joint session of AAQ, ASA, and SAA, Montreal, 1992.

[52] Ciborra, *Teams, Markets and Systems;* Malone, Yates, and Benjamin, "Electronic Markets and Electronic Hierarchies."

[53] For an extended discussion of this point, see two reports by the Social Science Research Council Ad Hoc Panel on Computers and Contemporary Life, *What Do Computers Do?* (Summer 1991) and *Sense and Nonsense about Computers in Society—An Essay by Social Scientists* (Summer 1993). These reports were developed and prepared with support from the John and Mary Markle Foundation (New York).

otherwise managing it with the care that other important organizational resources receive. Whose job it is to make these decisions is also unclear. Senior management is usually involved in decisions about other critical resources, but it rarely treats electronic information and communication as matters that merit higher-level concern.[54] In some organizations, these issues are treated as technical ones and are deferred to specialized information technology departments; in others, they by default become matters left to end users of the new media.[55] In neither case is the organization's interest in the resources generated by such media defined and safeguarded, since neither group is sufficiently knowledgeable about the organization's overall business processes and strategic plans.

Second, the future location and nature of information technology expertise is unclear. Contrary to expectations voiced in the early 1980s, the advent of microcomputers and end-user computing did not lead to the demise of centralized information systems functions. It did, however, precipitate changes in the size, focus, tasks, and knowledge requirements of these systems. At the same time, user departments acquired greater technical autonomy (e.g., in choosing microcomputer software and sometimes also local area networks and hardware) and concurrently developed greater internal technical expertise. It is thus not uncommon to learn about role conflict and antagonism between technical experts in centralized information systems departments and expert users ("local gurus") in line departments.[56] At present, there are urgent organizationwide needs for the development and maintenance of a shared communications and computing infrastructure, interoperable systems, and integrated applications. Responding appropriately to these needs may require centralized authority. Organizational subunits, however, are taking on increased responsibility for development, maintenance, and management of applications relevant to their substantive functions. Yet these tools can be fully effective only when they are embedded in the organizational infrastructure and can be used in conjunction with its generic tools. How roles should be allocated among these sources of expertise, or between them and third-party providers of information system and technology services, is yet to be determined.[57]

Finally, because electronic media in organizations are relatively recent, little theoretical guidance can be drawn from existing research to manage the technology better. The study of how technologies influence the organization of work has a long history. However, computer-based information and communication networks are so different from other technologies that some scholars suggest they raise questions about prior theories of the relationships between technology and organizational design.[58]

[54] Bikson and Frinking, *Preserving the Present.*

[55] See also Bikson and Law, "Electronic Information Media and Records Management Methods"; and Bikson and Schieber, *Relationships Between Electronic Information Media and Records Management Practices.*

[56] For example, see Stasz, Bikson, Eveland, and Mittman, *Information Technology in the US Forest Service;* Stasz, Bikson, and Shapiro, *Assessing the Forest Service's Implementation of an Agency-Wide Information System;* and T. K. Bikson, C. Stasz, and D. A. Mankin, *Computer-Mediated Work: Individual and Organizational Impacts in a Corporate Headquarters* (Santa Monica, Calif.: RAND R-3308-OTA, 1985).

[57] A. Boynton, G. Jacobs, and R. Zmud, "Whose Responsibility Is IT Management?" *Sloan Management Review* (Summer 1992): 23–28.

[58] Jolene Galagher and Robert Kraut, "Computer-Mediated Communication and Collaborative Writing: Media Influence and Adaptation to Communication Constraints," *Proceedings of the Conference on Computer Supported Cooperative Work* (New York: Associaiton for Computing Machinery, 1992), 155–62; George Huber, "A Theory of the Effects of Advanced Information Technologies on Organizational Design, Intelligence, and Decision Making," *Academy of Management Review* 15 (1990): 47–71.

Sociotechnical uncertainty. Despite these uncertainties (or because of them), it is safe to argue that new electronic media and organizational design have manifested and will continue to exhibit ongoing reciprocal change. When both kinds of changes are innovative and mutually adaptive, the new organizational forms to emerge cannot be predicted in advance, and stability should not be expected in the near future.

Organizations and their information and communication technologies are best considered as a complex whole. Sociotechnical systems theory, originally developed in relation to manufacturing technologies in industrial organizations, is perhaps best suited to provide a theoretical base for understanding electronic media in white-collar work. It argues for a "mutual adaptation" view of the implementation of new technologies in organizations, treating the social system of work and the technical system of work as inherently interdependent; each is an open system susceptible to independent sources of influence, but changes in one cannot help but result in changes in the other.[59]

In spite of the fact that white-collar employees (sometimes known as knowledge workers) rarely think of their tasks as machine dependent, the reciprocal influence of technical and social aspects of work based on new electronic media is abundantly clear. The literature of business process redesign, although not developing out of a sociotechnical systems perspective, supports the view that new electronic media permit the uncoupling and rearranging of key organizational processes to achieve much more effective organizational designs.[60] This view closely links organizational transformation to new technological opportunities. Another example has to do with the changing sectoral landscape. It has been noted that because new electronic media make organizational functions reconfigurable and relatively independent of location they have enabled the restructuring not just of organizations but of entire industrial sectors—creating new industries and joining others, particularly in information-intensive service areas such as finance, banking, and insurance.[61]

Sociotechnical systems theory regards technological innovation as inherently incomplete and unpredictable. That's because two open systems are involved: the technical system (electronic hardware, software, networks, and so on) is open in being affected by new breakthroughs that are always extending and altering what it provides; the social system (of work groups, task interdependencies, and so on) is open in that it is subject to new members, new practices, and new organizational procedures. Further, changes in one of these systems affects the other—they are reciprocally influential. What this means, then, is that it is not possible to know in advance all the effects of a new technology; the result will be innovative change in the sociotechnical system of work.[62] For example, it is a safe technical prediction that the near future will bring broadband networks into use in organizations, and that open systems standards will permit integration of the diverse

[59] Sociotechnical systems theory is summarized in relation to the introduction of computer technology into white collar work in T. K. Bikson and J. D. Eveland, "Integrating New Tools into Information Work," in *People and Technology in the Workplace,* edited by D. Langford et al. (Washington, D.C.: National Academy Press, 1991), 229–52; and in T. K. Bikson and J. D. Eveland, *New Office Technology: Planning for People,* Work In America Institute's Series on Productivity (New York: Pergamon Press, 1986). See also E. W. Trist, *The Evolution of Sociotechnical Systems* (Toronto: Ontario Quality of Work Life Centre, 1981).

[60] Davenport and Short, "The New Industrial Engineering."

[61] National Research Council, *Information Technology in the Service Society.*

[62] Bikson and Eveland, "Integrating New Tools into Information Work"; Bikson and Eveland, *New Office Technology.*

applications they support,[63] but, as Weissman points out, technology "is not self-implementing." In the implementation process, new technology is adapted to extant organizational contexts even as users modify their tasks to take better advantage of electronic tools.[64] As a result, it is not possible to predict either the new kinds of goods and services, or the new kinds of organizational processes and designs, that will be engendered when such media come into widespread use. Consequently, the generic infrastructure within which varied interactive end-user tools may be developed and deployed has been called a "platform for surprises."[65]

That profound changes are under way in most technologized organizations is not generally questioned. The question is rather what the new organizational designs are—or should be—like. Some scholars have referred to a "paradigm shift" in organizations today.[66] This has not yet occurred, and I think it can be argued that we are observing shifts without the insights that would be accompanied by a revolution in organizational paradigms. As is characteristic of preparadigmatic thinking, however, some imaginative metaphors for the technologically transformed organization are appearing in the interim:

- the organization as web (versus discrete units)
- the organization as jelly fish (versus dinosaur)
- the organization with a central nervous system
- the organization as intellectual holding company (for electronically linked activities)[67]

The title of this article is thus meant quite literally; organizational design is a work in progress. By doing their work using the new technologies, communities of practice are reinventing the organization.[68]

Next Steps

Given this Protean state of affairs, attempts to draw conclusions or make recommendations may seem unwarranted. Nonetheless, it seems feasible to put forward a few suggestions to decision makers in organizations as well as to students of organizational behavior. (The latter category is meant to include us all.)

First, it seems evident that organizational decision makers should focus now on learning how to manage change well. Because the outcomes of rapid advances in electronic media and their uses in varied work contexts are inherently unpredictable, it would be wise to learn as much as possible about the characteristics of technological innovation processes themselves that make them go well or badly. In this way, organizational stakeholders can attempt to nurture positive change proactively.[69]

[63] Benjamin and Blount, "Critical IT Issues."

[64] Bikson, Gutek, and Mankin, "Implementing Computerized Procedures in Office Settings."

[65] Claudio Ciborra, "From Thinking to Tinkering: The Grassroots of Strategic Information Systems," *The Information Society* 8, no. 4 (1992): 297–310.

[66] A detailed account of "paradigms" and "paradigm shifts" is provided in T. S. Kuhn, *The Structure of Scientific Revolutions* (Chicago, Ill.: University of Chicago Press, 1970). Discussions of new paradigms for the design and management of organizations in the 1990s and beyond are available in, for example, *The New Paradigm of Business,* edited by M. Ray and A. Rinzler (Los Angeles, Calif.: Pedigree Books, 1993); Peter Drucker, *Post-Capitalist Society* (New York: Harpter Collins, 1993); W. H. Davidow and M. S. Malone, *The Virtual Corporation* (New York: Harper Collins, 1992); and W. B. Wriston, *The Twilight of Sovereignty* (New York: Charles Scribner's & Sons, 1992).

[67] These metaphors come from R. Kling and W. Scacchi, "The Web of Computing: Computer Technology as Social Organization," *Advances in Computers* 21 (1982): 2–60; and Quinn, *Intelligent Enterprises.*

[68] J. S. Brown and P. Duguid, "Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning and Innovation," *Organization Science* 2 no. 1: 40–57; see also J. S. Brown, "Research That Reinvents the Corporation."

[69] Bikson, Gutek, and Mankin, *Implementing Computerized Procedures in Office Settings;* Mankin, Bikson, Gutek, and Stasz, "Managing Technological Change."

Second, capabilities of the technology to document and store information about emerging organizational forms should be exploited. This kind of effort undoubtedly requires collaboration on the part of policy makers, technical experts, information resource managers, and user units in organizations. Interestingly, optimistic predictions for future advances in computer-based media (e.g., size, price, and performance) in the past two decades have generally been exceeded by actual technology development. Predictions about organizational change, in contrast, have generally outpaced the course of real-world events.[70] This suggests that there is still time to capture the evolution of the twenty-first-century organization.

Being able to document and understand new organizational forms and functions is not just of interest to archivists and records managers. Organizational memory and organizational learning are presently regarded as matters of profound strategic concern at the highest levels of management; they should also become matters of action. Intense competitive pressures—both local and global—make timely, responsive, and competent management of information resources and communication media a survival issue for postindustrial organizations.

Finally, the continued well-being of organizations requires an ability to study, understand, and guide organizational change while it is happening. Perhaps the challenge to all of us is to learn how to do organizational sociology in real time.

[70] Benjamin and Blount, "Critical IT Issues"; cf. R. I. Benjamin, "Information Technology in the 1990s: A Long Range Planning Scenario," *MIS Quarterly* 6 (June 1982): 11–31.

Organizational Trends

Commentary

JOAN WARNOW-BLEWETT

About the author: Joan Warnow-Blewett is associate director of the American Institute of Physics Center for History of Physics now located in College Park, Maryland. Her activities and writings focus on: (1) cooperative documentation strategies, especially appraisal studies and preservation of materials at appropriate repositories, and (2) documentation research (including macroappraisal) to resolve archival problems, expecially those pertaining to changes in organizational structures and communication patterns. She chaired the Joint Committee on Archives of Science and Technology and is a fellow of the Society of American Archivists.

LEARNING ORGANIZATIONAL SOCIOLOGY in real time can, as Tora Bikson says, be a challenge. It can also be rewarding to archivists. Today I will use the physics community as a case study to illustrate how knowledge of organizational patterns and trends, such as those discussed in Bikson's interesting paper, can provide critical assistance to archivists.

The Center for History of Physics of the American Institute of Physics (AIP) is currently engaged in a long-term study of a particular kind of adhocracy: the multi-institutional collaboration. Since the Second World War, this has increasingly been the organizational framework for much significant scientific research. This kind of work group has spread beyond science and technology to many areas of our society; all archivists should be concerned about resolving the archival problems that stand in the way of documenting these adhocracies.

Despite its significance, collaborative research in physics has received only slight attention from scholars and, when we started our project, we could not find adequate records of any collaboration in a repository. In order to locate and preserve historical records, we knew we would first need some idea of the process of collaborative research and how the records are generated and used.

In our work, which began in 1989, we have drawn on the skills of archivists, historians, and sociologists and—most important of all—the knowledge of distinguished scientists from the discipline under study. My remarks focus on organizational trends in high-energy physics—the subject of the first phase of our study, which is now completed.

The two-year study of high-energy physics research examined experiments carried out at five of the world's major accelerator laboratories. A broad picture of changes in the structure of collaborations—such as size and length of experiments—was obtained by using databases on high-energy physics

experiments and publications. At a more detailed level, the project conducted interviews on twenty-seven selected experimental collaborations. In selecting experiments, our aim was to cover a range of historical, sociological, and scientific parameters and a variety of archival situations. For each collaboration, we interviewed individuals at various levels to acquire a full perspective on the project. We used a structured interview question set designed for high-energy physics. Some three hundred interviews were systematically analyzed, resulting in the following findings.

In high-energy physics, collaborations form around an experiment. Members build detectors for use at an accelerator, gather and analyze data, and publish findings. The collaborations consist of groups from universities and, often, from the accelerator laboratory itself. The individual groups are assigned specific responsibilities for building components of the detector and other tasks. The size and complexity of collaborations and the research facilities have grown dramatically. A few facts should help to illustrate this statement.

The accelerators that provide beams of particles for experiments have rapidly increased in size and sophistication. The cosmotron at Brookhaven National Laboratory completed in the early 1950s was the first to reach one billion volts and the last high-energy accelerator you could capture in one photograph. By 1968, Hans Bethe and Boyce McDaniel were able to bicycle through the tunnel of the synchrotron at Cornell, showing how much larger accelerators had become in little more than one decade. The ring at Fermilab (the Fermi National Accelerator Laboratory) built in the 1970s, is more than six kilometers in circumference. By the mid-1980s, CERN (the European Organization for Nuclear Research) was constructing its Large-Electron-Positron ring; the ring is 27 kilometers in circumference and passes under both Switzerland and France. A visit to CERN by Pope John Paul II illustrated that high-energy physics is both fundamental and spectacular.

The topic of this paper is the dramatic growth of the collaborations that use these accelerators. Many flags stand in front of Fermilab, representing the nationalities of research groups currently participating in experiments at the laboratory. And Fermilab is not alone; collaborations in high-energy physics started quite modestly back in the 1950s—a few people from one or more universities. A rather typical collaboration now might include one hundred physicists from ten or more universities, and there would be more than a 50-50 chance that it would be international in makeup. Detectors built by experiments to measure particles and their interactions are also growing in size, complexity, and cost. A recent article by the Collider Detector at Fermilab collaboration took more than a full page just to list the official authors and their twenty-five affiliations.[1] The list does not include the engineers, technicians, or other support staff. Last year, when the Superconducting Super Collider Laboratory (SSC) was still under construction in Texas, it received a proposal signed by 991 researchers for an experiment to build and use a detector; once an experiment is approved, more institutions may join and more people added, especially postdoctoral and graduate students. Many large experiments take a decade or more from start to finish.

Collaborative research of this kind is *Big Science*—sometimes called *Very Big Science*. More than anything else, it is the increased complexity and rising costs of detectors for experiments that have contributed to the size of collaborations in high-energy physics. Any group with the ambition to build an expensive detector has

[1]F. Abe et al., "Limits on the Production of Massive Stable Charged Particles," *Physical Review D: Particles and Fields*, Third Series 46 (1 September 1992): R1889–1894.

had to convince physicists from other institutions or countries to join in the experiment.

The AIP study's historical and sociological analysis covered organizational structures and operational functions through all stages of an experiment. I will now focus on several of these structures and functions of collaborations in high-energy physics that are of particular interest because of their serious archival implications. These are data gathering, communication, and the role of spokesperson (the head person) and the accelerator laboratory.

The purpose of detectors is to gather data. As you may well imagine, experimental advances have come as physicists have created more sensitive ways to measure the properties of particles. But we also learned that a number of experiments simply could not have taken place a decade earlier because computers were not advanced enough. Without increased computer power, the development of complex detectors would be useless. Strong ties have developed between the physicists and computer corporations. Bikson's "technology push" and "demand pull" are both evident.

The archival issue is the long-term value of the experimental research data. We found that these data are not needed for scientific purposes after a brief period of analysis; in addition, they are not useful for historical and other scholarly purposes. Archivists and records managers have reason to be concerned about retaining electronic data for some other disciplines, but they can confidently destroy them for high-energy physics. A small sample from each decade, preserved for exhibit purposes in a national laboratory or museum, would meet all future needs.

In terms of organizational strategies and communication, we found that high-energy physics experiments require that all collaborations combine three organizational strategies. Each collaboration blends these strategies in ways that offer the best chance of handling its toughest difficulties. As Bikson might say, the organization's perceived performance needs or difficulties determine the shape of the strategy. First, the laboratory is treated as an organizational headquarters through which the outlying institutions pass and receive information. This strategy becomes more dominant when the detectors are so complex that the collaboration sends a postdoctoral student to the laboratory to monitor progress and problems in building detector components. Second, the collaboration determines the extent to which labor should be divided, with collaborators working independently, or duplicated. The need to duplicate efforts takes precedence when puzzling or controversial findings are claimed; here reproducibility of results from data analysis is essential. Third, collaborations take into account the fact that any individual's research can make use of equipment he or she did not build and software he or she did not write; it therefore requires an information pool that enables collaborators to take full advantage of what others have developed.

In any one of these strategies, the individuals or groups that need to communicate are likely to be different. Viewed over time, our study brings out one major trend: the intracollaboration information network (for example, collaborationwide mailings and technical memoranda) has become increasingly formal and increasingly electronic.

High-energy physicists now generally communicate through electronic media. The Japanese physicists I interviewed took credit for introducing fax communications, and we found evidence of e-mail as early as 1982. The availability of electronic media may not be the cause for larger collaborations, but they certainly have enabled these large, far-flung mini-institutions to carry out their organizational strategies effectively and rapidly.

In high-energy physics experiments, a spokesperson has been both an intellectual

leader and an administrative convenience—an individual designated to speak for the collaboration to the laboratory and to inform collaborators of laboratory requirements. More recent collaborations tend to create administrative substructures to handle collaboration business or to change spokespersons over the course of their runs. Managerial burdens of spokespersons have come to outweigh the opportunity for exercising scientific leadership and judgment.

Collaborations have traditionally designed and built components of their detectors largely at their home institutions and without oversight from the laboratories. More recently, however, a number of factors have contributed to shifting power and accountability from the university groups to the national laboratories. A decline in sophisticated laboratory and shop facilities at many colleges and universities has led to the fabrication of more detector components at the accelerator sites. Beginning in the late 1970s, the laboratories have had tighter control over experiments—at least the larger, more expensive ones. In the United States, funding for building these experiments is increasingly likely to come directly to the laboratories for distribution to the collaboration groups. Finally, most laboratories now require detailed contracts covering the responsibilities of both the laboratory and each of the institutional members of collaborations for the performance of experiments. These findings are strong indications of shifts of power and accountability within the organizational structure of collaborations.

We found that some particular circumstances affected (in a positive way) the creation or retention of valuable documentation. These include the size and geographical dispersal of institutions, the emergence of fax and electronic mail, the need to communicate with engineers, and the importance or controversial nature of experimental results. We are particularly delighted with the rise of e-mail, which is easily stored and thus often saved; before e-mail, physicists tended to use the telephone, a practice that normally leaves no paper trail.

The historical-sociological analysis of organizational trends is extremely useful for archival purposes when combined with patterns of records creation, retention and destruction, and likely locations of records. In addition, our findings, coupled with records appraisal, show that the main locations of valuable records are in the hands of spokespersons; at the laboratories; and, to a lesser extent, with leaders of the individual institutional groups that are members of a collaboration. We established that a core set of records could provide adequate documentation of most collaborations. Among these are proposal files, contractual agreements, and progress and other reports. Many of these records traditionally have been kept by the labs, but they have yet to be scheduled for permanent retention.

Our main concern is to secure the additional documentation needed for especially significant experiments. Take, for example, the importance of saving one full set of those collaborationwide mailings mentioned earlier. Where should this documentation be located? The issue rests on the understanding of ownership and primary responsibility. Ownership is particularly rigorous when the records are federal, but academic archives may question why they should save collaborationwide records when their faculty was only one of a number of institutional groups on an experiment. If we are to document significant multi-institutional collaborations without undue duplication of effort, the community will need to develop a broader sense of responsibility and cooperation. This is a serious challenge.

In our appraisal guidelines, we point out that many valuable records are increasingly created in electronic format. In addition to collaborationwide mailings and e-mail, these include notebooks and correspondence of

individual members and logbooks of detector operations. Other archivists are dealing with the problems associated with preserving and migrating records in electronic format. Their success would provide a major breakthrough in documenting modern science.

Whether valuable evidence is on paper or in electronic format, our findings show that archival action should be swift. Like other groups, most physicists keep documents only if they think they will be useful to themselves. Good recordkeeping may be acknowledged by all as necessary while the experimental process is alive, but when the experiment is over, records can easily be neglected, forgotten, or destroyed. A decade from now, many of the records located by the AIP project may well be gone. To be most effective in documenting multi-institutional collaborations, future archival efforts should take place during the brief period of years when the recordkeeping needs of the scientific collaboration coincide with the goals of archivists.

The AIP study's recommendations for action are addressed to the laboratories, universities, and federal agencies. However, our single most important recommendation is addressed to the laboratories. During our study, we identified an opportune point of leverage that could have a major impact on documenting future experiments; this point of leverage is the laboratory's contractual agreement with the collaboration. We ask that, once an experiment has been approved, the laboratory should have the spokesperson identify one of the collaboration members who would be responsible for its collaborationwide records. In addition— where historical significance warrants—individuals should be named to be responsible for group-level documentation of innovative detector components or techniques. This information should be incorporated into the contractual agreement. Use of this simple mechanism would assist archivists everywhere by ensuring that records would be available for appraisal and by providing information on their location.

I have discussed patterns of collaborations in the experimental, laboratory-based field of high-energy physics. For those of you who want to know more, our final reports are available on request from the AIP.[2] Of course, the patterns found here do not necessarily predict those in other disciplines. We are finding interesting differences in our current work on collaborations in the field sciences of space science and geophysics. To give but one example, unlike high-energy physics, these disciplines need data collected at different times and places for long-term scientific work. During the final phase of the long-term study, scheduled to begin in late 1994, we will focus on comparative studies of collaboration patterns in other fields of science and technology and questions of documentation policy and practice.

In closing, I want to thank Tora Bikson for her remark that learning organizational sociology in real time can be the challenge for us all. I hope that in this brief statement I have been able to provide some idea of how valuable systematic surveys of organizational structures and operational functions can be in resolving archival problems. This kind of research is fascinating and, I believe, cost effective. I recommend it to you.

[2]Joan Warnow-Blewett et al., *AIP Study of Multi-Institutional Collaborations, Phase I: High-Energy Physics. Report No. 1: Summary of Project Activities and Findings / Project Recommendations; Report No. 2: Documenting Collaborations in High-Energy Physics; Report No. 3: Catalog of Selected Historical Materials; Report No. 4: Historical Findings on Collaborations in High-Energy Physics* (New York: American Institute of Physics, 1992).

Organizational Trends

Commentary

VICTORIA IRONS WALCH

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THE ORGANIZATIONAL CHANGES described by Tora Bikson are affecting archival practice in many ways. Joan Warnow-Blewett presents in her commentary in this issue one perspective on how records themselves are changing. I would like to focus on what Bikson's research has to tell us about changes in *archival* organizations, specifically in the organizations within which archivists work, on the one hand, and in archival professional associations, on the other.

Archivists, of course, carry out their work in a variety of organizational settings. In some cases, like that of a state archives, the function resides in something identifiable as an organization unto itself, a sizable staff and even its own building. At the other extreme is the typical business or religious archives, in which a one- or two-person staff carries out the archival function for a much larger organization whose mission is entirely different. Occupying a sort of middle ground are college and university archives, which are often embedded in university libraries. Archivists there have the benefit of working in immediate proximity with closely allied professionals on the library staff while serving a larger organization that, we might hope, shares their overall intellectual and cultural values.

The question is how we can improve the interaction between the individuals carrying out archival functions and all the other parts of the larger organizations for which they are trying to preserve documentation. A growing number of our archival colleagues are calling on us to think "strategically," and that is exactly what we must do to take advantage of the changes that Tora Bikson is describing.

In a study for the United Nations, Bikson noted that the successful utilization of electronic records management methods will be "determined by the extent to which high-level policy makers become aware of electronic records management problems and set viable strategic directions for organizations in this information resource demand."[1] She observed in her article in this issue that "organizational memory and or-

[1]Tora K. Bikson and Sally Ann Law, *Electronic Information Media and Records Management Methods: A Survey of Practices in United Nations Organizations* (Santa Monica, Calif.: RAND, 1991), 16.

ganizational learning are presently regarded as matters of profound strategic concern at the highest levels of management."

If this is true, then we have a tremendous opportunity to exert our influence, but we probably need help in determining the best strategy to make it happen. I would be interested in Bikson's advice on how archivists should ensure that high-level policy makers get the message and how to capitalize on their supposed predisposition toward the importance of organizational memory. What strategies have worked best in the organizations she has studied? Perhaps just as useful, what tactics have failed?

Bikson also notes the emergence of interoffice teams to solve problems and plan innovations in large organizations. It is easy to recognize the value of encouraging archivists to become members of teams that will develop and oversee policies affecting long-term access. Archivists may even need to help organize such teams in the first place and could choose several approaches.

Should they try to engage the interest and support of mid-level employees in other departments (possibly the information technology support staff and the major user groups), then approach the higher-level decision makers with their shared concerns? Or should the archivist try to target one or two senior officials directly?

Another slant on organizational change which I did not find in Bikson's research, but which I would appreciate her insight on, is the concept of "cycles." Society in general and archivists in particular are intrigued and sometimes guided by discussions of cycles in other contexts. Examples are Arthur Schlesinger's cycles of history and the recent pop-sociological analysis of generational cycles that has Bill Clinton's "Boomer" generation battling with George Bush's "Civic" generation.[2] And of course, there is our very own life cycle of records.

Assuming that someone must have analyzed cycles in organizational development, I went to a local business school library and found several shelves of books on the topic. I have to admit that my favorite title was *Barbarians to Bureaucrats*,[3] but there were literally scores of books available. I had too little time and *much* too limited experience in reading management literature to discern the relative value of any of them or their applicability to the archival issues at hand. The questions I was trying to answer, and that I would pose to Bikson, are whether the concept of organizational cycles is a valid area of study in the first place and, if it is, whether understanding cycles can help archivists choose the optimum point in an organization's development to introduce the idea of an archival program (or attempt to greatly expand the influence of an existing one).

I would guess that the methods for "making the sale" might vary, depending on cycles or stages of development. Young, dynamic organizations might be more inclined to embrace the notion of archives if archives are cast as providing long-term control and access to information—a strategic imperative for preserving a vital corporate asset. Older, stable organizations might appreciate the more altruistic, almost sentimental, values of corporate history, cultural significance, and public relations that are also embodied in archival programs.

These are all ways in which archivists might take advantage of organizational changes to get their foot in the door and begin to influence corporate policy. Once

[2]Arthur M. Schlesinger, *The Cycles of American History* (Boston: Houghton Mifflin, 1986); William Strauss and Neil Howe, *Generations: The History of America's Future*, 1584 to 2069 (New York: Morrow, 1991).

[3]Lawrence M. Miller, *Barbarians to Bureaucrats: Corporate Life Cycle Strategies, Lessons from the Rise and Fall of Civilizations* (New York: Clarkson Potter, 1989).

they are invited to the table, however, archivists will have to make very careful use of their limited resources to have the optimum effect on changing recordkeeping practices.

In discussing the changing demands brought about by the move to electronic information systems, one of the assertions heard most often is that archivists must be involved at the creation of information systems in order to ensure that archival requirements for long-term preservation and use are embedded in the system design. I thoroughly agree with this view, but what we all must understand is that we cannot expect to have an actual archivist sitting in the room every time a new system is begun. As a practical matter, we will have to assert our presence largely through policy and procedure, not physical presence.

The National Academy for Public Administration (NAPA) recently completed a study of databases in the federal government for the National Archives. The NAPA report gives us some interesting numbers to play with. Their initial inventory found a total of more than 10,000 databases in operation throughout the agencies of the federal government in 1989–90. The NAPA study team identified 1,789 of these as "major" databases, but they decided that only 919 were worthy of further examination by panels of experts to determine their long-term value. After this expert review, only 448, less than 5 percent of the original number located, were identified as worthy of transfer to the National Archives.[4]

To make what is admittedly a gross generalization out of these findings, one might project that only one in twenty of all successfully implemented systems may actually produce documentation that can be considered archival. That figure does not even take into account the many systems that die during their planning or start-up phases.

Even if every archivist in the National Archives were deployed during the last decade to rout out incipient systems and assert archival interests, they could never have found them all in time, and 95 percent of those archivists would have wasted their energy anyway.

What we really need is an agreed-upon set of policies and procedures that will ensure that long-term archival needs—and thereby the needs of the organization—are met. A small but determined number of archivists are focusing on the implementation of standards, especially document interchange standards, as one way of ensuring the transferability and interoperability of today's electronic records on tomorrow's hardware. Their investigations need to be supported, both intellectually and financially, by the archival profession as a whole. We must also monitor their progress and incorporate their findings and recommendations into local archival programs.

I would like to turn now to the other "archival organization," the professional association as exemplified by the Society of American Archivists (SAA). Bikson's descriptions of the ways task groups can facilitate work across hierarchical, social, institutional, and geographic boundaries certainly is demonstrated in SAA. I think it is also possible to draw conclusions from Bikson's research about how electronic communications have already changed the inner workings of SAA. The potential exists for making even greater, and very positive, changes if these technologies are implemented well.

I have become intimately acquainted with archival task groups of various kinds over the past several years. In fact, they have been my life blood. As many of you probably know, I began free-lancing in 1984, working as an independent archivist em-

[4]National Academy of Public Administration, *The Archives of the Future: Archival Strategies for the Treatment of Electronic Databases. A Report for the National Archives and Records Administration* (Washington, D.C.: NAPA, [1992]).

ployed as a project coordinator for a series of grant-funded initiatives. Most of them have been formally sponsored by a professional association, either SAA or the National Association of Government Archives and Records Administration, and most have resulted in reports and recommendations that were meant to be implemented either by the associations themselves or the broader profession through repositories and individual archivists.

In each of these projects, the participants were drawn from archival repositories nationwide. Geography has had very little effect on our ability to work together. Desktop computing and a friendly local copy shop have provided clerical support; the telephone and, more recently, e-mail have kept us connected; and overnight mail and fax machines can deliver documents faster than anyone could hand-deliver them, no matter how close coworkers are located.

I have worked directly with only a few of the many task forces and committees that have been active change agents in SAA during the past decade. SAA, like every professional association, has always depended on committees to get its work done, but it seems that some fundamental shift was signaled in the early 1980s during the work of the National Information Systems Task Force (NISTF). Even Dick Lytle, the NISTF chair, noted in his review of their work that the process was ultimately as important as the product.[5] NISTF's contributions to archival practice were considerable, including the USMARC AMC format and much advanced thinking about the need for and functions of information interchange among archival organizations. But these changes probably would not have taken hold if the process was not so broadly participatory, with representatives from all sectors contributing to the task force and a concerted effort to keep the larger archival community informed and involved.

In one of her earlier studies, Bikson noted that "electronically supported groups develop a richer communications structure with less hierarchical differentiation, broader participation, and more fluctuating and situational leadership structures. This appears in turn to be associated with greater feelings of involvement in the task and greater satisfaction and identification with group products."[6]

There is a lesson here for SAA. Every professional association wants to promote "broader participation," "greater feelings of involvement," and "greater satisfaction" among its members. The task forces and committees on which we depend for much of our innovative insights and forward progress would operate even better if they were supported by easy and widely available electronic communications capabilities.

Currently, access to communication networks such as Bitnet and Internet is unevenly distributed throughout the archival community in the United States. Although there are no hard data to prove it, it is evident that many college and university archivists have ready and inexpensive (if not free) access to the networks through their institutions and have become accustomed to conducting professional business via e-mail. By contrast, I have better e-mail accessibility through my CompuServe account than is available to most state archivists or many staff members at the National Archives, who cannot communicate outside their institutions. And, most frustrating for the conduct of SAA work, at the

[5]Richard H. Lytle, "An Analysis of the Work of the National Information Systems Task Force," *American Archivist* 47 (Fall 1984): 357–65.

[6]Tora K. Bikson and J. D. Eveland, *The Interplay of Work Group Structures and Computer Support* (Santa Monica, Calif.: RAND, 1991), 285. Also published as Chapter 10 in *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work*, edited by R. Kraut et al. (Hillsdale, N.J.: Erlbaum, 1990).

moment, is that the SAA central office staff still has no e-mail capability, although I understand it is coming with an imminent computer upgrade.*

To make the best use of electronic communications, it would be helpful to have better information on the capabilities that are currently available within repositories and to individual archivists. SAA should consider surveying its members to determine available resources and actual and potential uses of electronic communications.

In 1991, two special librarians conducted a survey of their colleagues to understand how special librarians were using the Internet.[7] They concluded that, while there was significant activity related to remote database searches, file transfers, and other work-related transactions, their primary use was for communication. They expressed it as filling a need for "community formation"—"to learn what is going on in their profession, to bounce ideas off others, to obtain information from people, not machines."

Like special librarians, archivists tend to work alone or on small staffs, largely isolated from others who share their immediate interests or concerns. Many have suggested that this is one of the reasons that the professional associations, both national and regional, provide such a vital service through their meetings for bringing together widely separated colleagues. How wonderful it would be if we could extend this collegiality through electronic communications.

Tora Bikson has pointed out that electronic media improve "the efficiency of direct contacts, providing easy access to shared data and allowing more efficient production of print documents."[8] Certainly the clerical and editorial aspects of preparing reports would be more easily handled. But more important for SAA, participation could be broadened to include individuals whose budgets or time constraints would not allow them to travel to several meetings. The development of an electronic query system, run out of the SAA office, could give the entire profession quick access to such tools as a calendar of upcoming meetings and other events, drafts of documents under consideration by various task forces and committees, and lists of current standards applicable to archival practice. All of the membership could stay better informed and more involved in the work of the organization.

As an aside, I do not think that SAA needs to attempt to provide an electronic discussion forum. That function is already working quite well in the independently run ARCHIVES listserv owned and operated by John Harlan out of Indiana. I do think it says something about the demand for electronic communications, however, and about the lag within SAA and other organizations in meeting that demand, that this listserv sprang up wholly outside existing archival organizations.

SAA can and should do much more to prepare its members to fully master the changes and opportunities brought about by new technologies. Although I am not able to go into any detail here, I hope that you will watch for the final report of the Automated Records and Techniques Curriculum Project that should appear in the American Archivist in early 1993.** The participants in this SAA-sponsored project

*_Editor's note_: As of 14 February 1994, the Society of American Archivists announced that it now has e-mail capability and can receive messages at info@saa.mhs.compuserve.com.

[7]Sharyn J. Ladner and Hope N. Tillman, "Special Librarians and the National Research and Education Network," unpublished manuscript, 8 September 1992.

[8]Bikson and Eveland, *The Interplay of Work Group Structures and Computer Support*, 286.

**_Editor's note:_ This issue appeared as the Summer 1993 issue of the *American Archivist*.

have developed learning objectives for archivists covering both electronic records and the application of automation in archives. The first section of the document outlines a foundation of knowledge and principles about automation and its impact on archives that we hope every archivist will be exposed to by the end of the century. The document also includes an extensive management section, recognizing that archivists will have to exert their influence more through oversight than through hands-on custody as a growing volume of information is created and stored in electronic form.

We encourage SAA to take a strong lead in planning and coordinating educational opportunities, but not necessarily as the sole or even principal provider of education. Instead we hope for growing availability of sound graduate education and substantive continuing education opportunities through institutes and internships, self-directed learning, and better access to information resources.

The greatest challenge to us all, as individual archivists and collectively as a profession, is to learn not just to cope with change but to capitalize on the opportunities it presents. As bureaucracies flatten and new communication channels open, all functions, including those associated with archives, should be integrated more fully throughout the organizations in which we work. If we speak up at the appropriate time, we can become part of the teams that will build the new information systems in these organizations rather than remain on the sidelines to pick up any remnants of documentation that exist after the active players run their course. And if we actively participate in our professional associations, we can share our experience and learn from our peers, improving the quality of archival service nationwide and even worldwide.