Chapter 4

The Changing Nature of Office Work

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Chapter 4

The Changing Nature of Office Work

Translating the capabilities of office automation technology into tangible operating benefits for an organization illustrates effects at many levels—individual tasks, the work process, organizational structure and culture, and quality of working life. These effects are at the core of the most interesting and pressing issues related to office automation. Yet, they are difficult to address because it is not possible to give a simple or universal description of the effects of automation on workers, jobs, or organizations.

This chapter looks primarily at the effects of office automation on the nature of office work, on job content, and on organizations. It examines the effects of office automation on the work process; on specific tasks, skills, and jobs; and on promotional opportunities. Next it discusses the possibility of structural or cultural change in organizations that adopt office automation. Finally, it reviews some of the major factors that contribute to successful implementation of office automation.

One point to be emphasized throughout this chapter is that the technology itself is not the only factor—and may not be the most important factor—in bringing about these changes. Managerial strategies-decisions about the organization's goals and the role of people and technology in achieving them—are of major importance in determining how the technology is used. In many cases, it can be seen that outcomes are more dependent on how the technology is used rather than on what specific equipment is employed.

CASE STUDIES

Many of the examples used in this chapter were taken from case studies of offices using automated equipment. In addition to the case studies in the literature, OTA commissioned a number of small case studies, discussed in more detail in appendix B.

Case studies provide a rich source of detailed information about the process of implementing office automation and the possible changes in tasks, jobs, work processes, and organizations. They allow one to view the intended and unintended consequences at many levels, and in a variety of contexts. In this chapter, case studies are used to provide illustrative details about the effects of technology in a wide variety of organizations. These observations form the basis of some cautious generalizations about the effects of office automation on organizations.

Caution is needed in making use of case material for a number of reasons. First, the methodology and level of detail of published case studies vary widely. Some are highly quantitative, others depend largely on qualitative, participant-observer, or anecdotal information.

Second, the organizations studied are all unique. Authority structure, corporate culture, management philosophy, internal dynamics, financial health, and operating environment are different. To the extent that these factors of themselves cause certain outcomes, or moderate the effects of technological change, it is difficult to state authoritatively that the result observed at one study site can be expected at other locations.

Third, the technology itself is defined differently from one organization to another and from one study to another. Office automation in one organization may be word processing capability used almost as a direct substitution for typewriters; in another it may be an extensive multiuser, multifunction operational system governing the production of the organization's primary product. Many possible systems and combinations of functions, includ-

ing text processing, messaging and communication, decision-support software, graphics, and numerous special purpose applications may have a separate effect on the individual, the job, or the organization. The choice of features, the way the work process is organized to use them, and the order and timing of system introduction, often make each case of office automation unique.

Finally, the time factor must be considered. User reactions and use of technology in a "honeymoon" phase shortly after the equipment is up and running may be different from what happens at a later date when new capabilities or limitations are fully understood. Some changes in the work process may take place immediately after implementation, while others may not become evident for some time. Thus, the findings of a case study may depend on where the organization was in the system life cycle when the study was carried out. There are few longitudinal studies that follow the same set of organizations over time. Even within one study it can be difficult to compare 'before' with 'after' in an environment where new technology is introduced gradually over a period of months or years, and where systems are continually being upgraded or expanded.

Despite these difficulties, case studies are often the only information available, and they capture the detail necessary for understanding dynamic change within the organizations.

THE INDIVIDUAL AND THE WORK PROCESS

The Nature of Office Work

Office automation has transformed office work. Many offices are now semiautomated environments where people and computers interact. An "office," in the sense of a working unit of people doing information processing work, is seldom a totally automated environment. A fully automated procedure is one that does not require human intervention in order to produce its final output. Automatic data processing falls into this category; all transformation of information is internal to the computer. But such fully automated procedures usually make up only part of the work. Office work usually involves a series of steps, some are fully automated, some are manual, and some require interaction between people and computers.

For the purpose of this chapter, a task will be considered any clearly definable activity that forms a step in producing the final product of the office. Tasks may be performed by people or by machines. The *work process* is the social and technical organization of work. It is the way people and machines are organized to produce a result—the way information or materials flow from one to another until the final product is completed. *Jobs are* organizationally defined positions that are usually associated with a bundle of tasks and a particular role with a defined set of responsibilities in the work process. The *work unit* or *office* is a group of people of any size, with responsibility for producing some identifiable final product. The work unit has a skill and task mix, that is, its members are at different levels, have different roles, and perform a range of functions to produce their product. *Skills are* the attributes and knowledge that workers need to perform useful activities.

The impact of office automation on office work goes beyond changes in tasks. It can introduce new tasks, change the nature of the skills required, modify the work process, and ultimately can cause or be associated with changes in jobs and in organizational culture and structure. This is at least in part because computer-based technology bundles tasks in a way that is different from the way they would be done manually. When part of a process becomes automated, the tasks that remain to be done by people may be different kinds of tasks. A new process is necessary for integrating the work done by people and the work done by machines to accommodate those differ-

ences. When the work process changes, the organizational structure, which defines the roles and responsibilities of the members, can also change.

Take, for example, an office where a professional researcher writes reports and a secretary types them. Introducing a word processor can change the work process in a number of ways. First, the nature of some tasks will change, and the new tasks will require different skills. If the professional decides to use the word processor, then composing on a keyboard will require skills quite different from those of writing by hand. Some skills needed for old tasks–like the secretary's ability to neatly paste up final copies—may seldom be used.

Further, a change may take place in the process that governs the interactions of author, secretary, and other people needed to produce the report. Partially completed drafts may no longer pass between the author and the secretary. The secretary may be left out of the revision procedure entirely, or at least the secretary's responsibilities may no longer include the task of typing the author's reports.

There are also some points where the technology does not dictate a change, but allows an opportunity for choice. The word processor could be given to the secretary instead of to the author. The author might still hand write drafts, with the secretary keying in the document and making corrections on the word processor. In this case, the word processor is more like a simple substitute for the secretary's typewriter. The relationship of author and secretary, and the flow of work between them, might have been altered only a little, although the secretary will have to learn new skills. In another scenario, that relationship might be severed completely. The secretary might be reclassified as a word processing operator and moved to a newly created pool to key and correct drafts for many authors, as part of a change in the structure of the organization.

The use of new technology also introduces new steps and new tasks. For example, use of an automated system introduces the need to make backup copies, design and use an electronic filing system, and manage disk space or diskette storage. Decisions about whether these tasks will be handled by all users, by secretaries, by a system administrator, or by some combination will affect the work process.

There is also the possibility that the availability of the technology will catalyze its own use. In the experience of many authors, the ease of editing a document on a word processor sometimes leads to additional rewriting, so that this step can sometimes seem to be repeated almost indefinitely.

Thus, even with this simple example it is possible to see how changes at the level of the task, job, work process, and organization could take place as a result of office automation.

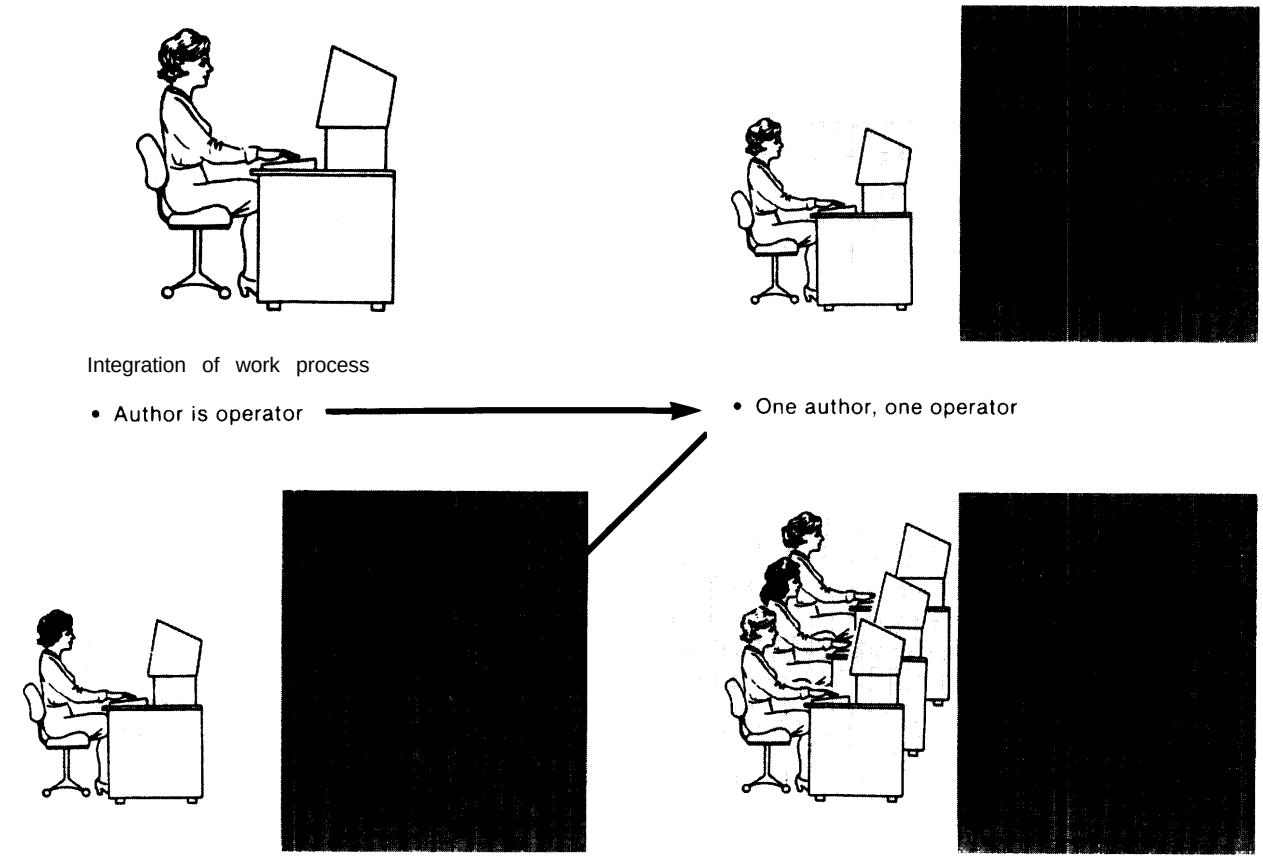
The Work Process

The bundle of tasks an individual performs describes the job, but the job is more than merely the set of tasks. The job is an organizationally defined position. In many organizations it is characterized by a job description that legitimizes the position. People identify with their jobs. The job defines a role within the work process and within the social structure; it is the point of articulation between the individual, the technology, and the organization. Thus it is not sufficient to talk about how office automation affects individual tasks. Jobs also change-the bundle of tasks, the role in the work process, the position in the organization, and the self perception.

Division of labor is necessary when there is too much work for one person to handle. Once a division of labor is made, the work process governs the relationship of the various workers to the partially completed product.

One way of looking at work process is as a continuum that runs from the most integrated to the most differentiated. Figure 4- I shows five possible steps along this continuum for a word processing office. The most integrated is the one where authors do their own word processing and have complete responsibility for all steps in the process and control

Figure 4.1 .— Possible Variations of Work Process for Word Processing



SOURCE Adapted from S M Pomfret, C W Olphert, and K D Eason, "Work Organ izationImplications of Word Process ing, " *Proceed/rigs of the1st /F/P Conference on Human·Computer Interaction (/N TERACT '84),* VOI 2, 1984, pp. 357-363

over the end product. The most differentiated is one where authors send work to a centralized word processing pool where operators have specialized tasks–some key in text, some proofread, some do corrections, etc. Between these extremes might be one-on-one relationships between author and operator, or situations where one operator or a team of operators focus on all stages of work for a particular group of authors.

The basic concept of work integration or differentiation can apply to a large extent regardless of the level of technology employed. The example above works equally well if the technology used is typewriters or quill pens. There is a popular perception that advancing technology is associated with increasing differentiation and fragmentation of work. The manufacturing assembly line, with workers performing repetitive tasks, is a product of the industrial revolution, not of earlier craft manufacturing. Many people's only image of office automation is a picture of the centralized word processing or data-entry pool. Although there has been a connection between computerization and fragmentation of work in the past, other forces are also at work. Office automation technology offers the possibility of reintegrating the work process in some cases.

Another way of looking at the work process and the way it changes with automation is in terms of the three generic types of work processes in offices identified by Giuliano—preindustrial, industrial, and information age. [1]

The preindustrial form of organization is used by many small and medium sized offices, for example, a real estate brokerage or professional office. These work units may have a number of workers with different jobs, or roles, in the work process. However, each worker is to some extent a craftsman. Each works with some independence and performs a variety of tasks. There has been little effort to completely standardize or systemize the work process. A variety of individual work styles is tolerated. There may be some fuzziness or overlap in responsibilities and workers may be sufficiently familiar with the work of others to switch tasks occasionally, or take over in an emergency.

While the preindustrial style of organization works well in many contexts, it is often inefficient in handling large numbers of transactions. Thus, in the insurance industry, banking, or the billing departments of large firms, where high transaction volume is handled, industrial-style offices evolved. They are designed to organize people to serve the needs of a large, rigid production system. The industrial office is a production line. Workers are differentiated into functional groups, for example-typists, log-in clerks, validation clerks, and signature control clerks. Each group has its own supervisor, and is responsible for some step in the processing of a transaction. Documents related to customer transactions flow from one functional area to the next, from one "out' box to the next "in' box, receiving some incremental processing at each stop.

The flow of work in an industrial office is consciously designed according to principles of "scientific management" first articulated for manufacturing by Fredrick W. Taylor in the early 1900s. With Taylorization, a complex production process is analyzed and divided into a series of simple tasks that can each be performed quickly and efficiently. workers are assigned to perform a single task, or a narrow range of tasks, in a routine and repetitive way. The industrial form of work organization is a deliberate attempt to increase efficiency by rationalizing the work process, and by reducing individual discretion and variation.

Because industrial-style offices were ones in which the work process had been consciously analyzed and the individual tasks identified, isolated, and standardized, they were ideal candidates for the early introduction of computers. Certain tasks could be automated completely, making use of the computer's ability to do large batches of calculations quickly. However, many manual tasks remained in preparing data for the computer or making use of computer output.

[1] Vincent E. Giuliano, "The Mechanization of Office Work" *Scientific American*, September 1982, pp. 149-164.

Some have argued that computerization allows managers to speed the process of Taylorizing and routinizing office work in order to reduce costs and increase management control.' Certainly, as automation began to be used in offices, it appeared that Taylorization and computerization were mutually complementary and interdependent processes, as computers were first introduced in those areas where manual processes had already been 'industrialized."3

Indeed, computerization seems to have intensified the factory-like nature of industrial-style offices. "Pools" of functionally similar workers existed before, but the trend toward specialization increased with computerization, especially in routine data-entry tasks:

> Routine keyboarding was separated more sharply from other clerical functions and was often spatially isolated . . . As a result of the heightened fragmentation of work, processing personnel (both data processing and word processing) typically worked at machines all day. . . both the technical and social relations of work in these centralized word processing and data processing centers were factory-like. The work process was machine paced and often machine supervised; autonomy of the operator was minimal; competence measured by manual dexterity and speed.[4]

Taylorization is not limited to clerical processing functions. It isolates predictable tasks. Professional or managerial jobs can be analyzed and the more routine functions stripped away. Baran and Teegarden note that underwriting, the main professional occupation in the insurance industry, has been increasingly rationalized. At one firm, this was done by splitting off the lower level functions and creating a new clerical position called underwriting technical assistant to perform them. Remaining professional positions were divided into specialty categories.[5]

Photo credit: Michael Smith

Some offices are in factories. Note that some of these clerical workers are protecting their ears from excess noise.

Photo credit Michael Smith

Some offices where large numbers of transactions are handled resemble factories.

The industrial style of office organization works well for highly routine processes. It has some disadvantages, in dealing with ' 'exceptions" or nonroutine situations, and is usually not efficient for customized services. Some experts also note that it is susceptible to possible long-term growth of overhead costs. For example, in order to deal with error detection and correction it maybe necessary to add more steps, thus making the process longer and more unwieldy. Generally, no one employee has all the information needed to correct an error, so mistakes may persist or build on one another; papers might cycle through the system several times before they are corrected.

'For example, see Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century (New* York: Monthly Review Press, 1974), pp. 293-358.

'Barbara Baran and Suzanne Teegarden, "Women's Labor in the Office of the Future: Changes in the Occupational Structure of the Insurance Industry, " Department of City and Regional Planning, University of California, Berkeley, 1983, p. 11.

'Ibid.

Ibid.

It can become difficult to provide quick, accurate customer service when work is processed in a production line fashion. The process of issuing an international letter of credit at one bank required 23 steps performed by 14 workers over a 3-day period, and generated stubs and carbon copies to be stored in a number of locations.' A customer with a question had a difficult time finding the one worker with the right bit of information to answer it, and if a customer wanted a transaction to be modified, the whole process had to start over again.

Finally, for many workers, the endless repetition of a limited range of tasks is boring. Yet information-handling tasks, even boring ones, usually require a high degree of focused attention. The result can often be a high error rate in the work, and a high turnover rate among the employees. These problems will be discussed at greater length in the next chapter.

The Information Age Office

For some businesses, office automation offers the possibility of restructuring the work process in a way that reduces some of the problems of the industrial style of work organization. This new approach has been called "post industrial' or "information age' and is characterized by an electronic reintegration of the steps involved in producing a product.

Electronic reintegration of work represents a new approach to rationalization of work. Instead of attempting to make the work process efficient by rationalizing each task and function separately, this approach seeks to rationalize a whole procedure, perhaps along product or market lines. This is possible because the technology allows: 1) the integration of information from many sources, and z) the distribution of information to many locations.

A general example can be seen in the case of the bank mentioned above. Under the old system, each worker performed one or two steps in the processing of all letters of credit. Under the revised work process, each worker, with the aid of a computer workstation and a client database, performs all the necessary steps in processing letters of credit for a particular set of clients. The database contains all information related to the customer's account. The customer service worker is the single point of contact between the customer and the bank for corrections or inquiries.

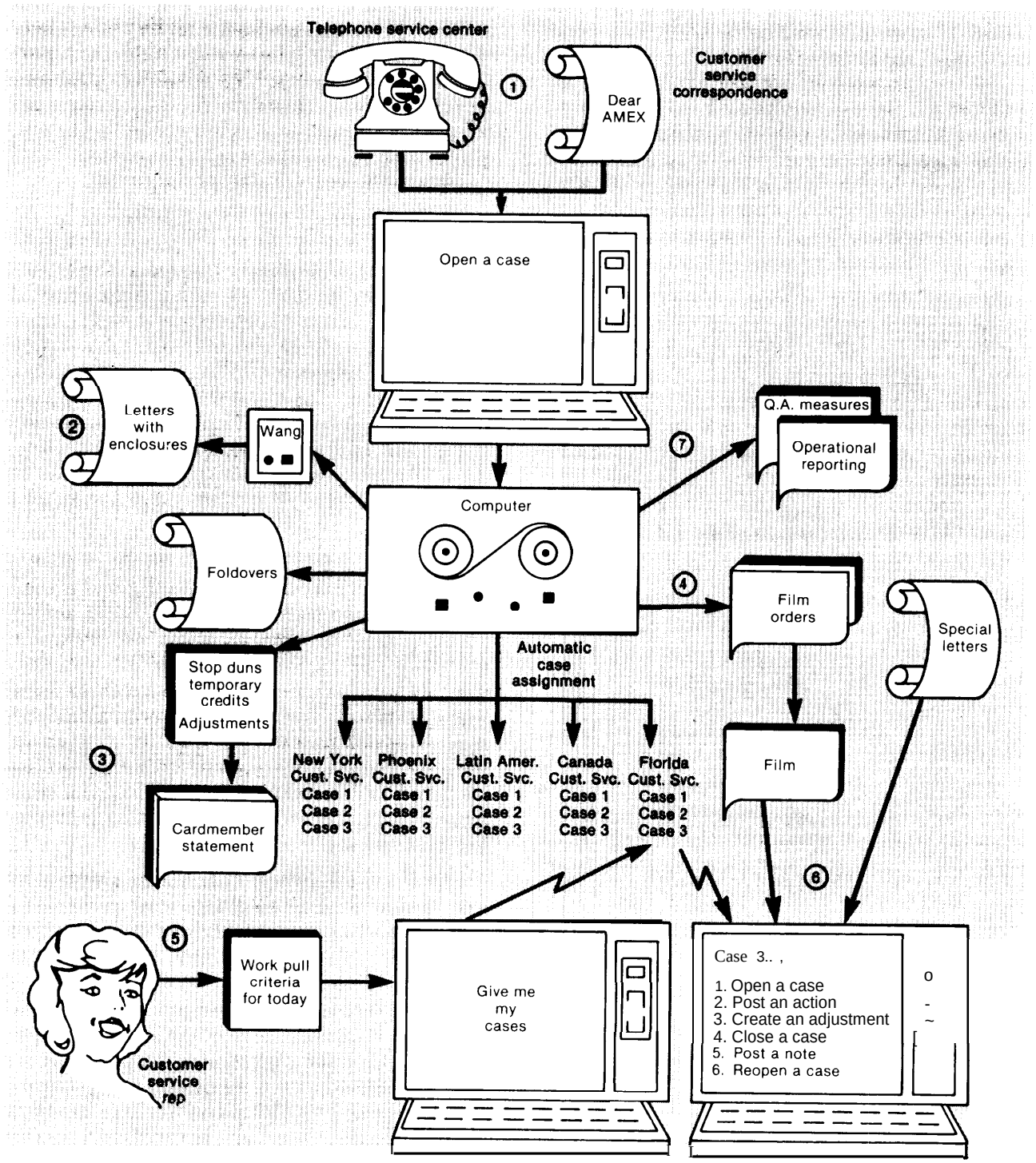
An illustration of the capabilities of an integrated customer service system at American Express is shown in figure *4-2*. customer service representatives have the ability to deal with a wide variety of activities related to their cases. Working from the on-line database they can answer telephone inquires, send written replies to mail inquires, make credit adjustments, stop automatic duns, or issue a special statement. In addition to the on-line database, the customer service workers have access to historical records stored on computer output microfilm.

Electronic reintegration allows a worker a view of the whole operation and gives a variety of tasks to perform. Roth factors are indicative of a "de-Taylorization" of work, and probably contribute to greater job satisfaction, and in many cases, greater autonomy and responsibility. However, electronic reintegration does not necessarily lead to greater autonomy, responsibility, or discretion. Because the work is dependent on the use of the computer, it can be subject to machine monitoring and pacing.

When a whole process cannot be handled by one kind of worker, electronic integration can still be used to accommodate a decentralized team approach to the division of labor. Some insurance firms have created small teams of raters, underwriters, and clerical support workers to work on specific product lines. Workers that were formerly separated by function are now integrated into a team that serves a specific market. Organizing the workers in teams rather than isolating them in functional groups allows them greater understanding of the whole production process and facilitates com munication.

'Richard Matteis, "The New Back Office Focuses on Customer Service," *Harvard Business Review*, March-April 1979, pp. 146-159.

Figure 4-2.— Model of an Integrated Customer Service System



SOURCE Jay W Spechler D[rector Performance Englneerlng American Express Co , personal communication 1985

Baran and Teegarden suggest that in the insurance business, firms will tend to continue to use the industrial-style work process to produce and distribute standardized products. Much of the work will be highly routine, and the work force will consist of a shrinking number of low-skilled clericals and a few highly skilled professionals. With these products the goal is to reduce unit costs as far as possible and to minimize labor costs. For more specialized products, those that require customizing or responsiveness to individual client needs, there may be more use of the team approach along with integrated office automation systems.[7]

[7]Baran and Teegarden, op. cit., p. 21.

TASK CHANGE AND COMPUTER-MEDIATED WORK

One commonly noted characteristic of work with computers is that they make work more abstract and alter the worker's relationship to the task. This is sometimes called a "computer mediated" relationship, in that the individual must now do the task through the medium of the computer system rather than through direct contact with the objects of the tasks Using any sort of tool can, of course, distance a worker from direct tactile contact with an object. But most manual or power tools still allow the worker to remain cIose enough to the object to get direct feedback about the condition of the object, the status of the process, or the need for adjustments. When a computer is used, feedback is indirect, in the form of symbols generated by the information system.

Office work is already abstract. What is actually being processed is information. Yet from the point of view of the worker, this information becomes concrete because it is carried on physical objects–signature cards, account ledgers, invoices, letters, reports, and checks. Most manual or mechanically aided office tasks involve transforming the information by manipulating the object—copying, typing, updating, or signing it. When computers are introduced, many of these objects disappear completely. The worker is left to deal with intangible information, which is transformed in invisible ways inside the computer.

The rules by which information is prepared or transformed also change with computer mediation. Quantitative comparisons are easy for computers to handle, qualitative judgments are not. Thus, in the process of restructuring work to be done by computers, qualitative aspects of information are either quantified or lost. Correctness of data or procedures must be redefined to fit the formal logic of the computer, and formal correctness can become more important than the relevance of information content.[8] Human judgments are often replaced with computer-based decisions and human error detection or correction become difficult.

The language of the human-computer interface is different from human language, as well. Although computers are becoming easier to use, they still require human operators to learn specific codes and procedural commands. Further, even when these commands are similar to plain English, the formalized process by which the computer works may be quite different from human thought patterns. The human operator must learn to think and to perform actions in a precise order that reflects the logical sequence built into the software.

The ability to think in a way that parallels computer logic is not a trivial intellectual discipline, and represents a new way of working for many people. For example, retrieving information from a computerized database re-

[6]See, for example, Shoshanah Zuboff, "New Worlds of Computer-Mediated Work," *Harvard Business Review*, September-October 1982, pp. 142-152.

[8]Further discussion is in Gunnar Aronsson, "Changed Work Qualification Structure in Computer-Mediated Work," National Board of occupational Safety and Health, Solna, Sweden, 1984.

quires different modes of thought than finding a folder in a filing cabinet. Physical search is aided by physical aids to memory—thickness of the file, color, a coffee stain on the corner. These do not exist in a computer-based file. There is only a name, constructed according to rules inherent in the computer logic. A search through a database requires use of the right key words, in the proper relationship; otherwise the search may yield fault y results.

An example of how tasks change when computers take over part of the process may be seen in banks. With computerization, the process of fabricating accounts, the principal activity of a bank, was made internal to the computer. These procedures had previously been done manually, or with the assistance of mechanical accounting machines. The role of human operators then changed from one of doing banking to one of surveillance of the computer as it does banking. Adler points out that:

> . . . a series of tasks formerly considered the very essence of bank work have been eliminated, including accounting imputation and adjustment, classification of documents, multiple entries of data, manual data search, and supervision by signature.[10]

He also notes that new tasks were introduced. For example, "Accountants now diagnose and rectify residues and anomalies listed by the computer system. New types of errors–and fraud—appear.[11]

[10] Paul Adler. "Rethinking the Skill Requirements of New Technologies, " Working Paper 9-784-027, Graduate School of Business Administration, Harvard University, Boston, October 1983, p. 17.

[11] Ibid.

Some observers note that the increased abstraction can affect people's understanding of the work. Some managers in banking have noted, for example, that new employees—those who have only worked on the automated systems—understand the system, but don't necessarily understand banking. They think like computer programmers instead of like bankers. As one manager said:

> Now you make an input and it's gone. People become more technical and sophisticated, but they have an inferior understanding of the banking business. New people have no idea of the manual procedures so they never see or understand the process, People start creating programs that don't necessarily reflect the spirit of the operation.[12]

Clearly employees acquire new skills, they learn to interact with the computer, they may never learn certain old skills. To the extent that processes are automated and these skills are not needed any more, this may not be a problem. But, if the skills are still needed, either at that job level or at another, there may be costs to individuals or the organization for allowing them to be lost. To continue the example above, an understanding of basic banking practice probably is necessary for promotion above the lowest operational levels. To the extent that employees do not gain it by doing bank work, it may be necessary to acquire it through formal training.

[12] Shoshanah Zuboff, "Problems of Symbolic Toil: How People Fare With Computer-Mediated Work," *Dissent*, winter 1982, pp. 51-61.

JOB CHANGES WITH AUTOMATION

Office automation can change jobs in many ways. The automated system may completely take over certain tasks. To the extent that certain processes become completely automated, jobs that consist solely of those tasks or processes might be eliminated. This does not necessarily mean that the people are eliminated from the organization-they may be retrained and transferred—but particular positions no onger exist.

On the other hand, office automation creates new tasks, either supporting the system or related to new products made possible by the system. These tasks may be incorporated into existing jobs or new jobs may be created, as in cases where a trainer or systems specialist position is created after introduction of office automation.

Finally, very commonly, a change in the work process modifies jobs through the addition or deletion of tasks. This can also result in a change in the boundaries between jobs, transferring a task from one job to another. Any of these changes may or may not be accompanied by a formal change in job titles, descriptions, or compensation.

The boundaries between clerical and professional and between clerical and managerial are showing interesting changes with office automation. Some researchers have referred to this redistribution of labor as the "clericalization of professional work' and the ' 'professionalization of clerical work. I[5] Most clear is the shift of keyboarding tasks when professionals and managers acquire terminals or personal computers. Individuals who would never have typed their own memos and reports now routinely draft them on their personal computers. Clerical workers have not stopped doing keyboard work completely, however. Secretaries may work on documents at a later stage to revise, format, or print them, or they may still key documents that professionals and managers choose not to key themselves. Nevertheless, many organizations have seen a decrease in the amount of time secretaries and other clerical workers spend in keyboarding or revising original material when professionals and managers begin using the system.

By the same token, secretaries and some other clerical workers have taken over tasks formerly defined as professional. In case studies of two different banking organizations, for example, secretaries began using on-line databases and statistical software available on their terminals to collect data and do analyses formerly done by economists. " Clearly, new technology is not the only factor in clerical workers' being able to take on new and interesting tasks; there must be management support for these job changes.

The question of whether changes related to automation lead to an increase or a decrease in skill is a hotly debated one. Often the terms job "de-skilling" and "enrichment" are used to describe the changes. Enrichment usually implies an increase in task variety, autonomy, skills acquisition, and other factors that are considered to contribute to job satisfaction. De-skilling usually means the removal of these features, usually through simplifying the work and narrowing the number of tasks performed, and is usually associated with rationalizing or Taylorizing the work. Both de-skilling and enrichment could be accompanied by job "enlargement, that is, an increase in workload.

It is clear that the impacts of office automation will vary from one job to another. The following is a brief summary of some generic changes that have been seen to affect different categories of workers.

Management and Professional Jobs

Increasingly, computers are helping professionals get more work done by providing more and better information, by providing tools to aid in formulating professional opinions, and by taking over some routine decisions. Traditionally, professionals and managers have high levels of autonomy in their work. " Use of new technology can give managers and professionals better control over their time and even greater autonomy in their jobs. For example, electronic messaging may reduce telephone

[5]See, for example, Joan Greenbaum, Cydney Pullman, and Sharon Szymanski, "Effects of Office Automation on the Public Sector Workforce: A Case Study, " OTA contract No. 433-7990.0, April 19/!5.

[6]B.C. Amick and J. Damron, "Considerations in Defining Office Automation: A Case Study in the Eastern Africa Region of the World Bank, " *Human Computer* Interaction: *Proceedings of the First USA-Japan Conference cm Human Computer Interaction.* Gavriel Salvendy (cd.) (Amsterdam: Elsevier Science Publishers, 1984), pp. 439-445. See also app. B, "Computer Mediated Work in Commercial Banking."

B. Kaplan, et al., *Job Demands and Workers Health* (Washington, DC: U.S. Government Printing Office, 1975).

an

call-backs, or in some cases, the number of meetings. Managers can get up-to-date information on factory operations or business activity by accessing on-line databases within their companies. They may be able to manipulate these data, to do "what if" studies to determine the probable outcomes of their decisions before actually making them. Managers and professionals can avoid the need for outside data processing or other expert help by using spread-sheet software or information databases at their own terminals. They can produce polished reports on their own printers without a secretary or a graphics artist.[16]

Along with these advantages, there can be some drawbacks as well.

Greater autonomy, for example, can have its disadvantages. When managers and professionals demonstrate less need for a secretary to do their typing, they may lose the secretary entirely, even if they still want one for other duties—or for a status symbol.

In another example, a manager who is pleased to get up-to-date information about factory operations through the office automation system, may be dismayed to find that the same information is available to a senior executive, who is therefore capable of more closely monitoring or second-guessing decisions. In this case, the use of the technology might lead to a reduction in autonomy for the lower level manager.

"Knowledge engineers" have been attempting to identify the skills, information, and expertise that go into managerial and professional judgments and to incorporate these into software. The results are a variety of computer-based models, expert systems, and decision-support systems.

Some analysts have expressed fears that computer-based models are making professional and managerial work more routine. There are also fears that some people are going too far in allowing them to replace human judgment. Human judgment is not perfect, but its imperfection is generally recognized and expected. Many people have higher expectations of computers, and sometimes a misplaced faith in their accuracy. A computer-based model, no matter how good, is only a partial representation of complex relationships, and its internal assumptions, theoretical biases, and mathematical quirks can produce results that are not consistent with the real world. Overconfidence in the effectiveness of computer-based models, some believe, can lead to neglect of other forms of research that were, before computerization, the basis of expertise. Skill in these areas is still important as long as the model is incomplete.[17]

The ability of computers to give the wrong answer to six significant figures is sometimes called "the tyranny of illusory precision. " Its danger to professionals and managers has probably been exacerbated by the growing use of computer graphics. Advertisements by computer companies rightly tout the greater per-

[16] Alexia, Martin, *Office Automation: Catalyst for Change,* SRI, International, 1983, p. 9.

[17] Linda Sandier, "Securities Risk: Wall Street Is Finding Its Trusty Computers Have Their Dark Side, " *Wall Street Journal,* Dec. *4, 1984,* p. 1.

suasiveness of good graphics (the CEO adopts the proposal illustrated by manager A's colorful pie charts, but he throws manager B's laboriously typed tables into the trash). However, slickness of presentation and effectiveness of results are not necessarily related.

Some professionals have expressed fears that too much use of computer-based information or decision-support software is limiting creative problem solving. Much of the value of a professional judgment is that it weighs many factors, many of which are unquantifiable, or even ambiguous or fuzzy. Someone who formulates a professional opinion gives weight to the nonquantifiable information in a "gut feeling" based on experience. Information available through a computer database may be more complete than information accumulated through other means, but it is also "perfect "-ambiguity has been removed. Some writers have suggested that ambiguous situations provide a "free space" for creative thinking that is fundamental to professional work.[18]

The problem may be short term. Continued research and development along with practical use will further demonstrate both the potential and the limitations of computer-based tools in aiding decisionmaking. If professionals and managers who put too much reliance on computer systems make more mistakes than those who rely more on traditional skills, they will presumably prove less effective over time.

Clerical Jobs

It is in the area of clerical jobs that most studies of the effects of office automation have focused, and it is here that many of the impacts seem apparent.[19] Nevertheless, it is hard to generalize, because so many impacts depend on how the technology is implemented in a particular organization, rather than on the technology itself.

For many clerical workers, both quantitative and qualitative data show that workload has changed following the introduction of office automation. The work pressure scale from the NIOSH study shows that the introduction of a computer terminal has led workers to report greater work pressure. In most cases this is because management choice has been to redesign work according to the "industrial" or production-line model. The most common scenarios are those of the secretarial worker, the data-entry clerk,[20] or the directory assistance operator.[21] In each case, rationalization of the job fragments it into its component parts. A secretary, for example, who previously did filing, typing, answering phones, and a number of nonroutine tasks may end up only doing word processing.

Work pressure may also increase when the work is less paced by the person and more by the computer terminal. In the extreme case, the directory assistance operator may be expected to take a call every 30 seconds, with calls continually forwarded to the operator by the computer. It is this combination of pacing and specialization that leads to increased workload.[22]

Whether the worker's autonomy and control are increased or decreased on the job can depend on how the automated system is designed. This can be seen, for example, in some of the automated collection systems being used

[18] Zuboff, op. cit.

[19] Examples include: Mary C. Murphree, "Rationalization and Satisfaction in Clerical Work: A Case Study of Wall Street Legal Secretaries," Ph.D. dissertation, Department of Sociology, Columbia University, 1981: Evelyn N. Glenn and Rosalyn L. Feldberg, "Proletarianizing Clerical Work: Technology and organizational Control in the Office," *Case Studies in the Labor Process,* Andrew Zimbalist [cd.) (New York: Monthly Review Press, 1978), pp. 51 -72; and Robert A. Arndt, and Larry Chapman, " Potential Office Hazards and Controls," OTA Case Study, 1984.

[20] Michael J. Smith, B.G. F. Cohen, and L.W. Stammerjohn, "An Investigation of Health Complaints and Job Stress in Video Display Operations," *Human Factors* 24:4, 1981, pp. 387-400; Gunn Johansson and Gunnar Aronsson, "Stress Reactions in Computerized Administrative Work" Reports for the Department of Psychology, University of Stockholm, Supplement 50, 1980.

"Note the example cited in B.C. Amick and D.D. Celentano, "Human Factors Epidemiology: An Integrated Approach to the Study of Health Issues in the Off ice," *Human Aspects in Office Automation,* B.G F. Cohen (cd.) (Amsterdam: I+; lsevier Science Publishers, 1984), pp. 153-166.

[22] R. Feldberg and E. Glenn, "Technology and Work Degradation: Effects of Office Automation on Women Clerical Workers," *Machina Ex Dea: Feminist Perspectives on Technology* (New York: Pergamon Press, 1984).

both by private firms and government agencies. Often these are implemented in **a way** that reduces autonomy. Under a manual system, the individual worker had some discretion about which account **to** pursue, when to start a new file, or how often to call. Many automated systems make all those decisions. The system makes other decisions as the worker keys new information into the files during telephone calls with the delinquent accounts. The worker's individual assessment of priorities or intuitive judgments of which people are most likely **to** respond to extra cajoling become less important. The automated system determines when, how often, and how long each call should be. Sometimes the worker has no understanding of the whole case, except through the notes provided by the system. Under a manual system, a worker ends each day with a big pile of completed work and a sense of accomplishment; a machinepaced system may continue to send new work at the same rate, no matter how much is accomplished.

On the other hand, if designed differently, the same sort of system can maintain worker autonomy and control while providing the advantages of a computer-based information system. For example, work can be bundled so that one worker, or a team of workers, follows a certain set of accounts from beginning to end, and has the satisfaction of seeing the big picture in each case. If the system is modifiable by the user, so as to give some discretion about timing and duration of tasks or to allow use of individual expertise, it can offer the best features of both the manual and automated systems. Autonomy is not directly tied to the technology and is related to characteristics of the organization and the work process prior to automation.

Changes in the work process can lead to a redistribution of tasks, which may either reduce or increase workload for clerical workers. Where professionals and managers have begun to do most of their own keyboard work, or where keyboarding is sent to a word processing pool, secretaries may find their typing load considerably reduced. How this change is handled depends on managerial and individual decisions. In one OTA case study site, a New York City office, secretaries organized themselves to solicit overflow typing from other departments.

In the case of one Wall Street law firm, legal secretaries found they were losing their keyboard work to the word processing pool and their lawyering' tasks to paralegals. As a result, their work is generally now limited to performing "primarily those nonroutine tasks that involve social skills, time emergencies, and multiple contingencies, " such as fielding phone calls, gatekeeping, coaxing rush jobs through the bureaucracy, etc. The firm has made a deliberate effort to reduce the number of secretaries and to eliminate the one-secretary-one-attorney relationship. Increasingly, secretaries work for more than one attorney or as members of small clusters in teams with other secretaries. [23]

The allocation of tasks is a management decision. In the case of the law firm, business and economic factors moved management to allocate tasks in a new way. A centralized word processing pool appeared to minimize capital costs and ensure maximum use of equipment. Technology helped make the reallocation of tasks possible, but did not guarantee it. The other change in the legal secretaries' work had more to do with accounting procedures than with technology; "lawyering'" work done by paraprofessionals is billable to clients, but the same work done by legal secretaries is considered an overhead expense. Economic factors motivate both the acquisition of new technology and the assignment of work.

For secretaries at one major bank the increase in workload relates not to fragmentation, but to the addition of new and interesting tasks. When personal computers were introduced into their work unit their keyboarding duties did not decline; the unit withdrew from the typing pool it had used previously, making secretaries responsible for more key-

-'Mary C. Murphree, ''Brave New Office: The Changing World of the Legal Secretary,'' *My Troubles Are Going To Have Trouble With Me: Everyday Trials and Triumphs of Women Workers*, K. Sacks and D, Remy, (eds.) (New Brunswick, NJ: Rutgers University Press, Douglas Series, 1984).

boarding. At the same time, the secretaries discovered that the statistical packages and databases available on their terminals allowed them to do some types of work previously done by professionals. They found this work an enjoyable challenge and do not wish to give it up, even though it increases their workload. 24

Job Ladders and Mobility

Changes in job content may affect career mobility within organizations (internal labor markets) as well as mobility within the economy at large (external labor markets). In many firms employees have the possibility of moving up job ladders within the organization—acquiring new skills, assuming greater responsibility, and receiving higher compensation. The development of these opportunities and the cultivation of this internal labor market has been very important to some firms. Some indeed consider the experience of working up through the ranks, with its concomitant understanding of internal operations and demonstrated loyalty to the firm, to be more important than any amount of outside training. These firms may have a policy of filling certain positions only through promotions rather than from outside.

Both company policy and the shape of the job ladders may change over time due to any number of factors, including technological change. What will be the impact of those changes directly related to office automation, or to the changes in work process or job definition permitted by technological change?

On the one hand, the fragmentation of work into a multiplicity of narrowly defined jobs has traditionally aroused concern about the availability of "good" jobs. On the other hand, the prospect that office automation may lead to more standardized jobs raises concern about potential polarization of job opportunities into low skill, low wage and high skill, high wage jobs with breaks in the job ladder between them.

The import of diminished mobility must be judged relative to the context, which includes both internal and external labor market conditions. In many industries, internal job ladders have been significant factors in the past. Capable and ambitious workers could learn the industry from the ground up, coming in as clerical workers and working their way up through lower level supervisory (or paraprofessional) jobs into management levels. In the insurance industry, for example, clerical workers might become raters and later underwriters."

> Some technologies provided a natural learning sequence so that workers learned on the job how to carry out more complex tasks and operations. Firms that anticipated future growth wisely saw to it that there were pools of workers at the various intermediate skill levels available for promotion so that expansion could be smooth and free of external labor market constraints. "

The insurance industry traditionally selected and trained managers from within the industry, usually from within the firm. In other industries too, such as retail trade, the internal job market was the most significant and employers provided much formal and informal training for lower level employees. Although the messenger-to-manager or clerk-to-CEO paths were trod to the end by very few, the possibility that a combination of diligence, striving, and luck could take one to the top was a powerful motivating factor.

Some researchers have suggested a growing trend in recent decades to externalize both training and recruitment. In other words, employers are depending more on lateral recruitment of managers and skilled workers trained in colleges and business schools. [27] This also

[1] B.C. Amick and J. Damron, op. cit., pp. 439-445.

[2] It has been pointed out by several researchers that this job ladder worked well only for male clerical workers before the early 1970s; women clerical workers seldom made the climb. Under pressure of equal opportunity initiatives this became a significant job ladder for women in the 1970s, but is now said to be truncated by the automation of rating and routine underwriting.

-*Eileen Appelbaum, School of Business Administration, Department of Economics, Temple University, personal communication, Feb. 5, 198,5.

See for example, Thierry J. Noyelle, "Employment and Career opportunities for Women Minorities in a Changing Economy: The Experience of Large and Medium Sized Firms, " Conservation of Human Resources, Columbia University, January 19N3,

applies to lower level workers, because of the longer years of schooling for the general population and the growing availability of vocational schools and community colleges, employers can rely on the public sector for training once provided within the firm. For those who cannot or do not get that training and education—for reasons related to socioeconomic conditions, culture, talents, or the driving necessity of earning a living early in life—a critical alternative path to better jobs is being eroded.

Office automation could further weaken and truncate internal job ladders by completely automating some of the jobs that provided the intermediate rungs, and by encouraging employers to rationalize, simplify, and narrow tasks so that workers learn about only smaller and smaller fragments of the total work of the organization. This also makes the individual worker less and less valuable to the employer since he or she can be readily replaced by others who require only the briefest training, or have already learned the same simple procedures in other firms or other industries. Their skills are, in other words, fully standardized.

This tendency from one perspective increases the mobility of workers, who can move relatively easily from one firm to another or from one industry to another with fully transferable skills. But it does not increase their upward mobility at the same time. If the supply of lower level jobs shrinks and the supply of higher level jobs increases, such workers may not benefit because the higher level jobs are likely to be filled laterally, with people who have had the benefit of higher education–or more recent education.

Some researchers believe these trends are leading to a polarization of the labor force into low skill, low paid jobs and high skilled, high paid jobs, with few opportunities in between. Empirical evidence regarding any economy-wide trend toward job polarization within organizations gives conflicting signals. Polarization of jobs has occurred in such office-oriented industries as banking and insurance; examples are provided in previously cited research by Baran and Appelbaum. Conditions in those industries are not necessarily generalizable to general office circumstances, where initial staffing patterns are different and motivations regarding job design are also different. In many general office environments with lower levels of clerical employment (the extreme being the one-secretary office) office automation is not driven as strongly by the objective of immediate reductions in force. In many such offices, there is perhaps a stronger need for quality improvement, greater timeliness, and workload leveling. The result could be a greater tendency for job enhancement and possibly improved internal job ladders.

Many people advance their careers by moving from one organization to another. Thus, the external labor market is also a source of opportunity. In professional, technical, and managerial occupations, advancement by moving between organizations, as well as by moving within them is relatively common. A study of occupational mobility noted that most job changes during the study period occurred within the same major occupational group, especially for both male and female professionals.[24] Indeed, mobility of these personnel seems to be the foundation for the employment agency and placement business.

Although some people can advance readily via the external labor market, some groups find that more difficult. In many cases, a change in jobs does not reflect advancement. It was noted in the previously cited occupational mobility study that a relatively high percentage of women who had recently moved into manager or sales positions had previously been clerical workers. However, the largest group of women changing jobs were those who moved from one clerical occupation to another.[29] For lower level clerical workers, advancement through job changes is likely to require formal, external training, if on-the-job acquisition of skills needed for higher level positions is diminished. A reduction in intraorganiza-

[24] Ellen Sehgal, "occupational Mobility and Job Tenure in 1983, " *Monthly Labor Review*, October 1984, pp. 18-23.
[29] Ibid.

tional career ladders is a shift in training burden from employer to employee. That burden is aggravated inasmuch as access to good education and training is uneven; job opportunities may be increasingly tied to social class or economic means.

ORGANIZATIONAL STRUCTURE AND RELATIONSHIPS

Changes in the structure of organizations related to introduction of office automation can be influenced by economic, environmental, or cultural considerations, in addition to technology. Managerial strategies-upper level decisions about the organization's goals and the role of technology and of people in achieving them—are probably the major considerations.

Formal structural changes (i.e., something that would be noticed on the organization chart) might take place during implementation of office automation or shortly afterwards, perhaps reflecting a change in the work process. For instance, in some firms, the creation of administrative centers and the aggregation of all support personnel in word processing pools accompanied the decision to adopt office automation technology. On the other hand, change may not be reflected formally at all, but may only be seen as changes in communication patterns or in power relationships between groups or departments.

Organizational effects often take place over a period of time, as part of an evolutionary process. As familiarity with technology and its capability grows, structural changes may be introduced that allow the organization to take better advantage of those capabilities. New product lines made possible by the technology may emerge, which in turn give rise to new work groups or departments.

Power and Access to Information

Early research on the computerization of organizations suggested that introduction of computing appeared to change power relationships, and a central preoccupation of research in the 1970s, was whether computers led to growing centralization of power among upper level managers. The sources of organizational power include such things as control over resources, information, critical technical skills, or coping capability .30 As control over the computer offered senior management many of these things, some researchers predicted that computerization would increase the centralization of decisionmaking power.

These studies were done for the most part in the era of mainframe computers. However, even in the age of personal computing and distributed processing, there may be reason to believe that integrated information systems can aid in the centralization of organizational power. Possible routinization of middle management work, through dependence on computer-based information systems and decision-support models, was discussed earlier. Some researchers have pointed out that any worker whose job becomes more routine becomes less powerful, less able to offer a unique contribution to the organization. While middle managers may retain responsibility y for making certain decisions, their range of choices could become more rigidly circumscribed by the assumptions inherent in their decision-support system. Their authority could be accompanied by increased supervision and control, as higher level management will have access to the same information and decision aids.[31] Another expert has suggested that "paradoxically, [centralization] may be manifested by locating decisions at lower levels but controlling decision outcomes through the provision of performance records. "3[2] It has been suggested that the widespread use of integrated office auto-

[1]Jeffrey Pfeffer, *Power in Organizations* (Marshfield, MA: Pitman Publishing Inc., 1981), p. 274.

[2]M. Lynne Markus, *Systems in Organizations: Bugs and Features* (Boston, MA: Pitman Publishing Inc., 1984), pp. 52-53.

[3]Daniel Robey, "Computer Information Systems and Organizational Structure, " *Communications of the ACM*, October 1981, pp. 619687.

mation systems reduces the need for middle management and could ultimately lead to a flattening of some organizational pyramids .33

The concept of centralization is too simple to describe all the possible changes in power relationships that might result from the introduction of office automation. Organizations are not monolithic; different departments, work groups, or factions may be affected differentially.

A set of case studies found that introduction of automated production scheduling systems into Danish plants altered the power relationships among management groups because of differential access to information. The plants had a matrix organization, with major decisions being made by interdepartmental teams of production planners, production managers, and plant managers.[34] The new computer-based production planning system was 'owned' and mainly used by production planners. It seems to have concentrated up-to-date knowledge in their hands, thus giving them greater power over production decisions and higher status as compared to production managers and plant mangers. These shifts of influence were evidently unintended by the designers of the system. One expert[35] in interpreting the same study, points out that this concentration of power caused the matrix arrangement to lose some of its anticipated effectiveness, although it was still retained, largely for symbolic or ideological reasons.

In one of the OTA case studies, Aircraft Instruments Plant, the introduction of the MRP II planning and scheduling system seems to have given greater power to production-support office workers while taking some discretion away from the supervisors on the factory floor. (See appendix B.) While access to up-to-date information is partly responsible for this shift, even more important is the ability to act on information. Under the new system, only production-support staff have the authority to override the system when the automatic response would be inappropriate. Because of the complexity of the work and also because of some conceptual problems in the system's design, such conditions arise frequently. Previously, factory supervisors might have dealt with exception conditions on their own authority, but now they must request permission from production support.

On the other hand, where shifts in relative power are inappropriate to the "corporate culture" of any organization, management has the option of reinforcing existing lines of authority and modifying the automated system to ensure that change does not take place.

One example is that of a military organization that replaced its manual logistics system with a computerized one. Under the old system, senior officers received requests for equipment transfers and had junior officers to compile a detailed report on which to base a decision. The junior officers gathered information for these reports through written documents and through telephone contacts with a network of supply officers at other installations. With the new system, the junior officers worked at computer terminals with on-line access to information about the location and status of equipment, a decision-support system to calculate least-cost routing, and the means to implement transfers. Because the junior officers had timely and complete information, people began making requests for equipment directly to them rather than going through proper channels, and the junior officers sometimes could not resist the temptation to respond, even though they did not have authority to do so. Senior officers attempted to have the new system removed. In the end it was retained, but it was redesigned so that junior officers were unable to take action based on their decisions.[36]

[33] Rolf T. Wigand, "Integrated Communications and Work Efficiency: Impacts on organizational Structure and Power," paper presented at the International Communication Association Annual Convention, Honolulu, Hawaii, May 22-27, 1985, p. 16.

[34] N. Bjorn-Anderson and P. Pederson, "Computer Systems as a Vehicle for Changes in the Management Structure, I nformation Systems Research Group, University of Copenhagen, Working Paper 77-3, 1977. Cited in Rob Kling, "Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research," *Computing Survey* 12 (March 1980), pp. 61-110.

[35] Robey, op. cit.

[36] Markus, op. cit., p. 74.

Photo credit: Smithsonian Institution

Photo credit: Smithsonian Institution

Photo credit Bill Kelley Communication Workers of 4 me, IL a

Advances in microelectronic technology have made telephone operators more productive

Many firms are using integrated databases, and employees at various levels need access to it in order to do their jobs. However, access to different parts of the database can be stratified so that existing organizational lines of authority are not threatened.

End-User Computing Power

Since one source of power is control over resources and since the computer itself (or what it can do) is a resource, there has been some dispersal or shifting of power in many organizations. Only a few years ago computers were a scarce resource; data processing professionals usually acted as gatekeepers between all other departments and the computer, and thus were in a position of power. Over the past 5 to 10 years, with the declining cost of electronic hardware, computer power has become much more widely dispersed throughout many organizations.

High costs of computer equipment used to make centralization more attractive. Lower prices, increased capabilities, and the ability to link workstations in networks now make it possible for firms to disperse data processing and word processing capabilities. This does not necessarily mean that the word processing pools have disappeared (although they have in many firms) but that word processing capability is now available to private secretaries, receptionists, professionals, and others. Nor are centralized data processing departments likely to disappear, as many organizations continue to need the power of mainframe computers and the expertise of computer professionals. However, the ability to do a growing variety of data processing activities can now be brought directly to every professional and manager.

In some organizations there maybe an overall strategy to keep centralized control over computer resources, to maintain compatibility between systems, to make sure that personal computer users can access databases, etc. This function may be performed by the data processing department or by some other office automation group. Where some other group is designated, turf difficulties with the data processing department have often arisen with the continuing convergence of word processing, data processing and communication. In one Fortune 500 company, conflict between the data processing department and ad hoc office automation group was finally resolved when the office automation group was assigned responsibility for managing all resources for data and word processing within the firm. The data processing department was limited to providing data processing services for external clients .37

In many cases, organizations have acquired office automation, especially personal computers, without a grand plan, in response to grass roots decisions at the individual or departmental level. Later attempts to standardize or to centralize control of the organization's information resources inevitably result in battles when different kinds of equipment or different philosophies of operation have already become entrenched. No system is perfect for everyone's needs, and many groups may want to influence the development of office automation systems to make them most suitable to their own needs or most acceptable from their own bias.

Communication

Additional organizational implications of office automation are related to their effects on communication within organizations. An interesting sidelight on the case involving the military logistics office is the way in which the new system changed communication patterns. The senior officers were "left out of the loop, " when supply officers began contacting junior officers directly for equipment transfers. In addition, however, the flow of information reversed along the junior officers network of telephone contacts. The junior officers had created these networks to call out for information. However, once the on-line system came into place, the junior officers became a source of systemwide information. Their form-

37 "Ginger Levin, "Excellence in Information Resource Management, " GHL Inc., Washington, DC, 1984.

er informants made use of the same telephone network, with its established informal working relationships, past favors, friendships, etc., to call in for information or for emergency equipment transfers.

Changes in communication patterns maybe at the base of many of the organizational changes associated with office automation, simply because communication is such a major part of white-collar workers' jobs. Managers, especially, spend a large portion of their time communicating. It is estimated that from 46 to 77 percent of their day is spent in oral communication, including both telephone conversations and face-to-face meetings.[38]

The introduction of new pathways of communication may bypass traditional gatekeepers and make profound changes in "who talks to whom. " Although some researchers have predicted that full access by many workers to a linked electronic system could lead to a complete reshuffling of power relationships, giving most power to those with access to the system, [39] there is little evidence that formal hierarchies are greatly affected by innovations like electronic mail and messaging. In fact, these systems are often constructed in such a way as to reinforce the existing hierarchy, e.g., automatically sending information copies to managers of all their subordinate's messages, but not the other way around. There are some anecdotes of superiors using the system to intensify pressure on subordinates ("I requested that information an hour ago! Don't you check your messages?"). In addition, even in a completely wide open system, where everyone theoretically has access to everyone else, it *is* doubtful that everyone has something useful to say to everyone else.

However, there are cases where use of an electronic mail system has lead to the undermining of an organization's traditional hierarchy and authority structure. In one example, members of a disbanded project team used their firm's electronic mail system to continue work on an abandoned project, eventually convincing management to revive it. At the same firm, the electronic mail system became a means of exchanging complaints and criticisms about management.[40] More recently there have been other reports of electronic messaging systems being used for "flaming, or emotional outbursts related to organizational or other problems .41 Such "subversive" use of electronic mail probably depends a good deal both on corporate culture and on the configuration and capabilities of the system. Anecdotes from other firms suggest that their electronic mail is never used for complaints or any communication with implications for internal politics because electronic messages are more easily traced than paper ones.

It is not yet clear how effectively electronic messaging will replace face-to-face or telephone communication. Early evaluations have not shown consistent patterns of replacement of telephone, face-to-face, or written messages with electronic messages across organizations. At some organizations, as at OTA case study site Company *XYZ*, electronic mail has been consciously rejected because personal communication is considered important to the corporate culture. In another OTA case study, Office of the Special Trade Representative, internal electronic mail is used extensively for circulation of documents for comment and it would be used externally if other agencies were equipped.

Many managers do not use electronic mail extensively to replace face-to-face meetings or telephone calls. This may be attributable to two factors. First, use of the technology may interfere with the personal management style. Second, there may be dissonance between the electronic system and the type of information being transferred. In one study, over one-third of the messages exchanged in face-to-face or

[38] Margarethe H. Olson, " New Information Technology and Organizational Culture," *MIS Quarterly Special Issue 198,2, pp. 71-92.*

[39] *See* for example, Carol T. Gaffney, "The Impact of office Automation on Power in organizations, " Proceedings of AFIPS Office Automation Conference, Philadelphia, February 1983, pp. 216-21 '7.

[40] "Tlarkus, 'p. 60, citing Ralph Emmett,"VNET or Gripenet? *Datamation,* November 1981, pp. 48-58.

[41] "Con\ versations by Computer, " *Electronic Services Unlimited,* October 1984.

telephone meetings contained 'soft information, that is, they conveyed opinion or conjecture. It is possible that messages of this sort cannot be effectively communicated through electronic mail.[42] Another researcher has noted that teleconferencing also is more successfully used for giving or receiving factual information, and less so for complex tasks like bargaining and persuasion.[43] These factors make it likely that these technologies are more likely to reinforce existing trends in the organization rather than to bring about radical changes.

Major changes in the way people communicate at work may come, not from electronic mail, but from common access to databases and to computer operations that control the work process. If office automation offers employees new access to information, it can also change their informal patterns of communication. For example, where coordination between work groups is taken care of in informal 'hallway conferences' among work group members, there is opportunity for social interaction as well as the exchange of work-related information. The introduction of an office automation system with a shared database may allow these groups to accomplish coordination through the system, and the people may no longer need to see one another for that purpose.

At Aircraft Instruments Plant, an OTA case study site, coordination through the system, and the elimination of informal conferences and negotiations, were clearly goals of the new MRP II system. Although these goals have not yet been achieved, the new system has clearly changed patterns of communication within the plant and its offices. Informal conferences continue, but now a major purpose of negotiation is to get permission to override the system. (See appendix B for further information.)

This integrative quality of computer systems, which when successful allows coordination without physical proximity, leads directly to the subject of the next section.

Dispersion of Work Activity

Perhaps the most powerful effect of the communication features of office systems is the ability to change the location and geographic distribution of work activity. Once words, data, or pictures have been converted to electronic form they can be sent to a device across the room, across town, or halfway around the world with almost equal ease. As a result, people do not have to be aggregated in one place in order to work in the same "office.

Traditionally, information-intensive services have located in large cities where they have the advantage of proximity to other organizations and people. To the extent that telecommunication can substitute for proximity, organizations will have many more choices in where to locate. Many see this as leading to a more geographically dispersed style of functioning because:

> . . . the increasing spread (and cheapness) of telecommunication reduces the former external economies of physical proximity, we see the dispersal of corporate headquarters and major white-collar operators like the insurance industry from the decaying central cities to the suburbs.[44]

Firms might minimize use of expensive big city office space not only by locating in the suburbs, but by moving to or establishing branches in small cities or towns, or even in foreign countries so long as a suitable work force and an adequate telecommunications system are available. The departments most likely to be located in remote locations are those that need little outside contact or that primarily engage in routine communications.[45] So long as coordination and integration of work can take place electronically, there is no longer much need for spatial proximity.

In a study of automation in the insurance industry, it was pointed out that the centralizing and dispersing tendencies of automation are complementary.[46] Procedures for insurance

'-Olson, op. cit.

"Thomas Mandeville, "The Spatial Effects of Information Technology, Some Literature," *Futures*, February 1983, p. 67.

"Ibid.

' Ibid.

" Barbara Baran, '*Technological Innovation and Regulation: The Transformation of the Labor Process in the Insurance Industry, prepared for Technology- and Economic Transition Project, Office of Technology Assessment, OTA contract No. 3433 -3610.0 Washington, DC, January 1985, p. 95.

rating, underwriting, and claims handling are increasingly being standardized and automated. A recent trend has been to centralize physically the databases on which these activities depend. Many insurance companies are now consolidating their regional offices into two or three highly automated regional centers. At the same time, these firms are disbanding some of their large centralized data-entry pools. Data-entry work is being dispersed to functional departments located in agencies or field offices, connected by on-line terminals to computers at the regional centers. Functional units within the company can be integrated electronically through the computer even if they are geographically distant. At the same time, "because in all cases information is being increasingly consolidated in central master files, although access to it is proliferating and decentralizing spatially, decentralized production is fully compatible with centralized direction and control."[47]

Spatial dispersion of office work could have major effects on the labor force of the future and could have differential impacts based on race and class. Large data processing pools often employ high proportions of minority women in low-skilled clerical jobs. These are the jobs that are increasingly being automated away. The more highly skilled clerical jobs that remain will increasingly be located outside of cities as organizations search for lower cost, nonunionized or more highly educated labor. In one insurance company relocation, labor force characteristics were explicitly important in the location decision—the company sought to place its offices in communities where women were "well educated, of German descent, with unemployed husbands '—as these were considered the most likely to put in a good days' work."[4']

There is probably a limit to how far spatial dispersion can go. Most organizations are unlikely to scatter branch offices across the country simply because office automation makes it possible. Certain activities may not lend themselves easily to dispersion. Because of the unsuitability of telecommunications for activities like negotiating, persuading, or exchanging soft information, [qg] it is likely that some critical mass of employees would have to remain near each other for face-to-face meetings. In addition, other cultural, logistical, and cost factors unrelated to the features of office automation may limit the number of separate installations.

1 hici.

"Baran and Teegarden, op. cit., pp. :]0-31.

'"olson notes that this may he one reason why many managers have not started using electronic mail to replace face-to-face meetings. See Olson, op. cit.

IMPLEMENTATION

While advertisements are full of the promised benefits of office automation, there are a vast number of horror stories about unsuccessful attempts. The technological and organizational barriers to be overcome, the internal political battles that often must be fought, the planning and redesign of work to be done, are daunting. After hearing and seeing some of the things that can go wrong, those responsible for bringing office automation to their own organizations may consider an implementation to be successful if it is not completely botched—if productivity does not plummet or employee turnover does not rise to the ceiling.

Paul Strassman, formerly Vice President of Xerox, noted that many organizations greatly underestimate the organizational costs (as opposed to technological costs) of automation. Organizational costs, for example, inefficiency while learning new procedures, time lost for training, time spent negotiating with peers about new work processes, can add up to several thousand dollars per employee in the first year if properly noted and accounted for. [50] Where organizational issues like job redesign and workflow restructuring have not been

"Paul A. Strassman, "The Real Cost of OA," *Datamation*, Feb. 1, 1985, pp. 82-94.

properly managed, organizational costs can more than offset productivity gains expected from new technology. A number of firms are demonstrably worse off with automation than they were without it, at least in the short run. However, these new tools are becoming increasingly available and increasingly necessary for doing business in the present era. It is possible to learn something from successful implementations to avoid the problems experienced in horror stories.

The success of the introduction of office systems into an existing organization has been found to depend on a number of circumstances that surround the implementation. Although various researchers disagree on the relative strength of their influence, there seems to be some general agreement on their importance and direction.[51] These variables include the *reason for adoption*, the involvement of key *actors*, the use of *adaptive planning* procedures, level of *user participation* in planning and decisionmaking, and *training* and *incentives* for users, and *training*.

Reason for Adoption

In most discussions of successful installations of office systems, there was a clearly identified organizational objective. Organizational goals involving improved outputs have been associated with success more often than organizational goals defined only by cost reduction. Cases where a technological opportunity was seized, without demonstrated organizational need were those where there was least evidence of success.[52]

These findings are in line with admonitions to tie system planning closely to the office's *business function*.[53] Where there is a clear understanding of the output to be produced and the role of automation in improving that output, there is a greater likelihood of selecting and designing a system which achieves that objective.

Although cost reduction can be an important objective, a narrow focus on cost reduction alone may not have the desired results if the organization's goals and the work process leading to the achievement of those goals have not been thoroughly analyzed.

In the case of Company XYZ, an OTA case study site, use of information technology was seen as a competitive weapon, a means of both cutting costs and increasing market share. However, cost cutting was placed in context of the type of work done at XYZ and the corporate philosophy.

> The goal was to replace old, rigid, batch-oriented information systems and manual technology with flexible cutting-edge electronic tools, and concurrently to give users a renewed sense of power, insight and enthusiasm about their tasks, so as to improve organizational performance.[54]

This focus on user needs led to the criterion that any system selected should be manipulable by users and should:

> . . . augment the worker rather than automate the work. Being able to ask good questions, do insightful analyses, take the initiative, and make a decision are emphasized as distinctly human skills that computers can assist but not replace.

While other firms will have different goals and a different philosophy about the role of their workers, analysis of organizational goals and the role of computers in achieving them is still important.

Key Actors

Another important element in successful implementation is the "key actor. " This can sometimes be a top management official who

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[51] Tora Bikson, Barbara Gutek, and Don A. Mankin. "Implementation of Information Technology in Office Settings: Review of Relevant Literature, " Rand Corp., Santa Monica, CA, November 1981.

[52] Ibid.

[53] Michael Hammer and Michael Zisman, "Design and Implementation of Office Information Systems, " Laboratory for Computer Science, Massachusetts Institute of Technology, OAM-005, May 1979.

[54] Tora Bikson, Don Manken, and Cathleen Statz, "Individual and Organizational Impacts of Computer-Mediated Work: A Case Study," prepared for Office of Technology Assessment, 1985, p. 21.

clearly supports innovation, but in many cases a "technological entrepreneur" somewhere below the top level of the firm maybe the prime motivating force in a successful introduction of new technology. In some studies it has been found that the role of the unit manager is essential in successful implementation. [55]

Support and understanding of top management are also crucial. In the case of XYZ, the CEO was the inspiration behind the move to automation, although actual responsibility was delegated. Having management support guaranteed needed resources and also provided guidance in developing a system that matched corporate philosophy.

On the other hand, lack of top management support seems to have aggravated some of the problems in the Aircraft Instruments Plant case study. For example, insufficient funds and time for training, both of which undercut the success of the implementation, were probably related to lack of senior management understanding of the need. Senior management did not ease production quotas when the new system was first introduced, even though it would be reasonable to expect some decline in productivity as people learned to use the system. Further, ongoing performance measures were not modified to fit the scheduling process inherent in the system. Thus, toward the end of each month managers all scrambled to bypass the system and manually schedule projects with high dollar value but low priority, in order to meet dollar quotas. This is likely to continue as long as management priorities and system priorities are in conflict.

Adaptive Planning

A planning process that is flexible and continuous, both before and during introduction, also seems to be associated with successful implementation. It is inevitable that both the organization and the system will change somewhat in the process of implementation. A plan "set in concrete, which cannot be modified to accommodate changed user needs or new information, can seldom be successful. In some cases, with sufficient flexibility on the part of the planners and the users, even a "drop it in their laps' approach to implementation—one where users have minimal involvement in planning—can work. A generic system can be modified to fit an organization needs during the early days of operational use. However, users may not be sufficiently flexible, and adaptability may not be the only requisite for success." In general, research in t he literature as well as "how to' articles in the computer and management trade press agree that involving users in the planning process is highly desirable.

Users in' the Implementation Process

There are at least three areas where users must be taken into account—design and implementation, training, and incentives for users. Before the user can be adequately involved in the process, however, it is necessary to ask "who is the user?"

Although the term "user-driven" is often used in designing office automation equipment, there are several conceptions of who the user is, and it is not always clear which 'user' is being addressed or represented. Wynn points out at least three levels of 'user. '[57] One is the organization or department that intends to develop an automated system. Another is the person or group of people within the organization with the authority to make decisions about the purchase of equipment. This is often the "user" that the vendor is trying hardest to please. The third is the "end user, " that is, the person who actually operates a computer or terminal. The needs, opinions, and level of knowledge about office practices of these different types of user are not necessarily identical; they may not even be in harmony in some cases.

Ibid,; and Bikson, Gutek, and Mankin, op. cit.

[56]Ron H. Epstein, "An Approach to Inb-educing and Evaluating Automated Office Systems, *Electronic Office: Management and Technology* (Pennsauken, NJ: Auerbach Publishers. 1980).

'Eleanor H. Wynn, "The User as a Representation Issue, " Proceedings of the Hawaii International Conference on System Sciences, 1983.

User Involvement in Design and Implementation

Successful implementations of office automation technology tend to include users of all types in the process. While there maybe some difficulties in involving future end users in system selection when they are not yet familiar with computers, there are benefits to be derived from the investment of time and effort necessary to bring them up to speed. No one knows better than the actual end user exactly what he or she does and how it might be done better. User needs may not be well understood by system designers or vendors, or even by managers in the same firm. Attempts to divine needs without asking can too often lead to the use of social stereotypes (clerical workers do not make decisions, managers will not type) instead of fact. Getting the user perspective early in the planning process can save costly retrofitting or other problems later. Methods for involving the users in the design process can include interaction with the entire user community by collecting design data through surveys and polls, or by having user representatives on the design task force or committee.

Finally, involving users in the design process can help to overcome some of the resistance to use of new systems often classified as "fear of computers, " "technophobia," or simply "fear of change. While some have assumed that certain types of people "naturally' resist new technology (e.g., older workers, less educated workers, etc.) Wynn notes that:

> The hidden assumption in these notions is that the reason people may not rush to be new users of technology is a) psychological rather than rational in nature; b) the fault of the user not of the equipment. Both of these assumptions, if acted upon, cause development organizations to do nothing at all to solve the problem, to go ahead and design as they see fit and see if people can be forced to use the resulting system, or to go to great lengths to cater to the users' supposed psychological and cognitive incapacity, mostly by trying to "advertise away" the problem.[58]

[58] Eleanor H. Wynn, "Linking User Responses to the Design Chain, AFIPS Office Automation Conference, San Francisco, Apr. 5-7, 1982.

Several studies have shown that what managers or system designers sometimes perceive as clerical workers' irrational fears of technology are actually very rational concerns. Wynn found in open-ended interviews at several firms that clerical workers were concerned, for example, that they might not be able to learn the system, that the equipment chosen was wrong for the job, that new measures of job performance were wrong for the job, that they might lose their jobs and be unemployed. She concluded that "people can be seen to resist not change itself, but change for the worse. '[59]

Managers often do not perceive these specific concerns, but view them as generalized irrational fear. In one survey of Fortune 500 firms, over half (57 percent) of the managers attributed employees' apprehension about new systems to general, unfocused fear, while only 8 percent attributed it to fear of computers and 4 percent to skepticism about management's ability to manage the change. On the other hand, only 20 percent of clerical workers attributed other workers' apprehension to general fears. Most (30 percent) identified concern about computers—presumably fear of being unable to learn to use the new system. About 25 percent cited skepticism about management choices, and 22 percent cited job security as the major worry.[60]

Training

Training employees to use automated equipment is essential to making most effective use of it, and most researchers agree that the importance of training to a successful implementation cannot be overemphasized. As Strassman notes, "Training, training, training: these are the top three priorities to changing work in the automated office. [61] A training plan is a necessary part of the implementation plan when an organization begins using office automation system. In addition, continuing efforts

[59] Ibid.

[60] Research and Forecasts, Inc., *The Kelly Report on People in the Electronic* Office *II: How* Office *Workers View Automation* (Troy, MI: Kelly Services, Inc., 1983), p. 10.

[61] Paul A. Strassman, *Information Payoff: The Transformation of Work in the Electronic Age (New* York: The Free Press, 1985), p. 81.

are necessary–for training new employees and for upgrading the skills of current ones.

An adequate training program may often constitute one of the major costs involved in introducing automated office equipment. Unfortunately, many firms grossly underestimate the need. In a number of surveys, workers and managers in automated offices have cited lack of adequate training as one of the major problems related to the implementation of office automation equipment.[62] Training is discussed in more detail in chapter 3.

Incentives for Users

The introduction of new technology can cause, or at least be associated with, changes in the way people do their jobs; in the way they interact with other people; and in the amount of power, authority, and self-determination, they have at work. To the extent that people perceive the changes associated with a new system as changes for the worse, "disimplementation' or damaging resistance can result. Many successful implementations have featured incentives to encourage users to accept the new system, acquire new skills, or accept changes in the social or organizational context. While benefits for the firm, such as increased productivity, may be important to some workers, more personally relevant rewards are also important, for example higher wages, opportunity for other training or advancement. However intangibles such as protecting the worker's self-esteem are also extremely important. In this regard, involving workers in the change process can in itself be an incentive.

> [The employee] should see himself as the master of the machine, not its servant; not as a victim of the office design, but as a participant in it . . . When invited as collaborators, many office workers will respond with enthusiasm to office system automation. [63]

[62] See for example, Honeywell Technalysis, *Office Automation and the Workplace*, Honeywell, Inc., November 1984; and Kelly Services, Inc., *The Kelly Report cm People in the Electronic Office*, results of surveys performed by Research and Forecasts, Inc.. three volumes, 1984.

[63] Hammer and Zisman, op. cit., pp. 34-35.