IMPACT OF INFORMATION TECHNOLOGY ON WORK ORGANIZATION: A POSITIVE VIEW

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INTRODUCTION

The purpose of this paper is to present a position with regard to the impact of information and communications technology on the organization of work. The position, simply stated, is that this new generation of technology has the potential to improve individual quality of work life, to increase competence and individual responsibility in work, and to increase individual flexibility and autonomy. The basic argument is that information technology, like the generations of technology before it, is neutral; the value systems of its designers and its implementors determine its impacts on work organization. However, information technology is inherently more flexible than production technology preceding it, permitting a wider range of choices with respect to both design and implementation.

This paper will focus on work organization in a relatively narrow sense. It primarily deals with work changes within a particular organization. Thus it will not deal with overall employment levels and employment shifts, but will discuss shifts in definitions of jobs that remain within an organization. The emphasis is on white-collar or office work and information (office automation) technologies, as opposed to blue-collar work and automation of the shop floor. The paper will discuss changes in individual work, redefinition of classes of work, and potential changes in organizational structures, both authority and physical.

TRENDS IN INFORMATION AND COMMUNICATION TECHNOLOGIES

Before the potential impacts of information and communication technology can be discussed, it is necessary to identify the most significant technological trends. In general, this paper only deals with technologies which are practical and feasible today. However, since they have not become commonplace in many organizations we are currently experiencing a transition period. Since the technologies have not yet come into common use, the opportunity exists to influence implementation in order to bring about positive impacts and minimize dysfunctional consequences. On the other hand, concrete knowledge or understanding of the potential impacts of these technologies, positive or negative, is limited.

Office automation is a concept that implies a packaging of a variety of computer and communications components rather than a specific type of technology. Word processing, the production of text with the support of sophisticated electronic text handling facilities, is already well established in organizations. Use of electronic mail, both text-based and utilizing "voice-store-and forward" technology, is growing rapidly. Future office automation systems will include electronic filing, electronic scheduling, graphics facilities, and facsimile transmission.

The most significant development in current office automation technology is the "packaging" of these capabilities in an "integrated" system. The trend is to "intelligent workstations", microcomputer-based systems containing the capabilities listed above, linked through internal communications networks to other workstations.

Workstations can be specialized: secretarial workstations will have specialized capabilities for word processing and special links to one or several managerial workstations; programmer workstations will be designed for programming functionality; managerial workstations may have voice store-and-forward message switching built in. Variations in workstation design may be built primarily into the software and/or keyboard design, or workstations may be specially tailored from "off the shelf" components to suit individual needs and work styles.

Currently, intelligent workstations are prohibitively expensive for all but the most highly-paid professionals. However, as the cost of hardware decreases, the feasibility of widespread adoption of such workstations increases. One estimate shows the cost of a workstation will be 11 percent of a clerical salary and four percent of a professional salary by 1990, a percentage which approaches the relative cost of a business telephone today (Benjamin).

TECHNOLOGY AND WORK SPECIALIZATION

In this section, the technologies described above will be related to alternatives for work specialization. First, a framework for categorizing the dimensions of work specialization is presented. The potential impacts of information technology on specialization of office work are then discussed.

FRAMEWORK OF TECHNOLOGY AND WORK SPECIALIZATION

The impact of information technology on individual work organization can be understood within the context of a framework of work specialization developed by Mintzberg (1979). The framework is depicted in Figure 1.

The horizontal dimension of work specialization refers to the number of units of work, or tasks, performed, and the degree of skill required to perform each work unit.

At the extreme of high specialization, the work is subdivided into the smallest and most simple units and a different person performs each unit repetitively. The goals are to improve the efficiency of the entire process and to reduce the skill level required of any individual employee. Those tasks in computer-supported office work that can be relegated to the computer are programmed or "automated". At the extreme of low horizontal specialization, often referred to as "job enrichment", a single person performs many related tasks in an integrated fashion to produce a single whole unit of output.

The vertical dimension of work specialization concerns the location of control over the work, or the degree of separation of control over work from its performance. With high vertical specialization, a significant degree of the mental work involving planning, design, calculation, and creative intellectual thinking is removed from the physical processes of carrying out the results of the mental effort. Furthermore, control of the physical production in terms of pacing, production expectations or quotas, and surveillance

is concentrated in the work of the planners (Braverman, 1974). With low vertical specialization, the planning and execution of the work are both the responsibility of a single individual; furthermore the individual performing the work controls its pace and receives feedback directly from output measures.

THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY

Alternatives with respect to horizontal and vertical specialization are relatively simple to identify when one is considering production technology as a substitute for (or augmentor of) human physical labor. Horizontal specialization deals with physical movement and dexterity, while vertical specialization concerns machine pacing, monitoring, and recording of physical movements. Is information technology fundamentally different from production technology?

The premise of this position paper, already stated, is that information technology is inherently more flexible than its predecessors, thus providing a wider range of options in terms of horizontal and vertical specialization. There are at least five significant differences:

1. The key resource to be manipulated and controlled is information rather than physical power;

2. The tasks to be accomplished are cognitive rather than physical in nature; hence, they are not directly observable or substitutable;

3. The need to organize work to achieve economies of scale of the equipment is not compelling;

4. The need for the individual to be close to the equipment to operate it is reduced;

5. Because of the inherent flexibility of the technology, the value systems of its designers and implementors have an even greater influence on the nature of its impacts on work organization.

The premise of this position paper is that both low horizontal specialization and low vertical specialization are desirable goals from the standpoint of both the employee and overall organizational performance. Rather than review the arguments regarding quality of work life and organizational performance, it will be assumed that high quality of work life is an overriding goal of organizations and society. Furthermore, it will be assumed that the dimensions of vertical and horizontal specialization are significant components of a high quality of work life. In the remainder of the paper, the potential for information technology to provide high quality work life on these two dimensions will be examined.

EVIDENCE REGARDING HORIZONTAL SPECIALIZATION

Clearly office technology is flexible with regard to horizontal work specialization. The constraint of physical location is reduced, since the key resources required to execute the work process are data rather than physical materials. The cost of the equipment is oribinally high, generating a move to centralization to achieve

economies of scale. Thus the introduction of the first generation of word processing was accompanied by reorganization of the job of typing into "word processing centers". In general, however, the decreasing cost of the next generations of the technology no longer justify the need for centralization; word processing centers are disappearing and the tasks are being redistributed in the same way that data entry and typing pools were previously decentralized.

Thus the division of labor, not only among workers but between worker and machine, is determined based on software constraints (the values of the designers of the system) and the goals of system implementation (the values of the system implementors).

The basic argument commonly presented regarding deskilling is based on the work of Braverman (1974): there is a pervasive tendency for jobs in capitalist organizations to be reorganized at lower skill levels than previously (Attewell, 1982). In other words, the value systems of both designers and implementors of technology will consistently guide them to increase horizontal specialization with the introduction of technology. This argument has been made eloquently in the United States using the phrase "The office of the future is the factory of the past" (Gregory and Nussbaum, 1983). The response to what is viewed as an inevitable conclusion is that office workers should organize to gain power over their work lives. It should be noted that in the United States only 3 percent of office workers employed in the private sector are unionized.

A strong counterargument to Braverman's thesis is the "curvilinear hypothesis" (Shepard, 1977), which states that after a certain point of horizontal specialization is reached, the next phase is automation of the more repetitious part of the work. The work that remains is upgraded in skill requirements and involves more machine maintenance and monitoring than physical effort; thus there is less division of labor and the work is more interesting. This thesis has been demonstrated with production work in certain technologically advanced industries (Blauner,1964; Faunce,1965; Shepard, 1971; Attewell, 1982, p. 27). A corollary counter-argument to Braverman's thesis concerns the generational effects of horizontal specialization. If horizontal specialization is increased, the more repetitious and boring tasks are assigned elsewhere, leaving the remaining work to be more interesting; furthermore, the tasks which to the skilled worker were routine may actually represent an upgrading of skill requirements for the person to which they are assigned.

The first debates regarding office automation and deskilling appeared in the early 1960's; the bulk of research to date is from that decade. A review by Shepard (1971) lists seven studies in which, rather than systematic deskilling, lower-level clerical positions were eliminated due to automation and the proportion of higher-level clerical jobs increased. A more recent study of the insurance industry shows the same trend (Attewell, 1982).

An interesting analysis of the banking industry by Adler (1983) supports the curvilinear hypothesis for low-level clerical jobs. He argues that banking has gone through four phases of technology assimilation:

- Manual "back office" processing
- Mechanization of manual processing
- Bulk computer processing
- Integrated computer processing

Adler argues that the last phase is significantly different from the previous three, in that "the role of the worker is to assure the interface between the computer and the client". Increasing horizontal specialization was dominant in the first three phases but is not possible with the fourth; indeed, it represents a significant upgrading of skills and requires both job-specific and general (i.e., the banking business) training.

Adler also argues that the traditional models of production technology and work specialization are not adequate for integrated computer processing. He identifies three dimensions of difference:

INTEGRATED COMPUTER PROCESSING	PRODUCTION TECHNOLOGY
SOCIAL: Worker has a sense of responsibility for production	PRIVATE: Worker has a purely instrumentalist attitude toward work; responsible for work effort only
ABSTRACT: Abstract, mental, machine-mediated tasks with cognitive learning but low inherent interest	CONCRETE: Tangible immediacy of tasks and goals, with manual or rote learning
COLLECTIVE: Systemic interdependence; critical role of coordination between tasks; team work encouraged	INDIVIDUAL: Stand-alone or purely mechanical, sequential linkage of individualized jobs

Adler's conclusions are based on qualitative observations of a single bank; to date there is little systematic evidence to guide understanding of why these differences might occur or whether their source is organizational structure, technological requirements, or individual perceptions. Considerable research is required to enhance our understanding of the simple observation that there is a difference.

Further evidence of the upgrading of skills required in information-intensive industries such as banking is provided by the movement of back office operations out of urban areas. In New York City, for example, the ability to gain access to an educated female suburban work force has been an important factor in the relocation of "back-office" operations out of the central city. This movement has accelerated over the last decade as increasing reliance on electronic systems has upgraded the skills required (Moss, 1983); at the same time, physical constraints on the location of the work have been removed.

Two current examples of skills for which the impact of information technology on horizontal specialization can be demonstrated are programming languages and word processing.

Programming Languages

It has been argued that each new generation of programming languages (from assemblers to procedural languages to the current "fourth generation languages") represents systematic "deskilling" of the programming profession (Kraft, 1977; Greenbaum, 1979). However,

there is also evidence that the proportion of jobs in the systems professions requiring higher skills (i.e., systems analyst) shows continuing growth to offset overall downgrading of the profession. Furthermore, fourth generation languages, which require relatively little formal training, can be introduced in such a way that "programming" represents a skill upgrade to certain workers (e.g., clerks) or is decentralized to other areas of the organization (e.g., users). The remaining systems professionals concentrate on the more interesting work of systems analysis and design. Thus rather than representing widespread deskilling, fourth generation languages represent a restructuring of the programming profession in which some work is downgraded and some upgraded, significant retraining is required, but pervasive deskilling of the same job does not occur.

Word Processing

In the U.S., a great deal of attention has been paid to the potential for word processing to create massive deskilling of clerical jobs. Although there are isolated incidents of the techology being introduced in this way, the overwhelming evidence from recent surveys shows that employees feel otherwise (Honeywell,1983; Professional Secretaries International,1983; Kelly Services, 1983; 9 to 5, 1984). When employees were asked about the effect of word processing on their work, the overwhelming majority felt the new skill had a positive effect. In one survey (Kelly Services, 1983), 90 percent felt that word processing had improved their chances for advancement. In another (9 to 5,1984), 70 percent felt their jobs were more interesting and more enjoyable; only 6.5 percent reported their jobs

were more routine.

Another potential problem is pointed out, however, by the three surveys of office workers where managers were also interviewed (Professional Secretaries International, 1983; Kelly Services, 1983; Honeywell,1983). Their perceptions differed sharply from those of the employees on two important points: they did not feel the employees' skills had been upgraded, and they did not feel that the employees' chances for advancement had increased. Thus, this relatively "mature" office technology is beginning to show a generational effect: an increase in employee frustration and alienation when potential rewards and advancement based on upgraded skills do not materialize. Nevertheless, there is little evidence of the perception of deskilling.

Summary -- Horizontal Specialization

In information-intensive industries such as banking and insurance, there is some evidence that deskilling has occurred; however, there are also signs of support for the "curvilinear hypothesis". The information technology with which this paper primarily deals -- flexible, powerful, integrated -- may require upgrading of certain new types of skills such as algorithmic thinking and the ability to deal with abstractions. The most repetitive functions are automated or decentralized to the point of origin (user, client), where they are combined with other tasks rather than being highly specialized. The jobs that remain likely represent upgrading of skills rather than the opposite. In order for such an organization of work to be successful in terms of organizational performance and

individual motivation, however, the upgraded jobs require recognition of their higher status through rewards and chances for advancement.

EVIDENCE REGARDING VERTICAL SPECIALIZATION

Alternatives with respect to vertical specialization of information work have two components: the degree to which conception of a task is removed from its execution (Braverman, 1974), and the availability of control information regarding the performance of the work.

Traditionally, office work has been organized so that conception is separated from execution; a "principal" conceives of an idea and its manifestation (in the form of a document, design, graphic, oral presentation, etc.), and a "support person" produces the manifestation of the principal's conception with minimal consideration of the concept itself. On the other hand, a single person with access to the necessary information and technology may be responsible for both the conception and execution of the work. An example is the preparation and distribution of a memorandum by its author at a workstation, rather than dictating it to a support person who subsequently transcribes and distributes it.

There is little evidence to date regarding the relative merits of combining work conception with execution versus reinforcing its separation. Information technology is highly flexible in this regard: it permits "thinking" and "doing" to be combined in powerful ways. The workstation replaces the pen as the "tool" and efficiencies are gained through reduction in transcribing. However, arguments for how

to organize "knowledge work" center primarily on efficiency issues and research is required in order to gain insight into how the nature of the work itself changes when conception and execution are combined.

The second aspect of vertical specialization of information work concerns location of control over the work pace and availability of control information. In the extreme of high vertical specialization, information work is machine-paced (i.e., 30 seconds per customer service request) or based on volume quotas of very small units (i.e., number of documents typed, forms processed, etc., per hour). Work can also be monitored continuously and/or electronically, so that the employee is not aware of physical surveillance. At the extreme of low vertical specialization, the employee has access to all the necessary resources (primarily information) to perform the task, has autonomy to set his or her own work pace and schedule of tasks (within some reasonable limits), and has complete access to control information as well as knowledge of how/when it is being used by others (Wineman, 1982). However, research suggests that these problems may be more a factor of the organization of the work, particularly high job demand and low personal involvement in or control over the work, than the ergonomics of the equipment (Dainoff,1981; Wineman, 1982).

One interesting study focuses on the effects of both horizontal and vertical specialization on supervisory behavior (Kipnis,1984). The researcher found, through both field studies and laboratory experiments, that the more routinized the job, the more the supervisor:

1. Evaluated the employee's performance less favorably,

2. Attributed unsatisfactory performance to a lack of employee motivation,

3. Less frequently attributed satisfactory performance to employee skills and abilities.

Summary -- Vertical Specialization

In summary, there is limited evidence that lack of control over one's own work pace and output may have adverse consequences for employee physical and mental health as well as performance. The potential for continuous, invisible monitoring is of significant concern and in some countries legislation exists to prevent it. The potential to use the technology to increase employee autonomy and self-control over work has not been explored adequately. Research on information technology and vertical specialization is critically needed.

AN EXAMINATION OF VALUE SYSTEMS

This paper has expressed the view that information technology is highly flexible in terms of its application to work specialization. It follows that those responsible for designing and implementing the technology have significantly more influence in how it is used than designers and implementors of previous technologies. In this section, the value systems of designers and implementors of information technology are examined. "Designers refers to the group of people, primarily employees of a computer vendor, who decide on the hardware and software characteristics for a general class of machines. "Implementors" are those with the responsibility for selecting a

general system (hardware and software) and tailoring it to a specific work environment.

VALUE SYSTEMS OF DESIGNERS

The basic hardware component of information technology, the chip, has two important features: it is extremely powerful at extremely low cost. Although costs of telecommunications capabilities are now an inhibiting factor in their use, it is expected that the ratio of cost to power of telecommunications will also shift steadily in favor of widespread availability. This trend has permitted a shift in design of computer systems from "batch" systems, where the human component was secondary to efficient machine functioning, to "online" systems involving human-machine interaction. The division of labor between human and machine is today manifested in two somewhat different design approaches:

- The computer is considered a <u>tool</u> for augmentation of human processing, rather than the primary component of a process around which human labor evolves.
- The division of labor shifts in favor of the machine, so that as computing power increases, the machine can take on more tasks efficiently.

Computer hardware and software designers are highly-skilled professionals who enjoy a great deal of autonomy in and responsibility for their own work. It is not surprising, therefore, that the latest advances in "intelligent workstations" reflect the type of power, functionality, and flexibility they value in their own work, and thus follow the first design option identified above.

An interesting example of designing the system as a tool to extend human capabilities is AUGMENT, a system which was conceptualized as early as 1963 (Engelbart, 1963) and is still considered highly advanced relative to other designs of its type. A basic premise of the system is that "the intellectual effectiveness of an individual is dependent on factors which are subject to direct redesign in pursuit of an increase in that effectiveness" (Engelbart, 1963). In other words, methods of manipulating symbols and concepts in the process of understanding and solving problems can be enhanced through the power of the computer in close interaction with it. This concept is still the driving force in a publication twenty years later which states, "Our design goal was to provide as much capability as possible for each level of system usage skill, and a continuous evolution path between skill levels. We believe firmly that knowledge workers are motivated to grow in knowledge and skill and that provisions in system design should support this." (Engelbart, 1984, p.1).

Many other examples of systems which put functionality, power, and control into the hands of their users are in the process of design at various research centers (Sluizer and Cashman, 1984; Ellis and Bernal, 1984; Holt et al, 1983; Kedzierski, 1984; Trigg and Weiser, 1984). They are popular with and used heavily by the communities for which they were designed. Engelbart reports (1984, p. 8): "Perhaps the best way for very brief summarization of what AUGMENT's users feel about its unique features is simply to say that those who leave its working environment really miss them."

These and other advanced "intelligent workstation" systems demonstrate the potential for information technology to support the desirable extremes on both dimensions of work organization:

1. Low horizontal specialization through support of a wide variety of tasks covering a broad spectrum of skill levels and integrated to provide switching from one level and type of task to another;

2. Low vertical specialization through distribution of control over work pace, scheduling, and recording of accomplishments to the local workstation.

However, such systems are not in widespread use today although a few products with these capabilities are commercially available (e.g., Xerox STAR, Apple LISA). These systems are still prohibitively expensive for all but the most highly-paid, highly-skilled professional. Furthermore, much of their functionality can only be exploited if there exists a large community of users both within and across organizations.

There is of course another argument prohibiting widespread use of these workstations: such power, functionality, and flexibility are not necessary for most information workers. The assumption that these capabilities are not necessary or desirable for most types of information work drives the second design approach: increase the number and scope of tasks performed by the machine and reduce the human component to that of simple low-level input or monitoring. Prevalent system designs reflect this value system, which is quite different from the values the designers bring to the systems they use

themselves.

An example of such a design approach is a typical shared-resource word processing system consisting of a cluster of workstations with a shared disk and printer. Both the hardware, in particular the keyboard design, and the software are designed for a single function only, that of entering or modifying text. Usually the system is not programmable or the facility for "programming" is limited to a highly constrained set of parameters. A typical large system also has a "supervisory console" which is used for distributing work, monitoring work processes, and measuring and reporting on outputs on a variety of dimensions (lines or pages produced, error rate, keystrokes per unit time, etc.). Typically this information is not available to the individual operator except through the filter of supervisory verbal feedback.

In contrast, professional or "intelligent" workstations also have word processing capabilities, but the features are based on the assumption that the operator will be doing a variety of other tasks besides entering text; flexibility and functionality are considered before speed on input. Monitoring or production counts are rarely found in intelligent workstations unless they are provided as feedback for the individual performing the work.

VALUE SYSTEMS OF IMPLEMENTORS

"Implementors" of information systems, as opposed to designers, are those who decide which system is to be installed in a particular using organization as well as the particular work organization for

which the system will be implemented. Thus implementors include management as well as application system analysts and "experts" in implementation of technology or organizational change. The value systems of the designers, described above, have been "packaged" into the available systems among which implementors have to choose. A particular system may be enhanced through application programming within the using organization to further tailor it to the value systems of the implementors.

The opposite position to the one taken by this paper, that new information technology will result in greater work specialization and reduced quality of work life, must rest on the assumption that the value systems of its implementors (i.e., management) will prevail. Their choice of designs will be determined by the goals of system implementation, which may be one of the following:

1. To reduce the cost of labor

2. To improve individual and/or organizational productivity

3. To increase organizational flexibility with respect to use human resource and task assignment

4. To increase control over the labor process.

It should be clear that there are multiple paths to accomplishing any or all of these objectives. Skill reduction or division of labor is only one, and office work has notoriously resisted the "rationalization" process required in order to identify and break down the tasks performed. An insightful example by an anthropologist shows

that even a relatively straightforward task (record-keeping of purchases in an accounting office) requires a great deal of background knowledge and unstructured, cognitively complex problem-solving procedures in order to deal with (frequent) exceptions (Suchman, 1983).

Two alternatives to division of labor and skill reduction may both satisfy the objectives of system implementation and improve quality of work life. One option, already discussed, is to automate those tasks which are the most routine and have the human only perform the more cognitively complex and challenging tasks. Second is decentralization of certain tasks to the point of origin, i.e., the customer. The most common example of decentralization is the replacement of bank tellers by Automated Teller Machines (ATMs). Not only are the most straightforward tasks automated, but the data entry is performed directly by the client. Such "point of sale" systems are becoming common with the spread of low-cost communications networks.

The one objective which most directly reflects a particular value system of implementors is that of increasing control over the labor process. This can be translated into systems which consistently remove control from the worker and rationalize the control process through the technology. However, although this value system seems to persist in our culture, its effectiveness in terms of organizational productivity has never been adequately demonstrated, particularly when its adverse consequences in terms of employer/employee relationships are taken into account (Edwards, 1979). The flexibility of information technology permits not only greater separation of control over work from its execution, but alternatively decentralization of

control to the point of execution to an extent not possible with previous generations of technology. It is just possible that the potential to decentralize control to users will result in changing values of the users themselves and increasing demands for work which is more enriched and more directly under self-control.

CHANGING DEFINITIONS OF WORK

In this section, some more speculative issues regarding the changing defintion of information work will be raised. The basic thesis is simple: with flexible information technology certain physical constraints on information work and any organizational transactions regarding information are removed. In particular, the need to be physically located in a central office site a fixed number of hours per day (9 to 5) is removed. The implications of this phenomenon are discussed below.

WORK IN THE HOME

In the U.S., there has been a great deal of attention paid recently to the phenomenon of "telecommuting", or work at home. The assumption is that with location independence given to more jobs through the use of computer and communications technology, the work location of choice will be the home. It is the author's contention that work at home is a symptom or example of the alternative applications of information technology to work organization. This point is demonstrated by two extreme examples of work at home.

In the first case, the job to be performed is clerical in nature, requiring relatively few specialized skills. The job has been organized following the extremes of high horizontal and vertical specialization. Well-defined performance measures or production quotase have been established so that close supervision is not required; typically the output is "delivered" via communication lines. Thus, since the work is simple and repetitive, neither training nor employee background are important. since the employee has little or no control over the work, there is no need for the employee to develop a relationship of trust or commitment with the company. Furthermore, the employee is often willing to accept a lower pay rate in order to forgo the costs of commuting, child care, clothes, etc. associated with travelling to a central workplace.

In the U.S. as in Europe, unions have called for a ban on home work because of its potential for exploitation of workers. Their arguments are based on a history of exploitation, as a result of which bans have been placed on home work for specific industries. In the U.S., one of these bans (on knitting of outerwear) has just been lifted permanently, reopening the debate and forcing a reexamination of the pressures for and against it in light of the needs of today's society.

The debate exists because for many, home work appears to be a very attractive option. The second example illustrates an "ideal" set of circumstances for work at home.

In the second case, the key factor is that the person working at home has a set of skills which are in demand, thus giving him or her leverage with the employer. The employee chooses to work at home for reasons of personal preference; since the employee may be considerably more productive working in an environment (the home) which is relatively free of distraction, the employer accepts it. Typically, the person does not have primary responsibility for day care.

The nature of the job is the opposite of the first example on both dimensions of specialization, and it is these characteristics which make it possible to do the work at home. The job has low horizontal specialization, since typically there are many tasks to be performed and there is a great deal of flexibility permissible in the pace and sequencing of those tasks. Thus the employee can stretch the work over twelve hours or work for very concentrated short periods in the middle of the night. More importantly, the job has low vertical specialization, so the employee has almost complete direct control over it in terms of pacing, monitoring of outputs, etc. It is precisely because of the low horizontal and vertical specialization of the work that it can be done at home.

It should be noted that in the U.S., to date, very few employers permit employees to work at home on a regular basis, even part-time. However, it continues to be the subject of considerable debate. Two other factors should be considered: social "values" that place a high priority on individual flexibility and autonomy, and lack of alternatives due to nonwork constraints such as child care.

There has been much discussion of the increasing number of self-employed professionals in the U.S. The assumption is that there is a generation of individuals who place greater value on autonomy than job security, and who therefore choose to be self-employed. Typically, they are consultants or "contractors" providing a specialized service to multiple clients. Many of them work out of their homes, and for the self-employed professional the personal computer is a valuable tool. If their skills are in demand, the arrangement can be quite lucrative. However, many "choose" this alternative because of frustration at lack of an adequate career path in their profession rather than because of a strong need for autonomy.

Many other employees, primarily women, need to provide an income while accommodating child care at the same time. To them, work at home is one of few viable options since, in the U.S. in particular, alternative child care facilities are woefully inadequate. Many turn to self-employment because it gives them the flexibility they need. Many others are willing to accept a lower wage in order to be permitted to work at home (hence the unions' concern). In point of fact, the costs of child care, commuting, clothes, lunches etc. associated with work outside the home make it impractical for many.

ALTERNATIVE ORGANIZATIONAL SCENARIOS

The above discussion implies that work at home will not be widespread within the next decade. Traditional offices will not be replaced on a large scale by "electronic cottages". However, information and communication technologies <u>will</u> impact organizational structures as well as the relationship between organizations and

employees. Some relatively conservative scenarios of organizational change are described below.

Location Independence

When integrated information technology becomes the dominant tool in all office jobs, the jobs as well as the people performing them will be highly "location independent". For the organization, location independence implies more efficient utilization of human resources. Work groups can be formed temporarily, bringing persons of particular skills together "electronically" without incurring employee relocation or travel expenses. Reorganization of authority structures may be greatly facilitated without incurring physical rearrangements.

Where will people work when their location is not critical? Most will continue to work in traditional offices. Their offices, however, may be physically separate from their immediate work group or subordinates, thus resulting in "remote supervision". Certainly some will have a computer terminal or personal computer at home, but primarily this will be used after regular work hours or for an occasional day at home to meet a critical deadline for a report. As now, there will be informal arrangements for work at home in special cases such as maternity leaves and long-term disability. The total amount of office space required to accommodate managers and professionals will not be reduced, although it may be allocated more efficiently.

Contract Employment

Depending on economic conditions, supply and demand for certain specialized skills, and worker demands for autonomy, it is possible that in the future significant numbers of personnel who would have been full-time employees will contract out their specialized skills to a number of different organizations. The employee benefits through increased autonomy; if the skill is in very short supply, the arrangement can be significantly more lucrative. The employee loses the protective benefits and job security of the organization, however, and income levels may be very uncertain. Although the organization may benefit from flexibility in utilization of human resources in the short term, it loses employee commitment. Those motivational bases of work which depend on organizational membership -- contribution to production of goods and services, social interaction, and status -- are lacking or significantly reduced.

Information technology may play a role in contract arrangements through specialized advertising services which match individuals with organizations' requirements for specialists. This scenario assumes the requisite skills can be provided through computer and communications technology, or at least the results of production can be transmitted electronically.

Flexible Work Options

At the other extreme from contracting for specialized services, organizations that are committed to long-term employment may seek out innovative approaches to accommodating employees' nonwork needs

through flexible work options. For many workers, accommodating work and non-work needs is becomingly increasingly complex. Women bear a disproportionate share of the burden because, while expecting equal standards of performance in the workplace, they continue to bear most of the responsibility for child care.

In an organization which places high value on retention of valued employees, mechanisms are put in place to accommodate non-work needs of both men and women. Work at home, either occasional or for long periods of time, can be one of several such options. Others are extended leaves of absence, job sharing, and flexible (very flexible) work hours. Information technology plays a significant part simply in facilitating the recognition that increased flexibility can be accommodated.

SUMMARY

This paper has discussed a range of issues regarding information technology and work organization. Its basic premise has been that the inherent flexibility of information technology provides a wide range of choices in both individual quality of work life and organizational structure. Its general points are summarized below.

* Information technology can be implemented in such a way as to increase or decrease both horizontal and vertical specialization. Evidence is mixed, but examples from information-intensive industries show the potential for skill upgrading of lower-level jobs. This comes about for two reasons:

1. The most routine aspects of the work are either automated or decentralized to the organizational boundary (i.e., the client).

2. The remaining work is cognitively complex, abstract, and highly interdependent, thus requiring greater skill than previously.

* Evidence of the potential of information technology to decrease horizontal and vertical specialization is demonstrated by "intelligent workstations" designed by and for computer professionals. Since they already have a high degree of autonomy and flexibility in their work, it is not surprising that their designs reflect it. A major obstacle to putting this form of power and flexibility into other forms of work is the value system designers apply to others; they look to the value systems of implementors, who seek control over the labor process.

* In the long run, organizations may take advantage of the flexibility of information technology through alterations in physical and organizational structure. "Location independence" of work permits remote collaboration and remote supervision. Physical location of work can be determined by criteria such as employee needs rather than location of physical resources. Ideally, organizational and employee needs for flexibility should be combined in such a way that both benefit.

* Information technology will not <u>cause</u> changes in value systems leading to enriched jobs, greater worker control, or scheduling arrangements that accommodate employee needs for flexibility. However, technology facilitates such alternatives more than ever. It

is the responsibility of system designers, system implementors, and policy makers to ensure that the tremendous power and flexibility of information technology be applied in ways that improve quality of work life.

REFERENCES

9 to 5 National Association of Working Women, National Survey on Women and Stress, Cleveland, OH, 1984.

Adler, Paul, "Rethinking the Skill Requirements of New Technologies," Working Paper 84-27, Harvard Business School, Boston, MA, 1982.

Applegath, John, Working Free, World Future Society Press, 1981.

Attewell, Paul, "The De-Skilling Controversy," Department of Sociology, University of California, Santa Cruz, 1982.

Benjamin

Blauner, Robert, Alienation and Freedom: The Factory Worker and His Industry, Chicago: University of Chicago Press, 1964.

Braverman, Harry, Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century, New York: Monthly Review, 1974.

Dainoff, M.J., Occupational Stress Factors in Video Display Terminal (VDT) Operation: A Review of Empirical Research, National Institute for Occupational Safety and Healty, Cincinnati, OH, 1981.

Edwards, Richard C., Contested Terrain: The Transformation of the Workplace in the Twentieth Century, New York: Basic Books, 1979.

Ellis, Clarence and Marc Bernal, "OFFICETALK-D: An Experimental Office Information System," Xerox, Palo Alto Research Center, Palo Alto, CA, 1984.

Engelbart, Douglas C., "A Conceptual Framework for the Augmentation of Man's Intellect," in P.W. Howerton and D.C. Weeks, Editors, Vistas in Information Handling, Volume I: The Augmentation of Man's Intellect by Machine, Washington, DC: Spartan Books, 1963.

Engelbart, Douglas C., "Authorship Provisions in AUGMENT," IEEE COMPCON Digest, March 1984.

Faunce, William A., "Automation and the Division of Labor," Social Problems, 13(Fall), 1965, pp. 149-160.

Greenbaum, Joan, In the Name of Efficiency: A Study of Change in Data Processing Work, Philadelphia: Temple University Press, 1979.

Gregory, Judith and Karen Nussbaum, "Race against Time: Automation of the Office," Office: Technology and People," 1(2+3), September 1983.

Hewes, Jeremy-Joan, Worksteads: Living and Working in the Same Place, New York: Doubleday, 1981.

Holt, A.W., H.R. Ramsey, and J.D. Grimes, "Coordination System Techonlogy as the Basis for a Programming Environment," Electrical Communication, 57 (4), 1983.

Honeywell, Inc., Office Automation and the Workplace: A National Survey, Minneapolis, MN, 1983.

Kedzierski, Beverly I. "Knowledge-Based Project Management and Communication Support in a System Development Environment," Proceedings, Fourth Jerusalem Conference on Information Technology, May 1984.

Kelly Services, Inc., The Kelly Report on People in the Electronic Office, Troy, MI, 1983.

Kipnis, David, "The Use of Power in Organizations and in Interpersonal Settings," Applied Social Psychology Annual, Vol. 5, S. Oskamp, Editor, Beverly Hills, CA: Sage, 1984.

Kraft, Philip, Programmers and Managers: The Routinization of Computer Programming in the United States, New York: Springer-Verlag, 1977.

Mintzberg, Henry, The Structuring of Organizations, Englewood Cliffs, NJ: Prentice-Hall, 1979.

Moss, Mitchell L., Back Office Operations: Emerging Trends and Policy Options, Graduate School of Public Administration, New York University, New York, NY, 1983.

Olson, Margrethe H., "Remote Office Work: Changing Work Patterns in Space and Time", Communications of the ACM, February 1983.

Professional Secretaries International, The Evolving Role of the Secretary in the Information Age, 1983.

Shepard, Jon M., "Technology, Alienation, and Job Satisfaction," Annual Review of Sociology, 3, 1977, pp. 1-21.

Sluizer, Suzanne and Paul M. Cashman, "XCP: An Experimental Tool for Managing Cooperative Activity," Intelligent Systems Technologies Group, Digital Equipment Corporation, Hudson, MA, 1984.

Suchman, Lucy A., "Office Procedure as Practical Action: Models of Work and System Design," ACM Transactions on Office Information Systems, 1(4), October 1983.

Toffler, Alvin, The Third Wave, New York: Bantam, 1980.

Trigg, Randall H., and Mark Weiser, "TEXTNET: A Network-Based Approach to Text Handling," Department of Computer Science, University of Maryland, College Park, MD, 1984.

Wineman, Jean D., "Office Design and Evaluation: an Overview", Environment and Behavior, 14(3), May 1982, pp. 271-298.