The Physiological and Managerial Impact of Automation on Libraries

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A RECENT COMPUTER JOURNAL carried a mock advertisement for the "most popular computer accessories," and listed a picture of a bottle of Tylenol®, Visine®, and a tube of Ben-Gay® (*InfoWorld*, p. 22). The implication of the ad was that three of the most common by-products for users of computers are headaches, eye strain, and backaches. There is little doubt that automation has produced a quantum leap in staff productivity in libraries. There is also little doubt that libraries, as organizations, have been much quicker to embrace automation for economic reasons than to deal with employee considerations that are the result of the changes.

The purpose of this article is to examine the impact of automation on employees and on the administration of library operations. The focus of this examination will be on the recent literature concerning the effect of automation on libraries as organizations, and, specifically, on the physiological and sociological influence of computerization on library employees. (This study is an expansion of an earlier work by Olsgaard [1985]).

Evans (in press) has pointed out that library automation is not an event but a continuing process. That is, automation doesn't occur just once—it is a never ending process of action and reaction within the library as an organizational unit. The character of the continuing cycle of library operations automation is given in Figure 1. The major components of the cycle can be expressed as: Operations and Reporting; Staffing; Planning; and Computing and Human Factors. Although the components of the cycle do not constitute discrete entities—i.e., they tend to merge into one another—they do provide a basis for examining the issues.

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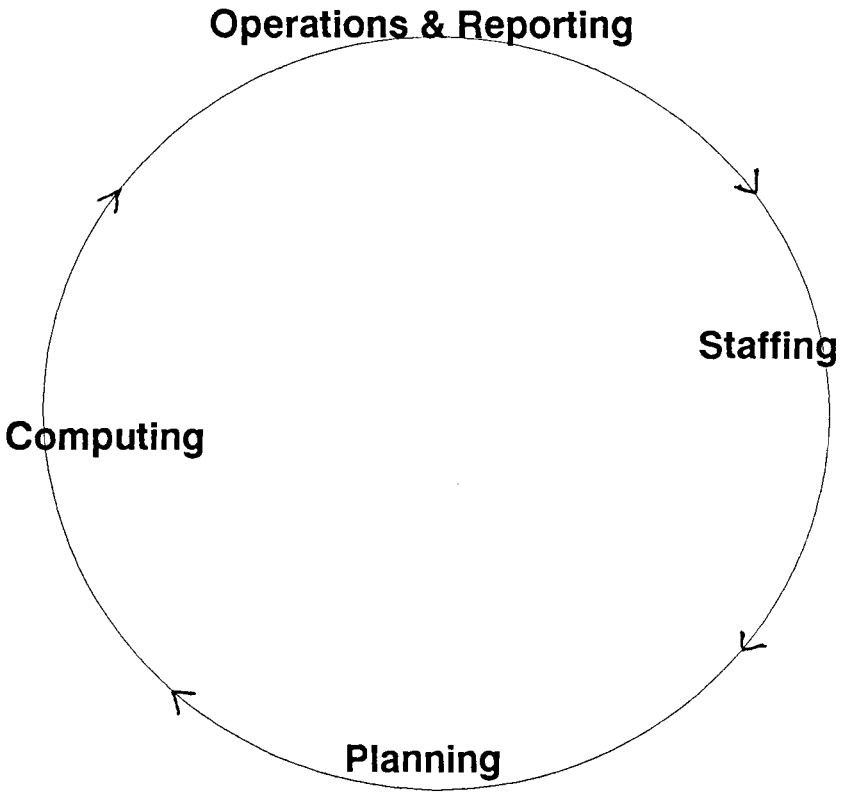

Figure 1. Cycle of library operations automation

Operations and Reporting

One effect of automation on the operations and reporting structure of libraries is the blurring of traditional lines of responsibility and authority. Atkinson (1984) has made a strong case for using automation as a mechanism to decentralize large central libraries and for redefining the nature of the organizational structure in libraries: "The rise of good, inexpensive, rapid, long-distance electronic document transmission may not only change the organizational patterns of individual libraries but may well change the patterns of librarianship as well" (pp. 109-14; see also Myers, 1986). Allen (1984) points out that technology will require libraries to rethink the traditional processes of operation and will necessitate the participation of staff at all levels. An example of this is given by Bednar (1988), who described the merging of various job types in the automating of cataloging at Penn State University.

The reporting function of automated library systems is usually thought of in terms of operations management. Most automated systems in libraries generate a variety of statistical reports that can and

should be, but probably aren't being, used in planning library operations. One of the primary objectives of Management Information Systems (MIS) is to more adequately put resources, such as computers, and staff together in order to achieve better productivity. MIS tells the policymakers how the organization is functioning so that changes can be instituted.

The most typical examples of the type of reports that are possible are those generated as a part of automated circulation systems. The normal circulation report matrix can include documentation as to: the number and type of user (e.g., faculty, adult, child), the subject areas in which circulation is occurring, the time of day or day of the week that the circulation took place, or a combination of all of these. For instance, an academic librarian could determine when most freshman students are using the library and plan staffing accordingly (Olsgaard, 1983; Hawks, 1988; Runyon, 1981).

The bright side of MIS is that it affords the opportunity to better utilize available resources in a rational way. The potentially dark side is that it can allow managers to individually track the productivity of a given staff member. Although Crowe and Anthes have addressed the ethical issues of library technology with regard to external users, little has been written on the ethical use of automation with regard to internal monitoring of library staff (Crowe & Anthes, 1988). The use of automated systems as a tool of employee supervision in libraries, and the concomitant privacy implications, are likely to become a major issue in the future.

Staffing

The second component in the automation cycle is the impact of computerization on the staff of the library. Staffing is literally the alpha and the omega—the beginning and the end—of all automation projects but probably receives the least amount of attention. In many library automation projects, those in charge of the project concern themselves with buying the hardware, doing the data conversion, loading the software, and then, almost as an afterthought, considering what the line personnel might think about the system. The primary reason for this problem is that library automation project teams are usually made up of librarians. Professional librarians are primarily managers. Ergo, librarians tend to concentrate on the management aspects of the automation process rather than on how the process will affect line personnel.

For example, when a large library is in the process of bringing up an automated circulation system, the librarians in charge of the process tend to focus on the cost of the system and the types of reports that the system can generate, because that is where the system will interact with their normal job duties. That is the librarians will tend to be less interested in the level of difficulty of checking materials in or out with the system since librarians in large libraries rarely spend much time

doing that activity. The paraprofessional staff, who do spend a great deal of time checking out materials, are rarely consulted about the automated system until after the fact. The contradiction in this mode of operation is that the paraprofessionals who use the system on a day-to-day basis will ultimately have a much stronger influence on whether the system implementation is successful than will the librarians who originally purchased the system.

One of the strongest components of any automation project has to be a concern with the manner in which the staff that will use the system will respond to its implementation. At least one study has estimated that over 85 percent of all failures in systems implementation can be attributed to "people problems" (Cirillo, 1983, p. 25). The literature would indicate that the most common effects of these people problems tend to be the fear of change, and, specifically, the fear of computers.

Fear of change is a natural human reaction. Most of us tend to develop routines that allow us a degree of control over familiar situations. Change, by definition, poses a threat to those routines. Automation, as an agent of change, has been well documented in the literature (Olsgaard, 1985). For instance, Jagodzinski (1985) points out that automation has an impact on many aspects central to the individuality of employees including their "professional status, job security and self-esteem..." (p. 134). Or as Ganus (1985) states: "Not only is there a fear that the environment will be dehumanized with the introduction of computers, but a fear that one's own 'territorial' workspace will be changed to something uncomfortable, even alien. A change of working relationships is uncomfortable, just as is any change of procedures with which one has already become familiar" (p. 28).

A relatively recent variation on the theme of computers as an agent of change is the study of the fear of computers. This field of inquiry has coined the terms "cyberphobia" and "technostress." As an exercise in social psychology, a study was conducted of cyberphobia in office workers in the Washington, D.C. area. Of those that responded, 14 percent were termed as being "computer anxious" (Gardner, et al., 1985). However, at least one study indicates that while computerization does change organizational structure, it has very little impact of any kind on the stress levels of employees (Leppanen, et al., 1986). Another study sees the proper application of psychological principles to computerization taking primarily the form of hardware and software design (Card, et al., 1983).

The consensus of the literature would tend to indicate that automation can be either a positive or negative force on employees depending on how the automation activity is implemented.

Positive Effects

The positive effects of automation on staff can be characterized as:

1. Automation can be designed to reduce repetitive work. For example,

the repetitive nature of typing and retyping letters from scratch can be reduced by using word processing equipment.
2. Automation can be used to upgrade the skills of employees. Employees can be freed to use more time on decision-making, planning, and supervision of other employees.
3. Automation can increase the variety of tasks conducted by the employee and provide flexibility in the times when those tasks are carried out.

Negative Effects

The negative effects of automation on staffing can be summarized as:

1. Automation can be used to "deskill" jobs. That is, automation can be used to lower position skill requirements by filling them with dull, repetitive duties of another sort. One could argue that an effect of automating library technical services procedures has been to deskill many technical services positions through the use of computers. For example, many librarians who were doing original cataloging now spend the majority of their time making minor screen modifications on one of the online cataloging systems.
2. Automation can eliminate jobs or force the complete retraining of personnel for different duties.
3. Automation can reduce the level and the quality of interpersonal communication (Roscow, 1984; Shiff, 1983; Schement, et al., 1985; Caudle & Newcome, 1986; Waters, 1986; Diebold, 1984).

Whether automation will have a positive or negative impact on the employees of the library will largely be determined by how well the system is planned.

Planning

There is no stronger consensus in the literature of automation than the view that adequate planning is essential to the overall success of automation implementation (Mick, 1983). However, much of the planning process in libraries has traditionally occurred only at the middle manager level; by design or choice, relatively few upper-level administrators (e.g., directors) or line personnel (e.g., paraprofessional staff) become associated with planning the system. Unfortunately, these two organizational levels will have a proportionately greater impact on the success of automation than will middle managers. Upper-level administrative participation is important because they control project funding and support. Paraprofessional participation is important because they will be doing a large share of the staff interaction with the system.

The management literature is particularly expressive in its support of upper-level administrative involvement in the planning process. The quantity of the literature on this topic can itself be rather intimidating. In reviewing the advice this literature has to offer, the administrator is

urged to: keep up with new developments in computerization (McAulay, 1987; Grant & Robinson, 1984); strive for "computer fluency" in order to communicate with systems designers (Keen, 1985); and "manage change" through involvement in the automation process (Rockart & Crescenzi, 1984; "Manage the impact," 1985). Perhaps the best rationale for administrative involvement is that if the administrator has a more personal stake in the success of the project, he/she will be much more forthcoming with financial support for the project (Allen, 1982; Quible & Hammer, 1984).

On the other end of the administrative spectrum, it is equally important for line personnel (e.g., paraprofessionals) to become involved in the automation planning process. A number of studies in both the management literature (Staples, 1985; Kanter, 1984; James, 1986; Franz & Robey, 1986), and in the literature of library and information science have demonstrated the favorable effects of staff involvement in the automation process (Bichteler, 1986; Horsnell, 1983; Drescher, et al., 1986; Henshaw, 1986; Allen, 1983). For instance, a 1984 survey of four Indiana companies concluded that:

> Managers frequently tend to assume that if subordinates are simply told why change is necessary, they will adapt compliantly. As this study indicates, this is clearly not the case. The extent to which operants accept technological change, and, indeed, welcome it, is largely determined by their involvement in the planning and implementation of the change. (Matherly & Matherly, 1985, p. 23)

Similar findings were reported in a survey of U.S. academic librarians by Olsgaard (1984) and in a survey of Canadian libraries by Dakshinamurti in 1984. Dakshinamurti (1985) states: "This clearly underscores the importance of allowing all staff members to have a say in proposed changes, particularly those workers affected by these changes" (p. 350).

Given the evidence of the research that has been conducted concerning the success of involvement of all levels of employees in the automation process, it is not surprising that the earlier mentioned studies exist. What is surprising is the number of guides to automation in libraries that do *not* include recommendations on employee participation.

Computing and Human Factors

One of the more popular topics in the literature of library and information science, in computing, and in management science is "human factors engineering." "Human factors engineering," or its more popular synonym "ergonomics," is the generic term which describes the study of any aspect of human-machine interaction. The purpose of ergonomic research is to explore the effect of physiological factors on employees who utilize computerized systems or other forms of equipment. As library employees are increasingly exposed to automation, physiological considerations will have a direct effect on continuing gains in staff productivity.

Although there is a considerable volume of material on the physiological aspects of ergonomics, much of it is rather repetitive. The basic recurring problem described in many types of organizations—and one could certainly include libraries in this listing—is that the primary emphasis has been on the purchase of technological machinery rather than adapting the machinery to fit the employee and the operational circumstances. Generally, these physiological conditions simply mean that since employees come in a wide variety of shapes and sizes, the machinery and furniture utilized by those employees should be adjustable to fit them. The following include some of the more basic hardware ergonomic considerations:

1. *Seating.* The chair should be adjustable in terms of height, back support, and armrests.
2. *Noise.* Employees should be protected from recurring sources of loud noise associated with automation (e.g., impact printers). The ambient noise level should not exceed 55 decibels.
3. *Tables.* The table that supports the microcomputer should be adjustable in terms of height and should be large enough to hold both the computer equipment and other work material.
4. *Computers.* Various accessories should be added to the basic microcomputer configuration that would allow adjustment of the video display terminal (VDT) in terms of height and angle. The purchase of an inexpensive glare screen for the VDT can significantly reduce eye strain. The keyboard should also be height adjustable.
5. *Lighting.* The VDT should be placed at a 90 degree angle to room windows to reduce glare. The general room lighting should provide 500-600 lux of indirect illumination.
6. *Other.* Many employees who spent a significant amount of time working with computers find other devices of great value. These items include footrests and the ability to change the color on VDT screens (Ergonomics, 1986; Owens, 1987; Thiel, 1983; Self, 1984; Vickery, 1984; Gordetsky, 1984; Mason, 1984; Schmidtke, 1984; Dainoff, 1984; Koffler, 1983; Roose, 1986; Bube, 1985).

An area of ergonomic consideration that has just begun to receive attention in the literature is "software ergonomics." Software ergonomics is the study of design factors that would increase the productivity of computer systems. This area of ergonomics can be as basic as the software having the ability to be either menu driven for novice users or command driven for the more experienced employee. Increasingly, software designers are writing programs that can adjust speed, help levels, and escape mechanisms to facilitate communication (Martin, 1986; Vigil, 1983; Ramsey & Grimes, 1983; Waite, 1982; Cockton, 1987). According to Otten (1984):

> the ergonomically conscientious software designer has the following general design objectives:
>
> 1. Minimum mental effort and strain for the user;

2. Minimum requirements for learning new procedures, definitions, codes and for unlearning long-practiced thinking patterns;
3. Ease of operation, simplicity of expressing commands to instruct the tool to perform specific tasks;
4. Prevention of frustration, provision of specific, relevant help whenever needed; and
5. Communication effectiveness, no need to consult reference material to interpret displays of responses and results of work. (pp. 19-25)

One additional ergonomic consideration that must be addressed is the health aspects of working with VDTs. Occasionally employees will become quite concerned over the effect of radiation in general, on pregnant women in particular, and on vision. Almost anyone who has spent a couple of days staring at a VDT can testify that this activity might cause eye strain or muscle fatigue, but there is no evidence that VDTs are a radiation hazard or cause eye damage (Miller, 1983). Henriques and LeGates (1984) state: "The facts are reassuring. All sorts of scientific and academic groups around the world have come to the conclusion that there is no health hazard connected with visual displays" (pp. 64-68).

The primary reason that library managers should be concerned with ergonomics is not just that employees will be less cranky—although that is probably a pretty good reason—but because ergonomically designed systems allow employees to be more productive. Experiments in various organizational and laboratory settings have demonstrated that when ergonomic techniques are utilized, employees work longer, faster, with fewer entry errors, and with fewer sick days. Depending on the study and the type of work analyzed, the increase in productivity can range from 4.5 percent to 23 percent. Springer (1984) points out that ergonomic modifications in the typical organization will pay for themselves in less than five years if a 3 percent increase in productivity is realized.

Conclusions

The purpose of this study was to examine some of the recent developments concerning the physiological and managerial aspects of library automation. Although the cycle of library operations automation was depicted as having four components, it should be emphasized that the components are interlocking and mutually supporting. That is, the organizational functions of operations and reporting affect, either positively or negatively, the staffing functions of the process. The staffing functions will affect the planning functions and so on.

In an earlier work, I have suggested that as automation processes in libraries matured, concern would move from technological considerations, to organizational considerations, to human considerations (Olsgaard, 1985). The literature of library and information science has a rich legacy of information on technological development and associated problems; it is currently building a corpus of material on the organizational impact of automation, but it has made little progress in coming

to grips with the reality of the personnel aspects of the process. The literature of the profession is still more concerned with making people fit machines than with having machines modified to fit people. The point of automation is not just to do what we have always done, faster. The object of library automation should be to do what we do, better and more productively. The profession generally has yet to discover that designing automated systems that will make the library employee's job easier and more rewarding is not only good humane policy, but will make good policy from a dollars and cents point of view.

REFERENCES

Allen, B. (1982). An unmanaged computer system can stop you dead. *Harvard Business Review, 60*(6), 77-87.

Allen, G. G. (1984). The response of professional librarians to the impact of technological and other changes. *Australian Academic and Research Libraries, 15*(June), 129-134.

Allen, K. G. (1983). Combating obstacles in an automated work environment. *Proceedings of the ASIS Annual Meeting, 20,* 290-293.

Atkinson, H. C. (1984). The impact of new technology on library organization. In J. Ehresmann (Ed.), *Bowker annual of library and booktrade information* (pp. 109-14). New York: Bowker.

Bednar, M. (1988). Automation of cataloging: Effects on use of staff, efficiency, and services to patrons. *Journal of Academic Librarianship, 14*(3), 145-149.

Bichteler, J. (1986). Human aspects of high tech in special libraries. *Special Libraries, 77*(Summer), 121-128.

Bube, J. L. (1985). The ergonomics/human factors approach to health sciences libraries. *Bulletin of the Medical Library Association, 73*(July), 254-258.

Card, S. K.; Moran, T. P.; & Newell, A. (1983). *The psychology of human-computer interaction.* Hillsdale, NJ: Lawrence Erlbaum.

Caudle, S. L., & Newcomer, K. E. (1986). Managing electronic patterns: The office of the future. *Information Management Review, 2*(2), 17-24.

Cirillo, D. J. (1983). Coping with causes of stress in the automated workplace. *Management Review, 72*(December), 25-28, 38-39.

Cockton, G. (1987). Interaction ergonomics, control and separation: Open problems in user interface management. *Information and Software Technology, 29*(May), 176-191.

Crowe, L., & Anthes, S. H. (1988). The academic librarian and information technology: Ethical issues. *College & Research Libraries, 49*(2), 123-130.

Dainoff, M. J. (1984). Ergonomics: More than just furniture. *Modern Office Technology, 29*(June), 71-80.

Dakshinamurti, G. (1985). Automation's effect on library personnel. *Canadian Library Journal, 42*(December), 343-51.

Diebold, J. (1984). How new technologies are making the automated office more human. *Management Review, 73*(November), 9-17.

Drescher, J. A., et al. (1986). Panel discussion: Reports on staff involvement in library automation. In D. Shaw (Ed.), *Human aspects of library automation* (proceedings of the 1985 clinic on library applications of data processing) (pp. 59-76). Urbana-Champaign, IL: University of Illinois, Graduate School of Library and Information Science.

Ergonomics. (1986). *Personnel Journal, 65*(6), 95-102.

Evans, J. E. (In Press). Administering the library automation process. In J. N. Olsgaard (Ed.), *The theory and practice of information science: A primer for library professionals.* Chicago: ALA.

Franz, C. R., & Robey, D. (1986). Organizational context, user involvement, and the usefulness of information systems. *Decision Sciences, 17*(3), 329-356.

Ganus, S. S. (1985). Office computers: Managing the human impact. *Journal of Information & Image Management, 18*(2/3), 26-31.

Gardner, E., et al. (1985). Human-oriented implementation cures "cyberphobia." *Data Management, 23*(November), 29-46.

Gordetsky, G. R. (1984). Management's challenge: The adjustment of man to machine. *The Office, 99*(June), 78.

Grant, K. A., & Robinson, R. (1984). Beyond productivity: Other issues in office automation. *Cost and Management, 58*(September/October), 44-48.

Hawks, C. P. (1988). Management information gleaned from automated library systems. *Information Technology and Libraries, 7*(2), 131-138.

Henriques, V., & LeGates, C. (1984). Facts about visual display safety. *Personnel Administrator, 29*(September), 64-68.

Henshaw, R. (1986). Library to library. *Wilson Library Bulletin, 60*(8), 44-45.

Horsnell, V. (1983). Libraries and human engineering. *Assistant Librarian, 76*(12), 177-182.

InfoWorld. (1985). 22 (advertisement).

Jagodzinski, A. P. (1985). The interaction between electronic storage systems and their users. In N. Fjallbrant (Ed.), *The future of information resources for science and technology and the role of libraries* (proceedings of the 11th meeting of IATUL) (pp. 133-37). Goteburg, Sweden: Chalmers University of Technology.

James, P. N. (1986). Investing in people: A new management commitment. *Journal of Information Systems Management, 3*(Fall), 58-60.

Kanter, R. M. (1984). Changes in office roles needed to make best use of automation? *Management Review, 73*(February), 29-30.

Keen, P. G. W. (1985). Computers and managerial choice. *Organizational Dynamics, 14*(Autumn), 35-49.

Koffler, R. P. (1983). The ergonomic art. *Datamation, 29*(June), 235-236.

Kull, D. (1984). Demystifying ergonomics. *Computer Decisions, 16*(September), 143-148.

Leppanen, A., et al. (1986). Effects of computerization on job demands and stress: The correspondence of subjective and objective data. In F. Klix & H. Wandke (Eds.), *Proceedings of the first network seminar of the International Union of Psychological Science on man-computer interaction research* (pp. 351-356). New York: North Holland.

Martin, M. P. (1986). The human connection in systems design. *Journal of Systems Management, 37*(October), 6-29.

Mason, R. M. (1984). Ergonomics: The human and the machine. *Library Journal, 109*(3), 331-332.

Matherly, T. A., & Matherly, D. M. (1985). Employee participation eases the transition to office automation. *Journal of Systems Management, 36*(February), 17-23.

McAulay, K. (1987). The changing role of management in information systems development. *Interfaces, 17*(May/June), 47-53.

Mick, C. A. (1983). Planning for office automation. *Journal of the American Society for Information Science, 34*(3), 229-232.

Miller, R. B. (1983). Radiation, ergonomics, ion depletion, and VDTs: Healthful use of visual display terminals. *Information Technology and Libraries, 2*(2), 151-158.

Myers, M. (1986). Personnel considerations in library automation. In D. L. Shaw (Ed.), *Human aspects of library automation: Helping staff and patrons cope* (proceedings of the 1985 clinic on library applications of data processing) (pp. 30-45). Urbana-Champaign, IL: University of Illinois, Graduate School of Library and Information Science.

Olsgaard, J. N. (1985). Automation as a socio-organizational agent of change: An evaluative literature review. *Information Technology and Libraries, 4*(1), 19-28.

Olsgaard, J. N. (1984). *The relationship between administrative style and the use of computer-based systems: An attitudinal study of academic library professions.* Ph.D. dissertation, University of Illinois at Urbana-Champaign.

Olsgaard, J. N. (1983). Characteristics of managerial resistance to library management information systems. In F. W. Lancaster (Ed.), *Library automation as a source of management information* (proceedings of the nineteenth annual clinic on library applications of data processing) (pp. 92-110). Urbana-Champaign, IL: University of Illinois, Graduate School of Library and Information Science.

Otten, K. W. (1984). Information tools: Hardware and software ergonomics determine user acceptance and productivity. *Journal of Information and Image Management, 17*(4), 19-26.

Owens, E. L. (1987). Ergonomics should incorporate human factors. *Data Management, 25*(May), 28-29.

Quible, Z., & Hammer, J. N. (1984). Office automation's impact on personnel. *Personnel Administrator, 29*(September), 25-32.

Ramsey, H. R., & Grimes, J. D. (1983). Human factors in interactive computer dialog. *Annual Review of Information Science and Technology, 18*, 29-59.

Rockart, J. F., & Crescenzi, A. D. (1985). Manage the impact of systems on people. *EDP Analyzer, 23*(May), 1-12.

Rockart, J. F., & Crescenzi, A. D. (1984). Engaging top management in information technology. *Sloan Management Review, 25*(4), 3-16.

Roose, T. (1986). Ergonomics in the library. *Library Journal, 111*(17), 54-55.

Roscow, J. M. (1984). People vs. high tech: Adapting new technologies to the workplace. *Management Review, 73*(September), 25-28.

Runyon, R. S. (1981). Towards the development of a library management information system. *College & Research Libraries, 42*(6), 539-548.

Schement, J. R., et al. (1985). Social forces affecting the success of introducing information technology into the workplace. *Proceedings of the ASIS Annual Meeting, 22*, 278-283.

Schmidtke, H., ed. (1984). *Ergonomic data for equipment design*. New York: Plenum Press.

Schneider, M. F. (1985). Why ergonomics can no longer be ignored. *Office Administration and Automation, 46*(July), 26-29.

Selders, W. J. H. (1983). Ergonomic work stations: Are they really needed? *The Office, 97*(June), 154, 159.

Self, J. (1984). Ergonomics and productivity in the electronic office. *Journal of Information and Image Management, 17*(4), 14-18.

Shiff, R. A. (1983). Office automation: The human equation. *Journal of Micrographics, 16*(May), 28-31.

Springer, T. J. (1984). Ergonomics: The real issues. *Office Administration and Automation, 45*(May), 69-72, 116-118.

Staples, E. R. (1985). Who's responsible for office automation? *Infosystems, 32*(February), 56-57.

Thiel, C. T. (1983). Productivity by design. *Infosystems, 30*, 30-38.

Vickery, A. (1984). An intelligent interface for online interaction. *Journal of Information Science, 9*(1), 7-18.

Vigil, P. J. (1983). The psychology of online searching. *Journal of the American Society for Information Science, 34*(July), 281-287.

Waite, R. (1982). Making information easy to use. *American Society for Information Science Bulletin, 9*(2), 34-37.

Waters, D. (1986). Assessing the impacts of new technology on library employees. *LASIE, 17*(1), 20-27.