Implementing Technological Change

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This article addresses some problems associated with technological change. The author examines the nature of data and technology, organizations, and computer-mediated work. Concepts of sociotechnical systems design are related to library automation. Finally, a set of strategies for facilitating technological change is proposed.

"It should be borne in mind that there is nothing more difficult to carry out, more doubtful of success, than to initiate a new order of things."—Niccolo Machiavelli, *The Prince*

nyone who has initiated changes in a library recognizes the truth of Machiavelli's statement. From moving the placement of a spine label, to implementing AACRII, to installing an automated system, innovations will likely meet some resistance. Automation is probably the most difficult change to implement, because it may alter virtually every library function, as well as the basic organizational structure. In a study of 117 ARL (Association of Research Libraries) libraries, the introduction of automated systems was the most frequently mentioned force contributing to organizational change.[1] More than a thousand libraries have installed automated systems since 1973.[2] Even more have made automation a part of their operations through participation in national bibliographic utilities. The internal changes resulting from technological innovation are legion, as are the number of staff who resist them.

Introducing new technologies or revamping existing applications will always produce change. Change, however, does not necessarily lead to resistance, tension, and conflict. The intent of this paper is to propose a set of strategies that will aid librarians in the introduction of technological innovation. In order to provide a context for these strategies, data, technology, organizations, and computer-mediated work are examined. Concepts of sociotechnical design are then related to library automation, and implementing strategies are discussed.

SECTION I

Politics of Data and the Power of Technology

This is an age of extensive and increasing automation. While visible in banks, grocery stores, and libraries, it is often invisible elsewhere. Much has been written about the speed of change and the amount of information being generated. Lucinda Conger calls the result "cognitive whiplash."[3] Widespread automation has become possible because of a combination of explosive growth in computer power and advances in telecommunications, both at relatively low cost.

Libraries generally turn to computers for relief from rising costs and increasing backlogs. They use the new technology to meet economic need and also to provide

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technological opportunities. The aim is to improve existing services, to introduce new services, and, ultimately, to apply computer technology to areas of management decision making. Libraries continue to expand the sophistication and number of computer applications. Change has become the constant.

Computer technology was originally regarded as a means for achieving savings at the technician and clerical levels. The newer waves of library automation are affecting highly skilled personnel. While performing basic tasks such as circulation control, a system generates data of significant value to the library manager. A manager has the capability of forecasting demand flows, providing time horizons for various functions, and collecting and analyzing a wealth of additional statistical data while the system engages in its primary function.

Early works on promoting innovation through the creative use of new technologies were driven by a technological imperative. Current management literature suggests that technological determinism can be avoided. This does not mean that technology is neutral. It requires a response from the user, but it does not prescribe the nature of that response. According to Shoshana Zuboff, the flexibility, memory, and remote access capabilities of information systems create new possibilities that provide choices in the design and introduction of applications.[4]

The intrinsic power of information, or what Peter Keen calls the "politics of data," is a fundamental element in planning for technological change.[5] Information as a resource symbolizes status, enhances authority, and shapes relationships. Information may be public or private, formal or informal; regardless of its form, the owner of information owns power. For many years, catalogers held uniquely powerful positions because they alone could interpret the MARC format; reference librarians needed their help to decipher the message implicit in a serials tag such as "785 05 (Absorbed in part by:)."

Computer systems frequently redistribute information, breaking up monopolies.

The display of a library's holdings in a national database opens up its resources to a much larger user group. As libraries began to participate in online, national, interlibrary loan networks, their control over collections and services was reduced. Little-known local collections became available for national use.

The use of electronic data decreases individual autonomy and increases the amount of control that can be exercised over library staff. Electronic data permit closer observation of subordinates' decision making and help in efforts to develop additional output measures. Ruth Hafner has explored the nationwide process of evaluation encouraged by cataloging networks. Peers, managers, critics, and consultants now evaluate catalogers' successes and failures. The power of individual catalogers is diluted.[6] Hafner describes the new technologies as a "direct attack" on the autonomy of the cataloger.[7] Networks maintain error tallies, hold training sessions, and, in several respects, have co-opted local decision-making responsibilities.

Nature of Organizations

Designing strategies for implementing technological change in libraries requires an understanding of organizational behavior. It is useful to apply Harold Leavitt's model of organizations to libraries. Leavitt identifies four increasingly complex, interrelated components: task, technology, structure, and people.[8] He notes that strong interdependence means a change in one component inevitably has planned or unplanned effects on the others.

"Task" describes the day-to-day duties and the knowledge and operator skills necessary to perform them. Task is the easiest component to alter. "Technology" should be understood not as methodology but as the principles that govern how the tasks are accomplished. Learning MARC tags or the new principles in AACRII means changing the technology used to create catalog records. "Structure" refers to how responsibility is distributed, roles are coordinated, and information is disseminated. This is the organizational

structure. Automating interlibrary loan functions through national utilities frequently requires structural changes. The need to coordinate database protocols, to schedule a terminal, or to provide OCLC-trained backup may move ILL from a circulation to a reference responsibility.

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"People" is the most powerful and complex component in Leavitt's model. Warren Bennis and others define the people component as the culture of an organization—the system of norms, beliefs and assumptions, and values that determine how people in the organization act, even when the action may be at odds with written policies and formal reporting relationships.[9] The organizational culture of a library is a potent force. It is nonverbal and intuitive, elusive, and resistant to efforts to control and change its nature.[10] A university administration may decide to restructure reporting lines so that the library and the computing center report to the same vice-president. This does not necessarily mean the library staff will perceive a common mission with the computer center or perceive the need to explore common problems together. Changes in basic library premises are the most difficult to implement.

With their multiple components, libraries are complex organisms characterized by homeostatic behavior. The inertia encountered in libraries is infamous.[11] In order to implement innovations successfully, one must unfreeze the status quo. Peter Keen points out that dramatic change rarely occurs in complex social systems.[12] Only small increments are possible. Compromise, far from being bad, becomes an essential aspect of the implementation process.

A recognition of the importance of quality of work life (QWL) to the individual is a significant factor in current management and library literature.[13] High QWL implies the fulfillment of human needs that are the source of motivation and involvement. The objective is to provide those social and psychological aspects of work that have been widely recognized, such as autonomy, discretion, variety, social connectedness (developing satisfying social relationships), feedback concerning performance, meaningful work, meaningful future (learning new skills and developing new talents), effective voice (having some say over how the work is performed), responsibility, ability to see one's contribution in the end product or service, and adequate and equitable reward. Robert D. Stueart writes that staff are libraries' major resource, and work satisfaction must be a prime consideration as preparations are made for change.[14]

Any innovation that individuals or groups perceive as intruding on their territory, limiting their autonomy, reducing their influence, or adding to their workload will be resisted and will cause staff fears.[15] Resistance exists to the extent that innovation requires change in skills, behavior, attitudes, social roles, and social context. Resistance and the difficulty of effecting change are related to the type of component. It is usually easier to master a new task than a new technology. Adopting a new technology is often easier than altering the organizational structure. Changes in the cultural fabric are the most threatening and are resisted most. The common thread in the resistance to change is the uncertainty and concern experienced by the staff about how the change will affect their work.

Computer-Mediated Libraries

Interaction among the demands of new technologies, the nature of organizations and information, and the responses of the men and women who must work with the new technological systems are resulting in new conceptions of work organization and behavior. Zuboff's comments on the nature of computer-mediated work are clearly descriptive of current trends in libraries.[16] Much library work has become abstract. A person accomplishes a task through the medium of the information

system. A reference librarian frequently responds to a reference question without ever touching traditional printed materials. An online database search may be conducted for an absent patron and the resulting printout mailed directly to the requestor. The library staff may be removed from the raw material, the product which results from the process, and perhaps even the user of that product. Work may no longer be tangible.

Employees often go to extremes to retain a direct connection to their work. In the late 1970s, some catalogers found it impossible to create bibliographic records in MARC format. They continued to type 3-by-5-inch cards which were then coded with MARC tags. A 3-by-5-inch card provided tangible proof that a title had been cataloged; online records may not provide the same sense of satisfaction. This is one of the reasons employees retain paper files. They may defend the practice as a necessary backup, but what they really want is something tangible.[17]

The social fabric of a library is affected by automation. Once jobs are reorganized, new patterns of communication and interaction become necessary. In time these patterns are likely to alter the organization's social structure. In automated cataloging operations personal work stations can create an uncomfortable isolation. The local social network may become fragmented and catalogers are distanced not only from public service operations but from other catalogers. Despite evidence of reduced face-to-face interaction, Zuboff indicates that technology can also make it easier to initiate dialogues and form coalitions within the organization.[18] Dispersed cataloging activities are possible. Geographic separation is not as significant as in the past. It is important to acknowledge that information technology has powerful, not necessarily negative, consequences for the structure and function of communication and social behavior in a library.

Computers in libraries offer new possibilities for supervision and control. Traditionally, supervision has depended on the quality of the relationship between supervisor and worker. By consulting printouts or visual displays, library supervisors can receive immediate information about how much employees are producing and increase observation without depending on face-to-face supervision. Remote supervision and greater access to subordinates' production levels become possible with computer-mediated work. According to Zuboff, this may lead employees to limit their risk-taking and initiating behaviors.[19]

The capacities of information systems can also alter relationships among library managers. Data can be available at all managerial levels. This new access raises a number of policy questions. What type of information is appropriate at each level of management? Who is responsible for evaluating the data? What type of experience in statistical analysis is necessary? Library managers need the time and skill to understand raw data. They must avoid the tendency to become bogged down in data, looking only at past and present experiences; they must plan for the future.[20]

Computer mediation of work has resulted in the birth of the information environment.[21] This environment is characterized by speed of access, retrieval, and information processing. Increased access to data and, in particular, data relevant to specific decision making, results in greater ease and convenience for review and reorganization. Increases in speed and amount of access to data influence feelings about power and orderliness. The results of automation can be seen as neat and nice, as augmenting power, or as increasing regimentation and encroaching on individual judgment and freedom.

SECTION II

Sociotechnical Systems Design

Individuals who design automated systems and plan implementation projects often focus on the task and technology subsystems and ignore or downplay the application's effect on people and the organizational structure. It is clear that new information systems inevitably affect how the staff relates to the tasks for which they are responsible, as well as to the organizational structure and culture. Wilson Luquire's research into attitudes toward au-

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tomation in academic libraries demonstrates the importance of considering what he calls the psychological point of view when introducing innovation.[22] However, the technical application itself cannot be ignored. One solution is to approach systems design and implementation in a way that combines both social and technical sensitivity.

Several researchers, primarily Enid Mumford and her colleagues, have developed a sociotechnical approach to systems design. Sociotechnical systems (STS) design acknowledges the interaction of technology and people; its goal is to produce systems that not only are technically efficient but that also lead to high job satisfaction.[23] Calvin Pava uses STS design in his strategies for automating offices.[24] According to Pava, planners who use STS design recognize that each application has a technical subsystem (the tools and techniques that transform the input into a product) and a social subsystem that joins the disconnected jobs together and coordinates them. The goal of STS design is to get the best match in the overall combination of social and technical factors.[25]

STS interventions typically involve the restructure of work method, the rearrangement of technology, or the redesign of the social structure. STS design aims to unfreeze the existing organization in order to facilitate change. The techniques proposed by Mumford parallel the model for change developed by Kurt Lewin.[26] Lewin's model states that successful change must move through three steps: (1) unfreeze: create a climate for change and get contracts/commitments with users; (2) change: analyze, design, develop, and install the new system; (3) refreeze: institutionalize the new system. This model emphasizes that stable organizational systems with supporting political coalitions need to be disturbed before change begins. The first step in STS intervention is designed to begin the unfreezing process and involves assessing the existing social system, primarily by measuring the job satisfaction of the work group. The intent is to create an environment open to exploring alternatives.

Lewin's change step begins when the job satisfaction data are used to set human (social) objectives directed at increasing job satisfaction. This can be the responsibility of the work group. Alternatives are developed that deal with work group structures, task allocation, and individual job designs. The technical experts examine alternatives for meeting the technical objectives of the system but usually do so prior to initiating the design effort. Once technical and social alternatives have been identified, the entire design team selects those alternatives that meet *both* objectives. If successful, the result should be improved task efficiency and job satisfaction.

After installation of a new system, the concluding step is refreezing. In this stage, the organization accepts the changes and becomes committed to them. If the organization has successfully worked through the preceding steps, refreezing should occur easily.

Although STS design is time consuming and can require special training, it can be used to introduce technological change with a minimum of stress and upheaval. As a result, the financial cost of implementation may be reduced. Serious staff/management problems can be avoided. According to Mumford, the successful implementation of a new computer system can provide the opportunity for acquiring human as well as technical gains.[27] Organizations characterized by inertia may be reluctant to take a risk.[28] Fear of the unknown is the critical element.

Change becomes more difficult to implement as the level of change increases. This can be linked to the four interrelated components of an organization: task, technology, structure, and people. The more sweeping and sophisticated the change, the more difficult it is to imple-

ment. Librarians who wish to manage change successfully must recognize the human factor at all levels.

SECTION III

Strategies for Change

How should a librarian plan for change? Management is traditionally defined as the act of controlling; strategy is the act of planning and directing. Considering the nature of organizations, technology, and the power of information, planning for change is a more appropriate concept than controlling change. Bennis defines planned change as the conscious, deliberate, and collaborative effort to improve the operations of a human system.[29] The most successful implementation projects tend to be those that result from a systematic effort to consider all components of the organization, particularly the social fabric. This paper concludes with a set of strategies for facilitating technological change based on STS design.

1. *Communication.* The role of communication is paramount because most resistance stems from communication failure. Appropriate information will assist the library organization to unfreeze and change. Staff need to know what change is going to mean to them in terms of their jobs, salaries, personal satisfaction, status, etc. Library managers should strive for open communication both horizontally and vertically, formally and informally. They should be prepared to convey information repeatedly. They must also be available and open to questions. They must be prepared to deal with resistance. Resistance demonstrates the employee's need to have some power over the situation. Managers should recognize that resistance may be appropriate; some innovations *are* poor. The employee usually has something of value to communicate about the nature of the system. The library manager should view the implementation process as joint problem solving, not as a win/lose conflict.

2. *Purpose.* Clearly stating goals is an essential element in the process of bringing about change. Management should state the reason for initiating a new system. Clear understanding by staff regarding the necessity for change is critical. They can then claim partnership in the change process.

3. *Leadership.* Success of a project depends on the support of middle and top management. Change is less avoidable if supervisors support fully the innovation. Large-scale change is a process of coalition building on the part of management. The presence of a clearly identified individual or group who champions and guides technological activity is essential. This may be the director of automation or an automation steering committee. This person or group must have the prestige, visibility, and legitimacy to move the project forward.

4. *Incentives.* Incentives may be formal or informal. Quality of work life studies have shown that employees are motivated by a mixture of incentives. The need for variety and opportunities to learn new skills and develop new talents is frequently a high priority on the part of staff and can be designed into the system. Job rotation, job enlargement, and job enrichment are more feasible in an automated environment. Further, it is more effective and efficient to have a staff person perform several functions.

The use of work groups can provide an incentive by satisfying the need for social connectedness. Small groups provide a link between the individual and the larger organization. They carry the added advantages of functioning both as a medium and as a target of change. Small groups within the library offer security in the midst of change.

Access to information conveys power, and an increase in social power may be perceived as an incentive. Perceiving a proposed change as congruent with self-interest complements incentive.

5. *Consequences.* Managers should make consequences clear. Organizations with highly visible consequences are quicker to suggest alternatives when faced with organizational changes and to make the necessary adjustments to react to change. When the effects of actions are clear, adap-

tion is easier. Procedures that enhance visibility of consequences will enhance efficiency.

6. *Time.* Adequate time is needed for implementation. A staff needs time to explore options, compare alternatives, and consider consequences. A gradual approach toward automation alleviates social inertia and helps reduce stress and tension.

7. *Incremental Implementation.* Introducing a project in several overlapping phases provides several benefits. Phasing makes it easier to see and define what benefits or problems are associated with each function; the impact on users is less drastic. Local priorities can be used to determine the sequence in which functions are implemented. Gantt charts are frequently used to present visually the idea that complex systems can evolve out of phased components.

Using prototypes in one or two sites on a full-production basis is another way to implement incrementally. This method offers a way to assess system impact on hardware and on users and to test training. Prototypes provide time to make needed changes before the system is expanded to include all users or all sites.

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8. *Collaboration.* Collaboration is an essential ingredient in effective planned change. People want a say in how their work is performed. Participative involvement increases commitment and cooperation. It offers wider resources for problem solving. The degree of collaboration achieved by staff members has a direct, positive impact. However, extensive participation of users at the design stage may increase the planning time and costs of the system. Libraries must recognize the trade-offs. Systems designed without the active involvement of users may initially

appear cost-effective on the basis of technical criteria, but, in fact, higher costs are often incurred in the long run. These higher costs result from resistance to change, poor system utilization, high turnover, and absenteeism.

9. *Design.* The design process should be open ended. Design is a dynamic, reiterative process; a certain degree of incompleteness allows for creativity. The library should expect the innovations to change over time. Variations can be legitimate forms of adaptation without implying failure of implementation. The design process should be initiated with few details. The details of a work system should be limited to what is absolutely essential because overspecification narrows options. Developing alternatives is useful. It will allow exploration of more options and increase the chances for the acceptance of one.

Practical design considerations should evolve out of an awareness of ergonomics. Plans for input and display variables, work station layout, and data manipulation and transfer should consider the library staff who will use the system. In addition, planners should consider work flow. The system should be designed with elements that facilitate its use.

10. *Training.* Ease of learning the new technology is a key factor in acceptance. Training is most successful if it is linked to the library's specific organizational context and tied to day-to-day operational needs. Local development (or at least modification) of training materials is desirable because it clearly provides this link. Online training manuals and simulations are useful, as is online documentation. Training sessions should be presented in a comfortable setting similar to the work environment.

SUMMARY AND IMPLICATIONS

It is clear that automation is becoming an integral part of internal operations as libraries implement new systems and revise existing applications. Plans to implement library automation projects must recognize the power of technology and the politics of data. Introducing automation in a library setting requires an under-

standing of the nature of organizations and the new environment of computer-mediated work. This paper has presented a set of strategies for the effective introduction of planned technological change. These strategies reflect a STS design approach. The social subsystem is as important as the technical subsystem. When the technical subsystem is based on information technology, the implementation is made more complex by the power and politics of information.

The strategies proposed in this paper can be time consuming and expensive. However, the beneficial results will ultimately outweigh any liabilities. Implementing technological innovation using STS design productively involves library staff in the change process. Stress and resistance are reduced and changes are more smoothly assimilated. Recognizing the contributions that library staff can make is central. Clearly, the introduction of a new computer system provides the opportunity for realizing human as well as technical benefits.

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