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OFFICE AUTOMATION:
THE DYNAMICS OF A TECHNOLOGICAL BOONDOGGLE

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For anyone who has taken the time to read these words given the title of the paper, the proposition that office automation will dramatically reshape American society within twenty years is probably assumed. Likewise, few would disagree with the assertion that the direction of office automation is largely driven by technological developments rather than responding to specific organizational or societal needs. (While most users are currently interested in office automation to reduce labor costs and improve productivity, they are seeking to take advantage of technological developments rather than guiding the form of automation.) The second fact was recently confirmed by a recent study here at M.I.T. of the current office automation efforts in nine large users (Driscoll, Sirbu, Alloway, Hammer, Harper, and Khalil 1980).

Less well-understood is presence of <u>choice</u> within any technology. There is no such thing as a technological inevitability. David Noble, a colleague here at M.I.T., has made that argument persuasively, and documented his contention in a series of compelling studies.[1] More recently, Wendy Mela and Richard Walton at Harvard Business School have supported the presence of technological choice in the specific area of concern here, namely advanced office technology.[2]

If the direction of technological development is not a given, and if office automation is certainly being driven by technological developments, then who is making the choices among technological alternatives? Noble believes that technology is a means of social control in the conflict between classes within the society. The ruling (capitalist) class selects specific technologies to maximize its control over the working class. My own analysis explores some additional explanations. The purpose of this paper is to analyze the current technological path of office automation, and to demonstrate the possibility of an alternative, more humanistic path.

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Then, I will explore the reasons for our current path and suggest actions for interested groups in the society who prefer my proposed humanistic alternative.

The Future of Office Automation

Because of my graduate work with Larry Williams and Tom Lodahl at Cornell in the early 70's, I have been studying office automation since the early days of word processing. More recently, I have conducted my own studies of electronic mail systems and the state of the office-automation art in large users.[3] Additionally, I have participated occasionally as M.I.T.'s representative on the Office Automation Roundtable and I conduct a weekly seminar here at M.I.T. on recent developments in office automation. As my presence in this Stanford symposium suggests, I am one of the "usual suspects" when somebody rounds up a crowd of experts to discuss office automation.

Based on this reasonably informed perspective, I detest what I now foresee as the future of office automation.

The smart money in the technological sweepstakes now rests on two entries: decision-support systems and "true" automation. Again and again, experts tout the advantages of these "totally integrated" approaches to office automation and contrast them with the incremental advantages of word processing. But, what is the inevitable result of these particular technologies which are currently being "chosen"?

Decision-support systems, as the first wave of the future, represent little more than the extension of the use of computers to managers (a clarification suggested by Kenan Saheen of the University of Massachusetts). A decision-support system focuses on the key decisions made by a manager or professional and tailors a computer-based system to support those decisions. Its components may vary, but typically they

include a regression-based forecasting tool for analyzing alternative decisions and direct access to organizational and outside data bases for input to the analysis. A well-known system developed here at M.I.T. by John Little and his colleagues, Brandaid, helps, as I understand it, a product manager select a marketing strategy for a given product.

Decision-support systems emphasize computer support for a few key managers in an organization and help them to make decisions as individuals. The complex communications links currently being developed for boards of directors can also be conceptualized as decision-support systems. Of course, such systems neglect current research on how decisions are actually made in organizations. Decisions, most scholars now agree, are the outcome of a complex social and political process involving many people and a variety of special interests. (Graham Allison's, The Essence of Decision (1971) best demonstrates this position). To the extent that decision-support systems are an attempt to rationalize this process, their implicit model of an organization emphasizes a few individuals, at high levels in organizations, making decisions with the support of technological wizardry to direct the actions of all the other people in the organization.

"True" office automation, the second wave of the future, arises from a distinction popularized by Michael Zisman, yet another M.I.T. affiliate, based on his work with Henry Morgan at Wharton (Zisman, 1978). Zisman correctly criticizes word processing and electronic mail as mere "mechanization" or the replacement of human labor with machine power. Automation, by contrast, is the exercise of discretion by machines. The computer system in true office automation controls office activities and exercises judgement in performing tasks according to its programmed logic. Research currently underway here at M.I.T. by Michael Hammer, Jay Kunin, Sandy Schoiket and others at the Laboratory for Computer Sciences (along

with other projects across the country) are now attempting to develop computer languages to supply the logic for such "true" automation.[4] They are attempting to discover all the structured work in offices which could be more efficiently performed by a computer system. Zisman's program for running the manuscript-review process for a journal editor is the best known example of such automation, but the current efforts are driving for the computerization of all structured tasks which possess some generalizability across offices.

What is the implication of such "true" office automation? The office of the future would maximize on machine efficiency by using the computer to gobble up the structured tasks in any office and leave people in only two roles: bosses and garbage collectors. The boss decides what tasks must be done (perhaps with the help of a decision-support system) and asks the systems analyst to prepare the program. The rest of the workforce picks up the garbage which is left over at the edges of the programmed tasks (Marvin Sirbu of the Center for Policy Alternatives at M.I.T. has elaborated this point in a recent paper).[5] Such leftovers have no internal coherence since their sole determining characteristic is that the machine couldn't do them. They do not form an integrated, purposeful whole which would engage the interest and attention of a human being. The only human control in the system resides at the top of the organization in the systems analyst or programmer and whatever collective action the lower level people can take to sabotage the system by letting the garbage pile up.

Figure 1 portrays the "office of the future" resulting from the current technological path. My assumption is that you will either like or dislike the picture depending on whether your present position makes it likely that you will be a boss/systems analyst or a garbage collector.

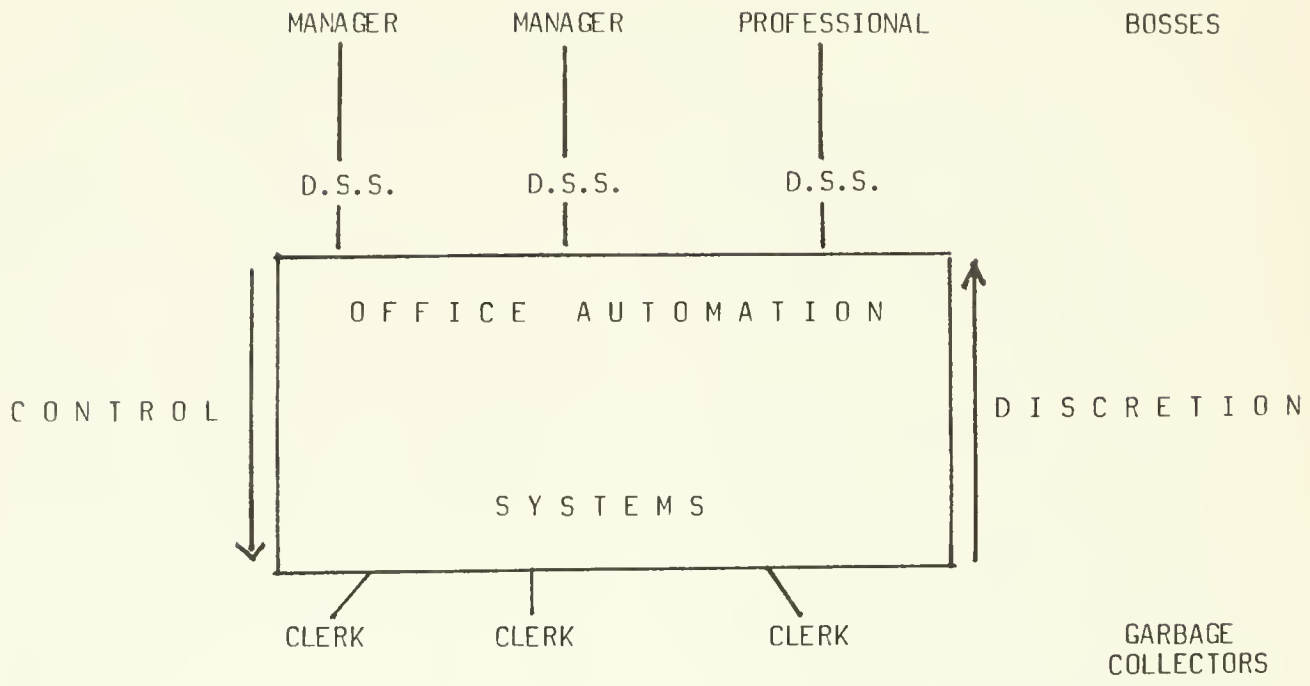

FIGURE 1: FUTURE OF OFFICE AUTOMATION

An Aside on Word Processing and Electronic Mail

The reader may quibble at my neglect of the two most popular current applications in office automation: word processing and electronic mail. I omit them because my intent is to project the future of the office given the logic of current technological development.

By the standard of future importance, word processing is widely considered irrelevant. While the largest sales volume is currently in stand-alone word processing systems to support secretaries, every single expert in the field (and indeed the current massive advertising campaigns from the vendors themselves) emphasizes the importance of integrated computer-based systems to support office workers. Text editing and retyping are downplayed as only one, minor feature of such a system.

Likewise electronic mail within organizations simply substitutes computer systems for existing communications media such as the telephone. To the extent electronic mail incorporates control decisions about storing messages, forwarding them, automatic addressing and other functions, it is evolving into precisely the "true" automation envisioned by Zisman. While the mere mechanization of some office tasks such as recording may save more time and money than current word processing systems, they do not represent the automation of the office which has excited so many of us.

With all that said, the evolution of word processing and electronic mail foreshadow precisely the nightmarish vision described in Figure 1. The logic of word processing has always been specialization and centralization. While the decline in product cost has made decentralized systems feasible, the vast majority of vendors and users talk about how to get as much typing as possible loaded onto a word-processing machine in order to reduce the number of secretaries in an office. This logic was

clear in the early days of large word processing centers, but remains today despite the pioneering efforts of Lodahl, Williams and Williams to point out the inefficiences of such specialized systems (1979).

The consequence of such specialization in word processing has been to increase the separation between boss and secretary in the office and to create a new breed of even more menial office workers. Little improvement in the jobs of non-word-processing secretaries has resulted, despite the advertising claims of the vendors about career paths for women.

This separation of secretary from boss will dominate future systems as can be seen from current discussions about inputting text to automated systems. One way or another, product designers are seeking ways to keep the boss from having to type. Menues of preprogrammed commands are presented requiring only a single keystroke for action, or an electronic "mouse" is moved across a pad to convey information, or the user simply touches the screen. In the most dramatic example, developed by Richard Bolt and his colleagues here in M.I.T.'s Architecture group,[6] the user sits in an easy chair with both hands on pressure-sensitive armrests allowing the user to "zoom" across a wall-sized projection of a desk top by pressing down with either hand.

The standard form of input for text from such high-status users, be they hunt-and-peckers, mice, pointers, or zoomers, is by dictation to a typist.

Likewise, the separation of high-skill and low-skill workers is increased by the more advanced versions of electronic mail. The major applications outside the research community, where we found the most widely used systems in our recent study (Bellinger, 1980), emphasize multi-media communications among key decision makers or in support of the board of

directors. Electronic mail does not appear likely to emerge as a substitute for the telephone for all office workers, rather it will only support key managers and professionals.

While these trends can be justified based on ease of user acceptance and the current cost of hardware, the leading edge of users and vendors in both word processing and electronic mail would clearly create an organization with two distinct social classes as portrayed in Figure 1.

Before exploring the reasons for that future, a few words are in order to appraise its value.

A Nightmare of Cost Ineffectiveness

An organizational innovation can always be appraised from two perspectives: the goals of the organization and the interests of the organization's members. Despite (or perhaps because of) their confusing connotations, the first perspective is usually called "rationality" or "economics" and the second "politics".

A "rational" perspective. There is little reason to believe the proposed office of the future will either save money or advance organizational objectives. A recent review of word processing in the federal government painted a negative picture of the economic impact of such systems.[7] More generally, our own recent analysis of some forty studies conducted by large office automation users revealed no single post-implementation, economic evaluation of an office-automation system (Driscoll et al., 1980). Despite the heavy emphasis that such users gave to cost savings in proposing new systems, they had never gone back to validate their claims.

Some recent attempts to cost justify office-automation systems are embarrassing from both a methodological and a managerial perspective.

Frequently the analyst will ask people on a questionnaire how much time they have saved from a new system and then multiply their response by current salary levels to estimate savings. A competent researcher would ask at least for a second, corroborating source of information and some comparison of time spent against a control group. A practical manager would want to know whether those projections ever turned up as hard dollars in a budget account which he or she could spend on something else. "Soft dollars" are viewed skeptically.

I have suggested the reasons for this disappointing economic performance of the current trend in office-automation systems in an earlier paper (Driscoll, 1979). Most generally, these systems neglect the interdependent nature of office work as the product of many people and they simultaneously fail to provide any motivation for most people to work any smarter or harder in pursuit of organizational objectives. For example, decision-making is a small (and some would argue insignificant) part of a manager's job (Mintzberg, 1974). Therefore the potential impact of decision-support systems is limited. Their likely impact is further eroded by their neglect of the social and political component of decisions. Similarly, "true" office automation promises to decrease the motivation of office workers. Their motivation springs in large part from the nature of the work itself as well as from their social contacts. An emphasis on maximizing machine efficiency, specialization, and centralization destroys these two mainsprings of worker motivation.

A political perspective. The social consequences of the current technological path are, if anything, even more negative than the economics. As Figure 1 illustrates, office automation is likely to increase the distance between people at the top and the bottom of organizations. The

few decision makers and systems analysts will command more in salaries, benefits, and differential treatment than do current managers. By contrast, the lower-level workers will find much of their work less interesting, have less chance for promotion (since the jump to decision maker is vastly more difficult), and have less power to demand reasonable salaries since many of their fragmented tasks can be performed by a newly hired worker with little or no training. Unless the reader advocates the overthrow of the current system of government in the United States by violent means, such a picture is distressing. It increases the likelihood of a revolution, but it contradicts our values of equal opportunity and individual mobility in the economic realm.

Alternative Technological Paths to the Office of the Future:

My explanation for the likely evolution of office automation takes two parts. First, a coherence and an inertia to the current trend that provides it with stability. Second, a series of external causes first established and now maintains the direction. I will address these two points in order.

Technological path is the term I have adopted to capture the notion of internal structure.[8] A path is not a chance stroll through the forest of technological innovation. One step follows another because of the contour of the ground, the color of the soil, and markers along the way. Even so, there seems a certain direction, inevitability, and sometimes human leadership that characterizes developments in office automation.

Systems analytic is the label I use to describe the current trend in office automation. Table 1 summarizes the features of the current path and contrasts it with a largely hypothetical alternative which I have labeled "humanistic." There is little original to these distinctions. What

deserves attention is the apparent clustering in the present technological path of so many wrong answers to the major questions about organizational behavior. A series of narrow, short-term perspectives characterizes the current approach.

For example, McGregor (1960) popularized the difference between optimistic and pessimistic assumptions about human nature held by managers. Successful managers tended to hold optimistic views, and his term for that constellation of assumptions has become rooted in the management literature as "Theory Y". By contrast, less successful managers more often hold pessimistic views of their fellow beings, characterized by McGregor as "Theory X". If there is an organizing framework for the present technological path, it is "Theory X" assumptions about human nature.

Designers of current office automation systems in the systems analytic path assume that people are lazy and cannot be trusted. Therefore, their systems seek to reduce skill levels required by the organization and to generate information by which operators can be controlled by higher level managers. The line-counter on word processors is the most obvious example.

This emphasis on measurement and control leads inevitably to the statement of objectives for the system in terms of efficiency, cost savings, and personnel reductions. Also implicit in this negative world view is the importance of the <u>few</u> motivated individuals at the <u>top</u> of the organization in setting its direction. This elite needs information, both to control the untrustworthy lot below them, and to enable the few to make the major decisions which impact organizational goals.

Unfortunately, this obsession with efficiency, cost savings, and reduction of inputs flies directly in the face of current wisdom about

managerial control. Some years ago Anthony and Dearden at Harvard Business School made two critical distinctions within the management process.[9] First, they argued that managers ought to concern themselves with effectiveness as well as efficiency. Effectiveness assesses progress towards objectives while efficiency merely assesses the number of inputs required for a given level of performance. Managers too often sacrifice effectiveness in the pursuit of efficiency. This trend was apparent in our recent evaluation of office automation efforts in large users.

The second distinction advanced by Anthony and Dearden separated operational control from strategic planning. The vital role for top management is setting strategic direction, not monitoring performance of lower-level workers.

The current path of office automation thus contradicts not only the best judgement of organizational psychologists about effective management, but the dominant conception of management control as well.

The most devastating shortcoming of the current path from my perspective, however, is its repressive political overtones. Clearly, the systems currently under development cater to the approval of a few key decision makers, since that is the current decision-making structure of most large organizations. The systems designers pay little heed to the needs and interests of the large number of lower-level participants whose working lives will be affected by this technology.

In addition, current systems ignore the external effects of office automation beyond the boundaries of the user organization. For example, at several conferences I have heard suggestions that much of the non-automated work, such as text input, might better be performed by part-time employees in their homes or subcontracted to "service bureaus." At a time when labor

economists are raising the possibility that the large supply of such lower-paid, temporary, dead-end jobs in our economy is the major cause of our chronically high unemployment, such an external effect is unconscionable for national employment policy.[10]

Likewise there are possible negative impacts on physical health from prolonged use of a cathode ray tube and unfortunate mental health implications of low-skilled, high-turnover, meaningless work.[11] However, if reactions at conferences on office automation are any indication, these health effects are among the few subjects guaranteed to induce boredom among current vendors and users.

The humanistic path, in contrast to the systems-analytical technological path, is marked by different initial assumptions about human nature and leads to quite different office-automation systems. Since workers are now assumed by systems designers in the humanistic path to have the potential for self-motivation and control, the immediate purpose of an automated system is to increase the flow of information to the system operators in order to allow them to utilize and increase their skills and knowledge. Decisions are spread as much as possible throughout the organization rather than being concentrated at the top.

Wendy Mela and Richard Walton provided a delightful example of a humanistic alternative from their own research at one of my recent seminars. The designer of a product information system for a large retailer of consumer goods assumed that the purpose of the new computer system was to provide information on stock levels, advertising campaigns, and the like to the national sales manager. That key decision maker could then better deploy his sales force and advertising budget. However, the local sales managers desired a system which provided them with the same

information so that these lower-level participants could make deployment decisions locally. Clearly, the computer can serve either group. A humanistic path would suggest providing the information to the local manager on the assumption that he or she wanted to act in the company's interest without the need for centralized control by the national sales manager.

A humanistic path also includes a focus on organizational objectives rather than inputs, since progress towards such goals is the focus of feedback to operators. Such an orientation towards goals, rather than inputs, implies and reinforces the humanistic path's attention to groups of people rather than individuals. Goal orientation emphasizes groups because objectives usually apply to some organizational unit rather than individuals. The focus on individuals in the systems-analytic path results only from the need assumed by the designer to control individual behavior, not from an intrinsic need by top managers to know how people accomplish their objectives.

And finally, a humanistic path gives explicit recognition to the quality-of-work-life issues neglected by systems analysis because a wider range of motives is attributed to individuals. People are assumed, in many cases, to desire meaningful work, training, and the opportunity for advancement. Therefore an effective system must provide such potential if it is to increase productivity.

On balance, then, the humanistic path reflects current wisdom about how to best motivate and manage people at work at the same time that it creates positive rather than negative effects outside the boundaries of the user. Why then is current practice pursuing the less desirable technological path?

Table 1: Alternative Technological Paths

	Systems Analytic	Humanistic
Assumptions about human nature	lazy, untrustworthy, need outside control	motivated, trustworthy, self-controlled
Immediate function of office automation	allow outside control, reduce skill requirements, provide information to key decision-makers	provide feedback to individual operators, utilize and increase skills and knowledge of operators
Unit of Analysis	individuals, tasks	groups, organizational units, functions
Scope of organizational objectives	efficiency	effectiveness, quality of work life
Target group	key decision makers	all organizational members
Constituency	top management	all organizational members
External effects on society	increase unemployment, threat to physical and mental health little impact on productivity	decrease unemployment, beneficial impact on mental health increased productivity

Causes of the Systems-Analytic Technological Path

The reasons for this domination of the systems-analytic technological path are multiple and grounded in the fabric of our society. Let me suggest psychological, organizational, and political forces at work.

Individual. Theory X as a cosmology is as American as apple pie. Our culture and media emphasize the importance of individual efforts and the need for external checks and balances on personal self-interest. The wellspring of energy for a capitalistic economy is the individual maximizing personal interest.

In addition, engineering (and other professional) education has been taken to task for inculcating Theory X assumptions about human behavior; Chris Argyris has also pointed out the self-sustaining nature of such beliefs.[12] For example, if you believe it necessary for productivity to put people in low-skill jobs and supervise them closely, then they will never demonstrate any imagination or initiative and thus will confirm your worst suspicions.

Thus, individual systems analysts and managers in many cases bring negative views about people to the task of designing and implementing office automation systems.

Organizational. At the organizational level, a new set of forces comes into play to support such individual tendencies. Top managers constitute the dominant group in most organizations and can be expected to direct the development of office-automation systems to support their current advantages. Money, power, and status go with current managerial jobs and, to date, relatively few managers have been willing to decrease voluntarily their share of such rewards.

From a functional perspective within organizations, office automation

is, in my own experience and research, most often an extension of traditional data-processing techniques of systems development. Very rarely is a behavioral scientist or even a representative from the personnel-management or human-resources function appointed to the task force coordinating office automation. Therefore the internal bearers of the humanistic perspective advocated here are systematically neglected by current organizations.

An interesting puzzle is why organizations have not adopted the humanistic path given its advantages (at least as I have claimed for it) in terms of organizational objectives. Some organizations have of course taken this path with substantial success.[13] My best explanation for this widespread suboptimization is the relatively loose connection between the installation of computer-based systems and measures of organizational effectiveness. Recall that in our review of user research, systems designers never returned to examine the economic effects of an office automation system. In the absence of such a reality check on system design, managers and systems analysts are relatively free to pursue the biases alluded to above.

Societal. The societal level provides perhaps the most convincing explanation for the systems-analytic path and reflects the dynamic described by Noble. In my years of attending conferences on office automation in the United States and Europe, I have encountered only one labor union official and he, not surprisingly, was from Sweden. In the United States, I have encountered no representative of government agencies (except as potential users of office automation). Thus, there is no systematic representation in the choice of a technological path by those interests most impaired by the current trends. Office work in the United

States is largely a nonunion sector at the present time. By the time these industries (banking, finance) and occupations (secretaries, clerks, technicians) become unionized, the technology will already be in place. The German Marshall Fund is supporting my current research to assess the impact of stronger labor unions on office automation in Western Europe. To my knowledge, the Departments of Labor and Health and Welfare have done nothing on this policy issue to date.

Ours is a pluralistic, capitalistic society. So long as the major actors in the determination of technological choice are large, private firms making and using office automation, there is little reason to expect a shift to a humanistic path unless some mass conversion from Theory X to Y among managers takes place. The present sermon is an effort at such conversion.

What is to be done?

There are some obvious implications from my pessimistic analysis.

Line managers ought to insist on careful, long-term, broad-gauge economic evaluations of office-automation projects. If Theory Y is true, as I sometimes believe, then the humanistic path, somewhat counterintuitively, would benefit from tighter evaluations. Managers should reject systems proposals which purport to justify office automation in labor cost savings and then repeatedly return with evaluations emphasizing qualitative benefits and "soft-dollar" savings. For line managers, simply insisting on some follow-up would be a refreshing and effective start.

Office-automation staffs, I'm afraid, emerge as the villains of this paper, despite my insistence that the causes of the problem are more widely rooted in the society. Therefore, office-automation staffs ought to undertake a massive review of their current strategy to evaluate my

analysis. Does the menu of future projects reflect the biases I allege towards decision support for key managers and the "true" automation of office work by the integration of multiple computer systems? Are the behavioral disciplines in fact neglected in systems design teams?

For those staffs pleading guilty or "nolo contendere", it is a trivial matter for a management-training staff to develop short workshops to convey the distinction between systems analysis and humanism. Systems analysts can gradually recognize some of their untested assumptions about human nature and see the choices possible in the design of office-automation systems from a humanistic perspective. Of course, as Argyris has argued for so long, recognizing some personal assumptions is not enough to change the most fundamental and unconscious assumptions controlling behavior. For such a deep change, continued monitoring by behavioral scientists with a humanistic bend is required. Mela and Walton are developing an organizational impact statement for office automation systems to highlight the negative impacts of the systems-analytic path.

Labor unions ought to use technological paths as a guide to their organizing efforts. Employers who pursue the current systems-analytic trend in office automation will do more to increase membership among office workers than will the women's movement. In particular, individuals affected by pilot office-automation projects provide a quick indication of the ripeness of an employer for organizing. Participants in pilot studies may also provide horror stories for other parts of the organization as well as a source of early members for the union's internal organizing committee.

Where a union currently holds bargaining rights for office workers, for example in the public sector in the United States, office automation should take a high priority in negotiations while there is still time to

influence the organization's choice of a technological path. Unions ought to demand notification about all new computer systems, participation in the design and especially the evaluation of the system, and training for designated union officials in systems design. Such requirements are mandated by law in Norway, so counterparts in European unions provide a good source of information to American trade unionists.

The list of possible government actions is extensive and I have treated the possible roles for the government in improving the quality of work life in an earlier work (see Beer and Driscoll, 1977). Of pressing importance is the need for a major research effort to test my speculations about the path of technological development and its deleterious impacts on the quality of employment opportunities in the U.S.

If my fears are confirmed, then it may be necessary for the federal government to increase substantially the minimum wage and mandate substantial fringe benefits such as portable pension coverage. Such changes would bring pressure on employers to avoid the creation of low-skill, high-turnover jobs. Such external pressures would make the systems-analytic technological path less economical by eliminating the cost advantage of low-skill jobs. Of course, such measures assume that managers are turning to office automation to save money and not just to increase control over the work force.

In short, if employers are, in fact, proceeding down the systems-analytic path, then office automation provides a crucial test of the viability of our pluralistic, capitalistic system. Will enlightened employer self-interest, collective bargaining, and federal labor-market policies control the nightmarish consequences that haunt my sleep or is office automation sowing the seeds of social revolution?

FOOTNOTES

[1]David Noble, Assistant Professor of Science, Technology and Society at M.I.T. inspired the current analysis when he presented his analysis of the evolution of numerically controlled machine tools to our Industrial Relations Seminar. A complete exposition of his argument appears in America by Design: Science, Technology, and the Rise of Corporate Capitalism (New York: Knopf, 1977) and in "Before the Fact: Social Choice in Machine Design", 1978.

[2]Professor Richard E. Walton and Research Associate Wendy Mela at Harvard Business School reported on their research to my Seminar on Office Automation. They are currently preparing a book on advanced office technology.

[3]The study of electronic mail is reported by two of my graduate students who in real life are managers for A.T.& T. and Boeing, respectively. A condensed version will be available in July, 1980. Hagood Bellinger, "Electronic Mail Systems: Are They Effective in the Office" (Unpublished Master's Thesis, M.I.T., 1980). Richard W. Alldredge, "Electronic Message Systems: Factors Affecting their Acceptance" (Unpublished Master's Thesis, M.I.T., 1980). The assessment of the state of the office-automation art in large users is listed in the references (Driscoll, et al., 1980) and is available from the Industrial Liaison Program at M.I.T. as of June, 1980.

[4]Associate Professor Michael Hammer, Associate Director of the Laboratory for Computer Science at M.I.T. and his Research Associate Jay Kunin have both reported at my seminar on their efforts to develop both an office specification language and a programming language for office automation. Additional information can be obtained by writing to them directly.

[5]Dr. Marvin Sirbu, Research Associate in the Center for Policy Alternatives at M.I.T., will provide copies of this paper ("Programming Organizational Structure") upon request.

[6]A recent description of this project is available upon request from Dr. Richard Bolt, Spatial Data Management Group, Architecture Department, M.I.T.

[7]The report is available from the U.S. Government, General Accounting Office. "Federal Productivity Suffers Because Word Processing Is Not Well-Managed", April, 1979. FG MSD -79-17.

[8]While I cannot specify the source of the phrase "technological path", I am reasonably certain that I did not coin the term. As noted in the text, the idea for this analysis was suggested by David Noble.

[9]A full statement of these concepts about the management control process is provided by the text. Robert N. Anthony and John Dearden. Management Control Systems: Text and Cases (3rd ed.) Homewood, Illinois: R.D. Irwin, 1976.

[10]Recent analysis suggests that unemployment is a natural consequence of the type of jobs in our economy. The more general conception identifies two types of jobs in our economy: primary-sector jobs with good pay, working conditions, and employment stability and secondary-sector jobs with the opposite characteristics. For an introduction to this analysis see Michael J. Piore (ed.) Unemployment and Inflation: Institutionalist and Structuralist Views. New York: M.E. Sharpe, 1979.

[11]Unfortunately, the potential physical and mental health consequences of office automation have been little-researched. The possible effects are eye strain, back strain, radiation, boredom, and the various abuses associated with tension (accumulation of nicotine, caffein, alcohol, and other drugs; overeating, depression, high blood pressure, and suicide). My present concern is based on anecdotal evidence and the growing body of research on health consequences of negative working conditions in general. Clearly what is vital here is empirical research to test the validity of these concerns.

[12]Chris Argyris has long been associated with this critique of work organizations and professional education. One starting point for the interested reader is "Double-Loop Learning in Organizations", Harvard Business Review. March-April 1977, Vol. 55, No. 5, pp. 111-125.

[13]See Richard J. Matteis, "The New Back Office Focuses on Customer Service", Harvard Business Review. March-April 1979, Vol. 57, No. 2, pp. 146-159.

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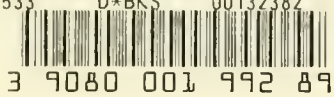
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Barocci, Thoma/Collective bargaining a
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HD28.M414 no.1123- 80
Katz, Ralph. /Project performance and
739554 D*BKS 00132646

3 9080 001 996 138

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Van Maanen, Jo/An occupation in transi
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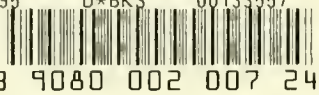
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Driscoll, Jame/Office automation :
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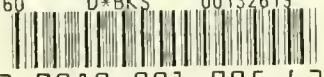
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