IMPACT OF OFFICE AUTOMATION ON SOCIETY:

Implications for Education, Policy and Research

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Leadership. It is also possible that what are generally considered to be good qualities of 'leadership' may be significantly altered. If face-to-face communication is replaced by electronic mail and computerized conferencing, leadership qualities attributed to physical appearance will be less important [21]. This has implications for opportunities for women, minorities, and especially the handicapped in managerial roles.

Quality of Life. On a broader scale, office automation has implications for the quality of life in general. Improved organizational efficiency may result in more leisure time, at least for the white-collar work force. When we realize that, through communications, the workplace can be expanded from 9-to-5 at a central place to 24 hours a day at any location, the flexibility provided can significantly improve the quality of leisure time even if the total amount of leisure time is not increased. Not having to commute every day would immediately improve the quality of life for many people! On the other hand, there may be important negative consequences of this trend, in the form of decreased social contacts and increased isolationism.

At this level there can also be indirect productivity benefits. It has been suggested [16] that "the main partners sharing in the benefits of information automation are the public." Less time spent waiting in lines for airline reservations, bank transactions, and supermarket checkout "contribute directly to the convenience, quality, and richness of our lives." The efficiency of such everyday activity is, in part, why the U.S. has higher overall productivity per capita than much of the world [29]. Thus, the real beneficiary of office automation may be the consumer, an aspect that is not easily incorporated into a cost/benefit analysis but nevertheless may be more important than any changes in internal office functioning.

This movement toward computer-augmented services is occurring in many areas outside the office. Airline reservation systems were the first of a growing number of transaction-driven systems which provide "one-stop" customer service [17]. These systems use the computer for all the customer support activities needed by the customer representative. In some cases such as automatic bank teller terminals, the human intermediary has disappeared completely [2]. These systems are increasingly being used as competitive services which companies must offer to maintain their market share in an industry, even if there are no direct productivity gains. Hence we may see newer technologies being adapted faster than expected, at least for customer service, as firms fight to increase or maintain their market share.

Some Historical Examples

Industrial Revolution and Beyond. At first glance, it may seem that our predictions are exaggerated. But there are historical precedents for the effects of technology on society. Some have referred to the new trend as the "Information Revolution" [32], implying that it will be as revolutionary for the white-collar work force as the Industrial Revolution was for blue-collar industries. Going back even further, we can guess that when the printing press was invented, no one realized what a significant contribution it would make to the development of culture.

The last century has seen numerous significant developments whose real impacts were not at all well understood before they began to be actually felt. Alexander Graham Bell would have been extremely surprised to find two or three telephones in every American home. The automobile drastically changed the community and social structure of the U.S.

Recent Developments. The electric typewriter, copy machine, and computer were all typically introduced into organizations for the express purpose of improving the efficiency of existing practices. Changes in the fundamental nature of business processes, influenced by the new technologies, happened slowly and were unplanned and often unanticipated. For instance, the computer and copy machine encouraged the proliferation of paperwork, and a 'need' developed because of the new capabilities. Today, many organizations could not cope with their internal transaction processing if the computer 'went down' and they had to return to manual processing.

Recent trends directly affect the quality of life of the consumer. Television affects our leisure time as well as our views of the world and the speed with which we learn about world events. Most recently, electronic funds transfer systems will, and are already beginning to, change the way we 'barter' for goods and services and manage money transfers.

Employment. What about the effect of new technology, especially the computer, on employment? Organizations did not often experience the anticipated decreases in employment levels when computers were introduced, and in fact the white-collar labor force has been increasing steadily [18]. However, there have been shifts in employment requirements to more technical jobs. For instance, in 1960 there were 13,000 computer specialists in the U.S.; by 1970 there were 258,000 [13]. Today we are all well aware of the shortage of trained computer specialists while the overall unemployment rate continues to be high.

With office automation, similar dramatic changes are likely to occur. It is our belief that if we can study and understand these changes before they become widespread, we can design the new technology to emphasize positive impacts and minimize detrimental effects on organizations and society in general.

Research on Social Impacts
Sample Hypotheses

We believe the research on broader impacts of office automation has so far been inadequate. Continuing research should address specific questions of employment levels, job/role definitions, and quality of work life as they relate to the new technologies. Currently, the same pattern is occurring as did with early computers; systems are being installed haphazardly and without full knowledge of their potential positive or negative consequences. Although some early successes have been reported [12, 14, 42, 43], most companies are struggling to control the proliferation of non-integrated word processing equipment and not planning adequately for future needs.

As a start at formalizing the work that needs to be done, we suggest several researchable hypotheses. In the next section we discuss several methodologies that are applicable to this type of research. Our hypotheses are all related to the organizational level, but similar hypotheses can be generated for broader levels of impact.

Impact on Productivity.

H1: With the introduction of office automation, the overall productivity of the organization will increase in proportion to the number of white collar workers (both management and support personnel).

We are careful not to predict direct decreases in white-collar employees, since new jobs will be created as old ones disappear. We also do not predict that the increases in productivity will be attributed to specific jobs, since some jobs will actually decrease in productivity and some will disappear. We do predict, however, that overall organizational performance will be more effective (i.e. productive) with the wide-scale acceptance of the automated office. The next two hypotheses deal with the supportive component of the organization.

Impact on Support Staff.

H2: The introduction of office automation will have a substantial structural impact on clerical employees, with many current jobs disappearing and a whole new set of job skills emerging.

H3: The introduction of office automation will lead to substantial productivity increases in certain task categories of the support component of the organization.

We predict that structural changes in clerical jobs will take place even if no overall productivity increases occur (H1). First, the role of information specialist will emerge, with finer degrees of specialization even within that category. Generally speaking, most clerical jobs will require more skills and specialized training than the lowest-level clerical jobs today. A whole class of clerical jobs, such as file clerks, bookkeepers, and timekeeping clerks, should disappear. On the other side, a hierarchical management structure of administrative support personnel

will develop. This, and the proliferation of specialized skill requirements for different functions, will provide career advancement opportunities for office support workers that never existed before.

The predicted employment shifts have rippling effects on employment in general as well as current educational requirements. It has been pointed out [13] that precisely those positions which we predict are most likely to disappear have grown the most in the last decades. From 1960 to 1970, the number of file clerks increased 141 percent, while bank tellers and cashiers increased 101 percent. Receptionists and secretaries increased by 97 and 86 percent, respectively. What will happen when these job definitions are restructured, especially with the growing female work force presently occupying primarily these jobs? What happens to the unskilled, especially female, worker?

Even though job definitions may change, many typical office jobs still need to be done. However, they will be done differently and, in many cases, much more productively. Typing and filing are two good examples. Filing may become such a simple 'button-pushing' task that it will be a by-product of other work. Typing, especially editting and modifying documents, will be much more efficient. As a result, fewer people will be needed to do these tasks and/or they will be incorporated into other roles. It is important to note that demonstrating productivity gains in these areas, though easy to do and commonly used to justify new office systems today, does not necessarily lead to increased organizational productivity overall (H1). Early studies of word processing have already shown this to be the case [11].

Managerial Impacts. The next three hypotheses focus on the managerial component.

> H4: Although the job of managing may not change as dramatically as office support jobs, office automation will significantly effect the methods managers use to do their jobs.
>
> H5: The introduction of office automation will permit an increase in the span of control of middle managers.
>
> H6: The introduction of office automation will cause the ratio of non-specialized managers to specialized managers to decline.

It is expected that, although managers will carry out the same tasks of decision-making and control, they will be able to accomplish them more efficiently, thus leading to an increase in the typical manager's span of control. It follows, of course, that there will be a decrease in the absolute numbers of middle managers required. The support staff for a manager will generally be information specialists, whereas today the typical manager would also have specialists in his or her respective functional area. The need for functional specialization in a support role should decrease; the middle manager will take on the required functional specialization with the aid of specialists in supplying the appropriate information.

Earlier Predictions. In the early 1970's, several researchers (notably Whisler [41]), made similar predictions about the impact of computers in the organization. The last decade has shown us that many of these predictions did not come true. Whisler, for instance, predicted that the introduction of a computer into an organization would result in a decrease in the number of middle managers. Although he found some support for this hypothesis in a sample of insurance companies, many studies since have had contradictory findings [10, 38, 39]. One study even showed an increase in both the absolute number and the number of levels of middle managers with the introduction of a computer [6].

We do not intend to be quite so firm with our sample hypotheses. At this stage, we are trying to suggest areas of possible impact, in order to guide further theory development as well as empirical research. Our sample hypotheses are meant to serve as examples of areas needing further study.

Suggested Methodologies for Research

Questions such as those reflected by our sample hypotheses should be investigated at a very early stage (now!) before the new technology proliferates with unexpected negative consequences. However, traditional methodologies such as cross-sectional and 'before-after' studies in multiple organizations are difficult, both because of a lack of common system components to evaluate across organizations and because at this point there are few systems to study at all.

We suggest several alternative methodologies based on systematically collecting data regarding the current state of affairs and projecting it into the future under varying conditions. These methodologies, including techniques for data collection, are briefly discussed below.

Modelling. There are several methods of modelling that aid in understanding the relationships among variables affected by office automation. Simulation and econometric modelling seem to hold the most promise. The main challenge at this point is to include all relevant variables and properly define them. Classes of variables should be examined on at least three levels: organizational, community, and national.

The secondary challenge for modelling approaches is collecting the appropriate data about current conditions and attitudes at the organizational, community and national levels. Some data collection techniques are discussed below.

Input-Output Analysis. A recently completed study funded jointly by the Department of Commerce and National Science Foundation [34] shows significant shifts in the GNP and labor force toward information 'industries' and makes numerous 'information policy' recommendations. A related modelling effort might project his data over the long-term with continued changes in this direction.

The Bureau of Labor Statistics will soon release a survey of the 1975 economy with a 190x190 industry input-output matrix, including a breakdown of each industry by occupation. This data could be used for predicting the long-term effects of different productivity changes on different occupations. The occupational breakdown of an industry could be used to predict the productivity effects of office automation on that industry. The long-term impacts of these effects can then be estimated (ceteris paribus) using conventional input-output analysis [34].

Case Studies. Although the new technologies are not sufficiently widespread to permit cross-sectional analysis, there are a number of organizations that have implemented some form of office automation focussing on a particular aspect such as electronic mail. We can do systematic case studies in order to identify and understand how it has affected productivity (both individual and nation-wide), the structure of the work-place, and the quality of life. Some potential sites for case studies of electronic mail are:

- Citibank
- DARCOM
- Yankee Group
- Texas Instruments
- IBM prototype

Although case studies have been done in all of these organizations they have generally focussed on evaluating individual productivity measures and demonstrable cost-savings. We suggest a historical approach which includes a broader perspective. We would focus on such questions as:

1. What new job definitions have been developed since the implementation of office automation?
2. What job categories have decreased, both in actual numbers and in proportion to the overall work force? What job categories have increased?
3. What is the average middle manager's span of control? Has it changed since implementation of the new system?

The users of the systems would be asked to respond to fairly specific, objective questions about their patterns of work.

1. What is your workday schedule? has it changed since the implementation of the new system?

2. Do you commute? Do you make regular trips to the 'office'? Have these increased or decreased? What about time in meetings, or travelling - have these been affected?

The general contribution to knowledge from case studies is to validate predictions about the effects of office automation. Any hard 'data' that can be collected can provide base line figures and help to validate the modelling efforts already suggested.

Other types of systems can be evaluated through case studies. Computerized conferencing, a similar but more formalized communications tool than electronic mail, can be studied [21]. It has already been suggested [21] that implementation of computerized conferencing affects not only work-hours and travel time, but leadership qualities as well. Outward signs of leadership and power (attractiveness, loud voice, etc) do not help a person dominate a computerized conference; advantages to the handicapped, for instance, may be significant.

There are a few examples where case studies can be performed at a community level. Columbus Ohio is involved in an experiment with a limited feedback mechanism to television networks that has proved useful for opinion polling and ratings. Such systems have broad implications for education in the home and for voting. Data can now be gathered on not only peoples' attitudes toward these systems, but how their work and leisure time habits may have been affected.

Viewdata, an 'information service' available to the home through the television screen, is now being used experimentally in England and might provide a rich testing ground for community and national-level effects of bringing information services into the home [1]. A similar service, called Teletext, is now being offered in Salt Lake City, Utah.

Delphi Techniques. Delphi is a technique for eliciting opinions and information from multiple experts on a particular subject while minimizing the undue influence of more forceful participants [26]. Delphi could be used very effectively to arrive at a consensus among 'futurists' regarding the future structure of work and community organizations. This is one method of collecting the appropriate definitions to be used in a modelling effort.

Sociometric Analysis. This technique, which is typically used to determine 'information-handlers' and 'leaders' in group decision-making, can be applied to analysis of communications patterns in organizations. The number, length and subject class of communication between superiors and subordinates, peers in different functional areas, etc. can be analyzed either through diaries and/or objective observation or, in the case of electronic mail, through analyses of stored messages. It has been predicted [12] that electronic mail will increase upward communication flow. There has also been some evidence of increased interdepartmental communication [43]. This implies that experts with information or skills that are valuable to other organization members would be more accessible, causing greater diffusion of specialized knowledge and/or increasing the power of the expert role.

Analysis of Organization Structure and Climate. We have already predicted that structural changes will occur in organizations, at least in the subsystem of administrative support. Ideally, long-term studies of organization structure before and after the introduction of office automation would provide meaningful information regarding structural changes. The 'before' measures should be taken now. This information should also help us identify those organizational characteristics that predispose an organization to use of automated office systems.

'Organization structure' refers to regularities in configuration that permit ongoing organizational activity. Numerous methods for measuring characteristics of organization structure are available: centralization of authority, standardization, and formalization [36], complexity [20], and integration and differentiation [23].

'Organization climate' measures focus on whether the organizational structure is a psychologically meaningful environment for the organization member [30]. Typical dimensions of organizational climate are: individual autonomy, degree of structure imposed on the position, reward orientation, consideration, warmth, and support [30]. Climate can be measured subjectively [25, 37] or through objective measures of 'critical incidents' such as turnover and absenteeism [5, 31].

Attitude Surveys. We believe that now, before office automation proliferates, is an appropriate time to assess people's attitudes about their jobs across many job categories. This will afford the opportunity to design new systems that eliminate or improve the quality of jobs that are highly unsatisfying, stressful, etc., while protecting those jobs that are rated highly from adverse effects. It has already been suggested that worker attitudes be measured in an intra-organizational setting or case study. Here it is suggested that attitudes be surveyed across multiple organizations, focusing on those job categories that are most likely to be affected by office automation. The following types of attitude measures are suggested:

1. Job satisfaction [19, 35]

2. Role conflict / role ambiguity [22]

3. Stress [27]

4. "Quality of life"

New Productivity Analysis. In order to get a true picture of the effects of office automation on society as a whole, it is imperative that we broaden our definition of productivity and develop new measures to assess it. Giuliano [16] suggests the following productivity factors that involve both information workers and those served by them:

1. Better utilization of human resources for human tasks

2. Decisions that are better and faster, and take into account more complex factors

3. Jobs that have potential for more personal involvement and creativity

4. Better products and services

5. A better chance to compete for the organization as a whole

6. Higher quality of life

Work measurements of specific tasks and cost analyses of time saved by eliminating them is clearly not adequate to assess the true productivity gains resulting from the new technology. Individuals in organizations must be viewed _in toto_, so that their productivity is reflected by their contribution to overall organizational effectiveness. A clear challenge to researchers is to develop adequate measures of overall productivity, which include all the potential benefits.

Motivation for Research on Social Impacts

We believe there are several important reasons why research on social impacts of office automation is urgent now, before it is implemented on a wide scale. The areas that will be affected include: education, policy, international trade, new product development, and social responsibility.

Implications for Education. One can see from the foregoing discussion that if the new technology proliferates unchecked, there may be a decrease in opportunities for unskilled workers. Educators have a clear challenge to begin to prepare the future work force in new skills to fill the position of 'information specialist'. We should also be prepared to retrain those workers in unskilled jobs for the transition. Few people in office support jobs have training in management skills, and yet a whole new hierarchy of management jobs will emerge, most likely to be filled by these same people. Finally, we should expand the training of those who will be designing automated office systems. The typical systems analyst today focuses on technical criteria; the designer of the new systems will need to understand organization design and organizational behavior as well, in order to design more 'human-oriented', flexible systems.

Policy Issues. Porat [34] suggests that government policy regarding the information industries is inadequate because it is restricted to vertical problems rather than the (horizontal) effect of information technology across all other sectors of the economy. He suggests establishment of a national information policy addressing "economic or social conflict engendered by the introduction of new information technology applications." Office automation is a case in point. It affects, for instance, privacy of information, national employment and welfare, transportation planning, and community planning, to name a few. Toffler [40] has suggested requiring 'impact statements' that address all areas of the economy and society that may be affected before a new technology is introduced.

International Trade Issues. The United States has had international trade problems for the last ten years. Many of these problems stem directly from the fact that productivity has been rising faster in other nations than it has in the U.S. One area where the U.S. still has a lead over many of its trading partners is in the area of computer and communications technologies. Intelligently used, these technologies may be able to pull many other industries forward. This is becoming increasingly important with the rapid redistribution of wealth due to the OPEC nations.

New Product Development. Typically, new technologies are developed more because the capability exists rather than to fill a real need. We hope that examination of the potential impacts of office automation can provide guidelines for new product development. Organizations with a large research and development component would greatly value any information that forecast future needs.

Social Responsibility. Having good forecasts against which to develop new products should also help to raise an organization's sense of social responsibility. Business organizations need to be motivated to develop new products and techniques that improve the quality of life in general, rather than concentrating on short-term profits. Research such as that suggested here does not guarantee that all potentially adverse impacts of office automation will be identified. However, businesses can take the responsibility to design automated office systems that minimize those negative affects that are identified. This challenge does not only affect the companies that produce automated office equipment, because it can also be implemented in ways that are either positive or negative regardless of functional components. System designers have the direct responsibility for, and should be rewarded for, designing systems to enrich peoples' jobs rather than de-enrich them.

Summary and Conclusions

In this paper we have attempted to raise some important issues of the broad impacts of office automation on society as a whole. We see a clear need for organizations to broaden their scope of planning for automated office systems, so that it includes extensive retraining of personnel, changes in organization structure, and even geographical reorganization. To those in education, there are challenges today to educate people for new skills and professions in information that do not yet exist. There is also the challenge to researchers to collect 'hard' data on the quality of work and life today and project it onto future dangers and opportunities in the light of the new technology. Finally, there is a challenge to the 'information industry' in general, to take the responsibility to examine the potential impacts of this new technology as part of the development process, and to view 'quality of life' improvements as an important parameter in the design of new systems.

The 'office of the future' can affect our lives negatively or positively. It is the responsibility of all involved to be aware of the many complex issues raised by these new technologies. A new revolution is almost upon us with the potential for dramatic societal impacts. It will take foresight and planning in order to usher in this new environment with as little dislocation as possible. The potential exists for these new

technologies to dramatically improve the quality of life, both on and off the job. Unfortunately, many pitfalls also exist which may be very easy to fall into. Much research must be done now in order to be prepared for the rapid changes which will inevitably come.

REFERENCES

1. Advertising Age, April 23, 1979, p. 94.

2. American Banker, July 9, 1979, p. 9.

3. Argyris, Chris, "Management Information Systems: The Challenge to Rationality and Emotionality," Management Science, February 1971.

4. Bair, James H., "Communication in the Office of the Future: Where the Real Payoffs May Be," SRI International Working Paper, September, 1978.

5. Barker, R. G. "Explorations in Ecological Psychology", American Psychologist, Volume 20, 1965.

6. Blau, Peter M., Cecilia McHugh Falbe, William McKinley, and Phelps K. Tracy, "Technology and Organization in Manufacturing," Administrative Science Quarterly, Volume 21, March 1976.

7. Carlisle, James H., "The Management Communication and Control of Office Automation," paper presented at the Infotech State of the Art Conference on "Convergence: Computers, Communications, and Office Automation," Paris, France, October 1978.

8. _____, "Evaluating the Impact of Office Automation and Top Management Communications," AFIPS National Computer Conference Preceedings, Montvale, N.J., 1976, pp.611-616.

9. Connell, John J., "The Office of the Future," Journal of Systems Management, February, 1979.

10. Delehanty, George E., "Computers and the Organizational Structure in Life Insurance Firms: The External and Internal Economic Environment," in Charles A. Myers, Editor, The Impact of Computers on Management, Cambridge: MIT Press, 1967.

11. Driscoll, James W., "People and the Automated Office," Datamation, Volume 25 (12), November 1979.

12. EDP Analyzer, "The Automated Office: Part I," Volume 16 (9), September, 1978.

13. Electronic Mail and Message Systems Newsletter, Volume 3 (22), November 15, 1979.

14. Engel, G. H., J. Groppuso, R. A. Lowenstein, and W. G. Traub, "An Office Communications System," IBM Systems Journal, Volume 18 (3), 1979.

15. Ernst, Martin L., "Productivity in New Forms," Special Advertising Section, Time Magazine, November 1979.

16. Giuliano, Dr. Vincent, "Partners for Profit in the Information Society," Special Advertising Section, Time Magazine, November 1979.

17. Gosden, John, "The Future of Office Automation: The 'IWIN' Philosophy", talk presented at New York University, December 1979.

18. Guzzardi, Walter, "Demography's Good News for the Eighties", Fortune, November 5, 1979.

19. Hackman, J. Richard and Greg R. Oldham, "Motivation through the Design of Work: Test of a Theory," Technical Report 6, Department of Administrative Sciences, Yale University, December 1974.

20. Hage, Jerald, and Michael Aiken, Social Change in Complex Organizations, New York: Random House, 1970.

21. Hiltz, Starr Roxanne and Murray Turoff, The Network Nation, Reading, MA: Addison-Wesley, 1979.

22. Kahn, R. L., D. M. Wolfe, J. E. Snoek, and R. A. Rosenthal, Organizational Stress: Studies in Role Conflict and Ambiguity, New York: Wiley, 1964.

23. Lawrence, Paul R. and Jay W. Lorsch, Organization and Environment: Managing Differentiation and Integration, Homewood, Illinois: Richard D. Irwin, 1969.

24. Leavitt, Harold J., and Thomas L. Whisler, "Management in the 1980's," Harvard Business Review, November-December 1958.

25. Litwin, G. H. and R. A. Stringer, Motivation and Organizational Climate, Cambridge: Harvard University, 1968.

26. MacCrimmon, Kenneth R. and Ronald N. Taylor, "Decision Making and Problem Solving," in Marvin D. Dunnette, Editor, Handbook of Industrial and Organizational Psychology, Chicago: Rand-McNally, 1976.

27. McGrath, J. E. (Ed.), Social and Psychological Factors in Stress, New York: Holt, Rinehart, and Winston, 1970.

28. Mintzberg, Henry, The Nature of Managerial Work, Harper and Row, 1973.

29. Newsweek, "Innovation: Has America Lost Its Edge?" June 4, 1979, p. 58.

30. Payne, R. L., "Organizational Climate: The Concept and Some Research Findings," Prakseologia, NR 39/40/ROK, 1971.

31. Payne, Roy and Derek S. Pugh, "Organizational Structure and Climate," in Marvin D. Dunnette, Editor, Handbook of Organizational and Industrial Psychology, Chicago: Rand-McNally, 1976.

32. Poppel, Harvey, "The Information Revolution: Winners and Losers," Harvard Business Review, January-February 1978.

33. _____, The Automated Office Moves In, Datamation Special Issue, December 1979.

34. Porat, M., The Information Economy: Definition and Measurement, Volume 1, U.S. Department of Commerce/Office of Telecommunications, May 1977.

35. Porter, L. W. and E. E. Lawler, Managerial Attitudes and Performance, Homewood, Ill: Dorsey Press, 1968.

36. Pugh, D. S., D. J. Hickson, C. R. Hinings, and C. Turner, "Dimensions of Organization Structure," Administrative Science Quarterly, Volume 13, June 1968.

37. Stern, G. G., People in Context: Measuring Person-Environment Congruence in Education and Industry, New York: Wiley, 1970.

38. Stewart, Rosemary, How Computers Affect Management, Cambridge: MIT Press, 1971.

39. Stone, Derek, "Changes in Organizational Design Induced by the Introduction of Computerized Information Systems: A Longitudinal Study in the Electricity Industry," in E. Grochla and N. Szyperski, Editors, Information Systems and Organizational Structure, Berlin, New York: Walter de Gruyter, 1975.

40. Toffler, Alvin, Future Shock, New York: Random House, 1970.

41. Whisler, Thomas L., The Impact of Computers on Organizations, New York: Praeger, 1970.

42. White, Robert B., "A Prototype for the Automated Office," Datamation, April 1977.

43. The Yankee Group, Report on Electronic Mail, November 1979.