A RAND NOTE

ADVANCED OFFICE SYSTEMS: AN EMPIRICAL LOOK AT UTILIZATION AND SATISFACTION

T. K. Bikson, B. A. Gutek

February 1983

N-1970-NSF

Prepared for

The National Science Foundation

35th Year

Rand
SANTA MONICA, CA 90406

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PREFACE

The research reported in this Note[1] is part of a two-year, still-in-progress, study titled "Implementing Computerized Procedures in Office Settings: Influences and Outcomes" (T. K. Bikson, Principal Investigator). The effort is supported by Grant No. ISI-8110792 from the National Science Foundation's Division of Industrial Science and Technological Innovation (Productivity Improvement Research Section). The project when complete will constitute a unique empirical effort to understand how human and organizational factors affect the implementation of information technology in diverse white collar work environments.

While the study's focus--computer-mediated information work--represents a relatively new direction for Rand, it rests on a conceptual and methodological framework developed and successfully deployed to address related questions in a range of previous studies. More specifically, the study augments prior Rand research on innovation and technological change in educational institutions and public service agencies (see Bibliography, Bikson et al., 1981, for a review of this work).

Although the findings-to-date are interim, the authors believe that they will be of interest to public and private sector decisionmakers involved in the introduction of information technology in white collar work. This Note should be of equal interest for research and policy in the more general area of technological innovation, implementation processes, and planned organizational change.

[1]A Note is used to publish a study's findings other than the final project output.

SUMMARY

Preliminary research findings from a study of advanced office systems in varied user contexts are summarized here. The study, funded by the National Science Foundation's Productivity Improvement Research Section, is intended to identify major factors that affect the integration of information technology into white collar work. Fifty-five offices participated; they range in size from 4 to 37 employees and represent 26 different organizations varying from very small to multinational operations. The data reported here, which come from the first set of questionnaires administered to 530 employees in the 55 offices, represent preliminary results. Thus, conclusions should be regarded as tentative and susceptible to modification by the results of later samples.

Several outcomes relevant to the implementation of advanced office systems emerged from early analyses: (1) White collar offices can be classified into four types: management and administration; data-oriented professional; text-oriented professional; and support staff. (2) White collar work forms systematic clusters of information-handling activities, some of which are performed by nearly everyone in an organization. (3) A large percentage of employees, including senior managers and professionals, already use computers in their work and most nonusers expect to do so in the future. (4) Four aspects of computer systems underlie user satisfaction: functionality, equipment performance, interaction features, and office environment. (5) Among these, satisfaction with functionality is the best predictor of use of the system. (6) The most important organizational influences on use of and satisfaction with information technology are variety in work and the organization's approach to technological change. A final report will pursue these issues in more detail.

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T. K. Bikson and B. A. Gutek
The Rand Corporation

INTRODUCTION

Preliminary research findings from a study of advanced office systems in varied user contexts are presented here. The research was funded by the National Science Foundation's Productivity Improvement Research Section; its goal is to identify major factors that determine how information technology is incorporated into white collar work.

A general understanding of how advanced office systems affect white collar work is urgently needed (see Bikson, 1981, for a more detailed account of these issues):

- White collar employees, who already constitute more than 50 percent of the nation's labor force, are its most rapidly growing subpopulation. And within any organization, whether product- or service-oriented, "office work" is highly labor intensive and relatively costly.

- Of the estimated 3.5 million offices in the U.S., about 1.5 million are currently large enough for some sort of advanced information system. That figure will increase as small flexible systems become more available and entry costs decline.

- Although computer technology is viewed as a way to improve productivity and decrease labor costs, very little is known about either the nature of white collar work or information systems in that context.

Consequently, we undertook a study of how computerized procedures are being introduced in private sector office settings where users are not computer experts. A fundamental idea guiding the study was that the sequence of implementation decisions--decisions about the kind of system to introduce and especially about how to introduce it--would significantly affect the outcomes of the effort. That is, they would have important short-term implications for utilization and satisfaction, with long-term impact on organizations and their productivity. Our basic research questions were:

(1) What is the nature of white collar work, and into what patterns do its tasks fall?

(2) Who is using computers in office work, and what kinds of procedures are being computerized?

(3) What do users like and not like about their computer systems? Do certain features of the systems and their implementation predict users' reactions?

(4) Are there any organizational characteristics that affect the implementation of an information system?

For purposes of this research, office settings were defined as organized white collar work units of four or more employees. Depending on the firm, these units may be called "departments," "teams," "sections," and the like. But all the units have a *skill mix* that may range from senior executive to entry level clerk, and all have *information handling* as a chief responsibility.

The advanced information technology of interest in this setting is the multifunction interactive computer system deployed to replace or enhance traditional office tasks. By *multifunction* we mean that the system is appropriate for a variety of white collar tasks; by *interactive* we mean that to some extent the user guides the system's activities online. The technological focus is broad, encompassing both standalone computers and multiple terminals linked to mainframe computers, as well as a number of intermediate architectures.

To examine the implementation of advanced office systems, we solicited the cooperation of organizations in which such technology had been installed for at least six months (a minimal period for overcoming initial equipment and transition difficulties). In each participating office we administered a survey to all members of the work group, whether or not they interacted directly with the computer. The survey inquired about information handling tasks, computer system features and usage, and effects on work. In addition, the survey included a number of standard measures of organization characteristics.

To supplement the survey information, we also collected descriptions of computer equipment and software, and related staffing and budgeting patterns. Finally we conducted a structured interview with the individual responsible for managing the work group.

Outcomes reported here are based on of the survey data, with interview responses used to guide their interpretation. Information from the interview protocols and other descriptive data have yet to be examined analytically in any detail. The basic findings are:

- White collar work can be analyzed in terms of systematic clusters of information-handling activities; some of these tasks are performed by nearly everyone in the organizational hierarchy.
- White collar workers are well educated and typically have some keyboarding skill; a substantial minority have had some contact with a computer in prior jobs.
- A large percentage of senior managers and professionals already use computers in their work, and most nonusers expect to do so in the near future.
- Four summary dimensions underlie users' satisfaction with their systems: functionality, equipment performance, system interaction, and office environment.
- Users are generally pleased with their system's functionality but give low ratings to the office environment and to some aspects of system interaction such as user manuals.
- Users believe that the technology has positive effects on the quality of their work and also on their productivity.
- User satisfaction with functionality is the best predictor of system utilization; functionality coupled with an adequate office environment constitutes the best predictor of overall satisfaction with the new technology.
- Key organizational determinants of employees' use of and satisfaction with technology are variety in work and the organization's approach to technological change.

Below we discuss the survey and its results in detail.

RESEARCH PARTICIPANTS

Table 1 characterizes the research sample. Fifty-five offices, representing 26 different organizations, participated in the research. The organizations ranged from as few as 10 employees to multinational operations. About half were engaged in manufacturing. The remainder provided a variety of services such as public information, financial management, research, and banking.

Table 1

CHARACTERISTICS OF THE RESEARCH SAMPLE

- o 26 Organizations
  - 50% manufacturing
  - 50% service
- o 55 Work Groups
  - 24% management, administration
  - 29% professional, text-oriented
  - 20% professional, data-oriented
  - 27% secretarial, clerical, technical support
- o 530 Surveyed Employees

The sample is not a random one; thus, it is *not* representative of office work groups in general. Rather, organizations were selected because they are early adopters of new technology. They either volunteered to participate or agreed to do so when asked. Nevertheless, the sample is diverse and shows the range of office functions that may involve computer use.

The focal point of the study is the work group rather than the individual. A work group is a group of four or more employees who share an information handling function--for example, writing and editing text, or preparing economic forecasts. The group might contain workers from several different occupations--for example, a writer, a manager, and a secretary. A group focus is appropriate because we are interested in how computer systems are implemented to assist certain white collar work functions rather than in how secretaries or managers or professionals, as individuals, use such systems.

The fifty-five work groups in our sample can be classified by organizational mission as follows:

- *Management and administration*, including personnel, contracts and grants, and financial management (Group I).

- *Text-oriented professionals*, including public information, law, report writing and editing (Group II).

- *Data-oriented professionals*, including economic modeling and forecasting, engineering design, and systems analysis (Group III).

- *Secretarial, clerical, and technical support*, including reservations, payroll, order entry, and inventory control (Group IV).

The work groups ranged in size from 4 to 37; the average size was 10.[1] While we cannot yet make causal inferences, it is interesting to note that in comparison with national data about white collar work, these groups contain a substantially smaller proportion of support staff relative to professionals and managers (see *Scientific American,* September 1982).

As Table 2 shows, the office employees in this sample are well educated.[2] Almost a third have a graduate degree of some kind; only 16 percent have never attended college. These data suggest that implementing a computer system in an office with a work force of this kind should not be viewed as parallel to factory automation of a century ago, where poorly educated workers performed routine, low-level tasks.[3] Indeed, we found that the variety in work permitted by an office system was a significant predictor of its use and success.

Almost half these workers can keyboard quickly, and a sizable proportion have had some contact with a computer in a previous job. However, as Table 3 shows, background varies considerably by work group

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[1] Preliminary analyses reported below relied on a hierarchical design, examining individuals within work groups and work groups within the type of group to which they belonged.

[2] Because of rounding, not all of the percentages in the tables total exactly 100.0 percent.

[3] Some open-ended comments in the survey suggest, however, that computer systems are being implemented in some offices as if the office workers were capable of performing only routine tasks. Workers complain that training sessions explain only key functions rather than describing the system function. As a result, new users do not know enough about the system's real capabilities to exploit them efficiently or to solve problems when they arise.

Table 2

EDUCATION LEVEL OF EMPLOYEES

Education	*Percent*
Less than high school	0.2
High school	16.1
Some college	33.8
College degree	19.5
Masters or other equivalent degree	24.2
Ph.D., M.D. or equivalent degree	6.2

type. For example, none of the support group had regular prior experience with a computer, while one-third of the data-oriented professionals had. The most proficient typists belong to the management/administration and to the text-oriented professional groups.

Table 3

PREVIOUS KEYBOARD EXPERIENCE
(percent of employees)

	Overall Percent	Group I Percent	Group II Percent	Group III Percent	Group IV Percent
Before coming to this office, did your work involve using computers?					
Not at all	53.4	61.3	51.1	42.4	75.0
Occasionally	24.2	19.3	33.8	24.2	25.0
Regularly	22.4	19.3	15.0	33.3	0.0
Which of the following best describes your proficiency in keyboarding or typing?					
Not at all	0.9	1.0	0.0	1.0	0.0
A few fingers, slowly	8.5	9.9	6.7	11.1	0.0
A few fingers, quickly	16.6	12.4	12.6	24.2	0.0
Touch typing, slowly	25.5	19.0	23.0	32.3	50.0
Touch typing, quickly	48.5	57.9	57.8	31.3	50.0

Key to Groups: I = Management, administration
II = Text-oriented professionals
III = Data-oriented professionals
IV = Support staff

WHAT INFORMATION WORKERS DO

One of the research goals was to learn what kinds of tasks information workers perform. We wanted to know whether these tasks fall into clusters that could become focal points in implementing information systems. In addition, we wanted to identify any tasks, or clusters of tasks, which virtually everyone--from managers to clerks--performs.

We asked our respondents whether or not they performed each of 17 different activities; we chose these activities because they are thought to occur frequently in white collar work and because they may be done with or without a terminal. Table 4 organizes the answers. Some tasks are performed by almost everyone; for example, the majority of workers in the sample at least occasionally write original material, proofread and correct, edit and rewrite, and maintain files. The tasks least widely performed are maintaining an inventory and programming.[4]

To determine whether the 17 different tasks formed clusters, we used a factor analysis procedure. Factor analysis determines statistically whether some tasks are usually done in conjunction with others.[5] This analysis generated four groups out of the 17 tasks (two tasks--administrative support and statistical computation--figure in two different groups). These task groups are shown in Table 4 along with the *factor loadings*. These numbers, given in parentheses after each of the tasks, show the strength of each item; the higher the factor loading, the more central that task is to the factor. For example, programming and maintaining a database are more central to Factor 3 than is statistical computation. Together the four factors account for about 60 percent of the variation in office work.

The factor analysis shows that white collar employees tend to perform groups of tasks. For example, people who write original material also proofread and edit, but they tend not to program, maintain a database, or do statistical computation.

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[4] Groups for whom programming was a central function were not included in the research project.

[5] An orthogonal varimax rotation was employed, and only factors with an eigenvalue > 1 were accepted. Subsequently we used factor scores as values for the generic activity variables defined by the four dimensions.

Table 4

INFORMATION-RELATED ACTIVITIES
of
OFFICE EMPLOYEES
(percent who do each)

	Overall Percent	Group I Percent	Group II Percent	Group III Percent	Group IV Percent
Activities: Factor 1					
Maintain files (.71)	56.9	58.5	48.5	55.6	64.3
Handle messages (.65)	48.5	53.7	36.8	37.4	62.9
Fill in forms (.62)	47.7	51.2	32.3	43.4	62.2
Process records (.59)	28.1	39.8	14.0	21.2	35.0
Keep activity logs (.55)	30.9	35.8	22.8	29.3	36.3
Maintain inventory (.55)	16.4	19.5	7.3	14.1	21.8
Keyboard text or date supplied by someone else (.53)	35.5	39.0	39.7	23.2	37.1
Administrative support (.37)	24.4	22.8	29.4	25.3	20.3
Activities: Factor 2					
Write original material (.84)	65.9	67.5	77.9	77.8	44.8
Proofread and correct (.77)	63.1	61.8	77.9	60.6	51.7
Edit and rewrite (.85)	56.5	52.0	74.3	70.7	33.6
Activities: Factor 3					
Programming (.76)	20.2	14.6	18.4	47.5	7.7
Maintain a database (.70)	25.0	31.7	32.4	24.2	13.3
Statistical computation (.47)	27.1	35.0	36.0	26.3	12.6
Activities: Factor 4					
Fiscal operations (.78)	24.0	30.1	34.6	18.2	12.6
Distribute information (.61)	46.5	59.3	47.1	43.4	37.1
Statistical computation (.52)*	27.1	35.0	36.0	26.3	12.6
Develop forms (.45)	35.5	36.6	43.4	35.3	27.3
Administrative support (.38)*	24.4	22.8	29.4	25.3	20.3
NUMBER OF ACTIVITIES PERFORMED					
3 or fewer	20.0	14.6	13.2	18.2	32.2
4 to 6	30.3	27.6	34.6	31.3	28.0
7 to 10	29.1	35.0	33.8	24.2	23.0
11 or more	20.6	22.8	18.4	26.3	16.8
	100.0	100.0	100.0	100.0	100.0

Key to Groups: I = Management, administration
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*When a task loads on two different factors, the stronger loading is starred.

The four factors bear some resemblance to the four work group types. Factor 1 describes clerical and administrative activities and includes many tasks performed by the management/administration and by the support groups. These tasks primarily involve the management of text information. In contrast, Factor 2 involves creating and altering text, activities associated with the text-oriented professionals. Factor 3 suggests a more sophisticated knowledge of computers and reflects computer use by engineering and other applied-science

professionals. Factor 4 involves the sophisticated manipulation of numeric data. Together, Factors 3 and 4 reflect the activities of the data-oriented professionals.

Since the defined clusters of activities are at least superficially similar to the group types, it is not surprising to learn that the groups perform these tasks at different rates. For example, almost half of the data-oriented professionals do programming in contrast to less than 8 percent of the support group employees. A less obvious example is processing records. Forty percent of the management group and 35 percent of the support group perform this task, but only 14 percent of the text-oriented professionals and 23 percent of the data-oriented professionals undertake records processing.

The lower portion of Table 4 shows how many different activities the members of each work group perform. More than 20 percent of the employees perform 11 or more of the 17 tasks and about an equal number perform 3 or less. Not surprisingly, management groups perform the widest range of tasks; those in support groups have the least diverse activities.

The figures reported in Table 4 should not be construed as measures of computer use. What they reflect is both the variety and the patterning in information handing activities among office workers. Implementation decisions for information systems should thus attempt to reflect the patterning while accommodating the variety.

COMPUTER USE AND USER SATISFACTION

The analysis just described suggests that a substantial number of the activities carried out by most white collar workers could *potentially* be aided by a computer. In fact, 67 percent of the employees in this sample *do* interact directly with a computer during the regular course of their work, and another 26 percent expect to do so in the near future. Table 5 breaks down the proportion of current users, expected users, and committed nonusers by specific occupational level in the organization. In contrast to widely publicized speculations about managerial and professional resistance, we found that employees at these occupational levels were both willing and able to convert to computerized systems; indeed, their responses to information technology

are significantly more positive than those of the support staff. It is noteworthy that, in offices where the technology is available, the overwhelming majority of employees in *all* occupational categories expect to be using computers as work tools in the near future.

Current users surveyed in this study vary widely in the amount of time that they typically spend at a terminal. About half use the computer 30 percent or less of their working time; another fourth spend up to 70 percent of their time at a terminal; and the remaining fourth may use a computer up to full time. Forty percent of the users have their own terminal; the others use shared workstations. Very few (only 17 percent) have a printer near their desk.

The equipment in use represents many different models, makes, and vendors. Most sites have at least two different types of terminals and printers, and system architectures and configurations are quite diverse. Software choices are even more varied. Given this heterogeneity, we sought to discover whether there are generic characteristics of advanced office systems--summary dimensions--that would capture user satisfaction.

Table 5

USE OF COMPUTERS AT WORK

(percent of employees)

Occupational Category:	Currently Use a Computer	Expect to Use a Computer	Do Not Expect to Use a Computer
Executive	36	46	18
Managerial	71	26	3
Professional	79	18	3
Technical	81	18	1
Secretarial	64	23	13
Clerical	73	21	6
Average (all categories)	67	26	7

To investigate this question, we asked respondents to indicate their level of satisfaction with a number of very general features of their computer system, using 4-point rating scales. Table 6 lists these general characteristics and the average ratings for the entire sample and for each type of work group.

To learn whether computer system features could be organized to form major dimensions underlying user satisfaction, we again performed a factor analysis. That analysis generated the four factors under which system characteristics are listed in Table 6. The factor loading appears in parentheses after each characteristic.

Table 6

MEAN SCORES
on
SATISFACTION WITH FEATURES OF THE OFFICE COMPUTER SYSTEM
(4 = very satisfied, 1 = very dissatisfied)

	Overall Mean	Group I Mean	Group II Mean	Group III Mean	Group IV Mean
Features: Factor 1					
Text or data alteration capability (.79)	3.4	3.4	3.5	3.4	3.2
Text or data entry capability (.75)	3.5	3.5	3.5	3.3	3.4
Organization of stored information (.74)	3.4	3.5	3.3	3.3	3.3
Information retrieval capability (.66)	3.3	3.4	3.4	3.1	3.2
Computer system's appropriateness for assisting your own particular job functions (.63)	3.3	3.5	3.4	3.2	3.4
Error detection and correction (.60)	3.2	3.2	3.0	2.9	3.4
Back-up to prevent accidental file loss (.55)*	3.1	3.4	3.0	3.0	3.0
Keyboard layout (.53)	3.5	3.6	3.6	3.2	3.6
Features: Factor 2					
Promptness of maintenance (.82)	2.9	2.8	2.9	2.6	3.0
Quality of maintenance (.80)	3.0	3.1	2.9	2.8	3.2
Quality of printout (.67)	3.4	3.5	3.4	3.2	3.6
Quality of the video display (.53)	3.5	3.6	3.5	3.2	3.6
Back-up to prevent accidental file loss (.50)	3.1	3.4	3.0	3.0	3.2
Features: Factor 3					
Quality of the operating manual (.78)	2.5	2.7	2.5	2.4	2.7
Type of dialog with the computer (.71)	3.3	3.4	3.3	3.0	3.3
Response time of the computer (.60)	2.8	2.9	2.9	2.3	2.9
Features: Factor 4					
Convenience and comfort of office furniture (.89)	3.1	3.1	3.0	2.6	3.2
Arrangement of equipment, furniture and space (.84)	2.8	2.9	2.8	2.5	3.0
OVERALL FRIENDLINESS OF THE COMPUTER SYSTEM	3.3	3.4	3.2	3.0	3.4

Key to Groups: I = Management, administration
II = Text-oriented professionals
III = Data-oriented professionals
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*When a task loads on two different factors, the stronger loading is starred.

The factors can be interpreted as follows:

(1) Functionality: how the system enters, alters, organizes, and stores information.

(2) Equipment performance: speed and quality of maintenance, plus video display and printout characteristics.

(3) Interaction: whether the user has what is needed to interact effectively with the computer.

(4) Environment: adequacy, convenience and comfort of equipment, furniture and space.

Together, these four factors account for more than 60 percent of the variation in user satisfaction with computer system features.

Mean satisfaction scores in Table 6 show clearly that users in this study are relatively happy with the functionality of their computer systems, especially with the text or data entry and editing capabilities. Reactions to equipment performance are mixed. The quality of printout and of video display get high marks, but promptness and quality of maintenance are given less satisfactory ratings. And, while users are clearly unhappy about the environment in which they operate, user manuals get the worst ratings of any individual characteristic.

Within these general patterns, there are statistically significant differences between user groups. For example, support groups are relatively pleased with the error detection and correction capabilities of the system, while data-oriented professionals find the system unsatisfactory in this respect. Management groups are more pleased with backup features than are any other groups.[6]

In part, the differences in user judgments appear to be influenced by previous experience with computers. The data-oriented professionals are clearly the most dissatisfied with their computer systems in spite of the fact that they are the heaviest users and that more than a third of them regularly used computers in previous jobs. In contrast, the

[6] In this and following tables where mean scores are provided, differences on the order of .2 to .3 may generally be regarded as statistically significant at $P < .05$ (using t tests for between-group comparisons) in preliminary one-way analyses of variance.

text-oriented professionals, more than half of whom had no prior computer experience, are the most satisfied with features of their office system.

We may surmise that the previous computer experience of the data-oriented workers makes them more critical and demanding of system performance. They are probably more knowledgeable about potential applications and compare their own equipment with more sophisticated and flexible systems now becoming available. Computers are not new work tools for them. While they have high expectations of how systems should work, they are more likely than other employees to be using older patchwork systems not really designed to handle interactive work.

On the other hand, the majority of text-oriented professionals seem to be getting their first taste of the speed and convenience that computers can bring to their basic tasks--writing and editing text. The contrast with the tedious process of preparing material on the typewriter is striking, and the computer provides a welcome increase in their ability to control production and meet deadlines. In addition, their briefer and more limited exposure to alternative computer systems tends to make them more pleased with the one they have. This interpretation implies that organizations would do well to implement systems that can be upgraded as users become more experienced and as new options become available.

Since the four dimensions--functionality, equipment performance, interaction, and environment--seemed to summarize user satisfaction quite well, we wanted to see if they would serve as general predictors of overall system friendliness, utilization levels, and satisfaction with the new technology. We had excluded "overall friendliness," the last item listed in Table 6, from the factor analysis because we regarded it as a product of all four system factors rather than as a specific feature.) We used standard statistical regression procedures to test these hypotheses.[7] As we expected, all four factors were significantly related to ratings of overall system friendliness, but the association was statistically weakest for the environmental factor (factor 4).

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[7] We used multiple regression procedures, with derived factor scores used as predictors of overall friendliness ratings, reported utilization levels, and satisfaction with the new technology.

Next, we sought to determine whether satisfaction on the four summary dimensions could predict reported levels of computer use. Employing similar statistical procedures to test this relationship, we discovered that utilization is significantly associated only with functionality. That is, among the sets of features studied, user satisfaction with system *functionality* is what predicts the extent to which information technology is incorporated into regular work.

Finally, we investigated the degree to which satisfaction on these four dimensions could predict overall satisfaction with the new technology. For this outcome, we found two factors to be significant: *functionality* and *environment*.

On the basis of these results and related interview responses, we drew two tentative conclusions for the implementation of advanced information systems.

(1) Effective implementation rquires that users be able and willing to use a system. Our results suggest that for this to happen, users must be satisfied with respect to four dimensions of computer systems: functionality, equipment performance, interaction, and environment.

(2) The implementation problems identified in the preceding discussion are not inherent computer problems--users are basically happy with system functionality. They are unhappy with system characteristics that *management can readily fix* such as unhelpful technical manuals and unaccommodating office environments.

PERCEIVED EFFECTS OF COMPUTER USE ON WORK PERFORMANCE

Ultimately, investigations of advanced information technology in private sector contexts are expected to address the issue of how computer use affects work performance. A major incentive for investing in office computer systems, according to our sample respondents and to reports in other literature, is the expectation of increased productivity or decreased labor costs. In our survey we therefore asked respondents to estimate two sorts of outcomes:

- The effects of computer use on the speed, quantity, type, and quality of white collar work of the sort done in their office as well as its effects on the general quality of working life.

- The effects of computer use on the quality and the productivity of their own work.

Table 7 summarizes the average responses for the entire sample and for each type of work group. It is evident that most employees think computer use will have a favorable effect on various aspects of work performance. Mean estimates in the upper portion of the table range from 3.4 to 3.7 on a four-point scale. However, as the bottom half of Table 7 shows, respondents were even more positive about the effects of computer use on the quality and productivity of their own work. These are self-report results that need to be supplemented by archival data and other objective measures. We will pursue such analyses in later stages of this research project. However, it is interesting to note that respondents were significantly more positive about how the computer might affect the quantity and quality of their own work than they were about how it might affect the quality of working life.

Between-group differences in judgments about work effects shown in Table 7 mirror previously reported differences in computer system satisfaction. The data-oriented professionals are less positive than

Table 7

MEAN SCORES ON ASSESSMENTS OF WORK PERFORMANCE
(4 = very positive or satisfactory,
1 = very negative or unsatisfactory)

	Overall Mean	Group I Mean	Group II Mean	Group III Mean	Group IV Mean
COMPUTER EFFECTS ON WORK					
On speed of work	3.5	3.4	3.6	3.3	3.5
On quantity of work	3.4	3.3	3.6	3.4	3.4
On type of work	3.4	3.3	3.5	3.3	3.5
On quality of work	3.5	3.4	3.7	3.5	3.4
On quality of working life	3.4	3.2	3.4	3.3	3.4
IMPACT ON PERFORMANCE					
Perceived productivity in own work	3.7	3.7	3.7	3.5	3.8
Perceived quality of own work	3.7	3.7	3.7	3.7	3.7

Key to Groups: I = Management, administration
II = Text-oriented professionals
III = Data-oriented professionals
IV = Support staff

other groups, while the text-oriented professionals are most enthusiastic. Not surprisingly, support groups report the greatest positive effect of computer use on productivity. Their estimate is consistent with the conclusions of others (e.g., Johnson and Taylor, 1983) that productivity gains through computerization of office work are most rapidly and easily achieved in secretarial and other support tasks.

We have described how satisfaction on the four summary dimensions of computer systems predicts the level of utilization and overall satisfaction with the new work tool. It is appropriate to end this discussion of preliminary research results by asking whether level of utilization and degree of satisfaction are directly linked to assessment of productivity. For the time being, the answer is no. Table 8 shows how work groups rated the extent to which they had incorporated the new technology into their daily work and their satisfaction with it. All groups report only intermediate levels of utilization. Moreover, statistical tests show no significant relationship between levels of use and levels of satisfaction with the technology. Nor is there a significant relationship between either of these variables and the very positive estimate just described of the computer's effect on worker productivity. In one sense, the lack of a connection is not surprising; decades of organizational research have been unable to demonstrate a consistent relationship between satisfaction and productivity at work (e.g. Brayfield and Crockett, 1955). On the other hand, given the billion dollar cost problems associated with white collar absenteeism, satisfaction with work would appear to be a necessary although not sufficient condition for productivity.

ORGANIZATIONAL CHARACTERISTICS THAT AFFECT IMPLEMENTATION

To link our characterization of activity in computerized offices with other national studies of the quality of working life, we included in our survey some standard measures of organizational characteristics.[8] These measures tapped such aspects of organizations as centralization of

[8] These measures were developed by the University of Michigan Survey Research Center and have been widely used in organizational research (e.g., Quinn and Shepard, 1974).

Table 8

MEAN SCORES ON LEVEL OF TECHNOLOGY USE AND SATISFACTION

	Overall Mean	Group I Mean	Group II Mean	Group III Mean	Group IV Mean
Extent of incorporation of new technology into daily work (3 = high level, 1 = low level)	2.2	2.0	2.2	2.3	2.3
Extent of satisfaction with new technology (4 = high level, 1 = low level)	3.2	3.1	3.4	3.1	3.1

Key to Groups: I = Management, administration
II = Text-oriented professionals
III = Data-oriented professionals
IV = Support staff

decisionmaking, employee autonomy, variety in work, challenge in work, and the organization's orientation toward change. Our hypothesis was that the organizational context for a major changes, such as the introduction of innovative office technology would certainly affect implementation success.

On the basis of survey data, two features of organizations in fact predict how completely users integrate information systems into their daily work and how happy they are with them (see Table 8, above):

(1) *Variety in work* significantly predicts the level of system use. This finding, coupled with the relatively high education level of the work force who will be using office computers, reinforces our concern that implementing information systems in the white collar environment should not be patterned on automating routine factory work.

(2) An organization's *orientation toward change* significantly predicts both level of system use and user satisfaction with the new technology. White collar workers appear to adapt more readily to innovative information systems in organizations where such change is viewed as a positive, problem-solving, and achievable goal.

Because an organization's change orientation appears to play such an important role in implementing an information system, we will explore it more thoroughly in subsequent research. Interview data and other descriptive information will help determine the ingredients of positive change orientation and suggest how organizations can best manage the process of embedding technology into information-related work.

These organizational findings, coupled with analyses of user satisfaction and dissatisfaction described above, strengthen our belief that problems with implementing computer systems in white collar settings are not technological in nature. Users think the technology itself is fine. What affects how much and how well it is used are organizational, environmental, and training matters that organizations should be able to address.

CONCLUSIONS

This Note reports preliminary findings from a study of computer-mediated office work. Conclusions are based on early analyses and thus should be considered both tentative and subject to modification. Further, because the study is unique in the extent to which it assesses office workers, white collar work, and use and satisfaction with advanced information technology, there is not as yet a body of similar studies whose results can be compared with those presented here. Finally, the sample on which this research relies is not a random one, so application of the findings to other settings is uncertain. Within these constraints, we offer a number of provisional conclusions.

In our sample of offices that adopted information technology early, white collar work can be described in terms of four systematic clusters of information handling activities. They are carried out by well-educated employees who, across sex and occupational categories, have some keyboarding skills. Many have used a computer in a previous job.

Contrary to popular reports, senior managers and professionals are not resistant to using computers in organizations where advanced office technology has been installed. Indeed, more than two-thirds of them already use a computer, and almost all the rest expect to do so in the near future.

On the whole, workers give the new technology itself high marks. They are, for the most part, satisfied with the functionality of the software and applications available to them. However, they are distinctly less happy with some features that affect the user interface--for example, user manuals and promptness of maintenance. And they find the environment in which the system is configured uncomfortable or inappropriate. Furthermore, specific features are evaluated differently depending on the type of office work users perform.

Four basic dimensions were found to summarize user reactions to the new systems and to predict both how much the system is used and how well users like it. Among them, functionality features predict how thoroughly the system is incorporated into daily work, and, together with environmental characteristics, predict overall satisfaction with the new technology.

Surveyed employees estimate that the computer will have very positive effects on the quality and productivity of their own work. However, they are less enthusiastic in their assessment of how it will affect the quality of working life.

Organizational characteristics appear to be at least as important as computer system characteristics in determining what happens when an innovative office system is implemented. In particular, variety of work and the organization's orientation toward change are significant predictors of how much the new system will be used and how satisfied users will be.

These findings suggest that the most critical problems in implementing information systems are not inherently technological ones. Instead, they involve characteristics of the organization and its implementation effort: how it structures work, how it approaches change, and how adequately it responds to employee needs in designing the user-computer interface. Understanding these issues will be a major goal in subsequent stages of this research.

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