C E Center for Effective Organizations

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Based on a presentation at the annual meeting of the World Future Society, Washington, D.C., July 21, 1982.

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THE IMPACT OF INFORMATION PROCESSING TECHNOLOGY ON OFFICE ROLES

by

Allan Mohrman

G 83-5 (33)

ABSTRACT

This paper provides a framework for understanding the intersection of office roles and office technology, and shows how roles were affected in a particular office setting.

THE IMPACT OF INFORMATION TECHNOLOGIES ON OFFICE ROLES

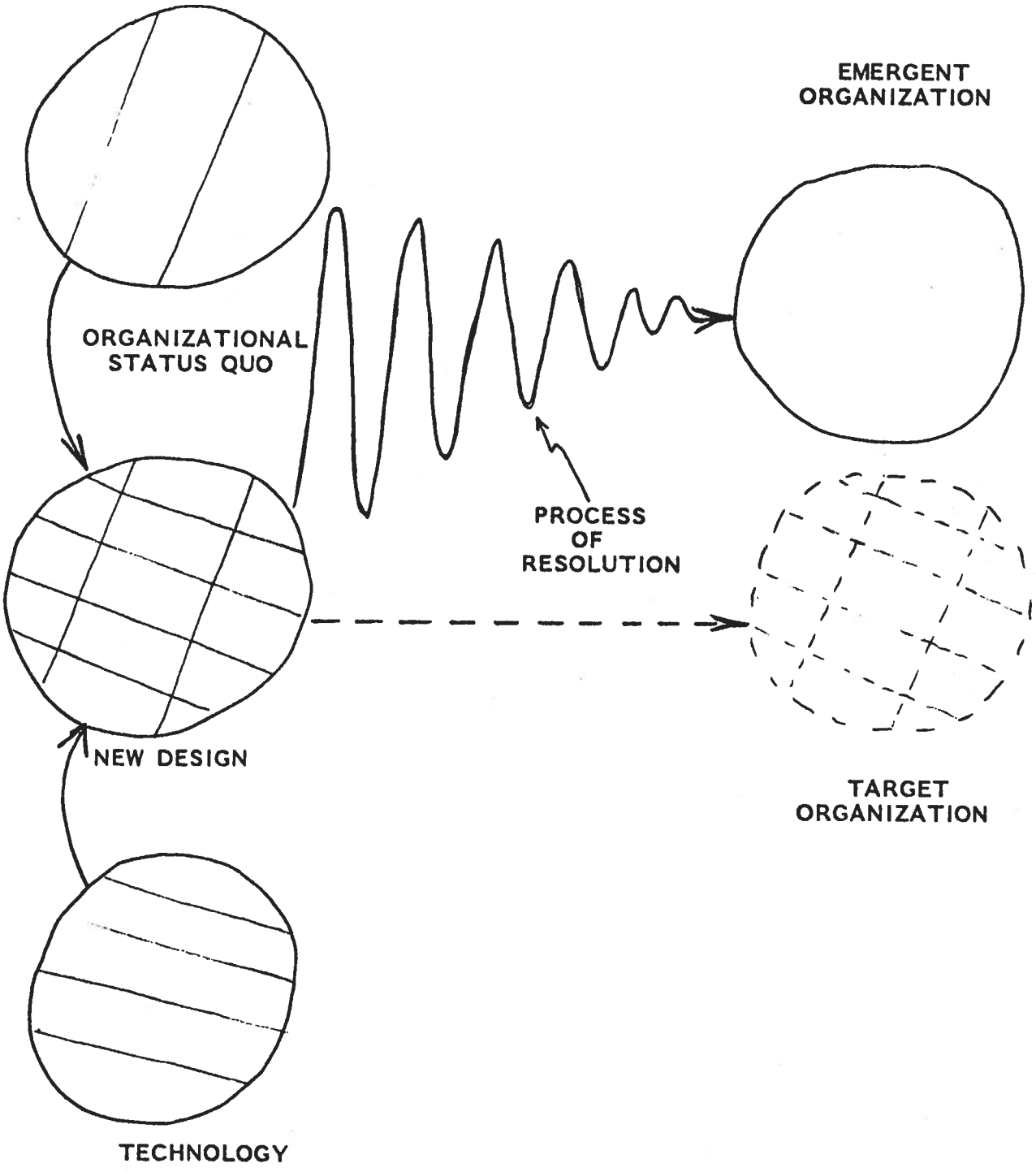
by

Allan M. Mohrman, Jr.

Our society is presently experiencing a technological revolution in the office place with the advent of computer based information processing technologies such as word processing, micro computers, and the electronic links among them. The purpose of this paper is to investigate the potential implications information processing technologies have for human roles and activities in the office. This will be done by first presenting a framework for categorizing this technology and its application in the office and, second, by presenting some illustrative results of research on a particular office implementation of this technology.

Figure 1 presents the framework that will guide the structure of this paper. The figure contains a number of elements, each of which will be discussed in further depth later. The organizational status quo represents the current structure and processes of office organization prior to implementation of this technology. The technology circle refers to the general nature of the technology prior to its configuration specifically for a particular office. The circle labeled New Design is the mix of technology configuration and adjustments in organization structure that are initially implemented. Invariably there are contradictions set up between the new design and the original organizational status quo of the office. The contradictions need to be resolved during an implementation process. The resolution will

FIGURE 1


EMERGENT
ORGANIZATION
ORGANIZATIONAL
STATUS QUO
PROCESS
OF
RESOLUTION
NEW DESIGN
TARGET
ORGANIZATION
TECHNOLOGY

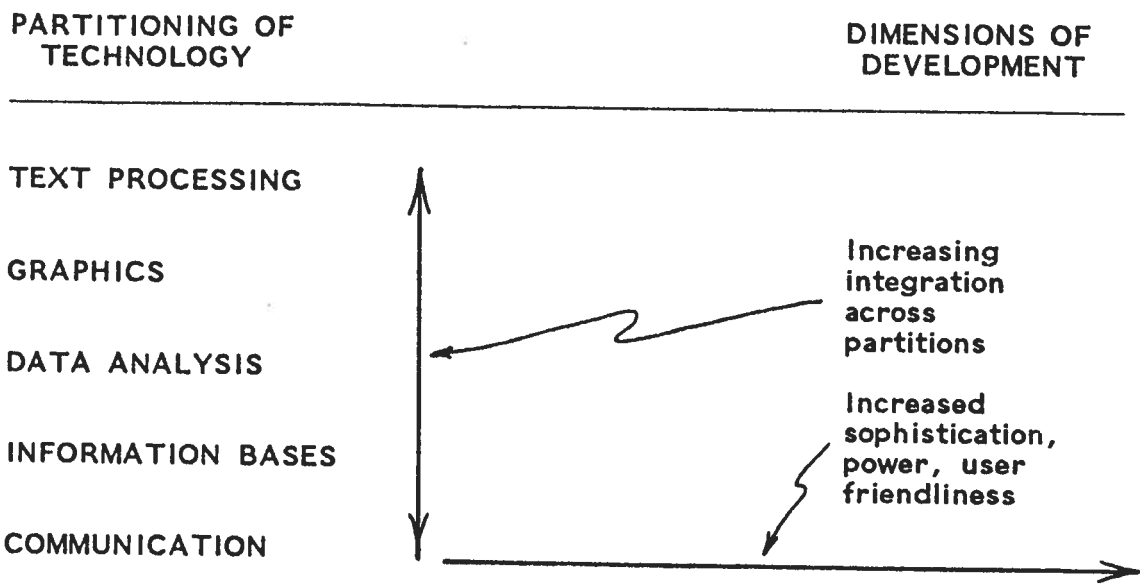
inevitably be an emergent organization different from either the original status quo or that envisioned by the new design.

Both organizations and technologies are human inventions and, as such, embody the frames of reference of their inventors. The various cross-hatchings of the elements in Figure 1 signify that both technology and human organization are embodiments of particular ways of conceiving of information processing in human organizations, i.e., frames of reference, that in simplest form are ways of categorizing or partitioning information processing functions. The initial step in designing either an organization or a technology is to differentiate it into subparts (Galbraith, 1978; Lawrence and Lorsch, 1967). The lines partitioning the elements of Figure 1 are meant to signify the ways those elements are divided in their subparts. Traditional offices and the new technologies developed for them have each come to be partitioned in characteristic ways. These are presented in the next two sections.

Technology Applications

The partitioning of information processing technology shown in Table 1 is a common one (e.g., Meyer, 1982). Text processing refers to the manipulation of textual materials. Most commonly this particular function is performed by the tools which we call word processors. Graphics is an information processing function consisting of specialized tools for converting between data and their visual representations. Data analysis is that function with which we perhaps most associate computers. It includes tools that perform the mathematical, arithmetic, analytical, and logical functions usually associated with computers. Information bases refers to those technologies that are developed

TABLE 1


PARTITIONING OF TECHNOLOGY
DIMENSIONS OF DEVELOPMENT
TEXT PROCESSING
GRAPHICS
DATA ANALYSIS
INFORMATION BASES
COMMUNICATION
Increasing integration across partitions
Increased sophistication, power, user friendliness

to store and access large amounts of information. Such things as numerical data bases and electronic text filing systems fit in this category. Finally, communication tools are those that allow electronic linkage and information transfer among computers and work stations. Electronic mail is the most prominent. Each of their partitions are complex and shifting combinations of hardware and software.

The Table 1 partitioning of the office technology is relatively exhaustive, although technological progress may eventually result in the development of other partitions (artificial intelligence, perhaps). In the short run the technology is developing in two dimensions. The first is toward increasing power, sophistication, flexibility, and user friendliness in these tools. For instance, word processors have become more than efficient replacements for typewriters. Word processing technology allows us to start utilizing the tool at the very inception of the idea, writing down notes, developing and arranging thoughts, and expanding and editing them into final documentation. Computer graphics technology has also developed tremendously and has become increasingly available in office-oriented tools. Communication functions have increased in sophistication so that not only is there work station to work station communication, but work stations specializing in the different functions of the technology partitions have become linked.

The second direction of development is integration among the partitions, facilitated in part by the increasing power of the communication function. The current integrative developments have created work stations with hardware and software capable of text processing, graphics, data processing, accessing information bases,

communicating with main frame computers and integrating the outputs of these functions. These multifunctional work stations allow the users to literally "cut and paste" electronically among the various functions.

Office Organizational Roles

Table 2 presents a role-based partitioning of office organization frequently assumed by those who are designing and thinking about the technology. The actors in the office place perform three basic organizational roles--managerial, secretarial/clerical, and professional. These roles are characterized by sets of activities. They also correspond to organizational units that perform these roles for the organization as a whole. The three roles can be mapped onto communication and information processing frameworks. For instance (Mason, 1981), the secretarial/ clerical role is associated with symbol production and communication, i.e., technical level information processing. The professional role is associated with the processes of giving and interpreting meaning, i.e., semantic levels of information processing. The managerial role is associated with the forming of intentions and the achievement of purposes, i.e., the influence level of information processing.

The Intended Organization: New Design

People who contemplate, plan, and design the application of the new technologies to the existing organizational situation in the office to some degree have an image of a new organizational design, one that integrates the technology and the existing office. In fact, the technology already embodies some office design. For instance, word processors have in the past almost exclusively been designed and

TABLE 2

PARTITIONING OF STATUS QUO

ROLES	ACTIVITIES	CORRESPONDING ORGANIZATIONAL UNITS
MANAGERIAL	ADMINISTRATION/DECISION MONITORING/CONTROLLING	ADMINISTRATION
SECRETARIAL/ CLERICAL	PRODUCTION/ "REALIZATION" ACTIVITIES	TYPING POOLS COPY CENTERS
PROFESSIONAL	CREATION/ DEVELOPMENT/ANALYSIS	R AND D ENGINEERING STAFF

considered as tools of secretaries to aid in the technical level of symbol manipulation. When people design tools for the data analysis or graphics functions, they usually think in terms of use by professionals to aid in the semantic processes of giving meaning to data. Information bases such as management information systems have been most frequently associated with managerial roles as tools for influence level processes of decision making, planning and monitoring. The forms of the technology itself thus contain images of how that technology is to be utilized in the role structure of the office place. But the technology does not just embody images of what the office is, it also embodies images of what the office should and could be. Designers of the technology certainly have some image of the form they would like the emergent organization to take. The newer network configurations, for instance, seem to stress the importance of organizational integration through lateral relationships, not hierarchical ones.

Intersecting the partitionings of the technology and of the office organization creates a matrix depicting the links between the technology and the organization structure. Such matrices keep track of how the developing aspects of information processing technology can affect the emergent organization.

Table 3 presents an early example of this intersection. In Table 3, the five partitions of the technology are intersected with the three partitions of the organization. This table represents the recent past of information processing technology. What was being automated was not the office as a unit, but those particular parts of the organization that as units performed certain functions in processing of information.

TABLE 3

MATRIX OF ORGANIZATION UNITS AND
INFORMATION PROCESSING TECHNOLOGY

TECHNOLOGY PARTITIONS	ORGANIZATIONAL PARTITIONS		
	MANAGEMENT/ ADMINISTRATION	SUPPORT	PROFESSIONAL
TEXT PROCESSING		WORD PROCESSING CENTERS	
GRAPHICS			DESIGN DEPARTMENTS
DATA ANALYSIS	DATA PROCESSING DEPARTMENTS		ENGINEERING DEPARTMENTS
INFORMATION BASES	DATA PROCESSING DEPARTMENTS		
COMMUNICATION			

For instance: textual processing, is done in a word processing unit that replaced the typing pool. Graphics are the domain of design oriented departments. Data analysis and data bases are the domain of data processing departments. Other analytical technologies have been utilized in engineering groups. The common design practice has been a one-to-one match between a particular kind of information processing tool and a particular unit of organization.

Table 4 demonstrates a more recent configuration for utilizing office technology. Here, instead of a one-to-one relationship between the technology and a particular organizational unit, the one-to-one relationship is between the tools and an organizational role. For instance, here the textual processing function is performed by word processors that are dedicated to secretaries. Data analysis can be done via personal computers or remote terminals dedicated to professionals in the same office. Managers, too, might have their own terminal, perhaps as part of management information systems supporting his or her particular role. A possible exception to this design rule is the potential of using electronic mail between different organizational roles.

The difficulty with this one-to-one relationship between technology partitions and the organizational roles or units is the technology will accentuate differentiation among the roles or units, making their task oriented integration more difficult (Lawrence and Lorsch, 1967; Galbraith, 1977). For instance, we are all (perhaps painfully) aware of the interface issues which can exist between word processing units and other departments of the organization.

TABLE 4

MATRIX OF ORGANIZATION ROLE AND
SPECIALIZED INFORMATION PROCESSING TECHNOLOGIES

TECHNOLOGY PARTITIONS	ORGANIZATIONAL PARTITIONS		
	MANAGERIAL	SECRETARIAL/ CLERICAL	PROFESSIONAL
TEXT PROCESSING		WORD PROCESSORS	
GRAPHICS			COMPUTER GRAPHICS
DATA ANALYSIS			REMOTE TERMINAL TO MAIN FRAME
INFORMATION BASES	MANAGEMENT INFORMATION SYSTEM		
COMMUNICATION			

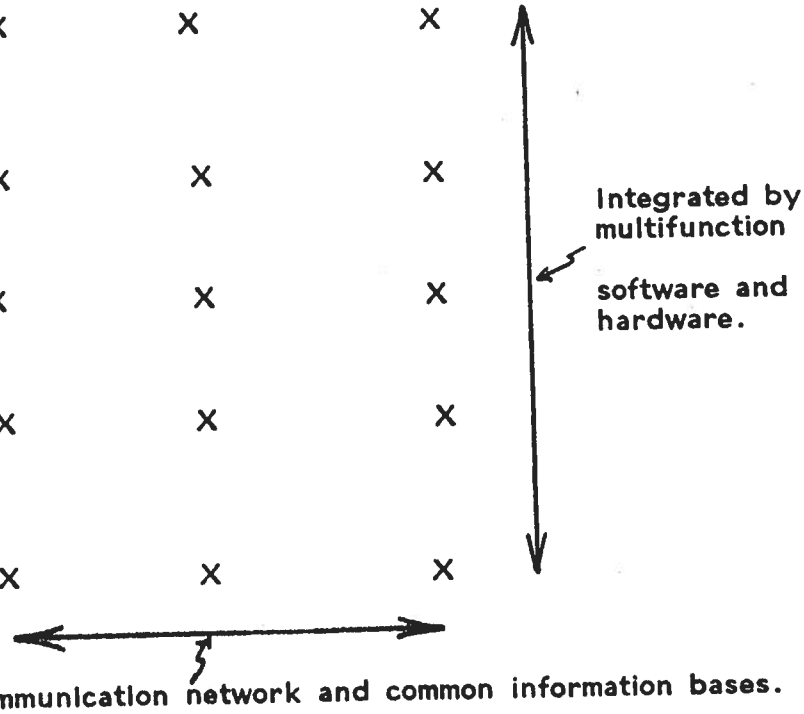
The technological trends toward increased sophistication and integration across the functions and roles provide different possibilities for melding technology with organizational structure. For instance, word processing work stations that have so often been associated with secretarial positions only, have, in their increased sophistication and user friendliness, also become compatible with the creative, developmental, and decision oriented tasks of professionals and managers. User friendliness in computer graphic technology and its integration with other technology functions has made it useful not only to managers and professionals for the purpose of preparing presentations and displaying various kinds of data, but also to those in secretarial and clerical roles for similar uses. Electronic mail is just one aspect of the integrative potential of the communication technologies. Many of the new technologies create integration over a number of different terminals and therefore the associated roles. In addition, the ability to simultaneously integrate the various technological functions, i.e., graphics, textual processing, data analysis, and communication with remote data bases, is fast dissolving the boundaries presently existing between the partitions of the technology. Indeed, the personal computers now proliferating are multifunctional tools. The result is represented in Table 5 in which the tools are multifunctional and applicable across all three roles and all five technological partitions. When this occurs, then the technological design reasons for assigning particular technologies to particular roles or units break down.

The breakdown of a predetermined link between technology and role creates a more flexible technology for application and adaptations. The

TABLE 5

MATRIX OF OFFICE ROLES AND
INTEGRATED INFORMATION PROCESSING TECHNOLOGIES

TECHNOLOGY PARTITIONS	ROLES		
	MANAGERIAL	SECRETARIAL/ CLERICAL	PROFESSIONAL
TEXT PROCESSING	X	X	X
GRAPHICS	X	X	X
DATA ANALYSIS	X	X	X
INFORMATION BASES	X	X	X
COMMUNICATION	X	X	X



X ≡ Fully integrated and distributed technology, networks of multifunction work stations.

flexibility brings a greater likelihood that there can eventually be an appropriate linkage between technology and the information processing functions of an office organization--a point of competitive significance to technology vendors. The flexibility also brings uncertainty about what the linkage might be. In such situations it is both more difficult and less desirable to predesign such linkages. For this reason, there are many situations in which office implementation of information processing technology is being "pilot tested" in a more free-form, experimental fashion. The integrated technology coupled with the free-form pilot can create a situation in which both technology and roles are flexible.

When technology no longer supports a preconceived role structure, all extant roles in the office organization potentially gain access to the same technology, information bases, and the power that goes along with them (e.g., Pfeffer, 1978, 1981). The multifunctionality of the technology allows some fluidity of function across the various roles in the organization, i.e., the content of roles can change. All this potentially allows for many "degrees of freedom" during pilot experimentation, subject to the preexisting norms, beliefs, and practices of the office place. Implementation is coupled with a technological flexibility to adjust to the issues that arise. If there is any technological imperative accompanying integrated multifunctional work stations, it is flexibility and the potential breakdown of role boundaries.

The Emergent Organization: Outcomes of a Pilot Implementation

For the past year and a half, we have been collecting data from a pilot implementation that sheds some light on the organization that is

emerging. This section reports these findings to indicate the kind of organizational impacts one can expect, not to indicate specific changes that will occur. In particular, the research questions are: does the technology result in changes among office role activities and what are the general tendencies of these changes if present?

The setting for these findings is the systems department for a large corporation, international in scope. The unit consists mostly of professionals who are primarily systems analysts. The remainder are managers and secretaries. The technology initially implemented in this unit consisted of word processing work stations. Many of these were later replaced by more sophisticated "professional" multifunctional work stations. A few work stations were electronically linked toward the end of the time period being considered. All secretaries and most managers and professionals had dedicated work stations. Others had access to both word processors and professional work stations available to multiple users and located in semipublic areas. Thus, the implementation of the technology did not reinforce the differentiation between organizational roles. There is potential here for shifting activities among organizational roles. While the majority of work stations are primarily word processors, they do have some data analysis capabilities. In addition, the professional work stations and the limited network further broadened the multifunctional nature of the technology available, i.e., graphics, data analysis, communication, and information base activities.

The data reported here were collected by two questionnaires approximately one year apart. The first questionnaire was administered at the beginning of implementation of free-standing work stations. The second questionnaire was administered just prior to the point of complete implementation of the network. The number of respondents returning completed, usable questionnaires were 54 (over 75% return rate) and 48 (over 67% return rate) respectively. This response rate was relatively comparable across all three roles.

Job Activity Work Station Usage: A list of job activities was provided each respondent on both the questionnaires. In the initial questionnaire, all respondents indicated whether or not they did that activity on a computerized work station. In the second questionnaire, we again asked them whether or not they used a work station to do the activity.

Job Activity Change Due to Work Station: In the second questionnaire, we asked whether the respondent was spending more, less, or the same amount of time doing the activity. If the respondent said that there had been a change, we asked if the respondent attributed that change to the presence of the work stations.

Job Activity Effectiveness: On both questionnaires, we asked how effective the respondents felt themselves to be in doing each activity at the time of the questionnaire. On the second questionnaire, we also asked how effective the respondents remembered themselves to have been at the time of the first questionnaire.

Results: Table 6 reports the full list of job activities presented to the respondents. The first column of Table 6 reports the percent of respondents to the second questionnaire, who indicated they use a work station to do the activity. The second column indicates the rank the Column 1 percentage has among all 23 of the possible activities. The third column reports the percentage of all respondents who reported that the time they spend on the activity had changed and that they attributed the change to the presence of the work stations. Thus, Column 3 indicates a composite activity impact of the work stations on the unit as a whole. The activities are ranked in Table 6 according to this index. For most of the activities, the attributed impact is the direction of more time being spent on the activity. Those activities showing mixed impacts--that is: for which some respondents attributed less time spent and for which other respondents attributed more time spent--are marked with asterisks.

Of the activities listed, almost all had some respondents who found a way to utilize the work station to do it. For instance, a few respondents had used the work stations to hold meetings, not by linking several together in an electronic meeting but by gathering around a single work station and using it as an electronic blackboard. Nevertheless, some activities were mediated by the work stations more than others. Being mediated by the work stations did not necessarily predict the work stations' impact on the activity, however. Both "meetings" and "errands" were activities relatively highly impacted by the presence of the work stations but not usually done with them. Interviews indicate that the increase in meetings was partly due to groups being convened to

TABLE 6

REPORTED JOB ACTIVITY IMPACTS OF WORK STATIONS AT T2

Activities (Ranked by Composite Impact)	%Who Use Work Station for Activity (Rank)	Composite Activity Impact of Work Stations [a]
1. Preparing Presentation Material	86 (3)	28.1
2. Meetings	12 (17)	28.0*
3. Proofing, Correcting, Revising	91 (2)	27.3
4. Scheduling, Keeping Calendars, Personal Planning	47 (8)	21.6
5. Writing, Composing	93 (1)	21.6
6. Creating, Designing, Conceptualizing	66 (4)	20.7
7. Searching, Pulling Files	28 (12)	19.0**
8. Errands	7 (19)	18.0*
9. Record Keeping	63 (5)	16.8*
10. Programming	33 (10)	14.5
11. Calculating, Statistical	53 (6)	14.5*
12. Conferring, Talking	6 (21)	14.0*
13. Using Telephone	11 (18)	14.0*
14. Traveling Away From Office	7 (20)	14.0*
15. Filing	30 (11)	14.0**
16. Planning, Organizing	51 (7)	13.0
17. Analyzing, Reviewing	34 (9)	12.6
18. Copying, Collating, Sorting, Distributing	17 (14)	10.3
19. Dictating	0 (22)	07.0
20. Typing What Someone Else Has Written	23 (13)	06.5
21. Reading	15 (15)	02.4
22. Mail Handling (personal and for others)	13 (16)	00.0
23. Taking Shorthand	0 (23)	00.0

* ≡ Activities for which work station impacts are reported in both directions

** ≡ Activities for which work station impacts are reported primarily in of less time spent on activity

a ≡ Computed by multiplying the percent of respondents who reported more time spent on the activity by the percent who attribute the increase to the presence of the work stations then adding this product to that of the percent reporting less time spent on the activity and the percent who attribute this decrease to the presence of the work station

deal with implementation issues. Some respondents, though, felt that meeting time was less due to the technology. In general, the results on Table 6 clearly indicate a considerable impact on the time spent on the activities, predominantly in an increasing direction. The activities most impacted in this way were preparation of presentation materials, proofing and revising, scheduling, writing and composing, creating and conceptualizing.

The question raised by this paper is not just what impacts there might be in general, but how these impacts might differ across the three office roles. Furthermore, do these activities show a pattern in the way they become distributed that reflects the multifunctional partitions of the technology?

Table 7 presents the pattern of the activities that resulted from the data. The activities in Table 7 were grouped into five categories based on factor analyses of the respondents' perceived effectiveness on each of the activities at the time of the second questionnaire. These factors do not correspond to the five partitions of the technology set forth earlier in this paper. There are at least two reasons for this. First, most of the work stations implemented were not completely multifunctional, and second, the list of activities provided did not adequately tap all possible technology functions. The five factors in the left hand column have been given tentative titles based on the activities that grouped in each. These groupings have a strong similarity with the technical, semantic, and influence levels of information system output mentioned earlier in this paper. These levels in the information system can be mapped onto the secretarial,

TABLE 7

ACTIVITY GROUPINGS

Factor Groupings of Activities	Significant Change in Perceived Effectiveness	Apparent Roles/Levels in Information System
1. "Handling Information"		
Filing	o	Secretarial, Clerical/ Technical Level
Searching, pulling files	o	
Mail handling	o	
Copying, collating, sorting	o	
2. "Reformatting Information"		
** Preparing presentation materials	+	
** Proofing, correcting, revising	+	
3. "Analyzing and Giving Meaning to Information"		
** Writing, composing	+	Professional/ Semantic Level
Reading	o	
* Creating, designing, conceptualizing	+	
* Analyzing, Reviewing	+	
* Calculating	+	
4. "Managing Intentions Through Information"		
* Record keeping	o	Managerial/ Influence Level
* Scheduling, keeping calendars	+	
* Planning, organizing	+	
5. "Communicating Information"		
Using telephone	+	Metarole/Channels of Communication
Conferring	+	
Meetings	+	

* ≡ Over 33% of respondents use work station to do this activity.
** ≡ Over 85% of respondents use work station to do this activity.
\+ ≡ $P \leq .05$ for paired T-Tests comparing T2 levels of perceived effectiveness with memories of T1 levels of effectiveness.
o ≡ No significant change in perceived effectiveness.

professional, and managerial roles, respectively. Accordingly, the right hand column names the role category or information system level that the factor appears to fit. A fourth category, metarole, contains those activities that involve communication and transcend role structures. Asterisks designate the activities that are most mediated by the technology. The center column indicates those activities for which there were significant changes in the perceived levels of effectiveness.

In general, the individual activities group rather neatly into the four role categories. Only three of the five factors were much mediated by the technology: "reformatting information," "analyzing and giving meaning to information," and "managing intentions through information." Each of these three factors fell into one of the three primary role categories. Positive changes in effectiveness are strongly related to the presence of the technology, and were spread across all four role categories. Only the communication activities showed increased effectiveness without being mediated by the technology.

Table 7 clearly shows that the activities group together in a way that is both connected to the presence of the technology and to the activity's functional level in the information system. In Table 8 the data indicate the degree to which changes in these activities are different for the three office roles.

In Table 8 the data are presented for each of the office roles. The first three columns present the changes in the percent of respondents in each role who reported using the work stations for each of the activities. The first number is the percent reporting such usage in the

TABLE 8

ACTIVITIES BY ROLES

Activity Grouping	% USING TERMINAL T1-T2			DOING TASK MORE OR LESS		
	Mngr.	Professionals	Secretaries	Mngr.	Pro.	Sec.
Technical Level						
1. Filing	0- 0	5-30	75-100			↘
Searching, pulling files	0- 0	9-29	25-100			
Mail handling	0- 0	7-17	0- 0			
Copying, collating, sorting	0- 0	0-17	25-100		↗	
2. Preparing presentation materials	29-83	14-86	75-100	↗	↗	↗
Proofing, correcting, revising	0-50	65-97	100-100	↗	↗	↗
Semantic Level						
3. Writing, composing	29-86	74-94	25-100		↗	↘
Reading	0- 0	2-12	50-100		↗	
Creating, designing, conceptualizing	14-40	26-69	25-100		↗	
Analyzing, Reviewing	0-20	23-39	0- 0		↗	
Calculating	0-60	16-50	75-100			↘
Influence Level						
4. Record keeping	14-50	12-63	25-100			
Scheduling, keeping calendars	14-17	16-53	25- 50	↗	↗	↗
Planning, organizing	14-50	12-52	25- 50	↗	↗	
Communication Level						
5. Using telephone	0- 0	2-15	0- 0			↘
Conferring, talking	0- 0	0-14	0- 50			
Meetings	0- 0	2-12	0- 50			↗

↗ over 1/5 of respondents reporting change in indicated direction, none in opposite direction.

↗ over 1/3 of respondents reporting change in indicated direction, none in opposite direction.

first questionnaire. (Recall that the work stations had been partially implemented at the time of the first questionnaire. Also a previous generation of word processors had been available to the secretaries and some of the professionals had used personal computers as well as terminals to the mainframe.) The second number refers to the corresponding percentage from the second questionnaire. Almost all roles reported increased usage of the workstations for almost all activities. By far, the highest usage occurs in the second technical level factor, "reformatting information," and this applies across all roles. Many of the activities in the semantic and influence levels also show strong changes in usage over the year that also apply to all roles. Usage in the first technical factor, "handling information," seems to be confined primarily to the secretarial role although some professionals are doing these activities with the work stations.

The more telling results are presented in the last three columns of Table 8. Here the respondents indicate whether they are doing the activity more, less, or the same. If the technology has any affect on the roles people perform it should begin to appear in these columns. In the first technical factor and the communication factor there have been at best mixed and slight effects. In the second technical factor and the influence factor, however, the changes are consistent and apply to all roles. All roles are performing both technical and influencing activities more. Semantic level activities, however, have increased only for the professionals and show a slight decrease for secretaries.

Conclusions

The data results indicate that the framework developed earlier in the paper is useful. Predictions of role shifts in activities based on this framework have been born out. Rather than depicting a migration of activities from one role to another the data show primarily increases in the doing of several activities. The primary effect of the technology is to increase the degree to which certain activities occupy office personnel.

Some types of activities show increases across all roles. All roles reported doing more technical level activities like preparing presentation materials and proofing and revising. These are activities directly supported by the work stations and represent valuable additions to the capabilities of all roles. Although they are technical level activities, there is a marked egalitarian pattern to the way they are performed by all roles. Perhaps this is due to the nature of these activities, that they are most effectively done by those having first hand experience with the information product at hand and that the work stations make these activities efficient for the same person.

A similar pattern of increases occurred for the influence level factor. Here again, it appears that managing techniques like scheduling and planning are not only enhanced but made generally available by the technology. All roles are able to perform these kinds of activities that apparently were not generally available prior to the implementation of the technology.

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