How Do People Organize Their Desks? Implications for the Design of Office Information Systems

THOMAS W. MALONE
Xerox Palo Alto Research Center

This paper describes a series of interviews focusing on the way professional and clerical office workers organize the information in their desks and offices. A number of implications for designing "natural" and convenient computer-based information systems are discussed.

Two principal claims are made: (1) A very important function of desk organization is to *remind* the user of things to do, not just to help the user *find* desired information. Failing to support this function may seriously impair the usefulness of electronic office systems, and explicitly facilitating it may provide an important advantage for automated office systems over their nonautomated predecessors. (2) The cognitive difficulty of categorizing information is an important factor in explaining how people organize their desks. Computer-based systems may help with this difficulty by (a) doing as much *automatic classification* as possible (e.g., based on access dates), and (b) including untitled "piles" of information arranged by physical location as well as explicitly titled and logically arranged "files."

Several other implications for the design of electronic office systems are discussed, and some differences in how people organize their desks are described.

Categories and Subject Descriptors: H.1.2 [**Models and Principles**]: User/Machine Systems— *human factors*; H.3.2 [**Information Storage and Retrieval**]: Information storage—*file organization*; H.4.1 [**Information Systems Applications**]: Office Automation—*equipment*; K.8 [**Computing Milieux**]: Personal Computing

General Terms: Design, Human Factors

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INTRODUCTION

A number of computer systems have been designed recently to provide "personal information environments" for their users. For instance, Goldstein and Bobrow [4, 5] describe a "semi-formal" system that allows users to organize personal information such as electronic mail and other documents into a network of nodes with labeled links between them. Negroponte [8] describes a data management system based on graphically representing information in "spatial" locations which users can view by pointing to, "zooming in" on, and so forth. Page [9] and Smith, Irby, Kimball, Verplank, and Harslem [10] describe office workstations with high-resolution simulated "desktops" upon which users can display and manipulate

information in something like the way they deal with paper, file folders, and other items on their real desktops. None of these systems, however, is based on a systematic understanding of how people actually use their desks and how they organize their personal information environments.

In this paper, I describe a series of interviews focusing on how people actually do organize the information in their desks and offices. I use the term *desk organization* loosely to include not only the desks, but also the tables, shelves, file cabinets, and other information repositories in people's offices. Then I discuss some implications of this study for the design of electronic office information systems. Some of the suggestions for system design are new; others are old ideas that are given new support by these naturalistic observations.

INTERVIEWS

Respondents

The ten people interviewed for this study were chosen to represent a broad spectrum of people who do much of their work at desks. They included three secretaries, three research scientists, one technical manager, one administrative manager, one purchasing agent, and one physician. All the interviewees except the physician worked at an industrial research center; the physician worked at a large medical clinic.

Method

Each person was interviewed for approximately one hour. The interviewees were asked to give the interviewer "a tour of their office," explaining what information was where and why it was there. No structured questions were used during this phase of the interviews. From time to time, the interviewer prompted respondents with questions like "Why is that there?" or summarized what the respondents had been saying and asked for confirmation. The interviewer also attempted to focus the discussion on the *information* present in the office, not on physical artifacts such as staplers, blank paper, and so forth. In cases where information repositories such as briefcases, bulletin boards, and computers were important to the interviewees, these were included in the discussions. The interviews were all tape-recorded and photographs were taken of the parts of the offices mentioned in the interviews.

At the end of their interviews, six of the interviewees were asked to find several documents in their office. These "probe" documents were chosen for each person by one of his or her co-workers. Since the primary purpose of these probes was to observe the different processes people used in finding things, no attempt was made to have the probes be of equal difficulty. The co-workers were asked to choose some documents they thought would be easy to find and some they thought would be hard to find. Because of the time required for this part of the interview, it was not used for all respondents.

Finally, all the respondents were asked a standard set of questions about how well they felt their office was organized and what problems they had in using it. These questions are listed in the appendix.

A Methodological Note

This study illustrates a form of exploratory observation, like that often used by anthropologists, that can be an extremely useful prelude to designing computer systems for human users (e.g., [11]). This study is not, and is not intended to be, a controlled experiment or a large sample survey. The goal of data gathering here is to obtain qualitative insights and compelling examples, *not* statistical proof of a priori conjectures. Where traditional experiments and surveys rely on the skill of the study *designer* to reduce the effect of biases of the observers, this methodology relies more on the skill and insight of the *observer* to discover unexpected phenomena and illuminating examples in the human systems being observed. Sometimes (as in this case), carefully controlled studies or more extensive naturalistic observations are suggested by the insights obtained from exploratory observation, and these are certainly worth performing. In other cases, the needs for designing systems (or time and budget constraints) do not justify other studies.

TWO EXAMPLES

To illustrate some of the rich detail involved in how people organize their office work spaces, I will briefly describe two of the cases studied. The two cases were selected to represent two important kinds of office organization that stood out in this study: one that relies heavily on files and precisely organized piles, the other that includes many very loosely characterized piles.

A "Neat" Office—Michael

Figure 1 shows a map of Michael's[1] office organization. As a purchasing agent, Michael's work is based primarily on a set of standard forms. The arrangement of his office reflects the flow of these forms, and the description will focus on this flow. There are different piles and files in the office for different kinds of forms and for forms in various stages of processing. Michael summarized one aspect of this as follows:

> The good stuff is all out on the table. The paperwork flow is always out. I don't put paperwork—other than the stuff that is in the suspense file—in a drawer.   (M.P., 10/27/81)

According to Michael's description,[2] purchase requisitions enter his office in his in-basket (top of tray A), and he sorts them into two groups awaiting processing in pile B. Some requisitions can be processed immediately and put in the out-basket (bottom of tray A); others are kept in the "hold" tray (middle of tray A) until further information can be collected (usually by telephone). Each morning, Michael sorts the processed forms from the out-basket (bottom of tray A) into folders in tray D for distribution.

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[1] The names and initials of all the interviewees and people they refer to have been changed.

[2] As Suchman has pointed out in [11], this description of the "routine" procedures may gloss over the work that is actually performed in individual instances. To the extent that Michael's description of the routine procedure accounts for his desk organization, however, it is sufficient for our purposes here.
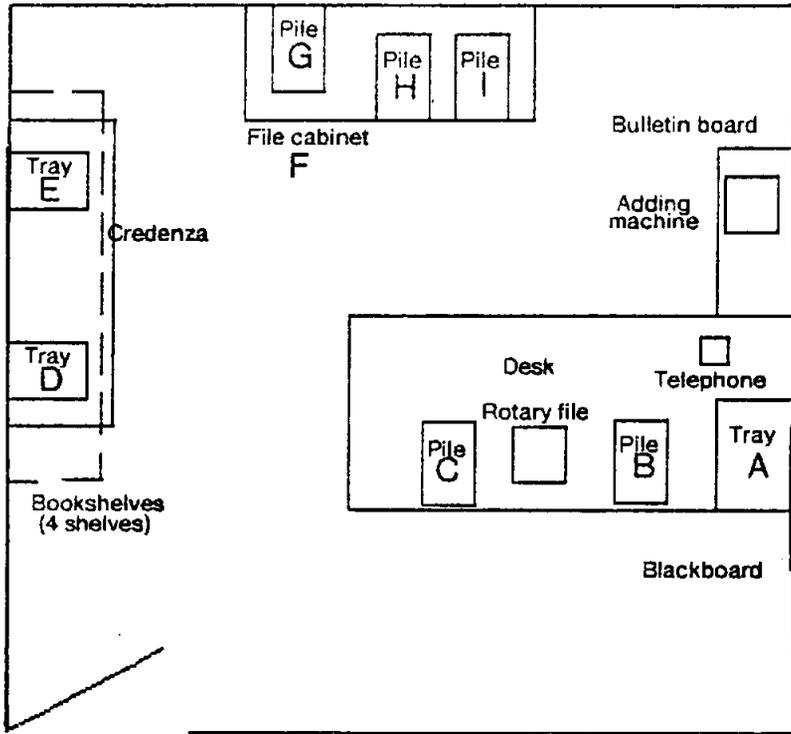
Fig. 1.   Map of Michael's office.

When his copy of a purchase order returns to Michael's in-basket, he files it in the suspense file (F) of open orders according to the date when the merchandise is supposed to be delivered. When forms confirming delivery ("receivers") arrive from the receiving department, they are temporarily placed in pile H and then matched with the purchase orders on file. (Michael uses a log book from tray E to find the suspense date under which each purchase order number is filed.) Every day or so, Michael pulls purchase orders from the file that are more than a week overdue and, if necessary, sends them to the expediter for investigation.

Pile G contains two kinds of unmatched forms: (1) receivers for which no purchase orders are on file, and (2) purchase orders that were filled immediately (usually by telephone) and are awaiting their corresponding receivers. Matching forms usually arrive within a few days, so pile G seldom has more than five or ten forms. Pile C contains purchase orders from file F that require some special action as a result of someone calling to check on them or change them.

The bookshelf contains primarily books and catalogs, loosely arranged. The bottom drawer of file F contains information on freight and commodities, arranged by subject. Information to be filed here is also stacked in pile I and tray E. The desk file drawer includes more product information, administrative memos, and blank forms—again arranged by subject. Michael sometimes uses his blackboard to list important things to remember to do, and he has a bulletin board that contains some telephone number and address lists.
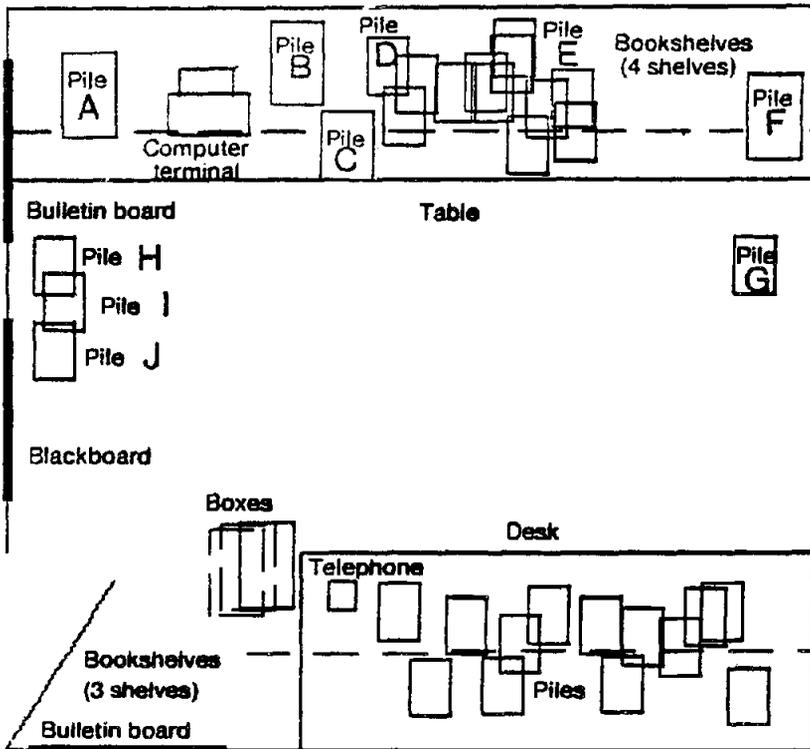
Fig. 2.   Map of Kenneth's office.

A "Messy" Office—Kenneth

Figure 2 shows a map of Kenneth's office organization. As a research scientist, Kenneth has very little routine paper flow. Most of the information in his office consists of books, papers, magazines, personal notes, and computer listings. In contrast to Michael's fairly neat and narrowly defined piles, Kenneth's office is filled with loosely stacked piles of mixed content. For example, here is how Kenneth describes the contents of piles A, B, C, D, and E:

> *Kenneth:* Beside my terminal [piles A and B] are basically piles of stuff about what I need in hacking in the recent past. The deeper you go, the further back it is. Off to the right [gestures to piles C, D, and E] is stuff that I've shoved to the right when the pile beside my terminal got too high. But I've periodically pruned it so it's no longer useful; it's just a pile of junk. . . ."
>
> *Interviewer:* . . . But these things [gestures to piles A and B]—you know pretty well what's in these piles?
>
> *Kenneth:* "Uh . . . there's probably one or two copies of the paper David and I have been working on, piles of notes on [two projects], and there's probably some other random things—documentation for computers . . . Here's—[pulls document out of pile B and reads its title]. Actually I have a newer one sitting in the—I know there's a newer one sitting in the pile [looks through the pile A] . . . and I don't know where it is. Ah! here's a good one—the new one.

A similar lack of clear organization prevails on the desk as well:

> *Kenneth:* The desk is sort of random. It's sort of mostly recent stuff, because I
> periodically do clean off my desk. For about 30 seconds it's clean. I usually separate
> it into piles that have to be instantly answered, should be answered in a week, or
> whatever has appropriate places. That pile there is mostly stuff that should be dealt
> with in a week . . . And its been sitting for months.
> 　　The desk mostly has right now sort of—I get infinite junk mail, subscribe to too
> many magazines. So a lot of that is magazine reading I haven't caught up on. And
> there's a few piles of critical stuff in there. I don't know . . . I'm sure when I find
> them, somebody will be mad at me for not answering their letter. I have a letter
> from Baker hidden someplace in here complaining about one of my papers. It's been
> here for a year and a half and I haven't answered it.   (K.H., 10/16/81)

The rest of the office has other piles of books and papers on the floor as well as
on tables and shelves. The bookshelves include binders of computer documenta-
tion, technical reports, and back issues of journals, some of which are filed with
carboard dividers. There are two bulletin boards containing assorted items such
as letters, phone messages, research notes, and a raffle ticket. The blackboard
contains, among other things, remnants of several conversations and two partially
redundant lists of things to do.[3]

Individual Differences

The difference among people that stood out most strongly in this study was the
variation in how precisely organized their offices were. At one extreme, offices
were filled with miscellaneous piles of paper, usually stacks of things to do
arranged in ill-defined groups. At the other extreme were offices that relied
heavily on information stored in files and in precisely characterized piles. In other
words, the two kinds of office organization could be called *neat* and *messy*.

Even though the ten people I interviewed did not constitute a large enough
sample upon which to base any confident statistical generalizations, they provided
some suggestive indications of differences between the two groups. As a rough
way of defining the two groups, I divided all the respondents into two groups
based on their answer to the question "How well organized would you say your
office is on a scale from 1 to 5?" The ratings people gave their own offices on this
question corresponded well with how I would have rated them. The four people
I would have considered messy were the ones who rated their offices 3.5 or below,
and the six I would have considered neat were the ones who rated their offices 4
or above. Using a rough method of counting piles in the photographs, there
actually were more piles in the messy offices than in the neat ones.

Two of the four people with messy offices complained that "medium important"
things sometimes "slipped through the cracks" in their office and did not get
done. None of the people with neat offices made this complaint. Even though no
effort was made to equate the difficulty of probe documents, it is also interesting
to note that of the three people with messy offices who were asked to find
documents in their offices, two were unable to find at least one document that

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[3] It is important to realize that this description of Kenneth's office does not imply that his work is
disorganized—in fact, quite the opposite seems to be true. It is true, however, that according to his
own description, the organization of Kenneth's thoughts and work is not clearly reflected in the
physical arrangement of information in his office.

was presumably somewhere in the office. Of the three people with neat offices who were asked to find similar documents, all were able to find the requested documents.

Even though these results are by no means conclusive, they give some support to the claim that people with messy offices do, indeed, have more problems finding information and remembering tasks than people with neat offices. (This claim seems eminently worthy of testing with a larger sample.) There is no indication in these results, however, that effort spent keeping an office neat is always worth it. For example, one of the people with a neat office said that he had spent over eight hours organizing the filing system in his desk drawer but that doing so had not been as valuable as he had expected.

Whether or not it is worth the effort to keep an office neat, it is clear that there is perceived social value placed on having a neat office. All of the people with messy offices made remarks that could be construed as joking or defensive about their offices, and several of the people with neat offices remarked about how they "couldn't stand clutter." If nothing else, the ability to hide some of this "clutter" in a computer system may be an important advantage of such systems for some people.

Differences Based on Job Content

The two examples described in the previous section suggest a possible relation between job content and neatness. The two people interviewed whose jobs involved a great deal of routine paper flow (the purchasing agent and a secretary who acted as a purchasing clerk) both had relatively neat desks. Of the eight people with nonroutine jobs, only half had neat desks and the other half had messy desks. In other words, neat desks may be more common among people with routine jobs than those with nonroutine jobs. (Paradoxically, neat desks may also be a sign of high organizational status. See Bralove [1]).

Clearly, a larger sample of people would be necessary to make any confident generalizations about the relationships between job content and desk organization. Aside from the possible difference in neatness, however, there seemed to be no consistent relationships in this study between the ways people organized their desks and the kinds of jobs they had. Managers and nonmanagers, case-oriented workers (e.g., physician and purchasing agent) and project-oriented workers (e.g., researchers), people with computer terminals and people without computer terminals all seemed to be use the same general kinds of organizing strategies. At the level of abstraction discussed in the remainder of this paper, differences in job content (and, by implication, differences in industry or location) do not seem to be a large factor.

MAJOR UNITS OF DESK ORGANIZATION

Two of the most important units of desk organization are *files* and *piles*.[4] Both files and piles are ways of collecting groups of elements into larger units. As

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[4] Tsichritzis [13, pp. 459, 462] makes a somewhat similar distinction in the Office Forms System (OFS): a *file* is a group of instances of the same type of form for which one or more ordered indices may be constructed, a *heap* is an unordered pile of documents of different types, and a *dossier* is a group of several different types of forms bearing some logical relation to one another.

Table I. Units of Desk Organization

	Elements titled	Elements ordered	Groups titled	Groups ordered
Files	Yes	Yes	?	?
Piles	?	No	No	?

defined in Table I, *files* are units where the elements (e.g., individual folders) are explicitly titled and arranged in some systematic order (e.g., alphabetical or chronological). In some cases, the groups themselves (e.g., entire file drawers) are also explicitly titled and systematically arranged; in other cases, they are not. In *piles*, on the other hand, the individual elements (papers, folders, etc.) are not necessarily titled, and they are not, in general, arranged in any particular order. (The dynamics of pile creation often give the piles a haphazard, inverse chronological order, but this is not usually a systematic or intentional arrangement.) Furthermore, the piles themselves are not titled and they are not necessarily arranged in any particular order on the desk or table top. Since piles have no systematic order, however, their spatial location is often especially important in finding them.

These technical definitions of files and piles were chosen to correspond to the commonsense meanings of the terms, but they can be extended to other uses as well. For instance, if the books on a shelf are not systematically arranged, the shelf can be considered a "pile" since its elements are unordered and the shelf itself is not titled. Shelves in a library would be examples of "files" in the sense used here since their elements are explicitly titled and systematically arranged. The dimensions of Table I can also be used to analyze other types of groupings. For example, a folder in a file drawer may be a group of elements (e.g., papers) that are not ordered, but the group itself (the folder) is explicitly titled. Thus the folder is neither a file nor a pile by these definitions.

Now what do these distinctions do for us? One of the first insights is that much of the organization on people's desktops consists of untitled piles, but that most computer systems require any new document or group to be titled. As suggested below, it may be desirable to incorporate the possibility of untitled piles in computer-based information systems.

FUNCTIONS OF DESK ORGANIZATION

It is no surprise that people organize their desks in part so that they can find things. But perhaps the most important insight from this study of desk organization was that, in addition to this *finding* function, an equally important function of most desk organizations is *reminding*. Much of the information that is visible on top of the desks and tables in most offices is there to *remind* the user of the office to do something, not just to be available when the person looks for it.

The distinction between finding and reminding rests on intentionality. If you become aware of something you intended to find, then the finding function has been served. But if, in the course of doing one thing, you become aware of something else without intending to, you have been reminded of the second thing. Thus piles on top of a desk remind their owners of things to do, without the owners having intentionally to look for what needs to be done. Even though

people sometimes intentionally look at their desktops to find what else needs to be done, a primary reason for placing tasks on the desktop in the first place is so that intentional search does not have to be relied upon.

Evidence for the Importance of Reminding

Five of the ten respondents made explicit remarks about the importance of reminding in determining what information was on top of their desks:

> If I don't put it here where I can visually see it, I won't do it. (M.P., 10/27/81)

> In that far left-hand corner, what you see is a couple of piles of things that I don't want to put away because I also use that as a prompter, okay. If it's on top of my desk it means that I really ought to look at it . . . . The further away from me it gets, however, the less often I am likely to look at it, except that it's always a reminder that it's there for a reason. I've not just put it there, and I've decided to file it there forever; I've put it there because I want to be visually reminded of it. And every time I look over there, I know what's over there. And I don't like it, but I know that I must get to it. And it may stay there for a week or two or longer. But it's not out of my field of vision and it is a visual prompter. It's always there. And if it's important to me, I won't really take it off my desk. I will leave it as far away from the primary work area as possible. But I can never completely ignore it. It makes for a sloppy desk, but I can never completely ignore it. It's not like putting it in a drawer. (A.D., 10/23/81)

> You don't want to put it [a pile on the desk] away because that way you'll never come across it again. [Long pause.] It's interesting how hard it is to characterize these things. I mean, in part for me, things that are out are things that—it's almost like leaving them out means that I don't have to characterize them. Leaving them out means I'm going to come across them again, and at the time that I come across them I'm going to decide what to do about them . . . Leaving them out means that I defer for now having to decide—either having to make use of, decide how to use them, or decide where to put them. (S.W., 10/12/81)

> I guess most of the stuff on the desktop is stuff that I feel is current in the sense that I have to deal with it—I should be doing something about it. This has been sitting here for over a month and I should be doing something about it right away, but it's problematic so it just sat . . . I didn't know quite what to do with it and life was so busy that . . . because it was a problem, I didn't do it. (B.J., 10/20/81)

> When I'm working on stuff, I always keep them out here so that I won't forget about them, 'cause if I put them away in the file where they'll be when I'm done then I forget. (D.R., 10/22/81)

In addition to these explicit remarks, a rough analysis of the piles visible in the photographs suggests that of those for which uses could be determined from the interviews about 67 percent were piles of things to do, presumably placed there to serve as reminders.

Evidence of Cognitive Difficulties in Classifying Information

As one of the respondents noted above, the difficulty of deciding how to classify something can be an important barrier to filing the information ("leaving [things] out means I don't have to characterize them"). Another respondent, in discussing how someone else could help keep his office organized said, "Well, see the hardest problem for me organizationally is deciding what the categories are and what category something is in" (K.H., 10/16/81). A third person had an elaborate (and presumably useful) system of cross-reference sheets in his author/subject files, but at the time of the interview, he had many documents scattered around his

office waiting to be filed. Apparently, the difficulty of classifying information in the file system was one of the forces leading to the creation of many vaguely classified piles on top of his desk and tables.

IMPLICATIONS FOR DESIGNING COMPUTER-BASED INFORMATION ENVIRONMENTS

There are several ways an analysis of existing desk organizations can inform the design of computer-based information environments. It can suggest problems in existing technology that might be solved by the new technology, and it can illuminate subtle but useful aspects of the existing technology that might inadvertently be lost in the new technology. I will discuss examples of both kinds of implications for the two functions of finding and reminding.

Finding

Computer systems can make both mechanical and cognitive simplifications in the three processes required for finding information: *creating classifications, classifying information*, and *retrieving information*.

Creating Classifications.   The mechanical difficulty of finding and labeling a new file folder is often nontrivial, especially when typed labels are used. When a filing system has several hierarchical levels (e.g., with different colored tabs and hanging folders), the mechanical difficulty of creating new categories can be a major barrier to keeping the file system current. For instance, one person (who had such a multileveled file system) had a number of loosely organized folders labeled with pencil at the back of his file drawer. He estimated that about 15 percent of his categories were obsolete and 15 percent more new categories should be added.

Computer systems can help with this problem by making the mechanical process of creating multileveled classification systems very easy.

Classifying Information.   Computers can help with the difficulties of classifying information in several ways:

(1) *Multiple classification.* Simply allowing the same document to be easily put in several categories is one way computers can simplify classification (e.g., see [2]).

(2) *Deferred classification.* Another way to simplify classification is to allow users to defer classification in the same way they do on desktops, by storing the information in some physical location (e.g., in a pile on a simulated desktop) without having to title the information explicitly.

These "electronic piles" should make the use of computer-based systems more natural. But without features like the automatic classification and reminding as discussed below, it could lead to computerized desks that are just as messy as some of their wooden counterparts.

In general, the notion of accessing information on the basis of its *spatial location*, instead of its logical classification, is an important feature of the way people organize their desktops that might profitably be incorporated into computer-based information systems. (See [7] for a lucid and foresightful analysis of this issue.)

(3) *Automatic classification.* Still another way to simplify classification is by automatically classifying information as much as possible. Some documents, such as electronic mail messages and on-line forms, contain explicit fields for information like title, author, and so forth. These documents can be automatically classified according to these fields, with no effort on the user's part. With more effort by the user, more complex sorting rules can be defined. Some relationships between documents (e.g., "in-reply-to") can also be used for automatic classification. A rough analysis of the file systems people described in this study suggests that relatively simple kinds of classification (e.g., author, title) account for a large proportion of the current file categories.

Another simple way of automatically classifying documents that is potentially very useful is based on when the documents were accessed. Two of the secretaries interviewed kept chronological files of all the documents they typed in order of creation. Both remarked about how this practice helped them find information that would otherwise have been hard to find. Another respondent, in trying to find a document, tried to remember when he had last seen it and with what other documents. Furthermore, causal observations suggest that the recency of dealing with a document is an important aspect of how we remember it.

A computer-based information system can implicitly classify all the documents it handles according to the dates on which they were accessed. Then the user can search for otherwise unclassified documents according to when he remembers creating, receiving, or otherwise accessing them. One can even imagine a system where users search for a document by a kind of simulated time-lapse photography of the history of their electronic desktop. They could "rewind" and "fast foward" the desktop to locate the last time the desired document was on the desk.

Retrieving Information. Conventional desk organizations (and many computer-based systems) allow users to specify only one retrieval key at a time (e.g., the title of the file folder or the nested sequence of titles in a hierarchical filing system). Many actual information needs seem to be more naturally specified by using more than one dimension at a time (e.g., "a message from M.A. Smith, last week, about the meeting in Palo Alto"). For instance, about one-third of the descriptions co-workers gave of documents for interviewees to find involved more than one dimension (e.g., author and title of a paper, or title of a form and the name of the person it was about). Furthermore, for about two-thirds of all the retrieval probes, the documents were not filed under the dimension(s) used in the description. For example, a document described by title and author was actually filed under the project to which it pertained. The ability to retrieve a given document using one or more of a number of different possible descriptors has been common in large database retrieval systems for some time (e.g. [6]) and would presumably be very useful in personal information systems as well (see [12]).

Reminding

Reminding is a subtle but very important aspect of desk organization. At the very least, computer-based information systems should not unintentionally be designed in a way that prevents their users from relying on the system for performing this reminding function of desk organization. To do this, systems

should make it easy for their users to store certain information so that it will automatically appear, without being requested. This may be one of the unexpected benefits of simulated desktops: documents can be left exposed on the desktop so that they serve as visible reminders.

By explicitly trying to facilitate reminding, computer-based systems may become even more useful. To design such systems well will require a better understanding of the subtleties of human scheduling, procrastination, and forgetting than is afforded by this study. But several possibilities seem intriguing. For example, if users classify the documents they want to be reminded of in terms of priority, then the system can indicate this priority in several different ways:

(1) *Frequency.* High priority tasks are displayed often, say every day, and low priority tasks are displayed seldom, say once a week or month. This scheme (which resembles one used by a manager and his secretary in the study) has an important advantage over piles on a desk. When things to be done are piled up on a desk, old things are covered up by new ones. With a frequency-based reminding system, even low priority items are guaranteed to appear occasionally.

(2) *Size.* Higher priority items are represented by larger icons.

(3) *Location.* Higher priority items are located in special places, for example, nearer the top of the screen.

(4) *Color.* Priority determines color, say red for high priority, blue for low priority, and others in between.

In addition to indicating priorities, a computer-based system can automatically change priorities over time. Some tasks, such as replying to important letters, probably increase in priority over time. Others, such as reading journal articles, probably decrease in priority the longer they remain undone. A semiintelligent reminding system could recognize some of these distinctions and have others assigned by the user. Then, for example, some documents on the screen might gradually change color, from blue to yellow to red, the longer they remained undone, while others would change in the opposite direction.

In addition to tasks that are classified by *priority*, there are tasks that are classified by *date* (e.g., deadline) and by *event* (e.g., some interviewees had things grouped to do when they returned to an inactive project or when they saw a certain person). Computer-based systems can easily issue reminders based on date, and some systems have been designed to trigger reminders based on certain kinds of events. For instance, Buneman, Morgan, and Zisman [3] describe a system which can alert its users when specified conditions occur in a database (e.g., a stock price reaches a new high).

CONCLUSIONS

One of the most salient features of the way people organize their offices is that some information is stored in *files* and some in *piles*. Offices that include many piles appear to be messy and may also be less useful to their occupants.

What, then, are the forces that lead to the creation of piles? There appear to be four:

(1) The mechanical difficulty of creating labeled file folders, binders, and so forth, especially if multiple levels of classification are desired.

(2) The cognitive difficulty of creating appropriate categories and deciding how to classify information in a way that will be easily retrievable.

(3) The desire to be reminded of tasks to be done.

(4) The desire to have frequently used information easily accessible.

Paradoxically, these forces can be self-defeating. As more and more information is stored in loosely characterized piles, it becomes harder and harder to find things, and items that were placed to be visible as reminders become covered up and no longer serve that purpose.

Electronic office systems can help with these problems by simplifying the mechanical processes of filing information and by providing "intelligent" aids for categorizing and retrieving information and for reminding about things to be done. At the same time, these systems should continue to provide two of the functions of conventional desks: easy storage of loosely classified information and convenient use of visible reminders.

APPENDIX

At the end of the interviews, all the respondents were asked the following standard set of questions:

1. How well organized would you say your office is on a scale from 1 to 5? [1 = not very well organized, 3 = about average, and 5 = very well organized]

2. What would you say are the biggest problems you have with the way your office is organized?

3. Do you keep lists of things to do?

4. Do you keep a calendar of appointments?

5. How often are you unable to find something you are looking for in your office? [Number of times per week or month]

6. How often do you forget to do something you were supposed to do? [Number of times per week or month]

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