The integrated office system of the future that relies upon computerized applications for most routine work will have to be a friendly system that can be used by individuals with a minimum of training and no previous computing experience. A discussion of the computer-assisted aids to office work that have evolved at the IBM Thomas J. Watson Research Center provides a preview of the possibilities for future office systems based on computers. We describe tasks that have been computerized, the environment in which automated office applications are used, and the reactions of people who use the computer for routine office work.

A research perspective on computer-assisted office work

By A. M. Gruhn and A. C. Hohl

Where interactive computing systems are available, there are often prototypical components of the office of the future. As a natural outgrowth of the availability of interactive systems and display terminals, a variety of office tasks have been "computerized" for the convenience of individuals at the IBM Thomas J. Watson Research Center in Yorktown Heights, New York. This paper reviews the automated office procedures that exist at the research facility in Yorktown and offers observations regarding their acceptance by the user community.

The applications discussed in this paper are used in real, working offices in a research laboratory. They do not exist in a test atmosphere; rather they are important facilities that enhance productivity and enable deadlines to be met. As a matter of convenience, the office applications have been made available on the large computer systems installed at the site for scientific computing. Most of them could just as easily be offered on much smaller computers.

In 1970 interactive computing services at Yorktown were used only by programmers and a few scientists. In eight years, the services provided by the Computing Center at the site have evolved into general facilities used routinely by hundreds of scientists and administrative personnel. As part of this evolution,

many tools that can be classified as *aids to office work* have appeared. Specific aids for text processing, for general information dissemination, for data base storage, query and retrieval, and for communication via electronic messages or mail are included in the descriptions of existing automated office procedures that follow.

Our intent in this paper is to give some samples of computer-assisted aids and not to exhaust the list of possible applications. We have therefore selected those aids which, in our experience, have proved most useful because they enhance productivity, and are both easy to invoke and predictable in behavior.

Many of the aids described are not unique to the Yorktown installation. What makes them of particular interest is the extent to which they are used by a large number of people, many of whom are not initially familiar with computers or computing systems. In the final section there is a discussion of the problems encountered by users of the automated office procedures and a summary of the reactions observed by the consultants who assist them.

Selection of computerized aids

A difficult decision faced by the designer of automated office aids is the selection of functions to be computerized. One must decide not only *what* to put on the computer, but more significantly *how* to do it. Furthermore, a good explanation of *why* a particular task should be selected must be available to allay any fears on the part of future users. We believe the importance of designing a good interface between the user and the computerized function cannot be overstressed. To be useful, the computerized function must be natural to use and must not perturb the remaining manual procedures.

The following criteria can be applied to office tasks to determine whether they are good candidates for a computer application. A "yes" answer to any of these questions indicates a likely candidate.

- Is the task a simple, repetitive sequence affecting data, and is this sequence executed often?
- Is there a sizeable and/or volatile body of information that must be maintained or that is frequently referred to by a variety of individuals?
- Is the function too time-consuming to do at all without the computer?
- Is the function one that does not yet exist, i.e., one that is not possible without the computer?
- Is the task one that can be enhanced by the use of an interactive computing environment?

A brief look at the table of contents of a secretarial handbook[1] suggests many candidates for computerization as outlined in the following section. We later describe facilities at Yorktown that provide computerized aids for most of these functions. As you read this paper, note that many of these functions require the involvement of *two* people—a sender and a receiver—and thus require that both the principal and the secretary (and coworkers with whom they deal) use the computerized aid. Ideally, an interactive display terminal should be at each desk to complement the communication service provided for voice by the ubiquitous telephone.

typical functions

To visualize an automated office, it is helpful to consider some of the functions that might be used in place of traditional manual office procedures. Later sections describe specific tools in use at Yorktown that fall into one or more of these categories.

Reminder systems handle volatile information that must be kept up-to-date. On-line calendars, tickler files, and follow-up files are some of the facilities that one might provide.

Filing systems with keyword retrieval and data security provide enhanced function and increased integrity when data is stored electronically.

Typing aids such as context editors, text formatters, chart makers, and spelling checkers enhance individual productivity.

Mail facilities for electronic mail as well as aids for generating batches of external mail from address lists ease the task of information exchange. Applications that personalize each piece of mail are attractive candidates.

Miscellaneous aids include tools for computing common figures (e.g., mileage for expense accounts), for rapid retrieval of information from lists (e.g., phone number lookup), and for manipulating structured files (sorting, rearranging, etc.).

New functions such as the preparation of high-quality, camera-ready reports are possible when an integrated office system is used. We will discuss computerized aids at Yorktown that assist in producing such reports.

The office environment at Yorktown

Before reviewing the computerized office procedures that are in use today at this research laboratory, let us describe our office environment. Office work at Yorktown comprises both general business functions and research functions. General business

functions include typing, document preparation, mailing, filing and retrieval; research functions include the rapid publication of a large number of technical reports and the organization of conferences and symposia.

The research office differs from the general business office only in the percentage of time spent on typical office procedures—less time is spent filing and processing letters or forms and more time is spent preparing manuscripts. There are special text-processing facilities, both hardware and software, that have been provided to make the document creation process easier. Nearly all of the secretaries at Yorktown use the computing facilities for some of their work, and it is not unusual for a secretary in a scientific department to spend well over 50 percent of her time on computerized text processing.

a typical office layout

A secretary at Yorktown typically supports a manager and the professionals who report to that manager. The secretary's office equipment often includes an IBM Communicating Magnetic Card Selectric Typewriter (CMCST) and an IBM 3277 Display Station. A suitable hard-copy printer will be located nearby if the secretary has only the display station in her office. The manager and the professionals may also have displays.

The display station is used for most entry and editing of data. As a terminal, the CMCST is used primarily as a printer; it is also used in stand-alone mode as a Mag Card Selectric typewriter. Many secretaries have two user accounts within the computing system. This permits them to edit files at the display using the primary account while completed documents are printing at the CMCST using the secondary account. Having a "second pair of hands" increases productivity; while one terminal is printing (and thus needs only casual attention), the other can be used for a different task.

communication paths

Many communication paths exist within the interactive computing system. We described above how the secretary communicates with herself using two user accounts. It is also possible to look at files owned by someone else (if you know the password), to obtain copies of those files, and to send copies of files to individuals at Yorktown or elsewhere on the internal computer network that links many IBM locations.[2] When communication involves the use of an interactive computer system, the amount of paper movement in an enterprise is reduced. Robert White of Citibank estimates, "Internally generated correspondence accounts for 90 percent of the paper that crosses our desks."[3] Electronic mail and sharing of files reduce significantly the amount of paper generated and speed the exchange of information.

the computer installation

The computer installation at Yorktown includes three IBM System/370 Model 168 mainframes, one Multiprocessor (MP), and one Attached Processor (AP). Two mainframes are dedicated to running the Virtual Machine Facility/370 (VM/370) with the Conversational Monitor System (CMS), and one to running the Multiple Virtual Storage (MVS) Time Sharing Option (TSO). Large amounts of computer resources are used for experimental software development and to support laboratory projects in mathematics and the physical sciences. Automated office procedures are only a small part of the computer usage.

computerized aids

The locally written or enhanced computer programs at Yorktown that can be applied in the office can be compared to a collection of tools in a tool box. When a function needs to be performed, the user goes to the tool box (here, the computing system as accessed from a display terminal) and selects the appropriate tool (by typing in the desired command). There may be two or more tools that will perform the desired task; in this case, the user picks one because it is easier to use or perhaps because it does a better job.

The office environment at Yorktown is a dynamic one. New aids are under development as this paper is being written, and others are being modified to improve their usability. We are constantly attempting to improve the facilities that are available and to understand why one tool becomes popular while another does not.

how aids are created

Many of the aids described in the next section evolved because a programmer wrote a specific tool for personal use, decided it had general applicability, modified it to be used by other individuals, tested it on friends, and announced its availability to the general computing community.

Other aids have been developed by groups in the Computing Systems and Computer Sciences departments of the Research Division of IBM. Several projects have contributed in an official capacity by providing local hardware and software facilities and by enhancing certain IBM products to support specialized functions.

It is important to note that the computing systems serve the entire user community and office applications share resources with such projects as physics experiments as well as software development projects. The computer is not dedicated to the support of the office; that is only one part of its overall workload. Since many applications run on the same computer, tools created for one set of users are available to others. The scientist finds it easy to use text-processing facilities, and the administrative user has ready access to calculation aids originally developed for technical users.

Selected aids

We now sample representative facilities in use at Yorktown.[4] References to additional information about the facilities are included where such information is available. The descriptions are grouped into the following categories:

- *Text-processing facilities* include locally written software and special hardware not generally available. Both provide assistance in standard administrative-secretarial jobs and also allow for the production of camera-ready output for books and other publications.
- *News facilities* allow the dissemination of timely information to all subscribers.
- *Help aids, query facilities*, and *on-line data bases* ensure documentation is current and immediately accessible.
- *Specialized tools* exist to enhance individual productivity, including calculation aids, quick lookup commands, automatic mail facilities, and other computer-assisted office procedures.

Text-processing facilities

Advanced tools have been developed at Yorktown to support the document processing typical of a research installation. Textbooks, articles for submission to technical journals, and internal reports are the main text products of the scientist at Yorktown. Text-processing facilities are used extensively in the organization of several symposia and conferences a year and in the publication of proceedings to be distributed at each event. The volume of letter and memo writing is lower than in most offices.

Because multiple operating systems are in use at Yorktown, a strategy was developed in the early 1970s to ease the movement of text-processing users from one system to another. Many users log on to a computing system only to perform simple operations such as the entry or modification of the text of a memo or report. An editing program helps the users to interact with the computer to create the file that contains the text of the report (and optionally, formatting instructions). We wanted to provide a coherent environment in which these users could perform their work. Specifically, one editing program was chosen to be supported on all the systems; it would be taught to the secretaries and other new users. The same text-formatting facilities would be provided on all systems (or at least, ways to transmit a file automatically to and from the appropriate processor). Where possible, aids that prove popular and useful on one system would be adapted to run on the other systems.

editing programs

There are three editing programs (also called editors) in wide use at Yorktown. An editor is a program used to enter data into a file and to modify existing files.

We have a locally enhanced version of EDIT,[5] the interactive editor provided with CMS. The enhancements include commands to allow editing of hexadecimal data, commands that give the user access to the current edit environment (such as window or current line number), and commands to set up default edit environments.

Another editing program, EDITOR, is an outgrowth of the original editor developed for CP/67 (Control Program/67) in the late 1960s. EDITOR has many features similar to the CMS EDIT enhancements. Its power comes largely from the macro interface and the large set of edit macros that accompany the basic editing software. For example, there is a PARA macro that takes a block of free format input and arranges it into a ragged right paragraph. The user has the option of specifying whether or not the first line is to be indented. Since EDITOR macros are much easier to write than EDIT macros, one is tempted to write more elaborate macros to simplify the tasks of entering and editing manuscripts or raw data.

REDIT,[6] the Research Context Editor, was originally supported under TSS/360. It now executes under both VM/370 and MVS/TSO and is taught to the secretarial and administrative support employees at Yorktown. Like EDITOR, it has a powerful macro capability.

All three editors offer facilities for locating and changing text on the basis of context, making global changes, moving and duplicating blocks of text, and loading part or all of another file into the file being edited. They also provide functions to change or specify file characteristics and to enter the hexadecimal codes for non-keyboard characters.

Facilities needed for editing text documents are available in all three of these editors largely because of the communication among the developers. When a function is added to one editor, the developers of the other editors find out about it and often incorporate a similar capability.

Current experimentation with new editors is addressing the effects of various techniques for full-screen editing in an attempt to define what is "good" full-screen support. In a full-screen editor, the user can directly alter the contents of any line he sees on the display screen; other editors allow changes to be made only in a designated *input area* that is typically one or two lines high.

The only full-screen editor that is available on all our computing systems is the Structured Programming Facility (SPF) Editor[7] that is available under TSO. We have installed an internally developed implementation of the SPF Editor that operates under CMS.

A user selects a particular editing program for use either because it is the one with which he is most comfortable (usually because it is the one he learned first), or because it provides some special feature needed for a particular editing task.

formatters

Formatting programs aid the user in creating nice document layouts. The user creates a file containing textual data combined with formatting instructions. The formatting program uses the instructions to determine the placement and spacing of the text on the pages of the document.

SCRIPT is the basic language used to format text. We provide several versions of SCRIPT as well as the Yorktown Formatting Language.[8] SCRIPT provides formatting for the common office printing devices, including the CMCST, high-speed line printers and the IBM 3800 laser printer. The Yorktown Formatting Language provides formatting for such high-quality output devices as photoprinters.

We provide SCRIPT/VS[9] and the Generalized Markup Language (GML)[10] that accompanies it. Users are slowly changing to SCRIPT/VS from older versions of SCRIPT.

We have enhanced an early version of SCRIPT (as well as VM/370 and the CMCSTs) to provide support for the Communicating Magnetic Card Selectric Typewriter stop code and reverse index features. The reverse index feature provides codes for "half up" and "half down" and makes it easy to produce simple mathematical expressions containing subscripts and superscripts. We plan to make this enhancement to SCRIPT/VS.

Much of the material produced at Yorktown is high-quality, camera-ready copy. At a display terminal, the user creates files containing text and formatting specifications in much the same way an editor marks up a manuscript to prepare it for printing. The Yorktown Formatting Language[8] program is used to process the user's files. The Yorktown Formatting Language consists of SCRIPT-like control words and enhancements that provide the capabilities needed for proportional text formatting. Since it is essentially a superset of SCRIPT (with a few restrictions), the user need learn only *one* formatting language to achieve a variety of styles of output.

Much technical (mathematical) information appears in the reports written by the Yorktown scientists. To aid in the formatting of technical text, we have developed the Yorktown Mathematical Formula Processor (YMFP). It exists as a component of the Yorktown Formatting Language. YMFP is designed after the Bell Labs formatting language EQN.[11] It provides a natural means of speci-

fying mathematical expressions. Formatting decisions such as the font to be used and the size and placement of subscripts or superscripts are made by YMFP, not by the user. For example, the statement

.eq y = sum from x = 1 to infinity of 1 over x sup 3

causes the following equation to appear in the output:

$$y = \sum_{x=1}^{\infty} \frac{1}{x^3}$$

The file created by the user is processed by the Yorktown Formatting Language program. The output from this program must be processed by TERMTEXT/Format (TT/F).[12] TT/F is a text formatter that creates full, multicolumn pages suitable for output from a photoprinter or a line printer. Its language is more awkward to use than SCRIPT, and we therefore use the Yorktown Formatting Language as our user interface to TERMTEXT/Format.

macro facilities

P. J. Brown defines a macro very simply as "a facility for replacing one sequence of symbols by another."[13] Similarly he describes a macro processor as "a piece of computer software for supporting macro activity." Macro processors provide powerful tools for customizing formats and procedures. Many such facilities exist today at Yorktown and can be used to simplify routine office tasks.

EXEC 2[14,15] is a "computer language for word programming." It derives from the CMS EXEC language. EXEC 2 is well-suited for manipulating English-like words as they appear in computer command languages. It has facilities for simple string manipulation and integer arithmetic. At Yorktown, EXEC 2 coexists with the standard CMS EXEC processor. Users can create EXECs using either language. Since the EXEC 2 language eliminates the problems associated with CMS tokenization (CMS *words* are truncated to eight characters) and executes more efficiently, it is the language of choice for new facilities intended for use here.

Users at Yorktown have also developed special-purpose macro processors, some of which have application in the office environment. At this writing, there are at least four macro processors that perform specialized text-formatting transformations on an input file, thus reducing the keystrokes required to enter the text in the first place. Two are described here.

PREP2[16] is an aid to preparing files for output using the Yorktown Formatting Language. It was originally developed to assist in the input of special characters for RTC, an earlier formatting language used at Yorktown. PREP2 is used to simplify the task of entering

simple mathematical expressions and special graphics in a text file. It provides the user with an input file that is intuitively readable at the display station. Instead of viewing the font changes and hexadecimal notation required for a Greek alpha, for example, the user will see .AL when the file is edited and α when the file is printed.

TMP[17] is another text-oriented macro processor that can be used as a front end for our text formatter. TMP operates more efficiently than PREP2 and can reproduce many of the PREP2 functions. TMP allows the user to tailor the definition of text replacement macros to create a format that he finds readable and usable. TMP also has a "back end" processor that permits direct formatting of the text using TT/F, thus bypassing the Yorktown Formatting Language.

spelling verification

PROOFER is a spelling checker program that is in common use at Yorktown. This program is used to check all the words in a text file against a provided dictionary. When PROOFER is run against a file, the possible outputs include a listing of the words in the file that match words in the dictionary, a listing of the unmatched words (i.e., the potential misspellings) together with suggested correct spellings, and a copy of the document text with the unmatched words highlighted. The user can provide his own dictionary of correctly spelled words in order to personalize the verification process.

cipher

The CIPHER command gives the user access to a software implementation of the Data Encryption Standard (DES)[18] cryptographic algorithm originally developed by IBM and subsequently certified by the National Bureau of Standards as meeting the requirements for a national standard for data encipherment algorithms.

printing labels

The LABELPRT facility is used to print address labels on special forms. The file containing the labels must conform to a standard format. A printed mailing list and multiple copies of each label are possible as options on the LABELPRT command.

News facilities

Because the computing environment at Yorktown is so dynamic, there is a requirement for on-line "publication" of changes and additions to the available functions. If this information had to be printed and distributed in hard-copy form, it would no longer be timely, and many users would be inconvenienced. There are two on-line "newspapers" that users are encouraged to review on a daily basis. By including the appropriate commands in a logon procedure, users can ensure they will receive the latest an-

nouncements each time they use the computing system. The POSTER board presents articles of a general nature. NEWS is a facility for announcing changes to a particular disk containing software "tools" that is accessed by most users on a daily basis.

poster Items published on POSTER may address new software facilities or warn of hardware changes. They may announce classes being held that day, or they may contain general requests for information. If the topic of the POSTER article is of continuing interest, it will also be printed in the next issue of the Computing Center newsletter and will be entered into GETNEWS, the on-line newsletter data base.

news The NEWS announcements are usually of a technical nature and tell the programmers who access the software tools disk that something has been changed or added. NEWS announcements often refer to a longer explanatory document that also appears on the tools disk.

calendar The CALENDAR facility is used to announce events that are taking place within the building. It is an on-line version of the printed Research Calendar that is distributed on a weekly basis. Users can set up profiles describing the topics in which they have an interest. Each day when they sign on to the computer system, CALENDAR will remind them if talks on the specified subjects occur that day.

HELP aids, query facilities, and on-line data bases

Although there is a wealth of useful tools in existence for casual users, it is not always easy to discover what these tools are. Several interactive mechanisms have been established to provide users with current documentation of available facilities. We emphasize the two words interactive and current; *interactive* because users do not want an office filled with hard-copy documentation and *current* because users want documentation relating to today's computing environment, not yesterday's.

Our interactive computing facilities are constantly growing and changing, and hard-copy documentation may be outdated before it can be printed and distributed. We therefore attempt to keep as much as possible of our local systems documentation on line and use the hard-copy Computing System User's Guide[4] as an index to the GUIDE data base. When an update is made to a section of this data base, notification of the change is sent automatically to all users who have referred to that section.

There are at least three query facilities employed by our user community on a daily basis. HELP and GETNEWS provide information relating to use of the computing systems, whereas Query-by-

Example is used for application data bases. Multiple facilities exist because HELP and Query-by-Example are the results of research projects into user interfaces for natural language documents and relational data bases, respectively, whereas GETNEWS is an attempt to provide keyword access to the mass of local on-line documentation that exists at Yorktown.

help

The HELP facility was developed in an attempt to provide natural language querying of on-line manuals. There is no active development of HELP today, and what exists is a collection of on-line manuals structured for presentation at a display station. The query language employs menu selection and keyword triggers.

In addition to local documentation of facilities developed at Yorktown, a few manuals from the IBM Systems Library are included among the HELP data bases.

getnews

The Computing Center newsletter is issued monthly to users of the computing systems. In addition to the hard-copy newsletter, there is an on-line data base that is accessed using the GETNEWS command. Users can search the newsletters using keywords to locate relevant articles. A function called ALERT allows users to specify keywords of particular interest. If a new article relating to the user's keyword list is entered into the data base, a notification is automatically sent to the user before the newsletter is published.

Query-by-Example

Query-by-Example (QBE)[19] is a high-level data base management language that makes it particularly easy for users to query, update, define, and control a data base. QBE is used to track travel expense and travel data in at least one department, to keep records of instructors who have taught courses in the Education Department's programs, and to chart formal visits to the Research Center, including who attended and who gave presentations. Other experimental applications at our location include the management of library files and individual correspondence files.

archive

Technical manuscripts and reports must be kept available for revision during review for publication. The archive facility on VM/370 allows users to keep backup copies or multiple versions of these files available on line without cluttering up their assigned disk space. Retrieval of the files stored in the archive library is typically accomplished within an hour from the time of the request. The archive facility includes commands to store and retrieve files, to grant access privileges to other users, to tag files with descriptive information, and to list the contents of the archived library.

Specialized tools for communication

Communication with coworkers has been made easier by implementing interactive mail facilities and by providing access to on-

line data bases such as the IBM Research Division's telephone directory. There is also an experimental facility for the storage and retrieval of verbal messages.

mail The MAIL facility provides the user with a standard heading for a memo to another user of the internal computer network. The sender simply types in, for example, MAIL TERRY, and the following template is presented at the display terminal:

```
To: TF44EKFP(ABCD2)

From: GRUHN(YKTVMV)     Phone: 8-862-3000     78/04/28  14:19:10
```

The user types in his message and files it when it is complete and correct. At this point, it is sent to the addressee.

Note that the original command (MAIL TERRY) used the nickname TERRY, and the actual address was automatically located and inserted in the To: field. The sender's phone number and network address were also inserted automatically, together with the date and time of the message.

When a user *receives* mail, a command called CARDS may be used to read the file onto disk, display it immediately, and then append it to an appropriate file. The user can set up a NORMAL CARDS environment which, among other things, specifies whether the incoming mail is to be appended to a general "old mail" file that includes copies of all mail received, or whether it is to be sorted by name so that all incoming and outgoing correspondence with a certain individual appears in one file.

nickname In the above example, we illustrated one use of the NICKNAME facility. It is also possible to create lists of addressees and to refer to those lists when transmitting messages or mail electronically. For example, MAIL DEPT308 might cause the memo to be sent to each member of the indicated department. The To: field of the memo header would then include each member's network address. A CC: option allows the sending of copies to an additional set of individuals.

phone If you have ever spent precious minutes searching through desk drawers and stacks of papers looking for an in-house telephone directory, you will appreciate the convenience of an on-line telephone directory. At our location, a user logged on at a terminal can simply type PHONE JONES to look up the phone number of an associate whose last name is Jones. It is also possible to look up a room number to find out who the occupant is, or to look up a phone number and find out where it is located and to whom it belongs. You may not even have to know how to spell the name correctly. Because a PHONE request results in the display of a 10-line "page," a misspelled name or a partial name usually results in the display of the appropriate excerpt from the telephone directory.

The on-line telephone directory proved so useful that an additional data base of internal IBM tieline numbers and the associated geographical locations has been made available for interactive use. It operates in the same manner as the PHONE lookup. The on-line lookup mechanism is one that can be applied to any frequently referenced list of names, numbers, or items.

tieline

The Speech Filing System (SFS) is an experimental in-house computerized voice message system in use at this laboratory. This facility gives users the ability to enter, edit, list, index, and store verbal messages from any pushbutton-dial telephone and to send those messages to other SFS users.

speech filing system

Specialized tools for simple calculations

Simple calculations are often needed to complete forms or tally results for reports. In addition to the complex computational facilities such as APL and FORTRAN, there are some easy-to-use calculation tools available to the interactive user. Some of these facilities are special-purpose calculation aids, whereas others are of the more general desk calculator variety.

The MILEAGE function calculates the reimbursement for business travel in personal vehicles. The user can enter the number of miles driven, or the name of the place driven to, and the reimbursement is automatically computed and displayed at the terminal.

mileage

There are two aids in wide use at Yorktown that provide the functions of a pocket or desk calculator at the interactive terminal. For simple calculations, either aid is quite adequate, and users select one or the other largely based on whether they prefer the FORTRAN or APL style of arithmetic precedence.

"desk calculators"

The MATHC facility gives the power of an engineering desk calculator at the user's terminal. In addition to the arithmetic operations of addition, subtraction, multiplication, and division, MATHC has trigonometric functions and a few special functions such as HEX and AVERAGE. There is also provision for user-defined FORTRAN-like functions.

An expression evaluator named EQUALS can also be used to perform decimal or hexadecimal arithmetic. Evaluation is done using APL rules, but expressions are entered using FORTRAN operators (i.e., * means multiply) as a convenience for users whose display keyboards do not contain the appropriate APL characters for arithmetic operators.

Standard templates

There are many formats and procedures that are standard throughout the IBM Research Division. Some of these exist as

"electronic templates." An electronic template may simply be a data file with comments that the user can copy and tailor to achieve the desired result, or it may be an interactive program that prompts the user for the information required to satisfy the initial request.

For example, most of the articles submitted for publication by authors in the division are disseminated internally as research reports. To create the appropriate format for one of these reports, the secretary may simply copy the file named RCFORMAT and fill in the necessary data (title, author, abstract, body text).

Individual users have tailored other standard work products using similar facilities. Candidates for standardization include internal memos, letters, and articles for a particular journal. Some existing user applications include semi-automatic addressing of correspondence from a personal mailing list, automatic naming and formatting of letters and memos, and semi-automatic inclusion of specific references from a general reference list.

One of our goals for the future is to provide a data base of aids for generating text documents; at present, there is little sharing of templates among groups or departments, and it is difficult to learn just what does exist.

General aids

There are other miscellaneous facilities that make the computer a friendly and useful addition to one's office. If one simply wants to send a short message to another user, there is a message facility (MSG or RMSG) that can be issued without creating and editing a file. MSG JOE CAN YOU MEET IN SUE'S OFFICE NOW? is a sample use of such a facility.

There is another aid called REMEMBER that permits the user to store reminders for presentation at a later date. When a reminder comes due, it will be displayed for the user when he next signs on to the computing system. Another experimental facility called REMIND will send a message to the user at a specified time, for example,

14:25:02 MSG FROM REMIND: Department meeting in 5 minutes.

Observations on training and use

When a new computer-assisted procedure is introduced, there are questions that must be addressed. How are users to be trained in the use of the procedure? Is it necessary to take additional steps to ensure the computerized aid will be accepted by users? What

problems might be observed as a result of introducing the aid? In this section we look at some of the problems we have observed and the solutions we have attempted. The observations offered here are based on several years' contact with people who use computers in everyday office work.

Gruhn has programmed office/administrative applications for ten years and has for the past five years written and maintained programs in wide use by the text-processing community at IBM's Research Division. Hohl has had secretarial training and experience outside IBM and at Yorktown. From June 1976 to August 1978, Hohl was responsible for teaching and consulting with all users of text-processing and office applications at Yorktown, working closely with Gruhn and other members of the text-processing programming staff. During that two-year period more than 130 people attended formal classes, and an estimated 100 additional users received individual instruction and/or consulting assistance from the text-processing group. The observations that follow are based primarily on our joint experiences during that period.

training

Training includes individual instruction and formal classes. New users of the computing systems at Yorktown are asked to fill out a questionnaire detailing their expected use of computers. They are encouraged at that time to ask for individual instruction geared to those projected uses. This approach has evolved over the past two years and has been particularly successful in the areas of text processing and administrative computer usage.

In the past, formal introductory courses were offered. Experience has shown, however, that newcomers to the text processing facilities at Yorktown learn a little more quickly and with less initial frustration when they are introduced to the system individually. After such an introduction, which typically involves five to ten hours of instruction, the inexperienced user is ready to do simple work on the system and has the background to understand and assimilate the material presented in regularly scheduled courses.

Course offerings are flexible and are tailored to current needs and to the presentation of new material. A consultant is available to help users who missed a course and to troubleshoot when users run into problems they cannot solve themselves. In addition, mini-courses and seminars provide a forum for presenting new programs and reviews of existing facilities.

Users frequently find that a good source of help is a knowledgeable and friendly neighbor. Cooperation among people who use the computers for similar work allows the exchange of hints useful to the specific task at hand. This not only supplements the official training efforts, but helps new users view the use of the computing systems as a normal part of everyday work.

support

Technical administrative support is required to coordinate the growth of computerized aids to office work. Many administrative tasks are obvious choices for computerization—tasks that fulfill the criteria stated earlier. In many cases, clerical and administrative personnel are encouraged to "get the job computerized" without sufficient analysis of the most efficient and productive way of doing that. The atmosphere at Yorktown is one of *not* standardizing tasks, in order to stimulate the most ingenious and productive use of various facilities. However, the tools are available in such abundance that a naive user needs, at the least, some advice on which tools are best for the task at hand, and at the most, expert analysis of the job to be done. To computerize a set of tasks effectively, someone must study the existing procedures, be familiar with the available programs, and explain recommendations to inexperienced users. This kind of assistance is not now sufficiently available to support the rapidly growing demand of professional and administrative departments for computerized office functions.

documentation

On-line documentation is an important part of an interactive system. The feedback we have received from users at Yorktown has led us to conclude that there are three major factors affecting the successful use of on-line information as a reference to available programs: first, it is important that the information be kept current and easily understood; second, the user community must be aware of *what* is available on line and *how* to refer to it; and third, the user should be able to find out *who* is responsible for the creation or maintenance of a particular facility.

Some attempts have been made to answer these needs. The on-line news facilities provide a medium for alerting the user community to the existence of newly developed facilities. *A User's Guide to Computing Services and Systems at the Thomas J. Watson Research Center*[4] (also available on line in the GUIDE data base) provides an overview of the facilities available at Yorktown and references the on-line and hard-copy documentation of those facilities. The editor of the Computing Center newsletter at Yorktown is responsible for keeping the GETNEWS and GUIDE data bases up to date.

A convention has been established that all local facilities should be self-documenting, so that a user can get a quick guide to the use of an aid simply by typing its name followed by a ? at his terminal. When a facility is added to the software tools disk, the programmer who developed the facility must identify himself as its owner. Any user can then invoke the OWNER command to learn who is responsible for a specific tool.

Self-documenting commands and on-line referencing facilities are feasible only when display terminals are readily available. The

need for current information has prompted on-line documentation, and the increasing availability of display terminals has made it an acceptable way of accessing information. In the last five years, we have seen hundreds of people who had never before used a computing system become comfortable with "asking the computer" how to use the available resources.

There are several distinct advantages to documenting available facilities on line. Important to Yorktown computer users is the fact that some information is available *only* on line (for example, the ownership of a specific tool). Even when hard-copy reference material is available, the user can be assured that the on-line material represents the most up-to-date version of the documentation. Additionally, the user is freed from the necessity of having manuals at hand when the information is needed. The terminal at which he is working provides direct access to the documentation. The quick guide to the use of a program available by typing its name followed by a ? is a very fast way to review the use of a familiar command. Our experiences at Yorktown indicate that the on-line documentation of programs is a useful effort, and experiments continue to determine the most effective means of presenting such information.

informing users

A computerized aid is generally introduced to the computing community by an on-line announcement that includes some explanation of how to use the new facility, how to find out more about it, and the person to whom questions should be addressed. But, better mechanisms are needed to make users aware of available aids.

One frequently learns about a computerized aid from a coworker. It is probable that more information is passed by word of mouth than by any other means. This may be the best way for someone to learn about pertinent aids, since the information is likely to come from someone with similar requirements. However, second- or third-hand information is potentially misinformation.

If the user does not need a new program at the time its availability is announced, he may not remember that it exists when he *does* need it. We schedule seminars and review sessions throughout the year to remind users of the existence of a set of programs or options that provide a useful function.

individual instruction

We have observed new users of the computing systems approach computers and terminals with different attitudes. Many people are quite adventurous—seeing so many people using the system for a wide range of applications gives them the confidence to approach something new enthusiastically. Others are reluctant to give up an older method in which they are particularly competent for the as yet unproved (in their minds) advantages of a comput-

erized office application such as text processing or record-keeping. They are put in the position of starting over, of having to learn while they keep up with their daily work, and thereby of suffering a temporary loss of productivity. A third user approach is characterized by fear—fear of the machinery, fear of "breaking" the computer or of irrevocably messing up or losing data, or fear of the loss of control implied by the remoteness of a very large computer as contrasted with the control one has over, for instance, magnetic recording equipment and one's own file cabinet.

Individual instruction for the new user provides an effective and friendly introduction to computerized aids. The successful education of the fearful or reluctant new user involves several considerations. An instructor working with only one or two individuals at a time can frequently pinpoint and alleviate the specific cause of reluctance before it becomes a major problem. Assurances of backup of data and the integrity of the system sometimes help. Discussion and illustration of the specific advantages to be gained by the individual in the context of his job can give the necessary impetus for him to overcome his own reluctance. Encouraging the new user to discuss the application and his fear of the system with other, more experienced, users in his own area can help to relieve some anxiety. All of this involves quite a bit of individual attention, attention which seems to pay off in a more comfortable transition for the fearful user, less unlearning of misconceptions, and fewer questions to be addressed later to the consulting staff.

To provide individual instruction as needed for all new users, an investment in a sufficient number of competent tutors is required. We have one such tutor in the area of office applications, and we believe a second is needed. Consequently, some new users are treated to the "sink or swim" method of learning, which is usually all right for the adventurous and eager, but frustrating and discouraging for the reluctant.

learning from tutor and coworker

Individual instruction within the context of the job seems to be the most effective way to have a new user doing productive work after a short training period. It also reinforces at an early stage the user's perception of the advantages gained by using computers. In the absence of sufficient personnel for complete individual instruction and assistance, a compromise must be reached. One solution has been to give as much individual instruction as is feasible and then encourage the new user to work closely with coworkers "in context." He is also encouraged to come back to the consulting staff with specific problems or questions.

The tutor-coworker approach has many advantages. The knowledge gained by the newcomer through exposure to the combined experience of tutor and coworker includes an invaluable per-

spective on the applicability of the facilities chosen to accomplish a specific job. The example set by coworkers convinces the new user that the computer is an effective, comfortable and convenient tool.

Learning from tutor and coworker is effective, but not problem-free; there are also drawbacks. The coworkers may not be aware of the newest facilities, or may pass on misunderstandings, misinformation, or personal prejudices that require unlearning and retraining—problems that are minimized when the instructor is a disinterested person whose job it is to be aware of new facilities. However, the instructor's familiarity with *many* tools may not be sufficient; the advice he gives may be inappropriate because he is unfamiliar with the specific requirements of the job to be done and the most effective way to accomplish it. Cooperation between tutor and coworker and flexibility in the approach of both tutor and coworker are essential elements in teaching a new user quickly and comfortably.

alternative instruction

An individual's workload may preclude attendance at formal classes which are offered only twice a year. In addition, the number of tutors available for individual instruction is limited. We have therefore developed alternative educational aids. Some of the solutions include handouts containing examples with explanations, other small and easily referenced pieces of documentation on specific problems or needs, and frequent mini-courses and review sessions. New aids are provided by the text-processing consultant whenever there appears to be a need. A flurry of user questions on a specific topic or observed misuse of facilities that affects system performance may indicate that a review session or new documentation is appropriate.

user's responsibility

Effective use of the computer is in part the user's responsibility. At Yorktown the computing systems provide a large number of options for performing any given task. The courses and seminars are addressed to a heterogeneous group and attempt to provide *understanding* of each tool taught. In general, they do not supply a cookbook with recipes to accomplish given tasks. The result is that some people are overwhelmed by the need to choose for themselves (a problem we try to address in individual sessions). However, once a user becomes comfortable with exploring and choosing his own "best" way to approach a task, we find that some very sophisticated and ingenious uses of the facilities offered are developed (often by people with little previous computer experience.)

Secretaries who must learn a new system while satisfying heavy demands for manuscript preparation can evolve ingenious uses of existing programs. As an example, one secretary added entries to the conversion tables for an early version of PREP and then of-

fered her table to other users. Others have developed extensive sets of definitions that allow the Yorktown Formatting Language to replace short "names" with the long, difficult strings required for special kinds of output.

An experienced user with little time to spend on the project took advantage of PROOFER match/no-match output and existing comment facilities in the several programming languages that he used to create a file-referencing scheme.

The secretary, administrator, or scientist who becomes an expert creator of personalized applications (by tailoring existing facilities) finds the experience of coping with a large computing system and making it do what is wanted a very satisfying one. Because the selection of a particular aid falls largely to the user, he can gain confidence by getting good results. Confidence is reinforced by making more decisions, coping with problems, and getting results again. However, this suits best a person who likes to explore and is not afraid to make mistakes and try again. Sometimes the pressure of work and time can make this process difficult for new users, particularly secretaries and clerical workers who are likely to have many people making demands on their time.

changing relationships

Programmers, scientists, secretaries, and managers at Yorktown are involved in the use of the systems for daily work, with a large overlap in the uses to which they put the computer. The computerization of office tasks changes the relationships among principals and secretaries. Each person becomes expert in those functions he uses most, and people with very different training, background, and jobs find themselves exchanging hints and learning from one another.

In some cases, however, the principal knows far less about the computing system than the secretary, and may lack an appreciation of the expertise required to cope successfully with computers and of the advantages and problems of computer use. The secretary has become a specialist whose competence is recognized only by those who are themselves familiar with the specialty.

We see that in those cases where professional and secretary both use the computing systems—perhaps in different ways—there is often appreciation and cooperation, whereas this specialized knowledge can lead to a lack of understanding and appreciation when it is not understood by everyone involved.

streamlining document production

Cooperative techniques have been developed to streamline the production of documents. For example, most authors who are comfortable at a keyboard find that they save much of their own time, as well as the secretary's time, by doing the initial entering and/or the editing of the text of a document at a terminal, then

sending the file to the secretary for the more time-consuming specialized formatting.

Reports distilled from the contributions of several groups or individuals (monthly progress reports, for example) are conveniently gathered, integrated, edited, and printed using the computing system. Some technical groups now require that all members learn enough about computerized text processing to make their contributions to such reports on line.

The results of data processed in an APL environment or derived from programs used to analyze technical data can be arranged in tabular form in a file. Minimal editing is required to insert formatting controls and prepare the file to be incorporated into the manuscript that reports the results. One user has written a program that allows APL functions to be printed as part of a manuscript or report by automatically creating a file that contains the appropriate formatting controls.

Techniques such as these eliminate the retyping of such data, save the typist's time, reduce the chance of introducing errors into the data, and make proofreading much simpler for the author.

enthusiasm for computerized aids

Many professional or administrative employees exhibit an initial reluctance to use computerized aids. We have found that nearly all of them become happy, even enthusiastic, about computers sooner or later. Sometimes novelty wins their support—sending and receiving mail through the network is not only more efficient but also more fun than sending paper. Authors take unexpected pride in having some control over the form as well as the content of their manuscripts. Administrators can use on-line query systems to set up tidy referencing schemes for their own data, thus satisfying an organizational urge that once might have prompted new paper forms or filing systems. These satisfactions change the minds of people who initially regarded computer systems as cold and impersonal.

Other people object to losing "hands-on" control of their own documents. What if the system crashes? What if the printers break? What if my files get lost? These people are usually convinced by a demonstrated increase in efficiency. Of course, it is easier to remember the few times the system let you down than the many times you accomplished what would not have been feasible without a computer. However, the evidence accumulates to show even the most skeptical that computers—most of the time—do increase productivity.

We have observed that most reluctant users are turned into enthusiasts sooner or later depending on the degree of involvement.

People who are plunged into computer use with little or no choice may resist and protest loudly at first, but are usually quick converts. The reluctant user who can avoid using computers in his daily work may develop an anticomputing stance that is harder to change.

We have seen hundreds of people with very different backgrounds and requirements approach computer use with a variety of initial reactions. They have learned to cope with the new tools, incorporating them into established routines. Most of them have become enthusiastic about the new capabilities they gain through computing.

Summary

A study of the evolution of office work in this research laboratory provides valuable insight into requirements for an office of the future that is comfortable for its occupants.

Computer-assisted office aids at the IBM Thomas J. Watson Research Center have been accepted by a large number of users including scientists, administrators, and secretaries. Specific factors in the environment at the Research Center have contributed to this acceptance. First, the availability of display terminals (approximately one for every three employees) makes it as easy to access a computerized aid as it is to reach an individual using a desk-top telephone. Because the terminal is considered as essential as the telephone, there is no class distinction involved in using it; it is used because it provides access to necessary scientific or administrative tools. Finally, the hardware and software support groups cooperate closely with the user community to provide tools that truly meet user requirements.

The subjective information we have obtained as consultants for the user community shows that integration of the computer into an office environment can be a successful endeavor. We find that the users become more productive and more enthusiastic as the collection of computerized aids grows in number and sophistication.

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The authors are located at the IBM Thomas J. Watson Research Center, Yorktown Heights, NY 10598.

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