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A Pilot Implementation of Electronic Mail at Combustion Engineering

During the past century, the Industrial Revolution has brought about remarkable increases in output per worker. Now the same forces of technology that effected the spectacular growth of productivity in the factory are being applied to office and administrative areas. The results of this effort are grouped under the generic heading, "Office of the Future." Included in this broad category are the discrete subjects of facsimile transmission, word processing, teleconferencing, personal computing, private data bases, and electronic mail.

The term *Office of the Future* is a vague one. It has been used in the periodical literature to describe a most varied potpourri of hardware and concepts. Some descriptions sound like a page from a science fiction novel. Others involve significant changes in personnel, job descriptions and management organization.

In most discussions of the Office of the Future, there is mention of direct cost savings in postage and an increase in secretarial productivity (linked to the use of word-processing equipment). It is expected that many companies will pursue the main components of the Office of the Future in order to cut costs. Some companies may be forced to change their office structures because the availability of new career choices for women will make secretarial talent scarcer and more expensive. In addition to the savings in postage and increased secretarial output, Combustion Engineering (C-E) is interested in two important benefits it expects to receive from its venture into the Office of the Future. The first is an increase in executive productivity which will result from the manager's ability to interact with his peers without the need for face-to-face or "phone-to-phone" contact. The second benefit is the speed with which an executive

(even when out of the office) can find out what is happening and take appropriate action.

Combustion Engineering is in an ideal position to begin implementing the Office of the Future. It is a large ($2.3 billion annual sales), highly diversified supplier of energy equipment and building materials. C-E has a central computer processing facility in its Windsor, Connecticut, data center, and an international data network, consisting of 80,000 miles of leased telephone lines in North America and more than 20,000 miles in Europe, linking C-E sales and production facilities to the data center.

In addition to the ability to implement the Office of the Future, C-E has a need for its capabilities to unite a widely decentralized and highly diverse management organization. And it has a desire to provide its management with the best tools possible for their activities. The implementation of the Office of the Future at C-E began with a pilot installation of electronic mail. Electronic mail is the backbone of the Office of the Future. It is the thread that will ultimately link all the other parts and was the logical place to begin our implementation. The pilot project was designed and programmed in 1977 and was operational from January 1 to June 30, 1978.

While the term *electronic mail* is not quite as vague as the phrase "Office of the Future," it too has different definitions in different contexts. Some people use the term when referring to facsimile transmission (especially the new high-speed "fax"). In other companies, the term is used to denote a linkup of word processors or minicomputers in a store-and-forward or message-switch network. The meaning of the term "electronic mail" at C-E is very similar to what is meant by the computer message systems (CMS) mentioned in current literature. The concept can be defined more clearly by describing what electronic mail accomplishes and how it works.

Objectives of Electronic Mail

The purpose of electronic mail is to improve the efficiency and effectiveness of written communication by utilizing the power of the computer and the speed of data transmission. The objective is to make it faster, cheaper and easier to transmit information from person to person by applying the latest developments in data processing technology. It is expected that electronic mail will:

1. increase the speed of communication by making messages available to the recipient, regardless of location, instantly upon completion (or dispatch) by the author;

2. reduce the cost of communication by utilizing the existing data network to process messages at a cost substantially lower than that of first-class mail; and
3. improve the effectiveness of communication by providing a simple, easy-to-use system for the creation, transmission, retrieval and follow-up of messages.

Description of C-E's Pilot Project

To begin the movement toward the Office of the Future at Combustion Engineering, we designed and installed a prototype system for the "automatic transmission of mail" (ATOM). The ATOM System was the hub of a pilot project, the purpose of which was to provide information concerning the costs, benefits, desirability and usefulness of electronic mail at C-E, and was available to a selected group of approximately fifty users.

The ATOM System consists of a series of computer programs resident on the Amdahl 470 at the data center. We often referred to the Amdahl as the central post office where we all had post office boxes. During the pilot operation, we examined ways in which electronic mail could be implemented throughout C-E on a production basis that would maximize benefits and reduce costs.

The duration of the pilot project was six months, with monthly reviews scheduled. Participants in the pilot study were expected to evaluate the system which they used, and to suggest changes and improvements that should be made before participation in the system was opened to other operating areas.

The approach taken in implementing the ATOM System at C-E was (1) to build around the extensive international data network which was already in place, (2) to utilize the data management and retrieval capabilities of the INQUIRE software package, (3) to explore the use of the word-processing capabilities of minicomputers, and (4) to use the Network Operating System (NOS) of the Control Data Corporation (CDC) Cyber computer for on-line data entry. The pilot system was installed using IBM's Time-Sharing Option (TSO). This made access to mail contained in the system possible from any existing TSO terminal. The pilot system was also used to test a variety of new terminals which ranged from stationary typewriter-quality devices to lightweight portable models with thermal printers.

In summary, one could say that the ATOM System provided each participant with a secure mailbox housing all mail sent to or from that participant. By using a computer terminal, the participant was able, from

any location in the world, to create, scan, read print, pend, forward (with notations), or archive mail sent to him or her by others.

Creation of new documents was possible in two ways. Documents could be created on-line as part of the user's dialogue with the ATOM System, or off-line on a word-processing minicomputer to be transmitted to the system as a high-speed batch (Remote Job Entry) submission. Documents could also be created on-line to the Cyber computer and sent over the IBM-CDC link. All the mail sent to the system was prepared with the assistance of some type of word-processing text editor. For those items entered directly into the system, the text editor of IBM's TSO was used. For those created off-line on a word processor, its text editor was used; and for those created on-line to NOS, the University of Calgary's text editor was used. Each of these offered significant assistance in the creation of a document. This assistance was particularly important when making changes or corrections to the document.

Mail could be retrieved from the system by either a manager or a secretary. An important consideration in the system design was to make it convenient for an unassisted executive in a remote location to operate the system without difficulty or any special "data processing" training. This was accomplished by creating a user dialogue that prompted for all necessary inputs and used simple English statements. In this "unassisted" mode of operation, the executive would connect his portable terminal to the system and begin the dialogue. He would first see a count of what was in his mailbox. He could request more information about the documents in his mailbox (author, subject, etc.), or he could choose to read his mail. He might start with the rush documents, then read the short ones, and request that the long documents be sent to his nearest high-speed printer. He may use his terminal to forward messages to other people, or he may enter short messages directly from the terminal. If the manager chooses to enter correspondence into the system by dictating to his secretary, the message would be typed into a word-processing system (where it would be stored on a magnetic recording medium) and a draft printed out. After the draft was reviewed, corrections to the recorded document could easily be made. The finished letter would be transmitted to the Corporate Data Center for processing by the ATOM System's "postmaster." The postmaster function is performed by a batch program executed each time a group of letters is received from a word-processing machine, or each time a letter is entered and "mailed" from a portable terminal.

In addition to the transmission of mail from person to person, or from a person to a predefined group of people, the ATOM System has a "suspense file" or "follow-up" capability in which a document marked as pending is held in the system until the specified date on which it is to reappear in the owner's mailbox.

Features of the ATOM System

The capabilities offered to the participant in the ATOM System pilot project were designed to parallel closely the way we work (or would like to work) at our desks.

Immediately upon logging onto the system, the user receives a summarized count of what is in his "in-basket" awaiting his review. Once this display is completed, the participant can enter any of the twenty-one commands in the system repertoire. These commands are grouped into five functions (see Table 1). Following is a detailed description of the way in which the system operates.

TABLE 1. ON-LINE FACILITIES OF THE ATOM SYSTEM

Function	Command	Operand
Retrieval	COUNT (CO)*	
	INDEX (I)	IN (I)
	VIEW (V)	OUT (O)
	PRINT (P)	RUSH (R)
		NEW (N)
		UNSEEN (U)
		PENDING (P)
		ALL (A)
		or message numbers
Composition and	CREATE (C)	
Editing	EDIT (E)	File name
	MODIFY (M)	Message number
	FORWARD (F)	Message number
	VIEWHELD (VH)	File names
Distribution	HOLD (H)	File name
	SEND (S)	File name
Disposition	PEND (P)	Message numbers
	DELETE (D)	Message numbers
	DELFILES (DF)	File names
Information and	BOXID (B)	Characters
Assistance	WHOIS (W)	Characters
	HELP (HE)	Command name
	FILES (FI)	
	PASSWORD (PW)	OLD, NEW
	PAGE (P)	Screen lines
	QUIT (Q)	

*The short form of the command is in parentheses.
Notes: A comma, but no space, must come between the command and the operand. VIEW, PRINT, PEND and DELETE commands will work with a range of operands (### to ###) in place of a string of message numbers.

When a user signs onto the system, he is asked to supply an appropriate user identification code (Mailbox ID) and a unique password. If the user responds properly, he receives a display acknowledging that he is using the Electronic Mail System, and counts of the various types of messages (i.e., incoming, outgoing, new, etc.) in his "in-basket." After displaying these counts, the system subsequently prompts the user for a command. The list of commands that he may choose from can be categorized as: composition and editing commands, distribution commands, retrieval commands, disposition commands and information commands. Each of these can be abbreviated by using the first (or if necessary to resolve ambiguity, the first two) characters of the command name.

Composition and Editing Commands

The CREATE command is used to enter a new message into the system. Each message is composed of two parts: the heading and the text. When this command is given, the system prompts the user for heading information, which includes the mailbox identifiers of all intended recipients. The copies addressed to the recipients can be distinguished as originals, carbon copies or blind carbon copies. Additionally, the system will prompt the user for a subject, a date and a pending date. The user is also asked to indicate whether the message is rush, confidential or registered. Upon completion of the heading information, the user is prompted to enter the text of his message.

If a mistake is made during the composition of a message, or if changes need to be made to a message that has been held prior to distribution, the user would utilize the EDIT command. This command makes available all of the text-editing capabilities of IBM's TSO. However, it was found that most users needed only a small subset of these editing facilities. With the edit functions, users may insert, delete and modify lines of text, or replace one set of characters with another prior to making the message available for distribution.

If, however, a message has already been distributed, and the sender wishes to change its contents and redistribute it as a new letter, he or she may employ the MODIFY command. This command retrieves the original text from the user's outgoing "mailbox" so that either the heading or the text portion of the letter can be altered and redistributed.

Distribution Commands

In the event that a user wishes to save a message so that he or she may continue to work on it at a later time, the HOLD command is used. By supplying a "file name" with the command, the heading and text of the message are retained under this name and can be recalled for subsequent editing and distribution.

When the user wishes to distribute a message to all of the identified addressees, he or she simply enters the SEND command. The use of the command itself will send the current message; but if one or more file names are supplied, the named message files which have been saved with the HOLD command will be sent instead.

Often a recipient wishes to comment on a message and then redistribute it to different addressees. To accomplish this, the FORWARD command is used. This command retrieves the message from the user's "in-basket," prompts for a new addressee list and then for the comments. When the comments are followed by the text delimiter (*), the message and the comments are distributed to all intended recipients.

Retrieval Commands

When a user signs onto the ATOM System, a count of his messages is automatically displayed. However, the user may enter the COUNT command at any time. This command, with the appropriate subcommand, will display a count of new, unseen, confidential, pending, rush, incoming or outgoing mail. If the user simply types the word COUNT, the system will display a count of all messages in his or her mailbox, as well as the individual counts of each type of message listed above.

Generally, a user will want to see a summary of his or her mail without having to view the entire contents of each individual message. Thus, an INDEX command is provided which will display a list of the message numbers, senders, subjects, lengths and types of messages that have been received. If the user wants to be even more selective, the summaries can also be presented on the basis of whether they are incoming, new, unseen, rush, pending, or outgoing (e.g., the command INDEX,NEW will display summaries of all messages received since the last session).

At some point, the user will obviously want to read his mail. To do so, the VIEW command is used. The command by itself will present to the terminal all messages in the user's "in-basket." However, here too the user may want to be more selective. Entering one or more of the message numbers displayed in an index summary, or any of the message types mentioned in connection with the COUNT or INDEX command, will result in a display of the text of all messages specified.

Most managers have preferred to use a CRT teletypewriter device. Such users may wish to have a "hard copy" of certain messages. Consequently, through use of the PRINT command, all messages marked as incoming can be automatically routed to an appropriate line printer associated with a user's mailbox identifier. In many instances, however, the user may wish only to print messages of particular types. This can be accomplished by supplying the appropriate type name along with the

PRINT command (e.g., PRINT, NEW will route to an appropriate printer all messages not yet indexed).

Disposition Commands

Whenever a user wishes to have a memo "surface" in his or her mailbox on some future date, the user can employ the PEND command. Several messages can be pended at once, but this command must be used in conjunction with a pending date. Messages can also be given a pending date when they are created and forwarded. This capability can be used to establish a "tickler" or reminder file.

To remove the reference of a message from a mailbox, the DELETE command is used. This command, accompanied by a message number, logically disconnects a user from a specified message. The message will not actually disappear from the system until after all recipients have deleted it. Users are allowed to specify one or more message numbers (up to ten) following any invocation of the DELETE command.

Information Commands

Because messages are distributed on the basis of a user's mailbox identifier, it is important for the sender to be able to determine infrequently used identifiers. By supplying the intended recipient's name or some part of the name with the BOXID command, the system will display the names of one or more individuals, depending on the uniqueness of a matching character string, their locations and their mailbox identifiers. Conversely, a user may know the mailbox identifier but simply wish to verify the name, address or organizational entity of an individual within C-E. For this facility, the user enters the WHOIS command and supplies the mailbox identifier in question. The system responds with a display showing the mailbox identifier, the name associated with the identifier, the location and the internal C-E group/division/department code.

For beginning users, or users having infrequent exposure to the system, a HELP command is provided. Used by itself, this command lists all of the ATOM System commands along with their respective abbreviations. However, by supplying a command name with the HELP command, the user obtains a brief description and instructions for its use.

A major feature which was intentionally omitted from the ATOM System would have allowed for the sophisticated retrieval of documents (for example, by subject, author or phrases in context). There are two reasons why we have omitted this capability:

1. To be consistent with common business practice, it was decided to keep the "in-basket" and "file cabinet" separate. Most of us read our mail,

and then decide whether or not to keep it and where to file it. It is a good practice to keep the "in-basket" empty and we encourage that.

2. For purposes of training and implementation, it seemed easier to split the system in two parts; the first part is electronic mail and the second part is another component of the Office of the Future, commonly called the personal data base. This feature, which we have named "Archive," will be added to the production system as a second stage in the implementation. When installed, this feature will allow a system participant to select specific documents (either inbound or outbound), assign subject or file codes to them, and have them routed to the "Archive File Management System." The Archive will be an INQUIRE data base and will allow for the retrieval of documents based on any selection criteria (from, to, etc.), including words or combinations of words in text. We presently have "correspondence control systems" of this type operational.

The Objectives of the Pilot Project

The major goal of the pilot project was the selection of the best approach to use in implementing electronic mail at C-E. To arrive at this determination, many individual subjects had to be researched, including noncost advantages and benefits reported by participants, acceptability and adaptability of this new form of communication to users, acceptability of the system's behavior to users, and pilot costs and savings versus those of conventional office operations. The aggregate experience and supporting information obtained through the use of the pilot system will be the means through which the desirability of extending the application companywide will be determined. There are many individual subjects which were researched as part of the overall project. Some of these are:

1. *Hardware evaluation:* The pilot project was used to test various input and retrieval devices to ascertain their acceptability to the user population.
2. *Test of software:* The pilot project allowed us to test the "human engineering" of the ATOM System and the dialogue which takes place between the user and the computer.
3. *Determination of costs:* While an estimation of costs based on hypothetical usage of the system is possible, the pilot allowed actual costs to be recorded based on the use of the system in a working environment.
4. *Evaluation of the benefits:* The pilot operation was used to measure the tangible benefits and estimate the value of the intangible benefits derived from use of the system.

5. *Development of usage statistics:* As part of the research which was performed during the pilot project, the system gathered some basic statistics on usage, such as (a) the length, in lines, of the minimum, maximum and typical message; (b) the maximum and typical number of addressees for a message; (c) the use made of "group codes" and standard distribution lists; (d) the number of messages sent per day (maximum, minimum and typical), and classified as rush, confidential or registered; and (e) the number of sessions per day per user (maximum and typical), and the time and duration of these sessions.

6. *Analysis of user experience:* As another part of the research project, each participant was requested to comment on the benefits realized from the use of electronic mail, and to suggest changes that should be made to the system to improve its effectiveness. Each participant was requested to complete a monthly questionnaire.

An analysis of this questionnaire helped define how the ATOM System was used in actual practice and how the system may be improved:

1. Do managers participate directly, or do their secretaries do both input to and retrieval from the system?
2. Is the system used to reply to messages, and how often are they forwarded for reply or information?
3. Is the system used after hours to extend the workday?
4. Is the system used from off-site locations, and are portable terminals worthwhile?
5. Are "group codes" useful in addressing messages, and are standard distribution lists helpful?
6. What suggestions, complaints or comments can be collected from the participants?
7. Has the use of the system resulted in changes in work habits and what benefits, if any, resulted?

The extent of the information we were able to obtain from the evaluation of the pilot project explains why we took the approach of designing and installing a prototype instead of relying on market research studies and statistical analyses. We believed it vitally important to observe the human interface with electronic mail in a "nonlaboratory" environment.

Tangible Benefits

A primary objective of the pilot implementation was to identify and evaluate the benefits to be derived from the use of electronic mail. A partial list of anticipated benefits includes the following items:

1. elimination of postage and interoffice mail costs;
2. elimination of telecopier and TWX usage;
3. reduction in use of photocopying machines since there is no need to mail a copy to a recipient who is on the system;
4. significant increase in the productivity of the input typist through the word-processing machines used for input to the ATOM System;
5. elimination of the need to perform key-entry to correspondence control (Archive) systems since the key-entry of documents to the mail system will serve both functions (note: the feed between the ATOM System and the Archive System will allow for increased and improved use of file retrieval systems); and
6. reduction in the need for file storage space due to the archiving feature of the system which eliminates the need for subject files (or other cross-reference collections). If the full text of a document is retained in the Archive, only current working files need to be kept in the office.

Intangible Benefits

Some of the intangible benefits to be derived from use of the electronic mail system are as follows:

1. Information is available sooner, allowing management to speed up the decision process. The system also makes it easier and more convenient for people to share knowledge. The result is twofold: better decisions made more quickly.
2. The system is available most of the day anywhere in the world and is designed to be readily usable by people who are not data processing personnel. This allows management and key staff personnel to read or compose messages without regard to place or time, thus extending the productive day for system participants.