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DOCUMENT PRODUCTION AND CONTROL SYSTEMS

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This report was prepared and composed for printing on the SRI oNLine System (NLS), developed by the Augmentation Research Center.

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ABSTRACT

In order to understand how to design better computer-based aids to technical document production, we studied in detail the production cycles of an Air Force manual, SRI reports, and technical journals. We also studied the existing capabilities of 6 computer based aids: IBM's MCST, DEC's Datasystem 310W, Daconics, the Harris 2500, Proprietary Computer Systems (PCS) time-sharing services, and SRI's oNline System (NLS). In general we concluded that good progress has been made in typesetting and reducing the amount of retyping in production work, but that opportunities for marked improvement are to be found in formatting, production control, and draft generation and approval. Additional specific problem areas have been identified.

TABLE OF CONTENTS

PREFACE 2

Background 2a

The Publication Situation 2a1

The field of machine-aided document production is experiencing a period of chaotic growth. New hardware and systems ranging from typewriters with limited magnetic card memory to highly sophisticated systems such as SRI's oNline System (NLS) are flooding the marketplace. Most of these systems show minimal standardization of equipment, anticipation of system evolution, or problem orientation. Users report both successes and failures, but more frequently report uncertain outcomes in a field where the real costs of the old procedures are difficult to quantify, where organizational lines frequently inhibit change, and the effects, benefits, and shortcomings of adaptation of an unfamiliar medium into an unmeasured environment is difficult to project or evaluate. 2a1a

At the same time, the conventional methods of publication have become inadequate. Paper costs and labor costs are rising, production schedules are becoming tighter, large organizations more frequently require collaboration among people geographically scattered, and the acquisition of source material is often a burden. 2a1b

The increasing cost of conventional processing and the promise of economy and efficiency of computerized document production has brought many organizations to these alternative approaches to current equipment and procedures despite the seemingly equivocal results. The competitive edge becomes a threat to the continued existence of many traditional publishing operations as costs increase sharply. In addition, the pure volume of conventionally stored material is increasingly unmanageable, and growing technological pressures are accelerating transition to computer-aided document production systems. 2a1c

These pressures include: 2a1d

the rapid expansion of automated information storage and retrieval systems and abstracting services,

the growing number of client requests for material to be submitted in machine readable form,

the use of microfilm for document storage to employ space more efficiently and to increase the item reference speed,

the rapid transmission of documents and other textual material over large distances, and

the appearance of a very large number of computer aids and services in both the highly specialized areas as well as the general purpose text processing field.

Preface

Perhaps at the heart of much of this discussion is the implicit, often dramatic, change in procedures that attends incorporating new tools in the document preparation operation. Unless these are foreseen and prepared for, use of the tools will likely be abortive and result in extended deadlines rather than improved efficiency (13). 2a1e

The NLS Situation 2a2

For many years the Augmentation Research Center (ARC) has been developing a computer-based system (the oNLine System, NLS) for more effective handling of textual information in all forms (22). ARC staff have used NLS in the publication of their own reports, manuals, and proposals for a decade (23). 2a2a

In the last three years, clients of the NLS Utility have used the system increasingly for a variety of large-scale document production projects. Document work on the Utility has: 2a2b

- shown many strong NLS capabilities as a document production system from conception through publication and distribution to maintenance,
- brought to light limitations,
- brought to light possible extensions and enhancements,
- and created a body of users particularly within the Air Force that can contribute its experience and analysis to new development and benefit from increased productivity.

The general situation in manual and computer-aided publications was compared with the NLS experience and potential. This led to the conclusion that a very much better computer-based publication system could be designed in the NLS environment. To that end ARC submitted a proposal for research to Rome Air Development Center that resulted in this contract (12). 2a2c

The Organization of this Report 2b

The body of this report is divided into two parts; a description and analysis of selected existing production cycles, and the description and analysis of five existing support systems. Discussion and Conclusions are drawn from both analyses. A long appendix gives the questionnaires and answers which were the source of information regarding the existing production cycles. 2b1

THREE PRODUCTION CYCLES 3

Introduction 3a

What Our Study Included 3a1

This study differs from many previous efforts in this field by including the whole circular process from writing through approval, production, dissemination, and back to use of the document by succeeding writers. The questionnaires and flowcharts in this study deal with early steps in document production beyond the scope of some valuable previous studies such as the SRI Automated Text Handling System (1) and the Westat Report (2). 3a1a

In the history of development of aids to document production, innovation has tended to focus successively on different steps. First, it focused on research by the author, that is, aids to information retrieval such as Lockheed's Dialogue System (16). Later, it turned to printing, and a large variety of computer-based typesetting systems have been developed over the last few years (16). Now fresh attention is focusing on aids to editing and "text processing", such as the DEC 310W system and the Daconics system that are discussed in this report. 3a1b

Systems that encompass several such steps have begun to operate successfully only in specialized environments such as newspaper publication, for example, the Harris system, described below, and similar systems developed by Hendricks, Omnitext, and others (16). 3a1c

It is clear that able commercial organizations are attacking the problems of systematic support for various steps in the publications process. There are still many problems regarding cost effectiveness and technology transfer with these systems, but we expect satisfactory solutions will develop in the market place. This study will concentrate on optimizing the whole process. 3a1d

For example, the discussion of journal publication below shows that only certain steps have been made efficient (usually using obsolete technology) because the users are scattered and no single organization pays the whole bill. The situation is quite different in large corporations or government agencies, where people in different cities have to cooperate quickly and the same organization pays the whole bill. 3a1e

Definition of publication as this whole, partially circular, process implies dealing with people who are geographically and perhaps organizationally scattered. 3a1f

Problem Definition 3b

Examination of the flow of document production uncovered a core of functions necessary to the process that can be described in the categories listed below. These categories apply no matter what technology, organization or type of document involved. 3b1

Character Transfer 3b2

In non-computer aided publications, what we have called "character transfer" usually means typing, that is, moving characters from one place (the mind, notes, or draft copy) to another. With computer aids, character transfer is sometimes within a single medium (from one file or disc to another) and sometimes from one medium to another (e.g., magnetic card to disc or disc to phototypesetter). Transfers from one medium to another are generally cheaper and faster than typing, although an initial expenditure may be necessary to set up the system. Transfers within a medium are very much faster and cheaper than typing. 3b2a

If we assume a typist generates four 250-word pages an hour and that his labor costs $6 per hour, typing costs are 0.12 cents per character (6). Real costs are frequently higher. Often this cost is reduced by cutting up existing sheets and taping them together (what is called cut and paste, although paste is seldom actually involved). In a manual system, substantial retyping or cut and paste is necessary whenever the content of a page or the format is changed. Study of the flowcharts (3c2, 3d2, 3e2) will show many occasions on which arrows point back. When arrows point back, retyping usually is involved. 3b2b

Computer-based systems reduce typing costs in two ways; by allowing a typist to type faster and by replacing typing with same-medium copying. Typically a typist is 10-40 percent more productive at a keyboard supported by data processing equipment because he does not have to worry about carriage returns and can backspace-overstrike on the fly (6)*. The total cost may be higher than manual typing because of the cost of the supporting system, particularly if slow system response keeps the typist from going full speed. Computer systems that permit sophisticated and easy to use cross-file editing offer even greater savings by permitting authors and editors to copy previously typed materials at a small fraction of the retyping cost. 3b2c

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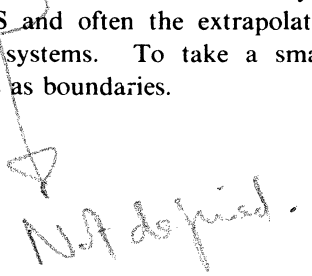
* This widely disseminated report is quite informative and offers guidelines for basic analysis of word processing in simple environments such as corporate offices. But it should be used carefully. The concept of word processing is based on ATMS and often the extrapolation does not consider the greater capabilities of other systems. To take a small example, its definition of "word" gives only spaces as boundaries.



Production Cycles
Problem Definition

Optical Character Recognition (OCR) at present is simply a way of recording characters for computer input and must compete with magnetic cards, cartridges, etc. That is, an extra typing step is added to create a draft that the OCR device can read. Special functions, such as delete previous character, allow a trained typist to work somewhat faster than for final draft typing. 3b2d

The repetitive correction characteristic of technical publication means that each character is typed, at SRI for example, the equivalent of about three times, and the total typing cost approaches 0.4 cents per character by the time a document goes in the mail. 3b2e

Highly automated production cycles such as that based on NLS for AFM 66-1, a large Air Force missile maintenance manual, reduce typing costs as much as four times. Most documents contain at least some text that is derived from other previously written documents. This material is almost always retyped entirely to be included in the new document. A computer system which gave writers online access to previously written material and access to a copying facility could conceivably reduce the average number of times a character is typed in a publication cycle to less than one. 3b2f

Formatting 3b3

Publication is, to a substantial degree, a process of imposing a format on a stream of characters. In the production cycles studied and in most technical publications, the final format cannot be produced until the last step. In manual systems such as the SRI Report Services or most journal production, the format is embodied in the unfinished document as conventions (e.g., underline for italics) and in forms attached to the document (e.g., forms that list where illustrations are to appear). 3b3a

These conventions add to the burden of retyping, and the forms are time consuming and prone to error. In the case of SRI, the forms add in the neighborhood of a quarter of a cent per character. In production of AFM 66-1 using NLS, as in most computer systems that aid the formatting part of the process, the format is stored as instruction codes that travel along with the file. In the best cases, no human intervention is needed after a single command to insert the codes in the file. Such computer-based formats are effective insofar as they are easy to design, easy to lay on each document as it begins production, and insofar as changes in content, partial rewriting, etc., do not mean manual adjustments of the format code. 3b3b

Some progress has been made toward making formatted copy available to workers before the end of production. The NLS Proof subsystem used in production of AFM 66-1 allows the editor to see a useful approximation of what the final pages will look like on a special high-resolution screen. Several word processing systems attempt with varying success to display accurate representations of typed pages on CRT screens, raster printers, or special line printer formatting. The Machine Aided

Editing (MAE) system at SRI portrays a highly effective image of a typed page. All these systems are limited by the accuracy of their representations of final copy, particularly with respect to characters outside the alphabet, by the number of formats they can show, or both. Only the NLS Proof system portrays proportional spacing on a CRT, for example, and it portrays only approximately. The screens to support the better systems, NLS Proof ($12,000) and MAE ($40,000), are expensive. 3b3c

The usefulness of such systems varies in context; they are most valuable when working out new formats or ~~if~~ changes in content effect format. In a well planned technical production cycle where the same formats are ~~being~~ repeated, they might not be much of an advantage. 3b3d

Quality Control 3b4

Quality control in these production systems concerns the quality of the characters as visible objects, the accuracy of retyping, and the integrity of the documents. In manual systems such as SRI's, proofreaders or authors scrutinize final copy for things like broken characters, and send pages back for retyping as needed. (See SRI Flowchart 4.) Proof reading controls accuracy of typing and is figured into the cost of typing. Procedures and forms such as page lists and lists of illustrations control the integrity of the document. 3b4a

The publications process may also affect the quality of writing e.g., by oppressive deadlines, limitations on format, and difficulty in retrieving previous publications as sources. 3b4b

Computer-aided systems that output to photocomposers, such as NLS, increase the quality of the appearance of the final output; those that output to selectric printers, daisy wheel printers, or line printers generally do not. 3b4c

Computer-aided systems greatly reduce typing accuracy problems by reducing retyping. In the case of NLS used in AFM 66-1, programs to automate some basic editing functions like hyphenation, spelling checking, and spacing between words improved text quality and so reduced the proofing load. The capacity to print only changed parts of the document also speeds proofing. 3b4d

Computer-aided systems reduce the cost of maintaining the integrity of the document much as they reduce the cost of formatting; by holding the structure of the document rigidly in the machine's file structure and by generating lists such as tables of contents or illustrations automatically. Computer systems that include large-scale, sophisticated file handling systems maintain the integrity of documents more effectively, e.g., they do not require offline storage and retrieval procedures for separate discs or cassettes. 3b4e

It is difficult to evaluate the benefit of computer-based systems to writers. In existing systems such as NLS, writers assert that the computer aids allow them to write better by smoothing out the process generally, particularly taking pressure off of deadlines

and producing clean draft copies easily. If writers worked online themselves, we could assume that appropriate computer-based systems could help them organize files and locate and copy related material. No writers in the production flows studied worked online and many writers do not like the idea. Reports from ARC of their own writing and from the Lockheed's use of the Autotext system for technical manuals indicated that at least productivity is increased in this way, but productivity is not necessarily quality. 3b4f

Production Communication 3b5

Publications is in general a process that involves communication among specialists who are often physically and organizationally scattered. Many of the problems discussed in terms of format and document integrity could be considered in terms of communication. If the first typist was also the final typist, he might not have to worry about format until the final typing. If the author were in close communication with the whole process, it would not be necessary for her to read galley proof, and reading proof costs money. The overhead for communication in the production of some journals makes the majority of the cost of production lie in retyping and in correspondence among the parties involved, costs that are greatly reduced when people work closely together. 3b5a

The communication problem is most acute when distribution is controlled, change pages must be mailed out, or the like. In these cases, the publishing organization cannot avoid communicating with the reader. 3b5b

Large-scale computer systems can offer some direct communication aids to scattered publication efforts such as teleconferencing facilities and the simple capacity for people in different places to look at the same file. For example, the format of AFM 66-1 was created and tested by specialists in California and applied to files input by production workers at Gunter Air Force Station (AFS) in Alabama, with ample chance for cross checking between the two groups by looking at the same result at the same time. 3b5c

There are some less obvious examples, for instance, the easy output of clean drafts by computer systems may be seen as a way of improving communication between the authors and the other workers in the process. 3b5d

Production control is another aspect of communications. A glance at the flowcharts will show that document production is a complicated process. In bureaucratic manual systems such as SRI's or those at large journals, time-consuming procedures and forms maintain production control. A large array of computer-based management aids such as PERT exist to control engineering projects, industrial production, and related processes. As far as we have discovered, they have been applied to document production only in elementary ways. As computers used in document production grow to include more and more steps of the process, an unusual opportunity will

develop for effective control. Because the object being produced is itself within the computer, the process of data gathering is much simplified from, say, a factory production line which requires sensors or input from the workers. Production of AFM 66-1 took advantage of this situation in various informal ways, e.g., it was possible for any one in the project at any time to list what files were in work and the date and time of the last change made to them. 3b5e

Distribution 3b6

In general, technical publications (unlike magazines) do not budget distributions as part of publications costs, and our sources provide little information on this subject. However, it is obvious that there are complex trade-offs in this area. For example, printing reports in smaller type may reduce mailing costs. For this reason, SRI which mails few reports is free to use 10-point (typewriter) characters as long as typing camera-ready copy remains cheaper than output from a photocomposer. When the publisher is carrying the cost of distribution and storage, the picture is quite different. Many U.S. government and large corporate manuals (e.g., automotive manuals) are distributed on microfilm, and some buyers of documentation services now require delivery in microfilm or computer readable tapes. Manual systems generally require an expensive change of medium including quality control to reach a typesetter or microfilm. Many computer systems send files directly to one or more specialized distribution media such as microfilm. 3b6a

Note also that the journal's use of smaller type that saves on mailing costs has some effect on the productivity of people who use the information. 3b6b

Storage and Retrieval 3b7

To estimate the importance of storage and retrieval, consider the following very rough calculation. The Westat Report states that there are 10,000 journals in the United States (2). The distribution of journals according to size is skewed, and it is hard to estimate the number of pages published by the 10,000 journals. However, the Westat Report offers a model of a "small" journal which we might reasonably take as average (2). It publishes 1,200 pages a year, which leads to a total journal publication in the United states of 12,000,000 pages a year. Westat also reports that writing journal articles before editing and review takes 2.9 hours per page; 34,800,000 hours are spent on this work (2). A very substantial part of that work is retrieving information, either from other journals or personal data bases (index cards, lab notes, and the like). If we figure an author's time at $10 per hour, the annual value of that time is $348,000,000. It appears that computer aids could accomplish large savings in this area if there were a proper way to deliver and charge for them. (See also reference 2.) 3b7a

Production Cycles
Journals

Journal Production 3c

Summary 3c1

Scientific and technical journal publication is carried on by isolated groups communicating through the U.S. mail. An author or authors write an article for the purpose of disseminating and archiving scientific information. Writing basically consists of organizing notes from work the author has done and notes from other sources, including references to previous articles, into some narrative format. An author mails the article to a periodical where an editor and staff evaluate it. As part of their evaluation, they mail copies to one or more reviewers. The editor then either rejects the article, accepts it as it is (very rare), or returns it to the author for correction. The corrected article is returned by the author and this version is printed and disseminated in an issue of the journal. The author's co-workers, who subscribe to the journal, read the article and frequently make it the basis of succeeding articles. With one exception, at each point where someone submits something to someone else, the recipient may reject it conditionally, creating quite complex cycles in some cases. The one exception is the journal subscriber. 3c1a

In an effort to establish and clarify the possibilities for computer support of journal publication, the National Science Foundation sponsored a study by the Westat Corporation which resulted in a report published in 1974 (2). It consists of the results of an extensive survey of journal author, editor, and subscriber practice, an economic analysis of present journal publications, and possible computer publications based on several models. Information from the Westat Report was used to answer the questions about journal production in the Appendix. The economic models, though useful and thought provoking, have not been an important source for our work; they limited themselves in how much they were willing to model changes in the basic flow, and they did not give the attention to detailed computer system features that are important to this study. 3c1b

The geographically and organizationally scattered support of journals presently dominates analysis of their publication problems. In the author's office, academic journals are the typical object of advanced data retrieval systems of the type that search for titles and abstracts, such as Lockheed's Dialogue (7). Highly capable phototypesetters including for example AKI's Ultra system, to name only one that has been used sucesfully in journal publication, are appearing in the compostion room. The Chemical Abstracts Service has developed a premier page formatter which is used on four American Chemical Society journals (8). Various text processing systems are beginning to enter the editorial offices. The National Science Foundation is sponsoring support of journal publications from central Editorial Pro-

cessing Centers (10). Present centers merely generate records of articles in computer readable medium as a by-product, but NSF looks on them as steps towards paperless publications (11). 3c1c

No system associated with a journal provides articles to an author except on paper, and no system provides a way for an author to assemble starting material, notes, or previous publications online. Authors have access to computer-based publications systems only in the very few cases where access is provided to them for other reasons. Journal publication is highly circular in the sense that a substantial part of the work of writing a journal article is searching, recopying, and integrating previously published information. 3c1d

It is not difficult to understand why development of aids to journal publication is fragmentary: no one is responsible for the cost of the overall cycle. Phototypesetters and page formatters help printers. Systems that combine computer aids to editing facilities with a phototypesetter help journals that print inhouse. Data retrieval helps researchers. 3c1e

Journal Flowchart 3c2

Journal Flowchart Chart 1 depicts the events in journal production from the author's plan to write an article through conditional acceptance by the journal. (see attached diagram) 3c2a

Chart 2 depicts events from selection of reviewers through accumulation of reviewers comments at the journal. (see attached diagram) 3c2b

Chart 3 shows events from preparation of reviews for the author to final approval by the editor. (see attached diagram) 3c2c

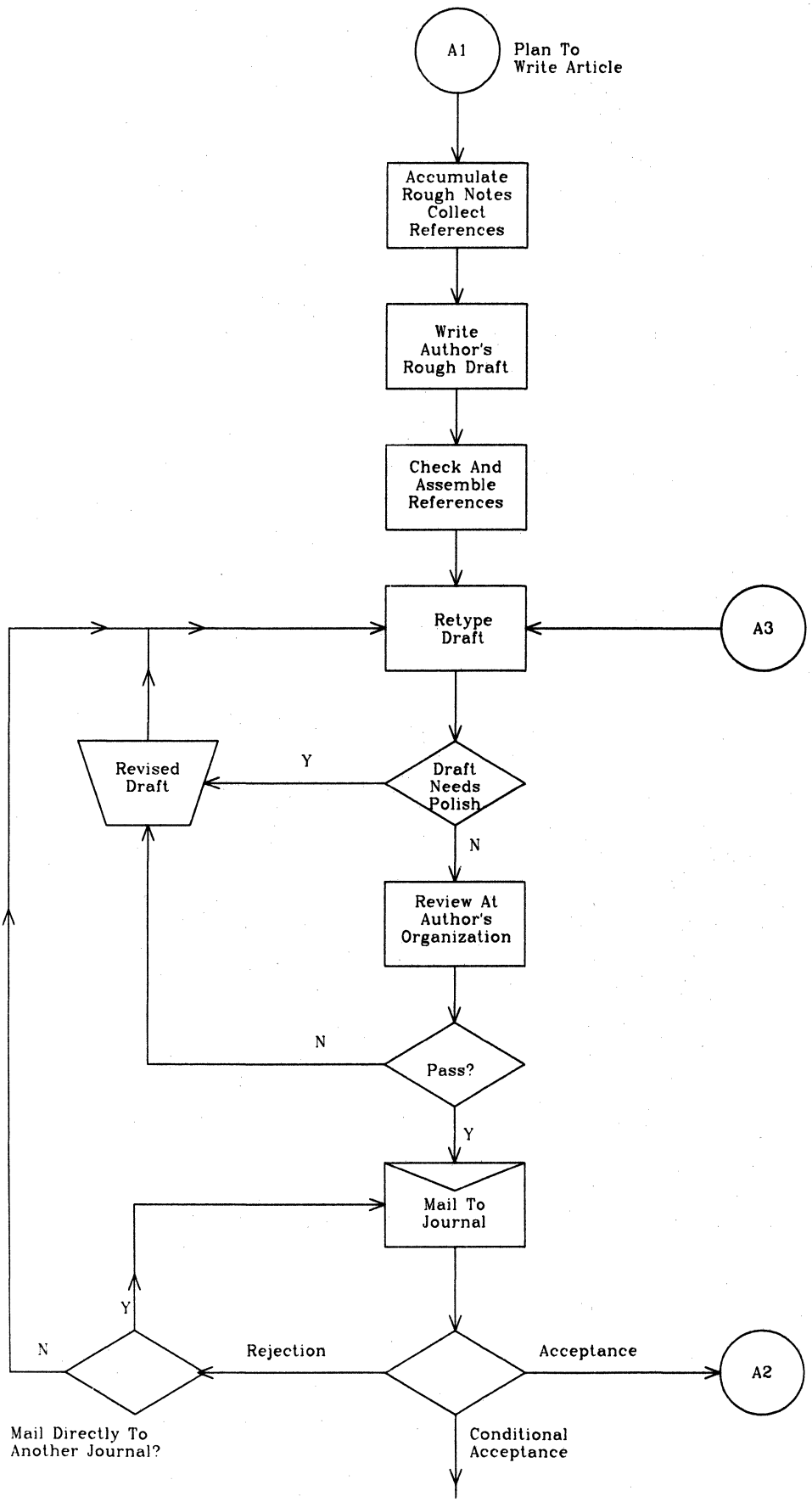
Chart 4 shows events from marking the manuscript for typesetting to editor's review of the page layout. (see attached diagram) 3c2d

Chart 5 depicts events from making final corrections and camera-ready copy to literature search by subsequent authors. (see attached diagram) 3c2e

Critical Points 3c3

Character Transfer 3c3a

In general, journal articles are written once by the author and retyped an equivalent of about three times. Retyping includes revision of text, formatting, and reformatting. (See Chart 2.) Any computer aids or integrated system of computer aids that reduced retyping and consequent proofing would reduce labor costs. Articles vary greatly in length, but for most journals, 5,000 characters is the average and storage units should be at least twice that at this stage. Even if formatting were automated, many of the changes would be detailed editing. Automated editing running as a batch process in the background would handle many


A1
Plan To
Write Article
Accumulate
Rough Notes
Collect
References
Write
Author's
Rough Draft
Check And
Assemble
References
Retype
Draft
A3
Revised
Draft
Y
Draft
Needs
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N
Review At
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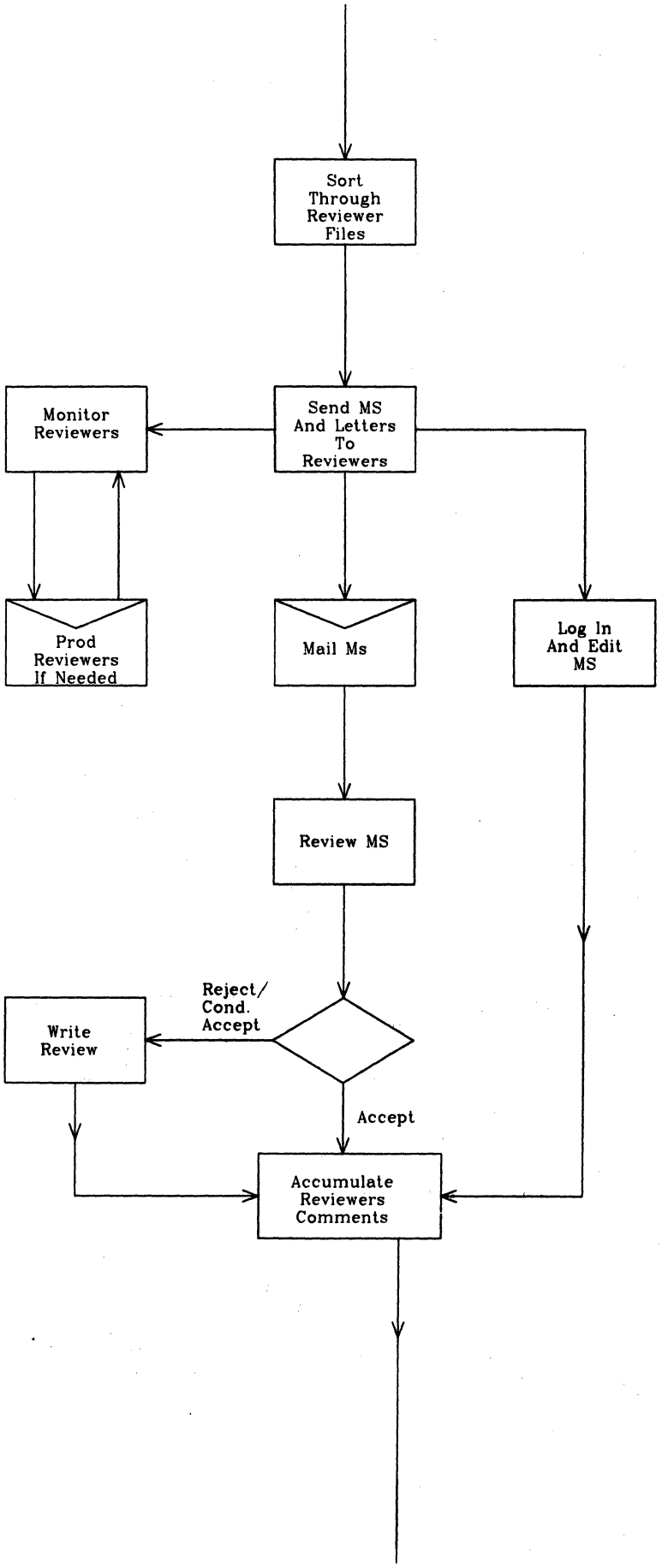
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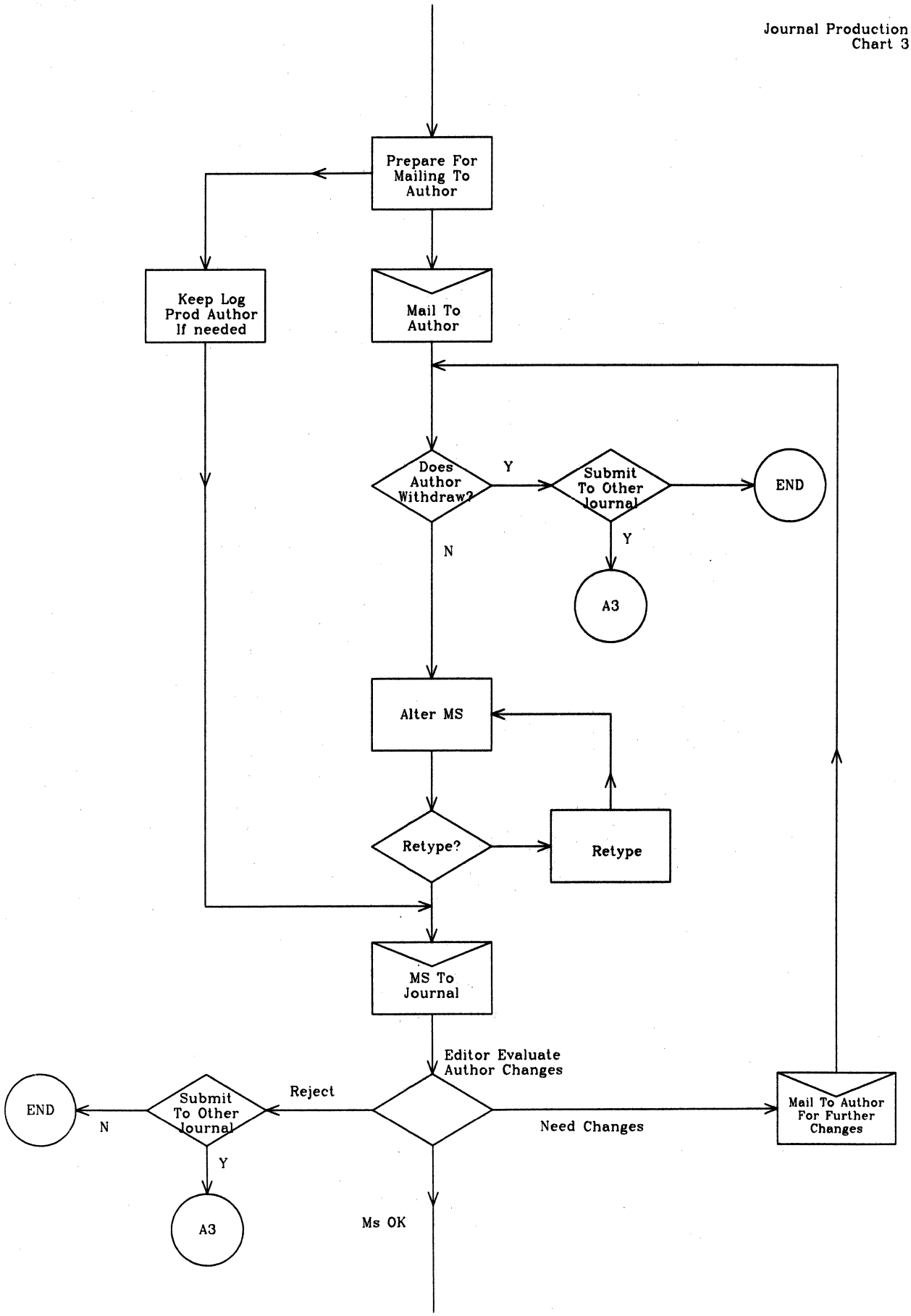
Send MS And Letters To Reviewers
Monitor Reviewers
Prod Reviewers If Needed
Mail Ms
Log In And Edit MS
Review MS
Reject/ Cond. Accept
Write Review
Accept
Accumulate Reviewers Comments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Keep Log Prod Author If needed
Mail To Author
Does Author Withdraw?
Y
Submit To Other Journal
END
Y
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A3
Alter MS
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Retype
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Editor Evaluate Author Changes
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Submit To Other Journal
Reject
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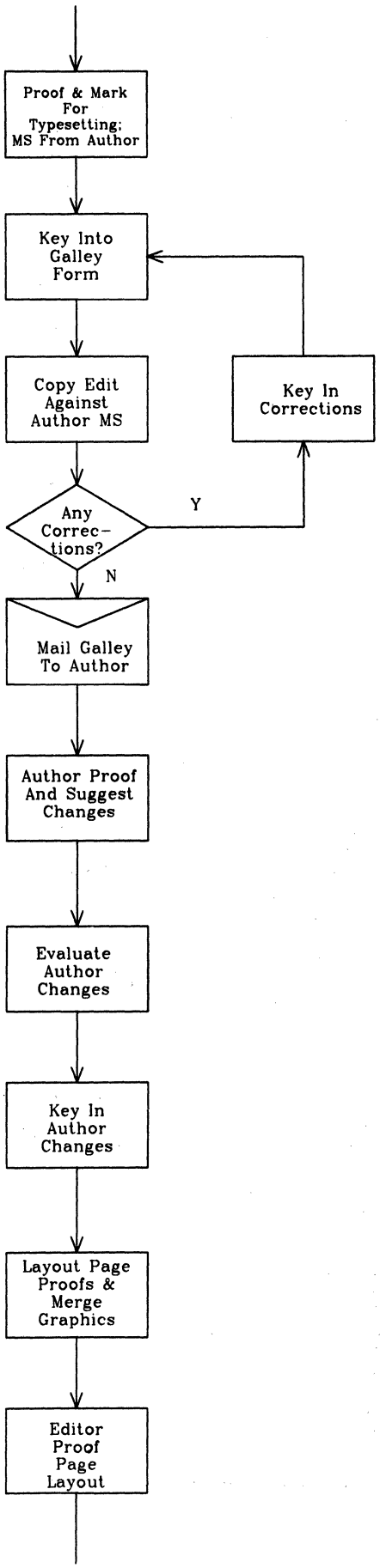
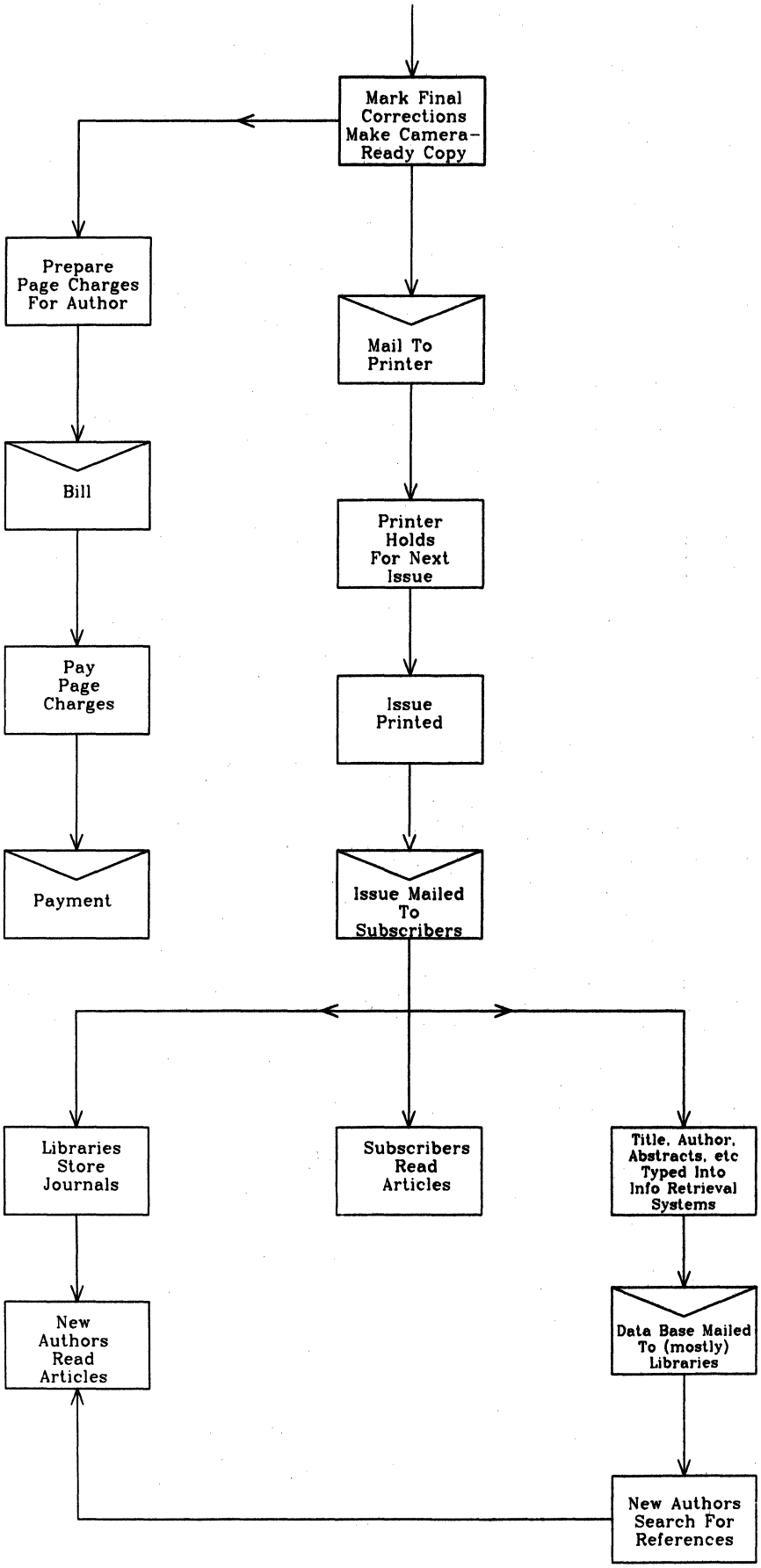
A3
Need Changes
Mail To Author For Further Changes
Ms OK


Proof & Mark For Typesetting; MS From Author
Key Into Galley Form
Copy Edit Against Author MS
Key In Corrections
Any Correc-tions?
Y
N
Mail Galley To Author
Author Proof And Suggest Changes
Evaluate Author Changes
Key In Author Changes
Layout Page Proofs & Merge Graphics
Editor Proof Page Layout

Journal Production
Chart 5



of these changes efficiently. A highly responsive system (where the user makes changes at her own speed) would be necessary to make cost effective use of the typist's time.

Formatting 3c3b

Page Layout

Many journals require demanding page layout in terms of special areas on the page (e.g., footnotes) and complex conditional cycles to allocate space (no more than one two-column figure on a page, to take a simple example). A complex trade-off exists between the cost of programming and running such page composition rules and intervention by the user, either in the form of interaction with the program or hand stripping camera-ready copy. A responsive system, in which the user could control the format visually by manipulating layout as graphics on a suitable screen, would probably make much more effective use of her time than inserting codes or verbal commands.

Some rapid publications journals eschew typesetting because of time. Typically, they Xerox typescripts from the author. If procedures and automated formatting could be worked out to produce camera-ready phototypeset manuscripts as quickly and reliably as present methods, such journals could realize advantages in handling costs and in readability of typeset documents.

Stored Formats

Single journals or groups of journals use standard formats, but journals all together vary widely in format. A full-page formatter that applied standard formats ("macros") with little command input and with little special training or tailoring would be necessary to avoid final page composition. Such a formatter would reduce the load on any previous typing steps. It would be particularly useful in the case of journals because the typists working for authors typically do not know the journal format well, and proportional spacing and complex page formats require tricky (highly representational) typing in the final stage. Ideally, the author's typist would have access to the journal's formatting macro and use would be simple enough for the occasional user.

Special Characters

Journal articles often contain equations and other complex notation. Any computer support system should be able to print common mathematical symbols and should include the capacity to change the size and location of the symbols flexibly on the page. A method of representing the symbols on display screens that is easy to type in and read is also desirable.

Table Making and Editing

A great deal of expensive slow tabular typing goes on in the offices of contributers to journals and in the typesetting step of various journal production cycles. The author's typist would find extremely useful a tabular input system that stored formats and allowed input of both rows and columns as straight typing. Many of the tables are larger than 8.5 by 11 inches, and the page formatter should be able to lay out widths up to at least 17 inches. Many of the tables are much larger than normal CRT screens.

A mechanism to create the illusion that the screen was a window moving freely over the surface of the table for editing and viewing purposes would be most useful (i.e., left, right, up, and down scrolling). Most of these tables are retyped at the typesetting stage (top of Chart 4) to suit them for printing with proportional fonts. Such typing is tricky and requires stringent proofing. The table handling system described above would be useful at this step if the tables arrived on paper. In addition, a system to transform monospaced tabbing into proportional tabbing would be necessary.

Indices

Many journals have indices and those that do not would generally like to. In many cases, the indices are cumulative and issued only in the final volume of each year (hence do not appear on the chart). A cost effective index making program would be a great help not only for printed indices, but to serve as a data base for automated retrieval. Index making programs should probably run in batch process rather than interactively.

Bibliographical Indices

Automatic generation of indices, references (in various formats), and bibliographies would be useful not only to journal publication, but in creating computer readable data bases for other online uses.

Hyphenation and Justification

Journals normally require hyphenation and justification. Most journals have specialized vocabularies and the hyphenation program must be able to learn new words.

Whole Issue Layout

Journals can save significant paper and mailing costs by beginning articles on the same page where the previous article ends, and this demands special page formatting for the first page of the second article. The criteria for deciding when an issue is full (a step in Chart 4) are complex and the issue may be subdivided into subjects. Insertion of advertising, announcements, and other fillers must be

considered. Development of a whole issue formatter would be cost effective in the long run only if it is useable for a number of journals. It would probably involve interaction with the production control system.

Character Quality

Many journals have standards of character sharpness that far exceed those of other technical publications and of most photocomposition devices. Some still use hot metal mainly for this reason. Planning for output must consider what devices (a Videocomp would be a candidate) can cost effectively meet these criteria.

Quality Control 3c3c

Based on experience in other publications cycles, a system that offers a more highly finished representation of the final format to an author earlier in the production cycle reduces the number of late changes by the author (shown in the middle of Chart 3). Such changes are particularly common and expensive in journals because communication between the author and the production cycle is restricted and because the change in form from typewriter to typesetter is dramatic. Authors working in NLS at ARC make changes at this stage only very rarely.

The reduction in retyping discussed under input and formatting reduces the quality control load, particularly if the automatic formatters involved are available at the author's site.

Automatic editing features such as a spelling checker would have the same effect.

Production Communication 3c3d

A glance at the number of envelopes on the charts gives a sense of the communication problem in journal production.

Production Control

Automated ways of collecting and displaying the status and charges on a job as it passes through production could replace filling out, filing, and reviewing various routing slips and card indices. These housekeeping jobs now take up something like three hours per article (21). Simulation of a basic general purpose information handling system suggests this figure might easily be cut in half (21). As more and more steps (e.g., completely online file storage) pass inside the computer, automated tracking will become easier. Such control might make it possible to charge authors (or organizations) specifically for the cost incurred in printing an article, something that is now done only occasionally in the case of special expenses such as color printing.

Reviewer Control

Journals have a special control problem with reviews. Most journals keep files of reviewers. The world of technical specialists is often constricted, and journals must select reviewers not only by competence, but also according to a list of other criteria such as whether the reviewer works for the author and whether the reviewer normally responds on time. Automated file maintenance and search for reviews integrated with control of the reviewers progress on articles on hand would be very helpful to editors.

Blue Pencil Subsystem

The most time consuming means of communicating among editors, reviewers, and authors is now notes written on the manuscript by one, and then interpreted by the other, by typists, and/or typesetters. If each had an opportunity to work online, an automated "blue pencil" system could reduce the investment of professional time for all concerned. In such a system, suggestions would be displayed online beside the text, and the author or editor could accept them by a single implementation command or add comments by a simple text insertion command. Note that users would need to learn only these functions to operate the system. A blue pencil system could extend to review by author's supervisors.

> Such a system would be much more effective on larger, more readable displays, preferably black on white, with clear character fonts adjustable in size.

Correspondence

The correspondence of journals with authors, reviewers, etc., now takes something like seven letters per article, pro rating the burden of rejecting articles, prodding reviewers, and the like. Many of the letters are highly repetitive; some are not. Four hours of clerical time is a general estimate of the time consumed. Use of a general-purpose publications system such as Daconics or NLS for this purpose could cut the time to an hour and a half or less. Use of a system with special letter preparation provisions such as Vydec or appropriate NLS subsystems could reduce it to half an hour. The cost effectiveness of these strategies would depend on the cost of the system and the cost of labor to the journal, which is often subsidized in some way (21).

Teleconferencing.

Teleconferencing is highly appropriate for journal production. It could not only replace considerable correspondence (see Chart 2), but holds the possibility of reducing the rigid and formalized procedures with attendant cost and time savings (although these cost savings are rather hard to figure exactly or estimate). It would be interesting to consider integration of teleconferencing with production control.

Communication Among Computer-Based Systems

A small amount of present journal production now passes through computer-based systems or automatic typewriters, and a substantial amount of work that goes into reports is derived from other computer systems. A system that could accept information from a variety of such sources would have a cost advantage.

Graphics

Most issues of most journals contain some articles with graphics, mostly line drawings. In general, they are created by the authors, handled in the journal offices as appendages to the manuscript, and added to the final layout in the form of photoreductions, shown near the bottom of Chart 4. Separate production flow is expensive in terms of time spent coordinating. NLS offers a system to handle certain graphics in a way that does not require a separate production flow. It is not clear that NLS Graphics is more cost effective than conventional methods for producing line drawings. However, even if NLS graphics or a similar system is as expensive as conventional graphics, there would be a saving through simplifying document production once the drawing is finished. A graphics input system would have to be available to the author, although it would not have to be NLS since NLS accepts graphics from a range of other systems.

Allocation of Cost

In this connection, note the allocation of cost for various services in models of highly automated systems. In a model based on several journals sharing NLS service from a single up-to-date machine, machine hardware cost is only 10 percent of the total; work at scattered locations and occasional use of terminals mean that communication costs and terminal costs are higher (9). Staff for the computer service is 14 percent and journal staff is 54 percent. The models of the Westat report give similar results (2).

Distribution 3c3e

Computer aids will not materially affect the cost or speed of distribution until distribution itself is online (11). Consideration of the cost in any detail is beyond the scope of this study, because it involves not only consideration of the future cost of communication and terminals, but understanding of the users total computer environment. Note however the brief discussion of expenditure in this area at (3b7a) above.

Storage and Retrieval 3c3f

A system which would lead to indices, abstracts, title word indices, or whole documents in online retrievable form would provide rapid access to previous related work. The capacity to add to online documents after publication is particularly

important for journals. New developments demand that citations to subsequent work be appended to old work. Citation indices exist in some fields, some computer generated, but the author must then find and copy the subsequent article.

Many journal authors use as sources large-scale computer data bases. Most use small-scale personal data bases (files of index cards for instance). Any system that economically assisted the transfer of that information into the file where the report is composed, or augmented the process of organization and cogitation, would assist the most expensive part of creating journal articles: writing. See (3b6) above.

Time 3c3g

Two time pressures exist on journal publication that are not easily analyzed in terms of person-hours. One is the value in prestige to the author of rapid publication, the other, more important, is the value to all people of making information available.

Publication now takes an average of five months and may take years (2). Reviewers claim that their work takes two weeks. There is a lot of tension and conflict between the authors, editors, and reviewers when there are delays in publication.

Existing text handling systems that take advantage of the communication aspects of systems such as NLS could reduce dissemination time to the length of time it takes to log in an item and review it, days at most in the case of something with time pressure (10, 11). As in the case of storage and dissemination, it is hard to evaluate at what point in the evolution of computer service it will become cost effective and who will pay for it.

SRI Reports 3d

Summary 3d1

SRI reports are written by technical specialists, approved by their managers, published by a separate organization within SRI, and mailed to customers who have paid for them. The people involved in preparing them are generally within walking distance of each other, and communicate with each other by phone, face to face, and by forms. Relations of the writers and approvers with the publications people tend to be formal. Generally, first drafts are based on notes from work and other publications and are typed by the author or a typist associated with the author. Succeeding whole or partial drafts are demanded by the approval process and usually are typed by a typist in the author's organization. The publications group imposes standards of clarity, organization, format, etc., and makes arrangements for final retyping, printing, and mailing. Manuscripts frequently cycle back to previous steps. Some computer-based aids exist at SRI (see Daconics below), but they do not effect the picture presented here. 3d1a

SRI Reports Flowchart 3d2

SRI Reports flowchart Chart 1 depicts events from the beginning of contract work through project manager approval. (see attached diagram) 3d2a

Chart 2 shows events from laboratory director review through author's response to Publications editing. (see attached diagram) 3d2b

Chart 3 is from re-editing by Publications through copy-proofing camera-ready copy. (see attached diagram) 3d2c

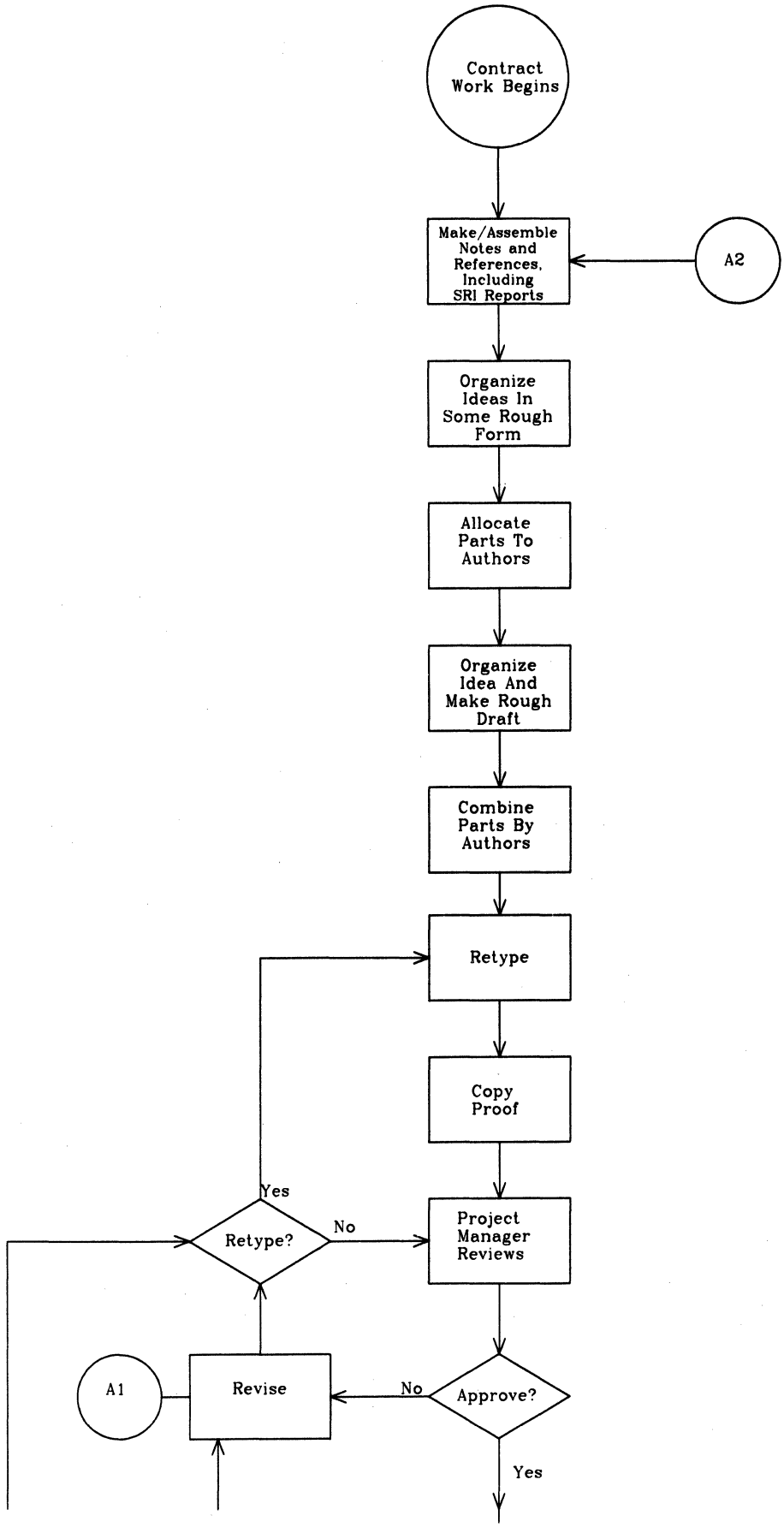
Chart 4 is from pagination through final proof by the author. (see attached diagram) 3d2d

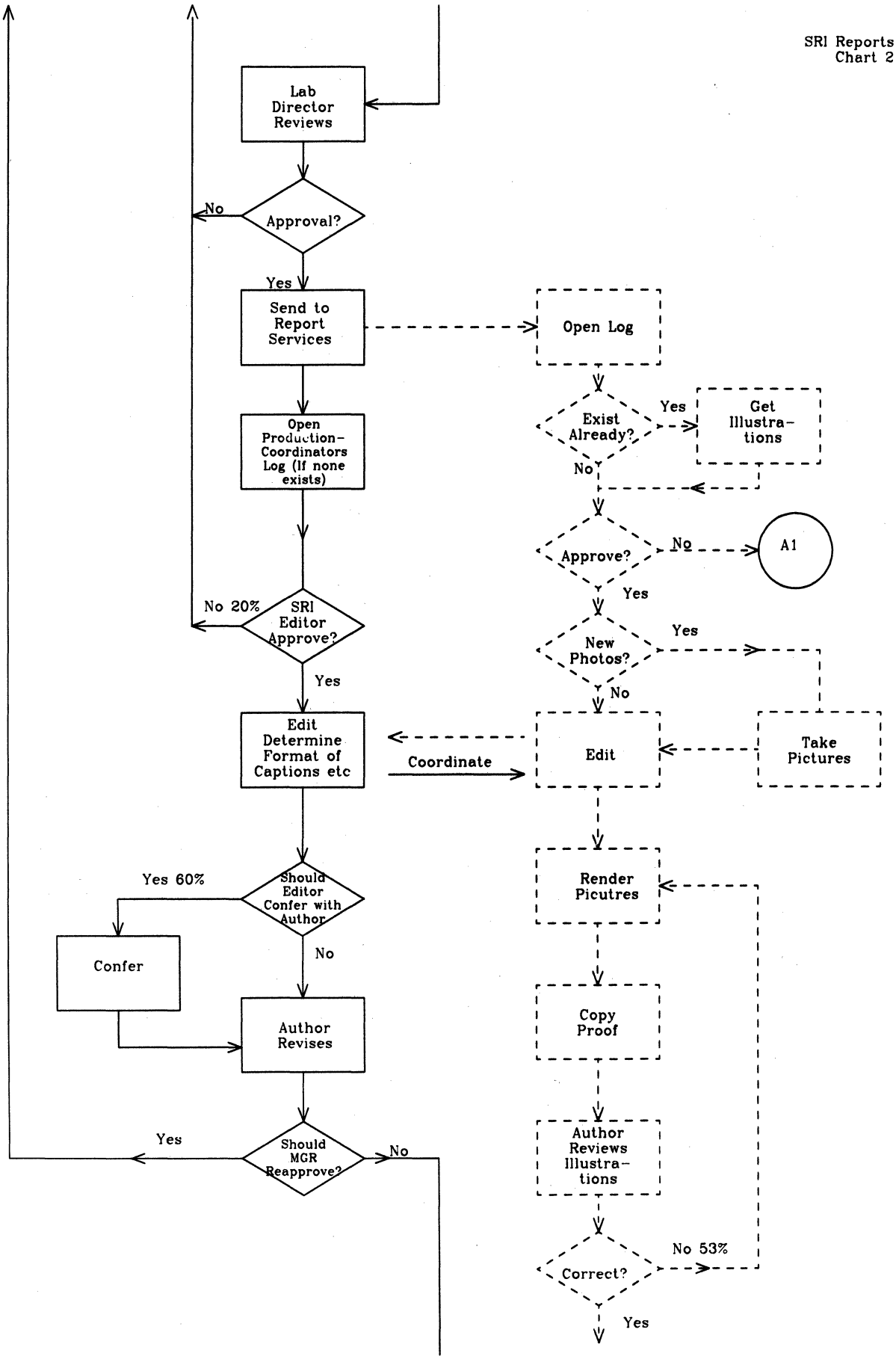
Chart 5 show events from distribution to research by subsequent authors. (see attached diagram) 3d2e

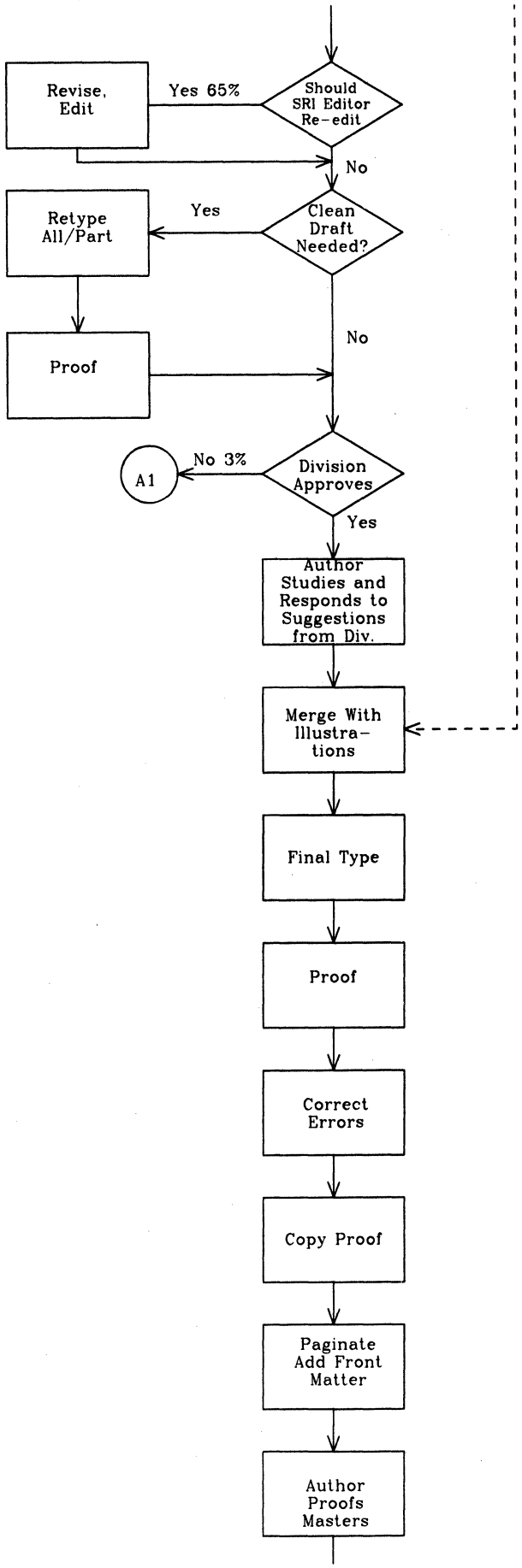
Critical Points 3d3

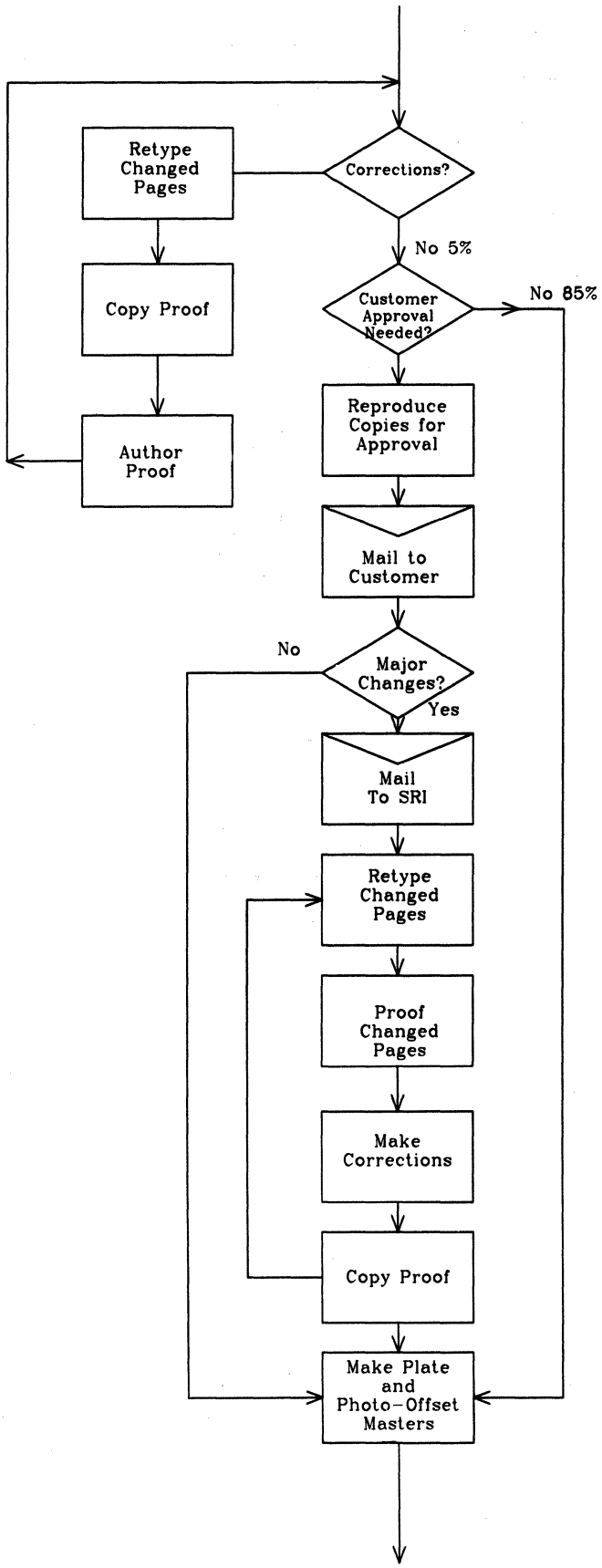
Character Transfer 3d3a

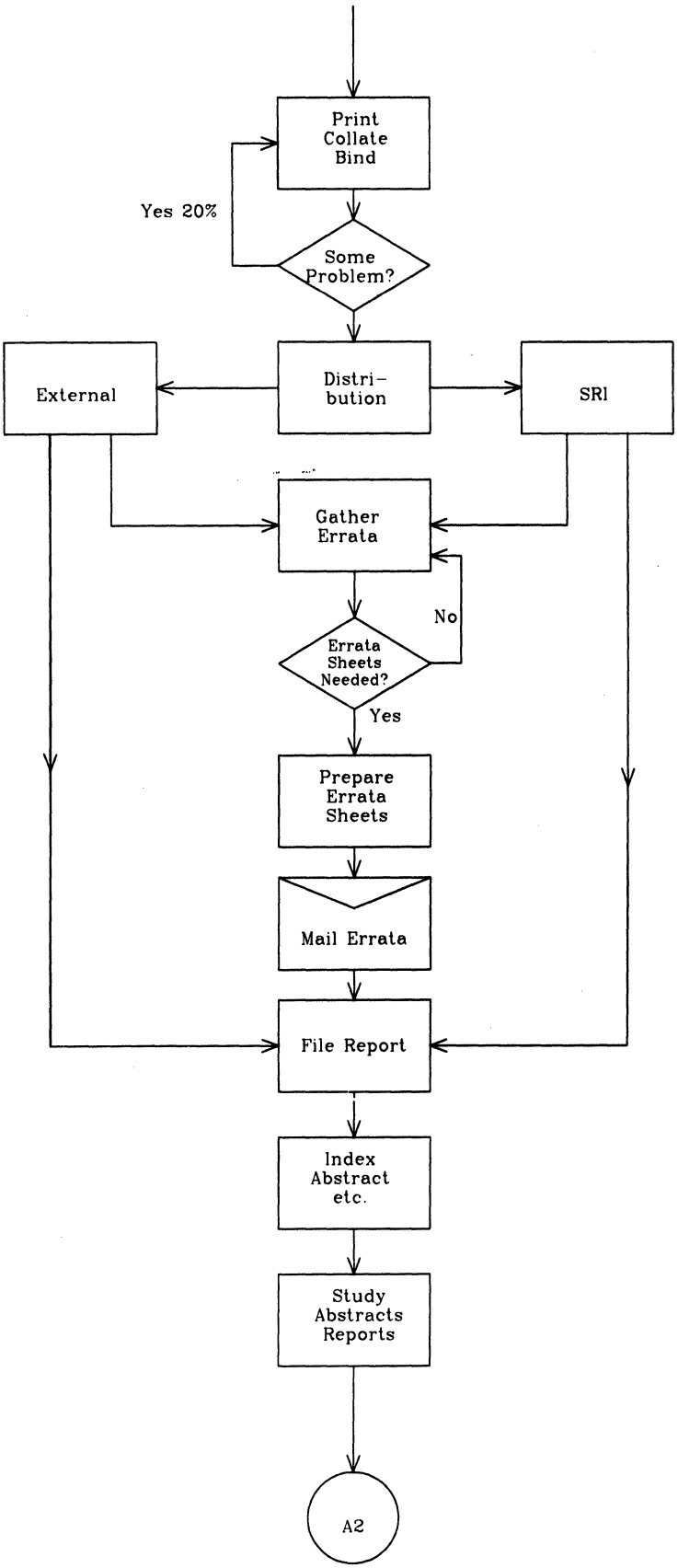
SRI reports are written once by the author and retyped an equivalent of about three times, considering the various partial revisions occasioned in the review and editing process. (See for example "Revise" on the lower-right-hand side of Chart 1 of the SRI flowchart.) Any system that reduces retyping and consequent proofing would help reduce costs and speed up the production process. The retyping is typically protracted over weeks and months and may involve rearrangement or changes in scattered parts of the document. Editors and typists often work with only one chapter or section of a report at a time; it would be extremely valuable if they had access to an up-to-date online version of the entire document. If formatting were automated, many detailed changes would still be


Contract Work Begins
Make/Assemble Notes and References, Including SRI Reports
A2
Organize Ideas In Some Rough Form
Allocate Parts To Authors
Organize Idea And Make Rough Draft
Combine Parts By Authors
Retype
Copy Proof
Project Manager Reviews
Approve?
No
Revise
A1
Retype?
Yes
No
Yes


Lab Director Reviews
Approval?
No
Yes
Send to Report Services
Open Log
Open Production-Coordinators Log (If none exists)
Exist Already?
Yes
Get Illustra-tions
No
Approve?
No
A1
Yes
No 20%
SRI Editor Approve?
New Photos?
Yes
No
Yes
Edit Determine Format of Captions etc
Coordinate
Edit
Take Pictures
Render Picutres
Yes 60%
Should Editor Confer with Author
Confer
No
Copy Proof
Author Revises
Author Reviews Illustra-tions
Yes
Should MGR Reapprove?
No
No 53%
Correct?
Yes


Revise, Edit
Yes 65%
Should SRI Editor Re-edit
No
Retype All/Part
Yes
Clean Draft Needed?
Proof
No
A1
No 3%
Division Approves
Yes
Author Studies and Responds to Suggestions from Div.
Merge With Illustra-tions
Final Type
Proof
Correct Errors
Copy Proof
Paginate Add Front Matter
Author Proofs Masters


Retype Changed Pages
Corrections?
No 5%
Copy Proof
Customer Approval Needed?
No 85%
Reproduce Copies for Approval
Author Proof
Mail to Customer
No
Major Changes?
Yes
Mail To SRI
Retype Changed Pages
Proof Changed Pages
Make Corrections
Copy Proof
Make Plate and Photo-Offset Masters


Print
Collate
Bind
Yes 20%
Some
Problem?
External
Distri-
bution
SRI
Gather
Errata
No
Errata
Sheets
Needed?
Yes
Prepare
Errata
Sheets
Mail Errata
File Report
Index
Abstract
etc.
Study
Abstracts
Reports
A2

made. However, automated computer editing running as a batch process in the background would handle efficiently many routine changes, e.g., correction of spaces after punctuation. A highly responsive system (where the online editor makes changes at her own speed) would be necessary to make cost effective use of the editor's time.

Formatting 3d3b

Stored Formats

SRI uses a small number of standard formats. A full-page formatter that applied standard formats ("macros") with little command input and requiring little special training or tailoring would be necessary to avoid the final typing. A full-page formatter would reduce the load on any previous typing steps by eliminating the need for hand-typed footers, headers, leading spaces, etc.

Special Characters

Many SRI reports contain equations. The computer support system must be able to print common mathematical symbols and include the capacity to change the size and location of the symbols flexibly on the page. It should also include a method of representing the symbols on display screens that is easy to type in and read.

Table Making and Editing

Most tables are hand typed at SRI, a slow and expensive process. A tabular input system that provides a choice of automatic formats could easily replace the tedious and costly work now done by typists. The input of both rows and columns would be straight typing. Many of the tables are larger than 8.5 by 11 inches, and the page formatter should be able lay out widths up to at least 17 inches. Tables are often much larger than normal CRT screens, and the provision of left, right, up, and down scrolling would augment editing procedures. Of course, screens that dislay a larger number of characters would also be useful. Although most tables are now printed in monospaced characters, if a formatter that set pages for a photocomposer were available at a comparable cost, much more printing would be proportionally spaced. If tables were still input and revised on monospaced screens, a system to transform monospaced tabbing into proportional tabbing would be necessary.

Indices

Few SRI reports have indices because of the time and expense required to make them. Publications personnel assert that if indices could be made automatically, they could be added usefully to many reports and could be accumulated as a data base of SRI work useful to SRI and its customers.

Production Cycles
SRI Reports

Hyphenation and Justification

SRI's system presently uses hyphenation but not justification. Quality control of hyphenation is troublesome. If automatic hyphenation and justification were available, it would be used to improve the appearance of reports and reduce quality control costs.

Graphics 3d3c

About 70 percent of SRI reports contain graphics, mostly line drawings. These illustrations are presently produced by graphic artists in SRI's Report Services. This separate production flow (represented on Charts 2 and 3) means increased expenses, time spent coordinating, and potential for errors. The Graphics subsystem enables NLS users to create complex line drawings (e.g., the flowcharts included in this report) and include them in text files. It is not clear that NLS Graphics is more cost effective than conventional methods for producing line drawings, but it greatly simplifies the produuction processs and reduces the potential for errors.

Quality Control 3d3d

The reduction in retyping as discussed under input and formatting reduces the need for proofing and reproofing.

Automatic editing features such as a spelling checker would help reduce repetitive correction procedures.

Output to a photocomposer could produce consistent, high-quality copy and so reduce the need to carefully check the appearance of characters.

If a system can provide a representation of the final format to an author early in the production cycle, the number of changes by the author after the step equivalent to final typing will be greatly reduced. Note on Chart 4 that 95 percent of authors make these changes. Authors working in NLS at ARC rarely make changes at this stage.

Production Communication 3d3e

Production Control

Automated systems to collect and display the status and charges on a job as it passes through production could replace filling out, filing, and retrieving several SRI production forms. As more work is done online (e.g. complete online file storage), automated tracking will become easier.

Blue Pencil Subsystem

Communication among authors and editors by marginal notes on the manuscript is nearly as time-consuming at SRI as it is in journal production. Note on Flowchart 2 that authors and editors meet only 60 percent of the time, and when

they do talk they normally cover only major points. If authors had an opportunity to work online, an automated "blue pencil" system could reduce time spent revising by editors and authors. With such a system, the editor's suggestions would be displayed online beside the text; the author could then accept them by a single implementation command or add comments by a simple text insertion command. Authors would need to learn only these functions to operate the system. The blue pencil system could also extend to review by author's supervisors.

Teleconferencing.

Teleconferencing would improve production flow when authors are at scattered SRI sites or when customers are involved in writing or making corrections.

Communication Among Computer-Based Systems

A small amount of SRI document production now passes through a computer-based system, and a substantial amount of work that goes into reports is derived from other computer systems. A system that could accept information from a variety of such sources would have a cost advantage.

Distribution 3d3f

Capacity to print through a phototypesetter would reduce mailing and similar costs. Output is occasionally demanded in computer readable form by customers, and we may expect this demand to increase. A system flexible in computer output would be useful as customers occasionally request output in the form of microfilm.

Storage and Retrieval 3d3g

A system that created indices, abstracts, title word indices, or whole documents in online retrievable form would provide rapid access to previous work for SRI staff and customers. The capacity to work online from such sources when writing new reports might reduce the retyping of SRI reports to less than one time.

Many SRI authors use large-scale computer data bases and or small-scale personal data bases (e.g., files of index cards) as sources. A system which economically transferred this information into the file where a report is composed would reduce the time spent on writing, the most expensive aspect of report production.

Production Cycles
AFM 66-1

AFM 66-1 3e

Summary 3e1

AFM 66-1 is a large technical manual that has been used and maintained by the Air Force for many years. It contains about 300 1000-word pages (or about 1500 typewritten pages) and is published in 12 volumes. Some volumes are revised and redistributed at least once a year. Periodically, the entire manual is revised. In general, the Air Force regulation states that corrections will accumulate until 40 percent of the pages of a volume are effected. At this point the entire volume is reissued. 3e1a

This work was done manually using typewriters until 1975. In 1975, six volumes needed revision. Time pressures were so great that the officer in charge of the revision process realized the deadline could not be met using manual methods. He requested and received permission to use NLS for the revision. 3e1b

The manual was not in machine readable form and the hard copy was not of a quality compatible with any available OCR device. The entire manual was typed onto MTST cartridges and translated through several steps into NLS files. Initial typing on the MTST and rough editing of the NLS files was done by one full-time operator in the six months prior to the scheduled rewrite. 3e1c

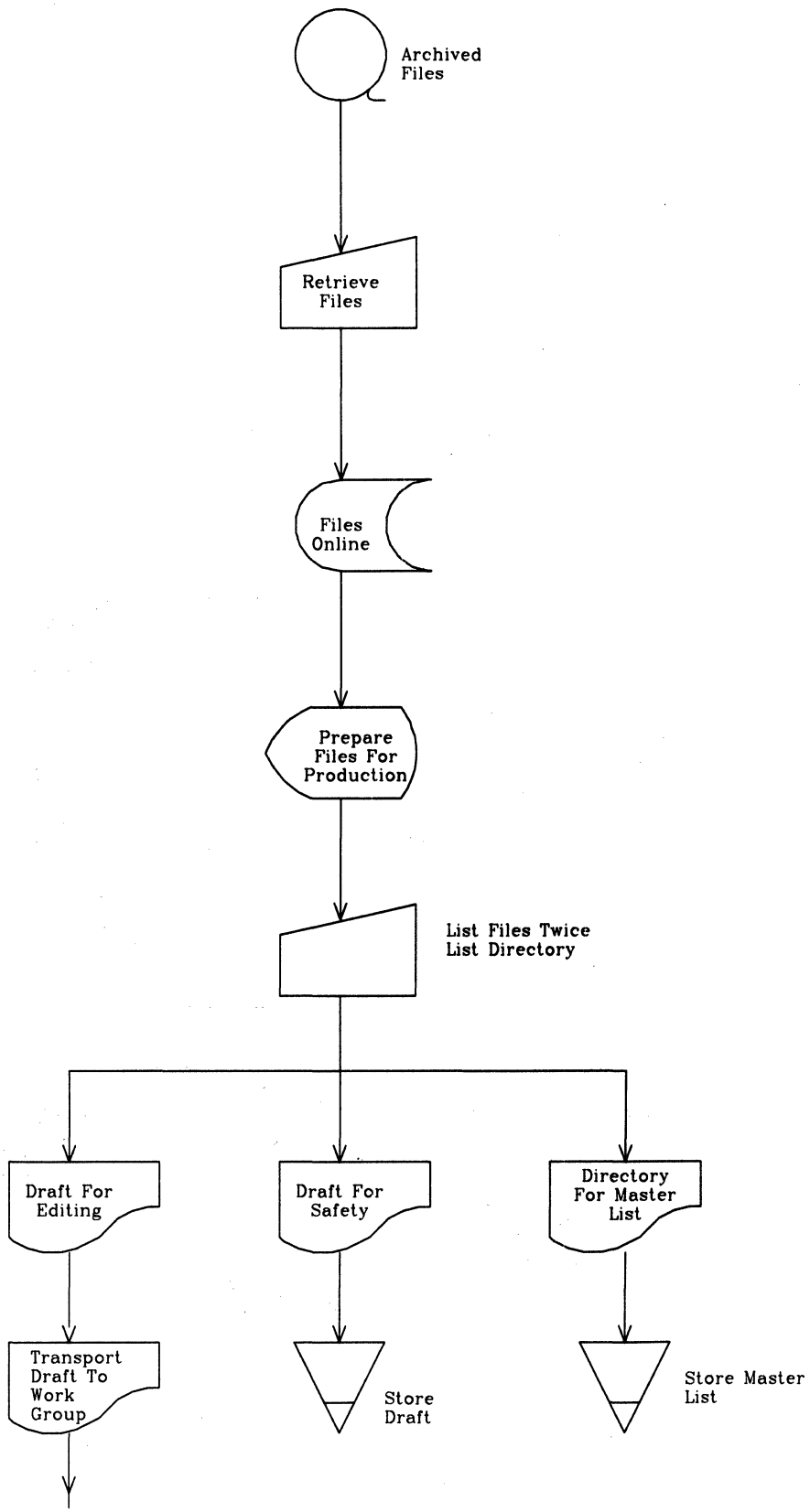
For the revision, 25 engineers, technicians, and technical writers were flown to Gunter AFS where NLS was being used experimentally. Line printer copies of the six volumes were given to the writers who marked their changes (in pencil) which were then made in the files by online typists. The next morning, line printer copies of the revised pages were given to a review board which made further changes and/or sent copy back to the first level of revisors. Cycles of revision were repeated several times. After two weeks, when everyone was satisfied with the text, an automatic program imposed format and page layout. Following final formatting for insertion of diagrams, the formatted text was written on computer tape and sent to a photocomposition vendor who returned camera-ready copy. The camera-ready copy was supplied to another Air Force agency (Data Automation) for printing and distribution to the field. 3e1d

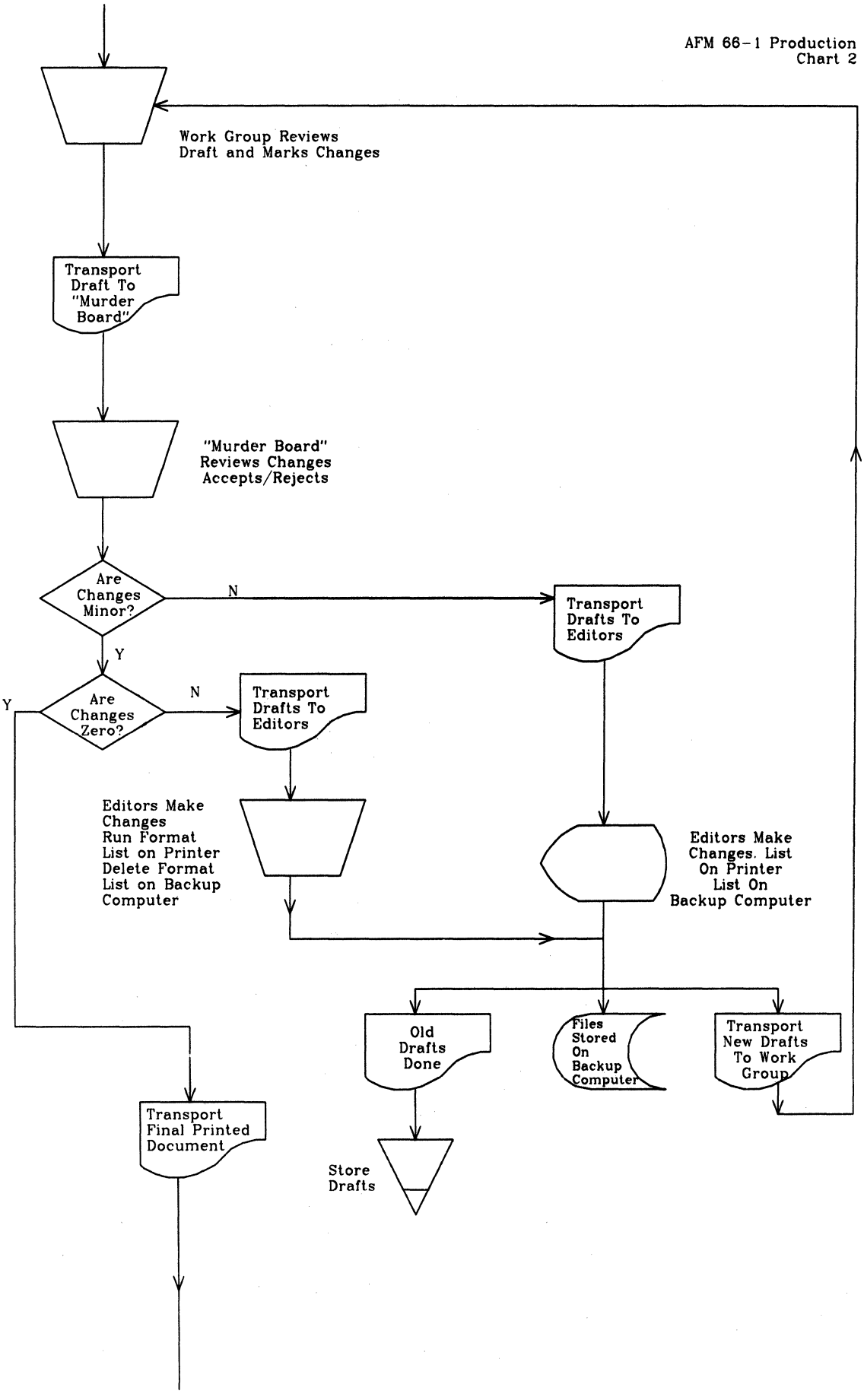
AFM 66-1 Flowchart 3e2

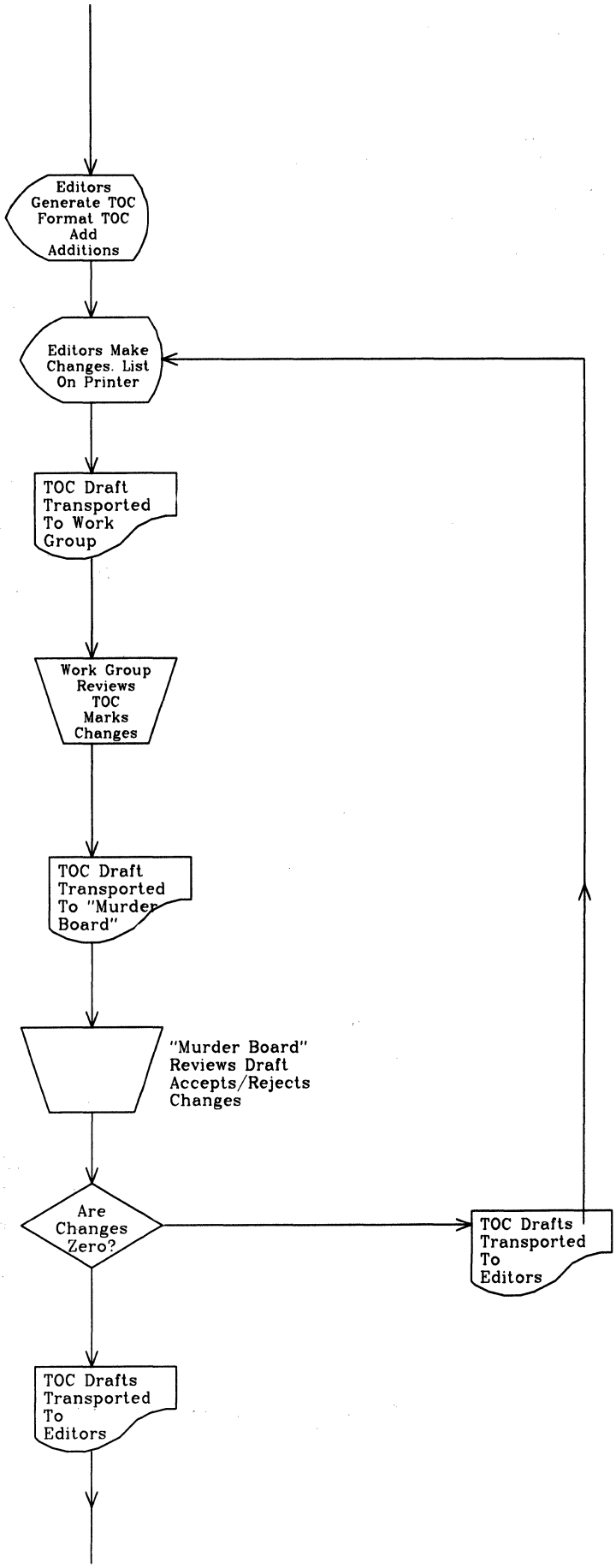
AFM 66-1 flowchart Chart 1 shows events from retrieval of archived files through transport of the printed draft to the work group. (see attached diagram) 3e2a

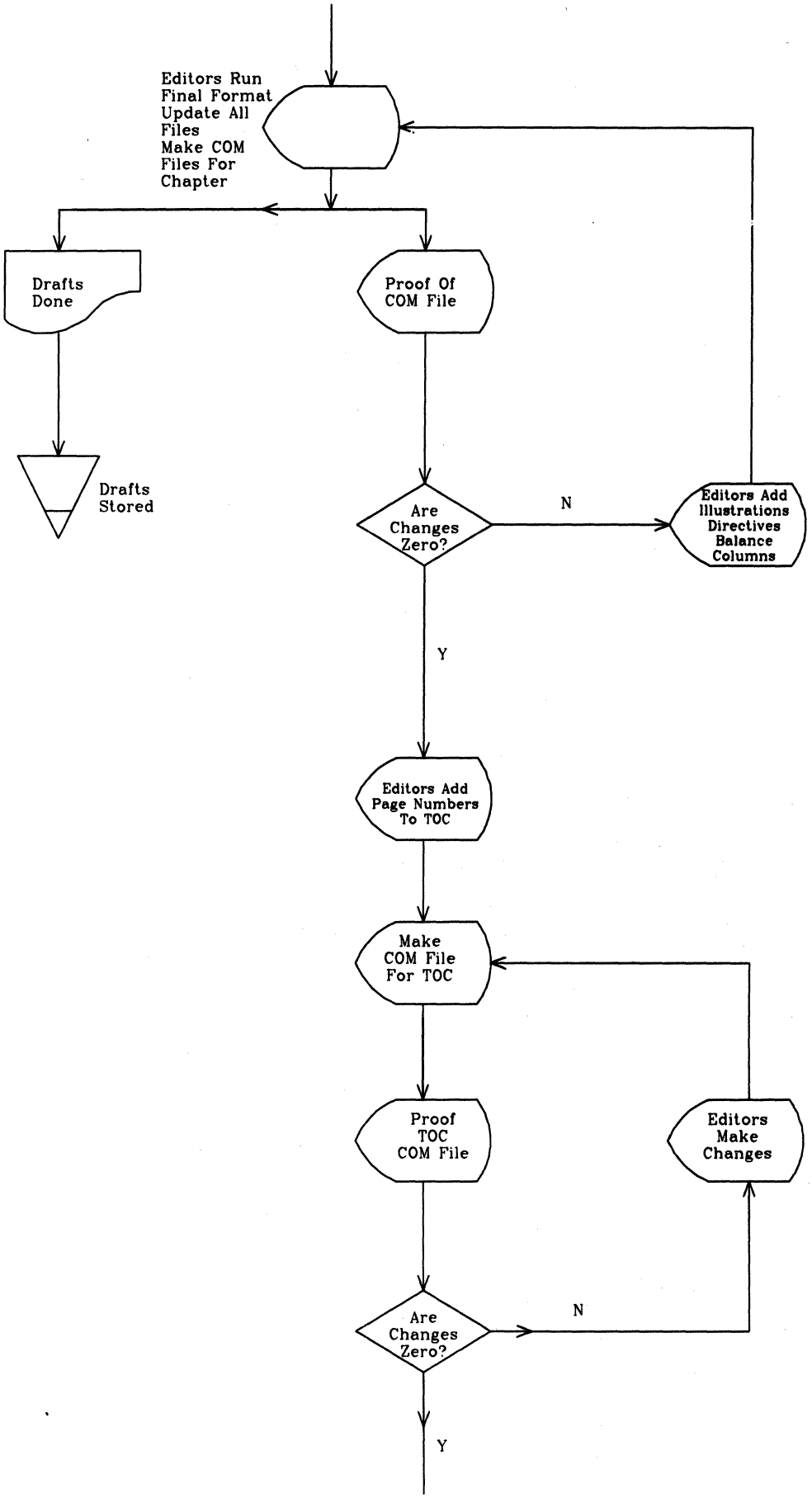
Chart 2 goes from work group review of the draft to the final line printer version. (see attached diagram) 3e2b

Chart 3 depicts the process of generating a correct table of contents. (see attached diagram) 3e2c


Archived Files
Retrieve Files
Files Online
Prepare Files For Production
List Files Twice
List Directory
Draft For Editing
Draft For Safety
Directory For Master List
Transport Draft To Work Group
Store Draft
Store Master List


Work Group Reviews
Draft and Marks Changes
Transport
Draft To
"Murder
Board"
"Murder Board"
Reviews Changes
Accepts/Rejects
Are
Changes
Minor?
N
Y
Transport
Drafts To
Editors
Are
Changes
Zero?
Y
N
Transport
Drafts To
Editors
Editors Make
Changes
Run Format
List on Printer
Delete Format
List on Backup
Computer
Editors Make
Changes. List
On Printer
List On
Backup Computer
Old
Drafts
Done
Files
Stored
On
Backup
Computer
Transport
New Drafts
To Work
Group
Transport
Final Printed
Document
Store
Drafts


Editors Generate TOC Format TOC Add Additions
Editors Make Changes. List On Printer
TOC Draft Transported To Work Group
Work Group Reviews TOC Marks Changes
TOC Draft Transported To "Murder Board"
"Murder Board" Reviews Draft Accepts/Rejects Changes
Are Changes Zero?
TOC Drafts Transported To Editors
TOC Drafts Transported To Editors


Editors Run
Final Format
Update All
Files
Make COM
Files For
Chapter
Drafts
Done
Drafts
Stored
Proof Of
COM File
Are
Changes
Zero?
N
Editors Add
Illustrations
Directives
Balance
Columns
Y
Editors Add
Page Numbers
To TOC
Make
COM File
For TOC
Proof
TOC
COM File
Editors
Make
Changes
Are
Changes
Zero?
N
Y

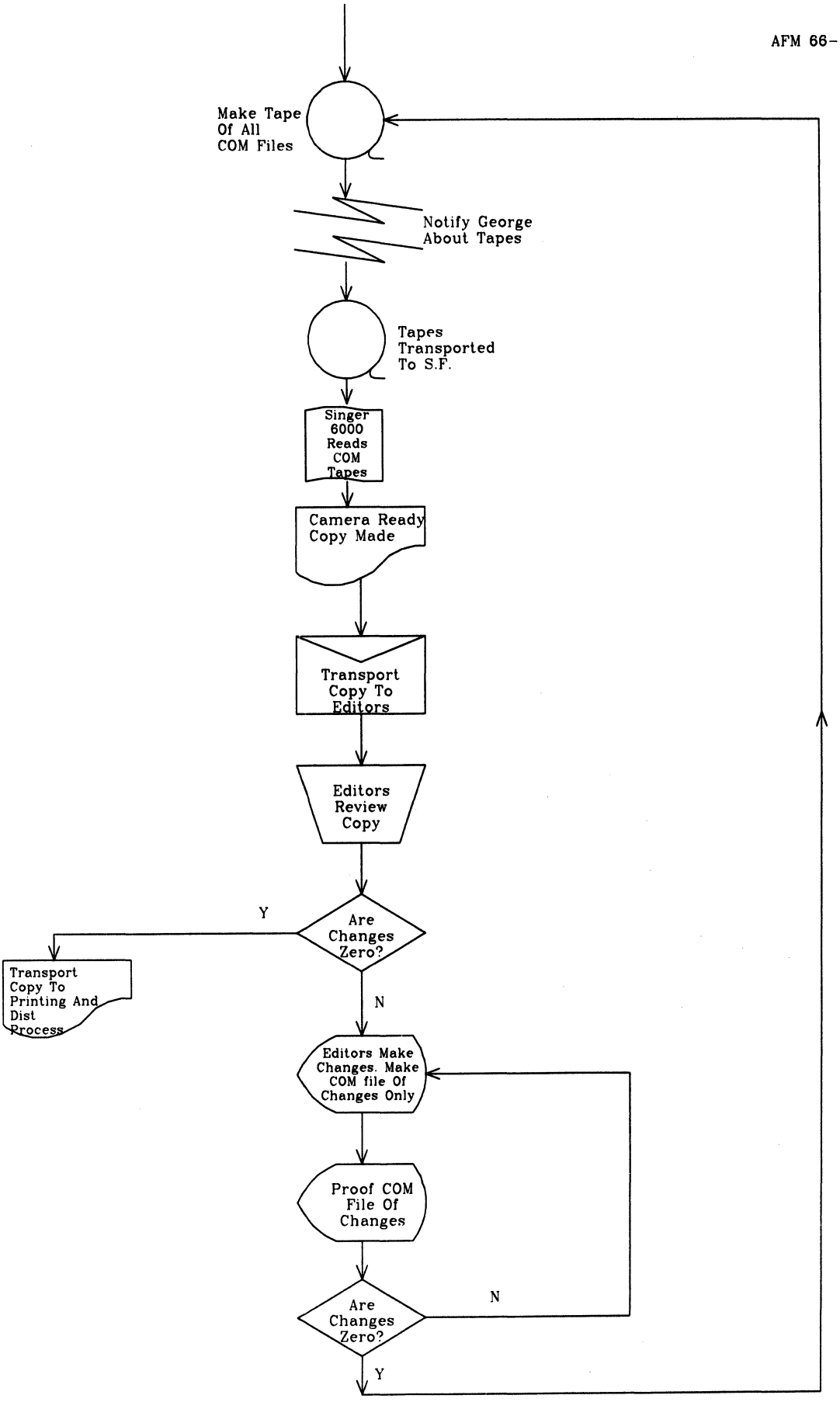

Make Tape Of All COM Files
Notify George About Tapes
Tapes Transported To S.F.
Singer 6000 Reads COM Tapes
Camera Ready Copy Made
Transport Copy To Editors
Editors Review Copy
Are Changes Zero?
Y
Transport Copy To Printing And Dist Process
N
Editors Make Changes. Make COM file Of Changes Only
Proof COM File Of Changes
Are Changes Zero?
N
Y

Chart 4 goes from insertion of format codes in the files through proof of photocomposed table of contents. (see attached diagram) 3e2d

Chart 5 depicts events from making a magnetic tape for the phototypesetter through printing and distribution of the revised manual. (see attached diagram) 3e2e

Critical Points 3e3

Character Transfer 3e3a

In this effort there were approximately 1.5 key strokes for every character finally printed.

Each character was key stroked once to bring it online. The original input was accomplished first by typing specially formatted text onto MTST cartridges, and then a series of machine translations created NLS files. The Air Force chose this route mostly on the basis of the available typists and equipment. Their analysis may have been correct for this case, particularly considering that the translation of the large number of pages justified some special programs that are not likely to be used again. However, in general, planners should consider carefully such alternatives as the offline text entry system, DEX, offered by NLS and OCR for bulk input of existing documents.

Some change was made on at least 40 percent of the document's pages; that is by definition what qualifies as a rewrite. Most of the paragraphs were kept intact and revisions were made to them. The 40 percent figure only gives a ball-park sense of how much retyping went on for two reasons.

First, revisions to revisions during the review process meant extra retyping.

Second, automated format changes and global substitutions mean that many characters were altered without retyping.

It is difficult to see how further substantial reductions could be made in total retyping without fundamental changes in procedures such as those discussed under Communication below. Processes that make revision more efficient such as extending substitutions to more than one file at once, substitution with ellipsis, or the blue pencil subsystem could modestly reduce retyping and speed production.

Each NLS file can hold up to about 200 of the final printed pages of 66-1. Each chapter was handled as one file which facilitated formatting, but some global changes or checks needed to be run over all chapters. The ability to edit and search across file boundaries would have been useful.

Production Cycles
AFM 66-1

NLS statements are limited to about 2,000 characters. Narrative technical writing fairly frequently exceeds this limit and paragraphs had to be rewritten because of it. Several additions to NLS to facilitate handling longer paragraphs would have been helpful:

Arbitrarily long statements.

Line-by-line scrolling on the display screen.

Highlighting of words or phrases that are the object of searches to identify them in screens full of text.

Screens that display more characters.

Formatting 3e3b

Automatic Formatting

A program was written which adds NLS Output Processor directives (25) to a file to create the format for photocomposer typesetting. Typists trained in NLS for document production imposed the formats, and they required little hand intervention once procedures had been worked out.

Table Making and Editing

Certain columnar material was handled in NLS but generally tables were treated as illustrations with attendant control costs. Table handling features such as those of Daconics would have increased efficiency. AFM 66-1 is not heavily tabular and the savings would not have been more than a small percent of typing time. In some cases, tables were handled as illustrations merely because they required ruling lines. A capability to rule lines in otherwise alphanumeric text would be particularly helpful.

Changed Pages

The Air Force would like to alter the revision procedure to revise and distribute only those pages of the manual that have changed. They have always accumulated changes and reissued whole volumes because of the complexity of the manual procedures for creating and disseminating changed pages. With the support of a full-page formatter such as exists in NLS or several other systems using large machines, it is easy to imagine an editor changing a page in a file online and instructing the system to make camera-ready copy of the changed page, any other pages effected, and a mailing list for distribution. If such a mechanism were available, perhaps fewer general rewrites would be necessary resulting in attendant savings from an even work load and reduced communication costs.

In fact after the period covered by this report, Gunter AFS began preparing changed pages for other manuals through NLS, although without all the automation mentioned above.

Analysis of future changed page procedures should include consideration of the Air Force's policy of converting many manuals to microfilm.

Graphics 3e3c

About 20 percent of the pages of AFM 66-1 have illustrations. Separate production flow of graphics offered problems in terms of time spent coordinating. NLS offers a system to handle certain graphics in a way that does not require a separate production flow. It is not yet clear that NLS Graphics is a more cost-effective medium than conventional methods for producing line drawings. However, if NLS graphics or similar systems are as expensive as conventional graphics, there is a saving through simplifying document production once the drawing is drafted.

Quality Control 3e3d

Quality control consisted of checks of camera-ready copy by the Air Force Data Automation Agency (DA) in Washington, D.C., proofing by revisors and editors, and the action of automatic editing and checking features such as the sentence spacing command in NLS' Modify subsystem and its Jump to Content command. Users commented that more automatic checking devices would have helped, including error checking over groups of files and search for errors common in this document (e.g., omission of the period after the first phrase in top-level statements).

If DA found an error, they repaired it by the usual, manual publications process of cutting and stripping.

Production Communication 3e3e

A Production Control System

The approval and control of this project was scattered over several Air Force agencies in Washington, Gunter AFS and elsewhere. A simple management information system that would accept the status of each document relative to approval and production steps of the document and allow those involved to read its status, or the status of all documents in the system etc., would help production such as AFM 66-1. Such a system could be adapted from a system existing in NLS to monitor a similar production cycle.

As deadlines approached, Gunter AFS documenters backed up critical files by transmitting them to a second machine. A system that permits such backup and where the process is easily automated (so tired workers late at night can press a button and have it happen) has a safety factor that is valuable both for saved files and feeling secure.

Some problems were discovered when the next rewrite began that an appropriate control system would have prevented. At the end of the first rewrite, people had not named and archived files systematically, and it was necessary to rely on their memory of what text was in what file.

Blue Pencil Subsystem

Note that a blue pencil subsystem such as described in 3d3e above could be used by the approvers and the review board (see Appendix, 3b3b) to reduce retyping.

Teleconferencing

Teleconferencing has great potential for AFM 66-1. It could reduce the problems of approval in the scattered agencies and eliminate the 25 writers' trip to Gunter AFS for the two weeks of revision creation.

Steady State Production

A blue pencil subsystem available to the scattered writers and leading to production of changed pages could revolutionize the process of revising documents such as AFM 66-1. AFM 66-1 has never actually been up-to-date in all it volumes and references to related documents, and this goal might be attained. More important in relation to direct publications costs, if revisors could accumulate changes and approval piecemeal without leaving their stations, what has been a frenzied effort with expensive travel could become a steady, local background activity.

Displays larger and more readable than those based on 512-line CRTs would facilitate blue pencil type features and acceptance of them by writers.

Distribution 3e3f

The Air Force has a policy of converting large technical manuals including AFM 66-1 to microfiche chiefly to reduce distribution and storage costs. The results of the revision cycle were not microfilmed because procedures for use in the field of fiche instead of hard copy were not ready, but the capablity exists in NLS. In the case of manual systems, the expense of the steps necessary for microfiling is considerable. Many of the users of such manuals have access to Air Force communication systems that enable them to read online files stored at a central computer. We would suggest serious consideration of providing online access to central computer files, or a mix of online access and other media, as an intriguing alternative to offline distribution.

Storage and Retrieval 3e3g

Unlike the SRI reports and journal articles, users of AFM 66-1 are not the same as writers.

Unlike the situation with SRI reports and journal articles, the writers had the opportunity to retrieve, copy, or edit the original material that was online. They

didn't. They arrived at Gunter AFS with no advanced knowledge that the files were online, no NLS training, and psychologically accustomed to having subordinates do "typing". Clearly, it would be possible to train writers or to create a special subsystem to accept their input (several subsystems that allow naive users to perform particular functions exist in NLS), but it would only be justified in terms of cost as part of a continuing program.

AFM 66-1 does not presently have an index. A system that would offer indexing with appropriate mechanisms for updating and changed pages would improve the usefulness of the document. Indexing the related manuals mentioned above would make AFM 66-1 more useful.

Special field forms now used by writers (see Appendix, 7c2c) constitute private data bases that are hand integrated into revisions. A provision to collect these data bases online could reduce retyping and improve control.

Addendum 3e4

Volume 10 of AFM 66-1 is now being rewritten at Gunter AFS. Air Force personnel have agreed to keep careful statistics on time spent. 3e4a

The rewrite has reached the stage when writers have finished and approved the document, and the draft has been delivered to the Data Automation agency at the Pentagon for final approval before production of camera-ready copy. 3e4b

We have received statistics from Gunter AFS on the number of pages revised, formatted, and printed and the number of hours of effort expended by the secretaries doing the work up to this point. 3e4c

The volume is approximately 172 250-word pages. Forty three percent of the paragraphs in the document were changed and of these possibly half were changed more than once. During the two week period the writers and reviewers were working at Gunter AFS, approximately 2,277 pages of drafts were printed. Of these, about 111 were pages showing only those paragraphs which had changed since the previous edit. This work was done by two secretaries who worked a total of 81 hours over the two weeks making changes, formatting, and printing the document. This is an average output of 28 pages printed an hour. This is a astounding figure when compared to page per hour output possible using other systems, and one wonders what the impact on the paper industry would be if NLS were widely used in this hard copy oriented fashion. 3e4d

The statistics were broken down as follows: time spent making changes and additions was 61 percent, formatting (i.e., inserting format directives) was 17 percent, and running the formatter (Output Processor) and sending the formatted output to the line printer was 22 percent. 3e4e

SIX EXISTING SYSTEMS 4

Introduction 4a

For the past two years ARC personnel have been collecting literature on commercially available aids to document production that have proven effective in production environments. These include large computer text editors, stand-alone word processing devices, minicomputer based systems and microcomputer, 'intelligent terminal', systems. Large numbers of new systems and devices have come onto the market, each purporting to support the document production process. A review of the literature reveals that while many of the devices effectively support a portion of the process in a particular context, none in fact manage to support the entire process from authorship through distribution. Most require very special organization settings (e.g., a centralized word processing department). 4a1

We examined a large number of text processing systems and did an in-depth study of a small, representative sample of those available systems. Our criteria for selecting the sample were: 4a2

The system has been used effectively in production environments. 4a2a

Reasonably detailed information is available on actual experience with the system, including production volume and cost figures where possible. 4a2b

The sample should include examples of stand-alone devices, large-scale computer-based systems, and minicomputer based systems. 4a2c

One system, the DEC 310W, was included because of client-expressed interest. 4a2d

Asking people with production experience what features they wished for has often proved disappointing. In talking with present users of both manual and computer-based systems, we have been impressed by how often people don't complain about what appears from the outside to be the limitations of their systems. People quickly notice when a system fails to deliver an overt or implied promise, as for example they quickly complain about slow response time, but people working on line-at-a-time, half-duplex paper terminals seldom wish they could separate their commands from there text more clearly, although users of fast displays say they would never want to go back to half-duplex paper terminals. 4a3

This quality of limited perspective extends to the difference between computer systems and manual systems. For example people with computer systems with limited file control complain they do not have more, while people with manual systems never have that complaint. It is as if file control were never a problem in manual systems, but in fact manual users are merely so used to the problem that it has become

invisible despite its high cost. The problem is there, solved by putting things in envelopes, putting things in filing cabinets, attaching paper clips, straightening desks, filling out forms, and many other time-consuming tasks. 4a4

MCST 4b

IBM's Magnetic Card Selectric typewriters (MCST) are representative of a large class of stand-alone 'Word Processing' systems that have been widely used over the past 15 years. These devices have proven effective in some instances and total failures in others. We include them in this study because the record of failures and successes can yield valuable information about the design of future document production systems. 4b1

Context of the Study 4b2

We worked briefly with a management consultant who did an in-depth study of the use of word processing equipment in the legal profession. We have been given access to the resulting reports and are free to use the information without revealing the names of the firms studied. 4b2a

Most of the firms studied used MCST IIs in a typing pool or word processing department environment. In general, the firms operate with one secretary to every two attorneys and have word processing departments of from two to five operators. The secretaries handle most short documents and memoranda using typewriters, and send longer documents to the word processing department. There was considerable variation in the percentage of documents done in word processing sections and those by the secretaries. 4b2b

Company A showed the greatest increase in typing pool productivity, from 20 pages a day per typist to 50 pages a day, when the typewriters were replaced by MCST IIs. The word processing section was located conveniently near the attorneys and their secretaries. In addition, one operator was available at night and on Saturdays. These factors probably account for the good acceptance of the service and the high percentage of the overall documents produced by them. 4b2c

A second company with about the same work load and workstation configuration achieved a smaller increase to about 40 pages a day per operator. The difference is explained by the fact that Company B operators did much of their own editing. They were provided with dictionaries, court rules, style manuals, etc., and were expected to produce nearly error free documents. The firm felt that this mode of operation encouraged enthusiasm and efficiency and maximized personal involvement and job satisfaction. Although it could not be measured, it is possible that the lower volume produced by company B was more than made up for by fewer errors and shorter correction times. 4b2d

A third company with a similar configuration experienced almost no increase in overall productivity because few attorneys used the service. The word processing department was located in a remote corner of the basement and no smooth procedures were developed for submitting, controlling, and distributing jobs. This has been

the experience generally with word processing. A surprising number of companies have stuck the word processing sections in unused, remote locations. Invariably when this is done, the service has failed. Operator moral is low. Time is wasted in submitting and retrieving documents. 4b2e

Physical Attributes 4b3

The MCST workstations are probably the best of all the stand-alone, typewriter word processing devices. The heavy duty selectric typewriters have excellent keyboards and quality printing that has not been matched by other manufacturers. The card unit is controlled by function buttons of which there is a minimum number conveniently located and clearly identified. 4b3a

The units are competitively priced, about $255 to $350 per month rental. 4b3b

The typewriter is an impact printer and operates at a noise level that makes it most unpleasant in an office environment. Print speeds are limited to about 15 characters per second which is a severe drawback when many drafts of long documents are needed quickly. 4b3c

The MCST II introduced a second card reading station. This made it much easier to do form letter type documents and documents using already prepared text. 4b3d

The capacity of a magnetic card is approximately equivalent to one 8 1/2 by 11 typed page. Experience with the earlier Magnetic Tape Selectric Typewriter (MTST) led IBM to believe that is is very difficult for secretaries to grasp the concept of a file on a tape. Also, the manual bookkeeping required to keep track of tapes with several files is cumbersome. The theory is that each card should be clipped to a hard copy of the page it contains. This probably works reasonably well for very short documents, but presents an almost impossible filing problem for the very long documents that are typical of the technical documentation area. 4b3e

Input/Output 4b4

Input is primarily from the keyboard. The MCST II, with two card capability, allows input from a second card. The communicating MCST can accept input from another communicating MCST or from a computer. 4b4a

Output is to the typewriter, to a card, or with the communicating MCST to a computer file or a second communicating MCST. 4b4b

Distribution/Access 4b5

Distribution is by traditional means only for all models except the communication MCST which can send text to a computer or to a second MCST. Access is from hard copy, from cards, and from a computer file or remote card (for communicating models). 4b5a

Existing Systems
MCST

Accounting and Control 4b6

No accounting or control features are available for the MCST as a stand alone device. There is no index record on a card and all cataloging, filing, etc., must be done manually. 4b6a

Company A, discussed above, found this such a severe limitation in their rapidly growing firm that, in spite of the success of the MCSTs as word processing tools, they are replacing them with PCS terminals. They will use the extended ATMS editor for document production and make extensive use of the batch programs offered by PCS for information storage and retrieval, accounting, client records, office and court calendars, case-load logs, etc. 4b6b

Another company found that the slow printing speeds made it impossible to meet court schedules in cases where very long (3000 pages) documents were required. They solved their problem by adding a communicating MCST and using a large computer service bureau's text editor and high-speed printer for long documents. On the basis of a one-year experiment with a portion of their work, they estimate use of the large-scale computer can reduce their word processing costs alone by 50 percent. 4b6c

Communication 4b7

The communicating model can communicate to other MCSTs. However, the very small capacity of a card reduces the usefulness of this feature. 4b7a

Editing 4b8

As the text is recorded on the magnetic card, the operator can backspace and strike over errors. While revising pre-recorded material, any text can be replaced and lines can be expanded to a limit of 100 characters total. There is no context searching capability, so text to be changed must be located by printing the content of the card. This may be done a line at a time, a word at a time, or a character at a time. 4b8a

The text can be realigned (i.e., margins can be changed) and the operator has the option of manually hyphenating words near the end of a line. 4b8b

Text, of course, can be copied from one card to another or to paper. 4b8c

Page Formatting 4b9

Page formatting is limited to justification with interword spacing and a special feature called paragraph indent that gives some help with outline format material. 4b9a

There are several hundred type fonts available. These include fonts for printing complex mathematical equations and graphs. Graphs and charts can be constructed using special fonts and the half line forward and backward spacing feature of the typewriter. It is extraordinarily difficult to use this feature, requiring many hours of trial and error work to construct and record a very simple diagram or chart. 4b9b

Training 4b10

Operation of the basic features of the workstation is so simple that only a few hours of instruction are needed. IBM provides a good three day training course which teaches the more complex ways to edit and manipulate the text on the cards. The operator's manual is excellent. 4b10a

DEC Datasystem 310W 4c

General Description of the DEC System 4c1

The DEC Datasystem 310W, a fairly new entrant into the word processing market, is an enhanced version of the DEC PDP-8A business data processing package (310). This system incorporates word processing capabilities and data base handling along with a user-programable business applications package called the COS-310. We will only discuss the word processing and data base handling capabilities in this report. 4c1a

The Datasystem 310W is made up of a VT52 DECscope video terminal, dual floppy discs, and a 45 cps Daisy Wheel printer. A configuration with two terminals and one printer is also possible. The system includes an asynchronous RS 232 plug to allow access to large time-sharing systems, phototypesetters, or other input and output devices accessible through the time-sharing system or by means of the RS 232 plug. 4c1b

Training and Documentation 4c2

DEC provides two days of training at its offices for new 310W operators. Three 310W user documents are available: a complete system reference manual, a tutorial users' guide, and a quick reference pamphlet. 4c2a

The system includes the aid of a menu, which displays the choices available to the user, and "cue cards", online instructions the user may call up for further information on how to use the features displayed on the menu. 4c2b

Input 4c3

Input is from the DECscope video terminal, which displays 24 lines of 80 characters each. A cursor is used, but instead of moving the cursor to the desired position on the screen, the user moves the line to the cursor which remains on the bottom line. Another unusual design feature is that the lines on the screen move from bottom to top, rather than top to bottom. This design was evidently an attempt to make operators used to conventional typewriters comfortable with the display medium. 4c3a

The system's data base capabilities allow the user to input files containing any number of fields of any length. 4c3b

Output 4c4

Terminal Output 4c4a

The user may scroll backwards and forwards. The system allows for both simple searches (searching a document for all occurrences of a particular string of characters) and conditional searches (searching files or lists for records that meet a defined set of logical conditions).

Hyphenation and justification may be done at the terminal. A provision for discretionary or mandatory hyphens is included. Like many other word processors, the terminal has a "hot zone" which causes word wrap to occur at the first interword space. When text is justified, the line is spaced out to the right margin.

Printer Output 4c4b

Special formatting features are set at the terminal, including bold face, underlining, superscripts, subscripts, headers, and footers. Top and bottom margins are user settable. Users may create and store formats for full page or column layout that can be called up any time with control function buttons. Whole files or selected portions of files may be formatted for output automatically according to these pre-stored layouts.

There is no pagination for terminal output, but two methods are available for printer output. The first, called "draft" paging, allows the user to set the number of lines to appear on each page for the entire document. The second method for "final copy" permits the user to scroll through the document, setting the number of lines for each page to allow for widows or special formatting. Needless to say, this method is somewhat tedious for long documents since each page must be formatted individually and any major change in the document requires that the process be repeated.

There is no provision for automatically changing type fonts and sizes on a single page or changing layout from page to page for a single document. Limited variable spacing between characters and lines is possible.

The Daisy Wheel printer can handle both individual sheets of paper and continuous rolls. Printing is at the rate of 45 characters per second.

Editing 4c5

In addition to typical editing functions of video word processors (such as delete and file merging for letters), the system also has a transpose function that allows characters to be reversed. A "cut and paste" function allows the user to move text segments of up to three pages within a file. There are also provisions for the storage of commonly used terms and longer boiler plate material (these may require up to four key strokes to access). 4c5a

Editing commands are implemented by an extensive set of prompts which, declared one analyst reporting on the system, would soon become "tedious and unnecessarily cumbersome". 4c5b

None of the editing commands can work on whole files at once, nor does the system provide any cross-file editing features. 4c5c

Existing Systems
DEC 310W

Production Flow and Control 4c6

The documents stored on each disc are indexed by title, file number, date of origin, and date of last modification. 4c6a

There are no access controls on any of the files on the disc. It is assumed that anyone who has a disc should have access to the files on it. A "real time" clock, which allows date and time to be automatically tagged to a document, is about the only production flow feature of the system. However, DEC is quick to point out that control features are not needed since the Datasystem 310W is a "one-user" system. 4c6b

Storage and Access 4c7

DEC has taken a random access approach with its two floppy discs. Data may be packed onto the discs to use all of the available 250,000 characters or just over 100 pages per disc. This means that one disc can be devoted totally to the user's needs while the other is the "system" disc. Fifty pages of the system disc are occupied by the system software, leaving room on it for a "shorthand dictionary" or boiler plate material. 4c7a

Full Page Formatting 4c8

The DEC VT52 display terminal does not handle a full-page of text. DEC does not seem to be moving in the direction of full-page displays. 4c8a

Communication 4c9

The operating system of the 310W allows optional teletype-like communications with any time-sharing system or with other Datasystem 310Ws. 4c9a

Cost and Cost Effectiveness 4c10

The Datasystem 310W sells for $22,600. (The same system without the business packages, called Wordsystem 100, sells for $19,000.) 4c10a

Daconics-Based Systems at SRI and Kaiser Aluminum and Chemical Corporation 4d

The Daconics system was included in the sample as a representative of general-purpose, high quality, minicomputer based systems. 4d1

Context of the Study 4d2

SRI Report Services, Word Processing Section 4d2a

SRI produces the bulk of their reports, averaging 10,000 pages per month, using traditional methods. Several experimental document production systems have been studied and used on an experimental basis for parts of the work load. A two workstation Daconics system was installed and put in use by Report Services about a year ago. The configuration includes one Diablo Hitype 30 cps printer and two Singer 8400 phototypesetters.

Cost of the Daconics hardware and maintenance, exclusive of the phototypesetters, is $2,400 a month on a short term lease. Purchase price is $53,000. Daconics is making available to SRI several OCR devices for short term experimentation.

The organizational setting at SRI is such that a report does not reach Report Services until it has progressed a considerable way through the production cycle, and it may have been reviewed, edited, and retyped several times already. It does not reach the Word Processing section of Report Services until it has been through several approval steps and Editing.

Detailed histories of 16 jobs handled on the Daconics were kept. The jobs ranged in size from 11 pages of input to 514 and produced 1844 pages of finished text. Detailed statistics kept during the period are given in a report on the experiment (14). Input rates ranged from a low of 2.4 pages per hour for tabular material to a high of 8.8 pages per hour for simple text. Corrections were made at the rate of 18.4 pages per hour. These rates represent terminal operators time and do not include the additional time for printing draft or final copies. The tables were entered and edited in about 70 percent of the time it took the same group to do the job on typewriters. Overall throughput for finished copy was 2.41 pages per hour. Based on this experiment, SRI has decided to continue using the Daconics on a limited basis, primarily for tabular material and those reports where a high revision rate is anticipated.

Kaiser Aluminum and Chemical Corporation, Word Processing 4d2b

The Word Processing department is an independent cost center and is financed by charging using departments for services. Kaiser Aluminum has made no attempt to force centralization of word processing throughout the Corporation. The company as a whole has been slow to accept changes in the document production process. Although the department is now producing about 6,000 pages of text

each month, this is a very small portion of the total produced throughout the company which still employs about 300 typists, including secretaries. Most work is done using conventional typewriters.

The Word Processing department was established about 5 years ago using an experimental stand-alone word processing device. The experimental hardware was withdrawn by the manufacturer after six months. The department found that it could not produce the same volume of output with typewriters without increasing costs substantially.

Ty-data word processing units were installed. This equipment is based on selectric typewriters with dual cassette stations. It is similar in features and capabilities to systems offered by Redactron, Wang, IBM MCST, and many others. It did not prove nearly as satisfactory as the experimental system and Kaiser's management continued an active search for a better system.

Three years ago, Daconics, a new company, gave them a demonstration of their display-based system. They were sufficiently impressed to replace the Ty-data units with the Daconics. This was one of the earliest Daconics systems used in a commercial production environment.

The Daconics configuration at Kaiser includes six display workstations, two Diablo printers, and a Mergenthaler VIP photocomposer.

Discussion of Features 4d3

Physical Attributes 4d3a

Both SRI and Kaiser expressed very favorable opinions of the display workstations. Operators particularly liked the orange on black characters, preferring that to other combinations they have tried. They commented on the clarity and freedom from flicker of the text on the plasma screen. Both groups reported problems with lighting. At SRI the workstations are in an inside room with bright, exposed fluorescent bulbs in the ceiling. The operators complained that the lights gave them headaches. At Kaiser the word processing rooms have floor to ceiling window walls on the long side of the rooms. The displays have to be very carefully positioned to avoid glare.

SRI reported excellent response on their two station system, however they are not using the computation feature of the system. Kaiser reports excellent response on their six station configuration, except when they are using the computation feature. This feature accomplishes automatic updating of totals in statistical and financial tables when individual data items are changed. They cannot maintain normal text entry and editing speeds if more than one of the stations is being used for computation. Even when computation is limited to one station, they experience some slow down.

When the Mergenthaler VIP was initially installed at Kaiser it was connected directly to the HP computer. However, there was a problem with software that caused random characters to disappear from the output. This created an impossible proof reading task. Daconics did not have the resources at that time to fix the problem so they disconnected the units and installed a paper tape punch on the HP and a reader on the VIP. The Kaiser staff look forward with some desperation to the day when the two devices can again be connected. They never want to see another piece of paper tape.

The HP 2100 minicomputer has proven reliable and service has been excellent whenever problems arose. Kaiser, having three years of experience, reports that minor problems have arisen only once every month or two. Kaiser lost files once due to hardware problems.

Both installations have experienced file destruction problems due primarily to software. Kaiser reports that files will sometimes 'merge'. A major problem noted at Kaiser was inadequate file protection from operator error. Daconics has added greater file security software recently so this problem will be diminished in the future.

Until very recently, workstations had to be located within two or three hundred feet of the computer. We have heard that this restriction has been decreased to two or three thousand feet. If true, this would allow use of the system to be expanded far beyond the final editing and proofing phases of the document production cycle for which it is used at both Kaiser and SRI. A document could be entered by the author, for instance.

Input/Output 4d3b

The HP minicomputer interfaces to a wide selection of input and output devices. The keyboard attached to the display has a good feel and seems well designed with a minimal number of function buttons. A particularly nice feature is the function button that allows the operator to display non-printing characters. Daconics is experimenting, with SRI, with various OCR devices and has had fairly good results with the first device, a Comp Scan Alpha. The error rate was close to zero. They did have problems with indented material, but that is regarded as a problem with the Daconics editor rather than with the input device or interface.

Input can also be from magnetic tape. Presumably a cassette reader could be interfaced with little difficulty.

Most word processing systems offer closely equivalent time savings derived primarily from the ability to back space over characters and words in the input

phase of document production. The advantage that Daconics seems to offer over many other systems is that they have provided a good interface to other storage media; paper through OCR and a variety of magnetic storage media.

Distribution/Access 4d3c

Distribution of completed documents is by traditional means. Conceivably, in an environment where reviews and authors had access to convenient workstations, distribution of drafts could be done by calling up files from disks. However, the online working disk space is small, 500 pages, and only one removable disk, also 500 pages, can be attached at a time. We think this restriction would make the process of getting the proper disk mounted too awkward to encourage this form of distribution.

Access is through removable disk packs, each containing a directory of files on the pack. The limited amount of text on each pack makes viewing or editing very large documents difficult. Installations that maintain a very large number of permanent documents have a troublesome control and storage problem with the many packs.

Accounting and Control 4d3d

There is essentially no mechanism for accounting and control on the single processor configuration. However, the ability to add a second programmable processor indicates that such mechanisms could be programmed at the installation. SRI's Report Services does keep a code in the directory of files that tells at what stage of the production process the document is.

Communication 4d3e

The only aid to communication offered by the system is by leaving messages in files. This, at best, is awkward and is not used at either SRI or Kaiser.

Editing 4d3f

In general, the editor is powerful and easy to use. It is two dimensional, not line oriented. Text is identified by cursor buttons, but operators who have not experienced the luxury of more sophisticated pointing devices don't seem to mind. Commands are two character codes that are sometimes mnemonic followed by a variable number of parameters.

A fairly major deficiency seems to be in the system's ability to handle indented material. This is done using the 'Paragraph Indent' special feature and necessitates a number of seemingly useless steps in editing indented or outline form documents.

There is a very good table entering feature that allows entry of tables up to 160 characters wide and 99 lines long. The entire width of the table can be displayed

either by wrapping the lines around or by splitting the screen, showing the left half of the table in the top half of the display and the right half in the bottom part of the display.

Cross-file copying is only possible using the 'Standard Paragraph' special package. This is probably adequate for a word processing center such as SRI Report Services where files of standard 'boiler plate' for the Institute can be kept and used in most reports. However, it is not particularly useful to an author who might want to copy selected portions of other documents into his file.

Hyphenation is automatic. A dictionary is provided with the system and it can be expanded or modified for special applications.

The footnote capability has a neat feature that allows footnotes to be entered in proper page position initially or entered in a separate file and merged with the paged text later.

There is a special feature that allows limited setting of mathematical equations for output on a phototypesetter. The method of entry and revision seems cumbersome and very difficult to use.

Page Formatting 4d3g

For a Printer

The system stores files in paged formats. When a file is created the operator must specify page size. This has the advantage that the page is displayed on the screen as it will look when printed. A slight disadvantage is that if page margins are changed, the entire file has to be re-paged before editing can continue. The screen displays approximately two thirds of an 8 1/2 X 11 inch page. Operators at both Kaiser and SRI said that having a full page displayed would be a really major improvement.

For a Photocomposer

Formatting for photocomposition is done by inserting commands delimited by the photo function key code into the text stream. The fact that files have no structure means that no global photocomposer codes can be given--the photo commands must be inserted everywhere. For example, if paragraph headings are to be in boldface type, the photo command must precede every paragraph heading and a second command restoring the type style must follow every heading.

No line drawing capability exists for the Daconics. Pictures and drawings are handled by leaving appropriate sized spaces for later merging of pictures by cutting and pasting.

Existing Systems
Daconics

Training

4d3h

Daconics offers a week of training at the Daconics office followed by a second week of programmed instruction and practice at the user's site. Both SRI and Kaiser say the training program is good and does the job. Kaiser, with three years experience, has recently decided to forego the week of training at Daconics and use their own trainers at Kaiser. They feel this is superior because new operators will practice with examples of real Kaiser work and will learn Kaiser style and special techniques from the beginning. The supervisor felt that Daconics trained operators had some unlearning to do before they could adapt to Kaiser rules.

Harris 2500 at the Baltimore Sun 4e

The Harris 2500 is a text handling system based on large minicomputers that augments newspaper production from writing stories to column composition. 4e1

Context--the Needs and Goals of the Baltimore Sun 4e2

The Baltimore Sun (owned by Sunpapers) publishes three newspapers--a morning paper (circulation approximately 180,000), an evening paper (circulation 185,000), and a Sunday paper (circulation 360,000). All three papers combined produce an average of 850 original pages a week. 4e2a

The decision to "modernize" was made by Sunpapers in 1972. The contract with Harris to install a system based on the Harris 2500/50 was signed in April, 1974, and the total conversion was completed in May, 1975. The major goal of Sunpapers was to get tighter control of the paper, reducing the errors and meeting deadlines. To achieve this, Sunpapers wanted an integrated, modular system that eventually would perform electronically-assisted page make-up. The major focus was on producing news copy, which took up 60-70 percent of composing room hours. 4e2b

General Description of the System at the Sun 4e3

The Harris installation at Sunpapers is composed of five 2500/50 systems. Three of them are parallel news room systems and two are composing room systems. Each newsroom system consists of a 64K DEC PDP-11/35, a DEC RS11 one half million byte fixed head disc, two DEC RKO5 2.4 million byte moving head discs, 25-26 Harris 1500 terminals, a Versatec electrostatic printer for on demand hard copy, and 3-5 Extel Model AF slow-speed printers for hard copy story abstracts. In addition, a back-up system with a 64K computer, a disc controller, and a 2.4 million byte moving head disc is provided for each newsroom system. A paper tape reader and punch is also included. 4e3a

The two composing room systems together consist of a 2500 system that serves as a data base manager for the 2200 display ad subsystems and a 2500 system for hyphenation and justification, allocating copy to the output typesetter, and backup. There are also two H2200 Display Controllers with three 2200 terminals each, six 1500 terminals, three Autologic APS 4-100 typesetters, and two CompuScan 170 OCRs. 4e3b

The composing room system is presently expanding to include a 2500/60 system to handle classified advertising. The 2500/60 system includes three dual-ported 66 million byte discs, enabling it to handle up to 96 terminals. At present, however, the Sun newspapers will rely on three OCRs and 6-10 1500 terminals. They plan to go to complete terminal input, but this will require further negotiations with the union. 4e3c

Most terminals are shared. Four reporters share a terminal, their four desks in a

cluster with the terminal on a swivel in the center. Copy editors for the morning and evening papers share a terminal, since each works a somewhat predictable shift. Each managing editor has his own terminal. 4e3d

Restructuring the Organization and Training 4e4

Sun staff members took an active part in the process of going electronic. They joined with management in assessing the needs of the papers, deciding on the vendor, and working with Harris through the difficult process of installation. Thus some psychological preparation had already taken place before conversion. 4e4a

Three steps were taken to introduce the Harris system into the composition process. The first was to change the physical plant, knocking out walls to provide a large, open office that would allow effective sharing of facilities. The second was a new user's manual written by the Sun staff itself, with an emphasis on how easy it is to use the system. The third step was careful, formal training, with each editor receiving 11 hours of hands-on training and four additional hours, conducted by the managing editors, devoted to copy flow and editing procedures. 4e4b

Input 4e5

Newsroom Input 4e5a

Wire Services

One moving disc on each newsroom system is reserved for wire service input; the other is for editorial copy. Each newsroom service carries at least five wire services, backed up by the hard copy from the wire service teleprinters. The user may read from the disc on which wire service news is captured, but he may not write on it. To make changes to a wire service story, it must first be copied to a "working" or editorial disc. This transfer procedure is not difficult, and has the advantage of keeping the wire service story in its original form until it is eventually written over by a new wire story.

1500 Terminals and Paper Tape

In the newsroom, nearly all input other than that from the wire services is typed in from 1500 video terminals. Paper tape input is also possible, but rarely used. The three newsroom systems support 76 terminals distributed among reporters and editors (a staff of about 300).

The Harris 1500 terminal has its own buffer memory, editing logic, character generator, and refresh circuitry. A 34,700 baud bit serial data transmission line interfaces it to a PDP-11/35. The terminal has a rather simple keyboard, closely resembling a typewriter, with a minimum of extra buttons. The four buttons for cursor control are located on either side of the space bar.

The 1500 display screen holds 12 lines of up to 80 characters, each character formed by a seven by nine dot matrix. Although the 1500 screen is small and sits low, and the display is not of particularly good quality, users don't seem to complain too much about it. What they do complain about is terminal reliablity, which has been one of Harris' major problems with the system. The 1500 terminals have had serious heating problems which Harris with some success has tried to correct, but the terminals still act up (garbage on the screens, blank screens, locked cursor) when the room is more than 80 degrees.

Composing Room Input 4e5b

The composing room supports both display and classified ads. There are four 1500 terminals for display ad input and six 2200 terminals for ad mark-up and layout. The Harris 2200 terminal is an area composition display that can handle type in a wide range of sizes and formats. It has no graphics capabilities, nor can blocks of type be moved around as a unit. The Sun reports that the 2200 terminal has been very reliable.

The new classified system currently being installed will only use 6-10 terminals at first, relying on three OCR units for most input.

Output 4e6

Display 4e6a

The 1500 display is the major device for viewing copy used by reporters and editors. The 2200 terminals are used for viewing and marking up display ads.

For the most part, a story is read and edited on the display. The size of the screen is small, sometimes making it difficult to get the "flow" of a story, but easy scrolling forwards and backwards, coupled with quick response, help to overcome this problem.

Until a story is hyphenated and justified, the line length occupies the whole width of the screen. The approximate story depth in column inches is provided for the user. If the reporter wants to see the story in columns, he may run it through hyphenation and justification from his terminal. It will then be redisplayed in its new form and an exact story depth in inches will be provided in bold face. Once a story is completed, the user gives the command to have it automatically set in type. It is then reprocessed through hyphenation and justification and queued for the typesetter.

One difficulty in accessing information on the display is the limited search capabilities of the terminal. Only scrolling backwards and forwards is available; there is no search for the beginning or end of the story, nor is any content searching possible.

Existing Systems
Baltimore Sun

Hard Copy 4e6b

As mentioned above, each newsroom system has its own Versatec printer and 3-5 Extel slow-speed printers (30 characters per second) for story abstracts. Although the Versatec printer can handle multiple fonts, it is only used as a line printer.

Hard copy is available on demand for both news stories and wire service stories. It is used to a varying degree for back-up, for scanning a whole story to get a better idea of its structure and impact, and for assembling the pieces of a breaking wire service story.

Hard copy abstracts are sometimes used to help control the flow of a story. When a story has been forwarded to the copy desk, a hard copy abstract is provided to notify the desk that the story is ready for the copy editor. This is used to a limited degree however--mostly at the main copy desk area where things are busiest and the printers may be accessed easily.

Output Typesetters 4e6c

Three 100-pica (full newspaper page size) Autologic APS-4 typesetters were chosen for the output typesetters because the Sun expects to move to full page make-up in the next few years. The typesetters are now arranged to dump eight-inch-wide exposed paper directly into the darkroom for processing.

Editing 4e7

Editing functions in the Harris system are quite simple and rather limited, operating in an overstrike mode. There are insert, character delete, and line delete functions, all performed by the 1500 terminal, as well as a move function performed by the host computer. The user may also combine two or more stories together with the "CHain" command. This command works across directories, but not across systems. There are no cross file or cross-directory commands. 4e7a

System commands such as move and print are somewhat cumbersome. First the user must push the "send line" button to communicate with the computer; he must then open up a blank line on his screen, type in the command, and press the "send line" key once again. 4e7b

Thus far users at the Sun feel that the editing commands available are adequate for their needs. Two new features they would like, which Harris is adding to systems now being installed, are an "edit trail" and split screen capability for the displays. The "edit trail" incorporates edits into a file in addition to the original text, making additions to the file instead of replacements. This enables an editor to go back to the story in some previous form if he chooses to, without having to keep a copy of the story around. Split screens will allow users to have two stories on a screen at one time, and move sections from one version to another. 4e7c

The limitations on scrolling and searches have already been pointed out. 4e7d

Production Flow and Control 4e8

User directories are essentially "in-baskets". No log-in procedure is required and anyone has access to any directory in his own system. Directory indices show a one-line entry for each story, an identification number, the slug line, and the length of the story. Wire directories show the same information with the addition of the first three lines of text. Any story may be transferred to any directory on any newsroom system with a single command; it is then moved from its origin directory and added to the top of the new directory. The most recent entry is always at the top. 4e8a

In general this ease of directory access has made the system easier and pleasanter to use, without causing control problems. Users concentrate on their own directory, moving stories to other directories when they are finished with them. They may also easily "fetch" any story, either through a directory or by typing in the story identification number. 4e8b

It should be made clear that the installation of the Harris system did not change the already well established copy flow procedures in the newsroom. Three system features are used to help these procedures: the slug line, the convention that adds new stories to the top of a directory, and in some cases hard copy abstracts (discussed above). In the display ad room, a job folder is passed to the mark-up man along with the online ad. 4e8c

The story slug line, which appears in the directory index, contains the original author, last writer, title, and editor. Additions to this basic information are made as the story moves from desk to desk. The section of the paper to which it will be assigned and instructions for the headline are added, and the copy editor initials the slug line when he is through with the story. 4e8d

Once a story has been sent to the typesetter, control over it is exercised by means of a "recovery" directory. If anyone wants to retrieve a story after it has been typeset, he may do so by accessing this directory. As many stories are kept in the recovery directory as there is extra space on the disc (with a user settable default minimum). When the disc space fills up, the oldest stories in the directory are automatically deleted. 4e8e

Storage and Access 4e9

The storage capacity of the Harris newsroom system is very limited. As mentioned above, each system has two 2.4 million byte moving head discs. Harris recognizes that this limited storage places too many constraints on its users and is now offering 66 million byte CDC 9762 disc drives in place of the 2.4 million byte RKO5s for both the Harris 2500/50 and 2500/20. 4e9a

Although Sun users observe strict procedures to get around these storage limitations, they still feel "very cramped". Only stories for the immediate edition may be kept online and only one version of each story is retained unless a user specifically copies

it. Reporters are urged not to keep unnecessary copies around. Feature stories, which are often written two to three weeks in advance, must be punched onto paper tape, which is read back into the system on the day it will appear in the paper. The Sun has also found the RKO5 disc drives very unreliable. 4e9b

There is no provision for online access to older material. If a user wants to store away a story once it has become dated, he must punch it out on paper tape and keep the tape in his desk. 4e9c

Page Formatting 4e10

Sunpapers hopes to go to full page layout without graphics in about two years; adding graphics capabilities will probably take longer. They are discussing this step with Harris. 4e10a

Communication 4e11

There is no online means of communication in the Harris system. 4e11a

Cost and Cost Effectiveness 4e12

It is estimated that the Sun installation costs about $3 million. A 2500/20 system with two discs, provisions to capture four wire services, a Versatec printer, an online interface for a Harris typesetter, and the necessary news copy software costs a little less than $110,000. To this must be added the cost of the one half million fixed head disc. A paper tape reader and punch is $7,000. The 1500 terminals are $7,500 apiece, with a $6,600 multiplexer needed for every eight terminals. 4e12a

The Sun investment is paying off. The goal of increased control over the papers, reflected in meeting deadlines and reducing errors, has been met. 4e12b

Before the conversion, the newspaper closing time for the first edition was 24 minutes after the deadline, for the second edition, an average of 21 minutes late. In August, 1975, three months after the conversion was completed, the closing time was seven minutes before the deadline for the first edition and two minutes early for the second edition. This improvement is not attributed to shorter writing times for the reporters. In fact, it takes reporters a little longer now because they spend time they could never afford before to polish their stories. Meeting deadlines probably results from less time to re-keyboard stories and more efficient procedures over all. 4e12c

Errors were reduced from 1,070 for a typical five week period to less than 45. This dramatic reduction is attributed to two factors. In the first place, copy editors now receive clean copy from reporters, as opposed to the triple-spaced typewritten drafts with heavy hand-written corrections they received prior to the conversion. In the second place, copy editors can now exercise total control over the final copy: what they approve is what appears in the paper. Before the conversion, the story was re-keyboarded in the composing room, where most of the errors were made. 4e12d

Furthermore, the new system is paying for itself. The labor contract signed at the time of the conversion guaranteed all current employees life time employment with Sunpapers if they wished. But as employees leave they are not replaced. With a projected attrition rate of 7 percent of the composing room work force per year, Sunpapers should save about $3.6 million in three years. 4e12e

The Harris System is a Newspaper System 4e13

The Harris system is presently designed for newspapers only, but it is expected that Harris will soon branch out into other publishing areas, such as the commercial market and in-plant publishing. At present, however, there is no software to handle large files (although there is a definite move in this direction, with bigger discs already available), an extended character set, or high quality hyphenation and justification, and the editing functions are purposefully kept simple to meet only what Harris sees as the limited demands of the newspaper environment. 4e13a

Proprietary Computer Systems (PCS) 4f

PCS is a California based computer service bureau that offers a wide range of computer services to remote users over phone lines. The services include remote job entry to batch processes, information retrieval and data management, interactive text editing, and document formatting and output to a tape for a COM device. In addition, the company has developed a set of special application packages tailored for text processing in law firms, financial management systems, a PERT project management system, etc. PCS also offers interactive user programming in APL. 4f1

The system runs on two IBM 360/65 computers. The text editor is a version of IBM's ATMS which has been enhanced by PCS. In general, PCS document production service is very similar to that offered by Bowne Timesharing. We chose PCS to include in this study because ATS is probably the best known and most widely used of the large-scale computer text editing and document formatting systems, and we have access to more information on actual cost in use than we were able to get for Bowne. 4f2

Context of the Study 4f3

Wells Fargo Bank 4f3a

The computer division of Wells Fargo Bank, Wellsco Data in San Francisco, uses PCS for all its technical documentation. This includes system documentation, application program documentation, user manuals, special reports, and proposals. Short memoranda, letters, and general office correspondence are done by secretaries using conventional typewriters.

The system is used only by trained ATMS operators. Programmers and authors submit hand written or typed drafts to the word processing group who enter the text into the system. Roughly formatted drafts are printed on standard (15 x 11) computer paper on the high-speed line-printer at the PCS home office in Southern California. Each night the printer output is flown to San Francisco airport and taken by special courier to the Wells Fargo office in San Francisco. Wells Fargo finds this turn around satisfactory except for periods in the fall and spring when the Los Angeles airport tends to be fogged in.

The Word Processing section has three Anderson Jacobson half duplex Qume printer terminals. At the present time, they have two trained operators and a trainee. This is the first time, during their three year use of the system that they have attempted to train an operator using the PCS training program and instruction package.

For the first six months of 1976 the department averaged 1,672 connect hours and 19,000 pages printed. This figure includes both rough drafts and final copy. The

average monthly cost for use of the system was $4,370. This figure includes all PCS charges: printing, shipping, communications, central processor usage, online disc storage, and archival storage and retrieval.

Overall, Wells is pleased with the system. Wells does not use any of the PCS batch programs or data management systems. We asked why they prefer PCS to a system such as Daconics which we estimate could produce the same volume of output at roughly half the cost. They said the controlling issue was the PCS archival and retrieval service and the ability to support fairly large files. They felt the problem of keeping track of large manuals on small removable disks would simply be too great.

Harrison Publications 4f3b

Harrison Publications is a one man company that specializes in in very technical documentation for small electronics firms. The company produces maintenance manuals for electronic instruments. Mr. Harrison, working from blueprints, writes the manuals and carries the process through to camera-ready copy for the finished document.

Harrison admits that he is not using the system as efficiently as he feels he could with more experience. He dictates the first draft, using a dictating machine, and has his secretary type a rough draft. Harrison then edits, with blue pencil, the draft, and hires an experienced ATMS operator to enter the document into the system.

Very short documents are being entered directly online by Harrison. He is finding this difficult because he says he has not yet learned to think at a keyboard and is also inexperienced with the PCS editor. His secretary has been through the PCS training program, but is still not able to use the terminal. He says he thinks she is 'afraid of it' even though she is an excellent typist.

Harrison estimates that his PCS charges represent about 10 percent of the total cost of producing a document.

The aspect of PCS that has impressed Mr. Harrison the most has been the PCS staff responsiveness to his problems. He said their claims about system features are sometimes overly optimistic, but they try very hard to get advertised features working.

Discussion of Features 4f4

Physical Attributes 4f4a

The PCS system runs on two IBM 360/65 computers. It supports 15 and 30 character per second hard copy terminals and IBM 3270 displays at 1200 BAUD. Both installations report response time is good. It should be noted that neither installation is using displays.

Existing Systems
PCS

The basic software is available from IBM for a user's inhouse IBM 360 or 370 computer on a lease basis. The control program, CICS, and editor, ATMS, lease for between $750 and $1000 per month . These systems run effectively only on large-scale IBM configurations, 360/50 at a minimum. One ATMS user running on an inhouse two megabyte IBM 370/155 reports that 12 online 3270 display workstations doing only editing and formatting use 50 percent of the CPU cycles. This seems very expensive.

Input/Output 4f4b

The system is oriented toward 2741 compatible terminals that use selectric typewriters. These terminals are very noisy. The Qume printers are quieter but still produce a noise level that is noticeable and disturbing in an office environment.

The IBM 3270 display workstations display 24 text lines of 80 characters each. The display characteristics compare unfavorably with those offered by many other systems, Daconics and Vydec in particular. Boeing Aircraft studied five test organizations performing pre-defined tasks using ATMS on 2741s and 3270s. The study showed a 97 percent increase in productivity for revision editing using the displays over the hard copy terminals. Wellsco Data realizes the advantage of the display terminals, but feels they would not be cost effective as connect charges would go from 2.85/hour to 5.00/hour plus an added communication charge.

Input may be from workstation keyboards, magnetic cards, magnetic tape, cassettes or OCR devices.

Magnetic tape output may be formatted for processing on photocomposition systems.

Distribution/Access 4f4c

Distribution of documents is by traditional means. This is somewhat complicated by the fact that PCS does not support high-speed line printers at a customer's site and must air mail printer listings from Los Angeles.

Presumably a document could be delivered by allowing the recipient access to the file online. As online storage is expensive and retrieval from archive tapes is complex and expensive, this does not seem practical.

Accounting and Control 4f4d

PCS offers a large selection of special purpose batch and interactive APL programs. These programs appear to be tailored to the legal profession, banking and investment companies and, to some extent, engineering firms. With some exceptions they do not seem useful to the technical document production process.

A sufficiently sophisticated user could use the remote batch job entry or interactive APL services to create his own accounting and control routines.

The library of APL programs includes a 'general purpose data base management' system that perhaps could be used for cataloging documents and control of the production process.

A highly complex project scheduling and analysis PERT system is available. It allows up to 1600 activity nodes. This also could be used for control of the production process.

All of these options would seem to require a great deal of training and computer expertise and the cost is high. APL use is charged at $15.00 per hour connect time plus additional charges for CPU cycles, printing, core used during program execution, sorting, disk space, archive tapes, and writing or retrieving files from archive.

Communication 4f4e

There is a message facility which allows sending a message to another user's 'message' file. The message may be sent either from working storage or from a permanent file. Message files are cleaned out manually by PCS operators once a week. As there is no charge for these files, users frequently use them to store text. When this is done, the system becomes marginally useful as a communication tool.

Editing 4f4f

The editor is strictly line oriented with the only mode of address being line number. This, plus the fact that line numbers for formatted text are not the same as for the unformatted text file, requires that operators always have current line number listings to make edits.

A full set of editing and formatting commands is available. However, the command language is non-mnemonic and unnatural. The operator must type the attention key after each command including backspace character.

Operators can enter text without worrying about line lengths. In practice, however, they don't. Because line numbers change when text is formatted, most operators try to enter the text as it will appear after final formatting.

All of the users we talked with complained that cross-file editing and copying is very difficult.

Page Formatting 4f4g

The formatting capability is powerful and more automatic than that of most systems we have studied. The command codes entered by the user are, like the editing commands, non-mnemonic and unnatural. Format commands are stored

in the 'formatted' file as executable text. This makes it very difficult to convert ATMS-PCS files for use with other systems or processes not designed specifically for these files.

Training 4f4h

PCS offers both operator training courses and a programmed instruction package. Customer consulting is provided both by site visits and through the message file.

Users report that it takes a minimum of three months for an operator to become effective and a year to achieve proficiency. It is not a system that could easily be used by authors or by occasional users.

The oNLine System (NLS) 4g

Most commercially available aids to document production are restricted to one type of publication (newspapers for example) or to a small number of steps in the publishing process and do not connect readily to other computer tools or address a broad spectrum of needs. The Augmentation Research Center (ARC) of SRI has been developing for the past 13 years a computer system called oNLine System (NLS) to supply many kinds of aids in a range of environments. 4g1

NLS provides a variety of ways to enter text, highly flexible editing and formatting, many kinds or output media, publication management aids, online communication and catalog facilities, and connection to other computer systems. 4g2

NLS is available as a computer utility service on various hosts affiliated with the computer network orignally sponsored by the Advanced Research Project Agency (ARPA) of the Department of Defence. NLS is also available as a software package for use on an inhouse computer. 4g3

A primary objective of this research is to recommend modifications, improvements, and extensions to the NLS document production process. We therefore want to look at its current capabilites critically, emphasizing weak points as well as strengths. 4g4

Context of the Study 4g5

ARC has been the creator and the most extensive user of NLS. It is a large and sophisticated system and is aimed at providing a consistent and comprehensive environment for knowledge work, of which document production and control is only one instance. 4g5a

ARC produces a large number of documents. Documents are produced for proposal writing, project reports for projects performed within ARC, NLS system documentation, and a very large number of user guides. Most documents are relatively short (20-70 pages) and the control mechanism is usually very simple. 4g5b

The number of authors of a document varies from one to as many as five and more. Writing is usually done simultaneously; each author is responsible for one logical unit (e.g., chapter) of the document, and all have access to each other's text. Authors do most of the editing and page formatting themselves. Only at the very final stages of document production (if at all) is a professional editor introduced to take care of final touches. 4g5c

Bibliographic searches and researching are done by authors online. The Journal (described below) provides the mechanism for online searching of any previously created documents. In addition, authors have personal online data bases in which they keep notes and results in an informal way (much like in a notebook) and use these data in the document writing process. 4g5d

Existing Systems
NLS

Discussion of Features 4g6

Physical Attributes 4g6a

NLS runs on Digital Equipment Corp (DEC) large-scale computers in the PDP-10 class. Access to the computer is achieved via phone lines or through the ARPA network (for certain government agencies and contractors). A minicomputer is located at ARC and acts as a terminal concentrator that interfaces the local terminal to whatever sites the user is allowed to use. It runs in a time-sharing environment under the BBN TENEX or DEC TOPS20 operating systems. The system is over ten years old, is constantly improved and upgraded, and provides a stable working environment.

The present computer configuration utilizes a 500K memory PDP-10 with 26,000 disc pages (a disc page is roughly equivalent to one text page). This configuration can satisfactorily support about 20 users; when the system becomes more heavily loaded, users often complain of the slow response and indicate a considerable reduction in their productivity.

NLS can be operated from two types of full duplex workstations: hard copy typewriter-type terminals and display terminals. A basic alphanumeric workstation consists of a CRT display and a keyboard; additional equipment that is part of the workstation is a pointing device (called a mouse) and a keyset which facilitates text editing. A second display that allows line drawings may be added to the workstation. The price of a display workstation (excluding communication and computer costs) is currently $6,000 when purchased or $370/month when leased. The display that allows line drawings and proofing photocomposition is $11,000 extra.

Software Environment 4g6b

NLS is divided into function oriented packages called subsystems. In the context of document production, NLS includes subsystems to edit text using structured files and a formatter that accepts directives for formatting a document for a line printer, a terminal, and a phototypesetter. A graphics subsystem allows online creating and editing of line drawings, which can be incorporated with text files to output documents that include both. A proofing subsystem enables the operator to check the page layout of documents which will be phototypeset. There is also a spelling correction program (currently not an integral part of NLS) and a variety of other tools to aid document production.

The user interface is a command language that is consistently structured across all subsystems. As part of the consistent interface, each user can define a profile which includes a variety of parameters that control the appearance of the system to that user. This profile includes choices of command word recognition modes,

page margin settings, the amount of prompting the system should give, etc. The profile is modifiable and enables the more advanced user to use the system more efficiently while giving more explanatory material to the beginner.

A key feature in the design of NLS is its hierarchically structured file system. This feature allows a user to view various outlines of his document and allows the page formatter to compose the page according to paragraph level.

Input/Output 4g6c

Input

Text can be entered into NLS directly at teletype or display terminals, from magnetic media created at offline terminals, or through copying online files from other computer systems or devices such as Optical Character Readers.

NLS files are tree structured and randomly organized. Text strings are variable length. Therefore, it often requires extensive editing or special-purpose programming to convert text created in a system that produces sequential fixed-length record-oriented files to NLS.

Deferred EXecution (DEX) is a complement to NLS for inserting text with minimal editing in an offline mode. The user records typewritten text and a set of special instructions on a magnetic tape cassette. During periods of low usage on the computer, the tape is read to produce an NLS file.

NLS enables the transfer of files from one computer attached to the Network to another by a single command. An operator may request to "load" a file currently residing in a foreign site, and will have the file loaded on his screen as soon as transfer is completed (subject, of course, to access rights).

The most common way to input text at ARC is through the display or typewriter workstation. The display workstation consists of a display and keyboard, a pointing device called a mouse, and a five-finger keyboard called a keyset. The input devices are connected to the terminal computer through a Line Processor.

The mouse is a hand-sized pointing device that rolls freely on any flat surface, moving the cursor on the display screen correspondingly. The keyset is a device with five piano-like keys for entering characters (and commands) at the display console. With his left hand on the keyset and his right hand on the mouse, the user can give all input to NLS without ever moving either hand to the keyboard, keeping his eyes on the screen while quickly specifying commands. Moving both hands to the keyboard is used only for typing in long text.

Illustrators graphics, that is line drawings, may be input to NLS text files and edited from a workstation equipped with a graphics display.

Output

NLS can be easily interfaced to a very wide variety of commercially available output devices. Terminals, magnetic tapes, files on discs, and cassettes are examples of currently supported devices. A direct interface to a phototypesetter could be made with minimal effort.

For most work, ARC users rely on their terminals (typewriter or display) and a line printer for output. Short documents and messages are usually read at the display or teletype terminal, whereas longer documents are printed on a high-speed line printer which may be at ARC, the Utility, or, in special cases, the users site.

For typewriter quality output, Qume or Diablo terminals are used. For photocomposition allowing the mixture of text, line drawings, and a variety of fonts, documents are formatted and output to a magnetic tape. Currently the ability to process these virtual photocomposer tape files has been implemented on a Singer 6000 and an Informational International Comp 80.

Distribution/Access 4g6d

Distribution

Distribution mechanisms for documents vary depending upon the recipients of the documents. Distribution of documents outside ARC and the ARPANET community (for example proposals and reports to government agencies) is done in the conventional way of mailing hard copy versions of the documents.

Within ARC, distribution is done via the ARC Journal supported by NLS. A document (or any part thereof) may be journalized and sent to any group of individuals. The content of the item is kept (forever) in a central location, and the individuals on the distribution list are notified of the existence of the item along with a path name enabling them to read it online or copy it to any of the available output devices.

ARC Journal items are "frozen" and may not be modified; thus a new version of a document is handled as a completely independent new item. The ARC Journal records the date and time of submission, the author, the distribution list, and other relevant information. It also catalogues all items according to date, author, title, and keywords. The catalog is available online and enables online searching of the entire ARC Journal. The author of a document may specify that only a selected group of individuals may gain access to the content of an item.

The ARC Journal was originally designed and implemented for a single computer site. It has since been extended to receive and deliver communications for two computer sites. The implementation is clumsy and should be generalized for multiple sites and made more efficient.

Access

Access to online files follows the regular rules of file retrieval, subject to access rights. More unique is the access to ARC Journal items. Individuals on the distribution list of an item have a path name through which they can access the data. Others not on the distribution list may search the various catalogs, find out the path name and view the data. The user may restrict access to a single person or a specific group of individuals.

Relying on its structured files, NLS provides viewing aids (Viewspecs) to facilitate online reading. The user may specify how and how much of a document he wants to see; he may look at an outline, the entire text, or a selected group of paragraphs. Viewspecs go a long way to make up for the difficulty of "thumbing through" material stored in a computer and displayed on a screen. The selective viewing is especially useful for intra-file searches, and when a reviewer needs to review only a part of the document.

Accounting and Control 4g6e

At present control of the text is limited to recording of the date and time the last change was made and the initials of the person who made that change.

A user at an ARC client organization has created a control system to track the progress of documents through a particular manual production flow. The subsystem, written with four simple commands to be used by otherwise untrained clerical help, first interogates the operator for basic informaton about the document (catalog number, person in charge, target dates for various approvals and steps in production). Thereafter it accepts intput to the effect that production dates have been met or slipped, approvals given, etc. The user may ask for the status of any document, all the documents queued at a given step, or the state of all documents in the system.

Communication 4g6f

Communication between NLS users is mostly done through the Journal. In addition to using the Journal as a means for document distribution, NLS users may send short messages to each other. These items are recorded as usual and serve as a log of the activity on a specific project or document.

ARC uses the ARPANET for its activities and uses a message sending mechanism (SNDMSG) provided by the hosts on the network. This facility is used when communicating with non-NLS users, and occasionally among NLS users when there is no necessity to record the message.

A unique screen-sharing facility is provided by NLS. It enables two display users to work concurrently on the same file. Both users have the same text displayed on their screens. Any modification to the text or viewing done by one user will

concurrently update the other user's screen. This feature is used when two or more authors have to work in close cooperation and where time and geographical distance do not permit face-to-face communication.

Editing 4g6g

The NLS editor, called BASE, is the most comprehensive and sophisticated among the editors reviewed in this study. The display version of NLS has a two-dimensional editor allowing the user to point to the text entities he refers to. The tree structured files, along with the viewspecs which unfold it, are the key to the great power of NLS editing and viewing.

The basic text entity is a statement which may be compared, in the document production context, to a paragraph of text. Within a statement other entities are defined such as words, characters, text, etc. Statements are grouped into branches, groups, and files; users may refer to those entities for the purpose of editing, viewing, and formatting, just as they can refer to words or characters. Indenting of text is handled automatically by the system, based on the structure of the file.

A variety of addressing mechanisms are available within the editor. In the display version, the most common addressing mechanism is the pointing device. In addition, users may refer to any entity of text by structure, by statement identifiers, by name, or by content. A unique feature of NLS is the "link, " a machine-readable pointer that can point to any piece of text in the entire NLS environment. Links are used in creating "virtual documents", cross references, and in general for providing path names to other text entities.

The built-in hierarchical file structure and the indenting feature contribute to the mechanism that allows users to change their "view" of a file. The user can easily control how his file will appear to him on an output device (including a display) by changing his "viewspecs". It allows the user to get an overview of the contents of a long file by specifying that only a few levels in the outline structure be shown and by limiting the number of lines in the output statements. This has the effect of presenting him with a high-level outline of the document.

Cross-file editing is efficient and as simple as intra-file editing since the addressing mechanism allows one to address any piece of text in the entire environment (subject to access rights, of course). To facilitate cross-file editing, NLS has a "split screen" feature that allows the user to split his screen into up to eight portions ("windows") and have a different piece of text (possibly from different files) displayed in each window, each with its own viewspecs.

Table entry and editing are performed by a special subsystem. This experimental subsystem recognizes entities such as row, column, entry, etc., and allows the

manipulation of these entities (copy, delete, justify, and so forth). This subsystem is a first step in providing a more efficient table handling mechanism, but it is far less efficient and less comprehensive than the BASE editor.

Page Formatting 4g6h

An NLS program, the Output Processor, is the module responsible for formatting an NLS file for printing on a line printer, teletype terminal, microfilm, or other output device. Coded Output Processor "directives", visible for editing but not printed, control page layout. Directives are very short acronyms or acronym-like formatting instructions that may be placed anywhere in a file just like any other string of text. The output processor makes use of NLS file structure in formatting. For example, a single directive, at the beginning of the file centers all the chapter headings (top level items) in this document. Directives are provided to create and control headers, footers, page numbers, table of contents, etc.

A properly outlined document will have most of its directives at the very beginning and very few within the text. This has the advantage that viewing and reading a document online will not be obstructed by directives within the text. Formatting complex documents (e.g., with frequent font changes) necessitates inserting a large amount of directives in the text, and since the NLS editor does not distinguish directives from other text, reading such a document online becomes somewhat awkward.

Additional subsystems are available to automatically format files according to a prescribed format. These subsystems insert the appropriate directives in the text and reduce considerably the effort of formatting a long document.

The Output Processor is capable of creating files to various output devices such as terminals, line printers, and COM devices. The repertoire of directives in the Output Processor includes directives to control the type and size of fonts and is capable of outputing line drawings created by the NLS Graphics subsystem. These features take effect only when COM is specified as the output device. In general, the same directives are used for all output devices; in some cases, such as COM, directives need more parameters than in the regular case. Unfortunately, files correctly formatted for one output device do not necessarily appear correctly formatted for other devices.

A proof subsystem, utilizing a Tektronix 4014-1 high-resolution display, provides a means to proof page layouts for COM output. A full page layout is displayed by Proof, one page at the time, obeying the directives in the text, except for font types, but including any line drawings in the text and approximate font size.

Training 4g6i

Training is provided by ARC trainers both at the user's site or at SRI. A set of graduated courses is used in the setting of small classes or one-to-one interaction. Self-teaching tutorials are also available for users to work through on their own, in conjunction with the formal training.

Online and hard copy versions of NLS documentation are both available. They range from a crib sheet listing the most frequently used commands to user guides and tutorials that take users step by step through a particular task.

NLS provides online context dependent information about the system and how to use it. It ranges from listing the current alternatives of command words to complete command syntax and comprehensive explanations. The Help command and the documentation it accesses are designed to logically guide the user to relevant information in various levels of detail according to the user's choice. This feature is frequently used by novice users of a subsystem, and is an integral part of user training.

NLS uses a natural command language with no acronyms. Each command begins with a verb which names the action to take place and a noun that specifies what object will be acted upon. This makes a substantial portion of the commands self explanatory and aids in remembering command words. This syntax is consistent across all subsystems.

The user profile described earlier is another feature that enables graduated adaptation of the system to the individual user. The novice user may see fewer commands, and may be prompted for fewer parameters in command specification. As the user acquires more expertise in using the system, he may change his profile to suit his more advanced capability.

DISCUSSION 5

Production Needs 5a

Communication 5a1

Communication through the U.S. mail characterizes the production cycle of academic journals. Postal mail imposes long schedule delays, the expensive processes of composing correspondence and filing coordinating drafts and their paper work, and of resolving ambiguities in a medium without live give and take. Any computer system that allowed reasonably economical communication between authors, reviewers, and editors offers the possibility of labor savings and important schedule improvement. The SRI flow had similar problems insofar as it depends on postal and U.S. mail. To produce the revised version of AFM 66-1, the Air Force accumulated notes for revision and assembled the writers involved in the same way they had always done for manual production. Communication in the production phase was largely via NLS, which allowed a well and timely coordinated effort although production personnel were distributed in Alabama, California, and Washington, D.C. 5a1a

Format Control 5a2

The manual methods studied convert rough draft to a printed format through a series of approximations characterized by the need for retyping repetitive material, control forms, and quality checks. The system based on NLS eliminated retyping and control forms by an automatic subsystem which could impose a full-page format at any step, but still suffered from some awkwardness in setting aside white space for graphics. 5a2a

Copying from Sources 5a3

The sources used for writing these documents, notes, outlines, other reports, and articles, were in every case copied by hand into the draft, typically involving one long hand and one typing step by the author. Availability of these sources online could reduce time spent in these steps and increase the intellectual effectiveness of the author. The existing published text of AFM 66-1 was typed online by production typists. Notes for revision were accumulated by the revisors and incorporated in two steps, fist as long hand notes by the revisors on drafts and then as changes to the online file be editors. (Subsequent revisions of 66-1 have required no retyping of unchanged text.) A mechanism that allowed potential revisions to be attached to the document online without becoming part of the text until review is complete would be of value. 5a3a

Discussion

Handling Tabular Material 5a4

The slowest kind of typing, whether input or revision, in all these documents is tabular typing. The most advanced table input system, found in the Daconics system used at SRI, cut the time to type in difficult tables about in half, not counting the advantages of future copying (14). Special provisions for handling tabular material exist in NLS, but are not sufficiently developed for use in AFM 66-1. No method of supporting technical documentation can fully succeed without an efficient method of handling complex tables. Besides ways to input rows and columns as continuous typing, move and edit rows, columns, and cells, and move and edit headings, subheadings, and the columns and rows included under subheadings, the system should include some method of gracefully using the screen to scan tables larger than the screen and an automated method of converting monospaced tables to proportionally spaced tables. 5a4a

File Control 5a5

Manual systems are faced with the problems of maintaining the integrity of documents, their schedules, accounting for time and materials, recording responsiblity for revisions, and coordinating associated paper. They fulfill this function with the "system" of file folders, file drawers, paper clips, desk stacks, routing sips, forms, etc., that has built up over the years. Computer-based systems that serve only to create drafts without flow or control taking place inside the computer (because of system limitations or inflexible procedures) may in fact make this problem worse because drafts are easy to make and because small-capacity storage media like magnetic cards are at least as hard to file as paper. In production of AFM-66, the "real" version was always the online version, and certain NLS and TENEX file control devices were used to track its progress and guarantee its interity. As production moves more within the computer, such control can be made more effective in systems with appropriate file mechanisms and programming possibilities. 5a5a

Illustrations 5a6

Study of the SRI flowcharts will show the problems of coordination forced on publications groups by the progress of text and illustrations in different media. The same situation exists in journal publication, although not explicitly portrayed. AFM 66-1 has only very limited illustration. Insofar as a system can carry illustrations in the same basic flow with text, it will be more effective. 5a6a

Illustrations are a very complex area because they exist in many media; line drawings, shaded drawings, photographs, color, etc. An elaborate technology and system of skills and roles has grown up around technical illustration. Anyone interested in designing or implementing changes will have to move slowly, case by case. 5a6b

System Capabilities 5b

Communications 5b1

Only systems based on connection to a central computer at least in the range of a large minicomputer presently offer the capacity to communicate the production control information discussed above. To be effective in a complex production process, the system should also offer at least simple automated search and retrieval mechanisms to store, organize, and restore old messages according to subject, date, and author. The NLS system has these capacities. PCS includes limited but useful message sending. Terminals such as the DEC 310 are typical of a class of terminal-based systems that could be connected to a central computer to handle message exchange. 5b1a

Distribution 5b2

Computer systems such as NLS, PCS, and Daconics that can format files for a phototypesetter currently help distribution by composing smaller, more readable printed documents or microfilm. Various photocomposition devices that contain small computers of their own can accept and format input from a wide variety of systems. 5b2a

In the long run, direct access by the user to documents in the computer is extremely attractive, particularly for documents such as AFM 66-1 which require frequent revision or journal articles that users may want to copy from. Such copying goes on within the NLS, PCS, and many large-system environments; Daconics offers a "standard paragraph" option which is not fully equivalent. 5b2b

In the case of academic journals and 66-1, a mechanism to attach comments after online distribution would be useful. 5b2c

Terminal systems like the 310W could be effective doorways to such distribution if connected to an appropriate central system. 5b2d

Planning for new developments in this area should include provision for creating, archiving, indexing, and retrieving files for reading online. 5b2e

Response Time 5b3

The advantages of reduced typing time because of copying and light editing on the fly can be realized only on a responsive system. The time spent by a typist waiting for response will quickly eat away the cost advantages of reduced retyping. There is also a serious psychological problem. When production workers who are used to being evaluated in lines per day are forced to sit idly while waiting for a character to appear on their paper or screen, they tend to go crazy. On a lightly loaded machine with at least 1200 baud transmission through the ARPA network, NLS is barely

Discussion

satisfactory in this respect; under normal daytime working loads, it is not satisfactory. This same complaint was occasionally heard of Daconics and PCS, although in the latter case the line-at-a-time mode of work tends to mask the problem. 5b3a

Systems that are based on time-sharing distant central computers and on 300-baud transmission lines cannot deliver adequate response for display editing. Therefore, a coherent set of text entry and light editing functions should be available at the local workstation independent of the central computer. Some systems developed recently or under development divide functions in this way to speed responsiveness and reduce communication costs. 5b3b

Reliability 5b4

Reliability is a more serious problem for big systems than for small systems. If a MCST Terminal or a DEC 310W breaks down, it can generally be repaired or replaced within hours to a couple of days at most; the stored material can be moved easily to a replacement. The only loss is the small amount of work in the immediate buffer and the time of the individual operator. Loss of a large machine can be catastrophic in the context of publication deadlines. 5b4a

Daconics machines have a good record of reliability, but occasional breakdowns have wiped out all the files on the current disk. In the infrequent event of machine failure, Daconics has been able to replace the machine in a couple of days. 5b4b

PCS runs two hosts side by side and switches users to the second host in case of failure. When that happens, files from the time of the user's last update are lost. 5b4c

NLS users have no backup facilities as such. However, several NLS machines are available on the ARPA network, and some publications users have working space on a second machine and they back up files automatically at frequent intervals as publications deadlines approach. This arrangement, though it has proven successful, requires access to resources that is not common to all NLS users and the process is not as automatic as it should be. 5b4d

Any system based on a large central machine should have an unobtrusive backup provision such as PCS's or a smoother working version of the NLS method. 5b4e

Small Document Systems 5b5

Note that some systems with very small file and computational capacity, such as the DEC 310W and MCST, are effective for short documents (e.g., business letters and memos) produced locally. They are much less effective for normal-scale technical documentation, mainly because of limited formatting and because file control must remain essentially as it is for paper. 5b5a

Terminals 5b6

Displays 5b6a

Display terminals are attractive because they are responsive, offer the possibility of pointing to text in commands, and offer ways to present feedback, status information, and prompting to the user without confusion with ordinary text. They are unattractive because in almost all cases they show less than a full page, they show only monospaced printing, the characters are hard to read, and ambient lighting may degrade their reability. The tide has turned towards use of display terminals with computer-based text handling systems in publications contexts. However, at some draft step the publication process must resort to printout or only partially satisfactory special display terminals until more powerful displays are generally available. Such displays must show full pages and accommodate at least forty special characters.

Half-duplex, Line-at-a-time Mode 5b6b

IBM's ATMS system and its descendants at IBM and in other organizations including PCS offer half-duplex, line-at-a-time response for input and editing. This means the user types characters which are held in the terminal until a line is filled and a carriage return typed. Then the whole line goes off to the computer which responds to the line as a whole. Other half-duplex systems exist particularly where IBM equipment is involved. Some systems derived from ATMS are operated on display terminals, but in this case, the display capabilities noted above are generally not being used. Such displays are merely simulating typewriters. Because of limitations on addressing and the confusing interweaving of text and commands on the paper in front of the operator, except for editing the paragraph local to the user's position at a given moment, these systems tend to be hard to learn and hard to use.

Training 5b7

Training seems to be about the same for the same functions in various systems. Systems take longer to learn in proportion as the command interaction is opaque to the user (PCS) and as there are more possible functions (NLS). In general, however, learning the basic functions of a production worker in publications seems to take about two weeks, requires subsequent practice, and benefits from comprehensive documentation that contains many clear simple examples including sequences of operations. 5b7a

Printing 5b8

For brief documents requiring a good appearance, a good connection to a selectric or daisy wheel type printing station is very important. MCST and Daconics are very good in this respect. 5b8a

Discussion

For longer documents, such printing devices are too slow and output to a line printer is necessary. Systems attached to central computers by 300-baud lines such as PCS cannot take advantage of the speed of the line printer. PCS offers to print drafts at its computer center and mail them to customers, an expensive process which causes painful delays. NLS, which has access to high-speed connections through the ARPA network, offers good connections to line printers at some sites. 5b8b

In lieu of wide availability of displays that can show the document in final form, the ability to print page proof surrogates is very useful. None of the systems described here offer page page proof surrogates, but systems similar to NLS and PCS offer them through oversized pages of monospaced type or raster printers. Either one of these is desirable. The oversized page strategy has the advantage that it can be printed on many line printers. 5b8c

All the timeshared systems studied here offer output to photocomposed pages in one form or another. Formatting complex pages or math on the Daconics demands a great deal of care from the user. NLS and PCS lack math setting. There is some awkwardness in using them in terms transferring files to tapes, billing, etc., which could easily be handled within the computer. See also formatting below. 5b8d

File Control 5b9

MCST, DEC 310W, and Daconics bundle files onto portable magnetic media of various sizes, comparable to a memo, a small binder, and a thick three-ring binder respectively. Once created, these magnetic media must be handled much as their paper equivalents, limiting their usefulness for large technical documents particularly where updating requires constant recourse to a library of existing sources. 5b9a

In a newspaper workroom, a system such as Harris' which essentially offers file control and routing for one day's edition is satisfactory, but the Baltimore Sun expressed the intention of buying more memory so it could use previous stories as sources more effectively. 5b9b

PCS and NLS offer adequate file capacity and archive retrieval systems. File status information is used for control purposes. The tools exist for file control programs to route, guarantee the integrity, and report the status of files, but they have not been extensively used for these purposes. Any large-scale publication system should have such tools available. 5b9c

Powerful file systems are much more useful if it is possible to search for, copy, and move information without regard to file boundaries except for privacy restrictions. NLS allows the user to ignore file boundaries except for deliberate access controls. This capacity was very useful in the multi-file AFM 66-1 environment. PCS and Daconics offer cross-file work in somewhat awkward form, and in the case of Daconics it is limited by their total file storage space of about 500 pages. 5b9d

Formatting 5b10

Numerous computer-based formatters are on the market. They vary in the amount of control accessable to the user, in creating full pages of columns, in the richness of possible layouts (e.g., multiple columns, math, several independently controllable headers and footers), in the availablity of global instructions, availability of proportionally spaced type, the ease with which the user may control them, etc. 5b10a

Form is intricately bound to content, particularly in technical documentation which depends heavily on tabular material and indenting. It is well know in publications circles that in conventional systems authors make numerous and expensive changes just before printing because their words look different to them when they see them typed in final format. Such changes are almost unknown in the ARC work environment where authors have access to formatted drafts early on. For this reason, we believe a full-page format should be available at any time to an author making initial drafts. Early formatted drafts preclude the sort of service arrangement in which a publications group sends a document, in the form of a stream of characters on a tape, to a service bureau where a format is imposed. To be fully effective, it demands full-page display with interactive reformatting. 5b10b

Of the systems discussed, Daconics, PCS, and NLS have full-page formatters. 5b10c

Setting complex math including about 40 special characters and setting in proportional spacing is necessary to any general-purpose technical documentation system, although it may not be necessary in many special cases. Of the systems surveyed, only certain Daconics configurations had limited math setting cabilities, which made them the system of choice in certain applications even with Daconics' various limitations. 5b10d

In general, the formatters control layout through more or less incomprehensible bits of code embedded in the text. If such code is necessary, it must be possible to quickly and simply make it invisible when the user wants to read the text. Of the systems surveyed, none really had this capability, although NLS can perform an awkward approximation. It must be possible to set format globally; that is, if indenting is one half an inch, it must remain one half an inch through succeeding pages until changed. With Daconics, much time consumed by editing is necessary because formatting is only partially global. 5b10e

If the user wants to go beyond layouts very close to the default, inserting codes is a precise and complicated task requiring special training. For many cases, NLS ameliorates this problem by providing canned formats and by allowing formatting based on hierarchic organization, which is particularly valuable in technical documentation. Many difficult cases remain, particularly in view of changed pages and cases where changes in content demand changes in form. In a sense, this is a non-technical problem because the computer has handed many of the tools of a skilled

Discussion

linetype operator to casual users. Yet we can certainly imagine more powerful computer-based aids to implementing formats. A method for designing formats with a sensation of freedom and power to the user similar to hand lettering a sign should be available. The formats should then extend to succeeding pages without human intervention except in special cases. 5b10f

Tabular Material 5b11

Of the systems surveyed, only Daconics had an effective adaptation available to deal with tabular material on the small screens. This adaptation, although lacking many of the features for an ideal system described above, is so powerful that SRI takes the trouble to use Daconics for some difficult tabular material in otherwise manually published documents. NLS has a useful system for the special input and editing demands of tables with one level of heading, but this is severely limited by the viewing available. NLS and all the other systems are seriously handicapped by their lack of better tools for inputting, editing, and printing tables. 5b11a

Illustrations 5b12

Of the systems surveyed, only NLS attempts to deal with illustrations. NLS offers a line drawing system that has proved very useful in the hands of computer specialists at ARC. It has the advantage that illustrations may be printed by photocomposers from the same file as the text. We recommend cautious extension of this system into other production environments to learn more. 5b12a

Cost Comparisons 5b13

Although cost figures are available for the performance of some of these systems in particular applications, comparisons are very difficult because the systems perform different functions and create different work and production patterns. For example, a study of the productivity of automatic typewriter centers typically reports the number and cost of pages of output per day including overhead (6). In terms of file control, we are not sure what this cost includes. We may only guess that it includes the time spent by the typist filing paper, cards, or cartridges and filling out forms, but not the time of other clerical employees involved or the typist's supervisor. In a system based on a central computer such as PCS or NLS, the equivalent cost may or may not appear as charges for CPU, on- and offline storage, and operator labor cost with their overhead burden. Users of Daconics, which has limited online file controls, divide such costs between machine charges and manual filing costs in a way which depends on the size of the documents involved, the amount of quoting from previous documents, and the rate of throughput. 5b13a

Allocation of communication and illustration costs have similar ambiguities. 5b13b

Such concrete items as page counts have different meanings in automated work areas. People working with systems with ready access to rapid printers tend to print out many drafts. For example, the people working on AFM-66-1, who were also making

use of special-purpose drafts such as headers only or recently changed paragraphs only, printed an average of 28 pages an hour, eight hours a day for the two weeks revision process. But it is hardly meaningful to say that the two editors involved were producing at a rate of 14 pages per hour or about 50 cents a page. 5b13c

The possible cost advantage of a system like NLS, where a document may at any time be sent to a system for cataloging, is hard to compare. 5b13d

Reticence on the part of large organizations is also a stumbling block to presentation of effective cost comparisons. We have been given access to a number of internal reports that we may not quote specifically or cite. We apologize to our readers for the resulting gaps in our references and references to documents not widely avialalbe. 5b13e

With all these cautions, we can note that the widely disseminated report by Klaus Haider (6) gives costs per page of clean copy in a group producing 700 pages per month as follows: for an MCST, $6.47; for a microcomputer similar to a 310W station, $5.20; for ATMS, which is similar to PCS, $6.13. An unpublished Air Force study based on Haider's methods found a cost of $4.49 for NLS and $6.80 for PCS. The same study suggested a possible cost of $3.78 for a hypothetical system based on NLS and an intelligent terminal that performed local editing. Using slightly higher labor and overhead rates and an expensive six-month lease, an SRI study found an average cost of $5.79 per page for a Daconics (14). With simple text, the cost was about half that amount, and the most complex tables cost about twice that. A study at the Educationa Testing Service (20) suggests that production of manuals on ATMS cost about the same as publishing them via typewriters. 5b13f

The Baltimore Sun, like other newspapers, is not willing to disseminate cost-benefit figures, but we may assume that their system has cost at least 2 million dollars, and that a common write off period for such systems is 2.5 years. Their managment appears well satisfied which indicates the installation will save them the cost of ther investment in that period, chiefly through reduced labor costs. 5b13g

All that is really clear from these and other similar figures available from various sources (16-20) is that computer-aided systems have evolved to the point that they are sometimes cheaper than the manual systems they have replaced, and that the results vary widely with the functions and accounting methods involved. 5b13h

In planning for future systems, it is well to consider that in general labor costs are rising, communications costs are falling slowly, and computer CPU costs are falling sharply (15). In the future, it will be more and more cost effective to convert labor costs into CPU cost wherever possible, e.g., by moving file control, production quality assurance, flow control, and communication functions into the machine. 5b13i

CONCLUSIONS 6

In general, computer aids are valuable insofar as they economically: 6a

reduce the overall labor cost, 6a1

compress the time required to produce a document in final form, 6a2

improve communication among the production team; writers, editors, reviewers, artists, and managers, 6a3

reduce the cost of distribution, archival, and retrieval, 6a4

improve the quality, accuracy, appearance, and timeliness of the final product, 6a5

and facilitate the intellectual task of the writer. 6a6

None of the systems studied satisfy all the criteria. In fact, only NLS attempts to satisfy them all, with varying degrees of success. 6b

Two major disadvantages of using large-scale, computer-based editors in production environments are unresponsiveness and unreliability, i.e., no one can work when the computer is unavailable. Both of these problems can be solved by moving a set of basic editing and formatting tools into the workstation itself. 6c

Several potentially powerful NLS tools have never been completed. Others are difficult to use. These include: 6d

a distributed, reliable and faster delivery system (5b1,5b2), 6d1

a more powerful and easier to use page formatter and proof capability (5b10), 6d2

a better table handling facility (5b11a), 6d3

and a display workstation that presents a full page of text as it will appear on paper, including line drawings (5b6b). 6d4

The next phases of this project will look closely at both the conceptual design and implementation of these problem areas. 6e

NLS can be modified and extended to meet these needs where other systems studied cannot for some very basic reasons. NLS was designed from the beginning to support the entire process of information handling. The system has some unique characteristics that simplify the change process; random access and hierarchically structured files, user interface routines cleanly separated from the rest of the system, easily extended and modified user interface, and a two-dimensional, display-oriented editor. 6f

APPENDIX 7

Questions and Answers about Journal Production 7a

Organizational Setting 7a1

Authorization 7a1a

How does the idea get started?

Usually the author(s) initiate. Suggestions or pressure may come from the institution where the author works or from the source of support for the work.

Is there a chain of approval before work begins?

Authors often have to clear allocation of their time.

Is authorization a form?

Not normally.

Author 7a1b

Is there one or many?

Usually more than one. Varies widely with academic discipline, from one to a dozen or more. Where there are many authors, authorship usually represents credit for work and not more than one to three people are involved in writing and publication.

If many, are they in one place or scattered?

May be scattered, but if so usually the writing is done in one place. If better facilities were available, scattered authors might participate more meaningfully.

Do the authors search sources, ask people questions?

Online?

Through some sort of data base management?

Not usually interactively. Many reference guides, e.g., Chemical Abstracts, are based on computer files but in the large majority of cases the author uses them in hard copy. Automated reference searches such as Lockheed's Dialog and various medical systems are increasingly available but certainly are involved in less than 10 percent of all author's time. The Westat Report (2) suggests that in 1974 up to 12 percent of authors made some kind of use of terminals that might be used to search data bases, and we may expect that number to grow as long as the references that are checked by hand are checked by expensive people.

Would teleconferencing be appropriate?

Not usually among authors. In the majority of cases, authors have access to one another by word of mouth and search sources (references, their lab notebooks). Teleconferencing would not usually be useful, but see the previous answer.

Appendix
Journals

Offline?

An author typically spends quite a bit of time in a library searching for references at this stage. The Westat Report found that for an average of 40 hours per article authors frequently correspond with other workers in the field and exchange ides with scattered workers in the same subject, e.g., at meetings. This is an important part of scientific problem solving.

Would it be useful to put the sources online?

Very much so, see cost discussion below.

What percent of the sources of the document is boiler plate? By boiler plate we mean units of a paragraph, or larger, that are copied with little or no change from previous documents.

The percentage of boiler plate is trivial except for cover pages and the like.

Does the author construct personal data systems (e.g., index card files or notebooks)?

Usually. Cummulatively a very substantiai amount of time goes into such systems.

How does the author write?

Most commonly the author writes in longhand or types a rough draft which is retyped by a secretary. We have no figures on the percent of authors that type rough drafts, but my guess is it's a substantial fraction, less than half. The Westat Report (2) found that 13 percent of authors made use in some way of mag-card-type typewriters and about six percent made use of online systems. The authors' use of electronic media appears to be almost entirely through secretaries.

How long does writing take in calendar time?

Two months per article is a good round number; it varies widely.

About how many hours of a persons time does writing take?

An average of 94 hours per article, 53 of author's time and 11 of a secretary's (2).

To estimate the importance of storage and retrieval, consider the following very rough calculation. It is said (2) that there are 10,000 journals in the United States. The distribution of journals according to size is skewed and it is hard to estimate the number of pages the 10,000 journals publish each year. The Westat Report (2) offers a model of a "small" journal which we might reasonably take as average. It publishes 1,200 pages a year which leads to a total journal publication in the United states of 12,000,000 pages a year.

Westat (2) also reports that writing journal articles before editing and review takes 2.9 hours per page. 34,800,000 hours are then spent on this work. A very substantial part of that work is retrieving information either from other journals or personal data bases (index cards, lab notes, and the like). If we figure author's time

at $10/hour, the annual value of that time is $348,000,000. It appears that computer aides could accomplish large savings in this area if there were a proper way to deliver and charge for them. (See also 2.)

How many times per year do the same or different authors write such a document? Closely similar documents?

Two would be typical, varies widely.

Approval 7a1c

What forms are associated with the document?

Forms may be required for approval, production control, or formatting at the author's organization, separately at the journal, or both. Large journals and large organizations that surround authors tend toward the sort of forms described below for SRI report production.

Is there a specific chain of approval?

Yes, frequently two. Approval may be at the author's organization, at the journal, or both. At the author's organization (Chart 1), it usually includes reading and revison by supervisors and colleagues, and may include editing for style, grammar, and conformity to journal format. Practice varies from journal to journal, but typically includes rejection, tentative acceptance, or outright acceptance by the journal editor, separate review in parallel by one to three reviewers, review of the resulting package by the journal editor, and give and take with the author about making changes in the manuscript as a result of the editor's and reviewer's comments. (Chart 2)

Does approval have a schedule? If so, what is the schedule?

There is time pressure and a set order, but not typically a precise schedule.

Does approval include committees?

Not usually in the sense of all members interacting. The star form with communication centered on the editor described above is typical. Teleconferencing facilities might make committee actions possible.

Are the approvers in one place or scattered?

Scattered.

Do any approvals require revision of the document?

Which ones?

See (7a1c) above.

How many times is a documen: likely to return to the same approver before it is allowed to go on?

It usually passes each approver once only.

Appendix
Journals

Who retypes?

The author's secretary may retype; the final corrected version is normally retyped at the journal as a last step before the printing process.

How is copy proofing done?

The last draft corrected by the author is compared to the draft prepared by the journal staff to go to the printer.

How long does approval take in calendar time?

An average of five months (2). Reviewers, on the other hand, claim to take two weeks. There is a lot of tension and conflict about this period.

About how many hours of person-time does approval take?

Eleven hours at the journal and 6 hours by reviewers (2). Of the 11 hours, 2 1/2 are for retyping prior to printing, 4 2/3 are copy proofing, and 1 1/3 are for housekeeping functions such as correspondence with authors and reviewers. Note that the expensive copy proofing is necessary because of the limitations in communication between the author and the journal staff. Of the 6 hours by reviewers some substantial fraction is checking references.

Would teleconferencing be appropriate?

Highly.

How many times per year do the approvers see such a document? Closely similar documents?

Reviewers about twice and journal editors hundreds of times (2).

Government Security Classification 7a1d

None.

Are publications specialists involved in production of this document, if so at what point? Describe briefly the flow between the author's organization and the publication specialists. 7a1e

Yes. See (7a1c).

(By publications specialist we mean people who type, edit, format, and the like: those who work with whatever documents may require their attention without regard to content.)

Is a publications number or equivalent attached to the document?

Practice varies.

Is there a publications control log?

The journal keeps some sort of record of the progress of the article. Practice varies widely, but it is most commonly a form or forms attached to the article plus a card

file of all articles in the publication cycle. Besides files on individual articles, journals usually have files of reviewers which can be quite complicated and involve considerable time in upkeep.

Is there cost accounting for time and materials used in producing the document? How is it done? 7a1f

Journals generally discuss cost by dividing their total expense by the number of pages they publish. Tracking of the cost of individual articles is very rare except where authors are charged for changes after galley is set. When authors are charged for pages, they are charged *pro rata.*

Is there a schedule from authorization to approval? From approval to dissemination? If so, what is the schedule? 7a1g

Authorization, if any, is wholly separate from approval. The journal normally has a publications schedule from the completion of review (approval) to dissemination (mailing the issue to the subscriber.) Such schedules vary widely but are usually several months.

Style 7a2

Are there illustrations? 7a2a

If yes, characterize them briefly, i.e., do they include half tones, charts, logic diagrams, perspective drawings, graphs, or other forms?

Journals commonly contain complex line drawings, charts, and graphs; perspective drawing and half tones are unusual but definitely occur. Some journals charge the author for printing half tones, color, or other special media.

Does publication require any ancillary information about the illustrations, e.g., catalog numbers or approval for publication?

Illustrations are normally prepared by the author. They have a separate flow at the journal and their identification with the journal article requires upkeep, usually something like a routing slip.

Tables? If yes, characterize them briefly. 7a2b

Yes, in considerable variety, usually proportionally spaced, and often requiring justification of text, overlapping rules, levels of headings, boxing, etc.

Is the document printed with proportional spacing or monospaced (like typewriter printing)? 7a2c

Proportionally printed in a large majority of cases.

References? 7a2d

Yes.

Bibliography? 7a2e

Appendix
Journals

Often.

Math? If yes, characterize it briefly. 7a2f

Many journals require setting equations, most at one time or another. They require extended character sets, sub- and superscripts. The number of extra characters required to cover most applications is of the order of 40 (the Greek alphabet and a few other characters), but equations also require flexible location of characters, and characters such as integral signs that extend over several lines and vary in size. Demanding math is generally treated like illustrations and is often provided by the author through the journal to the printer.

Is there an established or semi-established page format? If yes, describe the following: 7a2g

Headers

Footers

Headings

Paragraph or similar numbering

Indenting

Conventions for setting special text (quotations, secondary material, references, etc.)

Footnotes

References

Bibliography

Tables of Contents

Indices

Title Pages and other front matter

If yes, are they forms?

Fonts

Journals have set formats. They vary from journal to journal but normally include all of the above. They are not forms.

Are covers required? End papers? If yes, describe them briefly. Are they forms? 7a2h

Yes, covers vary with journal but are most often typeset. They are not forms.

Are characters outside ASCII required? Desirable? 7a2i

Yes, see math above.

Production Processes 7a3

How often is the text substantially retyped and at what points? 7a3a

Call it an average of 3.5 times. Normally three times, twice by the author or

author's secretary and once when galleys are made. However, extensive review inside the author's organization or at the journal may cause retyping usually by the author's secretary. About half of all manuscripts are rejected and submitted to other journals which usually means retyping to conform to the new journal's style.

How often are paragraphs or larger units moved around in the document and at what point? 7a3b

Normally once during the writing process. Such revision occurs once during journal review for about a third of the manuscripts (2).

How often are many words, phrases, or headers in the document altered, and at what points? 7a3c

Normally in effect 2.5 times. That is, the manuscript may be revised by the author as a piecemeal process which amounts to something like one revision, and the resulting manuscript does NOT conform to the journal's style with respect to headers, abbreviation of units, etc. The person who introduces these changes is most often the author's secretary, either before the article is submitted to the journal or in response to the journal's review. If however, an item is rejected and submitted to another journal, which occurs for about half of the manuscripts, varying widely with the discipline, then headings, abbreviations, etc., usually have to be revised.

How often and when is the document proofed? (By "proofed" we mean one draft compared word by word for conformity to another draft.) 7a3d

Typically twice; once at journal office before the manuscript goes to galley proofs, and once by the author reading galley proofs. In the latter step, the author often introduces corrections or outright changes which she recognizes as important only when she sees the printed form of the article. Such changes are the source of friction between editors and authors.

How often and when is the document copy-edited? (By "copy-edit" we mean someone checking for errors such as typos, spelling, grammar, non-conformity to style, etc.) 7a3e

Two and one half times, that is, once for each retyping (see below).

Printing 7a4

How is the final version printed? 7a4a

Letter press or photo-offset.

How many words long is the final version? 7a4b

Typically 4000, varies widely (2).

Who does the layout? 7a4c

That task is distributed among several people and steps. The final typist, usually the

Appendix
Journals

author's secretary, creates a draft which conforms to the journal style. In various ways that conformity is approximate, e.g., underlining for italics. A journal proofer will probably note corrections. The person who sets the galley partly translates what he sees in the final typed manuscript into actual journal format. Someone who creates page layouts usually finishes the process. This last person has production graphic arts skills.

Who does the final proofing and in what medium? 7a4d

Typically the author does the final complete proofing on a galley. Page proofs are typically later proofed by someone in the journal office, but mostly for layout.

How long does printing take in calendar time? 7a4e

Six weeks is typical for the printing process, but varies widely with journal publication schedules

About how many hours of person-time does it take? 7a4f

If by printing we mean from final correction of galleys through mailing, about an hour.

Distribution and Life Cycle 7a5

How many copies are distributed? 7a5a

Varies from hundreds to tens of thousands and more in a few cases. Two thousand might be typical (see 2).

Is there a distribution list? 7a5b

Yes, the subscribers.

How many names?

See (7a5a)

In one place or scattered?

Scattered.

Is the same distribution list used for all or most such documents or does each instance have a unique list?

All the same.

Is access limited? 7a5c

No.

Are updates distributed? 7a5d

No.

How long does distribution take in calendar time? 7a5e

At U.S. Mail speed, it takes days to weeks.

Appendix
Journals

About how many hours of person-time does distribution consume? 7a5f

A couple of minutes based on postage.

Does each document have a control number or equivalent? 7a5g

No.

Are the authors, approvers, or publication personnel involved in cataloging? 7a5h

Not for the most part. Some journals provide keywords and similar information, sometimes derived from the author.

Are updates catalogued? 7a5i

No.

Is any known cataloging of the document based on an online system? If so, is a special data format required for that system? 7a5j

A number of online systems, e.g., Lockheed Dialog, catalog some journal items by title or abstract. These systems are selective and detached from normal journal publication except in a few cases. They normally require retyping, including reformatting the material that goes into the data base.

Online Use 7a6

Is the document read online? 7a6a

No.

Do personnel involved in production have access to an online system? 7a6b

Only in a few cases (2).

Do personnel involved in production have training in use of an online system? 7a6c

Only in a few cases (2).

Do personnel involved in production use an online system? 7a6d

Only in a few cases (2).

Linkage to Other Documents 7a7

Does this document require cross-references to other documents? 7a7a

Yes. Journal articles refer to each other frequently. The system is archival and the articles never change once they are published. Indexes of citations exist to deal with this problem. A dynamic system in which citations to subsequent related work could be attached to articles would be extremely useful. (Chart 4)

If yes, do the documents cited change either in content or in the location of the information cited during the lifetime of this document? 7a7b

No, but subsequent work is performed and reported which could be profitably cited if the medium allowed it.

Appendix
SRI Reports

Questions and Answers about SRI Report Production 7b

Organizational Setting 7b1

Authorization 7b1a

How does the idea get started?

In general, a contract calls for the report. In many cases the report, along with some provisions for schedule, content, and approval, is part of the proposal that led to a contract.

Is there a chain of approval before work begins?

Beginning work on a report is often scheduled in a contract. Usually there is no formal approval to begin work, but the project leader is involved in the decision to begin.

Is authorization a form?

Not usually.

If the document is wholly or partially classified, what security arrangements exist relative to online reading or writing?

Journals do not publish classified documents.

Author 7b1b

Is there one or many?

Either.

If many, are they in one place or scattered?

Usually within walking distance, occasionally at distant SRI offices or subcontractors.

Would teleconferencing be appropriate?

In some cases. Conference with remote authors occurs in a substantial minority of cases. It is most important in first draft revisions. It now takes the form of telephone conversations and exchange of text by mailing copies or by telecopiers.

Do the authors search sources, ask people questions?

Often.

Online?

Occasionally.

Through some sort of data base management?

Occasionally.

Would it be useful to put the sources online?

Some substantial part of the work of writing a report is searching for information in

previous SRI reports. We don't have very good information on the extent of searching old reports, which undoubtedly varies widely with the subject matter and the history of SRI work in the discipline, but a reasonable guess at what is typical is more than five percent and less than 25 percent.

What percent of the sources of the document is boiler plate? By "boiler plate" we mean units of a paragraph or larger that are copied with little or no change from previous documents.

Typically boiler plate is limited to header pages, distribution lists, covers, etc. Some reports have five to ten percent boiler plate.

Does the author construct personal data systems (e.g., index card files, or notebooks)?

Often.

How does the author write?

Dictate?

Longhand?

Type offline?

Type offline into magnetic media?

Type online?

Other

Mostly longhand or offline typing. The other methods are used some small percent of the time.

Is a rough draft typed for author's revisions?

Typed offline?

Typed offline into magnetic media?

Typed online?

Yes, usually typed offline, occasionally into magnetic media or online.

How long does writing take in calendar time?

Varies widely, weeks to months.

About how many person-hours does writing take?

Varies. Hard to define exactly because report writing overlaps with other contract analytical work. One to four hours for a 250-word page might be a reasonable guess, more often one than four (average 1.5?).

How many times per year do the same or different authors write such a document? Closely similar documents?

Varies. Two to four is not uncommon.

Appendix
SRI Reports

Approval 7b1c

What forms are associated with the document?

Practice varies for example by SRI division and according to whether a document is classified, but fundamentally there are 12 forms:

An Approval Form. This form has places for signatures and dates of approval inside SRI, but outside publications.

A Report Services Cost Record. Used mostly to gather information and establish cost to the project.

A Publications Production Schedule Record. Due dates for various steps.

A Production Control Log. List of jobs going on at Publications.

A Request for Illustrators to Work. Schedule, production information.

A Word List. Some informaion about document format and lists of hard words, abbreviations, etc., for production typists.

A Sizing Sheet. Page and location on the page of each figure, its size, and other information related to physical production.

A Production Work Order. Detailed instructions for photographers, press operators, and binders. Classified version differs from unclassified version.

A Pagination Sheet. Records the pages and locations of illustrations, tables, etc., after the document is final typed.

A Cover and Title Page Order. Cost information for covers, bibliographic and contractual information that appears on covers and title pages, in instruction for layout of these pages.

Time Sheets. Hours spent on the report by publications specialists, e.g., editors or binders. This form makes it possible to validate established costs.

Estimated time spent filling out forms?

For a 100-page report, about 40 minutes for forms having to do with administering production flow and about 3.3 hours for forms that embodied layout, paging, spelling, etc. That means .00001 hours per word for administration and .00013 hours per word for formatting. They break down as follows:

Pagination Sheet: 1.5 hours.

Word List: .5 hours.

Production Work Order: .3 hours.

Other forms having to do with work flow: .3 hours total.

Cover and Title Page Order: .3 hours.

Sizing Sheets: 1 hour for two figures.

Appendix
SRI Reports

Is there a specific chain of approval?

Typically approval has four stages:

Approval of a draft before SRI editing, usually by one or two people, typically the chief writer's boss and her boss. If the project is small ($500,000 or less), the chief writer is usually the project leader. If it is larger, the first approver is often the project leader.

Approval by SRI Editing.

Approval by Laboratory and Division directors after SRI Editing (depending on SRI Division).

Approval by SRI's customer.

Does approval include committees?

Not *de jure,* sometimes *de facto.*

Does approval have a schedule? If so, what is the schedule?

Yes, it varies. Typically it occupies a month or so before the report is due at the customer.

Are the approvers in one place or scattered?

Within walking distance, except for the customer.

Do any approvals require revision of the document?

Cumulatively and on the average, approval requires about three substantial revisions of the document and about three passes of "cleanup editing." (By "cleanup editing" I mean changing words, phrases, format, abbreviations, bibliographic format, and the like, but not changing the order of large blocks of the document.)

Which ones?

Informal approvals before editing. It's hard to get a handle on these, but I have a sense from experience that they require at least one and one half complete revisions of the document.

Formal approvals before editing. Thirty percent of documents require substantial revision at this stage.

Editing. Requires major revisions 37 percent of the time, and requires minor revisions almost invariably.

Formal approval. Within SRI after editing requires substantial revision about 35 percent of the time and minor revisions almost invariably.

Customer approval. Requires substantial revision about 5 percent of the time and minor revision seldom.

Appendix
SRI Reports

How many times is a document likely to return to the same approver before it is allowed to go on?

Informal approvals before editing:

Normally at least once.

Formal approvals before editing:

About a third of the manuscript returns once.

Editing requiring major revisions:

About a third of the manuscript returns once.

Formal approval within SRI after editing:

About a third of the manuscript returns once.

Customer approval:

Very seldom.

Who retypes?

Informal approvals before editing:

Normally a secretary in the author's organization. Revisions are not always fully retyped at this stage.

Formal approvals before editing:

Normally a secretary in the author's organization. Revisions are not always fully retyped at this stage.

Editing requiring major revisions:

Normally a secretary in the author's organization. Revisions are rarely fully retyped at this stage.

Formal approval within SRI after editing:

Retyping is distributed between secretaries in the author's organization and SRI Publications typists.

Customer approval:

Very seldom. SRI Publications typists do the work when necessary.

How long does approval take in calendar time?

Weeks.

About how many hours of person-time does approval take?

In the whole process of SRI editing, it takes about 20 minutes per page. I estimate that the author takes the same amount of time to respond. Figures are hard to come by, but I estimate the low-level SRI approval (before editing) takes the order of 10

minutes per page for the approvers and 20 per page for the author, and that high-level SRI approval takes the order of one minute per page for the approver and five minutes per page for the author.

How many times per year do the approvers see such a document? Closely similar documents?

On the order of one hundred a year in the case of editors and division level approvers, on the order of a couple of dozen a year at lower levels.

Government Security Classification 7b1d

Is the document wholly or partially classified? If yes, to what levels? If partially, how is it divided?

SRI publishes wholly, partially, and unclassified reports. Three percent are wholly or partly classified. SRI publications maintains classified facilities to handle classified reports. In general, partially classified documents are treated as if they were wholly classified.

Are publications specialists involved in production of this document, at what point? Describe briefly the flow between the author's organization and the publication specialists. 7b1e

(By publications specialist we mean people who type, edit, format, and the like, people who work with whatever documents may require their attention without regard to content.)

Is a publications number or equivalent attached to the document?

A production number is given. It is not used outside the production process.

Is there a publications control log?

Yes, in editing, typing in the later stage, and preparation for printing. See above. In general, reports that have been approved by supervisory levels immediately above the author pass to editors. Further revision is normally an interaction between the author and an editor. The editor's approval is normally necessary before the report can go on to higher management approval. After final management approval, publications people are in charge of production. They have the skills necessary for efficient formatting and preparation for printing. For logs see (7b1c) above.

Is there cost accounting for time and materials used in producing the document? How is it done? 7b1f

Time and materials are charged to projects by means of standard SRI accounting methods, that is, essentially collecting labor hours by means of time cards and materials costs by means of requisition forms. Time card entries by authors, typists in their organizations, and approvers, normally identify the project, but not whether the work involved was report writing. In the case of larger reports, writing may

Appendix
SRI Reports

appear as a separate sub charge on the project. SRI Report Production often does its part of a report on a fixed price basis. Editors, final typists, printers, binders and the like also note their time on a separate log so such charges are identifiable. Some approval work is not charged to the project.

Is there a schedule from authorization to approval? From approval to dissemination? If so, what is the schedule? 7b1g

Authorization and approval are normally scheduled; the schedules vary with the size of the reports. Work authorization is normally weeks to months, approval to dissemination is normally weeks.

Style 7b2

Are there illustrations? If yes, characterize them briefly, i.e., do they include half tones, charts, logic diagrams, perspective drawings, graphs, other forms? 7b2a

All of the above. Seventy percent of SRI reports contain illustrations. The majority of the illustrations are line drawings, but photographs, graphs, and flowcharts are common. Perspective drawings and color are unusual but occur.

Does publication require any ancillary information about the illustrations, e.g., catalog numbers or approval for publication?

Existing illustrations have file numbers. All illustrations must be approved by author as check prints.

Tables? If yes, characterize them briefly. 7b2b

The SRI text handling report (14) estimates that 80 percent of SRI reports include tables. It divides tables into those of less than a page, those of one page, and those of 15 or more columns which demand photoreduction in the 10-point, monospaced type normally used at SRI. In these terms about 80 percent of SRI reports contain small tables, about 80 percent contain medium sized tables, and about 60 percent contain large tables.

Is the document printed with proportional spacing or monospaced (like typewriter printing)? 7b2c

Monospaced in the large majority of cases.

References? 7b2d

Often.

Bibliographies? 7b2e

Often.

Math? If yes, characterize it briefly. 7b2f

Often. Vrying in complexity

Appendix
SRI Reports

Is there an established or semi-established page format? If yes, describe it. 7b2g

There are a number of standard formats varying with SRI divisions and sometimes with customers. A typical format is described below.

Headers

No.

Footers

Page numbers only.

Headings

For example:

```
                TOP LEVEL CENTERED, ALL CAPS
A.  Second Level Flush Left, Caps and Lower Case.
    1.  Third Level Indented, Caps and Lower Case
    (a)  Fourth Level Indented, Caps and Lower Case
```

Paragraph or similar numbering

The numbering on the Heading examples above is typical.

- Lists and list-like constructions often use bullets.

Indenting

The first line of paragraphs are indented 5 characters per level; the rest of the text is flush left.

Conventions for setting special text (quotations, secondary material, references, etc.)

Besides frequent use of bullets, the text of quotations is indented five spaces. The running text is single-space typing, so there is no change in line spacing tor quotations.

Footnotes

Sometimes. The footnote area is marked off by a short dashed line. Asterisks, daggers, etc., are used to call out footnotes.

References

Sometimes. When they appear, they employ a standard format which uses quotation marks and underlining to identify publications titles and media, for example:

K. Johnson, "Defense Pledges Profit Changes to Senate," Aviation Week, Vol. 76, No. 24, pp 28-29 (11 June 1962).

Bibliography

Appendix
SRI Reports

Sometimes. When they appear, they employ a standard format which uses quotation marks and underlining to identify publications titles and media, for example:

Ebert, R. J., "Methodology for Improving Subjective R&D Estimates," IEEE Trans. Engineering Management, Vol. EM-17, No. 3, pp.108-116, (August 1970).

Tables of Contents

Yes. Lists of figures and tables as well in many cases.

Indices

A: Rarely.

Title Pages and other front matter. If yes, are they forms?

SRI uses standard cover pages, they do not look like forms but in effect are, requiring signatures and certain information (title, contract number, and the like) at certain spots. DoD requirements may mean form DD 1473 is the title page.

Fonts

Normally IBM Prestige Elite. Title pages usually use Composers or Headliners.

Are characters outside ASCII required? Desirable? 7b2h

Yes, required for math.

Production Processes 7b3

How often is the text substantially retyped and at what points? 7b3a

About three, see (7b1c6a).

How often are paragraphs or larger units moved around in the document and at what point? 7b3b

About three, see (7b1c6a).

How often are many words, phrases, or headers in the document altered and at what points? 7b3c

About three, see (7b1c6a).

How often and when is the document proofed (by "proofed" we mean one draft compared word by word for conformity to another draft)? 7b3d

Typically three times; once by someone in the author's organization before the draft goes to SRI Editing, once by SRI Editing (a professional proofer), and once by the author when she sees the final mats.

How often and when is the document copy-edited (by "copy-edit" we mean someone checking for errors such as typos, spelling, grammar, non-conformity to style, etc.)? 7b3e

Typically once, when the final mats are typed from the corrected manuscript. In

some number of cases, less than 25 percent and more than 10, changes by the author after Division approval, or changes by the author after seeing final mats, demand retyping and/or copy proofing some pages.

Printing 7b4

How is the final version printed? 7b4a

Offset or electrostatic.

How many words long is the final version? 7b4b

Varies with a distribution, skewed towards the shorter reports. Average is 15,000 (60 250-word pages).

Who does the layout? 7b4c

SRI Report Services typists or department secrtaries, following SRI documented standards and instructions from editors noted on the draft.

Who does the final proofing and in what medium? 7b4d

The final formal proofing is by the author on final typed mats.

How long does printing take in calendar time? 7b4e

Typically a week or longer; can be a day or less under pressure.

About how many hours of person-time does it take? 7b4f

About one.

Distribution and Life Cycle 7b5

How many copies are distributed? 7b5a

Varies widely, from tens to thousands; 65-75 is typical.

Is there a distribution list? 7b5b

How many names?

In one place or scattered?

Is the same distribution list used for all or most such documents or does each instance have a unique list?

SRI reports typically have a distribution list provided by the customer, 25 is a typical number but it may vary, and an internal distribution list to people doing related work and the library. Besides this distribution, many reports are sent to government distribution centers or are kept by customers and SRI to be handed out to a variety of people for reference and publicity purposes.

Is access limited? How? 7b5c

In a minority of cases. Access limitation usually means the report has a U.S. government security classification or is proprietary to a commercial client. Access is

Appendix
SRI Reports

controlled by distributing the documents only to people on a distribution list and, in the case of classified documents, keeping them locked up and keeping a record of who possesses them. Some proprietary commercial reports are closely limited in access and distribution.

If the document is wholly or partially classified, what security arrangments exist relative to online reading or writing?

The small number of classified documents and commercially sensitive handled are not online.

Are updates distributed? Whole documents? Change pages? 7b5d

Very seldom.

How long does distribution take in calendar time? 7b5e

Distribution to the initial list is usually through the U.S. mail. The succeeding *ad lib* distribution may continue for months or years thereafter.

About how many hours of person-time does distribution consume? 7b5f

Perhaps a couple of hours per report at SRI. If we assume one dollar postage is a reasonable account of the cost and that postal employees earn $8 per hour, a 75-copy report takes about ten hours labor in the post office if it is mailed. We have even less information on costs inside user organizations. This estimate does not include, of course, time spent by readers looking for reports.

Does each document have a control number or equivalent? In the context of some larger cataloging system? 7b5g

No.

Are the authors, approvers, or publication personnel involved in cataloging? 7b5h

Not normally.

Are updates cataloged? 7b5i

Occasionally by some customers.

Is any known cataloging of the document based on an online system? If so, is a special data format required for that system? 7b5j

Occasionally by some customers or abstracting services.

Online Use 7b6

Is the document read online? 7b6a

Through what systems?

Is the file read online different from the file that is printed?

Are data base reading techniques used on the document?

Not normally, except for ARC reports.

Do personnel involved in production have access to an online system? 7b6b

Authors?

In a few cases.

Approvers?

Almost never.

Typists?

In a few cases.

Editors?

Almost never.

Illustrators?

Almost never.

Catalogers?

In a few cases.

What system(s)?

Daconics, MAE, NLS, Redactron, Vydec. Note that except at ARC, the main users of the limited online facilities at SRI are typists. That is, even when a document is online, editors mark and approvers read paper copies.

Do personnel involved in production have training in use of an online system? 7b6c

Authors?

In a few cases.

Approvers?

Almost never.

Typists?

In a few cases.

Editors?

Almost never.

Illustrators?

Almost never.

Catalogers?

In a few cases.

What system(s)?

Appendix
SRI Reports

Daconics, MAE, NLS, Redactron, Vydec.

Do personnel involved in production use an online system? 7b6d

Authors?

In a few cases.

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Almost never.

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In a few cases.

What system(s)?

Daconics, MAE, NLS, Redactron, Vydec. Note that except at ARC, the main users of the limited online facilities at SRI are typists. That is even when a document is online, editors mark and approvers read through paper copies of the document.

Linkage to other documents 7b7

Does this document require cross-references to other documents? 7b7a

Frequently (see 2g2f).

If yes, do the documents cited change either in content or in the location of the information cited during the lifetime of this document?

Most don't.

If yes, what is done to bring the change in the citation to the attention of readers?

Nothing.

If yes, are the other documents available online, and if so, in what systems?

Not normally.

Suggestions 7b8

Can you suggest where the processes listed above should be changed? If so, please give briefly the reasons. 7b8a

We need to collate references in reports into some retrievable form for secondary use.

Appendix
AFM 66-1

More reports need indices than have them. For that matter, storing indices in some retrievable form--collated with other indices--could provide a useful infomation base.

Appendix
AFM 66-1

Questions and Answers about AFM 66-1 Production 7c

These answers refer specifically to the rewrite of AFM 66-1 that took place during the year 1975. This document was originally put online at the Pentagon, but the major part of the rewrite was performed at Gunter AFS in Montgomery, Alabama. The manual consists of 12 volumes, but only seven were rewritten. A rewrite is necessary when at least 40 percent of a volume must be changed (in the last four years, all work on these volumes have been rewrites). 7c1

Organizational Setting 7c2

Authorization 7c2a

How does the idea get started?

The person responsible for the document decides when he thinks a volume should be rewritten. This decision is made on the basis of the following:

Annotated Current Version. A master copy of the last rewrite is annotated with all the changes that need to be made. These come from people in the field who find errors either typographical or in content. The mechanics in the field normally submit their findings to their local quality control people, who in turn, tell their major command headquarters. These are then phoned, mailed, teletyped or sent in memos to the person responsible for the manual.

Air Staff Policy Change. A meeting of officers at the Air Staff level or a general may issue an official policy change. They will inform the officer in charge of the manual who will then issue a letter to all the major commands telling them of the change. It will be stated that a waiver is granted for the last rewrite, but that in the next rewrite the change will be official.

Is there a chain of approval before work begins?

The officer in charge must submit his request for a rewrite to his superior and this eventually gets passed along to a general. An official plan must be drafted for the general who will issue the final approval. This plan includes the following:

Milestones. Estimates of the time needed for the rewrite are made. These are constantly modified according to the input from the other areas.

Tasking. A description is written about how the reworking will be done. This describes that a group will be convened at Gunter.

Request for Support. A special request to Gunter for person power support, terminal support, computer support, and graphics support is made. A request is also made of people at the Pentagon to ask if they could support a reworking of 66-1 in case Gunter is unable to do so.

Requests of Major Commands. The Major commands are asked for input on the

volume to be revised. This is an official request for errors and must be submitted using an official format. Major commands are also asked to identify people that will be able to go to Gunter for the two weeks of the reworking.

Data Automation Agency (DA). A letter is sent to DA to inform them that a reworking is going to take place. They are asked to look carefully at the present format of 66-1 and to comment if they have any objections on the current format.

Is authorization a form? If yes, does it continue to function through the life of the document? How many copies are made of the form? Where do they go?

The form "Request for Issuance of Publication" is prepared and this includes a distribution list for coordination. This form remains with the document during the rewrite, and the final approval signatures come from DA when the final proofing is done. If there are new forms to be developed for a document, then the "Request for Approval and Development of Form" form must be filled out and submitted to DA.

How long does it take in calendar time?

The approval time can continue for several months before the rewrite.

About how many hours person time does it take?

Don't know.

Author 7c2b

Is there one or many?

A group of approximately twenty people met at Gunter to do the actual rewriting. Different work groups were organized with about four to five in each group. These groups actually worked together on a document, although sometimes one or two people would go off and do some additional writing.

If many, are they in one place or scattered?

These 20 authors were flown in from all over the country and they met in one building at Gunter Air Force Station.

Do the authors search sources, ask people questions?

Online

The authors used printouts of the document that had been put online. No one actually searched sources of information online.

Offline

The authors used copies of the current version of the volume that had been annotated since the last rewrite. They also had special forms that had been filled out by people in the field that included suggestions for change. In addition, they had official papers that indicated the policy changes that the Air Staff had initiated since the last rewrite.

Appendix
AFM 66-1

What percent of the sources of the document is boiler plate? By boiler plate, we mean units of a paragraph or larger that are copied with little or no change from previous documents.

At least 40 percent of the pages of the document were changed, that is by definition what qualifies as a rewrite. Most of the paragraphs were kept intact and revisions were made to them.

How does the author write?

The authors made their changes in longhand on the printouts they were given. They used specific editing marks that made it easier for the editors to read. They wrote in longhand on pieces of paper any long insertions and these were attached to the printouts.

How does the editor work?

The editors received the marked up printouts and entered these corrections and changes online using TNLS or DNLS.

Is a rough draft typed for author's revisions?

A new rough draft was printed out on the line printer at Gunter and then given back to the authors for more revisions. When the corrections were very few, the rough drafts the authors received were formatted so that they could check references and paragraph numbering.

How long does writing take in calendar time?

This writing session lasted for two weeks. During this time two volumes were rewritten.

About how many hours of person-time does writing take?

The authors worked every day for two weeks for this rewrite.

How many times per year do the same or different authors write such a document? Closely similar documents?

A similar rewrite for two other volumes took place a few weeks after this one. This session only lasted for one week. There are no definite number of rewrites per year.

Approval 7c2c

What forms are associated with the document?

The forms that people from the major commands filled out on changes were used during the rewrite. The forms that the person in charge had filed with DA were not used during the actual rewrite.

Is there a specific chain of approval?

A group called the "Murder Board" which consisted of the Major in charge and one

other person was established to review all the writing that was done. This group looked at the changes the authors made before they were submitted to the editors. The Murder Board could arbitrarily accept or reject anything that the authors had written.

After the rewrite was completed, DA also had to approve the document.

Are the approvers in one place or scattered?

The "Murder Board" was located at Gunter in another room from the authors.

DA is located in Washington. The members of the "Murder Board" were based in Washington also. When they had to work with DA they were in the same city, but different sections.

Do any approvals require revision of the document?

Sometimes the "Murder Board would send copies back to the authors before the editors made the changes. Most often, the authors would get the copies back after the editors had made the changes that passed the "Murder Board." No retyping was necessary since the changes were made online. Copy proofing at this stage was also done by the authors. There is also a final copy proofing that was done by DA when they received the camera-ready copies.

DA looked at camera-ready copy. The first set of proofs was completely rejected due to too much white space between words. The second set of proofs was accepted and then sent to the printer.

How long does approval take in calendar time?

This approval lasted as long as the rewrite--two weeks.

The DA approval usually takes about two weeks for a 100-page document. One person is assigned to a single document. If the document needs to be returned to the person in charge, it usually remains there for a few days. It is then returned to DA where the printer packages are made ready, and this usually takes another two or three days.

About how many hours of person-time does approval take?

The "Murder Board" worked full time plus some weekend time.

One person working full time on a 100-page document does the first editing pass at DA in about two weeks (10 working days). The final proofing and preparation usually takes about two to three days.

Government Security Classification 7c2d

Is the document wholly or partially classified?

No.

Appendix
AFM 66-1

Are publications specialists involved in production of this document? If so, at what point? Describe briefly the flow between the author's organization and the publication specialists. 7c2e

The publications specialists at this point were the editors. They formatted the volumes when the authors were ready to see the formatted copies. Once the authors had finished the final changes, the editors ran the final format and generated a table of contents that needed to be approved by the authors. When all the changes were made, the editors had to make the files ready for COM production. Often the authors worked closely with the editors. They were interested to see what the editors were doing since many had no previous computer experience. Several times an author would sit next to an editor and together they would make changes online.

Up until the final changes were made, a master log was kept by the "Murder Board" as well as posted on the blackboard. This showed the stage of each chapter. A special place was reserved for drafts that the editors had completed. They were clearly marked so that changes were not entered twice.

Is there cost accounting for time and materials used in producing the document? How is it done? 7c2f

None to my knowledge.

Is there a schedule from authorization to approval? From approval to dissemination? If so, what is the schedule? 7c2g

The schedule that was established for the rewrite was that all the authors should complete their work during their two week stay at Gunter. After that, reasonable schedules (a few weeks to a month or two) were estalished for the editors to finish up their work, make COM takes, and have the final proofs delivered to the Pentagon. This schedule was changed because DA decided that there was too much white space between words, and then all the volumes had to be run through the format and COM process again.

Style 7c3

Are there illustrations? If yes, characterize them briefly, i.e., do they include half tones, charts, logic diagrams, perspective drawings, graphs, or other forms? 7c3a

This manual has illustrations that were prepared on mats and inserted into the document just before printing. The illustrations were hand drawn forms, samples of printed forms, computer printouts, tables, graphs, and charts. Even though NLS was being used to produce the text, the illustrations were produced in the usual manner. Most of the decisions about the illustrations were made at the Pentagon before the rewrite began. The actual graphics work was done at Gunter during the rewrite period. Specific arrangements were made with Gunter so that graphics people would be available for work.

Before the final COM tapes were made, the person in charge met with the editors and reviewed the illustrations. He informed them as to the space needed for each illustration and where each was to be located. The editors then formatted the files so that the right amount of space would be left.

Does publication require any ancilliary information about the illustrations, e.g., catalog numbers or approval for publication?

The "Murder Board" also approved the illustrations that were to be inserted.

Tables? 7c3b

Some tables were treated as other illustrations. They were produced offline and inserted during printing. If a table was really columnar material and did not require any special lines, it was produced online using NLS.

Is the document printed with proportional spacing or monospaced (like typewriter priniting)? 7c3c

The document was printed through COM with mostly proportional spacing. The paragraph numbers were monospaced.

References? 7c3d

Some references were made from one volume to another, or within one volume.

Bibliography? 7c3e

None.

Math? 7c3f

There were some mathematical formulas and most of them were simple enough to be inserted using NLS.

Is there an established or semi-established page format? If yes, describe it. 7c3g

There was a very specific format used. Headers contained the manual name, volume number, effective date, date of publication, and page number. No footers were used except on the first page of the Table of Contents. Paragraphs were numbered and lettered according to Air Force Standards. First lines were indented according to level and all subsequent lines were flush to the margin. Two columns were used. No footnotes or bibliographic references were included. A Table of Contents was automatically generated for each volume.

The font varied between 10 point (for headers and chapter titles) and eight point (for the body of the text). Originally, the volumes were printed in 10 point, but the final proofers decided that there was too much white space, so they redid all the volumes in eight point.

Are covers required? Endpapers? If yes, describe them briefly. Are they forms? 7c3h

No covers were required, but the first page of the Table of Contents was in a format

Appendix
AFM 66-1

different from subsequent pages. It had a special header, footer, and introductory paragraph. The footer described who was responsible for the document, what document it superseded, and what the distribution was.

Are characters outside ASCII required? Desirable? 7c3i

No.

Production Processes 7c4

How often is the text substantially reptyped and at what points? 7c4a

No text was substantially retyped once it was all online.

How often are paragraphs or larger units moved around in the document, and at what point? 7c4b

During the first week of the rewrite, entire paragraphs rewritten and/or moved around. When a paragraph was longer than 2000 characters, it was rewritten to make it shorter.

How often are many words, phrases, or headers in the document altered, and at what points? 7c4c

Throughout the entire rewrite, words and phrases were rewritten. Global substitutes were also performed to change things throughout an entire chapter.

How often and when is the document proofed (by "proofed" we mean one draft compared word by word for conformity to another draft)? 7c4d

The authors often kept old drafts so they could check to see the corrections were made properly. There was never a complete proof done.

How often and when is the document copy-edited (by "copy-edit" we mean someone checking for errors such as typos, spelling, grammar, non-conformity to style, etc.)? 7c4e

Every time the authors received a new draft, they copy-edited it to some degree. Before the final format was run, the Modify subsystem was run to check for correct spacing after punctuation. Global searches were done to help check for spelling errors.

Printing 7c5

How is the final version printed? 7c5a

The final version was printed by DA from the camera-ready COM proofs they received. They contracted out to a printer.

How many words long is the final version? 7c5b

We don't know how many words. The entire manual, all 12 volumes, is about 1500 typewritten pages.

Who does the layout? 7c5c

Appendix
AFM 66-1

The layout was done by the editors before the final camera-ready copy was generated. The editors left the appropriate space for the figures and tables, and these were put in by hand. DA received the final proofs, the figures, and tables. DA actually puts together the final package that goes out to the printer.

Who does the final proofing and in what medium? 7c5d

DA did the final proofing from the COM final proofs they received. Normally, DA does a proofing of the writing and sends the corrections back to the officer in charge. In this case, however, DA only proofed the final camera-ready copy.

How long does printing take in calendar time? 7c5e

DA estimated that the printing process takes about three weeks. The final packages are contracted out to printers.

About how many hours person-time does it take? 7c5f

Don't know.

Distribution and Life Cycle 7c6

How many copies are distributed? 7c6a

Don't know.

Is there a distribution list? 7c6b

An Air Force distribution center in Baltimore issues a document that announces to all the bases which publications will be issued in the near future. Each base responds with a request for a certain number of copies. The bulk of the copies goes to this center and is then distributed.

Is access limited? 7c6c

Access is limited to those who request copies.

Are updates distributed? 7c6d

If a document is to be rewritten, then distribution is determined by the number of requests received.

Change pages have never been issued for AF 66-1. There are provisions to handle them, and if there was a need, they would be distributed to those who had requested copies the first time.

How long does distribution take in calendar time? 7c6e

Several months.

About how many hours of person-time does distribution consume? 7c6f

Don't know.

Does each document have a control number or equivalent? In the context of some larger cataloging system? 7c6g

Appendix
AFM 66-1

The Manual number, AFM 66-1, is the control number.

Are the authors, approvers, or publication personnel involved in cataloging? 7c6h

Don't know, but probably yes.

Are updates cataloged? 7c6i

Don't know, but probably yes.

Is any known cataloging of the document based on an online system? If so, is a special data format required for that system? 7c6j

Don't know.

Online Use 7c7

Is the document read online? 7c7a

No.

Do personnel involved in production have access to an online sytem? 7c7b

Authors. The authors had access through the editors in that no authors were trained to use NLS. Since the rewrite, the person in charge has had access to the document and has used NLS to do content searches and to make some minor changes.

Typists: The typists used Mag Cards to insert the original text.

Editors. The editors used NLS to make all their changes and to format the chapters. They had access to both TNLS and DNLS and a graphics terminal to do the proofing.

Illustrators: No.

Do personnel involved in production have training in use of an online system? 7c7c

Authors: No.

Approvers: No.

Typists: The typists who inserted the original text had a small amount of NLS training.

Editors: Yes, extensive training in NLS.

Illustrators: No, the illustrators worked offline and submitted their final products to the approver who told the editors how much space to leave for the illustrations.

Do personnel involved in production use an online system? 7c7d

A: Authors: Some authors sat next to editors and told them about changes while the editors made them.

Approvers: Sometimes the approver also worked with an editor to make changes directly online.

Typists: The original typists entered the text using Mag Cards.

Appendix
AFM 66-1

Editors: The editors made all their changes using NLS.

Illustrators: No.

Linkage to Other documents 7c8

Does this document require cross-references to other documents? 7c8a

The different volumes in AF 66-1 reference one another. Often references are included in a particular manual and the authors doing the rewrites had to ckeck these references. An effort was made to rewrite all volumes that reference each other at the same time. There was no online linking from one document to another when references were made.

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