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INITIAL CONCEPTUALIZATION AND CHARACTERIZATION OF A NAVY AUTOMATED PUBLISHING SYSTEM

Volume 2: Technical Report

January, 1980

Prepared Under Contract Number N60921-79-C-0106

for

Naval Surface Weapons Center
White Oak, Silver Spring, Maryland

by

Norman Nisenoff
Audrey Clayton

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OF A
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This report describes an R&D study whose objective was the characterization of an automated publishing system for the Navy which could be introduced during the early 1980s and evolve incrementally to meet by the year 2000 the Navy's needs with regard to the publication of all non-tactical information. Both the methodology and the conclusions of the project are included in the 3-Volume report, together with recommendations for Navy actions to develop and test further the concept of such a system.

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FOREWORD

This report is submitted to the Naval Surface Weapons Center (NAVSWC) in compliance with the requirements of Contract Number N60921-79-C-0106 under which Forecasting International, Ltd. (FI) has studied the potential of advanced technology to assist the Navy Publications and Printing Service (NPPS) in the fulfillment of its mission. The project was funded by the Naval Supply Systems Command (NAVSUP) under the auspices of its Automated Graphic Sciences (AGS) program. The intent of the study was to conceptualize an automated publishing system for the Navy which could be introduced during the early 1980s and evolve incrementally to meet the Navy's needs, with regard to information designated for publication, by the year 2000. The effective date of this contract was February 15, 1979. See Appendix A for administrative project history.

ABSTRACT

There are many inadequacies in current Navy printing and publishing capabilities, and potential for improvement is offered by rapidly advancing computer and communications technologies. This report details the findings of a research and development program conducted by Forecasting International Ltd. to provide the Navy Publications and Printing Service with an automated system concept to address these shortcomings.

The Navy Automated Publishing System (NAPS) concept here described is intended to be introduced initially in the early 1980s, and evolve incrementally to meet, by the year 2000, the Navy's needs with regard to the publication of all non-tactical information. This 3-volume report presents a description of the methodology employed; a review of Navy needs in this time frame; a detailed discussion of the state-of-the-art in pertinent technologies and a forecast through the period of concern; and a broad conceptualization of both the year 2000 system and the incremental steps for its achievement. Recommendations for Navy actions to develop and test further the concept of such a system are also included.

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SECTION 1

1. OVERVIEW

1.1 Introduction

In February of 1979, Forecasting International, Ltd. (FI) was awarded a contract from the Naval Surface Weapons Center (NAVSWC) to perform research and development to conceive and characterize a Navy Automated Publishing System (NAPS). The course and the outcome of this research effort are documented in this report. The members of the FI study team wish to emphasize certain points prior to the main body of the discussion; while these same issues are raised at various points throughout the text, they are liable to be overlooked or under-emphasized in the midst of our attempts to deal with such complex and wide-ranging topics.

- o The Navy Publications and Printing Service (NPPS), according to its current mission statement (Exhibit 1.1) is the cognizant authority for the management of Navy publication: the process by which information is packaged and made available to a public. The current study was charged with exploring the potential of advanced technology to assist NPPS in the performance of its mission. In fulfilling this task, the study team has necessarily considered a wide spectrum of issues, including evolving definitions of publication and associated terminology; the Navy's changing needs for published information; and the resources available to NPPS in meeting those needs.

- o While the prime thrust of this effort is to apply the resource of advanced technology to the fulfillment of NPPS' existing mission, that mission is already in process of redefinition. The evolution of this mission over the time period of concern (1980-2000) is inevitable and an important component of the NAPS concept.

- o A major study was previously commissioned, and is continuing, to design a Navy-wide system (NTIPS) for the preparation and presentation of Navy technical information. The NAPS project has made extensive use of valuable data collected and made available by the NTIPP study team, which were not available elsewhere. We wish to emphasize that the studies are complementary; NTIPP considers the life cycle of

EXHIBIT 1.1

NPPS MISSION AND FUNCTIONS

The Navy Publications and Printing Service acts for the Secretary of the Navy on publications and printing matters requiring his direct supervision, in accordance with public law, by serving as the Department of the Navy central publications and printing management service, responsible for the conduct of the Navy's publications and printing program controlling the development of materials to be printed or duplicated by conventional or microform methods, and the procurement, production, and distribution of publications and printing. In fulfillment of this responsibility, the Director, Navy Publications and Printing Service Management Office implements measures recommended by the Navy Publications and Printing Policy Committee, as approved by the Assistant Secretary of the Navy (I&L) and acts for the Department of the Navy on publications and printing matters before the Joint Committee on Printing, the Public Printer (Government Printing Office), the Office of Management and Budget, the Comptroller General, and the Department of Defense.

The Navy Publications and Printing Service functions as an organizational element of the Naval Supply Systems Command, under a Deputy Commander/Director, and consists of a headquarters staff and field divisions, offices, branch offices, and satellites, identified as appropriate under the supplemental provisions to the Navy Industrial Fund charter for the Service.

The Navy Publications and Printing Service is chartered by the Department of Defense, under the Chief of Naval Material and the direction and supervision of the Commander, Naval Supply Systems Command, and within regulations of the Joint Committee on Printing, to finance its operations under the Navy Industrial Fund. Within the provisions of the charter, the Service provides printing and related services and products for the Department of the Navy, for other agencies of the Department of Defense, and for other agencies of the Government. The Service is chartered to exercise control over and to coordinate Department of the Navy publications and printing work, and the performance of other functions necessarily incident thereto. The Service is chartered and authorized to bill ordering entities in proportion to services rendered for expenses incurred in administration of industrially funded printing plants, and in the processing of procurements from Governmental and commercial sources.

technical information, from content generation/acquisition to its delivery to the end user. NAPS has no concern with content; it addresses the input, preparation, mastering, replication and distribution, by whatever means, of non-tactical information packaged for publication, of which technical information is only a subset.

- A natural consequence of the introduction of advanced technology in the accomplishment of any task is ultimately the expansion of capabilities. The automated publishing system concept presented in this document, and its interface with other existing and projected Navy information systems, will offer to the Navy the potential of information resource management over and above the responsibilities of NPPS.

- A systems concept for the automation of Navy publication is presented in Section 5 of the technical report. Of equal importance, however, is the identification, in Section 6, of other research and data-gathering efforts essential to the strategic planning which must precede and accompany the complete specification, design and implementation of such a system.

- Publication problems cannot be considered in isolation, since attempts at their solution inevitably affect and are affected by the larger concerns of the Navy in the overall management of its information resources. Accordingly, in this chapter we will examine briefly the spectrum of developments which pertain to the Navy's needs for published information and its problems in satisfying these needs. The role of NPPS in this process will be addressed subsequently.

1.2 Problem Definition

Many trends have combined in recent years to make more difficult the task of fulfilling Navy needs for the timely, efficient and effective provision of printed and published information. Some of the problems encountered in this area, as identified by the study team from numerous reports and discussions with Navy personnel, are summarized in Exhibit 1.2. These are not unique to the Navy, nor to the Federal government, but many of them are most apparent in this context. For example, in the production of print-on-paper, one

EXHIBIT 1.2

EXAMPLES OF NAVY INFORMATION-RELATED PROBLEMS

Volume/Diversity of Information

Increased production of print-on-paper
Increased diversity of media (e.g. paper, microform, electronic display)
Lack of standardization (forms, other documents)

Cost of Information Dissemination

Labor costs
Material costs

User-Data Match (primarily technical)

Increased sophistication of weapons systems and ancillary equipments combined with reduced education level of recruits
Increased turnover of uniformed personnel
Delays in updating cycle
Lag-time between delivery of hardware and delivery of technical documentation

estimate[1] is that more than $100 billion a year is spent in the U.S. on Federal paperwork, almost half of this figure by the Federal Government itself.

Largely as a result of attempts to reduce the growth rate of document production, there is within the Navy and elsewhere a marked trend toward the use of audio-visual media, microform and soft display, which diversity exacerbates the problems of control and retrieval, and emphasizes the need for establishing standards -- also a responsibility of NPPS.

In parallel with the increase in quantity, per item costs of publication and dissemination are spiralling due to costs of labor and material. There is also growing concern about the depletion of our paper supply, as one aspect of increased national awareness of our natural resources.

At a more specific level, NPPS and its customers are concerned over such factors as the turnaround time in fulfilling requests for printing; the lack of interface with users' word processors where material is originated; the poor quality of printing procured commercially; the enormous paper wastage resulting from discarding poorly composed copy, and also from unnecessary replication of forms/documents, etc.; the lack of skilled personnel to implement new technologies, and budgetary limitations which act to impede the improvement of in-house printing and publication capabilites. Many of these issues have management connotations, and this aspect also will be addressed in subsequent subsections.

In seeking a solution for these problems, it is essential to bear in mind that the basic concern of NPPS, as of any publisher, is ultimately the provision of information to multiple users. They are not interested in content <u>per se</u>, but rather in delivering to their many and varied customers, in as timely, convenient and inexpensive manner as possible, the particular information package or item needed in any specific instance. Thus the focus should be on the provision of information rather than the provision of a document. While technology can assist the "conventional" publication process,

[1] Citations and other footnotes will be found at the end of the corresponding major Section.

and indeed is already widespread in the printing and publishing industry in various manifestations, it is of more value to the present study to consider the more general situation of the potential contributions of advances in technology to the ultimate goal of information transfer. As is the case with many technological innovations, we will find that following this course will not only increase the capability of NPPS to accomplish its existing duties and objectives with greater efficiency and effectiveness, but will simultaneously allow the provision of services and capabilities not otherwise feasible or cost-justifiable.

In approaching this task, there are two issues of paramount concern: the explosion of information in the post-industrial societies in general, and specifically the Navy in the context of the present study; and the increasing technological advances which are forcing us to reconsider the definitions of such terms as printing and publishing. In the following subsection, we will discuss these issues, and thereby establish a context for an evolving concept of the role of NPPS in fulfilling its basic mission of providing printing and publishing services to the Navy in the most efficient manner.

1.3 Background

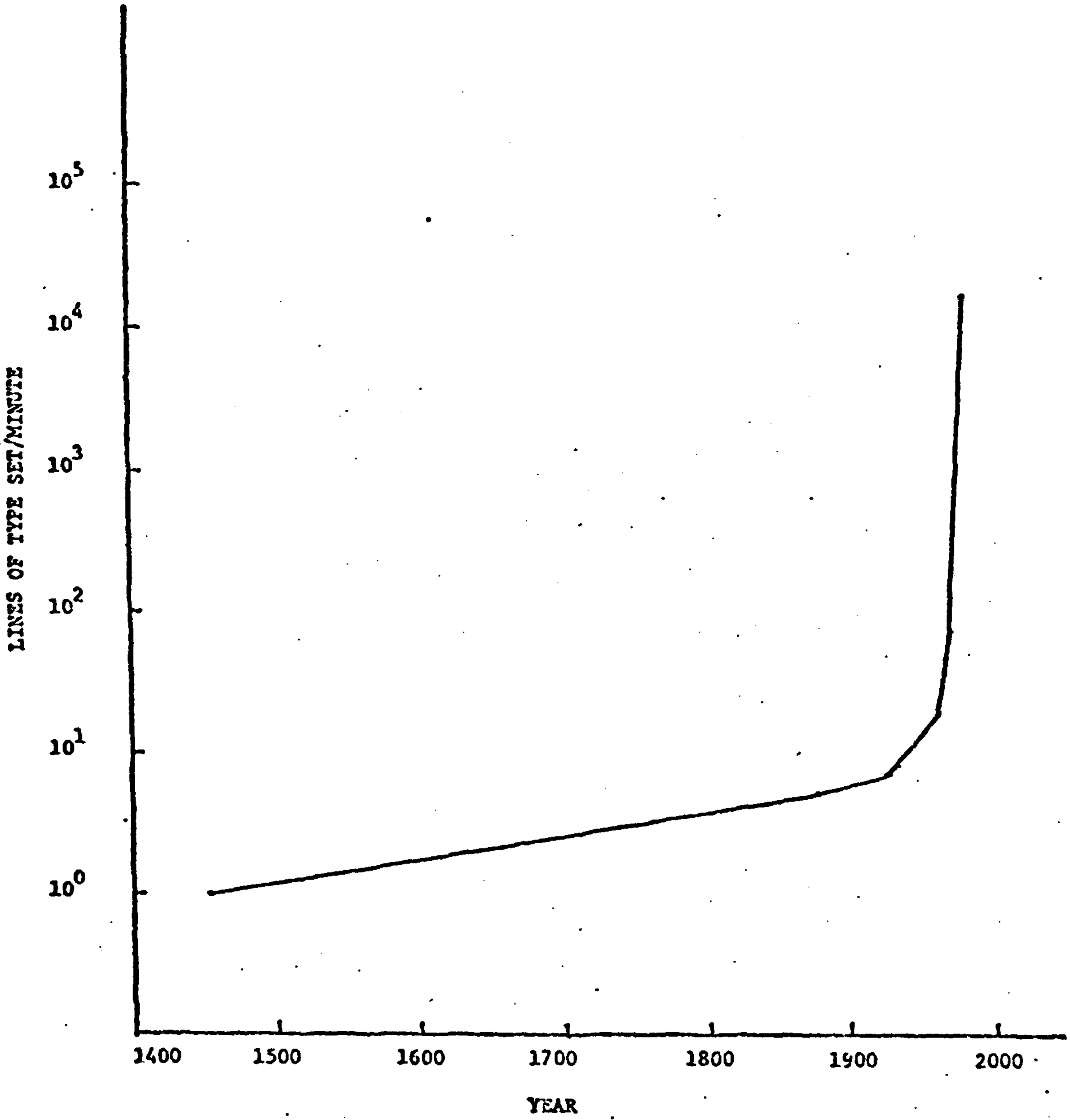
"The Information Explosion" is an expression with which we have all become familiar in recent years. While the exponential rate of growth identified by de Solla Price[2] in 1962 applies specifically to scientific publications -- the output of scientific and technical information in 1970 was variously estimated as 20 to 50 million words per day[3] -- the phenomenon is all pervasive. A typical university library of the 1970s may double its three million volumes within 15 years, and treble its cost.[4] The Yale University Library, if it is to remain current, will have by the year 2040, 200 million books, occupying over 6,000 miles of shelves; if it were to continue its use of card catalogs, by then there would be 750,000 drawers, requiring 80 acres of floor space.[5]

This exponential escalation in the amount of information being generated, distributed and stored results in greatly increased complexity and cost of information resource management. In the 1977 report of the Commission on Federal Paperwork, previously cited,[1] it was estimated that $100 billion per year is spent on information/paper generation and dissemination in response to Federal requirements alone, $43 billion of this total by governmental agencies. While deliberate efforts are being made to reduce this figure -- the goal is 20% decrease per year -- no effects have been identified to date. The response of the Office of Management and Budget to these recommendations is to focus on the need for better coordination and management by the Government of all its information sources.[6]

In 1440 A.D., Gutenberg combined several different technologies to produce, for the first time in Europe, a printing press with movable type. Thereafter, typesetting capabilities improved very slowly until the early years of the present century when the number of lines cast per minute rose from 5.6 to 15,000 within a span of 35 years (See Exhibit 1.3). However, the ability to produce copies, once the type was set, increased dramatically as labor-intensive processes were superseded by mechanization. Following the automation of paper production in 1798, Koenig's invention of the steampress in 1811 escalated the output by a factor of 20 or more while decreasing costs by about 25%.[7] In 1808, the hand press could produce about 300 sheets an hour, while by mid-century British and American presses were turning out twenty thousand impressions (10,000 sheets) per hour.[5] This increase in capabilities only compounds the problem, by making it easier and faster to produce more. Certainly the implication of the trend in Exhibit 1.3 is that speed is no longer the limiting factor. The very technologies which make information simpler to generate, reproduce and disseminate at the same time compound the problem of indexing, updating, storage and retrieval, and of recognizing and selecting that portion of the mass which is truly useful and desired at a specific time for a particular purpose. The National Science Foundation has suggested "that the limits of what can be communicated by printing, mailing, storing and retrieving pieces of paper may be at hand. Certainly, for any real improvement in the accessibility and usefulness of information, an alternative must be found."[8] Various experts view as a normal,

EXHIBIT 1.3

NUMBER OF LINES OF TYPE SET/MINUTE



Data Source:

Bagdikian, Ben H., The Information Machines: Their Impact on Man and The Media (New York, N.Y.: Harper & Rowe, 1971).

inevitable evolutionary process the large-scale replacement of print-on-paper by electronic media, continuing advances in computer science and communication-technology making feasible a global system in which many items of information are composed, published, disseminated and used in a completely electronic mode.[9] Where paper is still the medium of choice, the capability now exists for producing copies on demand, reducing the burdens of document storage and the costs of producing copies which are ultimately unused.

With the advent of advanced technology, the necessity for reviewing and revising the interpretation of terms such as "printing" and "publishing" has given rise to considerable concern at various levels of government and industry, ranging from labor unions to the U.S. Congress. The struggles of the National Commission on New Technological Uses of Copyrighted Works (CONTU) to extend copyright protection to non-print media helped to highlight the onset of a new era in information dissemination. Another manifestation of this concern are the current deliberations of the Joint Committee on Printing (JCP) relating to the revision of Title 44 of the United States Code. A specific question being addressed by the JCP is "what constitutes printing?" Existing legislation has not defined this term, nor has the need to do so been previously apparent. However, it is felt that its traditionally accepted interpretation has not kept pace with technology, and fails to accommodate recent developments. There is no longer necessarily a clearly distinguishable process called "printing" in the flow of information packages from generator to user.

The publishing cycle is also being affected by the trend towards capturing more original input data at the author's location, and by machine reading/manipulation of pre-existing materials. The ability to capture and edit original keystrokes at their source, the use of micrographics, video terminals for data retrieval, and the capability of automated composition of publications from centralized full-text data bases offer the potential of reduced cost and improved quality, reliability and promptness.

In a presentation to the Ad Hoc Advisory Committee to the JCP, a representative of industry[10] stressed that electronic storage should be regarded as an integral component of the printing process because the formatting and production of output from this medium is a logical adjunct to the printing process. During the same hearings, Mr. Ohrbach of the National Technical Information Service pointed out the trend toward fully integrated systems, and the danger that continued focusing (of the JCP) on individual processes or "black boxes" introduces the danger of sub-optimization. Mr. Horton of the Library of Congress also recommended that the focus of JCP deliberations be shifted from documents (containers) to information itself, an attitude shared by Ms. Hoduski of the JCP staff. She stated in the hearings that Title 44 started out as an "information" law and that it must be looked at in historical perspective, keeping the 21st Century in mind rather than the 19th.

We have quoted these various experts not to imply that this viewpoint represents a consensus or majority opinion, but rather to show that these questions of interpretation and expansion of purview are being addressed, and to establish a basis for our own approach.

Rapid strides are being made in the communication of information (via digital techniques) and the application of computer technology to typesetting and printing functions. Concurrent with the rapidly improving technological capability being provided by the communications/computing industry, costs have decreased at almost a commensurate rate. Thus, the application of such high technologies as digital communications and data/information processing technology to the Navy's publication needs becomes more and more attractive.

Coupling the consequences of these computer/communications trends with the fact that labor costs are increasing and the productivity of the individual office worker is remaining at approximately the same level (See Section 3, following), it is natural and urgent to explore the benefits and costs which may accrue to the Navy from the implementation of a nationwide communication/processing system to accomplish its publication functions.

1.4 Concerns of NPPS

Our discussion thus far has been at a level of generality dealing on the one hand with "information overload" affecting the nation at large and the Navy in particular; and on the other with the imprecision of the terms "printing" and "publishing" introduced by technological advances. These concerns are certainly shared by the Navy Publications and Printing Service, but there are also more sharply focused issues which must be addressed and decisions which must be taken in the near future in order to develop a coherent, coordinated, time-phased plan to improve the efficiency and effectiveness with which it fulfills its primary responsibility: the conduct of the Navy's publications and printing program. This program encompasses the acquisition of the initial information package, and subsequent production and dissemination of Navy information designated for publication, and includes the control of materials development, procurement, replication and delivery pursuant thereto. A draft charter revision, shortly to be considered for NPPS,[11] refers to its provision of replication and dissemination services for published information, regardless of the media involved, for the Department of the Navy, for other agencies of the Department of Defense, and for other agencies of the Government. Thus the concerns of NPPS are those common to all these bodies, as previously discussed, plus those publications-related problems specific to individual Commands, such as the administrative burden of the fleet which is closely related to paper production. A corollary of this linkage is that increased efficiency of NPPS, as reflected for instance in reduced cost per copy, is of benefit to all those it serves: CNET, currently limited by appropriation ceilings to producing only half the desired number of training manuals, would benefit from a reduction of 10% in cost per copy by being able to produce roughly 120 additional manuals (or to distribute 900 more copies of current manuals), based on 1976 production levels.[12]

With the escalation in the <u>production</u> of printed materials, there has been a concomitant increase in the rate of obsolescence. According to one estimate,[13] the Navy Publications and Forms Center (NPFC), for example, throws away several million pages per year for this reason (4-10 million pages of warehouse controlled documents) -- a persuasive argument towards the use of alternative approaches such as a policy of printing-on-demand. A related issue which has received considerable Navy-wide attention over the past few years is the serious deficiency in technical information accompanying hardware systems in the Fleet. This has been the thrust of a major program (NTIPP), previously mentioned, to coordinate the preparation and presentation of Navy technical information. However, this category, based on printing charges, constitutes only about 8 1/2% of Navy publication (or 17% if office related reprographics are excluded.[14]) The aim of NPPS is to develop an automated publishing system for the Department of the Navy which encompasses all types of non-tactical information designated for "publication", i.e. intended for multiple users. Such a system must offer to its users the following capabilities:

- interfacing with information generators within and outside the Navy, to accept or produce information packages in various media and formats;
- offer services designed to meet the information needs of an extremely broad spectrum of users, ranging from recruiting materials to requisition forms to technical manuals;
- facilitate the needs of the user to maintain that information in up-to-date form.

A major factor in the the success of such a system, and in the effective application of techhnology, is the development of economic and efficient government-wide standards of form and format applying to all appropriate publication media. This task, in so far as it relates to Navy publications, is also the responsibility of NPPS.

While the primary concern of this R&D study is with the application of advanced technology to the design of a system with these capabilities, it is essential to consider also the management and other constraints which affect the context in which the system must operate. These include such factors as:

- JCP regulations which currently require that preference be given to the outside procurement of printing services wherever feasible;
- the need to maintain an in-house publication capability for wartime contingencies;
- classified publications must be produced internally;

- high priority, fast turnaround materials must be produced internally;

- funding of NPPS through the Navy Industrial Fund.

In general these considerations are not anticipated to change, although it is possible that the first, in its objective of providing support to private industry, could be modified to require feeding different sectors of that industry. The potential evolution of factors such as this which influence the NPPS mission and its consequent tasks is further addressed in Section 2.

1.5 Overall Approach

Within the current study, the approach taken toward the design of such a Navy Automated Publishing System (NAPS) is summarized in Exhibit 1.4. Several of the component tasks were undertaken concurrently, so that the flow of this discussion may not parallel exactly the order in which the major activities are listed in that Exhibit.

An initial requirement of any planning process is the explicit or implicit visualization of that portion of the future environment which is relevant to those plans. Planning to meet the Navy's future information publication/distribution needs necessarily involves some kind of forecast of the type and extent of those future needs, and the technological, financial and human resources which will be available for their satisfaction.

As part of the process of determining requirements, questionnaires were designed and distributed to NPPS Division and Field Directors worldwide, soliciting their inputs to the process of prioritizing NPPS mid-to-long range goals. This task is discussed in detail in Section 2. However, in defining the necessary capabilities of such a conceptual system as NAPS, the needs of the wide spectrum of users must also be considered. Current and anticipated future Navy requirements for the publication of non-tactical information were explored by extensive review of existing documentation (see bibliography) supplemented by discussions with various representatives of NPPS and other Navy facilities in the Washington area and elsewhere.

A forecast of technologies pertinent to printing and

EXHIBIT 1.4

DESIGN CONCEPT

Assessment of current Navy publication needs and NPPS objectives;

Anticipation of year 2000 Navy publication needs;

Review of the state-of-the-art in applicable technologies;

Forecast of year 2000 capabilities in applicable technologies;

Conceptualization of year 2000 system capable of filling projected needs;

Development of nested set of systems to ensure a smooth transition from 1980 to 2000 utilizing evolving technological capabilities;

Identification of critical points in the achievement of the conceptual system;

Analysis of implications for Navy planners.

publishing functions was performed, starting with the substantial FI data base resulting from earlier studies,[15] expanding and updating as appropriate to the specific NAPS application. The major areas included in this forecast were:

- computers
- storage
- terminals
- networks
- software
- communications
- printing and publishing.

A partial listing of trends examined in this last category is included as Exhibit 1.5. The complete forecast is provided in Appendix B.

In conceptualizing a normative system goal for the year 2000, the study team utilized its accumulated technological expertise and awareness and the forecast just described, supplemented by:

- briefings and documentary information on various existing Navy research projects (especially NTIPP), requirements studies and planned implementation of pertinent new capabilities;

- discussions with NPPS management personnel concerning trends in shore and fleet requirements for publication;

- briefings from fleet support authorities at NPPSMO and at NPPSO, Norfolk, supplemented by visits to USS Nimitz (CVN-68) and USS John King (DDG-3) to survey existing conditions and obtain individual perceptions;

- visits to industrial innovative publication efforts to view sophisticated text processing systems and advanced automated equipment (e.g. Circle Graphics, R. R. Donnelley);

- visits to various governmental and industrial sites in the U.S/U.K. to examine and discuss implementations of "leading edge" information distribution techniques and networking concepts. (For example, IBM and IDC in the U.S.; ITV, BBC, the Post Office and the British Library in the U.K.)

As a consequence of the amalgamation of the insights thus

EXHIBIT 1.5

SUBSET OF TRENDS EXAMINED PERTAINING TO PRINTING AND PUBLISHING

Costs of composition and recording

Wage rates

Paper costs

Substitution of soft for hard copy media

Introduction rate for new typecasting techniques

Costs of paper vs. microfiche copies of reports

Number of lines of type set per minute

Number of hard copy pages produced

Number of soft copy pages produced

Percentage of total business demand for hard copy which could be satisfied by electronic printers

Percentage of characters-plus-graphics in all copies produced on electronic printers

Percentage of electronic printers accepting hard copy input

Of those electronic printers accepting hard copy input, percentage able to transmit electronically to similar devices

Percentage of copy volume on electronic printers produced by laser xerography obtained, an initial outline of the year 2000 system was developed, and is described below in subsection 1.6. A series of logical evolutionary transitions was then defined, working backwards from this design goal, covering the approximate periods 1995-2000, 1987-1995, and 1980-1987. This process of phased component introduction/conversion (referred to as "nested systems") incrementally bridges the gap between the present status of the Navy publications and printing program, and the year 2000 concept. Implementation of such a strategy enables the Navy to achieve maximum benefits in support of both fleet and shore establishments from advancing technology, minimum disruption of existing organizational structure, and optimum effectiveness and use of funds.

Previous in-house studies and a number of alternate sources were also consulted for events which may potentially affect developments in these categories (see Appendix C for methodological details). Those events considered by experts to be of high probability of occurrence in the next twenty years were time-sequenced into series of "event-trains" and their impacts upon the projective trends examined. (See Section 5). Some of the anticipated advances of potential application during this period are indicated in Exhibit 1.6.

Key events thus identified were examined in terms of opportunities for strategic intervention: for example, changes of research focus and/or of funding levels which could significantly affect the direction or timing of system evolution. This in turn permitted the preliminary outlining of areas to be addressed by an R&D program for the overall NAPS undertaking (see Section 6). Specific definition of such R&D projects must await more rigorous establishment of requirements data.

1.6 Year 2000 Concept

The optimum solution to the Navy's non-tactical information needs in the year 2000 appears to involve a major shift toward the complementary concepts of "demand printing" and soft display. Key features of the proposed system concept are:

- a global system of distributed data bases, access points and processing capabilities;

EXHIBIT 1.6

EXAMPLES OF POTENTIALLY RELEVANT TECHNOLOGICAL ADVANCES

PRESENT	Word Processors
	Laser Printers
	Fiber Optics
	Video Disks
	Computer Control
	Satellite Relays
	Updatable Film
1985-90	Bubble Memories
	Holography
	Very Large Scale Integration (VLSI)
1990-2000	Image Transmission and Processing

- utilization of a global communications network within which NAPS will be embedded;
- existence of a "meta-system" for monitoring and accessing performance data and aggregated information;
- interface with existing and planned Navy-wide data bases, facilities and communications links.

Thousands of users at the operational level would have access to appropriate subportions of the system in both real time and batch mode, and the system would adapt to the (stored or deduced) profile of user sophistication to provide interactive or pre-programmed services at an appropriate level. These users would not know, nor would they need to know, whether local or remote data banks or processing capabilities were being utilized to satisfy their needs, nor would they be aware of priority sequencing or time sharing aspects. Protocols, linkages and security/confidentiality/privacy protection would be provided by system software.

Communications within buildings or adjacent facilities would be via dedicated broadband channels, possibly fiber optic cables. These local networks would exchange information by various paths through a rich communications environment which provides time-shared telecommunications links (satellite, microwave, radio, digitized phone lines) between facilities afloat and ashore throughout the world. System management and monitoring would be accomplished via a superimposed meta-system capable of interfacing NAPS with management information systems in order to produce scheduled and on-demand usage reports for authorized users, as well as accurate, up to date information for Navy senior management decision makers.

The system would have audio/visual/tactile input sensors and multi-media processing and hard/soft output capability. Direct (non-digitized) image input, processing, storage, transmission and display, with 3D capability, are expected to be available by the year 2000. Information delivery in any medium can be on a scheduled or on-demand basis, but for "single-shot" uses, such as provision of instructions for a specific on-site repair job, the preferred mode of operation would be ephemeral presentation. Paper copy would be supplied only if environmental or other constraints made this the medium of choice; it would not be used routinely because of the burden of tracking and updating, and (in conflict situations) its vulnerability to capture. Throughout the development of the broad system concept, the entire spectrum of conflict possibilities was considered, from total peace to all-out nuclear warfare, with the consequent implications for availability of communications channels, variations in message priorities and dependence upon on-site information sources.

Given the variety of applications and virtually unlimited quantity of data which could be retained in such a distributed system, functions such as purchasing, stocking and resupply are easily assimilable, as well as the production of anticipatory forecasts of equipment/supply budgeting requirements.

We believe that by the time period toward which this effort is targeted, the state-of-the-art of securing classified information will have advanced to the point where a global network with secure subnetworks will be militarily viable certainly for non-tactical applications. Should this still not be acceptable, for whatever reason, the options remain of having a single totally secure network, or twinned systems without telecommunications interfaces between sensitive and non-sensitive subnetworks. In any case the meta-system would be totally secure.

1.7 Summary

The foregoing discussion has attempted to provide an outline of the project in terms of the problems to which it seeks to respond, the approaches employed, and the type of solution which is recommended. In subsequent sections this skeleton is buttressed by more detailed accounts of the process by which the study team determined the desirability, structure and feasibility of the Navy Automated Publishing System concept outlined in this report.

In Section 2, we describe the method by which the study team addressed the issue of determining NPPS goals and objectives within the time-frame of this particular planning activity, and the results achieved in terms of perceived priorities and foci of attention. This leads to the consideration, in Section 3, of what the Navy's problems will be over the next 20 years relative to the processing and distribution of non-tactical information.

A review of printing and publishing practices, and a forecast of pertinent technological capabilities for this time-frame are provided in Section 4. This is based on detailed accounts of established trends and predicted breakthroughs in a broad spectrum of disciplines, as well as a more general review of the industries involved, in various areas of data processing and communications, which are included in Appendix B.

Section 4 also synthesizes these various components: NPPS goals, Navy needs, and potential technological capabilities, and examines the implications for an overall system concept. This system is described in Section 5 as perceived for the year 2000, together with the series of interim implementations which span the gap existing between this normative goal and present practice.

The final section of this main technical volume consists of a detailed explanation of the conclusions and recommendations of the study team, based upon the data thus far developed, and sketches to the extent possible the outline of a proposed program for the Navy. This outline points out the need to address such issues as the future roles of NPPS and NPFC; to obtain requirements data needed to define the NAPS R&D program; and suggestions for appropriate facilities/sites/applications to serve as testbeds for implementation strategies.

Additional details of the methodology, together with a bibliography and administrative history of the project, are also provided in the set of Appendices, separately bound as Volume 3 of this report.

1.8 Citations and Footnotes

1. Final Summary Report: A Report of the Commission on Federal Paperwork (Washington, D. C.: USGPO, 1977).

2. de Solla Price, Derek J., Science Since Babylon (Yale University Press, 1962).

3. Saunders, W. L., "Economic Success: The Contribution of the Information Scientist", The Information Scientist, Vol. 2, No. 3 (1969).

4. Dunn, O.C., W.F. Seibert, and J. A. Scheuneman, The Past and Likely Future of 58 Research Libraries; 1951-1980, (West Lafayette, Indiana: Purdue University, 1965).

5. Bagdikian, Ben H., The Information Machines: Their Impact on Men and the Media (New York, N.Y.: Harper & Rowe, 1971).

6. Better Information Management Policies Needed: A Study of Scientific and Technical Bibliographic Services. Report to the Congress by the Comptroller General of the United States, PSAD-79-62, U.S. General Accounting Office, August 6, 1979.

7. Senders, J. W., C. M. B. Anderson and C. D. Hecht, Scientific Publication Systems: An Analysis of Past, Present and Future Methods of Scientific Communication PB-242 259 (Springfield, Va.: NTIS, June 1975).

8. National Science Foundation Request for Proposal 75-136: A Systems Analysis of Scientific and Technical Communication in the United States (Washington, D.C.: National Science Foundation, August 14, 1975).

9. Lancaster, F. W., Toward Paperless Information Systems (New York, N.Y.: Academic Press, 1978).

10. Dr. Nelson R. Eldred, Management of Techno-Economic Forecasting at the Graphics Art Technical Foundation.

11. NPPS Mission and Functions Statement, Draft Revision, July 1979.

12. An Automated Publishing System for the Naval Education and Training Command, TAEG Report No. 50 (Orlando, Fla.: Training Analysis and Evaluation Group, October 1977).

13. Baseline Description and Analysis of Operations of the Naval Publications and Forms Center (Draft), Sterling Systems, Incorporated, under Contract #N00167-78-C0101, March 12, 1979.

14. Discussion with James L. Cherny, Director, NPPS, April 19, 1979.

15. For example, see Nisenoff and Clayton, A Forecast of Technology for the Scientific and Technical Information Communities - Four volumes (Forecasting International, Ltd., 1975).

SECTION 2

2. NPPS GOALS AND OBJECTIVES

2.1 Definition

In the context of this study, we use the term "goals and objectives" in a very broad sense, taking into consideration:

- o the dominant focus of the project, which is to examine the feasibility of a "totally new nationwide communication/processing system for the generation, production and distribution of technical and training manuals, forms etc. for the U.S. Navy";[1]

- o the current mission and functions of NPPS, as determined from discussions with NPPS management personnel and from reading the original orders and directives establishing the Service and defining its charter and responsibilities;

- o detailed objectives appropriate to NPPS as determined again by discussions with individuals at NPPSMO, and from reviewing management briefs and reports and a wide variety of other documentation describing the provision of actual or contemplated services to the Navy afloat and ashore;

- o the overriding CNO objective to reduce administrative burden to the fleet.

2.2 Prioritization of Objectives

The goal of NPPS is the provision of responsive services in support of its charter as the Navy's publications and printing service. There is no existing set of defined objectives by which NPPS seeks to meet this goal. Based upon the sources mentioned above, and in an iterative fashion entailing comment by members of NPPSMO, an unofficial set of internal objectives pertinent to NPPS in the context of this project was developed by the study team and is shown here as Exhibit 2.1. This list was incorporated in a questionnaire (see Appendix D) which was distributed to NPPS Division Directors and Office Directors worldwide, soliciting their inputs to the process of prioritization. (Participants in the survey are listed by office in Appendix A. It was agreed that names would not be released.) An

EXHIBIT 2.1

UNOFFICIAL PARTIAL SET OF OBJECTIVES FOR THE 1980s
(As perceived by the study team)

To increase NPPS in-house composition facilities.

To reduce NPPS overhead costs.

To reduce NPPS equipment rental costs through various funding avenues.

To reduce the per-copy cost of all services provided by NPPS.

To automate production operations where and when feasible.

To automate administrative functions where and when feasible.

To consolidate Navy administrative printing and reproduction facilities under NPPS management.

To improve the communication of policy and the provision of guidance from Headquarters to the field.

To concentrate the thrust of NPPS on information transfer associated with office administration, rather than on the production and distribution of printed materials.

To maintain the NIF concept at NPPS.

To establish policy and procedures for NPPS approval of automated composition systems outside NPPS facilities.

To pursue an active investigation of advanced technologies having the potential of increasing the efficiency of NPPS services.

To improve opportunities for upward mobility of NPPS personnel.

To upgrade substantially the training of equipment operators.

To upgrade substantially the maintenance capability of equipment operators.

To develop alternatives for scarce resources.

To provide optimal integration of Navy-wide printing facilities.

To provide full support for the military lithographic rating program.

To provide full support for the fleet's shipboard printing facilities.

To provide full support for the Navy reprographics program.

To provide full support for the Navy word processing program.

To provide full support for the Navy forms management program.

excellent response rate (about 62%) was achieved.

It must be emphasized that, throughout this section, the "objectives" referred to were drawn up by the study team as relating to the overall goal of NPPS. In no way is this set officially approved by NPPS management nor by the Navy. The priorities indicated by NPPS field personnel reflect only their perceptions of the relative ranking of these objectives. Because of lack of time, no opportunity was given them to amend the list.

The survey participants provided relative rankings of the 22 objectives in terms of perceived priorities in the short and long term, and also assigned values ("weights") based on perceived relative importance of the individual objectives. Responses were analyzed using proven computerized normalization and regression methodologies. Results are included here as Exhibits 2.2 (short term) and 2.3 (long term). These are based upon analysis of between 18 and 23 individual questionnaires, the variation being due to some inconsistencies/errors in completion which invalidated certain responses.

The primary emphasis for the next 5 years revealed by this analysis of these objectives is upon the utilization of appropriate advanced technologies, consolidation of Navy printing and publishing services, and cost reduction. This reconfirms the premise upon which this NAPS research project is based, and it is of significance that this represents the consensus of managerial opinion throughout NPPS.

Looking ahead for a slightly longer period, the priorities 5-10 years out also confirm the need for the NAPS concept. Indeed, the application of advanced technologies is seen as even more urgent, rising from 3rd to 2nd in the prioritized list. These results are summarized in Exhibit 2.4. Also included in that Exhibit is a column headed "5-year Rank (technology-oriented respondents)", resulting from the analysis of that subset of the questionnaires for which objective 12 ranked among the top five. This separate analysis was conducted at the request of NPPSMO, to determine whether the opinions of these respondents differed markedly from those of the total set. Clearly this was not the case.

The implications for the NAPS concept of these perceived

EXHIBIT 2.2

SUGGESTED OBJECTIVES FOR THE 1980s
(As perceived by the study team)

SHORT TERM (NEXT 5 YEARS)

MEAN NORMALIZED RESPONSES	MEAN SCORE	STANDARD DEV	RANK
1 TO INCREASE NPPS IN-HOUSE COMPOSITION FACILITIES	0.02517	0.06470	18
2 TO REDUCE NPPS OVERHEAD COSTS	0.06869	0.05853	5
3 TO REDUCE NPPS EQUIPMENT RENTAL COSTS THROUGH VARIOUS FUNDING AVENUES	0.05995	0.02352	8
4 TO REDUCE THE PER-COPY COST OF ALL SERVICES PROVIDED BY NPPS	0.10198	0.10272	2
5 TO AUTOMATE PRODUCTION OPERATIONS WHERE AND WHEN FEASIBLE	0.06053	0.04197	7
6 TO AUTOMATE ADMINISTRATIVE OPERATIONS WHERE AND WHEN FEASIBLE	0.04118	0.02749	13
7 TO CONSOLIDATE NAVY ADMINISTRATIVE PRINTING AND REPRODUCTION FACILITIES UNDER NPPS	0.10204	0.03969	1
8 TO IMPROVE COMMUNICATION OF POLICY AND PROVISION OF GUIDANCE FROM HEADQUARTERS TO THE FIELD	0.05405	0.05654	9
9 TO CONCENTRATE ON OFFICE ADMINISTRATION INFO. TRANSFER NOT PRODUCTION/DISTRIBUTION OF PRINTED MATERIALS	0.04357	0.10365	12
10 TO MAINTAIN THE NIF CONCEPT AT NPPS	0.06057	0.06041	6
11 TO ESTABLISH POLICY AND PROCEDURES FOR NPPS APPROVAL FOR OFF-SITE AUTOMATED COMPOSITION SYSTEMS	0.03283	0.03350	15
12 TO ACTIVELY INVESTIGATE ADVANCED TECHNOLOGY CAPABLE OF INCREASING EFFICIENCY OF NPPS SERVICES	0.09190	0.07892	3
13 TO IMPROVE OPPORTUNITIES FOR UPWARD MOBILITY OF NPPS PERSONNEL	0.02716	0.03792	16
14 TO UPGRADE SUBSTANTIALLY THE TRAINING OF EQUIPMENT OPERATORS	0.02167	0.02287	20
15 TO UPGRADE SUBSTANTIALLY THE MAINTENANCE CAPABILITY OF EQUIPMENT OPERATORS	0.01836	0.02108	21
16 TO DEVELOP ALTERNATIVES FOR SCARCE RESOURCES	0.04544	0.04354	11
17 TO PROVIDE OPTIMAL INTEGRATION OF NAVY-WIDE PRINTING FACILITIES	0.06982	0.09699	4
18 TO PROVIDE FULL SUPPORT FOR THE MILITARY LITHOGRAPHIC RATING PROGRAM	0.01691	0.01268	22
19 TO PROVIDE FULL SUPPORT FOR THE FLEET'S SHIPBOARD PRINTING FACILITIES	0.02263	0.01274	19
20 TO PROVIDE FULL SUPPORT FOR THE NAVY REPROGRAPHICS PROGRAM	0.04850	0.03491	10
21 TO PROVIDE FULL SUPPORT FOR THE NAVY WORD PROCESSING PROGRAM	0.03539	0.04630	14
22 TO PROVIDE FULL SUPPORT FOR THE NAVY FORMS MANAGEMENT PROGRAM	0.02619	0.02356	17

EXHIBIT 2.3

SUGGESTED OBJECTIVES FOR THE 1980s
(As perceived by the study team)
LONG TERM (5-10 YEARS OUT)

MEAN NORMALIZED RESPONSES	MEAN SCORE	STANDARD DEV	RANK
1 TO INCREASE NPPS IN-HOUSE COMPOSITION FACILITIES	0.02679	0.07965	19
2 TO REDUCE NPPS OVERHEAD COSTS	0.07609	0.09070	6
3 TO REDUCE NPPS EQUIPMENT RENTAL COSTS THROUGH VARIOUS FUNDING AVENUES	0.05542	0.02833	11
4 TO REDUCE THE PER-COPY COST OF ALL SERVICES PROVIDED BY NPPS	0.09366	0.11635	3
5 TO AUTOMATE PRODUCTION OPERATIONS WHERE AND WHEN FEASIBLE	0.06032	0.06398	9
6 TO AUTOMATE ADMINISTRATIVE OPERATIONS WHERE AND WHEN FEASIBLE	0.04535	0.02752	13
7 TO CONSOLIDATE NAVY ADMINISTRATIVE PRINTING AND REPRODUCTION FACILITIES UNDER NPPS	0.21340	1.07777	1
8 TO IMPROVE COMMUNICATION OF POLICY AND PROVISION OF GUIDANCE FROM HEADQUARTERS TO THE FIELD	0.08139	0.13275	4
9 TO CONCENTRATE ON OFFICE ADMINISTRATION INFO. TRANSFER NOT PRODUCTION/DISTRIBUTION OF PRINTED MATERIALS	0.07467	0.22402	7
10 TO MAINTAIN THE NIF CONCEPT AT NPPS	0.08034	0.13774	5
11 TO ESTABLISH POLICY AND PROCEDURES FOR NPPS APPROVAL FOR OFF-SITE AUTOMATED COMPOSITION SYSTEMS	0.06031	0.22528	10
12 TO ACTIVELY INVESTIGATE ADVANCED TECHNOLOGY CAPABLE OF INCREASING EFFICIENCY OF NPPS SERVICES	0.09856	0.06561	2
13 TO IMPROVE OPPORTUNITIES FOR UPWARD MOBILITY OF NPPS PERSONNEL	0.03979	0.05148	17
14 TO UPGRADE SUBSTANTIALLY THE TRAINING OF EQUIPMENT OPERATORS	0.02331	0.02517	22
15 TO UPGRADE SUBSTANTIALLY THE MAINTENANCE CAPABILITY OF EQUIPMENT OPERATORS	0.03690	0.13315	15
16 TO DEVELOP ALTERNATIVES FOR SCARCE RESOURCES	0.05193	0.05281	12
17 TO PROVIDE OPTIMAL INTEGRATION OF NAVY-WIDE PRINTING FACILITIES	0.06672	0.12048	8
18 TO PROVIDE FULL SUPPORT FOR THE MILITARY LITHOGRAPHIC RATING PROGRAM	0.02713	0.06649	18
19 TO PROVIDE FULL SUPPORT THE FLEET'S SHIPBOARD PRINTING FACILITIES	0.02383	0.02193	21
20 TO PROVIDE FULL SUPPORT FOR THE NAVY REPROGRAPHICS PROGRAM	0.04170	0.03457	14
21 TO PROVIDE FULL SUPPORT FOR THE NAVY WORD PROCESSING PROGRAM	0.03296	0.04605	16
22 TO PROVIDE FULL SUPPORT FOR THE NAVY FORMS MANAGEMENT PROGRAM	0.02508	0.02654	20

EXHIBIT 2.4

TOP-RANKED OBJECTIVES

No.	Objective	5-Year Rank (all respondents)	5-Year Rank (technology-oriented respondents)	5-10 Year Rank (all respondents)
7	To consolidate Navy administrative printing and reproduction facilities under NPPS management.	1	2.	1
4	To reduce the per-copy cost of all services provided by NPPS.	2	3	3
12	To pursue an active investigation of advanced technologies having the potential of increasing the efficiency of NPPS services.	3	1	2
17	To provide optimal integration of Navy-wide printing facilities.	4	4	
2	To reduce NPPS overhead costs.	5		
10	To maintain the NIF concept at NPPS.		5	5
8	To improve the communication of policy and the provision of guidance from Headquarters to the field.			4

priorities among objectives are pointed out in the following subsection.

2.3 Implications for NAPS

As described briefly in Section 1.6, the concept of a Navy Automated Publishing System recommended by the study team is based upon a planned evolution toward soft copy and printing "on demand", embodied in a distributed system of data bases and multi-function work stations functioning within a rich communications environment. Exhibit 2.5 lists, for each unofficial objective formulated by the study team, the contribution which this NAPS concept makes toward the achievement of that objective. Note that the objectives are listed in terms of their perceived priorities over the next five years, as determined by the survey of NPPS field directors.

The relationship between the capabilities of NAPS, and the postulated objectives appropriate to NPPS in this context, are necessarily very general at this stage of conceptualization. It is the opinion of the study team that the structure and mission of NPPS will necessarily evolve in consonance with the evolution of NAPS, and that ultimately the NPPS role will focus upon management rather than the production services. The optimum set of objectives of NPPS in fulfilling its charter as the Navy's publisher, the manner in which these objectives are to be satisfied, and the intricate interrelationships between NPPS and NAPS, are issues to be addressed internally by NPPSMO.

2.4 Citations and Footnotes

1. Proposal to Perform R&D to Conceive and Characterize A Navy Automated Publishing System, Forecasting International, Ltd., October 30, 1978.

EXHIBIT 2.5

RELATIONSHIP OF NAPS TO POSTULATED OBJECTIVES

Objective # by Rank	NAPS Implications
1. To consolidate Navy administrative printing and reproduction facilities under NPPS.	Coordination and manageability implicit in NAPS concept as here described.
2. To reduce the per copy cost of all services provided by NPPS.	Reduction in per copy cost has to be demonstrated by cost-benefit analysis in the next phase of design, but this trend is a logical consequence of the technologies to be implemented.
3. To actively investigate advanced technology capable of increasing efficiency of NPPS services.	Advanced technology is introduced incrementally during the course of NAPS evolution as here described.
4. To provide optimal integration of Navy-wide printing facilities.	See comment on objective #1, above.
5. To reduce NPPS overhead costs.	Overhead costs are likely to be reduced due to improved formatting, and reduction in discards of paper copies. See also comment on objective #2, above.
6. To maintain the NIF concept at NPPS.	The concept of support to industry is retained in the NAPS concept here described, and especially by virtue of the recommended implementation strategies. However, the segment(s) supported may shift with the introduction of NAPS, from primarily printing shops toward communications and processing facilities.
7. To automate production operations where and when feasible.	Automation of production operations is implicit in the NAPS concept.
8. To reduce NPPS equipment rental costs through various funding avenues.	Not directly relevant.

EXHIBIT 2.5 (Continued)

Objective # by Rank	NAPS Implications
9. To improve communication of policy and provision of guidance from headquarters to the field.	Not directly relevant, but improved communications are intrinsic to the whole NAPS concept.
10. To provide full support for the Navy reprographics program.	Not directly relevant, but this objective would be indirectly served by the reduction in reprographic load, and the clearer definition of the appropriate use of reprographics, resulting from NAPS implementation.
11. To develop alternatives for scarce resources.	Paper usage would be greatly reduced. The substitution of electronic communications for paper distribution would also tend to conserve energy used for transportation of physical documents.
12. To concentrate on office administration information transfer not production/distribution of printed materials.	Information distribution as distinct from paper dissemination is intrinsic to the NAPS concept.
13. To automate administrative operations where and when feasible.	The NAPS meta-system essentially accomplishes this objective.
14. To provide full support for the Navy word processing program.	The integration of source data input as part of the NAPS distributed processing concept leads to the coordination and manageability needed to address this objective.
15. To establish policy and procedures for NPPS approval for off-site automated composition systems.	This would be a part of the implementation schema for NAPS.
16. To improve opportunities for upward mobility of NPPS personnel.	Not directly addressed, but would be a natural consequence of the upgrading and expansion of the role of NPPS.

EXHIBIT 2.5 (Continued)

Objective # by Rank	NAPS Implications
17. To provide full support for the Navy forms management program.	Implicit in the NAPS concept, because of the changes in forms handling.
18. To increase NPPS in-house composition facilities.	Not directly addressed, but will be in the detailed selection of implementation strategies.
19. To provide full support for the fleet's shipboard printing facilities.	Will be specifically addressed in the next phase of NAPS design.
20. To upgrade substantially the training of equipment operators.	Not directly relevant.
21. To upgrade substantially the maintenance capability of equipment operators.	Not directly relevant.
22. To provide full support for the military lithographic rating program.	Not directly relevant, but see comment on objective # 19.

SECTION 3

3. INFORMATION-RELATED PROBLEMS OF THE NEXT TWENTY YEARS

3.1 Introduction

The factors which dominate Navy information publication requirements at present and for the foreseeable future concern the quantity and quality of information needed, the resources available for information management, and the delays involved in satisfying a particular information need. Let us examine each of these aspects in turn, and discuss the implications for the current study.

The quantity of published information needed by the Navy is extremely difficult to assess. Available data concerning current and historic workloads in various categories are spotty and non-comparable; there is an urgent need for a Navy-wide coordinated effort to address this issue and provide an adequate basis for projection. This question is discussed in detail in Section 3.4. For all of these factors, the study team has found a noticeable lack of available data. We are grateful to the NTIPP study for helping to remedy this deficiency, although this has resulted in an unavoidable bias toward technical materials in the ensuing discussion.

Information quality, as it relates to content, is not a responsibility of NPPS and thus is outside the scope of this project. To the extent that the term is applied to the format and structure used for presentation of the information to the user, it is of direct concern to NPPS which is tasked with establishing and enforcing appropriate standards. However, this mission cannot be performed for the time-period of interest until the NAPS concept is well defined.

The question of the availability of needed resources for Navy information management is a critical one. Consideration of costs and manpower levels is undertaken in Sections 3.2 and 3.3 respectively, and other topics pertinent to information resource management are addressed in Section 3.5. Relevant technological resources and capabilities for the next two decades are separately discussed in Section 4.

The determination of what delays are acceptable in the provision of information can not be made in the general case: the decision is specific to each unique set of circumstances. However, it is safe to say that the faster the needed information can be supplied to the user, the better. In order to balance speed of response against the cost, much more detailed analyses must be performed in terms of equipment life cycles. Again, this level of detail is inappropriate and infeasible at this level of broad conceptualization.

3.2 Fiscal Considerations

As mentioned previously in Section 1, there are two over-riding factors which drive up the cost of publication in the Navy. One of these is poor composition: format itself is a major cost-driver. It has been estimated[1] that funding of an automated publishing system for the Naval Education and Training Command could be met from savings due to proper formatting, which would result in a compression factor of 2:1. This is an area where NAPS can play a major role in terms of standardization.

A second dominant factor is wastage, copies which are made unnecessarily. This encompasses two categories, one exemplified by the disposal of obsoleted documents at NPFC, which by one estimate[2] amounts to millions of pages per year, and the other by the estimated one billion copies (pages) per year made individually on Navy copiers[3] as a result of impatience over delays in the provision of needed information.

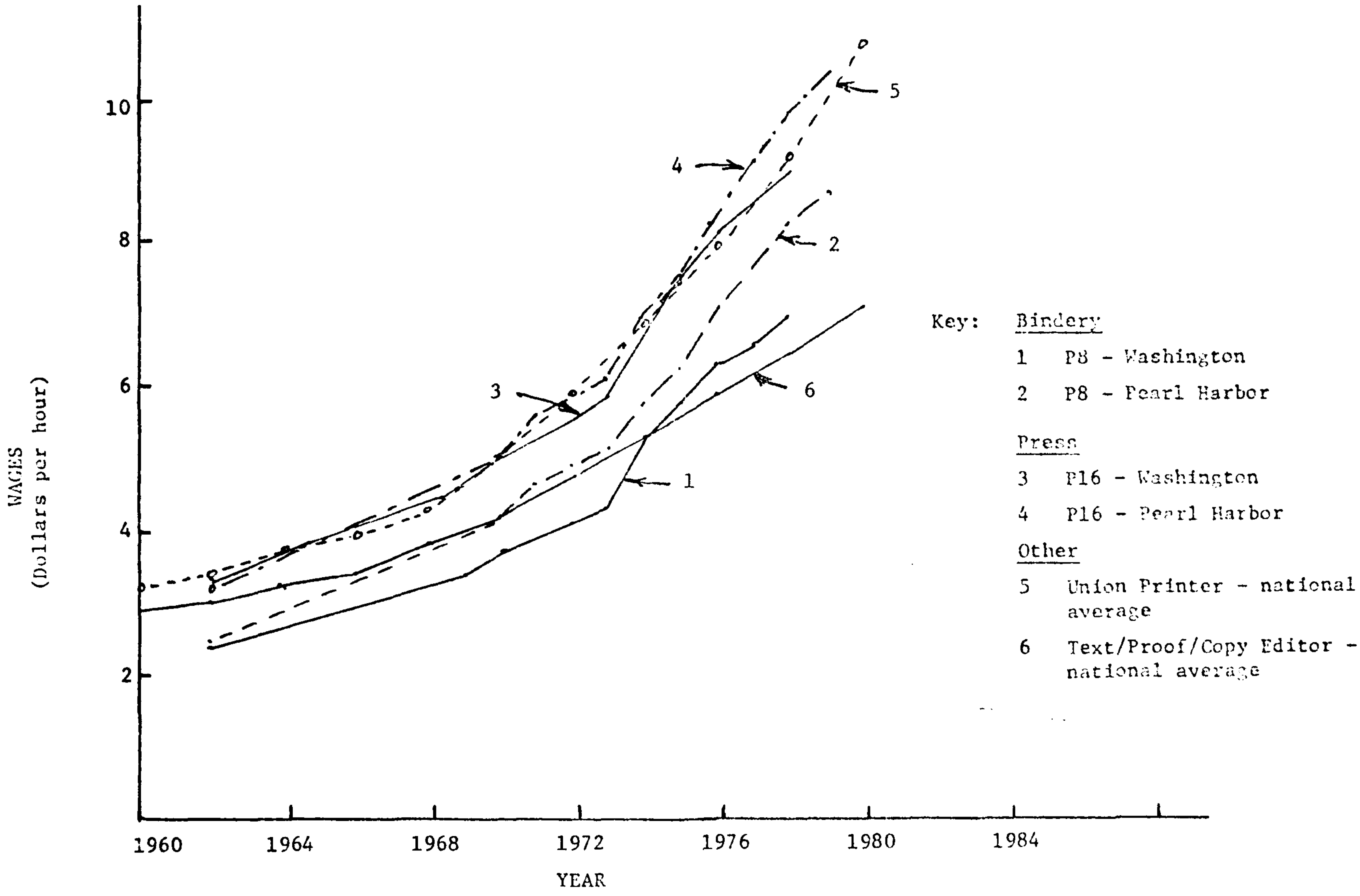
Other factors that currently have a major impact on publication costs are wages, equipment, paper and site support costs. These are also of major significance in considering information storage and retrieval. Exhibit 3.1 shows the trend in hourly wage rates over a twenty-year period for various personnel employed in the publishing industry.[4] While these figures are expressed in current dollars, there has also been an increase in "real" salary levels, particularly for union printers, whose constant dollar scale increased roughly 15% between 1962 and 1974, and is anticipated to increase an additional 7% by 1980.[4]

Equipment costs in the publishing industry, while more than

EXHIBIT 3.1

PERTINENT WAGE SCALES

(Current Dollars)



doubled in terms of current dollars, are nevertheless at their lowest level in twenty years as evidenced by the wholesale price index, measured in constant dollars, and the same is true of paper, although this is anticipated to cost $24.70 per hundred pounds in 1980, compared to $14.32 in 1960. The captive printing market, according to estimates by the In-plant Printing Management Association,[5] spends a minimum $5.5 million annually on paper. Navy expenditures for paper are much higher, amounting to an estimated 25-35% of annual revenue, i.e. about $30 million p.a.[3] To the extent that private sector office rentals are of concern in this context, it should be noted that average rental has not risen nearly as fast as wages, and in real terms has decreased consistently since 1960.[4]

The net result of these and other contributing factors however has been a steady increase in publishing costs, at least in the private sector. (The pricing structure and administrative program responsibilities of NPPS make it impracticable to perform a direct comparison of in-house costs with those of the industry as a whole.) Exhibit 3.2 tabulates these increases for a number of pertinent indicators.[1,4,6] Note that the area in which unit costs (in this case, hourly rate) have risen most sharply is precisely that where no automation whatsoever has been applied, to hold down the spiralling rate of increase: the hand labor needed for miscellaneous jobs in the bindery. During the period 1967 to 1977, the unit labor cost (labor cost per unit of output) in the printing and duplication sector of the Federal Government increased by 11.1% p.a., compared with an average of 7.2% for all Federal sectors measured, while productivity (output per employee-year) decreased in this sector by an average annual rate of 1.7% over the same period, compared with an average Federal increase of 1.3%. Exhibit 3.3 provides comparable data for several pertinent Federal sectors.[7]

Information-related activities are pervasive throughout all Federal activities, and difficult to separate as an individual item. Attempts have been made from time to time to segregate "information systems" as an identifiable category, but even this step has not met with significant success. This pervasiveness makes it difficult to estimate what financial resources will be available to meet mounting

EXHIBIT 3.2

EXAMPLES OF PRICES PERTAINING TO PRINTING AND PUBLISHING
(Current Dollars)

	Every two years													Every Year					
	1956	1958	1960	1962	1964	1966	1968	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Computed Average % Increase per annum
Journal Typesetting:[2]																			
Half-tone			3.45	3.64	3.85	4.05	4.45	5.12		6.00		6.75		7.48		8.29		9.18	8.3
Line drawing			1.75	1.82	1.92	2.02	2.22	2.56		3.00		3.37		3.73		4.14		4.59	8.2
Basic text page			12.66	13.36	14.10	14.85	16.30	18.79		22.00		24.75		27.44		30.40		35.63	8.3
Subsidiary text page			16.11	17.00	17.95	18.90	20.76	23.90		28.00		31.50		34.90		38.57		42.55	8.3
Tabular page			19.00	20.04	21.15	22.29	24.45	28.17		33.00		37.14		41.16		45.60		50.52	8.3
Blank page			3.45	3.64	3.65	4.05	4.45	5.12		6.00		6.75		7.45		8.29		9.18	8.3
Composition and Recording[2] (per journal article)			8.55	9.06	9.60	10.82	11.95	13.46		14.84		17.15		19.72		22.30		24.90	9.6
Printing costs:[2] plates and collecting per page			2.20															5.55	7.6
per impression			.0017															.0030	3.8
Journal manufacturing Cost per page[3]								52.00	53.50	55.20	57.20	65.00	73.50						8.3
Journal manufacturing Cost per journal[3]								83,390	88,300	95,250	98,470	110,120	122,900						9.5
Unit costs for printing:[4]																			
Text negatives	.60*													$1.05				2.06*	11.1
Line drawing negatives														.90					
Half-tone negatives														2.70					
Plates	.30*													.60					
Paper														.0029				.73*	6.5
Printing														.0005					
Folding														.00031					
Collating														.00125					
Binding														.03					
Hand labor in bindery	2.75*																	19.80*	28.2

*Based on NPPS pricing manuals for referenced time periods.

EXHIBIT 3.3

RATES OF CHANGE OF PRODUCTIVITY AND UNIT LABOR COST
IN THE FEDERAL GOVERNMENT, FY 1967-1977

Functional Grouping	Average Annual Rate of Change		
	Output per Employee Year	Compensation per Employee Year	Unit Labor Cost
Printing and Duplication	- 1.7	9.2	11.1
Information Services	.3	5.6	5.3
Communications (FY '73 - '77 Only)	9.2	7.9	-1.1
TOTAL	1.3	8.7	7.2

Source: Bureau of Labor Statistics, as quoted in Reference 5.

demands.

The dominant consideration on this issue is probably the fact that information generation in some categories, and particularly in that of education and training, is already budget-constrained. In FY 76 the total paper output of CNET Support was 750 million pages, but this would have doubled had the funding for printing been the $5 million requested rather than the $2.5 million actually budgeted. Increased consideration is now being given to on-board training and individualized instruction (see following subsection) which will only increase the disparity between requirements and available funds, since these techniques depend extensively on published materials. Capacity for annual CNET production of two billion pages, nearly three times the FY 76 output, may be required by the early 1980s.[1]

There are no indications that such budgetary constraints will change over the time period of concern to the present study.

3.3 Human Resources

The availability of manpower affects the information publication problems of the Navy in a variety of ways, both increasing the demand for published materials, and affecting the supply of personnel to meet that demand. In the military context, recruiting problems limit the supply of personnel to perform tasks associated with the generation, reproduction and distribution of published materials (for example, composition and production by fleet lithographers). The increased turnover and inadequate educational level of other Navy enlistees compound the problem by requiring more extensive documentation for this user community, a trend further enhanced by the ever growing sophistication of new equipments which they must be trained to operate and maintain. Similar developments are also observable in the private sector, where they potentially affect the contracted-out portion of the Navy's publications and printing program. In the following subsections we will consider available historic data and projections for indicators measuring these separate trends: labor pool, recruit capabilities and equipment complexity.

3.3.1 Labor Pool

Navy enlistment active duty accessions in 1977 were 2.7% below the target level.[8] In addition, turnover rates for Navy enlisted personnel are increasing and could, if unchecked, reach levels of 28.7% attrition and 23.5% desertion by 1995. Incentives proposed/instituted to address these problems unfortunately run counter to other moves aimed at increasing opportunities for promotion and decreasing compensation rates.[9] Conflict also arises between the recommendation of the Dedman Report to civilianize all shore military printing billets, and the response of NPPS that this course of action would impair the sea-shore rotation of the military lithographer.[10]

Exhibit 3.4 shows that the total population of 18-24 year olds in the U.S. will decline by about 15% through the time period of concern.[11] The male segment of this cohort, and specifically those under 20, will decline even faster, with rates of decrease varying from 15% to 25% between 1985 and 1995.[12] Exhibit 3.5 relates supply and demand between 1954 and 1994. Since all of the people reaching 18 years of age by that date have already been born, these projections are fairly reliable.[13]

From this potential labor pool, the number of individuals likely to enlist is also decreasing. There are two separate factors involved here: the declining enlistment in all services, and the decreased effect of the incentives for Navy enlistment. As mentioned previously, in 1977, the first full year of the all volunteer force (AVF) concept, Navy enlistment active duty accessions were 2.7% short of attaining their goal; by the end of FY 1977, the Navy was still 2% short of authorized strength, compared to .9% for total DoD and .1% for the Air Force.[8] The Navy shortfall was greater than that of any other Service.

Potentially the recruitment of women could help to compensate for this disparity in required and available candidates for enlistment, but the total Navy female force is projected to increase only slowly. By 1983 the DoD anticipates[8] that 40,000 enlisted women will be in the Navy, and women will comprise 11% of the total DoD enlisted force. A Brookings Institution Study[14] estimated the Navy's potential to use enlisted women to be 42,000, contingent upon the repeal of Section 6015 of Title 10 which precludes the use of women

EXHIBIT 3.4

TOTAL U.S. POPULATION AGES 18-24 YEARS

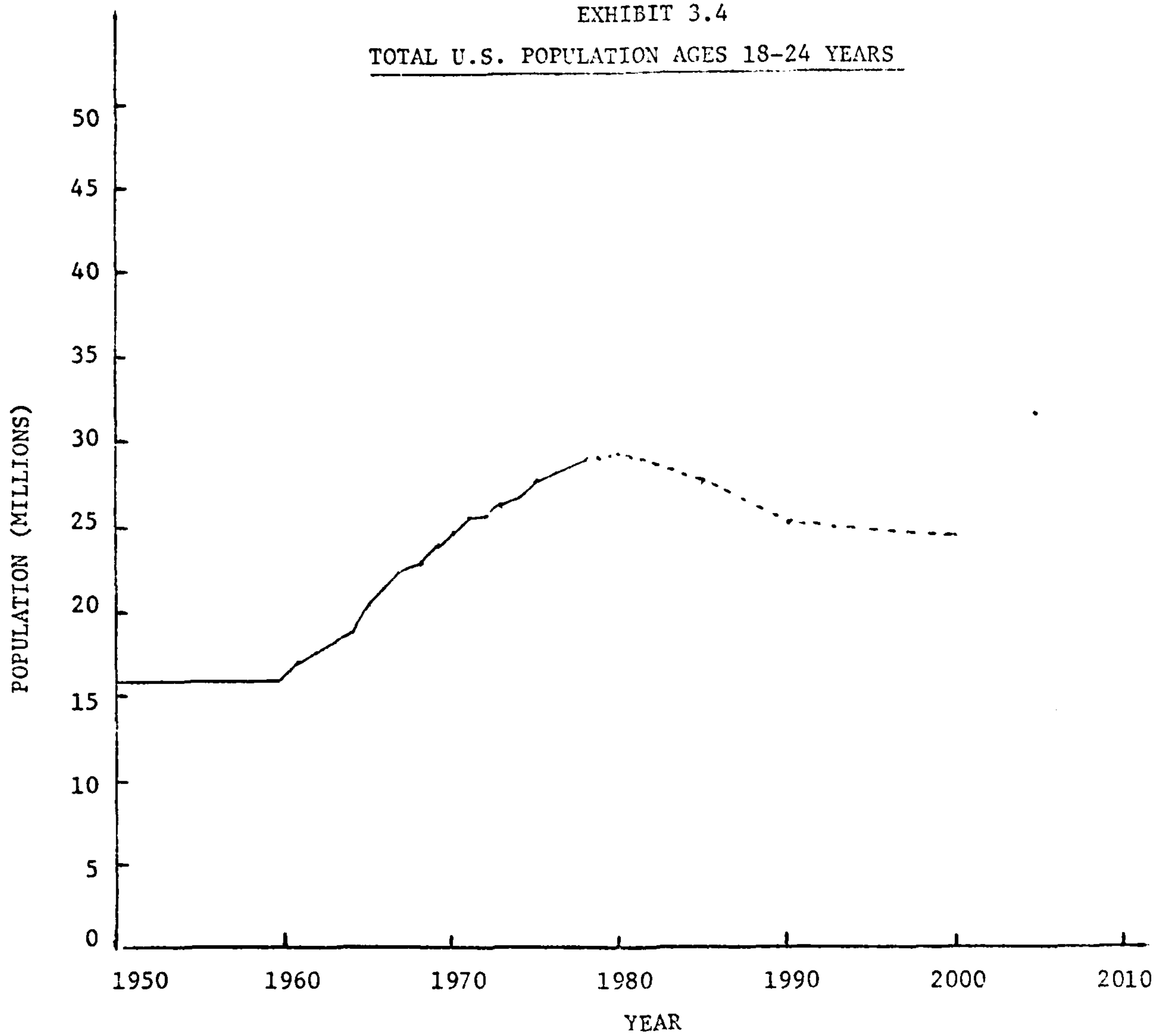
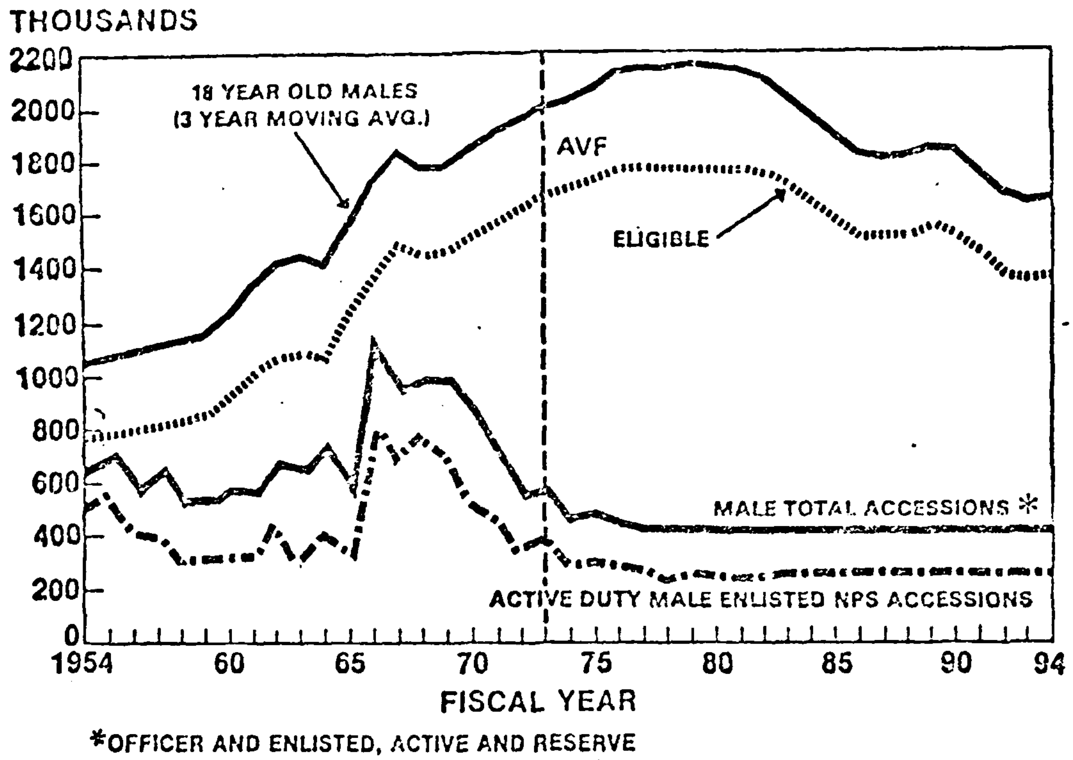


EXHIBIT 3.5

SUPPLY AND DEMAND FOR YOUNG MEN



on combatant craft. While this is not a large figure, Navy experience has been that, for enlistees, lost time for all causes runs about .63% for women compared to 1.1% for men[14] so that the productivity rate should increase. On the other hand women technicians may require the provision of more information than their male counterparts, at least in initial training, because of the cultural stereotypes and role identifications still persisting in the U.S.[15]

Total attrition of Navy enlisted personnel (defined as the percentage of male enlisted accessions entering in the specified year who leave prior to completing three years of service) is comparable to figures reported by other services, varying between 27% and 38%[8]. Around 42% of first enlistment personnel fail to finish their enlistments, and desertions are at an all-time high, more than doubling between 1972 and 1977. This trend, if continued, would imply a desertion rate of 6.9% by 1985, and 23.5% by 1995. This is an unrealistic projection, however, since actions will obviously be taken to modify the factors leading individuals to desert. Experience has shown that the average deserter serves on sea duty, is between 18 and 22 years old, ranks in the lower mental categories, and is in the first term of enlistment. Examples of management initiatives already developed to help correct this Navy problem include revised recruit screening procedures (which exacerbate the shortage of potential recruits), improved sea pay legislation, new leadership courses for junior officers, and re-enlistment bonuses. These incentives are counter to other moves aimed at limiting re-enlistments and restricting recruitment of persons with prior military service to those skills where there are insufficient career personnel. This is because experienced people are paid more and are more likely to stay until retirement, thereby increasing compensation costs. Also, high re-enlistment rates reduce opportunities for promotion, already severely restricted for ratings in the printing and publishing sector. The resolution of these conflicting aims will require a re-examination of policies to arrive at a better understanding of optimum age and experience mixes.

The increased emphasis on recruiting which has resulted from the all-volunteer-force (AVF) concept, the high rates of attrition referred to here, and the declining recruit quality discussed in the following subsection, also increases the Navy publications load. Recruiting materials constitute a significant segment of materials printed, and an expensive one; they are in color, on high quality stock, and procured externally.

3.3.2 Recruit Capabilities

The falling supply of recruits discussed in the previous paragraphs is exacerbated by a decrease in quality. With the population of high school graduates decreasing by almost 15% per year, by 1995 the shortfall for DoD prime recruits (male high school graduates in mental categories I-III) could in theory reach 42%, based on the assumption of high national unemployment rates.[16] In 1977, 34.2% of the recruits enlisted into the Navy were in Categories IIIB or IV.[17] (Category IV is marginally acceptable, Category V is not acceptable.) Many in Category IIIB may be functionally in Category IV. Although definitive data are lacking, there is also a feeling that the quality of even prime candidates is decreasing. Until recently there has been a national trend toward graduating high school attendees with less-than-adequate literacy level. The National Assessment of Educational Progress (NAEP) has noted that 17-year olds as a group made less accurate inferences from what they read, and were less adept at using reference works in 1973-4 than in 1969-70. McGraw Hill's Comprehensive Tests of Basic Skills (CTBS) show a nationwide decline in reading, language and math between 1968 and 1973 for students in grades six through ten.[18] (The CTBS does not cover eleventh and twelfth grades.)

Fortunately, there are indications of a turn-around in this trend with many schools now requiring seniors to pass "minimum competency tests" before graduating. Whether this trend is reversing or not, the Navy is expected to direct its attention toward reducing the need for prime recruits as previously defined.

This is counter to the increasing need for high skill personnel, which is further addressed in section 3.3.3. The overall Navy requirement for Petty Officers in FY 78 was 67% of the enlisted force; BuPers struggled to meet 61%, a shortfall of 28,000. For FY 1979, in the Navy Data System Technician rating, demand exceeds supply by 430, or 22% of the requirement.[17]

These discrepancies are resulting in policies directed toward increased information transfer, such as improved job oriented information and training, adaptive instruction, system-embedded maintenance and training, and use of operator and maintainer training devices.[17] These approaches again increase the production burden of CNET, previously discussed under section 3.2.1.

3.3.3 Equipment Sophistication

As has been mentioned several times in this report, NTIPP, a major study of problems relating to technical information, and potential solutions, is being managed by the David W. Taylor Naval Ship Research and Development Center (DTNSRDC), and has been of considerable assistance to the NAPS project. "Technical information" is used here in the particular sense of encompassing information which is acquired from a contractor to accompany a hardware system, and which serves the purpose of maintenance, training, logistics support or operation. This area is a small sector of total Navy publications based on annual revenue estimates, (about 8 1/2%)[21], but one critical to operational readiness and thus to the basic mission of the Navy.

The equipment fundamental to Navy operations, primarily ships, aircraft and weapons systems, is continually increasing in sophistication and complexity. This is especially true in avionics and other applications of advanced electronics and particularly semiconductor technology. Although universally accepted definitions have not been forthcoming to provide consistent time-series data for quantitative measures of complexity, in the context of the present study a more meaningful indicator is the associated volume of technical data. Exhibit 3.6 demonstrates that the number of pages of technical information required for supporting an aircraft has increased by a factor of approximately 800 in the past 40 years.[15] This places a heavy and ever-increasing burden on the technician; the estimated time spent by maintenance personnel in seeking information in 1977 was 30%,[15] compared to 20% in 1967.[20]

Such highly complex systems reinforce the need to acquire and train personnel for high aptitude occupations: the AEGIS weapons

EXHIBIT 3.6

TYPICAL TECHNICAL MANUAL GROWTH

1939	J-F	Goose	525 pages
1942	F-6F	Hellcat	950 pages
1946	F-8F	Bearcat	1,180 pages
1950	F-9F	Cougar	1,880 pages
1953	S-2	Tracker	12,500 pages
1962	A-6A	Intruder	150,000 pages
1969	F-4	Phantom	225,000 pages
1978	F-14	Tomcat	380,000 pages
1978	F-18	Hornet	>400,000 pages

system and the TRIDENT require respectively 90% and 67% Petty Officers.[17] At the request of OSD in 1977, an interservice task group prepared a white paper on the applicability of the latest technology in job aids and maintenance training to enhance military job proficiency. One major suggestion of this group was a greater investment in the job information itself.[17] So many of these diverse trends lead back to this single focus: information.

The quantity of information is the next subject to be explored in this discussion.

3.4 Information Quantities

As discussed in previous sections of this report, there are numerous factors resulting in an increase in the total quantity of Navy publication. Some of these are listed in Exhibit 3.7. In attempting to estimate workloads in various publication categories, however, we need first an unambiguous definition of these categories.

One approach is to segment the total body of Navy non-tactical information, designated for publication, by application area; we have employed the following categories, although we must emphasize that these are by no means mutually exclusive, and we have not encountered consistent definitions of what is included under each:

- maintenance and repair
- training
- finance
- administration
- supply
- procurement.

This lack of clear definitions and a structure for the categorization of information is a major problem, and one which the study team is certainly not the first to discover. According to one source,[21] most publications used in the Navy are administrative in nature, and NPPS is currently involved in the mass distribution of this information to multiple users and for archival purposes.

A separate breakdown is offered in a partial listing by type of document, consisting only of those warehouse controlled items stocked at the Naval Publications and Forms Center (NPFC). This includes:[2]

- military specifications

EXHIBIT 3.7

SOME FACTORS AFFECTING QUANTITY OF NAVY PUBLICATION

General increase in bureaucratic regulation and consequent documentation.

Freedom of Information Act - informing people of their rights.
- responding to requests for information.

All volunteer force - increase in recruiting materials.

Increased personnel turnover - increase in training materials.

Decrease in quality of recruits - redesign and reissue of training materials.
- redesign and reissue of operating and maintenance materials.

Lack of production standards - space-wasting composition.

Lack of control over commercial utility printing (lowest bidder concept)
- space-wasting composition.

High turnaround time for printing and publishing.
- unjustifiable stockpiling.
- high wastage due to obsolescence.

- military standards
- data item descriptions
- Naval instructions
- DoD directives
- qualified products lists
- Federal specifications
- Federal standards
- handbooks
- miscellaneous, including society/association documents.

This is hardly representative of Navy publications, however. Most warehouse controlled documents at NPFC are not Navy documents, and the major category of technical manuals at NPFC is not warehouse controlled.

The NAPS concept, outlined briefly in Section 1.5, includes as one component the use of demand printing technologies to satisfy a significant portion of Navy requirements for the publication of all non-tactical information. In order to assess the feasibility of this approach, we need some means of assessing workloads, both total and by category. However, even current workloads are difficult to estimate, to say the least, and the task would require far more resources in time and dollars than were available to this project. A categorization schema must be developed, and associated reliable quantitative data collected. This task is an essential preliminary to further specification of the NAPS system.

In the course of the current study, we have located and aggregated quantitative data in a few areas. The absence and/or inconsistency of the required data are roughly indicated in Exhibit 3.8, which relates in matrix form various categories of Navy non-tactical information to such measures as "inventory", "annual production" etc. The cell entries indicate the existence of some quantitative data for a particular measure (column) applied to a specific category (row); whether these data are for a single point in

EXHIBIT 3.8

AVAILABILITY OF QUANTITATIVE DATA ON NAVY INFORMATION

Information Category \ Available Quantitative Data	Annual Production	Inventory	Transmission	Annual Demand	Annual Costs	Obsolescence Rate	Morphological Characteristics	Manpower Levels
Maintenance and Repair	Cd Cx Hp	Cd Cp Cx	Cx Px				C	
Training	Cd,p Cx Pp	Cd Cp Cx					C	
Finance			Cx Px					
Administration			Cx Px	Cd	C$	Hy	C	C
Supply		Cx Px	Cx Px	Cm				
Procurement		Cx Px						

Key: C = Current year data only
H = Historic data
P = Projections

d = # documents
p = # pages
y = # years

x = # characters
$ = # dollars
m = # messages

Unless otherwise noted, data are available for only a portion of the specified category.

time, historic time series or projected values; and the unit of measurement (dollars, pages, messages etc.).

The purpose of including this Exhibit is to demonstrate the wide diversity and incompleteness of the existing "data-base", if such a term can properly be applied to such an agglomeration of incompatible information items. Subsequent Exhibits provide examples relating to particular information categories. For example, Exhibit 3.9 contains an estimate by Sterling Systems[2] of the number of documents demanded per year for warehouse controlled items at NPFC. This is reflected by the entry Cd in cell 4 of row 4 in Exhibit 3.8. The morphological characteristics (of just these items) are shown in Exhibit 3.10, while the historic trend in document age, the only time series data given, is included as Exhibit 3.11. Again we must emphasize the paramount importance to the pursuit of the NAPS concept of the collection of Navy-wide data to permit the construction of historic time-series and the development of credible projections in all categories.

An area of major concern to the Navy is the provision of printing and publishing services to the fleet. As a subset of these, primary categories of printing production services on board ship include:

- composition of copy/text
- daily administrative printing requirements
- forms
- reports/manual/booklets
- charts/maps
- ceremonial and public relation printing
- metal photo process

as well as the finishing/binding and packaging of these products. Workloads vary greatly with vessel, location, mission and time, and quantitative data are generally not available. A proposal for a fleet-wide survey is in preparation,[22] but the categorization will be in terms of production process and thus non-compatible with former breakouts (see Exhibit 3.12).

Shore support facilities (NPPSO, NPPSBO) also furnish a variety of printing, duplicating, copying and reproduction services to the

EXHIBIT 3.9

QUANTITATIVE DATA FOR WAREHOUSE CONTROLLED ITEMS AT NPFC*

Indicator	1979 Value/Estimate
# pages demanded per year	58.7 million
# documents demanded per year	3.2 million
Annual printing costs	$6 - $9 million
# pages disposed of per year	5 - 40 million
% documents revised at least once	60%
Average life of document	7 - 8 years
% documents replenished after initial stocking	43%
Frequency of replenishment	4 - 5 years
Average replenishment quantity	430
% total mail orders received from U.S. Navy	8%
% total mail orders received from private corporations/organizations	80%

*Private communication from Eric Jorgenson, DTNSRDC, 12/20/79.

EXHIBIT 3.10

MORPHOLOGICAL CHARACTERISTICS OF WAREHOUSE CONTROLLED ITEMS AT NPFC

14.7	Average pages per document
92%	Documents without separate covers
96%	Documents with conventional printing format
78%	Documents without technical line drawings
63%	Documents without illustrations
96%	Documents without photographs
57%	Documents containing reduced print
98.5%	Documents $\leq$ 8 1/2 x 11 inches
97.6%	Documents without foldouts
51.1%	Documents primarily textual content
48.9%	Documents primarily numeric content

EXHIBIT 3.11

PERCENT OF NPFC WAREHOUSED DOCUMENTS VERSUS DATE OF ISSUE (AS OF MARCH 1979)

EXHIBIT 3.12

PROPOSED SHIPBOARD PRINT SHOP SURVEY INSTRUMENT
(Excerpt)

Average monthly press production volume (impressions):
Estimated monthly press production volume under peak conditions:
Average number originals per job:
Average run length per job:
Percent total presswork w/a run length of 1-25 copies:
Percent total presswork w/a run length of 26-50 copies:
Percent total presswork w/a run length of 51-100 copies:
Percent total presswork w/a run length of 101-250 copies:
Percent total presswork w/a run length of 251-500 copies:
Percent total presswork w/a run length of 501-1000 copies:
Percent presswork w/a run length of over 1000 copies:
Percent presswork produced on offset plates:
Percent presswork produced on electrostatic plates:
Presswork represents what percentage of total shop workload:
Average monthly composition workload (based on 8 1/2" x 11" pg.):
Composition represents what percentage of total shop workload:
Average monthly metalphoto workload (in square inches):
Metalphoto represents what percentage of total shop workload:
Average monthly number of jobs produced on letterpress:
Letterpress represents what percentage of total shop workload:
Percent printing produced on 2 sides of sheet:
Percent originals requiring reduction:
Percent printing w/a finished size up to 8 1/2" x 11":
Percent workload requiring collating:
Average number of pieces per job requiring collating:
Percent workload requiring collating 1-10 pgs:
Percent workload requiring collating 11-20 pgs:
Percent workload requiring collating 21-30 pgs:
Percent workload requiring collating 31-40 pgs:
Percent workload requiring collating 41-50 pgs:
Percent workload requiring collating over 50 pgs:
Percent workload requiring folding:
Maximum sheet size of work requiring folding:
Percent workload requiring stapling:
Percent workload requiring drilling:
Percent workload requiring wrapping:
Percent workload requiring padding:
Total number of personnel in shop:
No. of rated personnel (LI) in shop:
No. of LIC:
No. of LI1:
No. of LI2:
No. of LI3:
No. of LISN:
No. of non-rated personnel:
Average daily hours of shop operation:

fleet that include the printing of technical manuals and the provision of metalphoto services. Short-term historic data are available for these on a plant-by-plant basis. These figures and other quantitative information relating to shore-based operations -- the bulk of NPPS business -- will become much more readily accessible with the full-scale implementation of PRMIS, the Printing Resources Management Information System.

As far as the off-ship communication of logistic (i.e. non-tactical) information is concerned, we do have some current data, based on a rather small sample, but no historic trends. Exhibit 3.13 shows the estimated total logistics data volume for SNAP II ships by major applications area. As noted in that study,[23] "volumetric reporting data (are) not available at this time to provide a meaningful estimate".

In the sub-area of technical manuals, itself a sub-set of technical information, a recent study by Hughes Ground Systems Group as part of the previously referenced NTIPS program has produced some quantitative estimates, as summarized in Exhibit 3.14. Note that the total Navy inventory of such manuals is estimated to contain approximately 25 million pages which, including content generation, represents a value of about $5 billion.[19] Again, no historic data are available.

An attempt to estimate the volume of information in the category of inventory control and orders for supplies [24] presents us with other isolated data points, summarized in Exhibits 3.15, 3.16.

CNET publishing function requirements in the training area[4] are summarized in Exhibit 3.17.

3.5 Other Considerations

While not acting as significant incentives towards the adoption of an automated publishing system, there are other information-related factors which are becoming of increasing concern to the Navy, and which must be considered in the development of the NAPS concept. Paramount among these concerns are the issues of security, privacy and freedom of information.

Security and privacy are terms which are frequently applied interchangeably, yet, particularly in the military context, there is

EXHIBIT 3.13

ESTIMATED DAILY SHIPBOARD LOGISTICS DATA COMMUNICATIONS

FUNCTIONAL AREAS	TOTAL EXTERNAL LOGISTIC DATA VOLUME FOR 277 SNAP II SHIPS IN CHARACTERS PER DAY		
	HIGH	LOW	AVERAGE
Pay and Personnel 54%	6,093,824	420,196	986,375
Maintenance 17%	1,918,430	132,284	310,526
Supply and Financial 29%	3,272,610	225,660	529,720
Total All Functional Areas 100%	11,284,864	778,140	1,826,621

TOTAL EXTERNAL LOGISTIC DATA VOLUME FOR AVERAGE SNAP II SHIP IN CHARACTERS PER DAY.		
HIGH	LOW	AVERAGE
40,740	2,809	6,594

EXHIBIT 3.14

CURRENT STATUS OF TECHNICAL MANUAL PROCESSING

Indicator		Total Navy Value/Estimate
Inventory:	# technical manuals	140k
	# text pages	17.4M
	# art pages	7.5M
	Average # text pages/publication	132
	Total # pages	24.9M
Yearly Production -		
New/Reissue:	# technical manuals	11.6k
	# text pages	2.1M
	# art pages	.95M
	Total # pages	3.05M
Update:	# technical manuals	--
	# text pages	204k - 317k
	# art pages	126k - 198k
	Total # pages	330k - 515k
In terms of data bits:		
Total technical manual inventory:		$1 - 129 \times 10^{12}$ bits
	text pages	$348\text{-}696 \times 10^{9}$ bits
	art pages	$800 \times 10^{9} - 128 \times 10^{12}$ bits
Yearly new technical manuals:		$942 \times 10^{9} - 15 \times 10^{12}$ bits
	text pages	$42 - 84 \times 10^{9}$ bits
	art pages	$900 \times 10^{9} - 14 \times 10^{12}$ bits
Yearly update:		$16 \times 10^{9} - 3 \times 10^{12}$ bits
	text pages	$4 - 13 \times 10^{9}$ bits
	art pages	$13 \times 10^{9} - 3 \times 10^{12}$ bits

EXHIBIT 3.15

ESTIMATED TELECOMMUNICATIONS MESSAGE LEVELS

	ASO	SPCC
Average monthly messages	1,867,918	1,233,328
Average daily messages	92,449	58,796
Average hourly messages	9,246	5,880
Peak # messages/hour	18,492	11,760
# remote terminals	204	251

EXHIBIT 3.16

ESTIMATED STORAGE FOR DISTRIBUTED FILES

(Millions of characters)

	ASO	SPCC
Purchase		
Bidders lists	4	8
Contract clauses	3	3
Financial		
Suspended invoice file	13.2	15.4
Completed invoice file	127.5	135.4
Personnel file	4.6	9.8
Price analysis file	41	51
RMS accounting file	593.1	335.4
ADP MIS		
Master job file	18	26.6
Library	16	20
Utilization	20	20

EXHIBIT 3.17

CNET PUBLISHING FUNCTION REQUIREMENTS

Function	Current Levels (1976)	Anticipated Levels (Early 1980s)
Authoring	137.3 million characters 281.4 man years p.a.	162.5 million characters 306.7 man years p.a.
Encoding	137.6 million characters 18.7 man years p.a.	162.8 million characters 20.9 man years p.a.
Editing	17.1 million characters 10.6 man years p.a.	19.6 million characters 11.5 man years p.a.
Composing	152.0 million characters 4.9 man years p.a.	177.2 million characters 4.9 man years p.a.
Typesetting	152.0 million characters	177.2 million characters
Illustrating	13.4 thousand illustrations 27.7 man years p.a.	17.4 thousand illustrations 38.7 man years p.a.
Platemaking:	88.2 thousand plates	100.2 thousand plates
Negatives	60.7 thousand negatives	72.7 thousand negatives
Half-Tones	6.8 thousand negatives	9.8 thousand negatives
"Cut-Ins"	8.8 thousand cut-ins	12.8 thousand cut-ins
Printing:		
Publications	1,097 publications	1,107 publications
Bindings	2903.1 thousand bindings	3803.1 thousand bindings
Impressions	972.4 thousand impressions	1080.4 thousand impressions
Total pages published	750 million	2 billion

a clear distinction to be drawn. Security encompasses "the procedural and technical measures required to prevent unauthorized access, modification, use and dissemination" of information in any form, and also the protection of informational materials and information systems from physical harm. When classified defense information is stored or processed in an automated system, the mutual isolation of users is called the multi-level security problem: the system must permit concurrent processing of information in different security classification categories, while still guaranteeing that no classified material is made accessible, accidentally or deliberately, to those who do not possess appropriate authorizations and security clearances.

Privacy deals with the rights of the individual regarding the collection of information in any record-keeping system about his person and activities, and the processing, dissemination, storage and use of this information in making determinations about him. Threats to individual privacy from manual record-keeping systems are potentially amplified in automated systems mainly because the latter are faster and more efficient, and because they permit linkages between systems and correlation of records on a much greater scale than previously possible.[25]

Privacy and security emerged separately as problem areas in the computer field. The former issue arose with a 1965 recommendation[26] that a data service center (National Data Bank) be established within the federal government. Following Congressional hearings,[27,28] the project was abandoned. Ten years later, after hearings reflecting national concern over the latent danger to individual rights and freedom,[29] the Privacy Act of 1974 was enacted, establishing the Privacy Protection Study Commission whose findings were published in 1977.[30]

The first apprehension over computer security began in the 1950s with concern over the degaussing of magnetic tapes, and preventing dissemination of classified information via electromagnetic emanations. By the mid-1960s, time-sharing and multiprogramming allowed computer systems to serve many users simultaneously, and on-line programming, job execution and data file manipulations could be performed from remotely located terminals. Since that time, solutions to the problem of physical security have been developed,[31,32] but it is only in the last few years that the potential of totally secure software and consequently totally secure automated systems has appeared attainable. Significant work in this area began when the rapidly decreasing costs of digital hardware made economic new, complex but more effective techniques such as the NBS encryption algorithm.[33] More recently, similar approaches by Rivest of MIT, and others,[34] have achieved a degree of success which fully supports our belief that the necessary security will be able to be guaranteed during the time period of concern, using a balanced combination of software, hardware and procedural control. However, considered in conjunction with the need for secure communications in general, DoD requirements may dictate separate and/or parallel systems for some portions of NAPS.

A third issue of concern to the Navy in this context, closely linked with that of privacy, is the Freedom of Information Act, the culmination of a long campaign in the 1960s to open up unclassified records of government agencies so that individuals would have access to information about themselves or information about goverment agency activities involving public matters.[35] There is a central conflict here which must be resolved appropriately to the interest of all parties in each specific context; between the legitimate need of the government (in this case, the Navy) for information about people in order to select the "best" information presentation mode/medium for a particular user, or in the aggregate to plan information systems; and the legitimate desire of the individual for privacy. Furthermore, since privacy safeguards can delay access to information needed for making determinations about an individual or can increase the associated costs, privacy can be in conflict even with the individual's own interests. The major impact of the Freedom of Information Act itself, however, in this context, is the resulting increase in publications burden. Not only must the system be prepared to respond to individual requests for information relating to that individual, but it is charged with informing individuals of their rights in this regard.

3.6 Summary

Because of the variety of topics addressed in this Section, it is appropriate at this point to summarize briefly the implications for the NAPS concept of these separate trends. Along with the increased demand for published information, we have noted increased costs for both manpower and materials. These together contribute to delays in the provision of accurate information, which aggravate the problems of maintenance and repair and are reflected in low levels of operational readiness. In other areas, impatience with such delays has contributed to a large increase in the individual use of copiers. An estimated one billion pages per year[3] are copied on Navy copiers, increasing costs, storage problems and the difficulty of updating. The increase in published information has been accompanied by a proliferation of media (paper, microform, on-line, audio/visual) and increased diversity of forms and formats, topics not addressed directly in this Section, but which are reflected both in decreasing productivity of the printing and publishing sector, and with complexities of storage and retrieval, resulting in the intangible but none the less apparent dissatisfaction of the Navy with its information resource management.

We have discussed the increasing sophistication of equipments which results in greater quantities of documentation for training, maintenance and operation; the decrease in number and intellectual caliber of Navy recruits, which requires the provision of more detailed information for these same tasks, and thus again increases the volume of material to be published. The same personnel limitations make it more difficult to provide satisfactory printing services afloat and, to a lesser extent, in shore support facilities.

Finally, we have mentioned the influence of societal concerns over privacy and freedom of information, and the increased burden of paperwork imposed by the Freedom of Information Act. The privacy issue will be a particularly sensitive area in terms of personnel/medical records, and in the area of matching maintenance/repair information with user profiles to optimize efficiency ("user/data match"). The matter of national security is also of paramount concern in any discussion of information dissemination, particularly when information is presented in ephemeral form and physical precautions for its protection are no longer sufficient. Information stored in forms not directly readable by users can be changed or accessed without leaving traces unless comprehensive audit trails are incorporated into the system design, and can be manipulated electronically from terminals remote from the physical storage of the data. Processing rules are expressed as programs stored in the same devices and in the same manner as the data; they too can be changed without trace. A properly designed and implemented computerized information system, however, can control errors and manage access to the records much more effectively than any manual record-keeping system.

A point made several times in this section, but one which merits repetition, is the critical lack of quantitative data concerning all aspects of Navy publication. An unambiguous categorization schema is urgently needed, to serve as the basis for a focused data-gathering effort. This information is essential not only to NAPS development, but for information resource management accountability.

3.7 Citations and Footnotes

1. An Automated Publishing System for the Naval Educational and Training Command, TAEG Report No. 50 (Orlando, Fla.: Training Analysis and Evaluation Group, October 1977).

2. Baseline Description and Analysis of Operations of the Naval Publications and Forms Center, Philadelphia, Pa.: Overview of Study Results, (Draft), Contract # N00167-78-C0101 (Washington, D. C.: Sterling Systems, Inc., March 1979).

3. Gacek, Dan, NPPSMO, private communication, based on Navy computerized records.

4. King, D. W., et al., Statistical Indicators of Scientific and Technical Communication (1960-1980). Volume II: A Research Report PB-254 060 (Springfield, Va.: NTIS, May 1976), augmented by private communication from the Defense Wage Staff, 9/13/79.

5. Ris, Howard C., "Paper Update", In-Plant Printer, May/June 1979.

6. Machlup, Fritz, et al., Information Through the Printed

Word: The Dissemination of Scholarly, Scientific and Intellectual Knowledge (Draft), New York University, March 15, 1978.

7. Productivity in the Federal Government, Staff Study prepared for the use of the Joint Economic Committee, Congress of the United States. USGPO, Washington, D. C., 1979.

8. Department of Defense Annual Report, FY 1979.

9. A Prediction of Aviation Logistics Requirements, (Draft) Naval Weapons Engineering Support Activity, Washington, D.C., June 1978.

10. Cherny, J. L., NPPS Management Report, delivered at the NAVSUP Management Information Center, 4 December 1978.

11. An Assessment of the Influence of Emerging Technologies and Other Factors on the People and Management of the Coast Guard (Draft Final Report), Forecasting International, Ltd., September 1979.

12. Based on figures provided by U. S. Department of Commerce.

13. Nelson, Gary R., "New Manpower and Logistics Policy Directions", Improved Technical Manuals and Their Impact on Life Cycle Costs, Supplement, Technical Manual Symposium Proceedings, National Security Industrial Association, November 1978.

14. Blinkin, Martin, and Shirley Bach, Women and the Miliary, Brookings Institution, 1977.

15. Frazier, Thomas W., et al., Implications of an All-Digital Navy Technical Information Presentation System, Final Report, Contract # N00019-78-C-0175, Behavior Technology Consultants, Inc., July 1979.

16. The Costs of Defense Manpower: Issues for 1978, Budget Issue Paper, Congressional Budget Office, January 1977.

17. Hart, Franklin A., "Front-End Analysis and the Skill Performance Aids Program", Improved Technical Manuals and Their Impact on Life Cycle Costs, Supplement, Technical Manual Symposium Proceedings, National Security Industrial Association, November 1978.

18. Jencks, Christopher, "What's Behind the Drop in Test Scores", Working Papers, July-August 1978.

19. Briefing on NTIPS (Navy Technical Information Presentation System) by Sam Rainey, Program Manager, DTNSRDC, to James L. Cherny, Director, NPPS, May 3, 1979.

20. A Field Survey of Electronic Maintenance Technical Data, Aerospace Medical Research Laboratories, AFSC, November 1967.

21. Private communication from Mr. James Cherny, Director, Navy Publications and Printing Service, April 13, 1979.

22. Planned Equipment Replacement Program for Shipboard Printing Facilities, NPPS Management Report, Draft, August 1979.

23. Shipboard Logistic Data Communications Study for SNAP II Program, Contract # N00600-76-A-0973, Final Report, SAI Comsystems Corporation, 15 August 1978.

24. Alexander, Clare, Resolicitation: ADS Plan Sizing Data, June 1, 1979.

25. Turn, Rein, and Willis H. Ware, Privacy and Security Issues in Information Systems, ADA 037696, July 1976.

26. Report of the Committee on the Preservation and Use of Economic Data to The Social Science Research Council (Richard Ruggles, Chairman), Washington, D. C., 1965.

27. Special Inquiry on Invasion of Privacy, Hearings, House Committee on Government Operations, Special Subcommittee on Invasions of Privacy, 89th Congress, Parts 1 and 2, U.S. Government Printing Office, Washington, D. C., 1966.

28. Computer Privacy, Hearings, Senate Committee on the Judiciary, Special Subcommittee on Administrative Practice and Procedure, U.S. Government Printing Office, Part I: 1967, Part II: 1968.

29. Privacy--The Collection, Use and Computerization of Personal Data, Joint Hearings, Ad Hoc Subcommittee on Privacy and Information Systems, Senate Committee on Operations, and Subcommittee on Constitutional Rights, Senate Committee on the Judiciary, 93rd Congress, 2nd Session, 1974.

30. The Report of the Privacy Protection Study Commission USGPO, July 1977.

31. Guidelines for Automatic Data Processing: Physical Security and Risk Management, AFIPS Publication No. 31, National Bureau of Standards, Washington, D. C., 1974.

32. AFIPS System Review Manual on Security, AFIPS Press, Montvale, New Jersey, 1974.

33. "National Bureau of Standards Encryption Algorithm," Federal Register, March 17, 1975.

34. Rivest, Ronald L., Adi Shamir and Len Adleman, On Digital Signatures and Public-Key Cryptosystems (Technical Memo 82) Massachusetts Institute of Technology, April 1977. For a review of progress in this area, see for example Hellman, Martin E., "The Mathematics of Public-Key Cryptography", Scientific American Vol. 241, No. 2, August 1979.

35. Bell, Daniel, "Communications Technology -- for better or for worse", Harvard Business Review, May-June 1979.

SECTION 4

4. SYNTHESIS OF FINDINGS

4.1 Problems to be Addressed by NAPS

Sections 1 and 3 of this report examined some of the problems which affect the publication and dissemination of Navy information packages today and are likely to do so in the future, and also reviewed some of the constraints which will affect any proposed solution to these problems. For example, the poor quality of much of this printed material is due, in part, to the combined effects of the requirement for commercial procurement and the selection of the lowest qualified bidder. The study team has no desire - nor charter - to propose that either of these policies be abandoned. However, it is possible to change their effects upon the Navy's printing and publishing system, by changing the nature and structure of that system.

From the extensive literature review, and the interviews with personnel from both industry and the Navy, which were conducted as a part of this study, a large list of such problems was identified which bear directly or indirectly on the NAPS concept. Some of these have been discussed in detail in this text, others have been mentioned only briefly. They do not constitute a consistent set, being collected from such a wide spectrum of sources. Possibly it is not a complete set, either, although it is unlikely that major problem areas have been overlooked. Apart from eliminating outright duplicates, and compressing original problem statements, the study team has made no significant changes in summarizing these identified problems in the following categories:

Quality:

- Poor quality of printing procured commercially.
- Poor formatting.
- Delays in updating cycle for technical information.

Quantity:

- Increased production of print-on-paper.
- Paper wastage due to poor formatting.
- Paper wastage due to discarding poor copies.

Paper wastage due to unnecessary replication of forms, documents, etc.
Paper wastage due to discarding obsolescent material.
Increased production requirements of the Commands, especially CNET.
Growth in technical information per system.
Heavy use of Navy copiers.

Time Delay:
Lag time between delivery of hardware and delivery of technical information.
Turnaround time in filling requests for printing.

Convenience/Efficiency:
Lack of interface with word processors at which material is originated.

Cost:
Information generation is budget-constrained.
Increasing labor costs.
Increasing equipment costs.
Increasing paper costs.
Increasing site support costs.
Increased costs of information resource management.
Increased per-item costs of publication.

Regulation:
JCP regulations on commercial procurements.
Wartime contingency capability must be maintained.
Classified printing and publication must be done in-house.
Paperwork burden imposed by government regulations in general and the "Freedom of Information Act" in particular.
Interface with areas of responsibility oriented towards "Automated Data Processing".

Management:
Increased diversity of media.
Increased diversity of forms, documents, etc.
Control of information is more difficult as paper production increases.
Retrieval of information is more difficult as paper production increases.
Lack of skilled personnel to implement new technologies.
Budgetary limitations impeding improvement of in-house publication capabilities.
Necessity for shore rotation of military lithographers.
Productivity is poor in office tasks.

Productivity is poor in the Federal printing and publishing sector.
Quantitative publication workload data are inadequate/unavailable.

Other:

Depletion of paper as a natural resource.
Security considerations.
Privacy/confidentiality considerations.

The categorization of these problems in many instances was highly arbitrary. In some cases, also, an entry is a consequence of one or more of the other problems listed. Issues which were specifically addressed in Section 3 but not included here since their primary implications for NAPS are in the concomitant increased burden on publication services, concern increased sophistication of weapons systems and ancillary equipment, and problems associated with armed forces recruitment and training.

In Exhibit 4.1, the problems here identified are associated with suggested mechanisms for their potential solution. For example, under the category of "Time Delay", entry 13 relates to the long turnaround time in filling requests to NPPS for printing services. While automation is certainly indicated as a means of reducing this delay, the study team believes that this approach will be effective only if it is accompanied by the imposition of appropriate media and format standards, an integrated management structure, and essential training/education programs. It may also be desirable to review and conceivably modify JCP regulations regarding commercial procurement (in wording only, not in intent), to avoid breaking the electronic chain which maximizes preparation and production efficiency.

In the following subsection, we review briefly the current status and anticipated developments in the printing and publishing industry. Subsequently, we examine supplemental technological opportunities for addressing the problems identified here, based upon an extensive evaluation of the state-of-the-art, and forecasts, the details of which will be found in Appendix B.

4.2 Printing and Publishing

4.2.1 Introduction

It is difficult to prepare either a state-of-the-art analysis

EXHIBIT 4.1

PUBLICATION-RELATED PROBLEMS AND MECHANISMS OF POTENTIAL SOLUTION

Problem Areas \ Mechanisms for Potential Solution	Automation	Management	Regulation	Standardization	Training/ Education	Comments
Quality:						
1. Poor quality of commercially procured printing	x	x	x	x		Quality would improve with automated composition. Minimal amount of printing procured commercially without automated composition.
2. Poor formatting	x	x		x	x	Formatting greatly improved by automation and enhanced page make-up capabilities (Reference TAEG 50).
3. Updating delays	x	x				Updating of on-line data bases much simpler than for multiple document repositories. Minimal number of paper copies, can be easily replaced in updated form using demand printing concept.
Quantity:						
4. Increased production of print-on-paper	x					NAPS emphasizes opposing trend.
5. Paper wastage due to poor formatting	x	x		x	x	See comment on problem #2, above.
6. Paper wastage due to discarding poor copies	x	x	x			See comments on problems #1 and 4, above.
7. Paper wastage due to unnecessary replication of forms, etc.	x	x				See comment on problems #3 and 4, above. Also NAPS changes the entire forms-handling process.
8. Paper wastage due to obsolescence	x	x				See comment on problem #3, above.
9. Increased production requirements of CNET & other Commands	x	x				It is anticipated that per copy costs will go down with the implementation of NAPS, and certainly production capabilities will increase.

EXHIBIT 4.1 (Continued)

Problem Areas \ Mechanisms for Potential Solution	Automation	Management	Regulation	Standardization	Training/ Education	Comments
10. Growth in quantity of technical information per system	x	x				See comment on problem #9. Also with automation there will be less duplication of information base where systems have common components.
11. Heavy use of Navy copiers	x	x				Reduced time-lag in provision of needed information, forms etc. will reduce incentive to make extra copies.
Time Delay:						
12. Lag time between hardware and technical information delivery	x	x		x		See comments on problems #9 and 10.
13. Turnaround time in filling requests for printing	x	x	x	x	x	See comment on problems #7 and 9. Also electronic transmission is much faster than physical transportation of documents.
Convenience/Efficiency:						
14. Lack of interface with word processors at which material is originated	x	x		x		Such an interface is implicit in the NAPS concept.
Cost:						
15. Information generation is budget-constrained	x	x		x		See comment on problem #9.
16. Labor costs are increasing	x					Human effort will be replaced by automation to the extent possible.
17. Equipment costs are increasing	x					Integration and coordination will permit maximum usage of equipment, reduce unnecessary duplication of equipment.
18. Paper costs are increasing	x					Paper usage will decrease.
19. Site support costs are increasing	x					Unnecessary duplication of facilities at different sites will be reduced, while distributed processing concept will maintain or increase capabilities.

EXHIBIT 4.1 (Continued)

Problem Areas \ Mechanisms for Potential Solution	Automation	Management	Regulation	Standardization	Training/ Education	Comments
20. Increased costs of information resource management	x	x		x	x	Observed trends have been for automation to improve management capabilities, reduce cost. This needs to be confirmed by detailed cost benefit analyses at later stages of planning NAPS implementation.
21. Increased per-item costs of publication	x	x		x	x	See comments on problem #20.
Regulations:						
22. JCP regulations regarding private sector			x			The intent of JCP regulations for commercial procurement can be preserved by adopting appropriate implementation strategies as recommended. The specific industrial segment supported may shift from printing shops to communications/processing facilities. Other considerations regarding in-house capabilities and wartime contingencies are incorporated in the implementation strategies.
23. Wartime contingency capability must be maintained						See comments on problem #22.
24. Classified printing and publication must be in-house						See comments on problem #22.
25. Paperwork burden imposed by government regulations	x			x		Cannot be solved, but will be eased by NAPS concept.
26. Paperwork burden of responding to FOIA* requests	x			x		Cannot be solved, but will be eased by NAPS concept.

*FOIA: Freedom of Information Act

EXHIBIT 4.1 (Continued)

Problem Areas \ Mechanisms for Potential Solution	Automation	Management	Regulation	Standardization	Training/ Education	Comments
27. Paperwork burden of informing of FOIA rights	x			x		Cannot be solved, but will be eased by NAPS concept.
Management:						
28. Increased diversity of media	x			x		Media diversity may not be reduced, but coordination and interfacing are implicit in NAPS concept.
29. Increased diversity of forms, documents	x	x		x		Simplified by NAPS concept. However, standards must be developed and enforced as part of the implementation strategy.
30. Control of information is more difficult as production increases	x			x		Management is facilitated by the NAPS concept and especially the meta-system.
31. Retrieval of information is more difficult as production increases	x			x		NAPS solves this problem.
32. Lack of skilled personnel to implement new technologies	x			x		Must be addressed in implementation strategy.
33. Budgetary limitations impeding in-house improvement						Must be addressed in implementation strategy, but see comment on problem #9.
34. Necessity for shore rotation of fleet lithographers	x				x	Must be addressed in next phase of NAPS program.
35. Productivity poor in office tasks	x			x	x	Automation demonstrably improves productivity.

EXHIBIT 4.1 (Continued)

Problem Areas / Mechanisms for Potential Solution	Automation	Management	Regulation	Standardization	Training/ Education	Comments
36. Productivity poor in printing and publishing	x			x	x	Automation demonstrably improves productivity.
37. Quantitative workload data not available	x	x				Must be addressed in next phase of NAPS program.
Other:						
38. Depletion of paper resource	x					Paper usage will decrease.
39. Security		x				Can be achieved as desired. Will be fully demonstrated in next phase of NAPS program.
40. Privacy/confidentiality		x				See comments on problem #39.

or a forecast of capabilities in the printing and publishing industry, in part because of the difficulties discussed in Section 1 concerning changing definitions and terminology, and in part because of the lack of meaningful quantitative indicators. A variety of substantive analyses have been prepared, however, in the course of recent studies (see for example references 1 through 6 in subsection 4.4). The reader is referred to these sources, whose content will not be duplicated here. Consequently, this discussion will not attempt to be exhaustive, but rather will address a few significant features and recent developments regarding this broad subject.

Navy publishing generally entails the mass production of documents such as instructions, standards, forms, manuals, catalogs, directories and reports. At present, most of this employs paper as a medium, although large-scale conversions to microfilm are in process.[7] Two systems currently operated by the Navy are of particular interest in this context, since they differ markedly from the conventional process to be described in the following subsection. The first of these, TRUMP (Technical Review and Update of Manuals and Publications)[8] is used by NAVAIR to convert existing technical manuals to microfilm, and subsequently provide automated updating of the microfilm copies. System input for text is by 35 mm microfilm, which is scanned by an image processor and subsequently stored in magnetic core memory. Graphics are merged later from 105 mm film. The output film is processed and duplicated, or used to make printing plates. A NAVSEA system, ADPREPS (Automated Document Preparation System)[9] is used to prepare new technical documents. High speed photocomposition is employed, to prepare camera ready copy from cassette tapes produced at video display terminals. Graphics are added manually. The final document is published by the NPPSO in paper or micrographic form.

In the following paragraphs, we review briefly current practice and anticipated developments in publishing. For the long term, however, as implied throughout this report, we see the primary focus shifting to electronic distribution in the context of Navy non-tactical information. The technologies pertinent to this concept are discussed below, in section 4.3. Consequently, in section 4.2.3, the discussion of anticipated developments is directed toward an overview of publishing practices rather than towards the technologies themselves.

4.2.2 State-of-the-Art

The use of electronics and computer techniques in all phases of publishing is rapidly spreading throughout the industry. Already the vast majority of U.S. newspapers are published electronically from the initial keying of a story by a reporter through to the composition and typesetting of composed galley. In the case of magazines, the concept has expanded to encompass full page composition, including all illustrations, as well as electronic transmission for typesetting at remote printing facilities. At the other end of the process, the Library of Congress no longer maintains a vast pre-printed inventory of its library cards from recent years, but prints cards electronically "on demand" for a specific user, using a laser xerographic printer and a magnetically stored data base.

A publishing system includes in general the following broad functions:

- o text input/edit
- o graphic input/edit
- o composition/typesetting
- o replication

These are examined individually in the following subsections.

4.2.2.1 Text Input/Edit

This may be accomplished in either interactive or batch mode, the former process utilizing simple keyboards or video display terminals (VDT), while batch mode involves OCR reading of previously typed materials, magnetic input, or microfilm. The output of the keyboard or VDT may be routed on-line to other equipment for composition, etc., or it may be stored (on tape or disk) for later batch input.

Optical character recognition of handwritten text, or voice input, are not employed in production runs at this time, except for experimental purposes. Available OCR devices generally impose strict limitations regarding the format and the kinds of acceptable handwriting; equipment purporting to be free of such constraints has thus far proved unreliable, and very slow because of the frequent need for operator intervention. The present use of voice recognition is limited by small vocabularies, simple syntax and/or restricted population of speakers. It is more applicable at this time to applications such as process control rather than to the field of publication.

However, as stated previously, both of these techniques are being investigated, and it is anticipated that voice input at least will be incorporated in NAPS-2000.

Most commonly, the greatest benefits can be derived from new technology if the data can be "captured" as early in the editorial/production process as possible, and advantage taken of electronic tools from that point forward. These tools include the capability of on-line editing, revision of previously input material, multiple use of previously input material, text analysis, and very powerful formatting and output controls. This formatting function can frequently be accomplished without requiring that the user imbed esoteric commands in the text file.

4.2.2.2 Graphic Input/Edit

At present, some forms of graphics (e.g. photographs and line graphs) can be processed electronically, but only at considerable cost,[10] and by the use of extensive storage. One continuous tone drawing of television quality, for example, requires about 10^5 bits.[7] Most graphics are handled separately from text in the form of micrographics, as in TRUMP and ADPREPS previously mentioned, or by using data compression or reduction techniques.

The NTIPP study, previously cited, estimated that 30 to 40% of the pages in technical manuals contain some form of graphic. Origination and updating are therefore highly labor intensive where separate handling is required, and this limits the improvement in total production time which can be achieved through further automation of text handling procedures.

There are thus major advantages to be gained by data compression/reduction through digitization, but progress in these areas is slow. Video disk and other mass storage technologies will be beneficial in allowing the merging of text and graphics in digital form, with consequent reduction in storage requirements, but the problems of drafting and editing graphics remain. Improvements here will come first through graphic software research and better use of dual media, for example a plasma display which can combine a projected image with a digitally generated display.[7]

The combination of digitized graphics and interactive displays provides a powerful tool for page makeup. U.S. News and World Report has been producing all editorial pages in this fashion since mid-1977. All line-art, half-tones and screen tint backgrounds, including colored screens and spot color, are digitized and stored in an (Atex) text processing computer. Pages are set on a CRT typesetter at the central office for proof purposes, and transmitted electronically to remote printing plants, where they are "typeset" on film which is used to make printing plates. By the end of 1980 they are expecting to use interactive graphic display tubes to speed the process of assembling page elements, and will also digitize and transmit color separation. Ultimately an increasing number of firms will adopt this approach, especially where complete pages are to be output to an electronic printer or laser plate-maker.[6]

4.2.2.3 Composition and Typesetting

Because composition involves a large number of judgmental decisions concerning the best use of space, necessary relationships between text and graphics, as well as aesthetic appearance, it is highly labor-intensive. Recent efforts have focused on photocomposition or electronic composition as a substitute for linotype and monotype processes. Electronic composition has advanced to the stage where there now exist:[11]

- Systems employing cathode ray tubes to place images on film, photographic paper or plate material;
- Systems employing either off-line digital computers or internal logic to perform the functions of hyphenation, line justification and page makeup;
- Systems producing multiple fonts of proportionally spaced characters; and
- Systems producing final output with a line resolution of not less than 600 lines per inch.

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Coupled with these developments is the emerging role of photocomposition in the typesetting industry. The advantages offered by these techniques differ according to the application, however. One-time works are not necessarily produced most economically by a computer, except where page makeup of some complexity is involved.

A typical example of the state-of-the-art in photocomposition devices is the Information International high performance COM unit, with composition and typesetting, used in TRUMP. It is expensive and relatively slow for its price range, but unique in its ability to merge text and graphics.[7]

Composition systems for formatting, page makeup, and the inclusion of digitized graphics will see great advances in technology and functional richness in the next several years. Systems capable of performing each of the necessary functions have already been demonstrated, but integrated systems remain deep in the research laboratories, as yet.

Improvements to come include systems which are capable of dealing with form and content simultaneously, systems with (perhaps interactive) hyphenation and justification routines which are adaptive as the page layout changes, and display the results immediately to the user, systems capable of the interactive creation and scaling of synthetic line art, and systems capable of the inclusion of all of these, together with scanned-in art and pictures, in interactive page makeup. Increasingly, such systems will also possess the capability to deal with color specifications for text and synthetic graphics and with digital color separations for scanned-in graphics and pictures.6

4.2.2.4 Replication

Under this heading are included paper printing, reprographic copying and film copying. The first of these is a well-established technology. The machinery for high production levels is sophisticated and expensive, so that new developments are introduced infrequently. Plate making and binding constitute the major bottlenecks in what is, overall, a high speed operation.

The reprographics area has benefited from recent technological advances, supported by automated document feed, and output collating and binding. However, the cost per copy remains high compared to printing, and its use should therefore be restricted to low quantity applications.

Demand printing is a concept which originated in the microfilm market, where a "master" stored on magnetic tape in a central location (or at many distributed locations) is used to produce a microfilm and subsequently a limited number of printed copies only in the number needed. The process is fast and economical, and publications support can be local, thereby avoiding long publications turnaround time, reducing packaging and transportation costs, and eliminating or reducing the need for large central document repositories. The term is now applied also to the production on demand of single paper copies of electronically stored information from on-line data bases.

One of the more recent developments in electronic publishing has been the introduction of laser xerographic output printers capable of producing reasonable facsimiles of graphic arts quality typefaces, and of including these along with line graphics and perhaps halftones on fully made-up pages. These devices are capable of producing the entire press run of limited-distribution publications directly from the electronic memory to the final printed page. It is one of these devices--a modified version of the Xerox 9700--which forms the basis for the Library of Congress' card printing system mentioned earlier.

Electronic printing using laser xerography has also been applied to the color xerographic marking engine. This type of electronic publishing output has applications even at the high-quality end of the spectrum for publications in which the final product is to be typeset and printed on gravure or offset color presses. The electronic color printer allows pre-press proofing of color masters without extensive (and messy) photographic techniques, which produce colors that are at best approximations to those which are obtained from a printing press, since they (unlike the xerographic ones) are formed in a different way.[6]

4.2.3 Anticipated Developments

A major concern is the increasing volume of material published, a topic touched upon earlier, in Section 3; publications have been increasing almost exponentially throughout this century, the precise rate of growth depending on the subject area. This point is further demonstrated in Exhibit 4.2, which shows the total sales of U.S. printing, publishing and allied industries since 1950, projected to 1990.[12] The micropublishing area is growing at an even faster rate. The dollar value of micrographic equipment sales and rentals for micropublishing[13] is shown in Exhibit 4.3 (note change of scale compared to Exhibit 4.2). In 1970 microfilm represented .25% of the total printing paper market; by 1985 it is projected to have reached 1% of the total.[13] Total revenue of the micropublishing industry was $57 million in 1972, and is anticipated to reach $400 million by 1980.[14]

The techniques employed within the industry are also changing rapidly. Within the realm of "traditional" typecasting, the time interval between the introduction of new techniques (Exhibit 4.4) has decreased to the point where changes are continually occurring in some portion of the industry,[15] and the whole concept of typecasting is rapidly becoming obsolete. New printing equipment has abolishhd the use of molten lead; the stereotype plate, a piece of metal upon which a raised impression of the type has been implanted for letterpress printing, is now frequently a flat photographic impression for offset printing.[16] The plate itself can be abolisned, and printing can be accomplished directly from the original without the use of an intermediate plate or master.[17] A computer can print directly onto paper the material required, or send it on a telephone wire to a home printer, or through the air to a television receiver. Although to date computerization has concentrated primarily on processes (e.g. electronic composition) clearly within the bounds of traditional printing, the introduction of non-impact page printers (e.g. IBM-3800) and computer output microfilm have transcended those bounds. More recently, Xerox has introduced its 9700 Electronic Printing System which operates at the speed of 2 copies per second and provides multi-font composition capabilities. This cannot be considered a substitute for line printers, but is more properly a combination of photocomposition and electrostatic duplicating

EXHIBIT 4.2

TOTAL SALES OF U.S. PRINTING, PUBLISHING & ALLIED INDUSTRIES

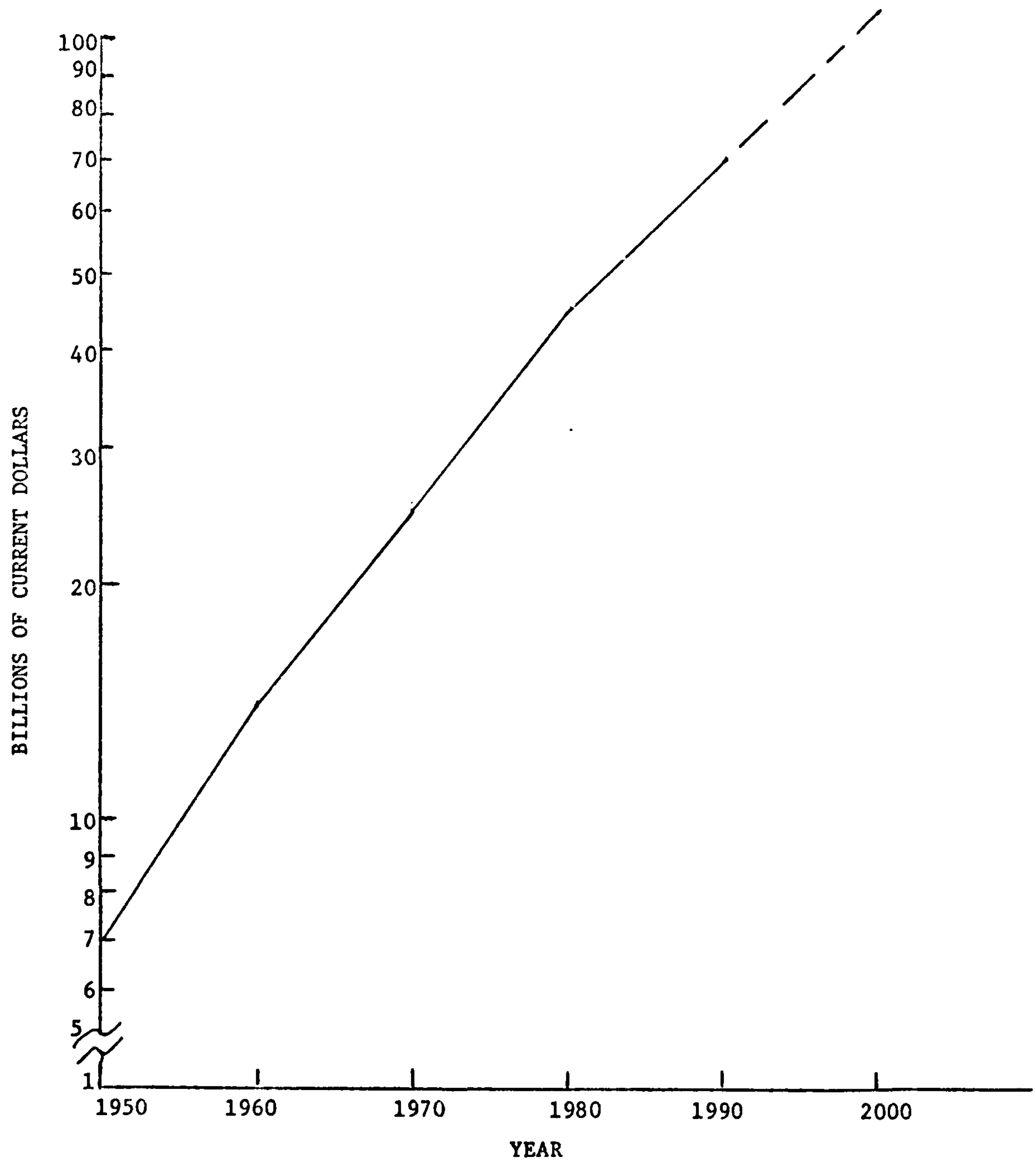


EXHIBIT 4.3

SALES AND RENTALS OF MICROGRAPHIC EQUIPMENT FOR MICROPUBLISHING

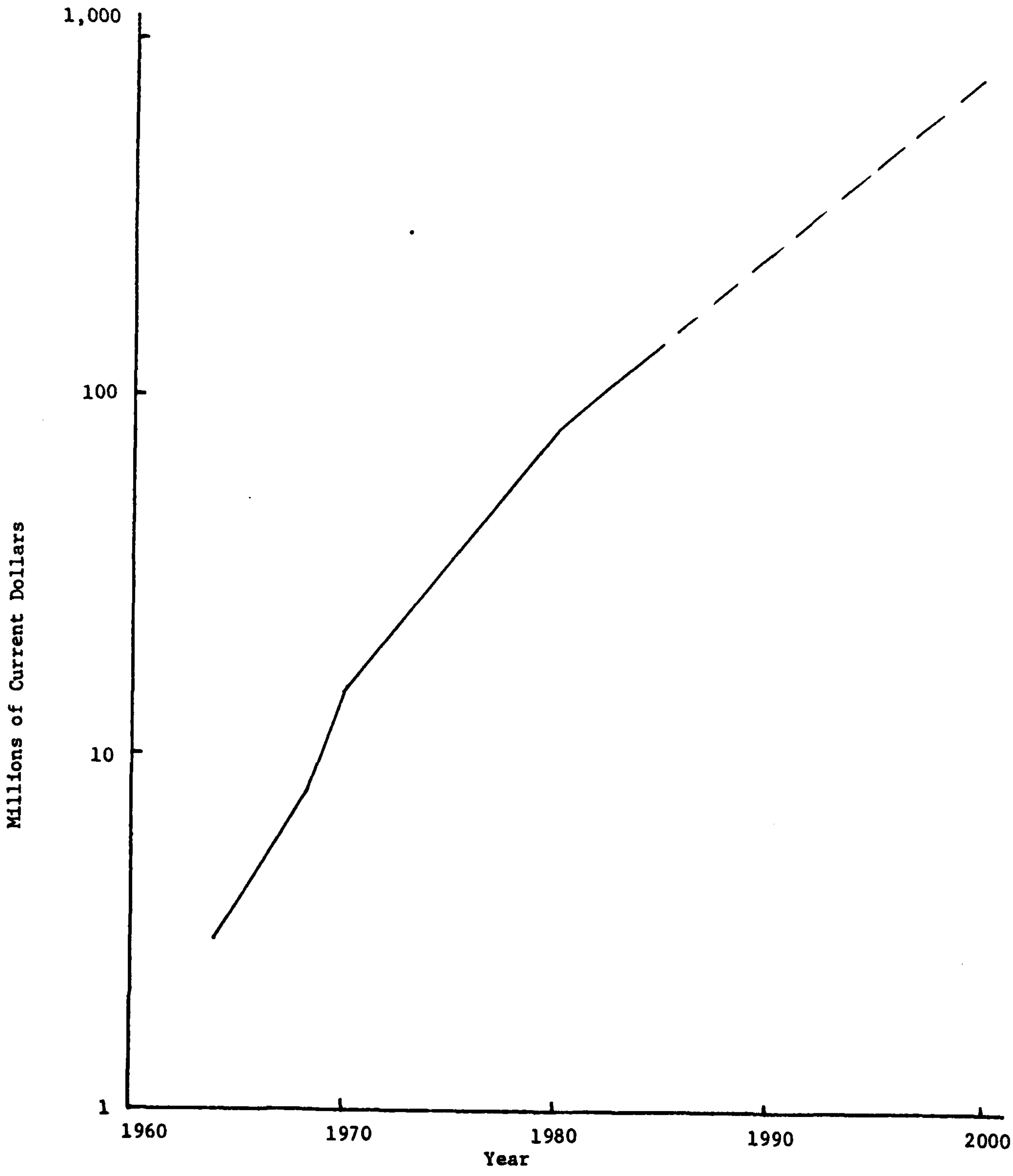
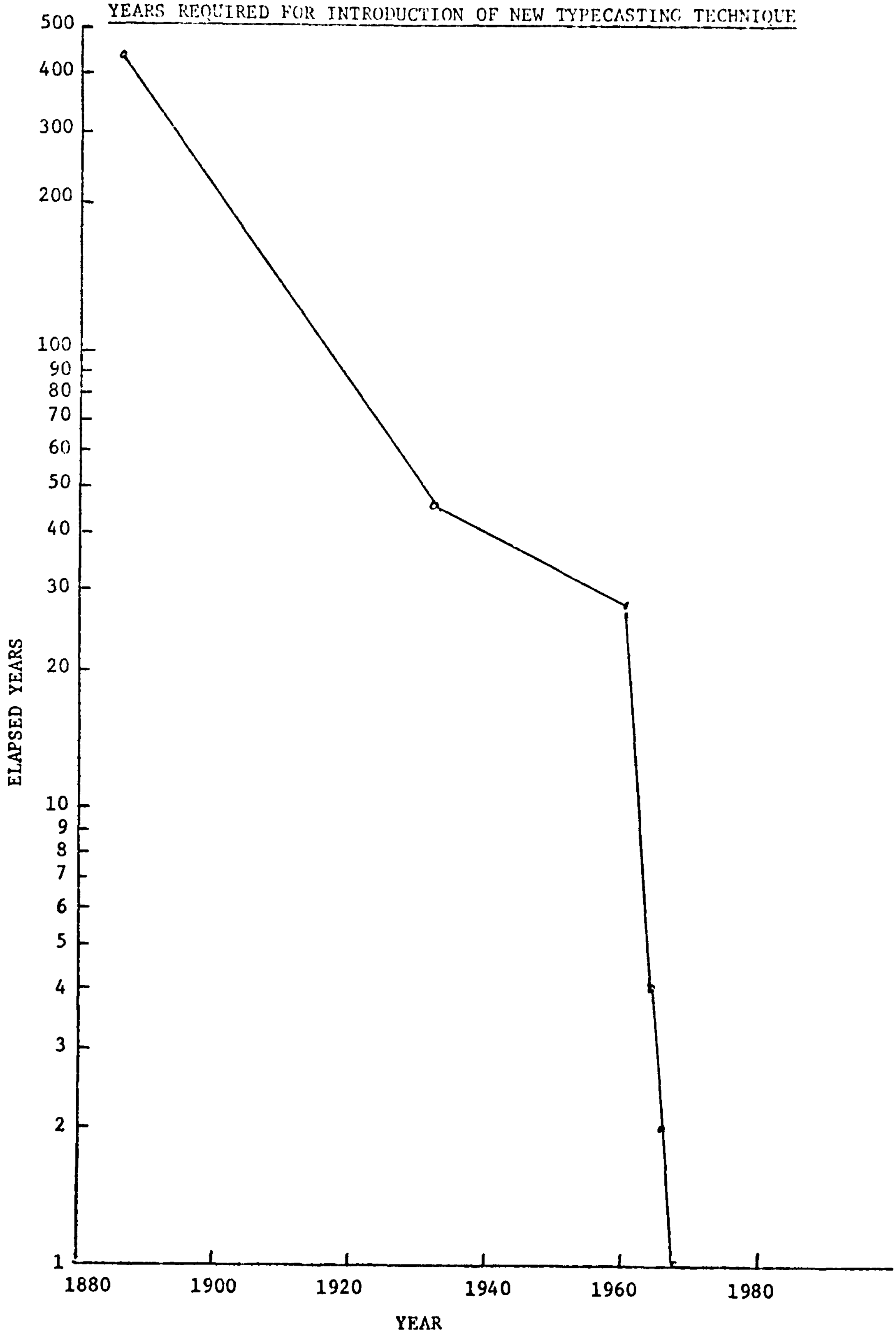


EXHIBIT 4.4

YEARS REQUIRED FOR INTRODUCTION OF NEW TYPECASTING TECHNIQUE



equipment. With a monthly production capability in excess of one million copies, the present cost of the Xerox 9700 constitutes the only factor prohibiting mass installations.[17]

These technological advances are having a marked effect on the industry. An estimate by Dataquest, Inc. of the volume of hard-copy business document generation throughout the United States in 1978 indicated that 28.8%, or 220 billion copies, were generated on computer-driven printers, and 52.3% (411 billion) on copiers or on xerographic and/or conventional duplicators.[17] By 1983, electronic printers are anticipated to satisfy 40% of this (business) market, and 51% by 1998.[18] This growth will be stimulated by many factors, including: faster and lower-cost communications (both local and cross-country); increasing costs and decreasing availability of clerical employees; larger and cheaper data banks, plus automated document storage and retrieval; improved performance, features, reliability and costs of electronic printers; the availability of high quality graphics and multi-color capability; and higher paper costs and paper shortages.

This change will occur not only in business communications. Lancaster predicts, on the basis of a Delphi survey, that by 1988 25% of all newly published technical reports will be published *only* in electronic form, and by the year 2000 this figure will rise to 90%.[19] Of even more significance is his estimate that this percentage (90%) of electronic publication for such reports could be *technologically* feasible by 1981, and *economically* feasible by 1992.

The anticipated percentages of copy volume produced using the four primary imaging technologies are shown in Exhibit 4.5.[18] Other contributing technologies are: fiber optic xerography (3% in 1983, 10% by 1998); electrostatic styli (3% decreasing to 2%); and thermal matrix (steady at 2%). The dominant technologies for various time frames, in terms of output copy volume, are listed in Exhibit 4.6.[18]

Note that laser xerography is expected to be both the fastest growing technology, and the dominant technology for high speed (greater than 40 copies per minute) production of hard copy, throughout the rest of the century. This is the technique used by both the Xerox 9700 and the IBM 6670.

EXHIBIT 4.5

PERCENTAGE OF ELECTRONIC PRINTER COPY VOLUME PRODUCED BY VARIOUS TECHNOLOGIES

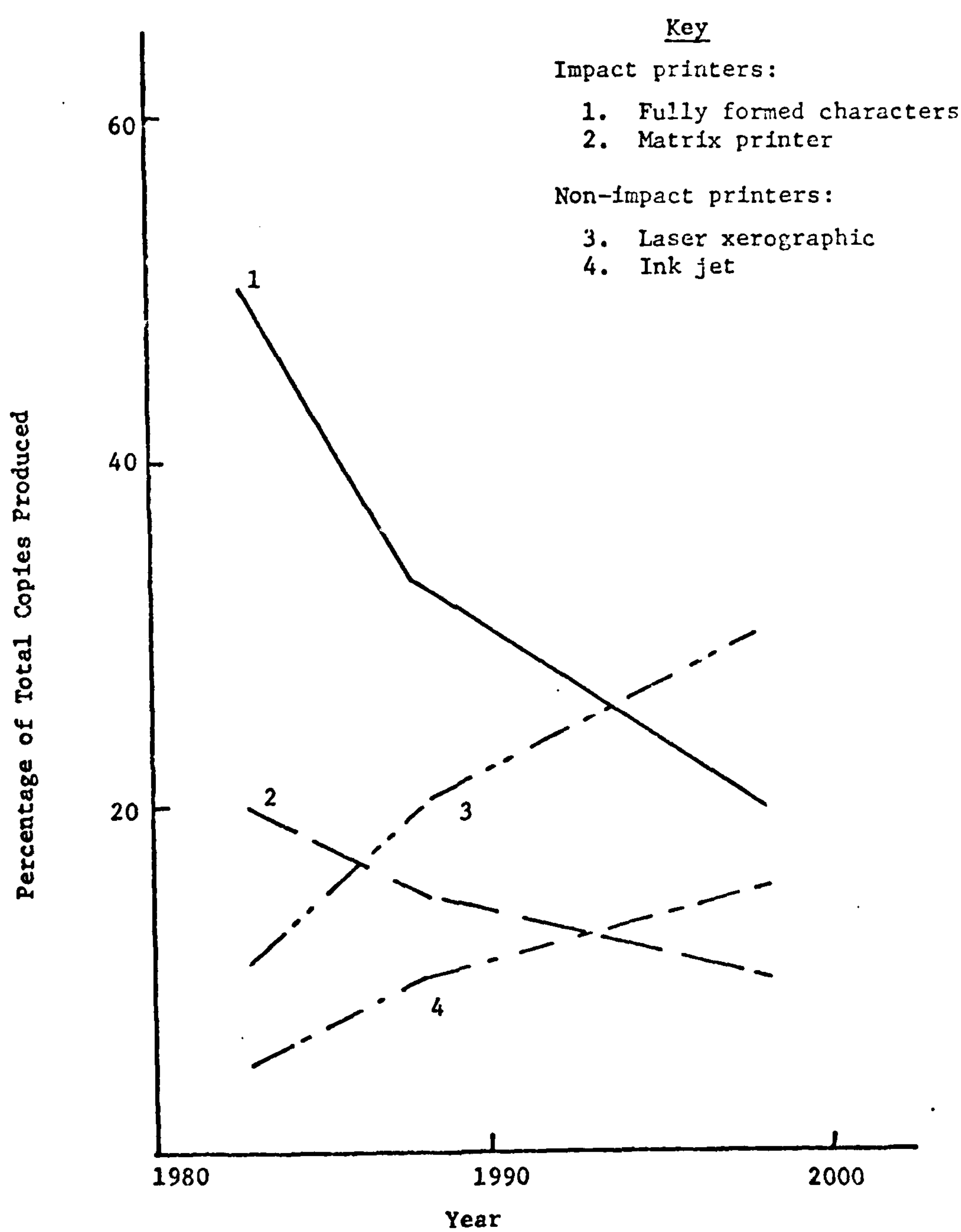


EXHIBIT 4.6

DOMINANT TECHNOLOGY BY COPY VOLUME AND TIME FRAME

Copy Volume	Year 1983	1988	1998
0 - 20 copies/min.	1	1	4
21 - 40	1	2	4
41 - 75	3	3	3
76 - 100	3	3	3
Over 100	3	3	3

Key:

1. Impact - fully formed characters.
2. Impact - matrix printer.
3. Laser xerography.
4. Ink jet.

In summary, the major trend in recent years and for the foreseeable future is for an increasing application of electronic techniques in all aspects of publishing. While computer-based text processing and typesetting systems have been available for almost 20 years, the commercial use of video terminals for text editing has spurred a major revolution. The first electronic newsroom system was installed at the Detroit News in 1972. Since then, virtually every sizeable U.S. newspaper has installed or plans to install such a system. Some are already on a second generation system, and these are now invading magazines, government agencies and "in-plant" documentation centers.

In the long run, however, electronic publishing systems will do more than provide a better means of producing "traditional" published materials. They also provide a bridge into a world in which information is stored and transported in digital form rather than as images on paper. With the increased integration of electronic processes into the publishing industry, it becomes less efficient arbitrarily to break the electronic chain of information delivery from generator to user. Digitally stored information may be transferred to paper when, where, and as needed. It may never be transferred to paper at all. The "publisher of the future" may think of himself as being in the information business rather than the document publishing business.

4.3 Technological Opportunities

4.3.1 Introduction

A spectrum of technologies potentially applicable to the NAPS concept was examined in terms of the current state-of-the-art, together with quantitative or qualitative forecasts for the time period of concern. The major hardware categories, from the point of view of NAPS, may be identified as follows:

- o Central processing
- o Main memory
- o Mass storage
- o Input
- o Output
- o Communications channels.

In the following subsections, each of these technology areas is reviewed briefly, in terms of those characteristics of value in this application, and their anticipated trend over the evolutionary development periods of NAPS, i.e. the present status, and projections for 1985, 1990 and 1995. This information is presented in summary form in Exhibit 4.7. The Section concludes with an outline of two special applications of particular concern to NAPS.

4.3.2 Central Processing

The architecture of the information handling system has been based until recently upon the central processor as hub, with main memory, mass storage and communications interfaces, structured as in Exhibit 4.8 Two developments have been occurring in parallel which affect the central processor concept: the evolution and subsequent of blurring of the distinction between mainframes, mini-computers and micro-computers (based originally on size and price); and distributed processing, wherein the processing is shared between multiple units (mainframes, minis, etc.) working in synchronous or, more commonly, asynchronous fashion.

Key characteristics for the central processor, in whatever manifestation, are measures of performance and of cost. Performance can be evaluated in terms of speed (e.g. average operations per second), or as a composite in terms of operations per dollar (or the inverse, cost per operation). For all three processor categories, cost is decreasing and performance is increasing almost exponentially, and these trends are anticipated to continue through the remainder of the century. In the smaller units, however (micros and small minis), the cost decrease may not be as apparent, since greatly enhanced capabilities are being offered to users commercially, with little or no decrease in price, as opposed to drastically reduced prices for equivalent capabilities.

A more qualitative criterion for evaluating processors is the ability to perform complex operations. This capability is also increasing, particularly with the smaller units.

Reliability is also increasing at a dramatic rate, to the extent where it is no longer a key factor in the decision to purchase. Environmental constraints have also disappeared to a large

EXHIBIT 4.7

SOTA AND FORECASTS FOR MAJOR SYSTEM COMPONENTS

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
1. Central Processors						
1.1 Main Frames						
1.1.1 Cost Performance (Leading Edge)	M Ops/Dollar	50	167	500	1670	Dollars are monthly rental.
1.1.2 Speed						
1.1.2.1 Leading Edge	M Ops/Second	3.0	30	200	1000	
1.1.2.2 Average	M Ops/Second	0.3	3	20	100	Calculation based upon main memory speed ratios.
1.2 Mini-Computers						
1.2.1 Speed	M Ops/Second	1.0	3	9	30	
1.2.2 Cost	K$	15	10	7	5	Estimated for performance level indicated in 1.2.1.
1.3 Micro-Processors						
1.3.1 Speed	M Ops/Second	1.0	3	9	30	
1.3.2 Cost	$	10	5	2	1	Estimated for performance level indicated in 1.3.1.

EXHIBIT 4.7 (Continued)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
2. Main Memory						
2.1 Cycle Time						
2.1.1 Leading Edge	NS	50	10	2	1	
2.1.2 Average	NS	500	100	20	10	
2.2 Capacity						
2.2.1 Minimum	M Bits	10	20	60	250	For leading edge systems
2.2.2 Maximum	M Bits	100	300	1000	3000	For leading edge systems
2.3 Cost						
2.3.1 High Performance	Cents/Bit	0.6	0.1	0.03	0.006	Bipolar
2.3.2 Low Performance	Cents/Bit	0.05	0.007	0.0008	0.0001	MOS

EXHIBIT 4.7 (Continued)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
4. Input						
4.1 Keyboards						
4.1.1 Cost	K Dollars	1.0	0.75	0.50	0.375	Based on the price of a "dumb" terminal
4.2 Optical Character Readers						
4.2.1 Reading Speed	Characters/Second	250	500	1,000	2,000	
4.2.2 Cost	K Dollars	50	25	15	10	
4.3 Voice Input						
4.3.1 Character Set	Sounds	200	500	1,000	1,000+	
4.3.2 Cost	K Dollars	75	25	15	10	

EXHIBIT 4.7 (Continued)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
5. Output						
5.1 Hard Copy						
5.1.1 Terminal Printer						
5.1.1.1 Output	Characters/Second	45	60	75	90-100	
5.1.1.2 Cost	K Dollars	1.0	0.75	0.50	0.375	Same as Keyboard (4.1.1)
5.1.2 High Speed Printer						
5.1.2.1 Output	M Characters/Second	1.0	1.5	2.5	5.0	Intelligent-Page Printers
5.1.2.2 Cost	K Dollars	200	150	100	50	
5.2 Soft Copy						
5.2.1 Screens						
5.2.1.1 Characters Per Frame	K Characters	2.0	2.5	3.0	3.5	Output Mechanism Only
5.5.1.2 Cost	K Dollars	0.6	0.2	0.05	0.025	
5.2.2 Audio						
5.2.2.1 Character Set	Sounds	500	1,000	2,000	4,000	
5.2.2.2 Cost	K Dollars	150	50	25	10	

EXHIBIT 4.7 (Continued)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
6. Communications Channels						
6.1 Voice Grade Land Lines						
6.1.1 Number of Telephones in U.S.	Millions	160	190	220	250	
6.1.2 Channel Miles	M Channel-Miles	$2.5 \cdot 10^3$	$6 \cdot 10^3$	$15 \cdot 10^3$	$35 \cdot 10^3$	
6.1.3 Cost	Dollars/Hour	9.0	7.5	6.0	5.0	
6.2 Satellite Channel						
6.2.1 Number of Commercial Wideband Channels	Number (Approximate)	400	1500	4,000	12,000	Source: J. Martino...
6.2.2 Cost	Dollars/Channel/Year	150	50	20	10	

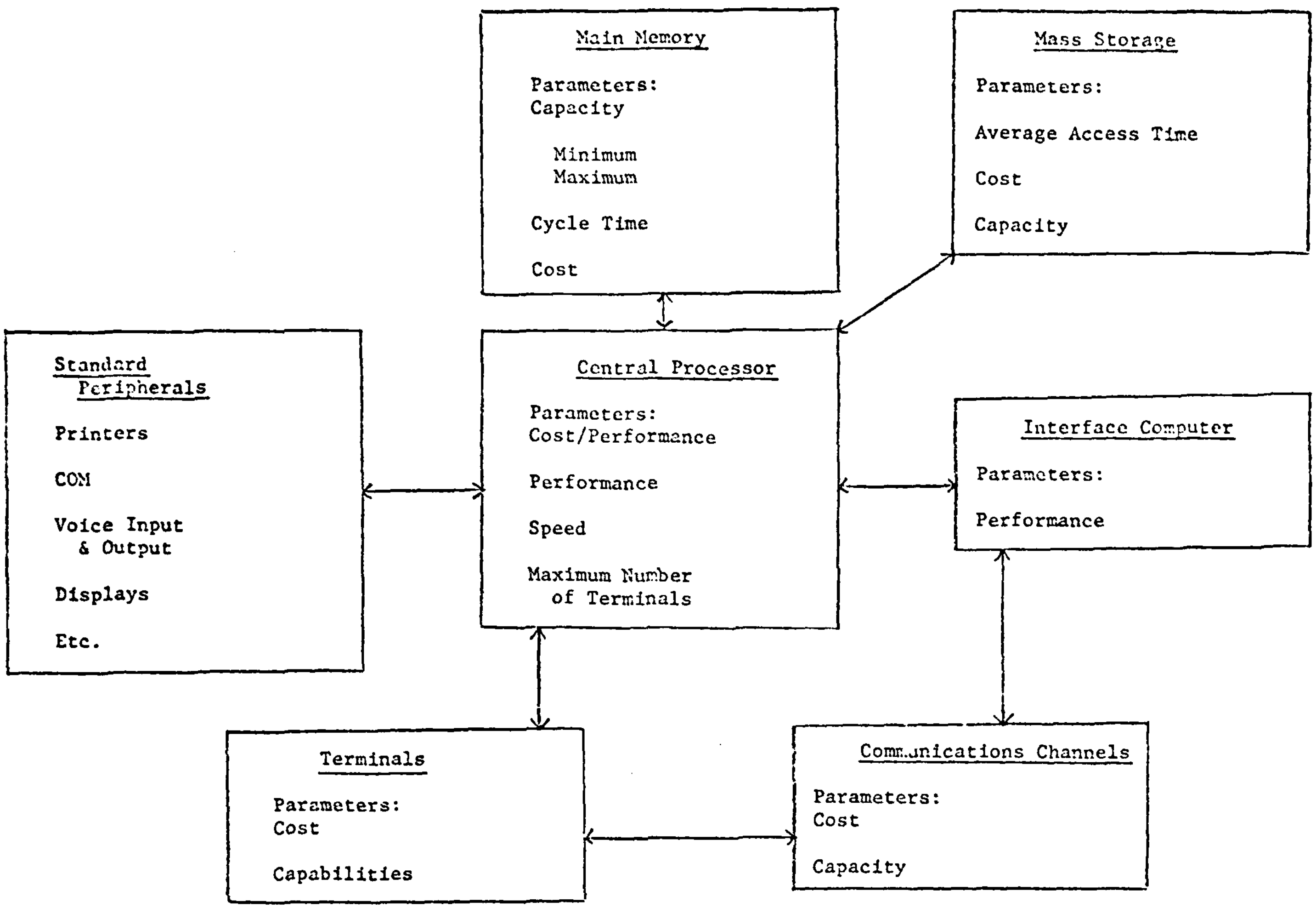


FIGURE 4.8

TYPICAL INFORMATION PROCESSING SYSTEM

1980

extent with the latest generation of equipments.

4.3.3 Main Memories

In the hierarchy of storage levels, the term "main memory" is applied to those storage locations containing the software and data pertaining to a particular current application. This definition excludes both the high-speed registers used for very-short-term operations involving single-item data transfer or manipulation; and, at the other end of the spectrum, the mass storage, either sequential or random-access, which is used for infrequently-accessed or archival material. Main memories are universally of the random access variety; that is, access to a particular item of information is obtained directly once its location is known. Sequential searching is not required.

Since the introduction of integrated circuits in the early 1970s, the use of semiconductors has increased to the point where 70% of all main memories are now of this type. Most of the remaining 30% utilize ferrite cores. While this proportion has changed drastically during recent years, the cost per bit of main memory has decreased steadily at approximately 40% per year regardless of the component type employed.

Characteristics of main memories which are of particular interest are the cycle time (which controls the time of access to a particular unit of information); the cost, and the capacity. In current systems, these last two factors are usually related. In general, a processor is purchased with a basic memory package, which can then be increased incrementally, at additional cost, up to a certain maximum size.

The speed (inverse of cycle time) of main memories has been increasing at approximately 30% per year over the past thirty years, while the capacity has increased at about 22% per year over the same period.

4.3.4 Mass Storage

Originally, mass storage units for information handling systems were sequential in nature; that is, item number 136, for example, would take longer to retrieve than items numbered 1 through 135, since these would have to be traversed before item 136 was reached. The medium of storage was usually a drum or tape, and although subsequent improvements (such as head per track) reduced the access time (for example, the search for item number 136 could start at item 100 rather than at item 1), the sequential nature was retained.

More recently, random access was achieved at this level of the storage hierarchy through the utilization of magnetic disks, whose development continues at a rapid rate. For both disks and tape (the use of magnetic drums is now very rare), the cost per bit has decreased by roughly two orders of magnitude over the past twenty years, and continues to decline at a lesser rate.

Access time has declined somewhat more slowly, particularly for tapes, but disk capacity has increased sharply, and will continue to do so over the next few years.

Throughout the remainder of the century, the major changes anticipated in the area of mass storage are the entry of video disk systems into the general marketplace; the use of microfilm or microfiche for input to the computer system; and the development of sophisticated text entry systems which will allow the input of printed information, previously generated and stored, without human intervention other than the physical handling of the medium.

4.3.5 Input

The early computers offered a clear distinction between input and output operations. The former was achieved usually direct from a keyboard, or indirectly through (previously keyboarded) paper tape or punched cards. Output was usually via a printer, physically separated from the input devices. More recently, input and output functions are co-located in a terminal unit, which may or may not reside at the processing site.

The major types of input applicable to the NAPS concept are keyboards, optical character readers and direct voice input. The cost of a simple keyboard (a "dumb" terminal) is decreasing, but this trend is less significant than the increased utilization of terminals with a varying degree of processing capability and built-in storage ("smart" or "intelligent" terminals).

Optical character readers have the advantage, as mentioned in the previous sub-section, that potentially they can be employed to input materials not specifically prepared for this application. Significant improvements are occurring in this area, in addition to an overall increase in speed and decrease in cost. These concern the number of fonts that can be read, and the ability to read hand-printed characters. Also the reliability of such equipments is increasing steadily.

Voice input is little used at present, and suffers from severe limitations as to the number of different speakers, and the size of the vocabulary. However, rapid progress in these areas is anticipated in the time-frame of interest.

4.3.6 Output

For an automated publishing system, such as NAPS, the types of output which are of interest include primarily printers, visual displays, and audio response. (Computer output microfilm is of concern only as an intermediate storage mechanism.) The early printers used in such applications were of the impact type, and thus severely limited in speed. Recent developments have tended towards the introduction of non-impact printers, which currently range in speed from 10 characters per second (comparable to the impact type) to as high as 10,000 lines per minute for electrostatic, xerographic or ink jet printers. Page printers are also now available which can provide, usually at additional cost, output on both sides of the paper, colored graphics, the mixing of type fonts/sizes on the same sheet, and selective editing. It is also possible to generate forms and insert variable data in a single operation, avoiding pre-printing.

Visual displays have achieved great advances since the early use of cathode ray tubes. During recent years, the cost per unit has decreased approximately 30% per year, while the number of characters displayed has increased between 5 and 7 1/2% per year.

The introduction of flat displays is occurring at a rate slower than originally anticipated, but plasma, electro-luminescent and liquid crystal devices are expected to play a significant role during the 10-20 year time-frame, and will certainly be useful to NAPS, particularly for technical information where environmental constraints may be critical.

Audio output is of limited application in this context, but those applications may be extremely valuable. The techniques to be utilized include both the combination of pre-recorded segments or syllables, and the use of audio synthesizers based upon LSI technology.

4.3.7 Communications

The utilization of a rich communications environment will be critical to the NAPS concept. Quantitative measures applicable to this environment are of limited utility. It is more important to recognize the rapid expansion of communications services and capabilities. For example, the introduction of packet-switching in combination with local communications (e.g. ring) networks offers the capability of alternative routing and the provision of communication between a large number of widely distributed users. The addition of microwave systems and satellite relays extends this to global coverage, with broadband (high capacity) capability.

During the past twenty-five years, the increase of remote terminal to computer, or computer to computer, telecommunications has been dramatic. An estimated 70% of all systems commercially available today have communications capability. The distributed processing concept thus offered is essential to the NAPS concept described in Section 5.

Of great significance in the consideration of strategy options for NAPS implementation is the availability of value-added networks such as Telenet, Tymnet and Graphnet. Services such as these fill a need primarily for the low-usage customer who wishes to pay on an "as needed" basis; at the other end of the spectrum services being developed by organizations such as ATT and IBM offer capabilities such as switching and routing, message storage and delayed delivery, mixed terminal interfacing and administrative monitoring of usage.

Thus, the communications environment will provide over the next 5-25 years not only the needed bandwidths and number of channels, but the types of software packages and control mechanisms essential to the feasibility of the NAPS concept herein presented.

4.3.8 Special Applications

4.3.8.1 Word Processors

The development and rapid spread of word processors is here considered separately from the categories listed in Exhibit 5.2, since this is an item which combines processing, storage, input and output capabilities, and usually communications, within a single unit. Of the various types of word processing equipment being actively marketed today, computer-like shared logic systems are likely to account for the largest portion of dollars spent in the U.S. word processing marketplace by the early 1980s, replacing the stand-alone display unit.

This area is another instance where the dominant trend is for greatly increased capability rather than for dramatic decreases in price. Average storage capacity is increasing steadily, as is printer speed. The price of shared logic systems, which are becoming both larger and more flexible, appears to be decreasing. While that of stand-alone units is increasing somewhat, this increase is accompanied by greater sophistication. In general, the rate of development is likely to be governed by the provision of the needed software and manufacturer support.

4.3.8.2 Teletext

One special type of service of considerable significance to NAPS is exemplified by the Viewdata system, a computer time-sharing service introduced in the early 1970s by the British Post Office. The Viewdata terminal uses an ordinary television set as a display, and a telephone provides a link to the computer for information retrieval and message switching. To send a message, the user (provider of the service) types in text, and supplies the Viewdata number of the intended recipient, who then receives the message the next time he telephones the Viewdata computer. Alternatively, the computer can call the recipient's telephone number, indicating with a special tone that a Viewdata message is to be sent. The recipient then turns on his TV terminal and receives the message. The system is not designed to do any kind of sophisticated word processing or office tasks.

More complex systems based on the same basic principles are being tested in the U.K., Canada, France, Netherlands and Japan.

Regulatory problems have thus far restricted activitites in this area in the United States, but the rate of development is now beginning to accelerate.

4.4 Citations and Footnotes

1. A Catalog of State-of-the-Art Components and Techniques for the Advanced Records Technologies and Systems (ARTS) Project, Technical Note 495, 3 volumes, (San Diego, Cal.: Naval Ocean Systems Center, September 1976).

2. The Impact of Technology on Graphic Communications 1976-1981 (New York, N.Y.: Printing Industries of America, April 1976).

3. An Initial Study of Current and Projected Publishing Technology Pertinent to the Navy Technical System (NTMS) Final Report, Contract # N00014-76-C-0407 (Menlo Park, Cal.: Stanford Research Institute, March 1976).

4. Navy Technical Manual System: Publishing System Technology Overview, Contract No. N00167-75-M-8190. (Gaithersburg, Md.: IBM, December 1975).

5. Systems and Feasibility Tradeoff Analyses: Task I Report (CDRL A001) Analysis of Current and Proposed Technical Manual Systems, Contract # N00600-76-C-1352 (Fullerton, Cal,: Hughes Aircraft o, March 1977).

6. Winter, Don, and Don Stewart, "Future Trends in Electronic Publishing", NFAIS Annual Conference, Arlington, Va., 1979 (Pasadena, Cal.: Xerox Electro-Optical Systems, 1979).

7. Final Report for AGS Program, Contract Number N00167-77-M-2674 (McLean, Va.: SAI Systems Corp., July 1977).

8. MIARS Controlled Tech Data with Microfilm and TRUMP Mechanized Update Techniques, Technical Data Management Projects of the Naval Air Systems Command, October 1974.

9. Requirements and Alternative Designs for Automating the Publication of NAVSEA MOTD at the NSDSA, Final Report, Contract No. N00014-76-C-0407 (Menlo Park, Cal.: Stanford Research Institute, November 1976).

10. King, D. W., and N. K. Roderer, The Electronic Alternative to Communication Through Paper-Based Journals, Final Report,, Contract No.. NSF-C-DSI76-155515 (Rockville, Md.: King Research, Inc., May 1978).

11. Electronic Composition: A Study of Costs (Washington, D.

C.: Joint Committee on Printing, December 1975).

12. "The Overall Market for Graphics, 1970-1990," Publishers Weekly, Vol. 198, No. 18 (November 2, 1970).

13. Photographic Equipment and Supplies, Paper P-31 (Cleveland, Ohio: Predicasts, Inc., 1972).

14. "The Dovetail Market," Office Products, Vol. 137, No. 1 (January 1973).

15. Bagdikian, Ben H., The Information Machines (New York, N.Y.: Harper & Row, 1971).

16. Smith, Anthony, "All the News that Fits in the Data Bank", Saturday Review 6/23/79.

17. Gacek, Daniel, Position Paper, 10/12/78.

18. Hard-Copy Output in the Future Office Environment (Cupertino, Cal.: Dataquest Inc., July 1979).

19. Lancaster, F. W. (Publication pending).

SECTION 5

5. SYSTEM CONCEPTS

5.1 Strategy Development

5.1.1 Strategy Generation Criteria

At the macro-level of conceptualization, which is all that it is feasible to accomplish at this phase of the NAPS research and development program, there are few factors which can be employed for the generation of alternative strategies. The initial questions formulated by the study team for discussion with personnel from NPPSMO and DTNSRDC were as follows:

- o Who owns the system?
- o Who operates/staffs the system?
- o Who manages the system?
- o How is the system funded?

The first three of these have the same options as regards possible strategies: the answer in each case could be the Navy, industry, or a Navy-industry mix. It was agreed during the discussions that Navy management constituted the only acceptable policy in this regard, so this question was, in effect, dropped from the list.

A number of funding schemes were offered for consideration, including both capitalization and operational aspects. For example, initial capitalization could be accomplished as a line-item in the Navy budget, or through NIF funds later replaced from revenue, etc. However, it was finally agreed that this was not a factor which should be considered in the course of strategy generation. Whatever strategy is adopted, Navy funds will be required at least at the 6.2 and 6.3 levels, and a whole spectrum of alternatives for both operational and start-up costs is available regardless of ownership and staffing decisions. Consequently, funding considerations were postponed until a later phase of system conceptualization, during the evaluation of the costs and benefits of alternative implementation schema. Similar considerations apply to such factors as dedicated versus time-shared equipment, or lease versus buy (except in so far as this relates to the question of system ownership).

We are thus reduced to a base-set of two criteria for strategy generation. The system may be owned by the Navy, or by industry, or by a mix of the two; and it may be operated by the Navy, or by industry, or by a mix of the two. In practice, of course, the number of possible "mixes" is virtually infinite. For the current purposes, a set of seven broad strategies was defined, each based upon overall Navy system management (although facilities management may vary as appropriate to the ownership/staffing configuration):

(1) Navy ownership, Navy staffing.

(2) The Navy owns the bulk of the system, some equipment being industry-owned. Virtually all operating is performed by Navy personnel.

(3) The Navy owns the bulk of the system, some equipment being industry-owned. Most of the operations are staffed by industry personnel.

(4) Navy and industry ownership of the system are about equally divided. Most operations are staffed by the Navy.

(5) Navy and industry ownership of the system are about equally divided. Most operations are staffed by industry.

(6) The bulk of the system is industry-owned, although the Navy owns some equipment. Most operations are performed by Navy personnel.

(7) The bulk of the system is industry-owned, although the Navy owns some equipment. Most operations are staffed by industry.

5.1.2 Strategy Evaluation Criteria

We perceive five major areas as being of significance at this level of conceptualization in evaluating the seven strategies itemized above. These may be categorized under the following headings: flexibility, performance, admininstration, feasibility, and technology transfer. Each category has associated with it a number of parameters, or measures of the extent to which a particular strategy satisfies its requirements. The list of such measures may be extended almost indefinitely. In the present context, the parameters chosen by the study team are listed in Exhibit 5.1, and defined as follows:

> Breadth of Application: The extent to which the system can support extension of critical functions, and absorb workload increases.
>
> Security: The extent to which access to data and facilities can be controlled.
>
> Response Time: The delay between request for and provision of a specified information package whose content already exists within the system.
>
> Size of Data Base: The quantity of current information held within the system whose publication may be required by NAPS users.
>
> Availability: The percentage of real time during which the system can support critical functions.
>
> User Interface Match: The extent to which the system interface (input/output) conforms to the capabilities and needs of a given operator and/or activity.
>
> Manageability: The degree to which the system lends itself to efficient administration of its components.
>
> Skill Level of Personnel Pool: The degree of success anticipated in operation of the system by available personnel.
>
> Technical Fe[illegible]bility: The probability that the technical capabilitie[illegible] plied by this strategy will be available at the required time-[illegible]riod.
>
> Political Feasibility: The probability that the strategy will be politically acceptable to the Navy and to Congress.
>
> Economic Feasibility: The probability that the strategy will be economically viable in the required time-period.
>
> Technology Transfer: The extent to which capabilities developed by individual industries or jointly throughout the private sector are transferred to the Navy environment.

Additional pertinent parameters not considered here, but which must be addressed in the next design phase, include: capacity (jobs per system size or cost); efficiency (cost per job); throughput (jobs per unit time); privacy and integrity.

5.1.3 Evaluation of Alternative Strategies

The study team performed an evaluation of the seven strategies

EXHIBIT 5-1

STRATEGY EVALUATION CRITERIA

Category	Parameter	Criterion Number
Flexibility:	Breadth of Application	1
Performance:	Security	2
	Response Time	3
	Size of Data Base	4
	Availability	5
	User Interface Match: Navy	6
	User Interface Match: Contractor	7
Administration:	Manageability	8
	Skill level of Personnel Pool	9
Feasibility:	Technical	10
	Political	11
	Economic	12
Technology Transfer:	Capability transfer from industrial state-of-the-art to Navy management	13

briefly defined in Section 5.1.1, in terms of the criteria listed in Section 5.1.2. At this level of aggregation, it was neither appropriate nor feasible to define precise scales of measurement. Accordingly, the assessment (summarized in matrix form in Exhibit 5.2) was completed in terms of an ordinal scale, that is the simplest listing available to establish an order of preference. (While this may in some instances approximate to an interval scale, the logic to be presented is not based on this as an attribute, due to the lack of a standardized unit of preference and a meaningful scale reference point.[1]) Here we use the integers from 1 through 4, in order of increasing preference.

It will be noted that Exhibit 5.2 also contains an entry for the "weight" of each major category. Here a ratio scale is employed, with values of 1, 2, 4 and 8, implying for example that the performance category is four times as significant as that of administration, and twice as important as the other factors listed. (This is in accordance with the observations of psychophysicist S.S. Stevens, and others, that the human mind makes comparisons geometrically, e.g. "this light is twice as bright as that."[2]) In computing the overall "index" for each strategy, the average entry in each category (arithmetic mean of parameter values) has been multiplied by the category weight, before summing by columns.

While it is clear that many of these decisions are largely arbitrary, and that the set of parameters employed as evaluation criteria is far from exhaustive, the study team believes that the indices resulting from this evaluation are significant and that the logic underlying their derivation is easily justifiable. Certainly the concept of a totally Navy-owned, Navy operated system (strategy 1) is not viable, if for no other reason than that the Joint Committee on Printing requires support of the private sector wherever possible. At the other extreme of the spectrum, alternative 7 postulates predominantly industry ownership and operation. (The need for in-house processing of classified and fast-turnaround material, and for war-time contingency capabilities, precludes consideration of an all-industry system strategy.) Although this option has some desirable features, it would remove any major incentive for the

EXHIBIT 5-2

STRATEGY EVALUATION MATRIX

STRATEGY EVALUATION CRITERIA		Wt	ALTERNATIVE STRATEGIES						
			Navy owned Navy staffed	Mostly Navy owned, staffed	Mostly Navy owned, industry staffed	Jointly owned, mostly Navy staffed	Jointly owned, mostly industry staffed	Mostly industry owned, Navy staffed	Mostly industry owned, staffed
			1	2	3	4	5	6	7
Flexibility	1	4	1	2	2	3	3	4	4
Performance	2		4	3	3	2	2	1	1
	3		4	3	3	2	2	1	1
	4		2	3	3	4	4	4	4
	5		4	3	3	2	2	1	1
	6		4	3	3	2	2	1	1
	7		1	2	2	3	3	4	4
Average		8	(3.2)	(2.8)	(2.8)	(2.5)	(2.5)	(2)	(2)
Adminis-tration	8		4	3	3	2	2	1	1
	9		2	3	4	3	4	3	4
Average		2	(3)	(3)	(3.5)	(2.5)	(3)	(2)	(2.5)
Feasibility	10		1	2	2	3	3	4	4
	11		1	3	2	3	4	2	2
	12		1	2	2	3	3	4	4
Average		4	(1)	(2.3)	(2)	(3)	(3.3)	(3.3)	(3.3)
Technology Transfer	13	4	2	3	3	4	3	3	2
WEIGHTED TOTAL			47.6	59.6	59.4	65	63.2	61.2	58.2

transfer of capabilities from the private to the public sector, and place an unreasonable degree of leverage in the hands of industry and the labor unions.

The strategies with the highest indices, and which the study team believes to be those of most value to the Navy in pursuing the NAPS concept, are thus defined as follows:

(a) Joint Navy-industry system ownership.
Predominantly Navy staffing.
Navy management.

(b) Joint Navy-industry system ownership.
Predominantly industry staffing.
Navy management.

(c) Predominantly industry ownership of system, but some equipment owned by the Navy.
Predominantly Navy staffing.
Navy management.

5.2 Systems Architecture

5.2.1 Introduction

The development of the architectural structure of a system is generally based upon an analysis of current requirements. To take into account the anticipated growth of the various applications, additional systems capabilities are usually identified and written into the specifications in some nebulous fashion. This approach can lead only to the design and implementation of an obsolete system.

An alternative approach is to identify in broad generic terms the system as conceived to satisfy the anticipated needs of some distant time-period. Taken in conjunction with the requirements analysis of today, we have thus two end points. With these two end point systems architectures defined, the necessary step-wise evolutionary progression from the present to the future can be established. This is the method employed here in terms of the NAPS concept. In section 5.2.2 are outlined the desired system capabilities for the year 2000. The necessary steps to achieve these capabilities starting from current Navy printing and publishing services are discussed in Sections 5.3. and 5.4.

5.2.2. The Normative System -- The Year 2000

5.2.2.1 Text Handling

In the year 2000 most textual information entering the NAPS system will be entered via a keyboard which is an integral component of an input/output terminal. This unit will contain sufficient processing capability and storage to permit an operator to perform his job to his limit of ability. Once a segment of input has been processed, it can either be stored locally or transmitted to the appropriate NAPS storage unit. In conjunction with the keyboard inputting of text, voice input will be employed extensively, not only for initial drafting of documentation but also for the editing function. Tables and other listings, if not prepared via a keyboard, will be entered by an optical character reading mechanism, the choice depending upon the form in which the data exist.

By the year 2000 most large and probably many medium-sized organizations will have available in some form broadband loop media (probably fiber optic or coaxial cables) for local communications. These loops will optimize the cost of systems, since a central processor incorporated in the loop will be capable of performing many more operations than any one application could require. Thus the local communications loop at a site will multiplex the information being entered from a large number of individual terminals.

The local processing which will support the inputting of information via the terminals (beyond and above the processing capability resident in the terminal) will be provided by extremely powerful outgrowths of the current microprocessor developments. These systems will be very small in size, will have tremendous computational and data manipulation power, and will provide extensive overhead and bookkeeping support to each of the user terminals. By the year 2000, these processors will not be uniquely dedicated to word or text processing but will support any form of processing that the user demands.

The word and text processing functions incorporated into the generalized processor support capability will be, in general, transparent to the user. That is, the user will not be aware of how the processor manipulates the data entered, nor be concerned about any ancillary functions, unless he commits an error which is identified by the system via a message to him through the terminal (display device).

The information entered will be manipulated/processed on a character-by-character basis when a terminal is being employed; however, once composed, a full page will be stored as an entity or image, capable of being recalled, modified, updated or erased as required by those editing and monitoring the production of the document.

Available communications will include not only terrestrial but satellite links, and will permit the transmission of massive amounts of information in very short periods of time. Since the basic storage mechanism will retain an image as a single entity, transmission of that image via these broadband capabilities will permit economical and efficient utilization of the communications environment.

Since the NAPS system will be required to operate during times of hostility, as well as in peacetime, a support or backup system will be essential, particularly for the fleet and those bases located outside the continental confines of the United States. This backup capability will be provided by an image storage mechanism, probably an advanced version of a video disk as currently envisioned. These disks or image storage media units will be prepared or tailored taking into account the specific needs of each designated user. Thus in the event of hostilities and the loss of direct communications channels, or in the event that the channel becomes clogged, the user will have a fall-back capability.

Navy personnel (either civilian or military) will be the heaviest users of the NAPS output capability. In the year 2000 the predominant method of accessing information from the system will be via soft display devices. This in turn will require, for many applications, high resolution display devices, probably not cathode ray in nature. Many applications will require multi-color capability and "microscoping" of portions of images such that the fine detail will be available when and if required by the user.

The second form of output support will be hard copy, provided by a full range of electronic page printers wherein an image can be transferred from the storage system to the printing mechanism and conveyed to paper for use as required.

An additional form of output will be audio in nature; that is, the system will provide a human-like voice to support the materials being shown on the screen as well as being printed by the electronic page printer. The combination should synergistically provide significantly higher transfer rates of information to the user than would result from the utilization of any single medium.

The processing of text information and its storage, transmission and utilization in the year 2000 will provide the Navy with a significant financial savings once the system is operational. The system will be designed in such a fashion that it will be capable of incorporating individual improvements in any segment of the system and thus be a living and growing system.

5.2.2.2 Graphics Handling

The handling of graphics in an automated publishing and dissemination system is much more complex than the handling of textual material due to the nature and diversity of the materials classified as graphics, which include not only simple line drawings and sketches and large engineering drawings (usually requiring very large pull-out sheets in any report), but also half-tones and photographs. Each of these categories requires special handling today. In the year 2000, as the integration of image acquisition, transmission, storage and display becomes available, it will matter very little what form of graphic material is being processed.

The entry of graphics in the year 2000 into the NAPS system will occur in one of two forms. Simple line drawings as well as complex circuit diagrams will be generated by the individual inputting the information on-line utilizing a graphic terminal. The information, once constructed and reviewed for accuracy, will be processed and stored.

The second form of entry will be through an image entry device which will "acquire" as a single entity the drawing previously generated by a human. Once the information has been acquired it will be transmitted, by fiber optic or equivalent communications, to a NAPS processing site. Here information associated with the particular image will be appended logically prior to storage. Any future processing associated with the image will be performed utilizing the same type of graphic terminal previously discussed.

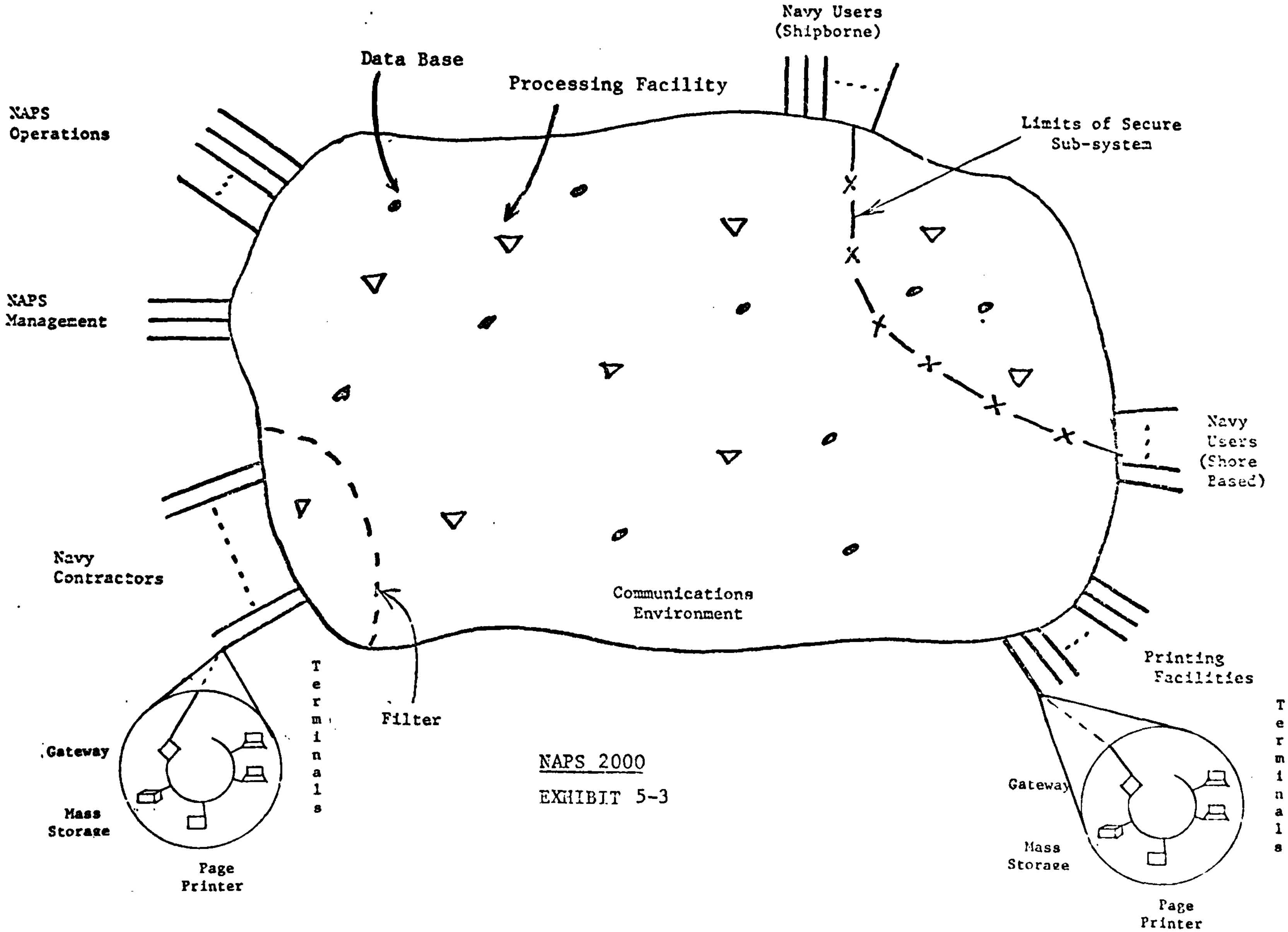
One of the major advantages to the storage of an image will be the capability of the user not only to recall the full image, but to amplify or "microscope" portions of that image for finer detail and greater resolution. Thus, an individual concerned with an engineering drawing of a particular piece of equipment will not only be able to use the total drawing but will be able to focus his attention upon any subportion of that drawing if need be. This microscoping capability will be supported or made possible by appropriate software.

Finally, it is conceived that fiber optics cables will permit the user to "extend" the face of the display terminal as he operates on a piece of equipment in such a fashion that, although the terminal may be located on a workbench, the actual display will be available to the user in any portion of the area he is assigned, and in any orientation necessary for his convenience.

5.2.2.3 Overview and Examples

At the highest level of abstraction the NAPS system, in the year 2000, will be global in nature, and together with its associated management or "meta" system will have many of the capabilities of an information system rather than of document production alone. The system will operate within a communications environment composed of both Navy dedicated systems as well as commercially available systems. Information handling capability will be drawn similarly from both dedicated Navy-owned systems (primarily for classified or very fast turnaround dissemination of information) and commercially installed systems which provide support and capability to the NAPS system as required. A conceptual representation of the year 2000 system is shown in Exhibit 5.3. Within the area labeled "Communications Environment", the scattered dots depict data bases, and the triangles computers/processing facilities, implying that none of these need to be co-located, and that multiple communications links exist.

In general, the system will be totally transparent to all



NAPS 2000

EXHIBIT 5-3

classes of users except those concerned with the intimate operation and development of the system. Thus, senior Navy personnel interested in determining the status of various aspects of the logistics operation of the Navy, either in general or concerning a specific segment of the responsibility of one Command, will be able to use English text language queries and receive responses in the context of their particular job and function. At the other end of the spectrum, personnel maintaining specific pieces of equipment on board ship can query the system and receive tailored replies which will either direct their maintenance operations, or provide the needed information, so that the maintenance operation can be performed in the most expeditious and effective fashion. The implication of tailoring the responses to the particular user, especially in this application, will require thorough cross-linking between the interface software and various personnel training records. The cross-linking of these files must be performed in such a manner that no invasion of privacy occurs, nor is the security of classified information compromised at any time within the operation of the system.

By the year 2000, as stated earlier, it is anticipated that the storage and transmission of images as single entities will be viable. This provides a tremendous opportunity to the NAPS system designer since these image storage techniques will allow selective updating. Thus rather than searching for a particular data element a specific image will be identified, located, retrieved, examined, modified if necessary, and restored. In all probability the initial capability for image storage and transmission will be based upon holographic techniques. Further, the marriage of holographic techniques with video disk technology should provide a significant enhancement of the capability of these systems to retain large segments of data inexpensively.

The concept for the year 2000 incorporates the complete integration of all non-tactical data at the applications level. Thus, for example, it is visualized that when a specific item must be replaced during maintenance and repair activities, this occurrence will automatically trigger all of the necessary actions to decrement the inventory, and resupply the component to the repair location. The system would also have the capability to activate a purchase request which could be transmitted via the network to a set of potential bidders so that the stock of reserve parts could be resupplied in a minimum amount of time and at a minimum cost.

In the more general case, purchasing offices could provide, via the electronic network, requests for bids to all those qualified or interested contractors for the development, construction, and supply of various items required by the system itself, since a complementary system which has the proper interfacing capabilities could be available within a potential contractor's facility. This system would allow the specifications (request for bid) to be copied directly into the potential contractor's system. Contractor personnel would be able to design a response on their system which, once reviewed and approved, could be transmitted electronically back to the Navy facility via the NAPS network.

The existence of this type of linkage not only within various Navy segments, but also between the Navy and systems operated by contractors, implies that the system is extremely dependent upon communications and the interfacing of the various systems to the communications environment. The communications environment as it exists today, and as it will grow to the year 2000, will provide multi-path linkage capability such that if any one segment or link is not operational, or not available because of an outbreak of hostilities, for example, other alternative routes will automatically be provided to the system. Thus any one point can always communicate either to an application package or to a second point as required.

The NAPS architecture will be such that the system is fail-safe and "fail-soft". Tasks can be reassigned based upon workload, on a "bid" basis. Replication and partitioning of data bases will be incorporated, the latter to improve access, and the former to reduce cost and to ensure recovery from catastrophe.

To illustrate more specifically the capabilities of the normative system, this sub-section will conclude with a description of the manner in which two common tasks are performed in the Navy today, as contrasted with the manner in which they could be performed using NAPS. It should be emphasized that while NPPS provides services essential to the accomplishment of these tasks in both time-frames, not all the associated activities fall under NPPS jurisdiction. Thus the benefits of automation are perceived by the end-user directly, as well as indirectly due to the improvement in service.

Let us consider first the activities involved with the publication and distribution of procurement solicitations. At present, a contracting officer prepares a solicitation by a "cutting and pasting" procedure, pulling sections and forms from a basic set of options to augment a rough copy specific to the application (statement of work, etc.). This is given to NPPS in typewritten form, where it is printed (internally or by contractor) for subsequ nt distribution as appropriate. These steps are summarized in Exhibit 5.4. The process generally takes a minimum of 6-8 weeks, even for a single-item, sole source procurement.

Under the NAPS concept, this would be a word processing type of application. The contracting officer could readily assemble the original at his multi-function work station, selecting appropriate attachments and insertions without the need for re-keyboarding, retrieving stored copies or duplicating from an earlier solicitation. Automated composition permits page compression and thus considerable space-saving. Necessary queries or requests for approval can be transmitted to other Navy (or contractor) sources, and responses received, via the same work station.

The contracting officer's copy can thus be assembled in a greatly reduced time-span, and initially forwarded to NPPS in paper copy for distribution through NAPS. Ultimately the entire distribution chain may be electronic until it reaches the end user. For major contractors, having access to NAPS terminals, the response to the solicitation could be accomplished in similar fashion.

It is impossible at this stage of system specification to provide reliable estimates of the time consumed by this procedure, especially since the demands of other projects on the contracting officer's time will become increasingly significant as the total time decreases. Nevertheless it seems reasonable to anticipate a considerable reduction in elapsed time.

EXHIBIT 5-4

STEPS ASSOCIATED WITH PROCUREMENT SOLICITATION GENERATION AND DISTRIBUTION

1. Job (Procurement) Authorization of a Particular Solicitation.

2. Identification (by Procurement Personnel) of All Pertinent Paragraphs, Attachments, etc.

3. Particularization of All Standard Clauses (by Procurement and Technical Personnel).

4. Assembling of Draft Package.

5. Review Prior to Reproduction/Printing.

6. Submission of NPPS or Other Reproduction Facility.

7. Reproduction of Required Number of Copies.

8. Addressing, Based Upon NPPS Maintained Distribution Lists.

9. Physical Distribution.

In the second example, the introduction, distribution and ultimate use of a new standardized form, the benefits offered by NAPS are even more apparent. At present, following official review and approval of a proposed form, NPPS employs a contractor to compose camera-ready copy. This is printed, and initial distribution made to users and to stockpoints such as NPFC (Exhibit 5.5, Section A). This process typically takes 6 months to a year to complete, and requires advance estimation of usage levels to determine how much stock should be stored.

When a would-be user exhausts his supply of forms, he should apply to NPFC and await re-supply, but may instead elect to duplicate a remaining copy (at a much higher cost). This latter alternative frequently becomes a way of life, the official supply chain being totally subverted with consequent loss of copy quality and increase in per copy cost. The insertion of data into a pre-printed form is a separate operation, following retrieval of the blank form. These steps are shown as Section B in Exhibit 5.5.

In the early stages of NAPS implementation, the new form can be prepared and reviewed using communicating word processors as described in the previous example, or by traditional means, but will then be available at each NPPSO. No prior estimate of usage levels will be needed, since the "form" will be stored electronically, or on magnetic tape. On demand from a user, the requisite number of paper forms can be produced immediately. If appropriate, by using the NPPSO's 9700 or similar equipment, the insertion of variable data on the form can be accomplished during the same step as production of the form itself.

Ultimately, the user will not even need to go to the NPPSO for re-supply, but will call up the form on his own terminal display, key in the variable data, and print (or transmit) the completed form after verification.

5.3 The Route to NAPS 2000

5.3.1 Introduction

The conceptualization of NAPS-2000, as described in the preceding section, focuses upon the technologies that will be employed to perform the critical functions associated with entering,

EXHIBIT 5-5

INTRODUCTION AND DISTRIBUTION
OF NEW STANDARDIZED FORMS

A

1. Preliminary Design of Proposed Form
2. Review and Modification
3. Forwarding of Draft to NPPS
4. Contractor Preparation of Camera-Ready Copy
5. Estimation of Usage Levels
6. Initial Printing
7. Initial Distribution to Users and Stock-Points

B

1. User Retrieves, Re-Orders, or Duplicates Own Form
2. User Enters Variable Information
3. Distribution of Completed Form

manipulating, storing and displaying information. The ability to focus upon these technologies in this qualitative fashion is the result of a very detailed analysis and forecast which is presented in Appendix B of this report. The fundamental principle underlying the forecast is that the inertias which are already operative in the information processing, communications and printing/publishing industries will continue to be operative during the next 20 years. Obviously, some of the quantitative forecasts may become less reliable as time moves out from our vantage point of today. However, the incorporation of a set of potential events, obtained from various surveys (see subsequent subsections), provides us with an increased level of assurance that the NAPS system will not only meet the requirements of today, but will be capable of incorporating new developments as they occur to provide the expanding levels of performance necessary for the future.

It is extremely important that the managers who are directing the development of NAPS understand that the system is not a static system to be implemented at one point in time, but will be constantly changing and expanding in capabilities. Consequently the monitoring function must include constant surveillance of R&D being performed both within governmental laboratories as well as by industry.

With the generation of the master plan for the conceptualization of the total NAPS system and the identification, within that plan, of key technologies which may be applicable and required as a base, the management monitoring operation must be capable of making decisions as to when and where to incorporate new developments for the system's growth and expansion. For example, the development of higher resolution terminals for soft display of information will continue in industry and will probably require very little impetus from either the government as a whole or the Navy NAPS program specifically. On the other hand, such developments as fundamental research in image processing and image transmission techniques may very well require specific encouragement by the NAPS team such that those developments will occur in a timely fashion in relation to the master NAPS plan.

To summarize, NAPS as conceived is a very complex system and will require the utilization of the most advanced and cost-effective components available. Thus the monitoring of the industry in general, and R&D products specifically, will be of major significance in its own right.

5.3.2 Input

The development of voice input techniques for use with computers is one of the more important technologies which must be monitored. Developments are currently underway and it is expected that these developments will progress, on their own, in such a fashion as to provide NAPS with sufficient capability to meet its requirements for this type of input during the mid-to-late 1980s. On the other hand, the development of image acquisition input techniques does not appear to be adequately funded nor staffed at present. A careful examination of the state-of-the-art in image acquisition input techniques should be undertaken at the earliest possible date.

Other input techniques not associated with the man-machine function, such as the acquisition of the large massive "data bases" which already exist in the forms of manuals, operational instructions, forms, etc., require specific attention. We do not expect that the image acquisition input techniques (discussed above) will be available to provide for the insertion of these documents and forms into the NAPS system data base. Therefore, alternate approaches will be required.

5.3.3 Processing

The development of information processors (mainframe and mini- and microprocessors) funded primarily by the commercial marketplace, is currently advancing at a pace more than adequate for the forecast needs of NAPS. On the other hand, NAPS will have to examine and probably fund significant software developments to provide unique capabilities required by the Navy Automated Publishing System. Specific to these developments will be the generation of a multi-processor, distributed operating system which, if possible, will incorporate security techniques as well as unclassified information in the same system. If an adequate level of assurance of security <u>cannot</u> be obtained, then a subsystem of NAPS will have to be designated to handle, process and disseminate classified information.

Not only will the NAPS system require a unique operating system, but in all probability the data management system and its subcomponents will also require either a unique implementation or significant tailoring of commercial packages. Thus, the examination of the data management problem presented by a system which will be required to store such massive amounts of data must be examined in great detail. In addition, the implications of image storage and the ability to update images, as opposed to dealing with individual characters or strings of characters, must be conceptualized and carefully evaluated.

Finally, a very extensive array of hardware handling software packages will also be necessary. Most of these should be available from commercial sources. Once again, the organization responsible for monitoring developments in the commercial and governmental laboratories must be constantly aware of what is being done, and what is not being done, such that the needs of NAPS can be addressed in a timely fashion.

5.3.4 Mass Storage

Again, as in the discussion of processors, the developments in this area are producing higher density equipments at a rate adequate for the NAPS implementation effort. One of the reasons for this is that the conceptualization of NAPS permits a large number of individual sites, and thus the number of units employed may vary depending upon the requirement presented to NAPS at any one time.

The development of video disk systems must be carefully monitored since they should form the basis of an image storage capability envisioned for the period beyond 1990.

5.3.5 Communications

NAPS will require extensive communications both in the continental United States as well as to overseas installations and ships at sea. During peacetime it is anticipated that a limited number of satellite communication links will be developed and made available. However, the communications environment for NAPS will include not only the more exotic forms of communication such as satellite links for ship to shore paths, etc. but all conventional means of communicating digital data. Local loops will provide the multiplexing capabilities at various installations since their use will significantly reduce the overall cost of the NAPS system by allowing time-sharing of processing, storage and communications control units.

The utilization of satellite broadband techniques for dissemination of informational instructions and subsidiary materials should also be examined. Again, the commercial efforts in this area by large corporations such as General Motors, the aircraft/space industry, etc. may provide significant capability which will not require additional funding from the NAPS program.

If the NAPS system cannot incorporate into a single entity the handling of classified and unclassified materials, the development of a secure communications network for the classified subsystem will be required.

5.3.6 Output

The development of high resolution display units is already underway. The cost of these units, however, is high and NAPS may be required either to develop alternative approaches or to encourage the development of lower cost high resolution display units of a non-conventional nature. It is highly probable that high resolution display units will become available, probably during the latter half of the 1980s; however, the need for these units must be addressed by the NAPS monitoring team at an earlier date. Alternative approaches can be examined; for example, a software implementation might be possible. Tradeoff studies would be appropriate in this area.

The second output method which requires careful consideration is the utilization of audio output based on voice synthesizers as an integral part of the NAPS system. Here there can be many benefits to the user if the system can properly implemented. Certainly significant strides are being made in voice synthesizers at this point in time and a thorough examination of that area appears to be warranted.

5.4 Systems Evolution

5.4.1 Introduction

Definition of the evolutionary process by which NAPS will advance from the capabilities of the current Navy printing and publishing service to the systems architecture perceived as a goal for the year 2000 depends upon the integration of three major inputs:

1. the current and future requirements placed upon the Navy automated publishing system from both a management as well as an operational standpoint;

2. the technological state-of-the-art from the present through the year 2000;

3. the identification of technological events not incorporated in that forecast, but which may nevertheless occur between now and the year 2000 and impact upon the state-of-the-art of information handling systems and upon NAPS itself.

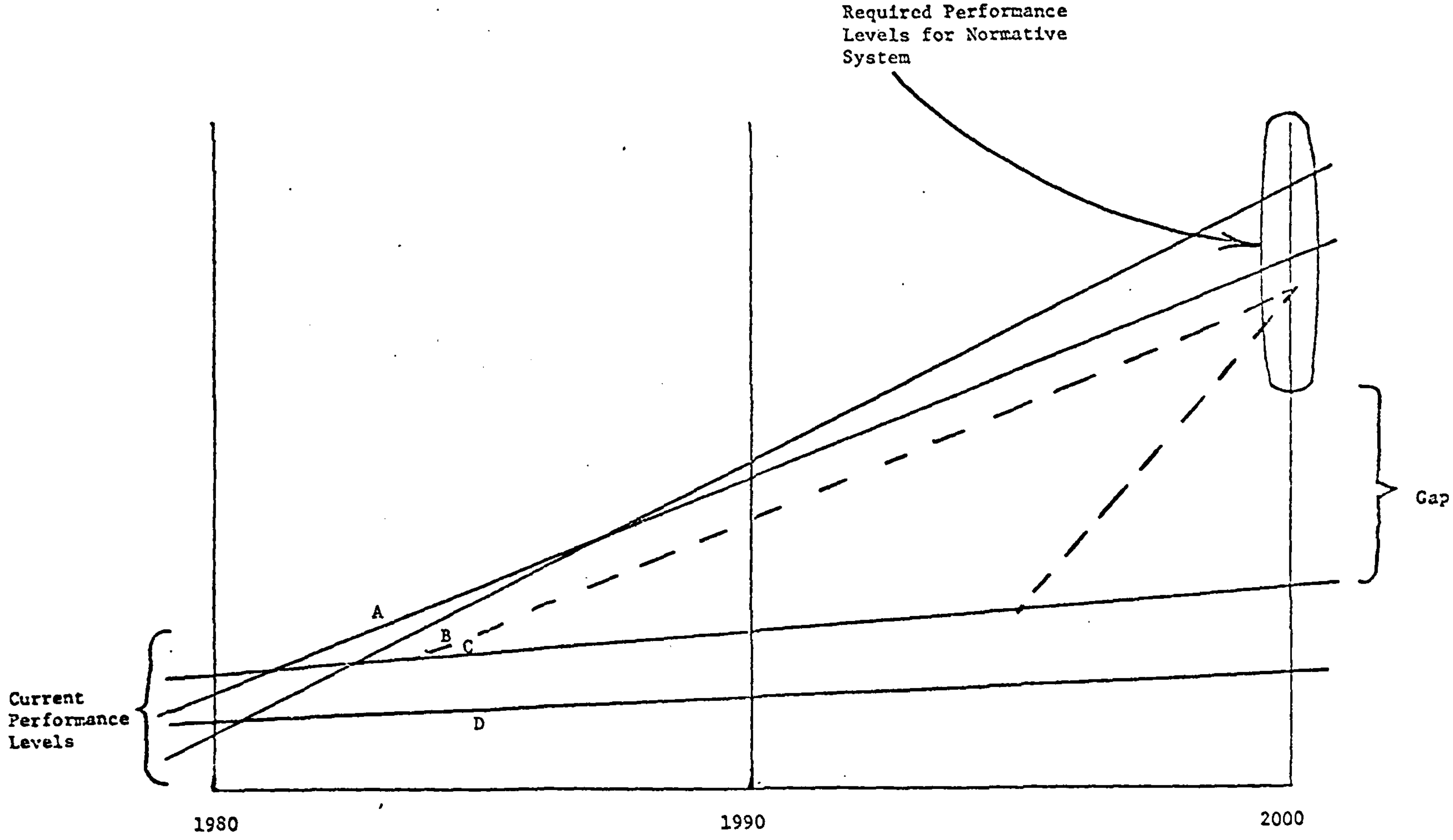
The necessity for all three ingredients, and the manner in which they interact, are illustrated in Exhibits 5.6 and 5.7. In the former, lines A-D depict forecast trends representing anticipated improvements in pertinent technologies. At the extreme right of the figure are shown the corresponding performance levels required of the normative system in the year 2000. Clearly trends A and B will supply the needed capabilities. Trends C and D indicate a potential performance gap. This corresponds to an instance where the occurrence of "breakthroughs", or other events not incorporated in the basic forecast, is needed to enhance the growth rate of appropriate capabilities. The dotted lines in the figure are intended to illustrate the point that the earlier such events occur, the smaller is the incremental improvement needed. This is of particular significance where the event is "controllable", a point which is further discussed below.

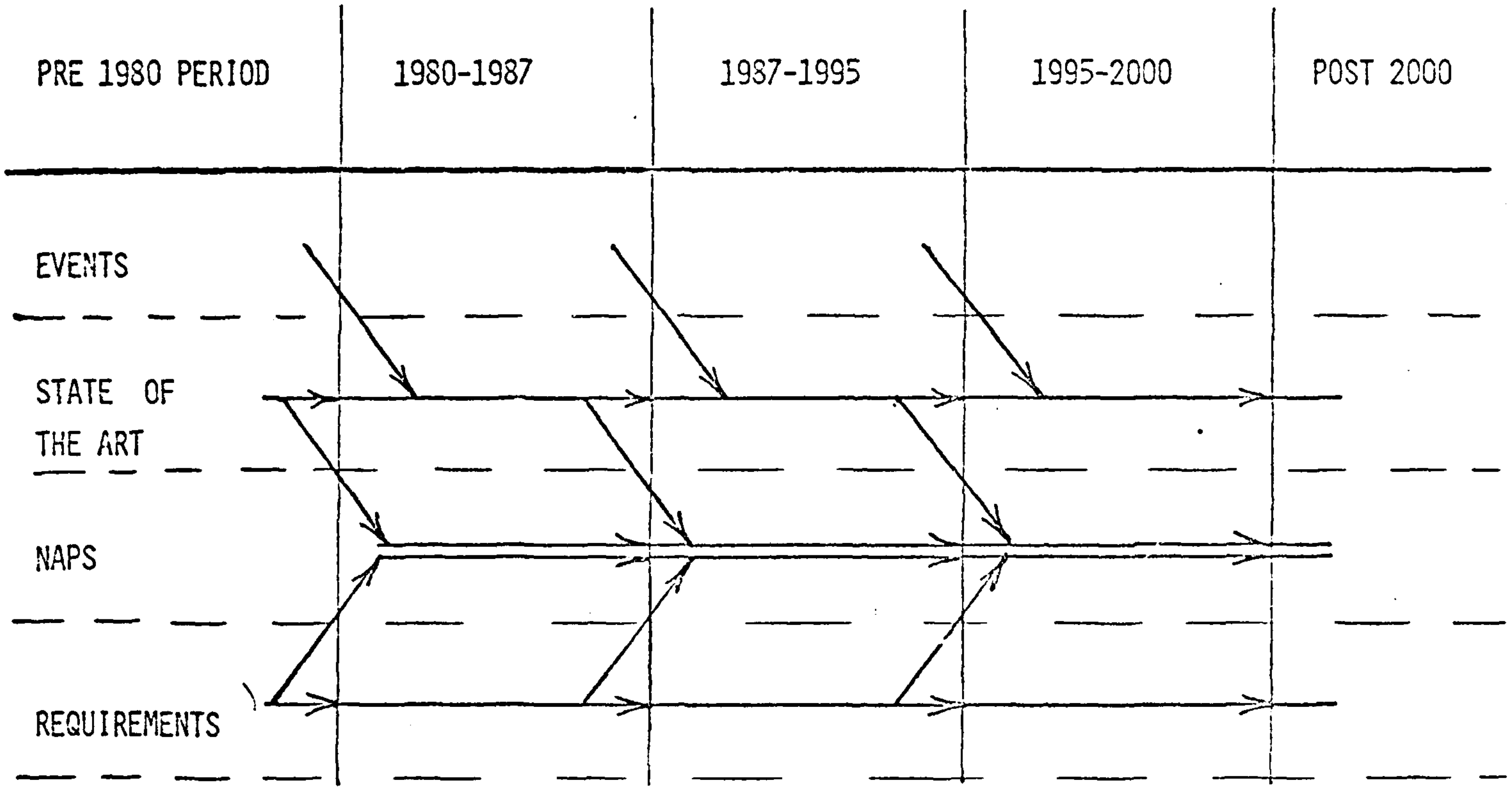
Exhibit 5.7 shows how the individual components interrelate over the three time-periods selected for the definition of system evolution: 1980-1987, 1987-1995, and 1995-2000. Note that the current state-of-the-art and the requirements for NAPS all feed into the initial time-period enabling details of the systems structure to be identified. Further, the time shift of technological events has been taken into account; events that occur in one time-period do not affect either the state-of-the-art or NAPS until the next time-period.

The one component not specifically identified in Exhibit 5.7 is

EXHIBIT 5-6

BENEFITS OF A NORMATIVE APPROACH





<u>IDEALIZED INTERACTION AMONG EVENTS, STATE OF THE ART REQUIREMENTS AND NAPS</u>

EXHIBIT 5-7

the normative concept previously described. This would correspond to the ultimate systems architecture and capability for the third time period, shown on the right-hand portion of the figure.

In the following subsections we will expand upon this discussion of the interaction of events and trends, in reviewing the technology base upon which the system design will be constructed; identify the events which will be incorporated to permit the growth and "maturing" of the NAPS system toward the ultimate normative implementation; and finally, provide systems descriptions which define the various stages of NAPS over the time periods examined.

5.4.2 Technology Base

Appendix B of this report provided a detailed discussion of the state-of-the-art of the various technologies which are to be applied in the NAPS concept, together with forecasts of key characteristics to the year 2000. These are summarized in Section 4, and constitute a firm framework for the total systems structure. Technological developments confidently anticipated by 1985, 1990 and 1995, respectively, were previously summarized in Exhibit 4.2, which is reproduced here as Exhibit 5.8 for easy reference.

In preparing a technology forecast such as those included in Appendix B, however, the basic technique employed is to examine the history of quantitative factors pertaining to that technology, to identify the trends thus established (i.e. by curve-fitting, smoothing "by eye" of minor variations, or similar techniques), to project these trends through the period of concern, and to review the projections for feasibility by the application of expert judgment. This last step is mandatory for the production of a reliable and useful forecast, since there may be physical limits to continued growth of a trend. Also, there are frequently new developments, either introduced too recently to be reflected in historic trends or known to be scheduled for market introduction in the near future, which may cause major trend shifts.

The technology forecasts previously provided in this report have indeed taken into consideration developments such as these, consisting of events recently occurring or confidently anticipated to occur in the immediate future. However, other technological events

EXHIBIT 5-8

SOTA AND FORECASTS FOR MAJOR SYSTEM COMPONENTS

System Component	Units	Base Point (1979-1980)	Projection 1985	Projection 1990	Projection 1995	Comments
1. Central Processors						
1.1 Main Frames						
1.1.1 Cost Performance Leading Edge	M Ops/Dollar	50	167	500	1670	Dollars are monthly rental.
1.1.2 Speed						
1.1.2.1 Leading Edge	M Ops/Second	3.0	30	200	1000	
1.1.2.2 Average		0.3	3	20	100	Calculation based upon main memory speed ratios.
1.2 Mini-Computers						
1.2.1 Speed	M Ops/Second	1.0	3	9	30	
1.2.2 Cost	K$	15	10	7	5	Estimated for performance level indicated in 1.2.1.
1.3 Micro-Processors						
1.3.1 Speed	M Ops/Second	1.0	3	9	30	
1.3.2 Cost	$	10	5	2	1	Estimated for performance level indicated in 1.3.1.
2. Main Memory						
2.1 Cycle Time						
2.1.1 Leading Edge	NS	50	10	2	1	
2.1.2 Average	NS	500	100	20	10	
2.2 Capacity						
2.2.1 Minimum	M Bits	10	20	60	250	For leading edge systems
2.2.2 Maximum	M Bits	100	300	1000	3000	For leading edge systems
2.3 Cost						
2.3.1 High Performance	Cents/Bit	0.6	0.1	0.03	0.006	Bipolar
2.3.2 Low Performance	Cents/Bit	0.05	0.007	0.0003	0.0001	MOS

EXHIBIT 5- 8 (CONTINUED)

System Component	Units	Base Point (1979-1980)	Projection 1985	Projection 1990	Projection 1995	Comments
3. Mass Storage						
3.1 Disk						
3.1.1 Fixed Head						
3.1.1.1 Average Access Time	Milliseconds	4	2	1.5	1.0	
3.1.1.2 Capacity	M Bits	20	50	80	100	
3.1.1.3 Cost		$1.75 - 10^{-2}$	$9-10^{-3}$	$4-10^{-3}$	$2-10^{-3}$	
3.1.2 Moving Head						
3.1.2.1 Average Access Time	Millisecond	30	10	6	3.5	
3.1.2.2 Capacity	M Bits	2,000	4,000	8,000	16,000	
3.1.2.3 Cost		$2 - 10^{-3}$	10^{-3}	$5-10^{-4}$	$2.5-10^{-4}$	
3.1.3 Magnetic Tape						
3.1.3.1 Average Access Time	Seconds	15	7 1/2	4	2.5	
3.1.3.2 Capacity	M Bits	100	150	200	250	Capacity per reel
3.1.3.3 Cost	Cents/Bit	$5 - 10^{-4}$	$2.5-10^{-4}$	$1.5-10^{-4}$	10^{-4}	

EXHIBIT 5-8 (CONTINUED)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
4. Input						
4.1 Keyboards						
4.1.1 Cost	K Dollars	1.0	0.75	0.50	0.375	Based on the price of a "dumb" terminal
4.2 Optical Character Readers						
4.2.1 Reading Speed	Characters/Second	250	500	1,000	2,000	
4.2.2 Cost	K Dollars	50.0	25	15	10	
4.3 Voice Input						
4.3.1 Character Set	Sounds	200	500	1,000	1,000+	
4.3.2 Cost	K Dollars	75	25	15	10	

EXHIBIT 5-8 (CONTINUED)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
5. Output						
5.1 Hard Copy						
5.1.1 Terminal Printer						
5.1.1.1 Output	Characters/ Second	45	60	75	90-100	
5.1.2 Cost	X Dollars	1.0	0.75	0.50	0.375	Same as Keyboard (4.1.1)
5.1.2 High Speed Printer						
5.1.2.1 Output	X Characters/Second	1.0	1.5	2.5	5.0	Intelligent-Page Printers
5.1.2.2 Cost	X Dollars	200	150	100	50	
5.2 Soft Copy						
5.2.1 Screens						
5.2.1.1 Characters Per Frame	X Characters	2.0	2.5	3.0	3.5	Output Mechanism Only
5.5.1.2 Cost	X Dollars	0.6	0.2	0.05	0.025	
5.2.2 Audio						
5.2.2.1 Character Set	Sounds	500	1,000	2,000	4,000	
5.2.2.2 Cost	X Dollars	150	50	25	10	

EXHIBIT 5-8 (CONTINUED)

System Component	Units	Base Point (1979-1980)	Projection 1985	1990	1995	Comments
6. Communications Channels						
6.1 Voice Grade Land Lines						
6.1.1 Number of Telephones in U.S.	Millions	160	190	220	250	
6.1.2 Channel Miles	M Channel-Miles	$2.5 \cdot 10^3$	$6 \cdot 10^3$	$15 \cdot 10^3$	$35 \cdot 10^3$	
6.1.3 Cost	Dollars/Hour	9.0	7.5	6.0	5.0	
6.2 Satellite Channel						
6.2.1 Number of Commercial Wideband Channels	Number (Approximate)	400	1500	4,000	12,000	Source: J. Martino...
6.2.2 Cost	Dollars/Channel/Year	150	50	20	10	

will occur during the twenty-year period which the NAPS concept is addressing. Many of these are not implicit in the generated forecasts because they are not certain to occur. Nevertheless, if expert judgment identifies such events as probable in this time-frame, their impact must certainly be considered. This is even more important where the events are partially controllable; a major reason for undertaking such a forecast is precisely to identify action options and stimulate actions while there is still time for their effect to be apparent in the time-frame for which we are planning. An obvious example of this type of option is the authorization for expending additional funds to advance the occurrence of a desirable technological event.

The means of selection of events to be considered, and the manner in which the impacts of these events are incorporated in the step-wise progression from the system architecture at one end-point (1980) to that at the other (2000) of the NAPS time-frame, are addressed in the following section.

5.4.3 Pertinent Events

The process of identifying events which may affect established trends in various technologies of interest during a particular time-frame is one which, of necessity, can never be complete. For practical purposes, an adequate set can be constructed by consulting acknowledged experts in the pertinent fields, whether this is done in person or via a literature search. The degree of spectrum coverage is significantly enhanced if the acquisition of candidate events is performed over an extended period of time.

"Identification" of an event, for the purpose intended here, involves both the formulation of a statement describing a technological development (for example, "commercialization of laser holographic memory"), and the location of this development in time. Clearly this latter function is purely subjective, and it is mandatory that it be accomplished by experts. Experience has demonstrated that it is most reliably accomplished by obtaining consensus among experts, or at least by employing some averaging process in case agreement cannot be reached. This is frequently achieved through extensive Delphi surveys relating specifically to very limited applications.

Because of time constraints on the NAPS effort, it was not practicable to conduct a survey for this purpose. However, the technologies of significance to this study have been the focus of earlier studies by Forecasting International, and we have been able to make use of their results. These investigations concerned the future of the scientific journal,[3] the future of libraries,[4] an analysis of competitive technologies in 1985,[5] and the impact of technology on the transfer of scientific and technical information.[6] We have also made extensive use of other related studies including those performed by the Japanese Ministry of International Trade and Industry (MITI);[7] Professor Lancaster of the University of Illinois;[8] George Bernstein,[9] now R&D Manager for Information Systems at the Naval Supply Command; and the most recent survey conducted by Dataquest.[10] Other sources, listed in the bibliography (Appendix D), provided individual events which augmented these basic sets.

In the surveys reported in many of these sources, experts were asked what pertinent events they expected to occur during a specified time-period, and were also required to express in some manner the probability of occurrence of each event at particular times. The approaches varied; some asked for estimates of probability at a given year (or years), while others asked in what year the probability would reach a specified value. For the NAPS study, we have selected those events reaching an estimated 50% probability of occurrence at some time during the period of concern (1980-2000).

It should be noted that the breadth of the probability distribution curve depends upon the degree of agreement existing among the individuals queried. It also reflects the possibility that deliberate action, such as the application of additional funds, could cause the event to occur earlier. More will be said on this point in Section 6.

The events selected for this NAPS analysis, categorized by technology area, are listed in Exhibits 5.9 through 5.13. The distribution of these events over the time-period of interest is shown in Exhibit 5.14. In each instance, the year associated with the event is that date at which experts estimate that it will have a 50%

EXHIBIT 5-9

CHRONOLOGICAL LIST OF EVENTS RELATING TO COMPUTERS

Year of 50% Probability	Event Statement
1982	Scratch pad memories will have an average access time of one nano-second.
1983	Built-in self-reconfiguration in computers becomes possible by automatic selection of redundant parts.
1987	Perfection of 10:1 data compression for transmission and storage.
1988	VLSI technology will allow 1,000,000 circuits per chip.
1994	Performance of mini/micro computers improves 100/1 as compared with 1975 performance.

EXHIBIT 5-10

CHRONOLOGICAL LIST OF EVENTS RELATING TO SOFTWARE

Year of 50% Probability	Event Statement
1984	Most general-purpose software will be in the form of firmware.
1985	Natural English-language file inquiry and updating are available.
1986	A content-addressing scheme will become economical as a result of the availability of larger associative memories and higher operating speeds.
1989	Programming by voice input.
1990	Natural language programming.
1994	Problem entry replaces software preparation.
1997	Modular and implicitly-programmed software will achieve virtually total penetration.

EXHIBIT 5-11

CHRONOLOGICAL LIST OF EVENTS RELATING TO STORAGE

Year of 50% Probability	Event Statement
1982	Wide use is made of the capability to "correct" microform images by erasing and rewriting on the same frame.
1983	Inexpensive solid-state memories will substantially supplant rotating memories.
1984	Commercialization of laser holographic memory.
1987	Introduction of video disc with random access capability.
1990	Commercialization of large capacity RAM capable of storing contents of entire central library.
1998	Development of techniques for high density data storage at the molecular level (cf. DNA, RNA).

EXHIBIT 5-12

CHRONOLOGICAL LIST OF EVENTS RELATING TO TERMINALS

Year of 50% Probability	Event Statement
1983	Automatic OCR multifont readers will be in common use; these readers can adjust to read different fonts without operator interference.
1985	Voice-activated typewriter developed.
1987	Introduction of 3D displays using laser projection.
	Voice-print pattern recognition techniques.
1991	3D displays will be in common use.
1996	Widespread adoption of high resolution CRT display for video text applications with capacity for making selected hard copy.
2000	Development of process permitting voice input to be translated directly to print.

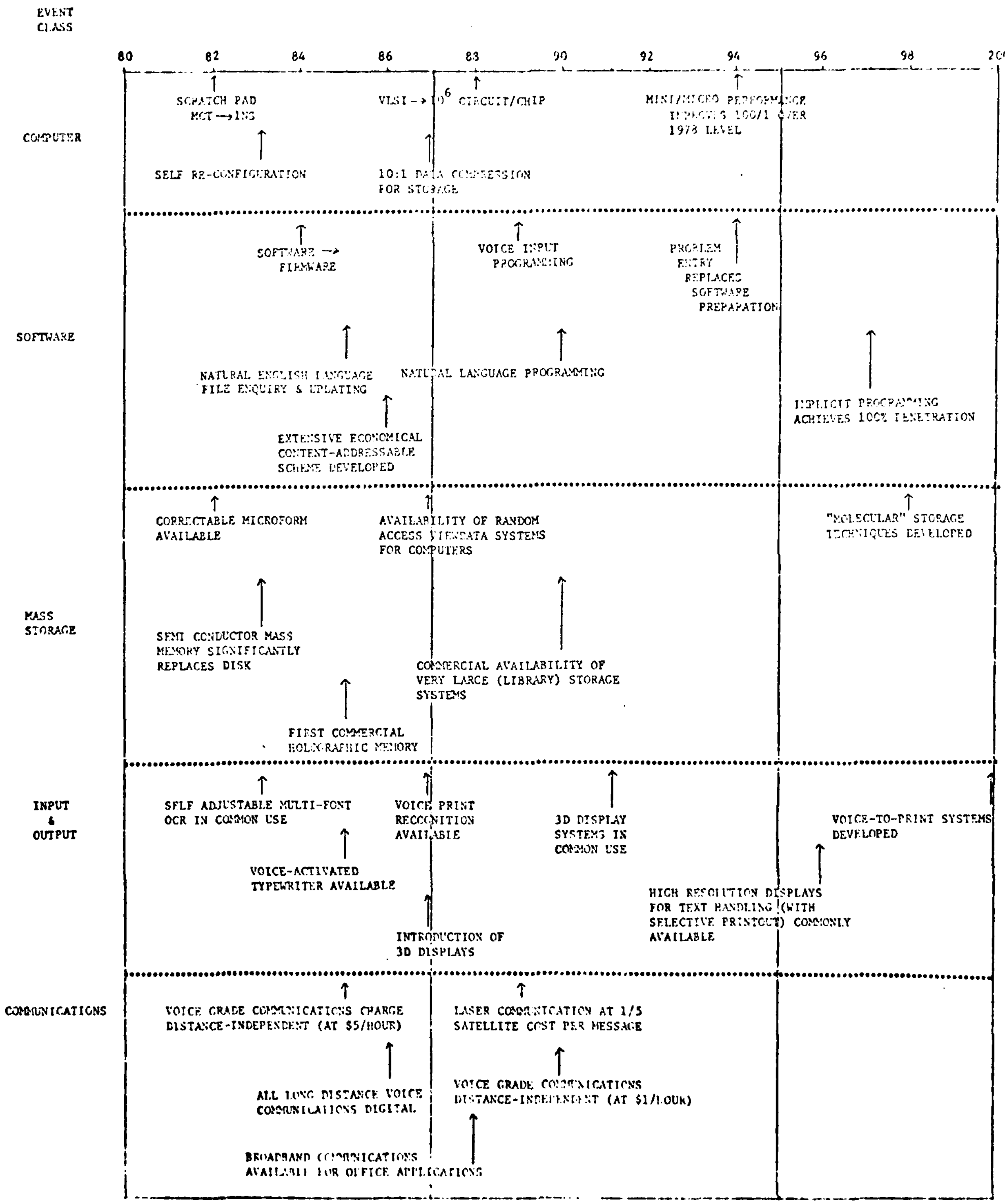
EXHIBIT 5-13

CHRONOLOGICAL LIST OF EVENTS RELATING TO COMMUNICATIONS

Year of 50% Probability	Event Statement
1985	Voice-grade communications will become distance-independent, and the cost will be $5.00/hour.
1986	All long distance voice communications will be digital in nature.
1988	Broadband communications availability for office applications.
1989	Communications by laser will be 1/5th the cost of satellite transmission (bits/sec/cent).
1990	Voice-grade line communications will become distance-independent, and the cost will be $1.00/hour.

EXHIBIT 5-14

NAPS EVENT TIME-LINE



chance of occurring, provided that no deliberate efforts are made to impede or advance this technology.

In order to assess the influence of the occurrence of these events upon the evolution of NAPS, we have defined seven major aspects of the total system:

1) Architecture
2) Systems Management
3) Management
4) Man-Machine Interfaces
5) Input/Output
6) Processing
7) Mass Storage
8) Communications

Rearrangement of the events according to their impacts upon these categories has been accomplished in Exhibits 5.15 through 5.17, for the three time-periods.

Because of the major shift anticipated for NAPS from the methods traditionally employed in the printing and publishing industries, and because the identified events directly relating to these industries were either included elsewhere or not primarily technological, these events were considered separately. They are listed in Exhibit 5.18.

5.4.4 Evolutionary Steps

Applying the methodology depicted previously in Exhibit 5.7, merging known requirements with the technological state-of-the-art and the occurrence of the specified events, for each of these categories we can describe the related characteristics for the three defined time-periods. This is accomplished in summary form in Exhibits 5.19 through 5.21. Thus, for example, Exhibit 5.19 lists system characteristics for the period 1980-1987; during this period, we see that communications (category 7) at the local level (7.1) will be a mix of direct dial, dedicated lines and hard wire, with initial co-ax cable loops at selected sites, and that software wil be application or site unique. At the national level (7.2), an initial mix of commercial and Navy networks (a policy resulting from the strategy evaluation) will be specified and placed into operation.

EXHIBIT 5-15

EVENTS CONSIDERED IN PERIOD 1, 1980-1987

Category	Date	Event Statement
Software	1984	Software (compilers, utilities, etc.) moved into firmware.
	1985	A natural English language system developed for file inquiry and updating.
	1986	An economically viable applications compatible associative addressable memory system developed.
Man-Machine Interface	1985	Voice activated typewriter commercially available.
	1987	Viable voice print recognition system available.
	1987	Initial 3D display devices become available.
Input/Output	1983	Self-adjusting multifont OCR in common use.
Processing	1982	1 NS scratch pad memories introduced.
	1983	Self-reconfiguration system introduced.
	1987	10:1 data compression transmission and storage techniques developed.
Mass Storage	1982	Updatable microfiche commercially available.
	1983	Semi-conductor, mass storage units become price competitive with magnetic disk system and begin to penetrate the market.
	1985	First, limited capability holographic memory introduced.
	1987	Commercial availability of random access video disks.
Communications	1985	Voice grade communications become distance independent.
	1986	Virtually all long distance communications digital in nature.

EXHIBIT 5-16

EVENTS CONSIDERED IN PERIOD 2, 1987-1995

Category	Date	Event Statement
Software	1989	Voice input perfected for on-line programming.
	1990	Natural language programming developed.
	1994	Problem oriented/descriptive languages developed.
Man-Machine Interfaces	1991	3D display systems in common use
Input/Output		
Processing	1988	VLSI chips with 10^6 circuits per chip become available.
	1994	Mini/micro processor performance increases by 100/1 as compared with 1975 level.
Mass Storage	1990	Availability of very large (library) storage systems.
Communications	1988	Broadband capability generally available for office applications.
	1989	Laser land communications available at 1/5 of satellite cost.
	1990	Voice grade communications (distance independent) available at $1/hour.

EXHIBIT 5-17

EVENTS CONSIDERED IN PERIOD 3, 1995-2000

Category	Date	Event Statement
Input/Output	1996	High resolution displays (with selective print-out) commercially available.
Software	1997	Implicit programming achieves 100% market penetration.
Mass Storage	1998	"Molecular" storage techniques developed.
Man-Machine Interfaces	2000	Voice to print system developed.

EXHIBIT 5-18

PREDICTED PRINTING AND PUBLISHING RELATED EVENTS

1981	Computers will be generally used for editorial functions at an early stage of S&T manuscript preparation.
1982	Widespread adoption of editing and decisions on format by CRT and light pen with capacity for mutual interaction by 2 or more editors at own consoles.
1983	Primary publishers will utilize a completely automated editorial processing center.
	Widespread adoption of digital storage of gross input for later call up and editing.
1984	Soft copy pages up 500% over 1978.
1987	Widespread adoption of reactive system with audio delivery over phone by computer-created voice.
	Hard copy pages up 50% over 1978.
1988	25% of all indexing and abstracting services published only in electronic form.
	25% of all newly published technical reports published only in electronic form.
1992	25% of all reference books now issued as print-on-paper will be discontinued in this form, and replaced by machine-readable files of comparable scope.
1993	20% of copies produced on electronic printers contain both characters and graphics.
	Widespread adoption of facsimile capable of rapid production of newspaper-like content.
	50% of all newly published technical reports published only in electronic form.
1994	Soft copy pages up 2500% over 1978.
	25% of all periodicals in science and technology published only in electronic form.
1996	Widespread adoption of high resolution CRT for video text with capacity for making selected hard copy.
	50% of all periodicals in science and technology available in both machine-readable and paper copy form.
2000	90% of all newly published technical reports published only in electronic form.

EXHIBIT 5-19

NAPS CHARACTERISTICS, 1980-1987

Characteristics	Status in Period 1: 1980-1987
0. Architecture	
0.1 Distribution	Initial testbed sites
0.2 Integration	None to minimal
0.3 Intra-System Interfaces	Definitions and final standards established Standards imposed
0.4 Inter-System Interfaces	Requirements investigation
0.5 Man-Machine Interfaces	Initial standards established
1. System Management	
1.1 Supervision	Requirements and output formats established and responsibility assigned
1.2 Monitoring	Requirements and output formats established and responsibility assigned
2. Software	
2.1 Operating System	
a. NAPS System	Requirements investigation
b. Individual Site	Individual site/installation operating system specified
2.2 Applications Package	One package specified for each application regardless of number of sites performing that application
2.3 Utilities	Developed/purchased as needed. Development of a NAPS compiler
3. Man-Machine Interfaces	
3.1 Data Manipulation	Applications oriented
3.2 Text Manipulation	Purchased/developed (no standardization)
3.3 Query	Applications oriented
3.4 User	
a. Individual	Application/site oriented
b. Multiple	Applications/device driven

EXHIBIT 5-19 (Continued)

Characteristics	Status in Period 1: 1980-1987
4. Input/Output	
4.1 Entry	Primarily via keyboard, introduction of OCR devices
4.2 Output	High speed printers, photocomposition outputs for document output
5. Processing	
5.1 System Administration	Individual applications oriented. Systems requirements study and development of specifications
5.2 Man-Machine Support	Individual application/system oriented or limited compatibility of terminal interface packages
5.3 Data Base	Individual applications oriented General requirements investigation. Setting of initial specifications
5.4 Computation	Individual applications orientation
6. Mass Storage	
6.1 Current Files	
6.1.1 Hardware	Magnetic disk and tapes. Investigation of video disk and updatable microfiche
6.1.2 DBMS	Site unique
6.2 Archival Files	
6.2.1 Hardware	Magnetic tape, microfiche
6.2.2 Software	Specifications for specific packages based upon identified requirements
7. Communication	
7.1 Local	
7.1.1 Hardware	Mix of direct dial, dedicated lines and hard wire (as appropriate) initial co-ax cable loops at selected sites
7.1.2 Software	Application/site unique

EXHIBIT 5-19(Continued)

Characteristics	Status in Period 1: 1980-1987
7.2 National	
7.2.1 Hardware	Initial mix of commercial and Navy networks (some dedicated) specified and placed into operation
7.2.2 Software	Very limited - requirements study and generation of specifications
7.3 Global	
7.3.1 Hardware	Initial mix of commercial and Navy networks (some dedicated) specified and placed into operation
7.3.2 Software	Very limited - requirements study and generation of specifications

EXHIBIT 5-20

NAPS CHARACTERISTICS, 1987-1995

Characteristics	Status in Period 2: 1987-1995
0. Architecture	
0.1 Distribution	All initial applications operational, additional applications added
0.2 Integration	Initial cross-linking and establishment of meta system
0.3 Intra-System Interfaces	Complete
0.4 Inter-System Interfaces	Final standards established and imposed
0.5 Man-Machine Interfaces	Final standards established and imposed for all "conventional" devices
1. System Management	
1.1 Supervision	System implanted
1.2 Monitoring	System implanted
2. Software	
2.1 Operating System	Totally resident in firmware
2.2 Applications Package	All new programs written in NAPS language
2.3 Utilities	Continued development (from a NAPS standpoint) continues
3. Man-Machine Interfaces	
3.1 Data Manipulation	High level languages will permit broad (cross application) data handling/manipulation Output will be tailored to the user
3.2 Text Manipulation	Standardization across application classes
3.3 Query	Flexible, "friendly" (customized on an
3.4 User	individual basis)
a. Individual	Significant proportion (>50%) soft copy. Voice input and, to some extent (< 25%) audio output
b. Multiple	Intelligent copiers for hard copy production, addressing, etc. Implementation of video text system for general application and training

EXHIBIT 5-20(Continued)

Characteristics	Status in Period 2: 1987-1995
4. Input/Output	
4.1 Entry	OCR for both historic and massive entry
4.2 Output	Initial application of high resolution (multi color) non-CRT screens, 3D and exploratory investigation of holographic displays.
5. Processing	
5.1 System Administration	Integrated monitoring capability and limited on demand information availability
5.2 Man-Machine Support	Full support for implemented applications and system usage training
5.3 Data Base	Initial integration of DB's, cross coupling where required to provide appearance of integration
5.4 Computation	Sufficient capability to support all application and ad hoc requirements
6. Mass Storage	
6.1 Current Files	
6.1.1 Hardware	Initial installation of VD's and experimentation with holographic-image storage mechanisms
6.1.2 DBMS	Generalized DBMS specified and initial utilization
6.2 Archival Files	
6.2.1 Hardware	Same as during 1980-1987
6.2.2 Software	Implementation of necessary software packages

EXHIBIT 5-20 (Continued)

Characteristics	Status in Period 2: 1987-1995
7. Communications	
7.1 Local	
7.1.1 Hardware	Extended installation of co-ax and fiber optic cables
7.1.2 Software	Unique software for traffic management developed and installed
7.2 National	
7.2.1 Hardware	Extended network (mixed commercial and Navy) placed into operation
7.2.2 Software	All operational and control/management software developed and tested
7.3 Global	
7.3.1 Hardware	Initial network (mixed commercial and Navy) placed into operation
7.3.2 Software	Operational procedures, software and control/management software specified, designed and tested. Initial usage begun.

EXHIBIT 5-21

NAPS CHARACTERISTICS, 1995-2000

Characteristics	Status in Period 3: 1995-2000
0. Architecture	
0.1 Distribution	Global system fully operational
0.2 Integration	Completion - to extent possible
0.3 Intra-System Interfaces	Fully operational
0.4 Inter-System Interfaces	Fully operational
0.5 Man-Machine Interfaces	Voice input/multi-media output fully implemented
1. System Management	
1.1 Supervision	Management monitoring and (high level) intervention (for scheduling and resource allocation) operational
1.2 Monitoring	Management monitoring and (high level) intervention (for scheduling and resource allocation) operational
2. Software	
2.1 Operating System	Totally transparent and self-adjusting
2.2 Applications Package	Investigation into concept manipulation rather than data
2.3 Utilities	Continued development in support of operating system and applications packages
3. Man-Machine Interfaces	
3.1 Data Manipulation	Continued development and extension of Period 2 capability and collateral management information generation as a by product of normal operation
3.2 Text Manipulation	Development of sophisticated cross-indexing and cross-referencing as a by product of normal operation
3.3 Query	Associative and relational links operational and screening of response monitoring
3.4 User	
a. Individual	Majority (>75%) of input and output by voice/audio transducers
b. Multiple	Continued application of intelligent copiers and computer stored "tickler" files, etc.

EXHIBIT 5-21(Continued)

Characteristics	Status in Period 3: 1995-2000
4. Input/Output	
4.1 Entry	Experimentation with image entry techniques for operational applications
4.2 Output	Continued application of 3D (where appropriate) and machine driven multi-image output techniques
5. Processing	
5.1 System Administration	Totally integrated and operational with full on-demand response capability
5.2 Man-Machine Support	Individual application/system oriented or limited compatibility of terminal interface packages
5.3 Data Base	DB's fully integrated and transparent to ordinary users
5.4 Computation	Individual applications orientation and significant forward looking (projective) modeling capability re normal operations and management control/administration
6. Mass Storage	
6.1 Current Files	
6.1.1 Hardware	Extensive upgrading of equipment to holographic/image storage devices
6.1.2 DBMS	Enhanced DBMS which permits selective abstraction and updating of images - totally transparent to users
6.2 Archival Files	
6.2.1 Hardware	Use of VD and holographic mechanisms
6.2.2 Software	Specifications for specific packages based upon identified requirements

EXHIBIT 5-21 (Continued)

Characteristics	Status in Period 3: 1995-2000
7. Communication	
7.1 Local	
7.1.1 Hardware	Conversion of key local loops to image transmission capability
7.1.2 Software	Development of required software to handle images on the loop.
7.2 National	
7.2.1 Hardware	Selective image transmission between local loops
7.2.2 Software	Extended to permit transmission of mixed (image and data-character) records
7.3 Global	
7.3.1 Hardware	System implemented as defined in Period 2
7.3.2 Software	Software fully implemented

However, there will be very little software capability at this stage, and a requirements study will be under way, resulting in the generation of specifications. A similar situation will pertain at the global level (7.3). By Period 3 (Exhibit 5.21), these capabilities will have expanded to the point where key local loops have image transmission capability, the national communications system can encompass selective image transmission between local loops, and a mixed commercial and Navy network exists on a global basis which permits the intermixing of image and data-character records during transmission.

We should note at this point that the merger of the requirements analysis, technological state-of-the-art and event occurrence at this level of system specification is accomplished only in the broadest terms, due primarily to the inadequacy of the available data base, referred to repeatedly in Sections 3 and 4. While this does not represent a major handicap at this stage, the acquisition of reliable estimates of current and projected workloads is essential to the next phase of NAPS specification and development. At that time, the predicted capabilities regarding cost, speed, reliability, size, etc. will be applied to these estimated requirements.

The progression of system characteristics for each category, over the three time-frames, reflects the transitions, triggered by the event occurrences, which lead from the existing Navy printing and publishing system to the ultimate normative implementation as visualized in Sections 1.6 and 5.2.

A schematic representation of those portions of NAPS which are anticipated to be implemented during the first period is provided in Exhibit 5.22. The actions to be taken by the Navy in accomplishing this progression are discussed below in Section 6.

5.5 Citations and Footnotes

1. Cetron, Marvin J., et al, Quantitative Decision Aids for RANN Program Management (Arlington, Va.: Forecasting International, Ltd., February 25, 1977).

2. Stevens, S. S., Handbook of Experimental Psychology Mathematics, Measurement, and Psychophysics (New York, N.Y.: John Wiley & Sons, Inc., 1951).

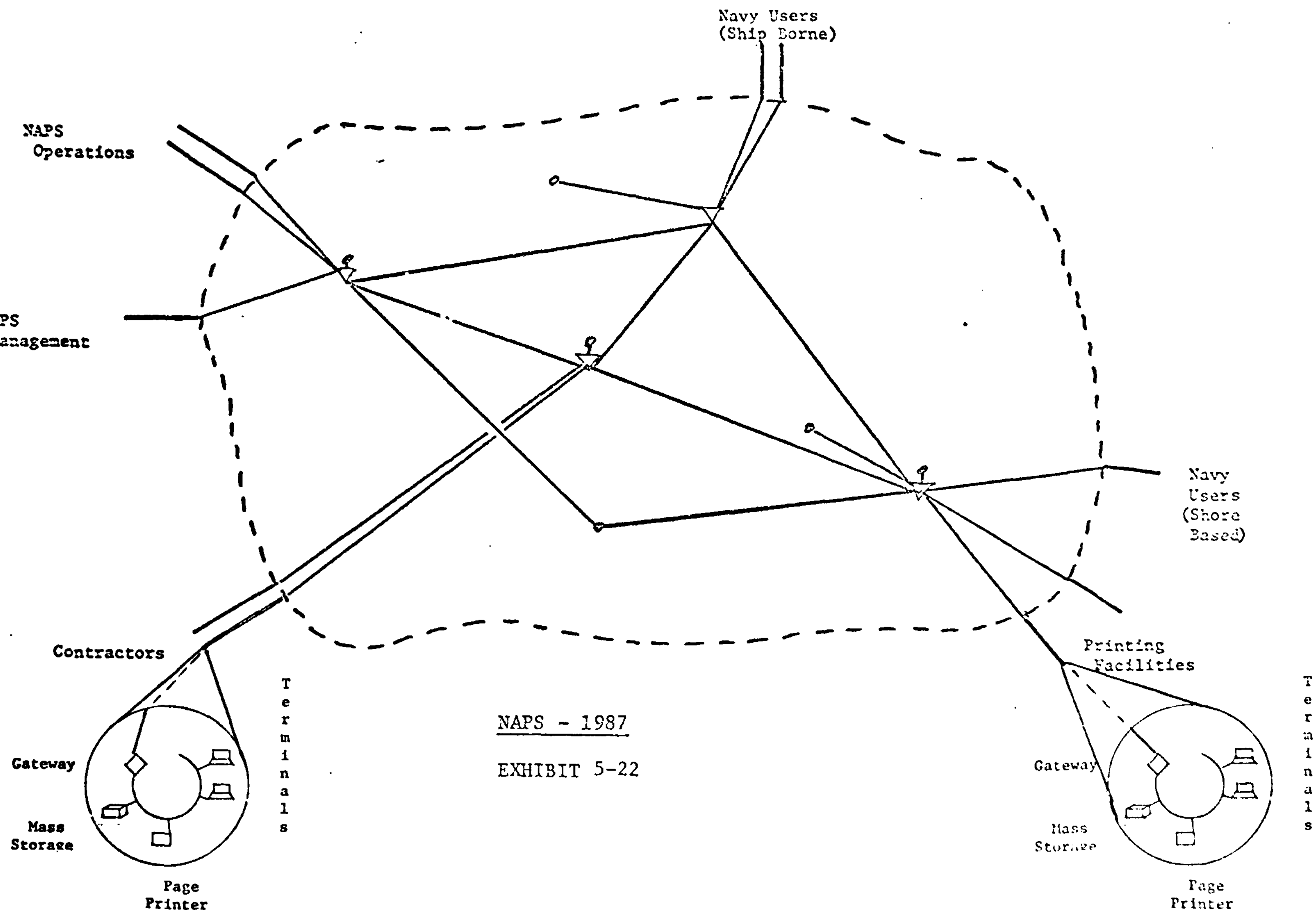


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EXHIBIT 5-22

3. Clayton, Audrey, and Norman Nisenoff, The Influence of Technology Upon Future Alternatives to the Scientific and Technical Journal (Arlington, Va: Forecasting International, 1975).

4. Technology Assessment of the Impact of Two Innovations Upon Technical Libraries (Arlington, Va: Forecasting International, 1977).

5. Costs and Benefits of Some Alternative Information Delivery Systems of 1985 (Arlington, Va: Forecasting International, 1977).

6. A Forecast of Technology for the Scientific and Technical Information Communities (Arlington, Va: Forecasting International, Ltd., May 1978).

7. Science and Technology Developments up to A.D. 2000 (Tokyo, Japan: Japan Techno-Economics Society, 1972).

8. Lancaster, F. W. (Publication pending).

9. Bernstein, George B., A Fifteen-Year Forecast of Information-Processing Technology (Washington, D. C.: Naval Supply Systems Command, Research & Development Division, January 20, 1969). (AD 681 752).

10. Hard-Copy Output in the Future Office Environment (Cupertino, California: Dataquest Inc., July 1979).

SECTION 6

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

At the broadest level of generality, and based upon the limited investigation which was performed under the constraints of available resources of time and funding, the most significant findings of the study team are as follows:

- The Navy's publication needs are currently suffering from major problems relating to quality, quantity, time-delay, convenience, cost, management and regulatory aspects.

- To overcome or ameliorate these problems, action must be taken in terms of automation, management, regulation, standardization and training/education.

- NPPS is aware, at both headquarters and field director levels, of the importance of applying advanced technology to meet its goal and charter of providing responsive publication services to the Navy. Recommended steps for accomplishing this task are detailed below in Section 6.2.

- The technologies pertinent to this concept are proceeding, in general, at a rate of growth sufficient to allow implementation of the total NAPS concept by the year 2000. This is confirmed by the technology forecast performed during the current effort, the NPPS test and evaluation of the Xerox 9700, the experience of the publishing industry and the aerospace industry in the private sector, and Command-specific capabilities such as TRUMP and ADPREPS.

- While the immediate focus is upon the conceptualization of a Navy Automated Publishing System (NAPS) as a production-oriented entity, introduction of such a system can be efficient and effective only if activities relating to the other aspects are constantly monitored, coordinated and reflected in the ultimate (normative) system.

- A recent report to Congress by the Comptroller General recommended that each department or agency should designate a top official (at a policy level) to coordinate and manage its information. This will reinforce the existing trend towards the establishment of information resource managers, and would mandate the concept of a system such as is contemplated for NAPS. It is important to avoid duplication of effort by bearing this role in mind in the formative stages of NAPS development.

- a categorization schema for non-tactical information, and associated quantitative data, are lacking, not only in the Navy but government-wide. These are essential not only to the NAPS design process, but as a basis for fiscal accountability.

- There is a clear need for the establishment and enforcement of format and media standards in a number of areas. There are currently too many allowed exceptions. The Navy Graphics Design Manual, for which a contract is in process of being let by NPPS, may form the basis for one such set of standards relating to typefaces, etc. The National Bureau of Standards may shortly issue format standards for publications, which should be reviewed and possibly adopted by NPPS. As NAPS is implemented, electronic interface standards will also need to be addressed.

- There is an increasing blurring of the boundaries between publishing functions and automated data processing. It therefore becomes a matter of urgency to classify the areas of responsibility within the Navy for equipment authorization, assets management and general guidance. Trends reinforcing this lack of distinction are the increase in "intelligence" (processing power) of word processors and reprographics equipment.

- With the increased integration of electronic processes into the publishing industry, it becomes less efficient arbitrarily to break the electronic chain of information delivery from generator to user.

- Although initially NAPS will be a production-oriented system, its evolution will be towards an end-user orientation.

- NPPS is likely to evolve as NAPS evolves, from production orientation to a management orientation, with a consequent shift in personnel requirements.

- Xerography and ink jet technologies will account for a major and increasing portion of print-on-paper production over the remainder of the century.

- With the extension of NAPS into the performance of on-board publishing functions, the whole relationship of NPPS with the fleet may change. Shipboard printing shops may be replaced by duplicating equipments and a NAPS and/or NTIPS interface, necessitating re-fitting or reconfiguration.

6.2 Suggestions for NPPS Actions

6.2.1 General Recommendations

- It is urgently incumbent upon NPPS, in addressing its goal of providing responsive and cost-effective publishing services to the Department of the Navy, to take the lead in designing, testing, implementing and managing an automated system to coordinate and accomplish Navy publication services, as outlined in this report.

- The Navy Automated Publishing System (NAPS) should be introduced incrementally over the next twenty years to achieve a rolling infusion of advanced technology and skills appropriate to meeting the Navy's publication needs in the year 2000.

- While automation is the primary focus of the recommended development program, this should be accompanied and supported by activities in the areas of standardization of input and output, regulation, management and traing/education.

- Analysis of publication-related problems indicates that the optimum configuration for NAPS will incorporate a distributed system of data bases, processing and printing facilities, embedded in a rich communications environment. The emphasis will be upon the provision of user multi-function work stations, with a gradual shift towards a balanced mix of soft display capabilities and printing on demand.

- A master plan for the development of NAPS is essential. Developments currently underway must be properly phased and integrated to avoid a series of individual, non-compatible, diverse systems.

- The most appropriate implementation strategy for NAPS will incorporate Navy management, and joint Navy-industry staffing and equipment ownership (see Section 5). Detailed cost benefit analyses should be undertaken prior to precise determination of interfaces and decisions concerning for example lease vs. buy, dedicated vs. time-shared equipments and services.

6.2.2 Specific Actions to be Taken

- A comprehensive categorization schema for Navy non-tactical information should be developed, and adopted by NPPS for quantitative workload assessment.

- An aggressive program must then be initiated to define the extent and volume of the various categories of publications to be affected by the implementation of NAPS.

- Once these requirements are established, the normative system (NAPS 2000) should be specified in quantitative form in sufficient detail for a life-cycle cost-benefit analysis to be performed.

- Alternative implementation strategies should be defined in sufficient detail to permit comparative cost-benefit analysis, and selection by NPPS of the preferred option.

- Alternative methods of funding the NAPS program in both the short and long term should be examined, and decisions made as to the optimum approach.

- Distinctions must be drawn between areas where NAPS can apply the results of industrial R&D, and those instances where specific research is required to be contracted/performed by the Navy itself. Appropriate projects should be undertaken to test prototypes or undertake R&D in accordance with these determinations. Accordingly, a Navy R&D program for NAPS should be prepared, which will avoid duplication of industry efforts while building up necessary in-house capabilities. We suggest that the most effective approach to the accomplishment of this program would entail the following initial actions by NPPS:

    1) Establish a panel of operational NPPS personnel to rule on all procurement requests for publishing and printing equipments, from whatever source, to ensure compatability/interface with the NAPS concept.

    2) Establish a panel of NPPS personnel, consultants and ex officio representatives of NAVSUP to review on a regular basis all problems arising in areas appropriate for AGS-program funding, potential projects relating to the solution of such problems, and the progress of on-going AGS projects, to establish priorities among these various efforts, and to identify any migration from the 6.2 to 6.3 funding category.

    3) Initiate a System Development Plan (SDP) for NAPS. The SDP is a planning and funding schedule procedure defined by the Department of Defense in response to OMB circular A-109, and embodied in directives 7920.1d and 7920.2i. It is anticipated that this procedure will shortly be adopted by the services. Because of this, to achieve the orderly and timely evolution of NAPS, it is recommended that NPPS follow

this approach in order that requisite levels of 6.2 and 6.3 funding can be determined and appropriated for associated activities. Speed is essential in moving into the lengthy SDP cycle to identify appropriate technologies, prototype efforts, and test bed applications and sites.

- o Testbed sites/applications should be identified and thorough requirements and implementation schedules generated. These sites/applications should be as self-contained as possible to assure:

  1) Success in identifying the requirements

  2) Design of the initial implementation

  3) Placing the application into operation.

  Site application selection should take into account:

  1) Impact of <u>success</u> upon the operation of the Navy, NPPS and the specific site selected.

  2) The negative consequences of <u>failure</u> not only upon NAPS but upon the selected site and all those relying upon that site for day-to-day operations.

  It is anticipated that initial selection will include one or more of the NPPS facilities which support SPCC, NPFC and CNET. It will also be advisable to develop in-house evaluation facilities, such as the contemplated Graphic Arts Testing Center, and on-site test beds for projects such as ADOPS (Automated Document Production System) currently being evaluated by the Fleet Combat Direction Systems Support Activity.

- o An essential ingredient of NAPS is the logical integration and interfacing of many data bases, which currently exist as independent entities, to facilitate source data capture, up-dating, file coordination and many management-oriented activities. NAPS system monitoring will be embodied in a meta system which will either interface with, or subsume, PRMIS. Further, the meta system must be capable not only of monitoring the various subcomponents of the NAPS system itself, but also of communicating through standardized procedures with such organizations as BuPers, BuMed, etc. One consequence of this integration is that activity at one data base would trigger up-date functions at other sites. NPPS should initiate an examination of all data bases (through or in conjunction with NAVDAC) to identify the sequence in which the automatic interfacing should be undertaken. Problems of compatibility of data structure, control procedures and protocols must be identified and methods of overcoming incompatibility formulated.

- A major study was originally initiated by DTNSRDC in 1974, and is continuing, to design a Navy-wide system (NTIPS) for the generation, distribution and control of Navy technical information for use in system operation, maintenance, training and logistic support. There is a considerable overlap between the concerns of NTIPS and NAPS; the former is concerned with technical information along a "horizontal time-line" from generation to ultimate use. NAPS, on the other hand, addresses a "vertical slice" in the handling of a much broader class of information (non-tactical), over a much narrower span (publication and dissemination) of its life cycle.

  The NTIPS concept comprises six major subsystems: definition/acquisition, TI generation, mastering/replication, distribution, delivery and control. For optimum satisfaction of the Navy's information needs, those systems falling under the charter of NPPS -- at a minimum, mastering/replication and distribution -- should be "folded in", or at least closely interfaced with NAPS. Close cooperation/coordination between the two study teams is essential in order to determine the type and extent of amalgamation, and the appropriate time for this to occur, and to avoid sub-optimization.

- The structure and mission of NPPS should be reviewed and if necessary revised to adjust to the capabilities of NAPS and the needs of the Navy. The current mission statement of NPPS establishes this organization as the cognizant authority for the management of Navy publication. It is, however, stated in terms of document production and distribution. With the gradual establishment of an electronic chain of information preparation, replication and dissemination, it is apparent that changes in wording are needed, and a new mission statement is already in process of drafting and approval.

  NPPS adoption of the proposed NAPS concept would emphasize even more strongly the need for such a re-evaluation of tasks and responsibilities appropriate to the role of the management of Navy publication, in order to encompass the management of the <u>functional equivalent</u> of printed materials.

- A survey and/or an evaluation of formats, styles and report/form structures employed both within the Navy and by contractors must be performed as a preliminary step towards the establishment of input and output standards.

- A careful review of OMB, GSA, Executive Orders from the

Office of the President of the United States and other agency regulations and rulings should be undertaken to determine their impact, if any, upon the development, implementation and operation of NAPS in the period 1980 through the year 2000.

o An examination of both the current legislation issued from the Joint Committee on Printing as well as the statutes governing the Freedom of Information must be examined in the context of the storage and dissemination of personnel information.

SECTION 7

7. SUMMARY

This report is the final product of a research study performed by Forecasting International, Ltd., to conceptualize an automated publishing system for the Navy. The problems which the Navy must face in this context have been identified as relating to information quantity, quality, timeliness, and the cost and convenience of providing needed information to the ultimate user. Questions of regulation and management have also been discussed in order to establish the environment in which such an automated system must function.

A detailed review of current and anticipated technological capabilities not only in the printing and publishing industry, but in the computer and communication fields, has been provided in order to demonstrate the feasibility of the system proposed for Navy publication in the year 2000. This system will be based upon distributed processing, data bases and user-site printing facilities, emphasizing soft display and demand printing, and utilizing a rich communications environment, both commercial and Navy-dedicated.

Based upon the sequential occurrence of events which will stimulate needed developments in contributory technologies, a phased program of system evolution has been outlined. This will permit a rolling infusion of technology, and the skills to harness that technology, to achieve NPPS goals by the year 2000.

The report concludes with a set of recommended actions for NPPS by means of which the development, testing and implementation of the Navy automated publishing system as here described can proceed in the most efficient and effective manner.