AD-A051 311 HUGHES AIRCRAFT CO FULLERTON CALIF GROUND SYSTEMS GROUP F/G 5/9
PRELIMINARY NTIP SYSTEM CONCEPT AND ALTERNATIVE CONFIGURATIONS.(U)
JAN 78 J E CONNELL, J J GOLDBERG N00600-76-C-1352

UNCLASSIFIED FR-77-12-150 NL

1 OF 3
AD
A051311

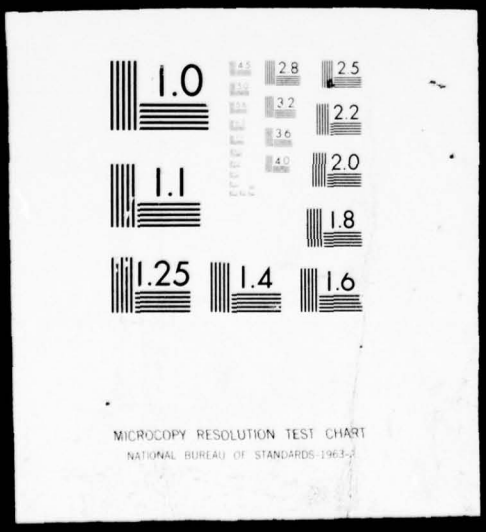


IFIED

1 OF 3

AD

A051311



AD A051311

DDC FILE COPY

12

144



HUGHES
HUGHES AIRCRAFT COMPANY
GROUND SYSTEMS GROUP
FULLERTON, CALIFORNIA

NAVY TECHNICAL INFORMATION
PRESENTATION PROGRAM

DDC
RECEIVED
MAR 16 1978

TASK 3 REPORT (CDRL A003)

PRELIMINARY NTIP SYSTEM CONCEPT AND ALTERNATIVE CONFIGURATIONS

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

Submitted by
NTIP Project, Hughes-Fullerton
to
David W. Taylor Naval Ship R&D Center (Code 1803)

Contract N00600-76-C-1352
27 January 1978

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: CDRL A003
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle): Task 3 Report
Preliminary NTIP System Concept and Alternative Configurations
(6)

5. TYPE OF REPORT & PERIOD COVERED: Final Rept. (9)
24 Jan 77 – 27 Jan 78 (14)
6. PERFORMING ORG. REPORT NUMBER: FR-77-12-150
1 on Task 3

7. AUTHOR(s)

8. CONTRACT OR GRANT NUMBER(s): (15) N00600-76-C-1352

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Hughes Aircraft Company
Ground Systems Group
Fullerton, California 92634

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
David W. Taylor Naval Ship Research and Development Center, Code 1803
Bethesda, Maryland 20084 (11)

12. REPORT DATE: 27 January 1978
13. NUMBER OF PAGES: 221

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)
(12) 244 p.

15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
(10) J. E. Connelly & A. Laicato
J. J. Goldberg

DDC RECEIVED MAR 16 1978 F

18. SUPPLEMENTARY NOTES
V. L. Kezauwerz
J. W. Kelsey

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Content Generation	Feedback
Distribution	Function
Feature of Effectiveness	Human Factors
	Integrated Logistics Support (ILS)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Task 3 report documents the preliminary system concept decisions for the NTIP System, together with the alternatives from which the system choices were selected. It represents the output of the third of seven tasks in Phase I of the Navy Technical Information Presentation Program (NTIPP) under the above-cited contract number. The technical approach to this task involved the application of systems engineering principles and methodology

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

172370

B

Item 19. Key Words (Continued)

Life Cycle Cost(s) (LCC)
Logistic Support Analysis (LSA)
Maintenance Dependency Chart (MDC)
Measure of Effectiveness (MOE)
Navy Technical Information Presentation Program (NTIPP)
Publishing
Readability
Reading Grade Level (RGL)
Replication
Specifications
Subfunction
Subsystem
System Acquisition Process (SAP)
Technical Manual (TM)
Update
User-Data Match

Item 20. Abstract (Continued)

to operate upon the data base produced in Task 1, and constrained by the preliminary requirements established in Task 2. The preliminary system concept described in this Task 3 report will be further exercised and refined through the performance and cost effectiveness tradeoffs of Tasks 4 and 5.



TASK 3 REPORT (CDRL A003)
PRELIMINARY NTIP SYSTEM CONCEPT AND ALTERNATIVE CONFIGURATIONS

NAVY TECHNICAL INFORMATION PRESENTATION PROGRAM

Submitted to

David W. Taylor Naval Ship R&D Center (Code 1803)

In Response to

Contract N00600-76-C-1352

by

Hughes Aircraft Company
Ground Systems Group
Fullerton, California

27 January 1978
FR 77-12-150

Approved for Public Release; Distribution Unlimited

FOREWORD

Hughes Ground Systems Group is pleased to submit this Task 3 Report, identified as CDRL Item A003, to the David W. Taylor Naval Ship Research and Development Center (DTNSRDC), Bethesda, Maryland in accordance with Contract N00600-76-C-1352 for the Navy Technical Information Presentation Program (NTIPP). This contract is under the technical management of Mr. S.C. Rainey and Mr. J.J. Fuller, both of DTNSRDC Code 1803.

Performing organization personnel who participated in the Task 3 effort and in the preparation of this report include the following individuals:

J.E. Connell
J.J. Goldberg
V.L. Kefauver
J.W. Kelsey
A. Laicato
C.E. Marvin
H.A. McDougal
N.S. Merlo
G.L. Sietsema
R.C. Sisman
J.R. Tracey
W.N. Waldau
V.C. Westgate
W.L. Taylor

TABLE OF CONTENTS

SECTION S – EXECUTIVE SUMMARY

Subsection S.1 – NTIPS Objectives
S.1.1 *The Navy TM Problem Involves Technical, Human Factors, and Procedural Elements* S-0
S.1.2 The Achievement of the NTIP Program Goals Requires a Definitive Preliminary Concept S-1

Subsection S.2 – System Concept
S.2.1 Overview of Preliminary NTIP System Concept S-2
S.2.2 TM Acquisition Must Insure that Technical Information is Properly Defined, Specified, and Procured S-3
S.2.3 The Approach to Content Generation Aims to Reduce Errors and Increase Efficiency in the TM Writing Process S-4
S.2.4 The Key Feature of the Publishing Subsystem is the Computerized Production Method S-5
S.2.5 Distribution Control is Computerized to get the Right TM/Update to the Right User S-6
S.2.6 NTIPS Management Subsystem Provides Control at Both "Corporate" and "Division" Levels S-7

Subsection S.3 – System Issues
S.3.1 Plans for System Evaluation and Cost Analysis S-8

SECTION 1 – INTRODUCTION AND METHODOLOGY

1.1 Objectives of Task 3 1-0
1.2 Approach to Task 3: Preliminary NTIP System Concept and Alternatives 1-2

SECTION 2 – NTIPS REQUIREMENTS

2.1 Program Goals and System-Level Requirements 2-0
2.2 Description of System Functional Requirements 2-6
2.3 Description of System Operational Sequence 2-12

SECTION 3 – PRELIMINARY NTIP SYSTEM CONCEPT

3.1 Description of Preliminary NTIP System Concept 3-0
3.2 Technical Approach to TM Acquisition Subsystem 3-6
3.3 Technical Approach to Content Generation Subsystem 3-8
3.4 Developing the Detailed TM Design 3-10
3.5 Establishing a Relationship Between TMs and Training 3-12
3.6 Technical Approach to Publishing Subsystem 3-16
3.7 Considerations in Selecting User Media 3-20
3.8 Use of Media in the User Community 3-24
3.9 Technical Approach to Distribution Subsystem 3-26
3.10 Technical Approach to Management Subsystem 3-30
3.11 Method for Updating Technical Manuals 3-32

SECTION 4 – SUBSYSTEM PRELIMINARY CONCEPTS AND ALTERNATIVES

Subsection 4.1 – TM Acquisition Subsystem
4.1.1 Description of TM Acquisition Subsystem 4-0
4.1.2 Description of User-Data Match Function 4-2
4.1.3 Description of TM Specification Function 4-6

TABLE OF CONTENTS (Continued)

4.1.3.1 Description of Technical Content Specifications 4-10
4.1.3.2 Description of Presentation Technique Specifications 4-14
4.1.3.3 Preliminary Concept of Readability for NTIPS 4-16
4.1.3.4 Considerations for Setting the RGL Requirements 4-20
4.1.3.5 Description of Access Specifications 4-22
4.1.3.6 Description of Publishing Processes Specifications 4-24
4.1.3.7 Description of Quality Control Specifications 4-26
4.1.4 Description of the TM Procurement Function 4-28

Subsection 4.2 – Content Generation Subsystem
4.2.1 Description of Content Generation Subsystem 4-30
4.2.2 Description of Engineering/Manufacturing Data Base 4-34
4.2.3 Description of Estimating Function 4-38
4.2.4 Description of Product Planning Subfunction 4-42
4.2.5 Description of the Operational Planning Subfunction 4-46
4.2.6 Description of Writing Function 4-50
4.2.7 Purpose and Description of the TM Development Guide 4-54
4.2.8 NTIPS TM Writers Guide 4-56

Subsection 4.3 – Publishing Subsystem
4.3.1 Description of Publishing Subsystem 4-60
4.3.2 Description of Digital Production Function 4-64
4.3.3 Digital Production Function Alternatives 4-68
4.3.4 Description of Mastering, Replication, and TM Supply Functions 4-72
4.3.5 Mastering, Replication, and TM Supply Function Alternatives 4-76

Subsection 4.4 – Distribution Subsystem
4.4.1 Description of Distribution Subsystem Preliminary Concept 4-78
4.4.2 Description of Initial Distribution Control Function 4-80
4.4.3 Description of Initial Distribution Control Function Alternatives 4-84
4.4.4 Description of the Resupply Function 4-84
4.4.5 Description of Resupply Function Alternatives 4-88
4.4.6 Description of the Archive Function 4-90
4.4.7 Digital Archive Technology Considerations 4-92
4.4.8 Description of Archive Function Alternatives 4-84

Subsection 4.5 – Management Subsystem
4.5.1 Overview of Management Subsystem Preliminary Concept 4-96
4.5.2 Description of the NTIP System Management Function 4-98
4.5.3 Description of NTIPS Operations Management Function 4-100
4.5.4 Support of Operations through the NTIPS Management Information System (MIS) 4-102
4.5.5 Description of the Centralized NTIPS Management Subsystem Alternative 4-104
4.5.6 Description of Decentralized NTIPS Management Subsystem Alternative 4-106

SECTION 5 – APPROACH TO TASKS 4 AND 5

5.1 Plans for Performance Evaluations of Preliminary Concept and Alternatives 5-0
5.2 Plans for NTIPS Cost Analysis 5-2

TABLE OF CONTENTS (Continued)

APPENDIX A – REFERENCES A-1
APPENDIX B – GLOSSARY OF ABBREVIATIONS AND ACRONYMS B-1
APPENDIX C – DEFINITIONS OF NTIPP TERMS C-1
APPENDIX D – DESCRIPTION OF SYSTEM OPERATIONAL SEQUENCE D-1

LIST OF FIGURES

Figure	Title	Page
1-1	Relationship of Task 3 to Overall NTIPP Effort	1-1
2-1	NTIPS Functional Block Diagram	2-11
2-2	Representative Section of Operational Sequence Diagram for TM Development	2-13
3-1	Preliminary NTIP System Concept	3-5
3-2	Detailed TM Design	3-11
3-3	TM Update System for Hardware-Related Updates	3-33
3-4	TM Update and Feedback System for Nonhardware-Related Updates	3-35
4-1	TM Acquisition Subsystem	4-1
4-2	Procedure for Using the Matrices in the User-Data Match Model	4-3
4-3	TM Specification Evolution Process	4-7
4-4	Proposed Technical Content Specification Modules	4-11
4-5	Ranking of Navy Ratings by GCT Scores and Equivalent RGL Scores	4-21
4-6	TM Procurement Function Organizational Alternatives	4-29
4-7	Content Generation Subsystem	4-31
4-8	Estimating Function	4-41
4-9	NTIPS Product Planning Subfunction	4-45
4-10	NTIPS Operational Planning Subfunction	4-49
4-11	NTIPS Preliminary Concept for Writing	4-53
4-12	Approach to TM Writers Guide	4-57
4-13	Publishing Subsystem	4-61
4-14	Subfunctions of the Digital Production Function	4-65
4-15	Mastering, Replication, and TM Supply Functions	4-73
4-16	Distribution Subsystem	4-79
4-17	Control of TM Distribution	4-81
4-18	Comparison of Centralized and Decentralized Initial Distribution Control Function	4-83
4-19	The Resupply Preliminary Concept	4-87
4-20	The Resupply Function in a Digital Environment	4-89
4-21	NTIPS Archive Function	4-91
4-22	Alternative Organizational Placements of the Archive Function	4-95
4-23	The NTIPS Management Subsystem	4-97
4-24	NTIPS Management Information System	4-103
4-25	Centralized Management Structure Comparison	4-105

LIST OF FIGURES (Continued)

Figure	Title	Page
4-26	Decentralized Management Structure Comparison	4-107
5-1	Performance Evaluation Process	5-1
5-2	Cost Analysis Reporting Matrix	5-3
D-1	NTIPS Functional Sequence Diagram	D-2
D-2	General NTIPS Operational Sequence Diagram	D-5
D-3	Operational Sequence Diagram	D-7

LIST OF TABLES

Table	Title	Page
2-1	Impact of NTIP Program Goals on System Requirements	2-1
2-2	Current Volume of Navy Technical Manuals	2-3
3-1	Approach to TM Acquisition	3-7
3-2	Content Generation Key Problems and Solutions	3-9
3-3	Matrix Showing Possible Assignment of Task-Related Factors of Training/Technical Manual Categories	3-13
3-4	NTIPS Publishing Approach	3-17
3-5	Implications of Media Selection	3-21
3-6	Usability of Media in the User Community	3-25
3-7	NTIPS Approaches to Problems in Distribution	3-27
3-8	Approach to NTIPS Management	3-31
4-1	Typical Technical Content Module Selections	4-13
4-2	Proposed Presentation Technique Specification Modules	4-15
4-3	Candidate Readability Formulas	4-17
4-4	Features of Readability Concept	4-19
4-5	Proposed TM Access Specification Modules	4-23
4-6	Proposed Publishing Process Specification Modules	4-25
4-7	Proposed Quality Control Specification Modules	4-27
4-8	NTIPS Engineering Manufacturing Data Base Characteristics	4-37
4-9	TM Development Guide as an Aid to TM Engineer	4-55
4-10	Methodology Needed for Candidate Media in Publishing Functions	4-63
4-11	Comparison of Preliminary Concept and Alternatives for Digital Production	4-69
4-12	Comparative Summary of Storage Alternatives	4-71
4-13	Mastering, Replication and TM Supply Alternatives	4-77
4-14	Navy TMs Converted from Pages to Digital Bits	4-93
4-15	NTIP System Management Function	4-99
4-16	NTIPS Operations Management Function	4-101

SECTION S
EXECUTIVE SUMMARY

Subsection S.1 – NTIPS Objectives

S.1.1 The Navy TM Problem Involves Technical, Human Factors, and Procedural Elements S-0

S.1.2 The Achievement of the NTIP Program Goals Requires a Definitive Preliminary Concept S-1

Subsection S.2 – System Concept

S.2.1 Overview of Preliminary NTIP System Concept..... S-2

S.2.2 TM Acquisition Must Insure that Technical Information is Properly Defined, Specified, and Procured S-3

S.2.3 The Approach to Content Generation Aims to Reduce Errors and Increase Efficiency in the TM Writing Process S-4

S.2.4 The Key Feature of the Publishing Subsystem is the Computerized Production Method S-5

S.2.5 Distribution Control is Computerized to get the Right TM/Update to the Right User S-6

S.2.6 NTIPS Management Subsystem Provides Control at Both "Corporate" and "Division" Levels S-7

Subsection S.3 – System Evaluation

S.3.1 Plans for System Evaluation and Cost Analysis..... S-8

The Navy TM Problem Involves Technical, Human Factors, and Procedural Elements

NTIPS

79132-191

- TM Specifications Not Tailored to Unique Equipment Requirements
- TM Contents and Presentation Techniques not Matched to the User
- Development of TMs not Coordinated with Training
- Engineering/Manufacturing Data Base Not Suited to TM Needs
- TM Writers Guide and TM Planning Guides Not Available
- TM Publishing, Updating, Distribution, and Archives are Slow and Archaic
- TM Process Unresponsive to User Feedback

The problem faced by NTIPS is the failure of Navy technical manuals to provide fleet personnel with accurate, usable, and up-to-date information. Consequences of this failure are improper equipment operation, inadequate preventive maintenance, and increased time for fault isolation and repair. The key problems are shown above.

First, TM specifications do not provide for the unique nature of the equipment being procured. Secondly, the TM contents and presentation techniques are specified in a general way which does not take into account the abilities, experience, and working environment of the user. Also, TMs currently being produced often do not meet training needs because of the lack of coordination between the two fields.

In the development of TMs, two major problems exist. The first is the failure of the engineering drawings, reports, and data to provide readily usable information for the development of technical manuals. This data is currently geared toward specifying the hardware for fabrication purposes. It does not provide an equal measure of operator- and maintenance-oriented data. The second problem concerns the lack of practical and definitive TM writers guides and TM development planning and management guides. The writers guides would introduce the TM writer to the NTIPS system and provide "how to" instructions on new techniques of presentation and readability. The planning and management handbooks would assist the TM engineers in understanding and applying techniques for effective TM development.

The failure of the present system to acknowledge or act on user-initiated corrections and today's time-consuming update methods make the user reluctant to use existing corrective feedback methods. To improve efficiency, increased automation of publishing, production, distribution, and archival functions is required. Solutions are needed which are integrated, Navy-wide, cost effective, and transitionable from the "old" TM system.

The Achievement of the NTIP Program Goals Requires a Definitive Preliminary Concept

NTIPS

7913-192

NTIP Program Goals

- Reduce Job Performance Time and errors
- Reduce Training Time
- Reduce TM Life-Cycle Costs

Task 3 Objectives

- Synthesize System Configuration
- Develop Preliminary System Concept and Functional and Subsystem-Level Alternatives
- Identify Additional R&D Requirements

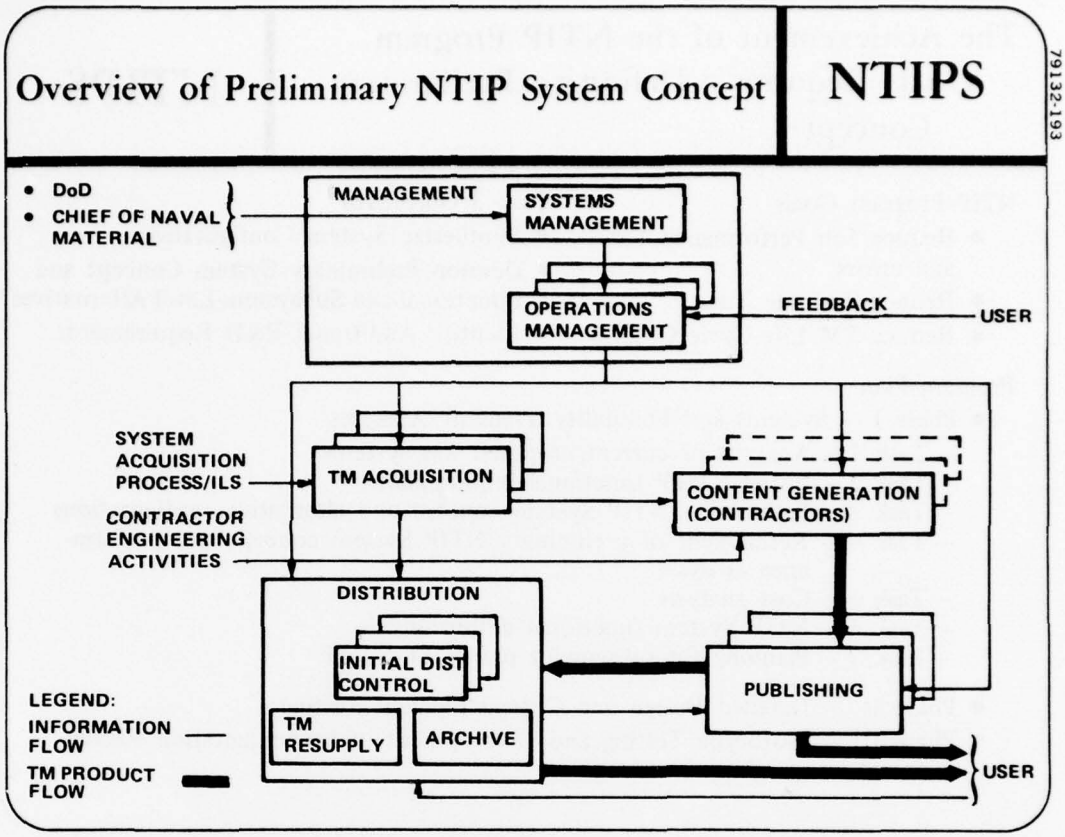
Program Plan

- Phase I – Systems and Feasibility Tradeoff Analyses
  - Task 1 – Analysis of current/proposed TM systems
  - Task 2 – Initial NTIPP functional requirements
  - Task 3 – Preliminary NTIP System concept and alternative configurations
  - Task 4 – Refinement of preliminary NTIP System concept and performance analysis
  - Task 5 – Cost analysis
  - Task 6 – NTIP System functional definitions
  - Task 7 – Planning for subsequent phases of NTIPP
- Phase II – Detailed Design and Critical Element Testing
- Phase III – Prototype Testing and Development of Implementation Recommendations

The goal of the current phase of the NTIP Program (Phase I, Systems and Feasibility Tradeoff Analyses) is the development of a functional definition of the NTIP System that will provide the basis for the detailed design effort in Phase II. The importance of Phase I is underscored by the fact that the quality of the concept formulated will ultimately determine the degree of attainment of the NTIP Program performance goals. These goals include: reduction in user job performance time by 10% and errors by 50%, reduction in training time by 5 to 25%, and reduction in TM life-cycle costs by 30%.

The objectives of Task 3 were to (a) synthesize a system configuration, (b) identify functional and subsystem-level alternatives, and (c) identify areas where additional research and development are required. In meeting these objectives, a preliminary system concept was developed which reflects the system-level and functional requirements developed in Task 2 (and refined during Task 3). In addition, the preliminary concept required sufficient detail to permit the conduct of performance evaluations (Task 4) and cost evaluations (Task 5). Task 3 also identified alternative approaches to implementing the requirements that were deemed feasible on the basis of a gross-level analysis with respect to practicality, cost, affordability, and performance.

A research approach consisting of problem identification, performance of detailed studies related to the problems identified, and postulation of candidate solutions was applied to each subsystem throughout the Task 1, 2, and 3 efforts. Evaluation of candidate solutions, and selection of a preliminary concept and alternatives were accomplished exclusively during the Task 3 effort.



The preliminary NTIP System concept takes full advantage of existing TM expertise within Navy organizations and emphasizes the importance of developing TMs that match the information needs of the user. This approach provides the NTIPS subsystems responsible for acquiring TMs with the ability to focus resources on this key area, with guidance and policy supplied by NTIPS management.

The Management Subsystem utilizes a single systems management function to guide the NTIPS system as a whole, and second-level operations management functions which are dedicated to the major acquisition activities (procurers of systems/equipments). The TM Acquisition Subsystems, dedicated to each major acquisition activity, specify the precise TM requirements for each procurement and implement procurement procedures to ensure timeliness and quality in TMs.

The Content Generation Subsystem is critical in that it represents the most significant and final point of impact on technical information quality. In this approach, the Contractors continue to be responsible for collecting the data, estimating the proposed TM acquisition cost, preparing TM planning documents, writing the TM, critiquing the TM, and performing validation, but under new ground rules and better guidelines.

Publishing provides decentralized internal Navy capabilities to accept the equipment contractor's digital output for processing through production, mastering, replication, and final delivery. A feature of this concept is automated facilities to process new and updated text and graphics.

Distribution controls the initial distribution of new and updated TMs, the storage and delivery of TMs for resupply, and TM archival storage. It features electronic media for working archives and automation of distribution control.

TM Acquisition Must Insure that Technical Information is Properly Defined, Specified, and Procured

NTIPS

79132-194

- User-Data Match Model – Provides a means by which user-optimized presentation techniques, related to his personnel characteristics, tasks, and working environment, are identified
- Modular Concept – Provides the means to custom-tailor a TM specification to a particular procurement and to reduce redundancy and extraneous information in the specification
- Specification Modules – Contain precise requirements for the technical content, presentation techniques, readability, vocabulary, access, publishing processes, and quality control of TMs
- Dedicated TM Procurement Function – Operates under NTIPS organizational structure to provide customized TM procurement services for a major acquisition activity
- TM Engineer – Oversees development of TM requirements, delivery, scheduling, proposal and contract preparation, quality assurance, budgeting and funding, and contract administration

The TM Acquisition Subsystem consists of three functions: user-data match, TM specifications, and TM procurement. These functions are responsible for determining user-data requirements, specifying the requirements, and purchasing the data. This subsystem is critical to successful system operation since it has the first and most significant impact on determining TM design. Other subsystems of NTIPS are not equipped to modify subtle mistakes or decisions made by this subsystem, and errors made will eventually be reflected in TMs and by the technician's inability to effectively use his TMs.

A user-data match model is proposed for aiding the selection of the best choices of information types that could be supplied to a user. This model utilizes three matrices which relate user personnel characteristics, presentation components, equipment type and task analysis, upon which the selection of presentation techniques are based.

Modular TM specifications afford the advantage of stating TM requirements in bite-sized chunks, or modules. These modules can then be combined in a multitude of ways to custom-tailor TM specifications to specific TM procurements. Computer-aided processing, storage, selection, formatting, and updating of the specification modules also enhances their ease of use and the capability to keep the specification modules current with state-of-the-art presentation technologies.

Dedicated TM procurement functions within NTIPS, run by Navy TM engineers with "captured" funds that are divorced from hardware acquisition activities, afford better organizational and funding control of this function. The procurement of TMs and budgeting of funds by a single, responsible expert activity should eliminate the problems due to inconsistent requirements and inappropriate funding priorities, and thus improve the resulting TM product.

The Approach to Content Generation Aims to Reduce Errors and Increase Efficiency in the TM Writing Process

NTIPS

79132-195

- TM Engineer
  - Plans, initiates and supervises TM development tasks and establishes interrelationships with design engineering, ILS, and QA activities
- TM Development Guide
  - Aids TM engineers in planning and managing development tasks
- Coordinated Planning
  - Provides compatibility of TM and other ILS element estimates and planning documents for completely integrated support package
- Upgraded Writing Staff
  - Provides more efficient data transformation
- Combined TM Reviews with Validation
  - Ensures TM accuracy and completeness
- Post-Program Review
  - Provides means for improving TM acquisition system

The content generation subsystem consists of three functions (estimating, planning and writing) for developing new and updated TMs. Content generation is the most significant part of NTIPS because it is the final point of impact on technical information quality. Hence, each function contains features that are designed to reduce errors in the process of transforming technical data contained in the engineering/manufacturing data base into technical information.

A new position is created that calls for a TM engineer, who would be responsible for planning, initiating and supervising all tasks associated with content generation. His responsibilities include coordinated planning and review of estimating and planning documents with other ILS elements to provide the user with a complete and compatible integrated logistic support package (i.e., TMs, training, spares provisioning, etc.).

Detailed guidance in the form of a TM Development Guide, which supplements instructions contained in TM requirements, would be produced. This guide would provide the TM engineer step-by-step instructions on how and when to accomplish the TM development tasks.

The procuring activity's final review would be combined with the technical review and TM validation. This would provide resolution of TM problems through a joint effort of all TM program participants and would improve TM completeness, technical accuracy, and user effectiveness.

The engineering/manufacturing data base would be improved by requiring the addition of maintenance data. Also, computer processing would be employed to make the data base more accurate and timely for the content generator.

The Key Feature of the Publishing Subsystem is the Computerized Production Method

NTIPS

79132-196

- Produces TMs in Paper and Microform Media
- Fully Automated, Internal Navy Capability for Text and Graphic Production
  - Will accept contractor's technical information in digital form
  - Will accept Navy technical information in paper, and convert by OCR
- Standardized Digital Publishing Methods and Requirements Among the Various Contractors and Navy Publications Operations

The preliminary concept of the Publishing Subsystem provides for Navy capability to not only process their own technical information into TMs, but to process equipment contractor's technical information into TMs as well.

The capability provided must handle over three million pages each year, the majority of which are presently processed (at least through mastering) by equipment contractors' publishing activities. Presently, the Navy creates and processes less than 50 thousand pages each year and converts only about 100 thousand pages yearly to a TM digital data base with their TRUMP system.

To handle the projected three million plus pages per year, a digital (computerized) TM data base must be created and maintained current for all in-production equipment. Although the digital data base is essential for updating TMs after the equipment transitions from in-production to out-of-production status, the digital data base is also necessary to digitally produce the in-production equipment technical information as TMs for replication and delivery to the users.

Fully automated text and graphic processing is the key feature that enables the digital production needed in this subsystem. Publishing must also provide a capability to output the digital production as masters of TM pages and for their replication and delivery.

Another key feature is to standardize digital publishing methods to facilitate the Navy processing of the various equipment contractors' technical information and the exchanging of work among Navy publishing operations. Having the same functional capability at each Navy publishing facility will help provide needed compatibility.

Distribution Control is Computerized to get the Right TM/Update to the Right User

NTIPS

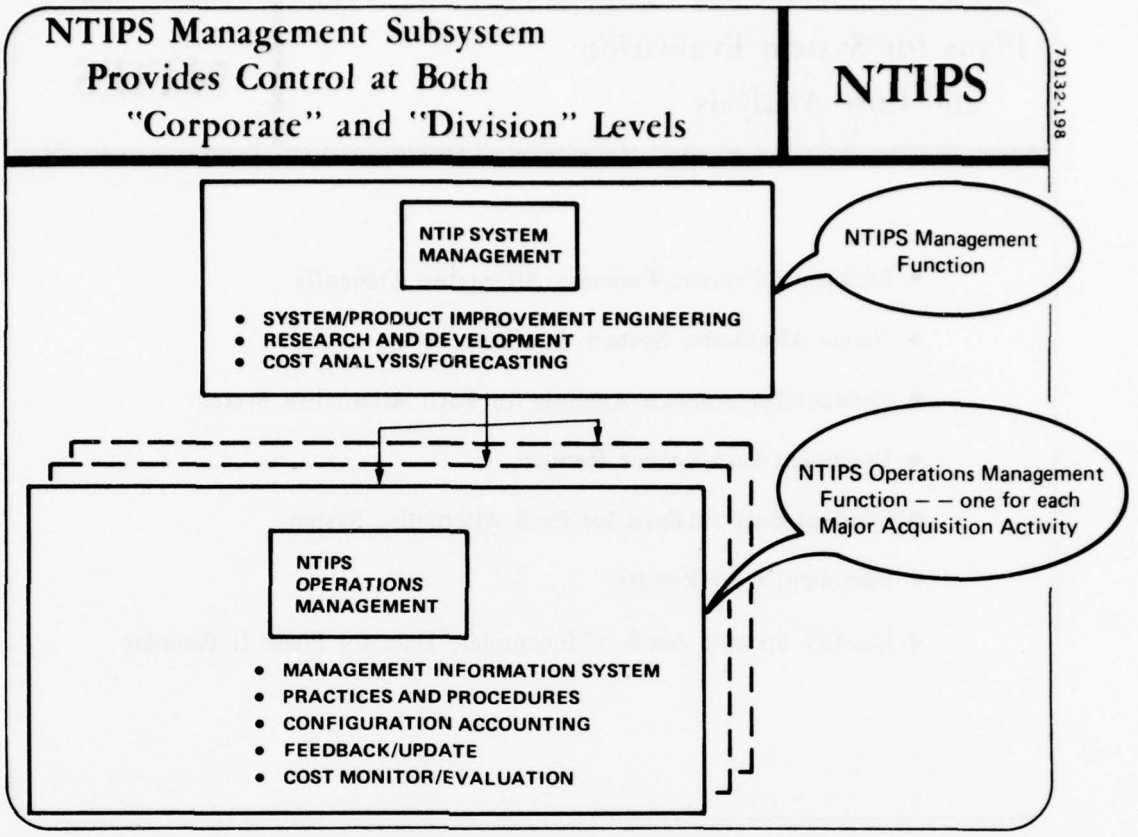
79132-197

- Decentralized Initial Distribution Control Capability
  - Automated Hardware/TM Configuration Management via MIS
  - Complete Use/Address File via MIS
- Centralized TM Resupply Capability within NTIPS
  - Automated Materials Management via MIS
  - Physical Storage to Accommodate Printed Paper Books and Microforms
- Centralized Dual Archives Support Publishing Activities
  - Digital Working Archive to Contain the Digital TM Data Base
  - Protected, Controlled Historical Archive to Contain Master Copy of All Navy TMs

The Distribution Subsystem must provide the capability to control the TM distribution for 12,000 new procurement actions and 20,000 TM updates each year. This role of initial distribution control works closely with TM procurement in the TM Acquisition Subsystem. A key element of distribution control is the mechanism to assure that the configuration of the TM furnished to the user matches the hardware configuration being used. Additionally, this function assures the timely delivery to users of their TMs and all subsequent updates. Both TM/equipment configuration management and the user/address file are elements of the Management Information System (MIS).

The second capability needed is to provide a warehouse for paper and/or microform copies of 150,000 different TMs. This function, TM resupply, maintains an adequate supply of each active TM to respond to user requests for TMs and coordinates replenishment with the major procurement activities when stock levels decline.

Finally, the Distribution Subsystem provides a dual archive of TM masters. A working archive provides a digital data base of all active TMs for processing by the Publishing Subsystem. The working archive is used for updating TMs when equipment is modified. The other, historical archive, is the repository of master copies of all TMs used by the Navy. Although designated "historical," this archive provides a back-up for the working archive.



The NTIPS Management subsystem is a two-tiered design that establishes system policies and objectives at a centralized system management level, and provides operational management support to the acquisition activities at the operations management level. At the first level, the NTIP System Management Subfunction is reponsible for the overall management of NTIPS, and establishes and promulgates all policies necessary for system operation. The system/product improvement engineering subfunction establishes quality assurance policy, evaluates TM quality, and assists with budget reviews and long-range planning. The research and development (R&D) subfunction provides Navy-wide coordination of all NTIPS-related R&D efforts and monitors on-going DoD/Industry efforts to determine applicability to NTIPS. Finally, the cost analysis/forecasting subfunction performs in-depth analyses of budgeting/scheduling data from Navy-wide NTIPS activities.

The second-level NTIPS operations management function is dedicated to the TM requirements of each of the major acquisition activities. The NTIPS operations management subfunction is responsible for guiding the operations of the NTIPS activities within its purview. The practices/procedures subfunction prepares detailed operating procedures for the NTIPS activities, while the Management Information System (MIS) maintains the management data collecting and reporting network that supports the NTIPS operations. The remaining three subfunctions (configuration accounting, feedback/update, cost monitor/evaluation) provide the TM configuration index, the feedback network, the out-of-production TM update system, and the cost monitoring and evaluation system.

Plans for System Evaluation and Cost Analysis

NTIPS

79132-199

- Perform Subsystem/Function Alternative Tradeoffs
- Define Alternative System Cost/Risk Levels
- Conduct Performance Analysis for Each Alternative System
- Document Performance Results
- Conduct Cost Analysis for Each Alternative System
- Document Cost Results
- Identify Specific Areas of Incomplete Data for Phase II Planning

The next tasks in NTIPP Phase I are refinement of the system concept and evaluation of system performance (Task 4), and cost analysis (Task 5). The main steps in these tasks are outlined above.

Task 3 described about 25 functional alternatives to the preliminary concept. The first step of the evaluation process will be tradeoffs among all alternatives defined at the function level. The next step will be the development of three cost/risk-level alternative system concepts from the available list of functional alternatives. In synthesizing these alternative systems from a cost/risk viewpoint, the intent is not to select the ultimate NTIP System strictly from these three alternatives, but to provide a viable context in which to conduct the system performance and cost evaluations.

The performance analysis will employ detailed effectiveness criteria at the functional level, including both features of effectiveness (FOEs) and measures of effectiveness (MOEs). In this analysis, significant gaps in the data base may be identified. If so, opportunities for capture of the data during Phase II will be identified to enable confirmation of the Phase I tradeoffs.

The next effort will be to develop cost comparisons for the three cost/risk system concepts. The cost analysis will treat the system alternatives on a function-by-function basis, and provide cost summaries at both the subsystem and system level. Needed cost data, not currently available, will be identified.

Finally, matrices will be developed to permit comparison of performance and cost of the three alternative NTIP systems at the function level. These matrices and their supporting rationale will provide the information relevant to the decisions involved in selecting the NTIP System concept.

SECTION 1
INTRODUCTION AND METHODOLOGY

1.1 Objectives of Task 3 1-0
1.2 Approach to Task 3: Preliminary NTIP System Concept and Alternatives 1-2

1.1 OBJECTIVES OF TASK 3

The objective of Task 3 is to develop a preliminary system concept and functional and subsystem-level alternatives in sufficient depth to enable performance and cost evaluations, prior to the functional definition of the selected system configuration.

The end product of the current phase of the NTIP Program (Phase I, Systems and Feasibility Tradeoff Analyses) is the development of functional definitions of the NTIP System that will become the groundwork for the detailed design effort in Phase II. The importance of Task 3 is underlined by the fact that the quality of the concept formulated will ultimately determine the degree of attainment of the NTIP Program performance goals. These goals include a reduction in user job performance time (10%) and errors (50%) as well as a reduction in training time (5% to 25%) and TM life-cycle costs (30%).

Phase I of the NTIP Program consists of seven tasks, as shown in Figure 1-1. Task 1 was a survey and analysis of current and proposed technical manual systems. Principal emphasis was directed to U.S. Navy technical manual operations (NAVAIR, NAVSEA, NAVELEX), but for comparison, some non-Navy TM activities (Army, Air Force) were also examined. The resulting information base is contained in the NTIP Task 1 Report, which is supplemented by the special report, "NTIPP Fleet Survey of Technical Manual Users." This survey was conducted at Pacific Fleet Activities from 1 November to 22 December 1976 by an NTIPS survey team that interviewed more than 400 Navy personnel. User comments on TMs were documented through a direct structured interview technique using a standard questionnaire.

The next step in the process was Task 2, the development of NTIPS requirements. These requirements serve as criteria for both system configuration synthesis and testing the acceptability of the preliminary concept and alternatives developed during Task 3. Requirements statements were arrived at principally through analysis of information researched during the conduct of Task 1 and the Fleet Survey.

The objective of the Task 3 effort was to develop a preliminary NTIP System concept that meets the system-level and functional requirements developed in Task 2 (and refined as a part of Task 3), and to identify functional and subsystem-level alternatives. The primary work of this task was to identify alternative approaches to implementing the requirements that were deemed feasible on the basis of a gross level analysis with respect to practicability, cost, affordability, and performance. However, a detailed discussion of the advantages and disadvantages of each alternative was intentionally omitted from this report pending the results of the performance and cost evaluations to be performed in Task 4 and Task 5.

As an example of this process, the requirements of the archive may be met by employing computer access and control and total digital storage of TMs. This approach may meet all the feasibility, performance, and operating cost criteria, yet fall beyond the limits of affordability criteria. An alternate approach would be to store all TMs in microform using computers for archival access and control.

An additional objective was to identify areas where additional research and development are required. As an example, user-data matching and the relationship between TMs and Training were identified as needing further research and development during Phase II of the NTIP Program.

The preliminary NTIP System concept and functional alternatives will be evaluated and ranked from a performance (Task 4) and a cost (Task 5) viewpoint. Based upon these analyses, selected NTIP System concepts will be functionally defined in Task 6. The functional definitions will be the basis for detailed design and testing in Phase II of the NTIP Program.

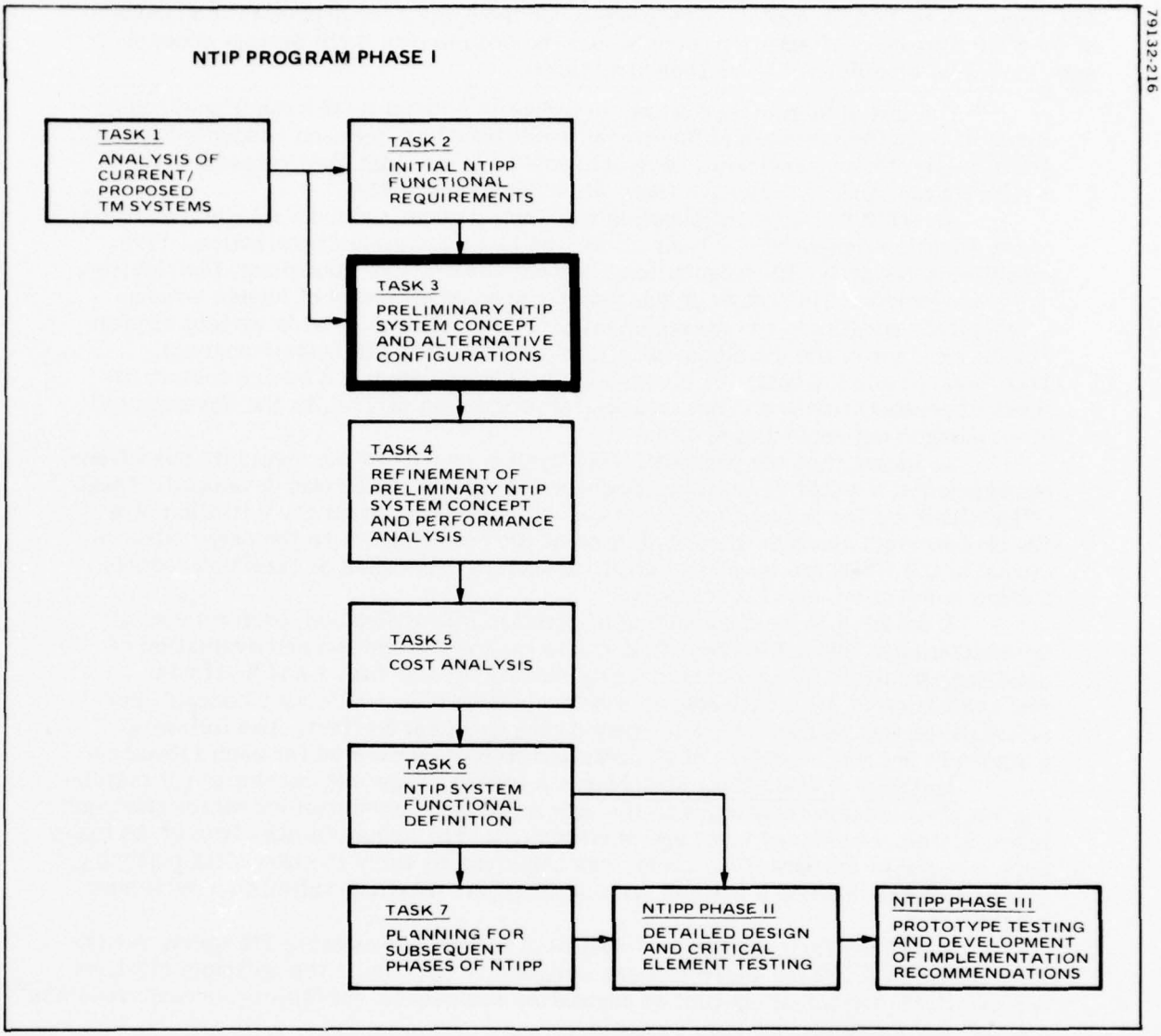


Figure 1-1. Relationship of Task 3 to Overall NTIPP Effort. The principal objective of the Task 3 effort was to synthesize a preliminary NTIP System concept that meets the requirements developed in Task 2 and refined in Task 3, define functional relationships, and identify feasible functional alternatives.

1.2 APPROACH TO TASK 3: PRELIMINARY NTIP SYSTEM CONCEPT AND ALTERNATIVES

The approach to Task 3 involved a refinement of the Task 2 requirements and synthesis of an NTIP System configuration, upon which the preliminary NTIP System concept and functional alternatives were then structured.

The initial step in Task 3 was to refine the initial NTIPP functional requirements at both the system and functional levels based on research conducted to date. Additionally, the requirements were analyzed to insure that they respond to the NTIP Program goals to improve fleet and training readiness.

An NTIP System configuration was then synthesized from a logical analysis of the functions required and their allocation to a subsystem organization. Five subsystems resulted: TM Acquisition, Content Generation, Publishing, Distribution, and Management. This range of subsystems involves a variety of human actions, mechanical operations, and management processes. Hence, a wide variety of problems is resident in the development of the preliminary NTIP System concept. This requires a broad range of technical approaches – from the human factors aspects of presentation techniques, to digital production of TMs, to the development of a management reporting system.

To insure that the proposed NTIP System configuration meets its operational requirements, a set of Operational Sequence Diagrams (OSD) was developed. These OSDs illustrate the sequence of events which must occur from the initiation of a TM procurement through the distribution of the resulting TM to the user. Also included in the OSDs are on-going activities such as processing of feedback reports, system monitoring, and TM resupply.

A detailed process consisting of problem indentification, performance of detailed studies related to identified problems, and postulation and evaluation of candidate solutions occurred continually throughout the Task 1 and 2 efforts. The evaluation of candidate solutions and selection of a preliminary concept and alternatives was performed exclusively during the Task 3 effort. The following paragraphs present examples of the detailed studies performed for each subsystem.

Methods of User-Data Matching – A methodology was developed for matching TM presentation techniques to the user based upon personnel characteristics, job tasks, system/equipment type, and environment. The human factors firm of Anacapa Sciences, Santa Barbara, California, was employed to study the user-data matching problem and to develop a method for selecting presentations suited to a particular user's needs.

New Specification System – Detailed analyses of existing TM specifications were performed. These analyses were designed to determine the optimum methods for specifying technical content, presentation techniques, readability, access, vocabulary, and publication processes requirements.

Content of Engineering/Manufacturing Data Base – The content of the engineering/manufacturing data base was examined to determine its applicability to the development of technical information. This examination focused on the potential for requiring the inclusion of specific types of maintenance information in the data base which would facilitate the development of technical information.

Performing a TM Design – The problems related to development of TM design disclosure documents such as bookplans and outlines were analyzed. This analysis focused on the role of human factors considerations, the required level of detail, the qualifications and types of personnel involved, and the need for coordination with training and design engineering.

TM Review Team Definition – Criteria for standardizing TM review teams were established. The number and type of team members (to include user, training,

and design engineering participation) and the responsibilities of each participant were determined.

Defining the Role of Quality Assurance – The amount of quality assurance emphasis that should be applied during the various phases of TM development was determined. Additionally, the extent of involvement and the responsibility of both content generating and TM acquisition personnel were evaluated. A major portion of this study was performed by Hageman Consulting Services of Fort Worth, Texas.

Upgrading of Technical Writers – Various ways of upgrading the capabilities of technical writers were surveyed. A number of potentially feasible approaches to this problem were uncovered, such as: (1) requiring certification of TM writers, (2) requiring that TM writers be graduate engineers, and (3) mandatory contractor-conducted TM writer training courses.

Plans for Applying Known Readability Remedies to TMs – A practical plan was prepared to apply known and proven methods of achieving readable writing in TMs. Existing readability measurement formulas were analyzed for applicability to technical manuals and the content of writers guidelines was planned to include items such as vocabulary controls and readability, writing, and editing practices.

Extent of Automated Graphic Processing – Available automated graphic processing systems were identified and their capabilities evaluated. A macro level analysis was conducted to determine the ability of automated graphic processing systems to meet NTIPS requirements for capacity and throughput rate.

ADP Applications to the Archive – The functions of the archive to which ADP can be applied were identified. Techniques of indexing, information retrieval, cataloging, and storage were surveyed to determine their applicability to the NTIPS archive.

Methods of Monitoring NTIP System Operating Costs – The cost monitoring points and methods of cost collection required to audit NTIP System operating costs were identified. Considerations in this study were the level of detail, frequency, and types of output reports.

SECTION 2
NTIPS REQUIREMENTS

2.1	Program Goals and System-Level Requirements	2-0
2.2	Description of System Functional Requirements.....	2-6
2.3	Description of System Operational Sequence.....	2-12

2.1 PROGRAM GOALS AND SYSTEM-LEVEL REQUIREMENTS

The Preliminary NTIP System concept is initially driven by a combination of program goals, system-level requirements, and system constraints.

The Navy Technical Manual System (NTMS) Program Development Plans[1,2] cited numerous problems and deficiencies in the current Navy system of TM development. (NTMS is now the Navy Technical Information Presentation System.) Recognition of these problems and deficiencies resulted in the formulation of program goals to improve fleet and training readiness[3]. These goals and their impact on system requirements are defined in Table 2-1. These goals, combined with the NTIPS analysis of current and proposed TM systems (Task 1) led to the identification of further system-level requirements and constraints to which the preliminary NTIP System concept must be responsive, as discussed below.

Ease of NTIPS Implementation – The NTIP System must evolve from the current Navy TM system. Consideration must be given to minimizing the impact on existing Navy organizations, personnel, and facilities. For example, the NTIPS mangement and TM acquisition organizations must be integrated into the existing Navy structures for performing these functions, rather than displace them.

Compatibility with the System Acquisition Process – System Acquisition Process refers to the process by which military hardware (e.g., ship, aircraft, or individual piece of electrical, electronic, or mechanical equipment) is procured. This process is carried out through four phases: concept formulation, validation, full-scale development, and production/deployment/support.

The NTIP System must respond to requirements placed on it by the System Acquisition Process through Integrated Logistic Support activities in order to ensure the development of quality TMs. The following are the requirements to which NTIPS must respond during the various System Acquisition Process phases.

Concept Formulation:

- Define preliminary requirements for TMs with respect to the operational and support capability of the proposed system.
- Formulate candidate TM concepts matched to the user needs.
- Select viable TM concepts for consideration during concept validation phase.
- Develop preliminary planning to implement TM concepts.

Validation:

- Define formal TM requirements which are compatible with the proposed system support concept.
- Establish criteria for assessing compliance with formal TM requirements.
- Evaluate proposed TM approaches for adherence to formal TM requirements based on established criteria.

1. Fuller, J.J., and Sulit, R.A., Navy Technical Manual System (NTMS) Implementation of Program Development Plan During FY 75, DTNSRDC, January 1975.
2. Sulit, R.A., et al, Navy Technical Manual System (NTMS) Program Development Plan, DTNSRDC, November 1974.
3. Fuller, J.J., and Sulit, R.A., Navy Technical Manual System (NTMS) Program Summary, DTNSRDC, March 1976.

TABLE 2-1. IMPACT OF NTIP PROGRAM GOALS ON SYSTEM REQUIREMENTS

Program Goals	Impact on System Requirements
• Improve TM comprehensibility and usability so as to reduce – Job performance time by 10% – Job performance errors by 50%	Provide a user-data match function that will maximize user effectiveness by selecting presentation techniques for individual procurements based upon: – Personnel characteristics – Equipment/system type – Environmental constraints – Task analysis Provide a TM specification function that will develop guidelines for: – Readability – Vocabulary – Presentation techniques – Technical content – Access Maximize the utility of data relative to TM effectiveness currently in the Maintenance Material Management (3-M) reports, as well as enhance the utility through improved recording of specifics concerning TMs.
• Insure that TM delivery precedes hardware delivery by at least 2 months	Improve the form and content of the engineering/ manufactuirng data base so that it can be more efficiently converted to technical information.
• Reduce training time by 5 to 25%	Provide guidelines for the performance of a Training/ Technical Manual Tradeoff for individual procurements. Provide for content generator coordination with training during TM development cycle.
• Reduce TM life-cycle costs by 30%	Improve the form and content of the engineering/ manufacturing data base so that it can be more efficiently converted to technical information. Provide a mechanism for improving content generation planning and writing efforts.
• Reduce update cycle time by 25%	Provide a centrally controlled multimedia storage facility for both active and inactive TM data banks.
• Standardize and improve coordination of the TM acquisition process	Provide a centralized system management organization which establishes TM acquisition policy for the entire Navy.
• Provide data for project management life-cycle cost decisions	Provide a mechanism for monitoring and evaluating all TM-related costs.

2.1 PROGRAM GOALS AND SYSTEM-LEVEL REQUIREMENTS (Continued)

Full-Scale Development:

- Provide guidance to selected content generator (i.e., in most cases the Contractor developing the system/equipment) and insure compliance with TM concept and schedules.
- Review preliminary TM and verify compliance with requirements.

Production/Deployment/Support:

- Develop plans and schedules for production of final TM
- Review final TM and verify compliance with requirements
- Publish and distribute final TM
- Maintain TMs

Training – Technical manuals are often the primary source of printed material used during training. However, there are certain characteristics of TMs that make them less than adequate for training applications (e.g., not structured in lesson plan form, lack of utilization of learning principles, etc.).

The NTIP System must provide for the involvement of the training community in the development of technical manuals. This involvement must insure TMs that not only provide adequate on-the-job information, but are compatible with the requirements for the training of those individuals who will eventually have to use the manuals. Additionally, guidelines must be developed for use in performing Training/Technical Manual Tradeoffs for individual procurements.

Exploiting Automation Technology – Automation would have the most pronounced effects on the publishing and management areas of the NTIP System, but might also have significant implications for distribution. In order to efficiently publish the large quantity of technical information received in various media from content generators, the NTIP System requires state-of-the-art automated text and graphic processing equipment. Additionally, a fully automated Management Information System (MIS) is required to store and analyze NTIP System cost and performance data, as well as to control TM initial distribution and resupply.

System Capacity – The term "capacity" refers to two parameters: volume and speed. With regard to volume, Table 2-2 presents a summary of the current level of Navy technical manual activity. It is projected that this level of activity will remain fairly constant over the next several years, fluctuating at an approximate rate of plus/minus 2 to 3 percent per year. These fluctuations are attributable to increases in volume as new material is processed, and decreases in volume as old (i.e., obsolete) material is deleted from the system. These figures provide a fairly sound estimate of the volume requirement that will be placed upon the NTIP System. Volume not only impacts the system from a production standpoint, but also has staffing implications because of the number of programs to be managed.

Speed refers to how fast the system produces and delivers TMs. The basic requirement is that NTIPS must always be capable of deliverying new TMs concurrent with system/equipment delivery. The period of time for producing TMs will vary depending upon whether a war or peace situation exists.

In considering delivery of TM updates, an additional requirement exists for the speed parameter. Updates are categorized into one of three priority classifications: (1) emergency, (2) urgent, and (3) routine. An emergency priority involves action to alleviate a condition that could cause injury to personnel, extensive damage to equipment or property, or inability to maintain equipment in an operational condition. An emergency priority requires a response within three calendar days. An urgent priority involves action to alleviate a condition that could result in damage to equipment or property, a reduction in equipment operational efficiency, or

corrective action within 10 working days. A routine priority involves normal manual improvement, potential personnel/equipment hazards with prolonged use, or a reduced operational equipment life. A routine priority requires that corrective action be initiated within 60 working days.

Developing More Effective TM Presentation Techniques – A primary objective of the NTIP System is the development of TM presentation techniques (FOMM, JPA, etc.) that satisfy the information needs of the user. There must be adequate provisions in the system for assessing the real everyday user requirements for technical information, responding to these requirements in the TM design, and evaluating the on-the-job effectiveness of the TM. The system must more effectively match existing presentation techniques to the user, as well as develop new techniques when called for by changing user requirements or the failure of existing techniques to be effective.

TABLE 2-2. CURRENT VOLUME OF NAVY TECHNICAL MANUALS

	NAVSEA	NAVAIR	NAVELEX	Total Navy
Inventory				
Number of TMs	95,000	25,000	20,000	140,000
Number of Text Pages	13,700,000	1,500,000	2,200,000	17,400,000
Number of Art Pages	5,600,000	1,000,000	900,000	7,500,000
Ave. Total Pgs/PUs per TM	203/265	100/---	115/190	188/---
Ave. Number Text Pgs.per TM	121	60	110	105
Ave.Number Art Pgs/PUs per TM	82/144	40/---	45/80	56/---
Total TM Pages	19,300,000	2,500,000	3,100,000	24,900,000
Yearly Production – New/Reissue				
Number of TMs	10,000	750+350 (F)	500	11,600
Number of Text Pages	2,000,000	220,000	55,000	2,275,000
Number of Art Pages	850,000	55,000	22,500	927,500
Total TM Pages	2,850,000	275,000	77,500	3,202,500
Yearly Production – Update				
Number of TMs	---	3,400-4,000	---	---
Number of Text Pages	144-240,000	255,000	36-53,000	435-548,000
Number of Art Pages	96-160,000	85,000	14-22,000	195-267,000
Total TM Pages	240-400,000	340,000	50-75,000	630-815,000
Out-of Production TMs				
Backlog Pages	51,000	15,000	105,000	171,000
Pages Added Yearly	5,250-16,000	1,000	6,000	12,250-23,000
% of Work Subcontracted	85%	New 98% Update 90%	98%	---

(F) TMs covering U.S. Aircraft purchased by foreign governments.

Sources are: NAVSEA data – Stanford Research Institute Report, "Requirements and Alternative Designs for Automating the Publication of NAVSEA MOTD at the NSDSA," January 1977.
NAVAIR data – Representative of NATSF – 1977
NAVELEX data – Representative of NAVELEX – 1977

2.1 PROGRAM GOALS AND SYSTEM-LEVEL REQUIREMENTS (Continued)

Media Flexibility – It can be expected that at the time of NTIP System implementation, technical information will be presented to the user in the same media as are currently used – printed paper books and cartridge and fiche microforms. This imposes a basic requirement on the NTIP System to be capable of producing technical information in these three media. However, advances in technology may provide new alternatives in the area of presentation media such as video discs and digital holograms. This imposes an additional requirement on the NTIP System to be capable of producing technical information in any of these advanced media.

Use of Contracting – The Office of Management and Budget Circular OMB-A76 states that it shall be the ". . . policy of Government to rely on the private sector for its goods and services except where such action is not in the national interest." The NTIP System must comply with this policy while maintaining some level of internal capability. Questions that bear on the contracting aspect of the NTIP System are, for example, should the system adopt the policy of contracting out some fixed percentage of the workload? What level of internal capability must be maintained in order to ensure a response capability during emergency situations (e.g., war)? How should the system be designed in terms of its capability to accommodate fluctuations against a day-to-day workload?

Responding to User Feedback – A primary objective of the NTIP System is to establish a feedback process that permits continual monitoring, evaluation, and response to user-initiated comments and suggestions concerning TMs in the field. This process must, in addition, be viable for several classes of user: maintenance technicians, system/equipment operators, and the training community.

Usability of Engineering/Manufacturing Data Base – The engineering/manufacturing data base (engineering drawings, test specifications, wire lists, parts lists, etc.) is the major source of data used to develop technical information. The development of technical information is thus highly dependent upon the content, quality, format, and completeness of the data, as well as the facility with which the data may be obtained. This impacts the NTIP System in the area of content generation. The NTIP System, then, must improve the form and content of the engineering/manufacturing data base so that it can be more efficiently converted to technical information.

Use of the 3-M Data Base – The primary concern here is to maximize the impact of this avenue of feedback from the user to the NTIP System. Currently, the Maintenance Material Management (3-M) reports do not reflect user awareness of the potential these reports have for providing feedback concerning the usability of TMs. The requirement thus imposed upon the NTIP System is one of determining how to maximize the utility (to TMs) of the data already in the 3-M data base, as well as to enhance the future utility of the 3-M system through improved recording of specifics concerning TMs.

2.2 DESCRIPTION OF SYSTEM FUNCTIONAL REQUIREMENTS

The NTIPP Task 2 Report detailed the functional requirements to which the preliminary NTIP System concept and alternatives must respond. The following is a refinement of those functional requirements based on research conducted to date.

An NTIP system configuration (Figure 2–1) was synthesized from a logical analysis of the functions required and their allocation to a subsystem organization. This configuration is intended to meet both the system-level requirements (Topic 2.1) and the functional requirements stated below. Consequently, it is the foundation upon which the preliminary system concept and alternatives described in this report have been structured.

Management Subsystem – The Management Subsystem is responsible for analyzing, coordinating, and controlling the overall operation of the NTIP System. In order to accomplish this, the following requirements must be met.

1. The Management Subsystem must:
   - Be organized to provide for both systems management and operations management functions.
   - Develop top level policies and procedures for all facets of system operation.
2. The system management function must:
   - Provide a command structure with the authority to manage, control, coordinate, and monitor overall system operation.
   - Establish policies to guide system operation that are in concert with DoD policies for the acquisition of TMs.
   - Administer Navy TM-related research and development activities and maintain liason with other DoD service branches and industry.
   - Conduct cost analysis/forecasting and reporting in the area of TM life-cycle costs and NTIPS costs.
   - Maintain a comprehensive and accurate Management Information System (MIS).
   - Provide for staffing of all TM activities.
   - Budget and distribute TM acquisition and system O&MN funds.
   - Administer system/product improvement engineering activities.
3. The operations management function must:
   - Develop and implement standard information reporting/gathering mechanisms.
   - Monitor and evaluate subsystem operations and implement changes to improve both cost and performance effectiveness.
   - Develop standardized procedures to guide operation of NTIPS subsystems.
   - Provide for accurate TM configuration accounting.
   - Monitor, evaluate, and respond to user feedback information.
   - Prioritize and initiate all TM updating actions.
   - Provide guidance to hardware acquisition activities on all TM-related matters.

TM Acquisition Subsystem – The TM Acquisition Subsystem provides the definitive guidelines for the TM procurement, and insures that these guidelines are met during the actual writing effort. It must meet the following requirements.

1. The TM Acquisition Subsystem must:
   - Be organized to provide user-data match, specification, and procurement functions.

- Be capable of identifying, specifying, and procuring TMs that respond to the requirements established by the system acquisition process/ILS structure.

2. The user-data match function must:
   - Select TM presentation techniques for individual procurements that will result in maximized TM effectiveness for the user based upon the following variables:
     - Personnel characteristics
     - Equipment/system type
     - Environmental constraints
     - Tasks to be performed
   - Specify guidelines for conduct of Training/Technical Manual tradeoffs.
   - Insure that decisions affecting TM development and training are based on the most complete and accurate LSA information.
3. The TM specification function must:
   - Provide requirements for validation and verification of TMs:
     - Criteria
     - Scheduling
     - Equipment required
     - Record keeping
   - Provide comprehensive quality assurance procedures for content generation, in accordance with readability, comprehensibility, accuracy, and usability guidelines developed to achieve user-data match.
   - Provide for logical arrangement of TM content for ease of use.
   - Provide for fast and easy access, comprehensive indexing, and simplified, as well as descriptive, numbering/divisions/titles/headings.
   - Provide for flexibility and variety of types and fonts, explicit covers, paper and film grades, TM sizes, and packaging techniques for user need and environmental conditions.
   - Provide guidance in the preparation of text and procedures for various equipment complexities vs. amount of built-in-test features and relationships to maintenance philosophy and user skill levels.
   - Provide flexibility and guidance in the use of existing media presentation methods such as hard copy, microforms, audio-visual, or digital devices.
   - Provide definitive guidance in the requirements for TM structure and the inclusion of various presentation techniques defined by user information needs, format used, equipment complexity and intended environment of use.
   - Provide coordination and requirements for timely generation and structure of material for multi-usage of TM in training classes.
4. The TM procurement function must:
   - Evaluate data requirements of hardware acquisition activities.
   - Determine total TM requirements.
   - Evaluate proposals and select appropriate content generator.
   - Prepare TM relevant sections of contract.
   - Provide quality assurance teams to evaluate TM products.
   - Define schedules for in-process reviews and define sample lots to be inspected.

2.2 DESCRIPTION OF SYSTEM FUNCTIONAL REQUIREMENTS (Continued)

Content Generation Subsystem – The Content Generation Subsystem provides the necessary capabilities to effectively estimate the total effort required to produce the TM, to develop a plan for its production, and then execute the writing tasks. To do this, the subsystem must meet the following requirements:

1. The Content Generation Subsystem must:
   - Be organized to provide for estimating, planning, and writing functions.
   - Provide quality assurance (in-process monitoring and final product review) using developed tools (formulas, checklists, statistical sampling techniques, etc.) to insure compliance with established requirements.
   - Maintain capability to deliver TMs within contractual time constraints.
2. The estimating function must:
   - Provide accurate estimates for producing TMs:
     - Cost
     - Labor
     - Materials
     - Schedules
3. The planning function must:
   - Develop TM planning and design disclosure documents that are fully detailed and customized to a particular system/equipment based on the content generator interface with training, maintenance engineering, provisioning, and design engineering.
4. The writing function must:
   - Provide the capability to develop technical information within established performance measures (such as man-hours per page-unit) based on the following:
     - Presentation Techniques (FOMM, JPA, etc.).
     - System/equipment types and complexity (electronic, mechanical, etc.)
     - Technical information category (theory of operation, troubleshooting, etc.).
     - Technical information types (narrative, procedural, graphics, etc.).
   - Develop new and updated TMs in compliance with data acquisition contractual requirements (CDRLs, DIDs, TMCRs, specifications, and standards).
   - Develop and validate procedural data using actual hardware to be deployed in the field.
   - Select writers based on match of the writer's capabilities/experience to the writer's task.
   - Provide for a working interface with design engineers.
   - Manage and monitor development of TMs by subcontractors (data houses) and equipment vendors.
   - Conduct IPRs.
   - Compile and disseminate program historical data, including costs.
   - Provide technical information in standardized form acceptable to digital production function of Publishing Subsystem.

Publishing Subsystem – This subsystem provides the necessary capability to convert the TM manuscript into a prescribed medium, and distribute copies to the designated user. The Publishing Subsystem must meet the following requirements:

1. The Publishing Subsystem must:
   - Be organized to provide digital production, mastering, replication, and TM supply functions.

- Provide a netted, centrally controlled, localized structure of publishing capabilities with common standards, policies and procedures.
- Provide a continuing technology assessment operation in disciplines related to TM production.
- Provide quality assurance of products and processes.

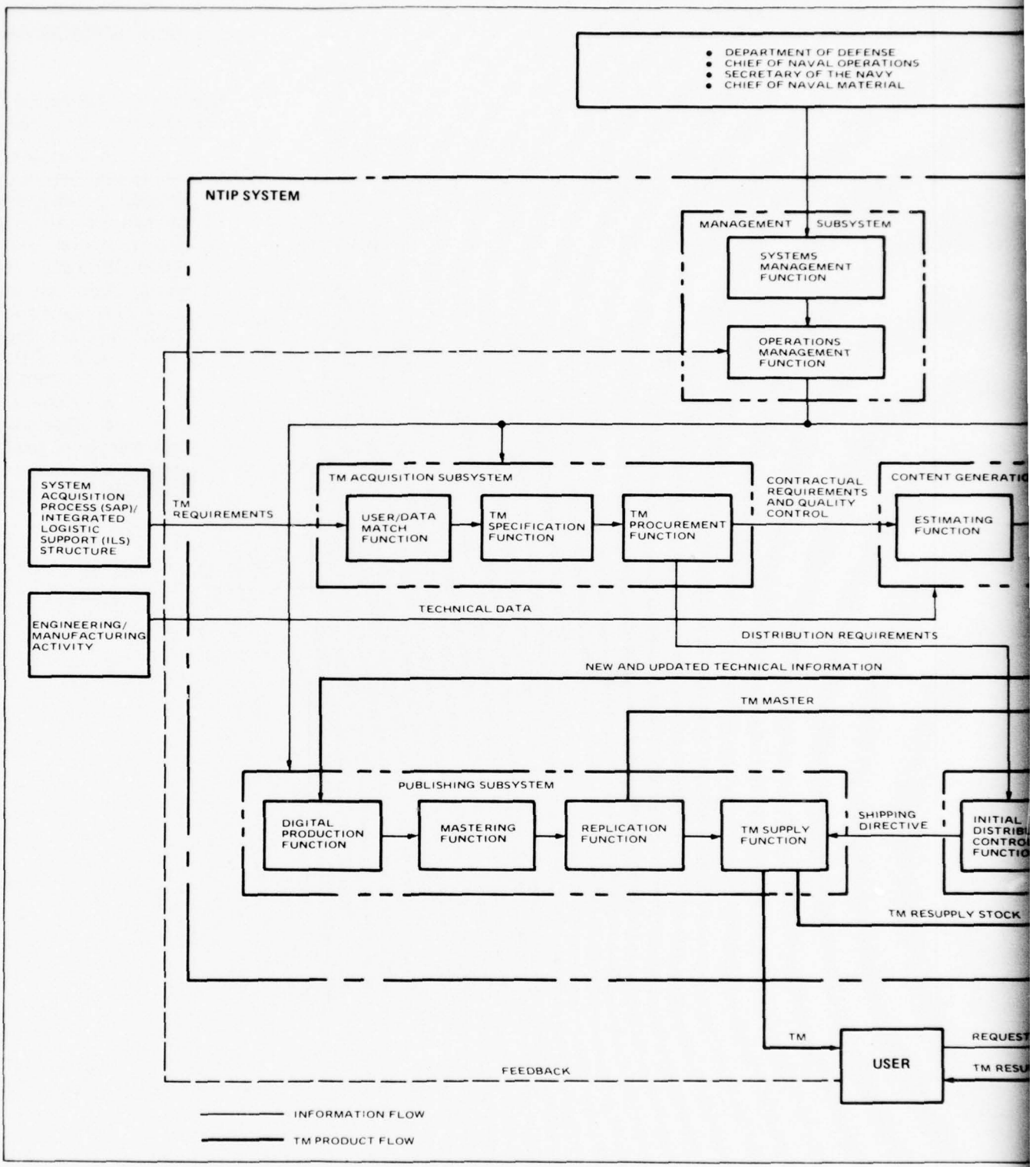
2. The digital production function must:
   - Provide the ability to:
     - Enter text and tabular material interactively or in a batch mode in an automated system.
     - Enter graphic material interactively or in a batch mode in an automated system.
     - Edit, update, and format text, tabular, and graphic material in an interactive mode in an automated system.
     - Store sufficient data in working storage to meet work-in-process needs.
     - Output in digital form, the structured TM for conversion into media such as, hardcopy, microfilm, video disc, or holograms.
   - Provide the ability to accept from contractors such input as:
     - Text material in digital form (with and without graphics) on magnetic tape (reel, cassette, cartridge), diskette, paper tape, as repro copy (with and without graphics), or copy prepared for optical character recognition (OCR).
     - Graphic material in digital form (image or intelligent form, separate from text) on magnetic tape (reel or diskette), as repro or original artwork.
3. The mastering function must:
   - Convert digital output into such media as repro copy, microform master, printing plate, video disc master, or hologram master.
4. The replication function must:
   - Convert microform masters, reproducible copy, and lithographic negatives to printing plates using contact and projection photographic/imaging means.
   - Print, collate, and bind using conventional devices.
   - Convert reproducible copy to microform masters using conventional photographic means.
   - Replicate from microform masters and digital-form masters, as required.
5. The TM supply function must:
   - Provide the capability to deliver (to the user) new and updated TMs from distribution inventories, using the selected media.

Distribution Subsystem – The distribution subsystem administers the distribution of new manuals, and the storage, retrieval and distribution of all previously deployed manuals. To accomplish this, it must meet the following requirements.

1. The Distribution Subsystem must:
   - Be organized to provide initial distribution control, TM resupply, and archive functions.

2.2 DESCRIPTION OF SYSTEM FUNCTIONAL REQUIREMENTS (Continued)

2. The initial distribution control function must:
   - Collect and assimilate requirements for the first-time distribution of new TMs.
   - Maintain address files for the automatic distribution of TM changes and revisions.
3. The TM resupply function must:
   - Maintain proper TM storage levels for user requriements.
   - Provide facilities for receipt, storage, and retrieval of all supplies of deployed Navy TMs and establish procedures for user access.
4. The archive function must:
   - Provide a centrally controlled multimedia storage facility for both active and inactive data banks.
   - Establish procedures and facilities for the receipt, storage, and retrieval of TM masters.


DEPARTMENT OF DEFENSE
CHIEF OF NAVAL OPERATIONS
SECRETARY OF THE NAVY
CHIEF OF NAVAL MATERIAL
NTIP SYSTEM
MANAGEMENT SUBSYSTEM
SYSTEMS MANAGEMENT FUNCTION
OPERATIONS MANAGEMENT FUNCTION
SYSTEM ACQUISITION PROCESS (SAP)/ INTEGRATED LOGISTIC SUPPORT (ILS) STRUCTURE
TM REQUIREMENTS
TM ACQUISITION SUBSYSTEM
USER/DATA MATCH FUNCTION
TM SPECIFICATION FUNCTION
TM PROCUREMENT FUNCTION
CONTRACTUAL REQUIREMENTS AND QUALITY CONTROL
CONTENT GENERATIO
ESTIMATING FUNCTION
ENGINEERING/ MANUFACTURING ACTIVITY
TECHNICAL DATA
DISTRIBUTION REQUIREMENTS
NEW AND UPDATED TECHNICAL INFORMATION
TM MASTER
PUBLISHING SUBSYSTEM
DIGITAL PRODUCTION FUNCTION
MASTERING FUNCTION
REPLICATION FUNCTION
TM SUPPLY FUNCTION
SHIPPING DIRECTIVE
INITIAL DISTRIBU CONTRO FUNCTIO
TM RESUPPLY STOCK
TM
USER
REQUEST
TM RESU
FEEDBACK
INFORMATION FLOW
TM PRODUCT FLOW

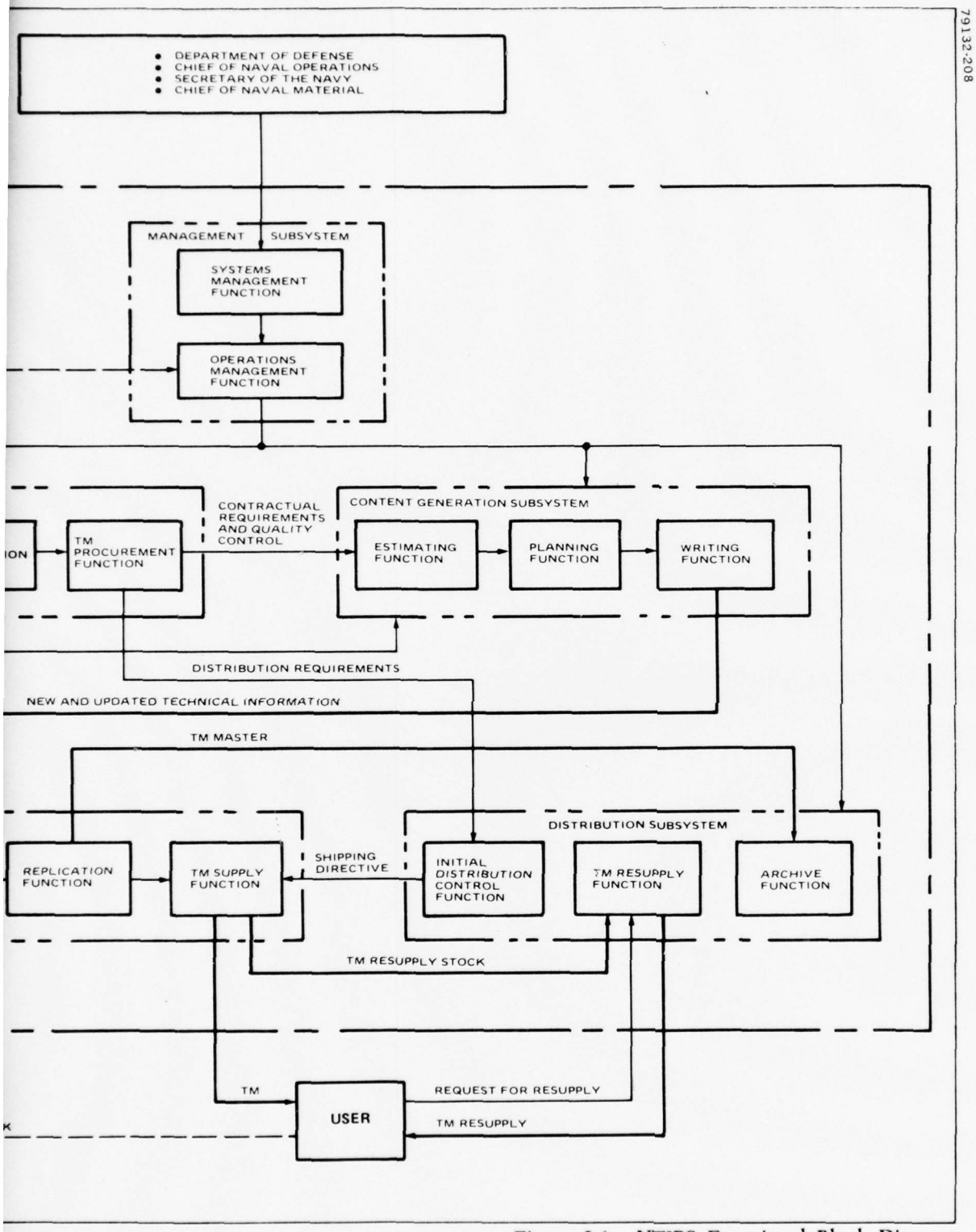


Figure 2-1. NTIPS Functional Block Diagram

2.3 DESCRIPTION OF SYSTEM OPERATIONAL SEQUENCE

Operational Sequence Diagrams (OSDs) were developed to confirm that the NTIP System configuration was based on consistent operational assumptions of product development.

A complex, interrelated sequence of events takes place among the main functional elements of the NTIP System, as a result of decisions to acquire new systems or equipment items for which NTIPS has technical manual responsibility. To insure that the proposed NTIP System configuration is compatible with this sequence of events, a set of operational sequence diagrams (OSD) was developed. These OSDs illustrate the sequence of events beginning with the initiation of a TM procurement and ending with the distribution of the resulting TM to the user. Ongoing activities such as system monitoring, TM resupply, and processing of feedback reports are also included.

A set of three diagrams was required to fully describe NTIPS sequences:

- NTIPS Functional Sequence
- General Operational Sequence for the NTIP System
- Operational Sequence for TM Development

An example of part of the TM development sequence diagram is reproduced in Figure 2-2. The complete set of diagrams and a detailed explanation is located in Appendix D of this report.

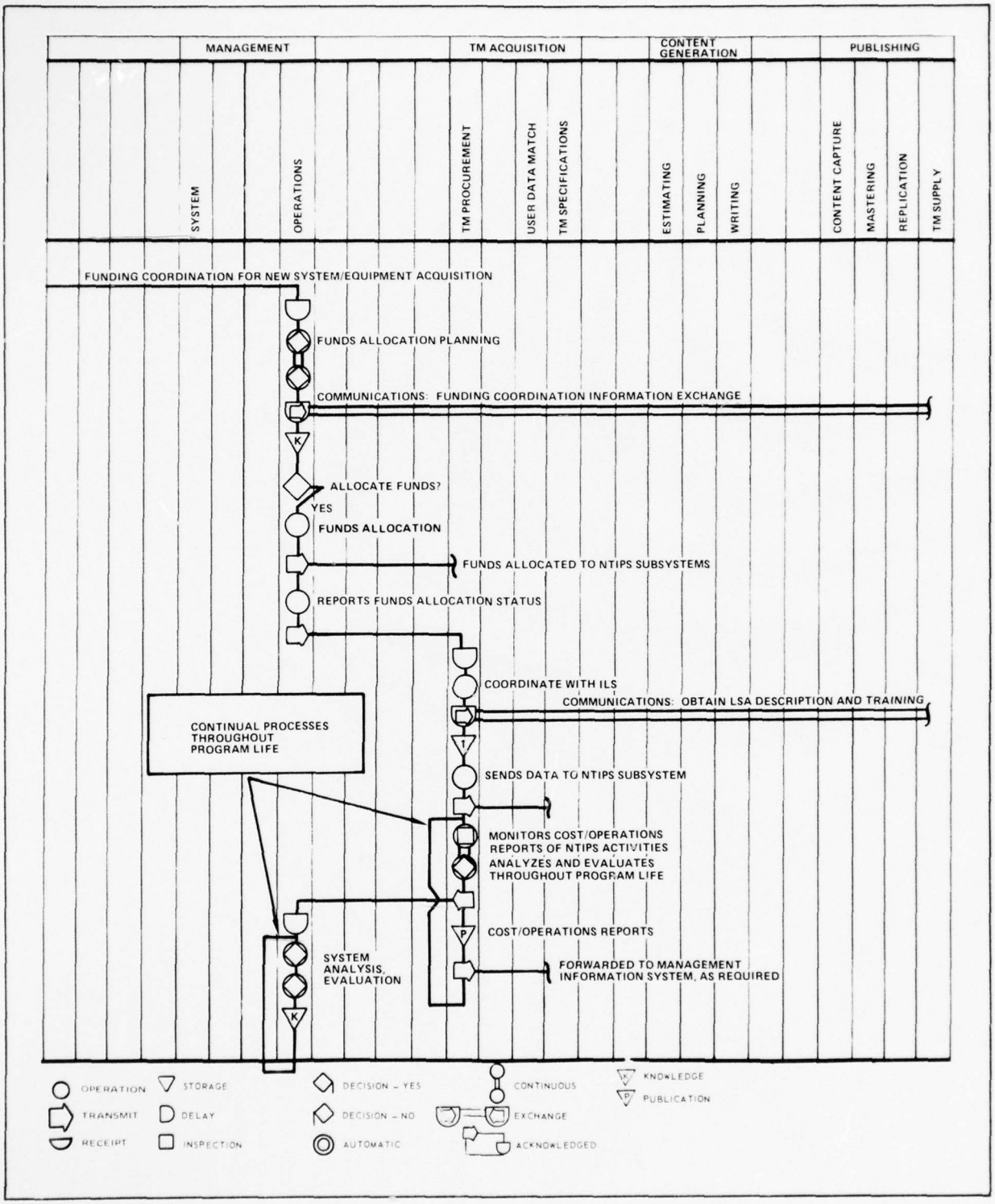


Figure 2-2. Representative Section of Operational Sequence Diagram for TM Development

SECTION 3
PRELIMINARY NTIP SYSTEM CONCEPT

3.1	Description of Preliminary NTIP System Concept	3-0
3.2	Technical Approach to TM Acquisition	3-6
3.3	Technical Approach to Content Generation Subsystem	3-8
3.4	Developing the Detailed TM Design	3-10
3.5	Establishing a Relationship Between TMs and Training	3-12
3.6	Technical Approach to Publishing Subsystem	3-16
3.7	Considerations in Selecting User Media	3-20
3.8	Use of Media in the User Community	3-24
3.9	Technical Approach to Distribution Subsystem	3-26
3.10	Technical Approach to Management Subsystem	3-30
3.11	Method for Updating Technical Manuals	3-32

3.1 SYNOPSIS OF PRELIMINARY NTIP SYSTEM CONCEPT

The preliminary NTIP System concept takes full advantage of existing Technical Manual expertise within Navy organizations, while allocating new responsibilities and functions to these organizations. The concept is a union of existing Navy TM activities that are refocused and complemented by new technologies to better serve the information needs of the user.

The preliminary NTIP System concept (see Figure 3-1) is an integrated network of Navy and contractor organizations as well as a set of procedures and technological recommendations for the acquisition and support of technical information for use in operating, maintaining, training, and logistic support for Navy Systems and equipment. The NTIP System configuration was synthesized from a logical analysis of the functions required and their allocation to subsystems. Five subsystems resulted: Management, TM Acquisition, Content Generation, Publishing, and Distribution. These subsystems invoke a variety of human actions, mechanical operations, and management processes. Hence, a broad range of technical approaches reside in the preliminary NTIP System concept.

Management Subsystem – The first-level systems management function is comprised of four subfunctions. The NTIP System management subfunction is responsible for the overall management of NTIPS, and establishes and promulgates all policies and directives necessary for system operation. The system/product improvement engineering subfunction performs in-depth analyses of budgeting and scheduling data from Navy-wide NTIPS activities, analyzes TM product quality, provides the engineering expertise for changes to NTIP System technology or design, and prepares all quality assurance policies for the NTIP System. The research and development (R&D) subfunction coordinates all Navy NTIPS-related R&D efforts and maintains contacts with on-going DoD and industry TM R&D efforts. The cost analysis/ forecasting subfunction maintains a comprehensive data base of cost breakdowns for specific activities of NTIPS, and also assists with budget reviews and long-range planning and forecasting.

The operations management function consists of six subfunctions. The operations management subfunction is responsible for implementing first-level policies, promulgating detailed operating procedures to its NTIPS activities, and guiding the operations of the NTIPS activities within its purview. The practices and procedures subfunction prepares the detailed operating procedures and maintains the manuals containing the procedures, practices, and the first-level policies. The Management Information System (MIS) subfunction maintains a data base of information covering TM operations and costs, a TM configuration index of all assigned users, and a listing of user feedback action items. The MIS also provides weekly cost and operations reports to support the daily operations of the remaining NTIPS subsystems.

The configuration accounting subfunction manages the numbering of TMs and maintains the user configuration index. The feedback and update subfunction manages the user feedback network and initiates updates of out-of-production TMs. The cost monitor/evaluation subfunction collects operational data from the NTIPS activities and evaluates the performance of specific TM projects.

TM Acquisition Subsystem – The preliminary concept for TM acquisition is that of decentralized subsystems within the NTIPS that are dedicated to each major acquisition activitiy. These subsystems would specify precise TM requirements for their particular users and implement procurement procedures to ensure timeliness and quality in TMs.

The TM Acquisition Subsystem analyzes the initial data requirements for a TM procurement, performs a user-data match, selects specifications that precisely define the TM requirements, develops contract documents, and initiates the acquisition processes to purchase TMs from the content generators.

New concepts for the TM Acquisition Subsystem would include: (1) formal matching of the data to the particular user, (2) automated, modular TM specifications, (3) TM procurement activities that are run by specialized "Navy TM Engineers," and (4) new TM funding structures. TM acquisition is the place where many TM problems can be solved, long before TM production is initiated. Improper decisions on data requirements, TM specifications, and procurement actions in this subsystem will result in substandard TMs downstream.

The preliminary concept of the user-data match function is to match a specified user's information needs, based on the tasks he must perform on particular equipments in known environments, to the information types and presentation techniques he can best utilize to perform the tasks. The tool for making this determination is a set of matrices that form the user-data match model (i.e. the matrices plotting task action versus presentation components, and environment versus physical characteristics of media).

The output of the user-data matching process would consist of a prioritized list of requirements and recommendations concerning the media and presentation techniques to be employed in presenting technical information (for every task action) to the user. This information would be forwarded to the Navy TM engineer, who would then select the presentation techniques and media features to be specified for the TM procurement. This selection would be based upon the affordability of the requirements/recommendations for that procurement.

The TM specification function selects specifications that define the content, quality control provisions, and standards that must be achieved in the development of TMs. The preliminary concept proposes a TM specification function within the NTIPS organizational structure that is dedicated to each major acquisition activity. Each of these functions would utilize an automated, modular, TM specification structure. Specification modules would be combined as necessary to describe the complete requirements for a particular TM procurement, including publishing processes for various media, quality control guidelines, etc.

The TM procurement function is responsible for negotiating the purchase of the TM. It develops TM contract documents, participates in negotiations with content generators, and provides quality control of the TM development process, all the way to the final buyoff. A procurement and funding structure is conceived that would prohibit reallocation of funds that have been dedicated to TMs.

Content Generation Subsystem – The Content Generation Subsystem represents the most significant and final point of impact on technical information quality. The content generator is resonsible for collecting the data, estimating the proposed TM acquisition cost, preparing technical publications planning documents, writing the TM, critiquing the TM, and performing validation. Guided by the data acquisition rules, the content generator performs the human transformation of the engineering/manufacturing data base into technical information.

The engineering/manufacturing data base is critical to the content generator because it is the sole source of system/equipment descriptions. The major problems associated with the data base are limited content (e.g., no maintenance data), accuracy and currentness. The preliminary concept would solve these problems by modifying the data base content requirements to add maintenance data, and

3.1 SYNOPSIS OF PRELIMINARY NTIP SYSTEM CONCEPT (Continued)

employing automated equipment to eliminate the time consuming and error prone manual methods for developing, checking, reproducing, and distributing the data base.

The Content Generation Subsystem consists of three functions (estimating, planning, and writing). The functions apply to both Navy in-house and contractor content generation activities. In addition, the preliminary concept would establish a TM engineering position which impacts all tasks of each function. The TM engineer provides for planning and technical guidance throughout the TM program. He is responsible for collecting the data, developing the TM estimates, preparing a detailed TM book plan, writing the TM, technically critiquing the TM, and performing validation. He is also responsible for establishing a discourse between the writers and instructors, as well as insuring that the engineering/manufacturing and logistic data base information is available. He confirms the optimum presentation methods identified by the user-data match model, allocates writer tasks, and insures content quality. The TM engineer also establishes interrelationships with the design engineering activity and the ILS elements to insure coordinated efforts in TM development.

To aid the TM engineer in performing his tasks, detailed guidance in the form of a TM Development Guide would be provided as part of the preliminary concept. This guide provides step-by-step instructions for the development of TM estimates and planning documents as well as for coordinating and supervising the actual TM development.

Estimating Function – An estimate is developed for each TM preparation effort based on the results of the analysis of the TM requirements and system/equipment design information. The estimate provides the TM Acquisition Subsystem with a detailed description of the cost and effort that would be incurred for the proposed TM.

Planning Function – The planning function, which encompasses the content generator's total planning effort, is divided into product planning and operational planning subfunctions. Product planning deals with those tasks related to the development of accurate and detailed TM bookplans and outlines. Operational planning covers those tasks related to the actual technical data development: applying the content generator's resources in the most efficient manner to prepare accurate and adequate technical data.

Writing Function – The content generator prepares the technical information in accordance with the directives and instructions developed in the planning function. Any writer training plans, prepared during operational planning, are implemented to upgrade the writing staff's capabilities. In the traditional writing effort, conflicting comments that result from independent TM manuscript reviews by the TM acquisition, design engineering, and training activities cause severe problems. These problems are resolved in the preliminary concept by performing a concurrent review and validation, with participation by all these activites including the user activity. Quality assurance personnel monitor the progress of the writing effort, review writer draft material, and generate and submit progress reports to the TM Acquisition Subsystem. Included in these reports are the technical information development problems that have been encountered, and their solutions. Direct Navy participation in contractor writing efforts consists of performing in-process reviews (IPRs) of writer draft TM material and participating in the concurrent TM manuscript review and validation performed by the contractor.

Publishing Subsystem – The preliminary concept for publishing provides decentralized internal Navy capabilities to accept the equipment contractor's digital output for processing through production, mastering, replication, and final delivery. A feature of this concept is automated facilities to process new and updated text and graphics.

The digital production function contains the entry, processing, and storage subfunctions. The entry subfunction provides the capability to receive technical information generated both by equipment contractors and internal Navy content generation activities, and to edit, update, and process the technical information for mastering of TMs.

The mastering function converts the processed output to masters (making the master for replication such as: repro copy, negative, or microform masters). This function must be able to accommodate paper and microform. The replication function contains the subfunctions needed to replicate the medium selected.

The TM supply function provides the capability for packaging and shipping new and updated TMs in response to distribution requirements provided by the Distribution Subsystem.

The Publishing Subsystem would be decentralized among the major acquisition activities. The functions established for each major acquisition activity could be organizationally either part of that activity or part of the NTIP System, but dedicated to the major acquisition activity. There is a need to distribute functions on the basis of the amount of work to be processed annually (3 to 4 million pages) plus the size of the TM inventory (25 million TM pages). These divisions can be made by specific commodity to be supported, assigned missions, geographical locations, or similar factors.

Technology and industry development trends show that, in the 1980-85 time frame, digital processing of text and graphics may reach full implementation throughout the publishing field. Those who support Navy TM requirements, including the very small Navy contractor, will either possess, or have access to, an automated digital publishing capability. Therefore, any requirement for contractors to deliver machine readable (digital tape) technical information to the Navy can be met.

The Navy has progressed significantly in the area of automation as evidenced by ADREPS and TRUMP. The Publishing Subsystem must accommodate both of these systems by bringing them to a level of performance that meets the Navy/Contractor interface requirements and can handle the type and volume of work expected by NTIPS. An alternative would be to develop totally new systems. Since some additional capability is needed to meet the expanded internal workload, new systems using the latest technology are a consideration.

Distribution Subsystem – The task of the initial distribution control function is to collect the information necessary to create shipping directives for newly acquired TMs and TM changes and revisions. In the preliminary concept, initial distribution control is decentralized, with one initial control function dedicated to each major acquisition activity. This eliminates the response problems inherent in a totally centralized system and utilizes existing Navy facilities.

A standardized approach to the collection of complete and accurate initial distribution information must be created if new TMs, changes, and revisions are to be delivered in a timely manner. The key to accomplishing this is the creation and maintenance of a computerized distribution address/quantity file. With over 140,000 TMs in the Navy's inventory, and with as many as 30,000 new TMs, changes, and revisions being processed each year, it is estimated that this file will require

3.1 SYNOPSIS OF PRELIMINARY NTIP SYSTEM CONCEPT (Continued)

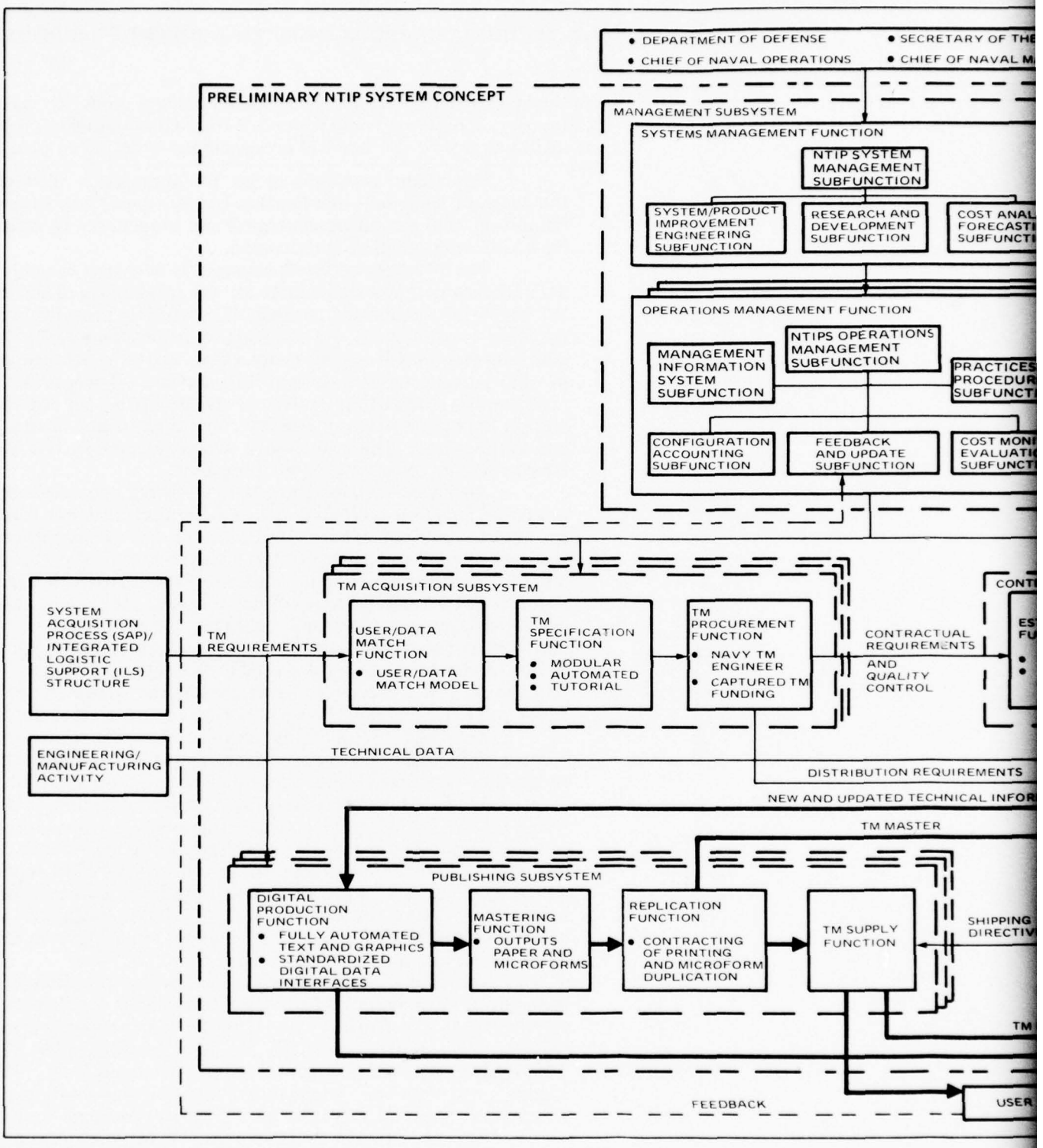
a storage capacity of approximately 2.8 billion bits to maintain the data on the number of TMs and addresses in the TM inventory.

The resupply function would be a single, centralized TM supply activity. The concept being proposed here is that it would be a functional part of the NTIPS Distribution Subsystem. This will allow the producers of TMs (i.e. NTIPS) more direct control of the supply of manuals to fleet users. It would provide central storage, retrieval, and control for all Navy TMs in a variety of media. Information management, control, and reporting will be automated as an element of MIS.

The initial concept of the archive function would establish capabilities for the storage, retrieval, and control of all masters and master records of TMs deployed by the Navy. The archive function would consist of an historical and working archive. The historical archive will provide for storage and accountability of the physical TM masters for every new or updated TM. The working archive will be primarily a digital data base only for the active TMs in the Navy's inventory. It would be used for replenishment of stock, or update of existing TMs without disturbing the historical archive.

The initial loading of the working archive data base with TMs received from contractors or prepared by Navy content generators is accomplished through the digital production function of the Publishing Subsystem. This input, and any subsequent moving of TMs to be reprocessed between the Publishing Subsystem and the working archive, is controlled through the MIS. MIS also provides NTIPS with access to an index of information on any active TM in the Navy.

New TM masters are sent to the historical archive from the Publishing Subsystem. As the subfunction is primarily a materials management activity, the MIS computer network will be used for creation and maintenance of records for control of the TM masters. Physical storage procedures will depend upon the media in which the masters have been produced. If in a condensed form, such as microfiche or roll microfilm, the masters will be stored in that medium. If, however, the masters require bulk storage, such as reproducible masters for paper manuals, they will be converted to a more condensed medium for storage in the historical archive files.


• DEPARTMENT OF DEFENSE
• SECRETARY OF THE
• CHIEF OF NAVAL OPERATIONS
• CHIEF OF NAVAL M
PRELIMINARY NTIP SYSTEM CONCEPT
MANAGEMENT SUBSYSTEM
SYSTEMS MANAGEMENT FUNCTION
NTIP SYSTEM MANAGEMENT SUBFUNCTION
SYSTEM/PRODUCT IMPROVEMENT ENGINEERING SUBFUNCTION
RESEARCH AND DEVELOPMENT SUBFUNCTION
COST ANAL FORECASTI SUBFUNCTI
OPERATIONS MANAGEMENT FUNCTION
MANAGEMENT INFORMATION SYSTEM SUBFUNCTION
NTIPS OPERATIONS MANAGEMENT SUBFUNCTION
PRACTICES PROCEDUR SUBFUNCTI
CONFIGURATION ACCOUNTING SUBFUNCTION
FEEDBACK AND UPDATE SUBFUNCTION
COST MONI EVALUATI SUBFUNCTI
SYSTEM ACQUISITION PROCESS (SAP)/ INTEGRATED LOGISTIC SUPPORT (ILS) STRUCTURE
TM REQUIREMENTS
TM ACQUISITION SUBSYSTEM
USER/DATA MATCH FUNCTION
• USER/DATA MATCH MODEL
TM SPECIFICATION FUNCTION
• MODULAR
• AUTOMATED
• TUTORIAL
TM PROCUREMENT FUNCTION
• NAVY TM ENGINEER
• CAPTURED TM FUNDING
CONTRACTUAL REQUIREMENTS
AND QUALITY CONTROL
CONTI
ES FU
ENGINEERING/ MANUFACTURING ACTIVITY
TECHNICAL DATA
DISTRIBUTION REQUIREMENTS
NEW AND UPDATED TECHNICAL INFOR
TM MASTER
PUBLISHING SUBSYSTEM
DIGITAL PRODUCTION FUNCTION
• FULLY AUTOMATED TEXT AND GRAPHICS
• STANDARDIZED DIGITAL DATA INTERFACES
MASTERING FUNCTION
• OUTPUTS PAPER AND MICROFORMS
REPLICATION FUNCTION
• CONTRACTING OF PRINTING AND MICROFORM DUPLICATION
TM SUPPLY FUNCTION
SHIPPING DIRECTIV
TM
FEEDBACK
USER

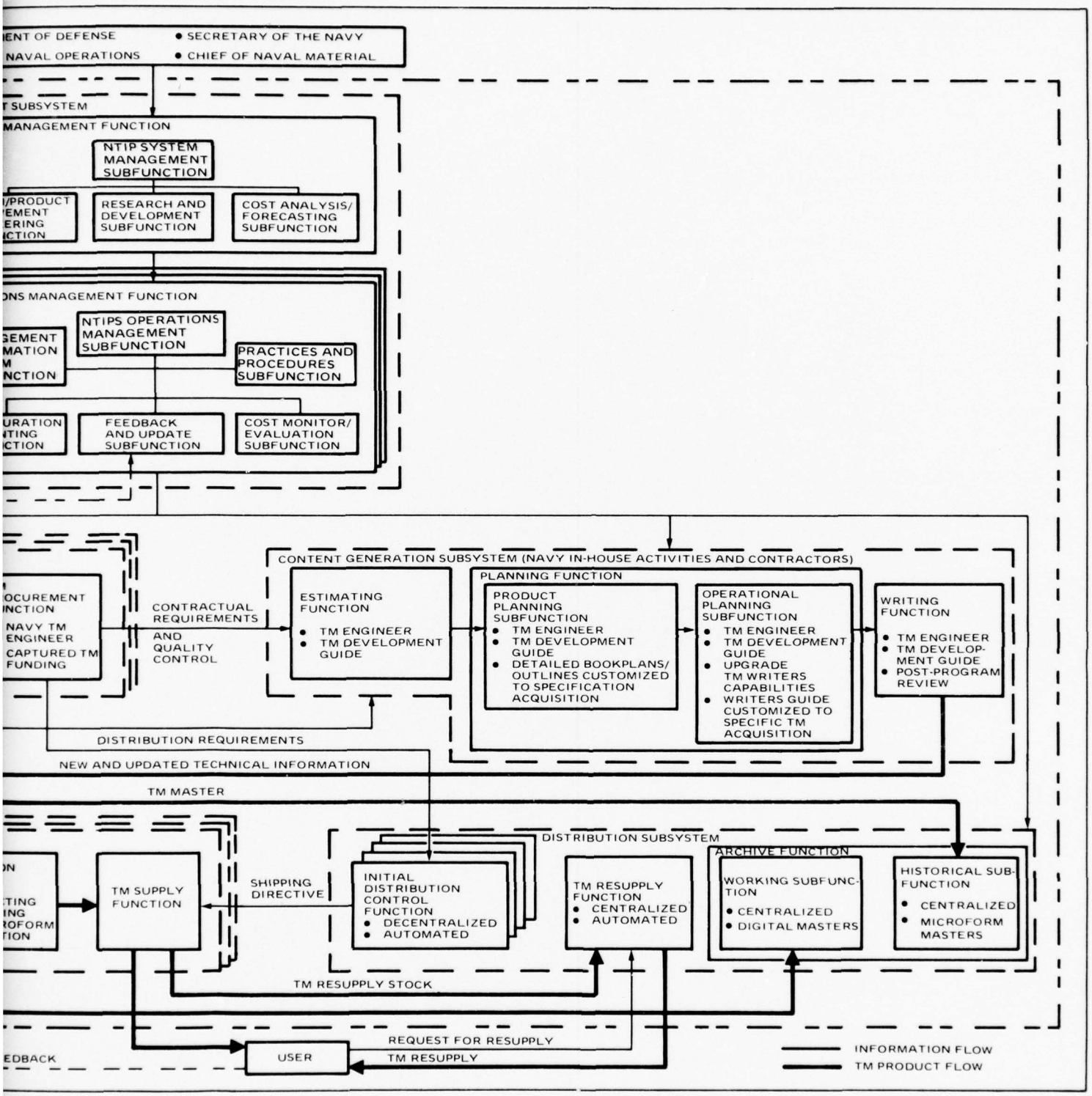


Figure 3-1. Preliminary NTIP System Concept.

3.2 TECHNICAL APPROACH TO TM ACQUISITION SUBSYSTEM

The concept for TM acquisition proposes using a model to match technical information to the user, specifying requirements with custom-tailored, modular TM specifications, and utilizing a well-defined TM procurement function to execute the purchase process.

Significant problems in the TM Acquisition Subsystem are: determining the types of technical information to buy, specifying the requirements for that information, and executing contracts and procedures to insure the timeliness and quality of information that is delivered.

The TM Acquisition Subsystem is designed to solve these problems (see Table 3-1). Subsystem activities include: (1) an analysis of initial data requirements during the hardware acquisition process, (2) matching presentation techniques and media features to user needs and environmental conditions, (3) maintenance, preparation, and selection of TM specifications that will give content generators precise guidance in what is required in technical information, (4) preparation of procurement documents and participating in contractual processes for the duration of the contract, and (5) implementation of quality control plans and teams for inprocess reviews and verification. These activities are performed by the user-data match, TM specifications, and TM procurement functions.

Approach to User-Data Match - Navy operation and maintenance personnel are being supplied technical information that does not fully support them in performing their tasks. The major problems arise from inappropriate information for the user to perform his tasks and misapplication of presentation techniques and media for conveying the information. One element of the NTIPS approach to this problem is the user-data match model. The model will assimilate user personnel characteristics, user task and equipment analyses, presentation techniques, and media considerations for environmental factors into a set of matrices that will aid in the selection of user-optimized presentation techniques. These models will identify the best media form for a particular technician to utilize in performing specific tasks on particular equipment under different environmental conditions.

Approach to TM Specification - Most TM specifications presently used employ a "cover the world" approach, attempting to describe in one place all TM requirements for mechanical, electrical, electronic, and hydraulic equipment to be used by organizational, intermediate, and depot personnel. Also, there is often a vast "daisy-chain" in TM specifications, involving as many as a dozen different documents in a particular TM procurement. When the requirements of some of these specifications are invoked in whole or part, while others are superseded or canceled in whole or part, it becomes very confusing for content generators to decide what is really needed or wanted in a TM. Finally, updating of specifications is frequently several years behind the required change, resulting in additional mismatching of TM content and user need.

The solution to these TM specification problems involves determining what is required in technical information for various Navy users and documenting the requirements in a flexible structure that can be easily accessed, formatted, and updated. Automated, modular, TM specifications is the chosen approach, permitting TM requirements to be documented in bite-sized increments, or modules. These modules can then be automatically selected and combined to form a complete, custom-tailored TM specification for a particular procurement.

Approach to TM Procurement - Totally unrelated TM procurement practices and processes from one major acquisition activity to the next results in inefficiencies within the Navy and their contractors such that a diversity of TMs with varying degrees of usefulness are being introduced into the fleet. Differences in funding

practices, quality control methods, and delegation of authority also plague current TM procurement functions.

The solution is to have several TM procurement functions, organizationally a part of NTIPS, each dedicated to and responsible for all matters relating to TM procurement for a major acquisition activity. This shifts responsibility and funding for TM procurement from the hardware project office to the NTIPS TM procurement function. A new position of "Navy TM engineer" would also be created to oversee and/or participate in all activities for TM procurement. The Navy TM engineer would be both a TM and QA specialist who would ensure that TM objectives are being realized. He would also disburse "captured funds" for the initial procurement and update of TMs.

TABLE 3-1. APPROACH TO TM ACQUISITION

Key Problems	NTIPS Approach
User-Data Match	
Users are not being supplied the types of technical information that match their: - skill levels - environment - operational and maintenance needs	Development of a user-data match model that will specify the types of data a specific class of Navy user requires, by task and equipment analysis, presentation techniques, and media for use environment
TM Specification	
TM specifications are inadequate, vague, and confusing in defining TM requirements from one TM procurement to the next	Development of TM specification modules with precisely defined requirements that may be mixed and matched in various combinations to meet specific information requirements
TM Procurement	
Inadequate enforcement of TM procurement requirements (including quality assurance provisions) and fragmented TM management responsibilities for TM acquisition	Development of a TM procurement function with new organizational funding structures and standardization of activities that are controlled by a "Navy TM engineer"

3.3 TECHNICAL APPROACH TO CONTENT GENERATION SUBSYSTEM

The main problems in the Content Generation Subsystem are low accuracy and efficiency in the transformation of technical data to technical information. Improvements are accomplished by assigning a TM engineer, using better specifications and writing guides, and employing procedural reforms.

Transformation of technical data to technical information takes place in the Content Generation Subsystem. This subsystem is responsible for collecting the technical data, preparing TM estimates and planning documents, writing the TM, critiquing the TM and performing validation. The major problems associated with this subsystem are in the accuracy and efficiency of transforming source data into the information presented in the TM.

Because the engineering/manufacturing data base is developed to satisfy the requirements of those two disciplines, it does not adequately address the needs of the content generator. Engineering drawings and specifications, prepared for hardware fabrication and test, do not contain needed maintenance data. The preliminary concept would improve the data base content by modifying content requirements (MIL-STD-100) to include maintenance data.

Also, manual methods employed to develop the data base present additional problems to the content generator because of the time-lag impact on accuracy and currency. Employing present-day capabilities of computers and their peripheral equipments would enable the manufacturer to reduce or eliminate many repetitive, time-consuming manual tasks, resulting in faster updating of the data base.

The preliminary concept would employ a TM engineer as one means for improving the transformation process. He is responsible for data collection, detailed TM book plan preparation, TM writing, TM technical critique and validation performance. He is also responsible for a cross fertilization between the writers and training instructors, as well as ensuring engineering/manufacturing and logistic data base information is available.

In the estimating function, little or no coordination exists between the content generator and the design engineering, ILS, and quality assurance activities. As a result, the TM estimate may be inaccurate in page count and man-hours as well as incompatible with other ILS element estimates (training, spares provisioning, etc.), thus limiting the total support package's ability to meet user needs. To solve this problem, the TM engineer, acting as content generator single point of contact, works closely with the hardware proposal management team, ILS elements, and the QA activity to develop the TM estimate based on inputs from these activities. The result is an integrated and more realistic pricing estimate for the TM contracting process.

Two major problems in planning the TM product are: (1) vague and nondetailed TM bookplans and outlines, and (2) incompatibility of TM planning documents with the other ILS elements planning documents. To deal with the first problem, the TM engineer uses the NTIPS-developed modular specifications and detailed system/equipment descriptions to prepare customized TM bookplans and outlines. The second problem is solved by establishing an ILS review team that reviews each TM planning document in light of the overall integrated support effort and resolves any conflicts.

For operational planning, the major problem is inefficient transformation of source data into technical information for the TM (resulting from poor matching of writers to TM work packages). To solve this problem, the TM engineer identifies the package requirements and writing staff capabilities, then matches the writer's capabilities to the work package requirements. If the need exists to upgrade the

practices, quality control methods, and delegation of authority also plague current TM procurement functions.

The solution is to have several TM procurement functions, organizationally a part of NTIPS, each dedicated to and responsible for all matters relating to TM procurement for a major acquisition activity. This shifts responsibility and funding for TM procurement from the hardware project office to the NTIPS TM procurement function. A new position of "Navy TM engineer" would also be created to oversee and/or participate in all activities for TM procurement. The Navy TM engineer would be both a TM and QA specialist who would ensure that TM objectives are being realized. He would also disburse "captured funds" for the initial procurement and update of TMs.

TABLE 3-1. APPROACH TO TM ACQUISITION

Key Problems	NTIPS Approach
User-Data Match	
Users are not being supplied the types of technical information that match their: – skill levels – environment – operational and maintenance needs	Development of a user-data match model that will specify the types of data a specific class of Navy user requires, by task and equipment analysis, presentation techniques, and media for use environment
TM Specification	
TM specifications are inadequate, vague, and confusing in defining TM requirements from one TM procurement to the next	Development of TM specification modules with precisely defined requirements that may be mixed and matched in various combinations to meet specific information requirements
TM Procurement	
Inadequate enforcement of TM procurement requirements (including quality assurance provisions) and fragmented TM management responsibilities for TM acquisition	Development of a TM procurement function with new organizational funding structures and standardization of activities that are controlled by a "Navy TM engineer"

3.3 TECHNICAL APPROACH TO CONTENT GENERATION SUBSYSTEM

The main problems in the Content Generation Subsystem are low accuracy and efficiency in the transformation of technical data to technical information. Improvements are accomplished by assigning a TM engineer, using better specifications and writing guides, and employing procedural reforms.

Transformation of technical data to technical information takes place in the Content Generation Subsystem. This subsystem is responsible for collecting the technical data, preparing TM estimates and planning documents, writing the TM, critiquing the TM and performing validation. The major problems associated with this subsystem are in the accuracy and efficiency of transforming source data into the information presented in the TM.

Because the engineering/manufacturing data base is developed to satisfy the requirements of those two disciplines, it does not adequately address the needs of the content generator. Engineering drawings and specifications, prepared for hardware fabrication and test, do not contain needed maintenance data. The preliminary concept would improve the data base content by modifying content requirements (MIL-STD-100) to include maintenance data.

Also, manual methods employed to develop the data base present additional problems to the content generator because of the time-lag impact on accuracy and currency. Employing present-day capabilities of computers and their peripheral equipments would enable the manufacturer to reduce or eliminate many repetitive, time-consuming manual tasks, resulting in faster updating of the data base.

The preliminary concept would employ a TM engineer as one means for improving the transformation process. He is responsible for data collection, detailed TM book plan preparation, TM writing, TM technical critique and validation performance. He is also responsible for a cross fertilization between the writers and training instructors, as well as ensuring engineering/manufacturing and logistic data base information is available.

In the estimating function, little or no coordination exists between the content generator and the design engineering, ILS, and quality assurance activities. As a result, the TM estimate may be inaccurate in page count and man-hours as well as incompatible with other ILS element estimates (training, spares provisioning, etc.), thus limiting the total support package's ability to meet user needs. To solve this problem, the TM engineer, acting as content generator single point of contact, works closely with the hardware proposal management team, ILS elements, and the QA activity to develop the TM estimate based on inputs from these activities. The result is an integrated and more realistic pricing estimate for the TM contracting process.

Two major problems in planning the TM product are: (1) vague and nondetailed TM bookplans and outlines, and (2) incompatibility of TM planning documents with the other ILS elements planning documents. To deal with the first problem, the TM engineer uses the NTIPS-developed modular specifications and detailed system/equipment descriptions to prepare customized TM bookplans and outlines. The second problem is solved by establishing an ILS review team that reviews each TM planning document in light of the overall integrated support effort and resolves any conflicts.

For operational planning, the major problem is inefficient transformation of source data into technical information for the TM (resulting from poor matching of writers to TM work packages). To solve this problem, the TM engineer identifies the package requirements and writing staff capabilities, then matches the writer's capabilities to the work package requirements. If the need exists to upgrade the

staff's capabilities to make satisfactory matches, the TM engineer has the option of employing graduate engineers trained in technical writing, providing equipment "hands-on" experience, or conducting writer training courses.

In the writing function, the current review and validation processes do not effectively measure TM content completeness, technical needs, or user effectiveness. The preliminary concept combines the design engineer's technical review, TM acquisition's review, and TM validation into a single effort, enabling all TM program participants to achieve consensus as a body in the resolution of TM problems.

Another problem, not related to a specific NTIPS function, is that there is no means for evaluating a recently completed TM acquisition program to identify future improvements. As a result, the Navy TM acquisition effort does not benefit from past problems and solutions. The preliminary concept establishes a post-program review to evaluate each program and its problems and their solutions, from which recommendations are submitted to the TM Acquisition Subsystem for review and action.

To aid the TM engineer in performing his duties, he would be provided with a TM Development Guide. This guide provides step-by-step instructions on how to accomplish each task and when to initiate it, as well as describing possible problem areas that may be encountered. This guide supplements the NTIPS-developed modular TM specifications.

TABLE 3-2. CONTENT GENERATION KEY PROBLEMS AND SOLUTIONS

Key Problems	NTIPS Solutions
• Subsystem – low data transformation accuracy and efficiency	TM engineer, TM Development Guide, and procedural reforms
• Engineering/Manufacturing Data Base – no maintenance data; limited accuracy and currency	Add maintenance requirements to MIL-STD-100; automate data base development
• Estimating – inaccurate TM estimates; poor compatibility with total ILS package	Coordinate TM estimating with design engineering, ILS elements, and QA
• Product Planning – vague TM bookplans; TM planning documents incompatible with other ILS plans	Modular TM specifications; coordinated development of TM and ILS planning documents
• Operational Planning – poor writer/work package matching	Upgrade writing staff capabilities
• Writing – ineffective checks of TM completeness, accuracy and usability	Concurrent performance of technical review, TM acquisitions, IPRs, and validation

3.4 DEVELOPING THE DETAILED TM DESIGN

The NTIPS TM design process provides a detailed TM bookplan for a given system that is customized to the equipment type, user personnel characteristics, and the operation and maintenance environments.

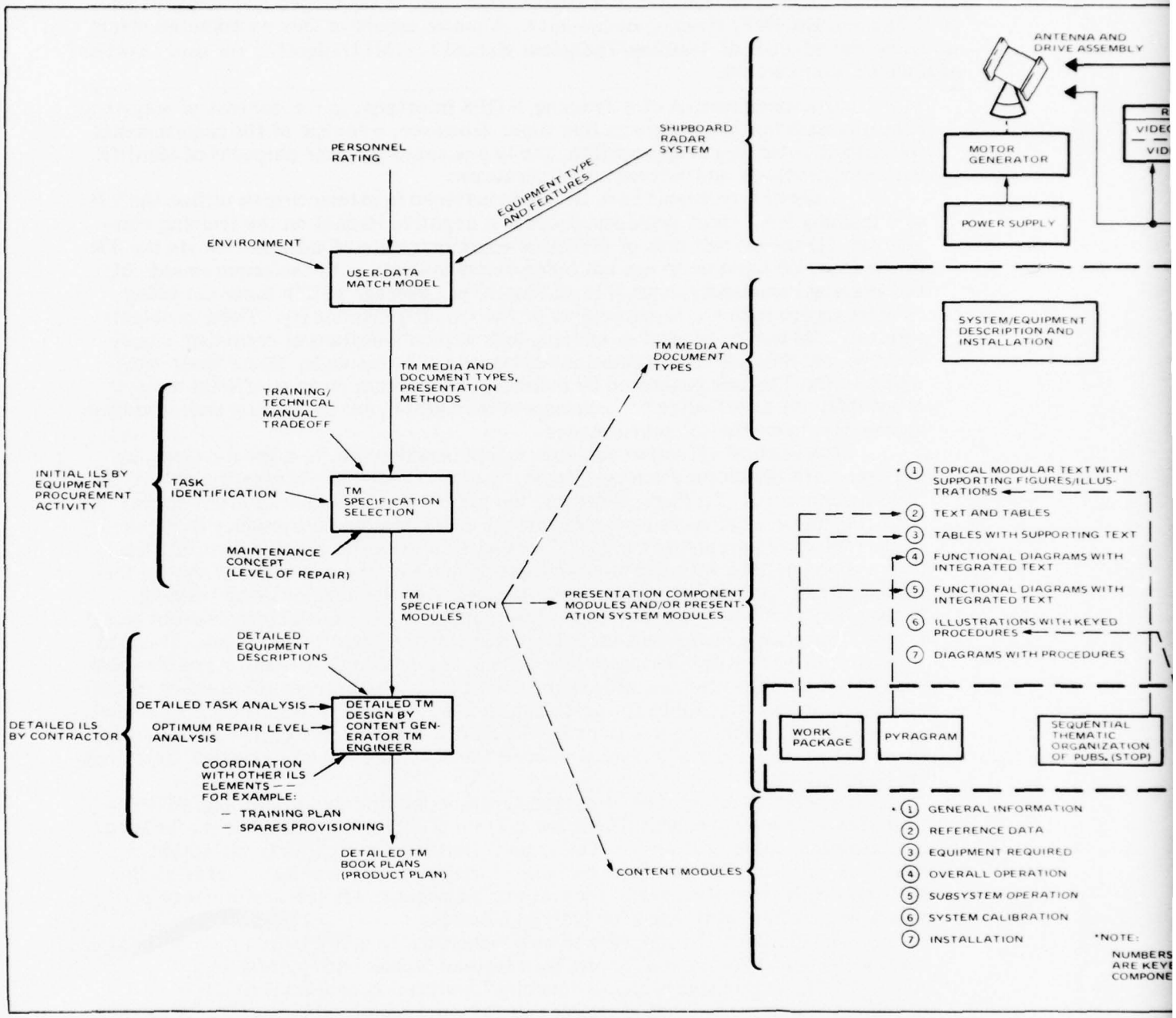
Designing TMs to support specific hardware acquisitions is one of the major features of the NTIP preliminary system concept. The following parameters are considered in the TM design effort: equipment type, user personnel characteristics, operation and maintenance environments, task analysis, and the training/technical manual tradeoff.

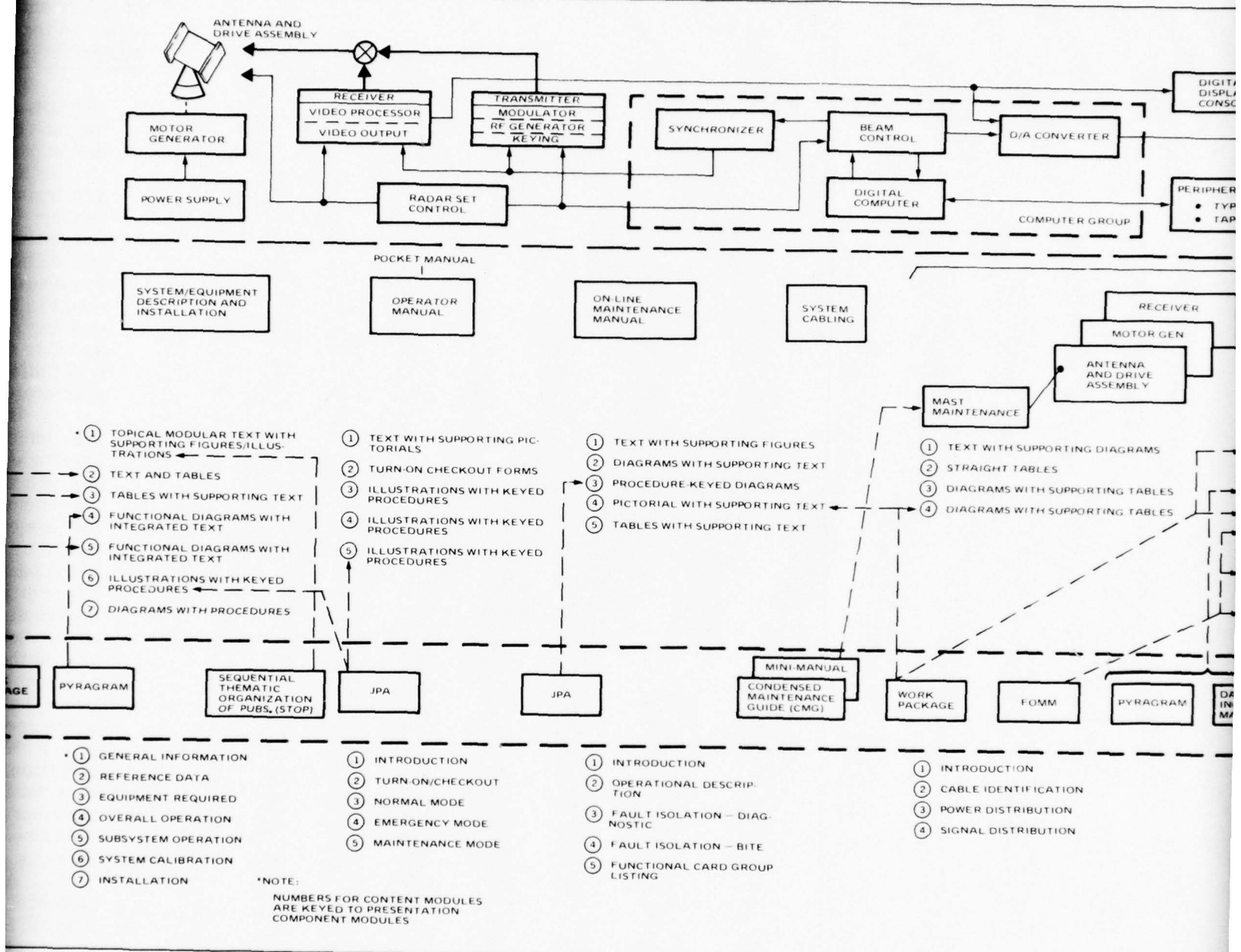
Applying the detailed TM design effort to a modern shipboard radar system would result in the detailed TM design documents illustrated in Figure 3-2. Such a radar would be classified primarily as an electrical/electronic equipment and includes variations in environment (internal/external workspace, exposure, and hazard), maintenance (repair levels), personnel (display operators and computer operators), and training, (C-school and OJT).

The first step in the TM product design process, which takes place in the NTIPS user-data match function, is matching the presentation methods and media to the user. Descriptions of the equipment types, personnel ratings, task actions to be performed, and environments are input to the user-data match model. The model's output identifies the media and types of TM documents (i.e., handbooks, work cards, microform, etc.), and presentation components (e.g., text with supporting pictorials, illustrations with keyed procedures, etc.). For example, corrective maintenance data for the antenna and its drive assembly would be contained in handbooks using a presentation system of diagrams with supporting text (PYRAGRAM). Parts lists for the drive assembly would use microfiche, and periodic maintenance would use work cards.

The next step in the development of the TM product design (performed in the TM specification function) is preparation of the TM specification document that will be used in the procurement process. Individual specification modules are selected from the TM modular specification categories covering TM content, presentation techniques, access, and readability. The selection is based on the results of the first-cut task identification and level of repair provided by the NTIPS user-data matching, and the training/technical manual tradeoff (tasks to be emphasized in training vs. tasks to be emphasized in TMs). For example, the radar operator's manual would contain specific modules defining operational content, i.e., introduction, turn-on/checkout, and normal, emergency, and maintenance modes of operation. The resultant customized document specifies to the content generator the number and types of TMs to be prepared, their content down to the chapter or section level, and the presentation techniques, access methods, and readability criteria to be employed.

The final step, occurring in the TM planning function of the Content Generation Subsystem, is to develop the detailed TM design. Based on the requirements in the TM specification and detailed descriptions of the individual units of the radar system, the content generator develops the preliminary planning documents down to the paragraph level. The content generator's close proximity to the hardware design engineering staff enables him to obtain detailed equipment information so that he can tailor the planning documents to the specific hardware characteristics. Through a coordinated effort with other ILS elements (i.e., training, detailed task analysis, optimum level of repair analysis, and spares provisioning), these documents are reviewed for compatibility with the overall support program planning. Based on the review results, the content generator prepares the final TM bookplans (detailed TM design) from which the actual TMs will be developed.


PERSONNEL RATING
SHIPBOARD RADAR SYSTEM
EQUIPMENT TYPE AND FEATURES
ENVIRONMENT
USER-DATA MATCH MODEL
TM MEDIA AND DOCUMENT TYPES, PRESENTATION METHODS
TRAINING/ TECHNICAL MANUAL TRADEOFF
INITIAL ILS BY EQUIPMENT PROCUREMENT ACTIVITY
TASK IDENTIFICATION
TM SPECIFICATION SELECTION
MAINTENANCE CONCEPT (LEVEL OF REPAIR)
TM SPECIFICATION MODULES
DETAILED EQUIPMENT DESCRIPTIONS
DETAILED TASK ANALYSIS
OPTIMUM REPAIR LEVEL ANALYSIS
DETAILED ILS BY CONTRACTOR
DETAILED TM DESIGN BY CONTENT GENERATOR TM ENGINEER
COORDINATION WITH OTHER ILS ELEMENTS — FOR EXAMPLE:
— TRAINING PLAN
— SPARES PROVISIONING
DETAILED TM BOOK PLANS (PRODUCT PLAN)
TM MEDIA AND DOCUMENT TYPES
PRESENTATION COMPONENT MODULES AND/OR PRESENTATION SYSTEM MODULES
CONTENT MODULES
ANTENNA AND DRIVE ASSEMBLY
MOTOR GENERATOR
POWER SUPPLY
SYSTEM/EQUIPMENT DESCRIPTION AND INSTALLATION
* 1 TOPICAL MODULAR TEXT WITH SUPPORTING FIGURES/ILLUSTRATIONS
2 TEXT AND TABLES
3 TABLES WITH SUPPORTING TEXT
4 FUNCTIONAL DIAGRAMS WITH INTEGRATED TEXT
5 FUNCTIONAL DIAGRAMS WITH INTEGRATED TEXT
6 ILLUSTRATIONS WITH KEYED PROCEDURES
7 DIAGRAMS WITH PROCEDURES
WORK PACKAGE
PYRAGRAM
SEQUENTIAL THEMATIC ORGANIZATION OF PUBS. (STOP)
* 1 GENERAL INFORMATION
2 REFERENCE DATA
3 EQUIPMENT REQUIRED
4 OVERALL OPERATION
5 SUBSYSTEM OPERATION
6 SYSTEM CALIBRATION
7 INSTALLATION
*NOTE:


ANTENNA AND DRIVE ASSEMBLY
MOTOR GENERATOR
POWER SUPPLY
RECEIVER
VIDEO PROCESSOR
VIDEO OUTPUT
TRANSMITTER
MODULATOR
RF GENERATOR
KEYING
RADAR SET CONTROL
SYNCHRONIZER
BEAM CONTROL
D/A CONVERTER
DIGITAL COMPUTER
COMPUTER GROUP
SYSTEM/EQUIPMENT DESCRIPTION AND INSTALLATION
POCKET MANUAL
OPERATOR MANUAL
ON-LINE MAINTENANCE MANUAL
SYSTEM CABLING
RECEIVER
MOTOR GEN
ANTENNA AND DRIVE ASSEMBLY
MAST MAINTENANCE
* (1) TOPICAL MODULAR TEXT WITH SUPPORTING FIGURES/ILLUSTRATIONS
(2) TEXT AND TABLES
(3) TABLES WITH SUPPORTING TEXT
(4) FUNCTIONAL DIAGRAMS WITH INTEGRATED TEXT
(5) FUNCTIONAL DIAGRAMS WITH INTEGRATED TEXT
(6) ILLUSTRATIONS WITH KEYED PROCEDURES
(7) DIAGRAMS WITH PROCEDURES
(1) TEXT WITH SUPPORTING PICTORIALS
(2) TURN-ON CHECKOUT FORMS
(3) ILLUSTRATIONS WITH KEYED PROCEDURES
(4) ILLUSTRATIONS WITH KEYED PROCEDURES
(5) ILLUSTRATIONS WITH KEYED PROCEDURES
(1) TEXT WITH SUPPORTING FIGURES
(2) DIAGRAMS WITH SUPPORTING TEXT
(3) PROCEDURE-KEYED DIAGRAMS
(4) PICTORIAL WITH SUPPORTING TEXT
(5) TABLES WITH SUPPORTING TEXT
(1) TEXT WITH SUPPORTING DIAGRAMS
(2) STRAIGHT TABLES
(3) DIAGRAMS WITH SUPPORTING TABLES
(4) DIAGRAMS WITH SUPPORTING TABLES
PYRAGRAM
SEQUENTIAL THEMATIC ORGANIZATION OF PUBS. (STOP)
JPA
JPA
MINI-MANUAL
CONDENSED MAINTENANCE GUIDE (CMG)
WORK PACKAGE
FOMM
PYRAGRAM
* (1) GENERAL INFORMATION
(2) REFERENCE DATA
(3) EQUIPMENT REQUIRED
(4) OVERALL OPERATION
(5) SUBSYSTEM OPERATION
(6) SYSTEM CALIBRATION
(7) INSTALLATION
(1) INTRODUCTION
(2) TURN-ON/CHECKOUT
(3) NORMAL MODE
(4) EMERGENCY MODE
(5) MAINTENANCE MODE
(1) INTRODUCTION
(2) OPERATIONAL DESCRIPTION
(3) FAULT ISOLATION — DIAGNOSTIC
(4) FAULT ISOLATION — BITE
(5) FUNCTIONAL CARD GROUP LISTING
(1) INTRODUCTION
(2) CABLE IDENTIFICATION
(3) POWER DISTRIBUTION
(4) SIGNAL DISTRIBUTION
*NOTE:
NUMBERS FOR CONTENT MODULES ARE KEYED TO PRESENTATION COMPONENT MODULES

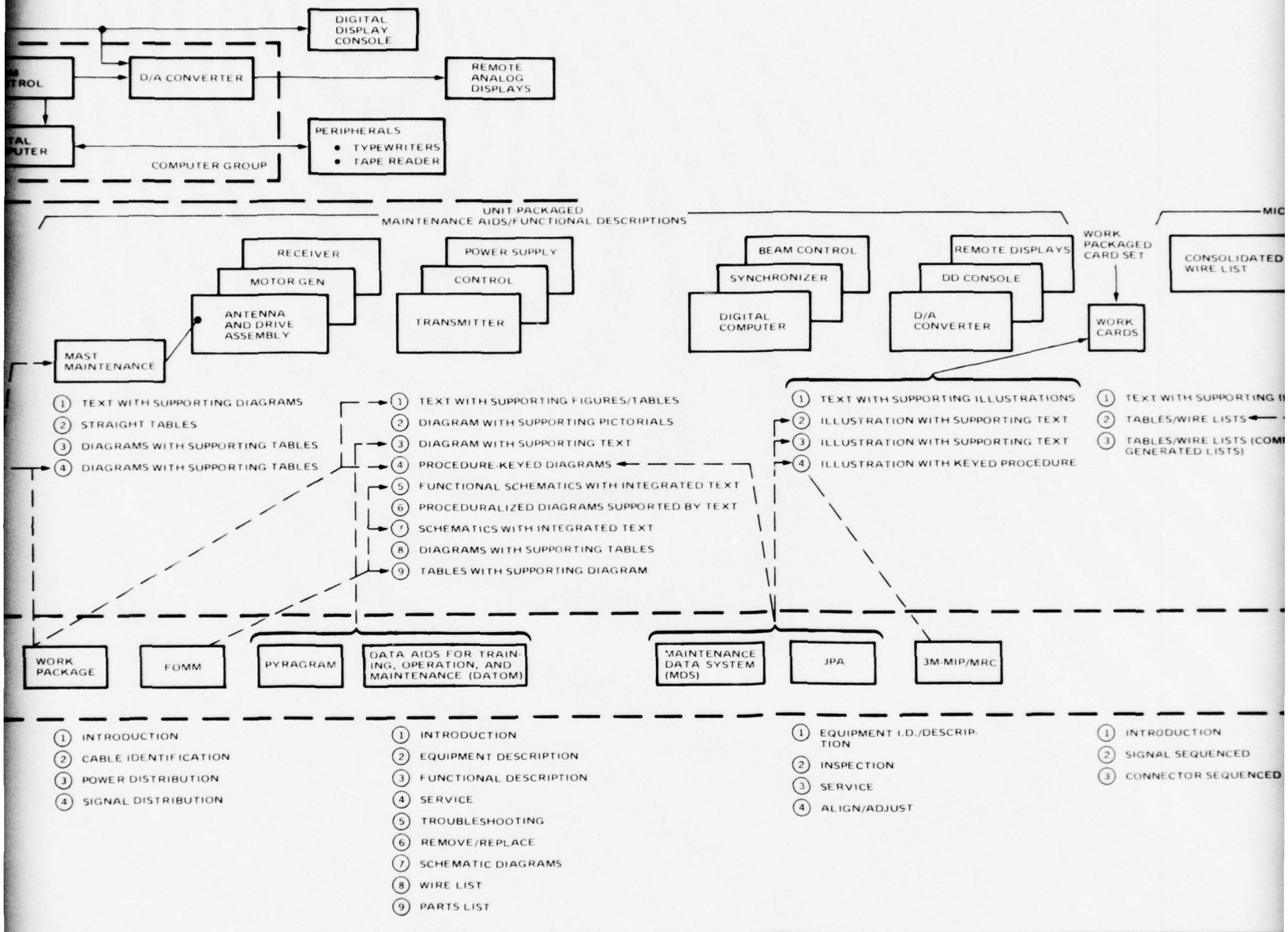
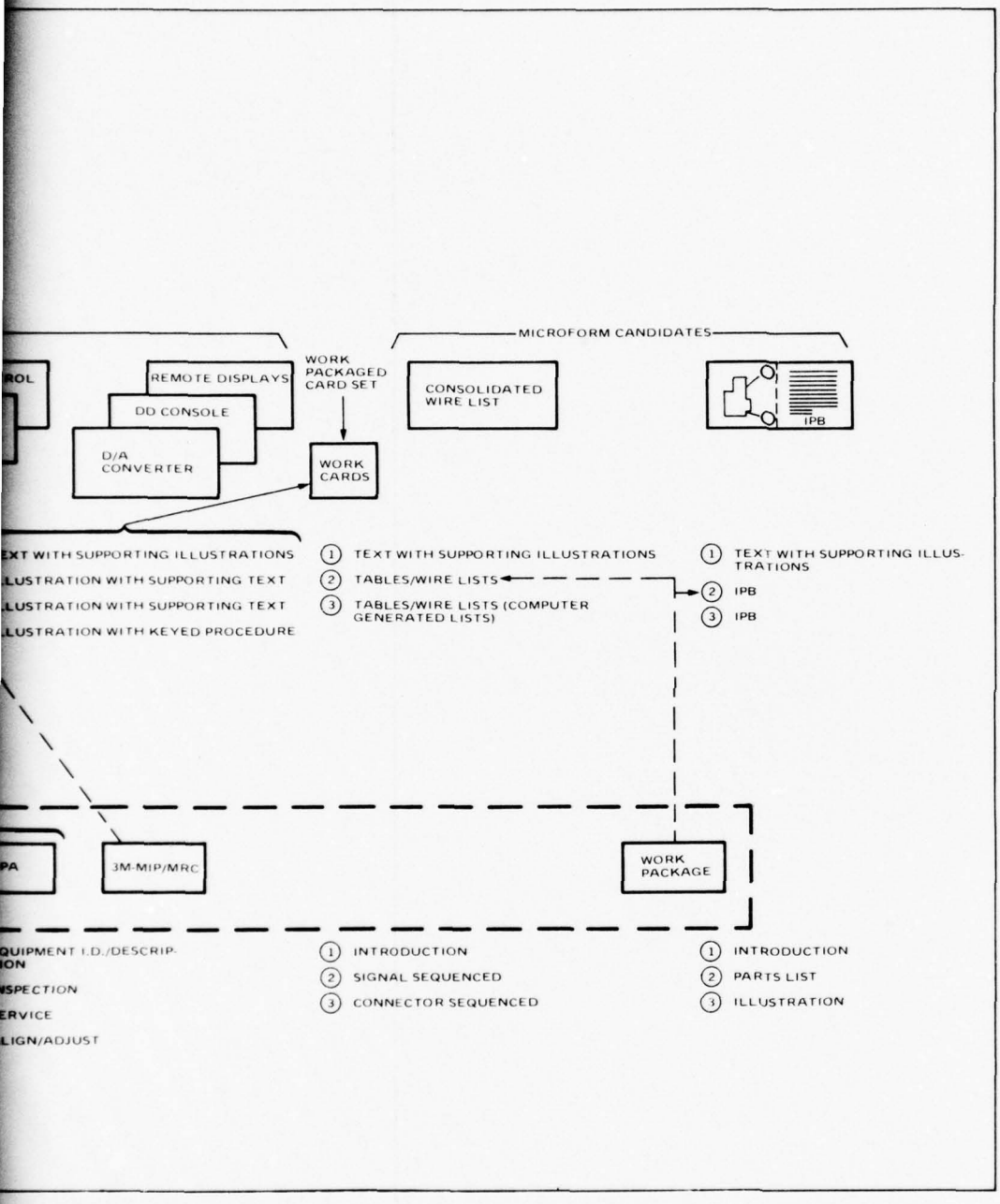


Figure 3-2. Detailed TM Design. A detailed bookplan for a considerations of user personnel characteristics, equipment des results of the training/technical manual tradeoff and the task can be developed, enabling establishment of the most effectiv



Detailed TM Design. A detailed bookplan for a shipboard radar system is derived from s of user personnel characteristics, equipment descriptions, and environment. With the training/technical manual tradeoff and the task analysis, the TM modular specification oped, enabling establishment of the most effective book content and format for the user.

3.5 ESTABLISHING A RELATIONSHIP BETWEEN TMs AND TRAINING

To insure the widest acceptance and utility, TMs must be developed as a joint effort of NTIPS and the Navy training community. A major aspect of this coordinated effort would be the conduct of Training/Technical Manual (T/TM) tradeoff(s) for every system/equipment procurement.

The specification of a Training/NTIPS interface, in the context of a system concept, would be premature at this time. However, a review of the requirements for such an interface is appropriate, and is presented here for purposes of identification of problems and relevant considerations.

Numerous problems have been encountered in attempting to utilize the TM as a training aid. Three problems produce a negative impact on the training community: (1) the overall lack of effective communication of information via the TM to the user, (2) topic coverage not being commensurate with the requirements of the training community, and (3) level (depth) of coverage within topic not being commensurate with the requirements of the training community. These problems result in TMs not being used as training aids without substantial rewriting, supplementing and deleting of information contained in the manuals. Since these "revisions" to the TMs are generated by individual instructors on an unofficial basis, it is not difficult to visualize the consequent inconsistencies in training and, of course ultimately, in on-the-job performance.

The issue of effective communication is addressed, to a great extent, by the user-data match function (see Topic 4.1.2) and need not necessarily involve the training community further. However, the other two issues (i.e., 2 and 3 above) indicate the need for increased involvement of the training community in the development of requirements for TMs. This would insure the development of TMs that are compatible with the requirements of not only the experienced user in the field, but also, just as important, serve the needs of the novice during training. In the past, TMs have been developed that contain either much more or much less information than a competent technician normally requires to do his job. This was the result of past attempts to produce technical manuals that would serve dual purposes – job-oriented manual and training textbook. However, in the absence of definite methods and guidelines for preparing the two kinds of information, this cannot be a viable approach. As indicated by the NTIPP Fleet Survey of Technical Manual Users the result can be a technical manual that is really not suited either to training or job application.

While the importance of establishing and maintaining a Training/NTIPS interaction is readily apparent, there are certain preliminary requirements for such a relationship to be productive. One such issue that requires early resolution is the clear definition of the exact purpose of the technical manual. That is, is the TM to be constructed primarily for training purposes or for job-performance purposes, or carefully optimized for both applications.

An approach that appears to have considerable merit is to optimize the technical manual for on-the-job use by a trained technician/operator (e.g., U.S. Army ITDT). In this approach, all "training" material is contained in a separate document which is used during training or for reference by the operator/technician. The TM, then, is not intended to "train" anyone to do anything. Rather, it is to be used by an individual in much the same way that a checklist would be used: the content is behavior directing, but assumes a user who has been trained to exhibit the expected behavior.

Guidelines for the T/TM Tradeoff – Once the training/job purposes of the TM have been determined, guidelines can be developed for the assignment of

information coverage to either training or the technical manual. Table 3-3 provides an indication of the diversity of task types that will have to be accommodated by the T/TM tradeoff, and how these tasks might be assigned to coverage in training, the TM, or both. This table is not the result of an exhaustive study and does not represent the extent of the guideline needed to perform the T/TM tradeoff.

The subsequent application of the necessary guidelines (for every system/equipment procurement) will constitute the T/TM tradeoff. This tradeoff will determine the quantity and type of information contained in the TM versus the quantity and type of information that should be acquired by the operator/maintenance technician during his training.

TABLE 3-3. MATRIX SHOWING POSSIBLE ASSIGNMENT OF TASK-RELATED FACTORS OF TRAINING/TECHNICAL MANUAL CATEGORIES

Factors Relating to Tasks	Now Covered		
	Primarily in Training	Primarily in TM	Both in Training and in TM
Tasks that are difficult to learn on the job	X		
Tasks that are most easily demonstrated	X		
Tasks/skills that require extensive practice or psychomotor skills	X		
Tasks critical to job/overall mission	X		
Tasks involving complex behavioral responses		X	
Tasks involving readings and measurements referred to in tables, diagrams, and charts			X
Tasks with branching step structures		X	
Tasks performed frequently on the job	X		
Tasks that can be mastered via low-cost training	X		
Rarely performed but critical tasks		X	
Tasks that are hard to conceptualize without visual reference		X	
Tasks that require access to system/subsystem data for completion			X
Tasks where speed of response is critical	X		
Tasks where there may be severe operational penalties for error	X		

3.5 ESTABLISHING A RELATIONSHIP BETWEEN TMs AND TRAINING (Continued)

Common sense suggests that certain tasks could be quickly excluded from a requirement for technical documentation. For example: (1) where the task has been previously learned, no further training or documentation is needed (such as use of common test equipment or tools); (2) documentation need not be provided where the task will be mastered (learned) during training (e.g., a basic skill, such as safety wiring); or (3) where the task requires neither training nor documentation because it can be quickly and accurately learned on the job (such as a simple inspection procedure). Similarly, there will be certain instances, such as parts lists, where it is self-evident that particular information will be provided to the user via the TM. However, other types of information (e.g., scheduled maintenance task descriptions) will be found to be not so readily consigned to exclusive coverage during training or in the technical documentation, nor can this information be excluded from presentation altogether. This is the type of information that will necessarily be covered both in training and in the TM, and will present the most difficult T/TM tradeoff problems in terms of requiring the careful application of T/TM tradeoff strategy.

Task Analyses – A factor that is crucial to the successful balance between training and TMs is the depth and accuracy of the task analysis performed during each procurement. It is the results of the task analysis that ultimately determines the pool of items that will be traded-off. Because of the importance of the task analysis to the quality of the final product, NTIPS and the Navy training community should jointly provide specifications concerning how the analysis should be conducted and what information (data elements) is to be generated. In addition, a determination must be made regarding how to use the data obtained from the three-year task inventory program carried out by the Navy Occupational Task Analysis Project.

Much work has already been done in this area, notably by Joyce, et al[1], and by Chenzoff[2]. Both these authors have described ways of gathering data for fully proceduralized job performance aids (JPA). Although the level of detail and purpose of JPAs may be different from the kind of TMs needed to maintain a complex system, Chenzoff and Joyce discuss a logical scheme for conducting detailed task analyses. It appears feasible to develop guidelines for assigning data items based on tasks to either training or to TMs, or to both. But, before this could be done, it would require that the Chief of Naval Education and Training develop precise definitions of the roles and objectives of the training community in developing TMs suitable for training applications. A close liaison would be required with schools serving various technical ratings, since their training patterns differ somewhat according to the complexity and type of equipment covered by the training.

Career Path Considerations – Training and TMs must be developed with due consideration for the user's career pattern. Some commands are reluctant to expend training funds on rates having a limited career future in the Navy. In these instances it may be more cost effective in the long run to develop TMs which contain a high proportion of training material. Maintenance performance and effectiveness, as acquired through training versus the TM, must be considered in terms of the relative return on dollar investment when judging the balance between training and TM content.

1. Joyce, R.P., Chenzoff, A.P., and Mulligan, J.F., Fully Proceduralized Job Performance Aids – Handbook for JPA Developers, Applied Science Associates, Valencia, PA, August 1973.
2. Chenzoff, A.P., Aeronautical Requirements – Integrated Development of Training/Performance-Aid Requirements for Naval Air Maintenance Personnel, Applied Science Associates, Valencia, PA, August 1973.

The pattern of training and career development followed by the various TM users is thus another important consideration in establishing guidelines for the T/TM tradeoff. Those individuals who follow an on-the-job training path typically pick up their required information on a trial-and-error basis, supplemented by general information from the achievement-in-rate manuals. These individuals will necessarily rely upon technical documentation to a relatively great extent, and thus a relatively high proportion of "training" material must be available to them via the TM. By way of contrast, those persons who follow the comparatively academic career path (i.e., from recruit training to "A" school, to "C" school, to operational assignment) seem to have relatively less requirement for training information in the TMs they use. That is, a higher proportion of this information will be presented during formal training and need not be duplicated in the TM.

The NTIPS requirements for each path are different. Analysis of the tasks carried out at different stages of a career must be done in the context of information needs for training. To date this type of analysis has not been done. The training community is, of course, vitally interested in improving the quality of technical information and TMs used in "C" school courses so that the difficult task of training on complex systems is more easily accomplished. If standard technical information supplied by equipment contractors were better suited to training needs, it would be a major accomplishment in cost/performance effectiveness.

Finally, the Navy's Training Analysis and Evaluation Group (TAEG) has published a Needs Assessment[3] which points to issues that TAEG feels address Training Command interests in NTIPP. Some of these issues, and their respective recommendations, require a clear and fairly precise determination of the relationship between the NTIP System and the Navy training community. This determination has not been made to date, but it is anticipated that during Phase II of NTIPP a working liaison will be established between the NTIPP staff and Navy training personnel. This liaison would provide a clearer perspective on the relationship between training and the TM that would, consequently, enhance the development of a T/TM.

3. Braby, R., Training Requirements for the Naval Technical Information Presentation Program: A Needs Assessment (Technical Memorandum 77-3), U.S. Navy Training Analysis and Evaluation Group, Orlando, FL, April 1977.

3.6 TECHNICAL APPROACH TO PUBLISHING SUBSYSTEM

To met the enormous initial publishing and updating requirements of the future, a fully automated publishing operation is needed. Thus, a digital data base and a digital production approach are proposed as a Navy internal capability.

Three to four million TM pages enter the Navy's TM inventory each year, most of them generated and published by equipment contractors. Eight hundred thousand pages of updates of in-production equipment TMs are also processed each year, again mostly by equipment contractors. Even updates on out-of-production equipment TMs are largely contracted by the Navy to publications services.

Under the concept envisioned, the Navy would develop an internal digital production capability by the early 1980s to perform all TM updates for out-of-production equipment, and also, if needed, for in-production equipment TMs. In the 1980s, the Navy would also perform all digital production of new technical information generated by Navy content generators and the processing into TM masters of all technical information output of equipment contractors. Ultimately, the majority of TM pages would be handled by Navy publishing activities to perform the digital production, preparation of masters in the prescribed medium, replication as needed, and delivery of the TMs to the user.

Essentially, the preliminary concept for publishing calls for a digital production function to enter digital magnetic tape output from equipment contractors and a full range of batch and interactive text and graphic entry devices to handle Navy internal content generation and TM updates. The digital production function provides the necessary computer processing capability and associated working storage. In addition, the Publishing Subsystem has the means to master the TM pages being processed for replication into a specified medium. Although printed paper books and microforms are the preliminary concept media choices, the capability is provided to transition into one or more other candidate media such as video discs or digital holograms.

Although the Navy has some publishing capability utilizing automated equipment (e.g., ADPREPS and TRUMP), what exists and what has been learned of plans for enhancements falls short of providing the capability described above for digital processing and mastering. Presently, no internal capability exists for replication of printed paper books or microforms since it is predominately contracted by NPPSO to printing contractors. However, whether this is the approach to be taken for new media still remains to be determined.

To achieve the full capability needed to publish the well over three million pages each year is not without problems. Several of these deal with developing and standardizing the digital processes and products that are needed, such as creating a digital TM data base (to become the working archive), being able to accept input from various equipment contractors, and providing the same digital production capability in different publishing operations. Other problems relate to the transition to new media and the use of contractors to perform publishing operations.

At the time a system/equipment transitions from in-production to out-of-production status, the TM data base (master copy of TM pages) is often either incomplete or in different output media forms (negatives, reproducibles, printed books), and it may be stored by the contractor, NPFC, or possibly at one of the CFAs, or scattered among all three. This situation imposes an added expense on the Navy internal publications activity in processing subsequent updates. Some form of master copy must be created (if none exists) in order to process TM changes. Therefore, the means will be provided in publishing activities to process all current TM data into a digital form for storage in a controlled working archive. Control of the input

to the data base is assigned to the Publishing Subsystem since the capabilities for entry and processing reside there.

The implementation of the above concept must consider that there are many different styles of outputs from contractors. This would impose a difficult task on the Navy activity inputting the TI to be processed or converted to a TM data base. That activity would have to be able to respond to such different inputs as paper tape; magnetic tape reels, cassettes, cartridges or discs; manuscript copy; original drawings; photo copies of drawings; and final repro copy. Navy-wide standards for both contractors and Navy input to the TM data base will be developed. A combination of digital magnetic tape, OCR, and graphic scanning (similar to that specified by the current NAVAIR "input control document" being reviewed for comments by NAVAIR contractors)[1] could realistically limit the forms of data to be input to publishing and, subsequently, the TM data base. However, a single form of acceptable equipment contractor output is recommended. That form is magnetic digital tape.

Additionally, the implementation must provide consistent and standard Navy publishing activities, which is not presently the situation. Two different publishing system approaches have been taken in the TRUMP and ADPREPS developments by NAVAIR and NAVSEA, while NAVELEX has no internal publishing capability. Internal publishing systems would be structured to accommodate the above input standards and handle the forecasted workloads. Further, Navy-wide automated publishing systems (all major acquisition activities) that are at least Navy compatible (perhaps DoD compatible) would result.

TABLE 3-4. NTIPS PUBLISHING APPROACH

Problem	Solution
Incomplete or nonexistent Navy data base of TM masters for either in-production or out-of-production equipment for use by Navy for TM updates.	Build a digital TM data base and keep it current while equipment is in production (using Publishing Subsystem to accept and process all technical information).
Diverse automated publishing capability throughout Navy, but too limited to support projected TM publishing needs.	Provide standardized automated digital publishing systems (using latest technology) to accept a full range of text and graphic formats from Equipment Contractors and Navy publications operations.

[1] Letter AIR 04A4; HLK; Sg/214, Review of Technical Review and Update of Manuals and Publications (TRUMP) Input Requirements, 10 August 1977.

3.6 TECHNICAL APPROACH TO PUBLISHING SUBSYSTEMS (Continued)

Although text automation has been highly developed, graphics automation has lagged. Current Navy system approaches to handling graphics is still visual/manual. Digital graphic processing is expected to continually progress into the 1980's, making digital graphics as cost-effective as digital text processing. In this case, the Navy should develop mechanisms to continually assess graphic automation development, and provide for graphics automation in the NTIP System design.

Printed paper books and microforms are the current user media and will be employed for several more years. It will probably be at least four or five years before any candidate media (video discs, holograms, direct digital, etc.) can be developed sufficiently to be implemented in place of paper and/or microforms. When a change is contemplated, the impact on the investment (facilities and equipment), the personnel, and the manner of doing business will have to be evaluated. The latter refers to the almost total dependence on contractors for replication, which could change with different media. NTIPS needs to be reactive to the different media possibilities and to the equipment/methods required to process, replicate, and supply each to the users.

Finally, how much internal publishing capability is acceptable must be determined in light of the interpretations made of the Office of Management and Budget and Congressional Joint Committee on Printing policies. For example, all TM printing is contracted, and TRUMP has been forced into a Government-owned/contractor-operated (GOCO) mode of operation. Continual assessment of publishing requirements pertaining to this problem area (particularly the changes that could result from media decisions) are needed and planned.

TABLE 3-4. NTIPS PUBLISHING APPROACH (Continued)

Problem	Solution
Automated graphics processing is lagging text processing in both extent of capability and cost (investment and operation).	Anticipate technology developments and a decline in costs will permit full automated graphics implementation in early 1980's.
Wide variety of text and graphics processing methods, technical information formats, and standards for replication and other publishing processes and products.	Develop Navywide standards for both contractors and Navy publishing activities, particularly for the interfaces of processes used and product formats.
Current printed paper books and microforms may be replaced by new media (e.g., video discs or holograms).	Although not imminent, the mastering and replication function, must be structured to make changeover to handle new media.
Present TM printing, microform duplication, and some digital production (e.g., TRUMP) are or are about to be performed by Contractors (OMB and JCP policy interpretation).	Role of Contractors to be continually assessed during design phase.

3.7 CONSIDERATIONS IN SELECTING TM MEDIA

The current primary media are printed paper books and microforms, but several other user media are viable candidates for the NTIP System. Initial considerations for selection of other media must account for various media transforms during processing.

The preliminary system concept has been developed to accommodate, as primary media, the currently used printed paper books (delivered to the user) and cartridge and fiche microforms. NTIPS is functionally structured to also accommodate other media considered as potential candidates for the 1980-85 time frame. Both the primary and potential media are described below and shown in Table 3-5. The following two currently used media were selected for the preliminary system concept since, even if a new medium is selected, these two will be used for at least five more years, and any new medium would have to transition from them.

Printed Paper Book – This is the familiar conventional printed pages of text and graphics collated and bound together as a book. The most common size is 8-1/2 by 11 inches, but they range in size from about 4 by 6 inches for pocket books to the 15 by 30 inches used for BAMAGAT and SIMM TMs. Color can be used, again SIMM is an example, but most paper books are black and white printing. Printed paper books require no special equipment to be employed by the user.

Microforms – These are greatly reduced photographic copies of pages of text and graphics. There are several forms in use, but the one that has achieved widest acceptance to date is the microfiche. This is a piece of film, measuring 105 by 148 mm, that has from 98 to several hundred pages per fiche. Other forms are roll film and aperture cards. Microforms require the user to have access to a viewer or viewer/printer. Microforms have black and white images. Color is possible, but seldom used.

The following are the three candidate media that are most likely to replace the current media in the 1980s. All are in early stages of development and will need to be tested in the user environment.

Video Disc – This is either a video or digital representation of pages of text and graphics. Several thousand pages are recorded on a hard 12-inch disc (that looks like a phonograph record) or a soft (floppy), transparent 12-inch disc. To be used, video discs require a converter, viewer, and (as needed) a replication device. Video discs are the only medium in the group that can provide sound and motion portrayals as well as the static picture of a page. Video discs provide color images using video and black and white images using digital.

Digital Hologram – This is also a digital representation of pages of text and graphics. Several thousand pages are contained on one piece of film measuring 105 x 148 millimeters. To be used, digital holograms need a converter, viewer, and (as needed) a replication device. One form of hologram combines microform images with digital data on the same film, providing additional versatility in field applications. Images are black and white.

Direct Digital – The direct transmission of digital representations of TM pages to the user from a centralized TM data base is the final candidate. To use the direct digital medium, a receiver, converter, viewer, and (as needed) a replication device are required. Images are black and white.

TABLE 3-5. IMPLICATIONS OF MEDIA SELECTION

Media	Processing	Delivery	User Devices	Storage	
				User	Processing
Preliminary System Concept					
• Printed Paper Books	Digital	Printed paper books	None	Paper books	Digital TM data bank
• Microforms	Digital	Microform	Viewer, Printer	Microform	Digital TM data bank
Candidate Media					
• Video Disc (Video)	Audio/visual (video methods)	Video disc	Converter, viewer	Video disc	Video
• Video Disc (Digital)	Digital	Video disc (digital)	Converter, viewer, printer	Video disc	Digital TM data bank
• Digital Holograms	Digital	Hologram film	Converter, viewer, printer	Hologram film	Digital TM data bank
• Direct Digital	Digital	Data comm. signal	Receiver, converter, viewer, printer	Digital memory	Digital TM data bank
Other Potential Media					
• Digital Memory (Deliverable)	Digital	Bubble or similar type memory device	Converter, viewer, printer	Digital memory	Digital TM data bank
• Digital Tape	Digital	Tape, cartridge, etc.	Converter, viewer, printer	Digital tape	Digital TM data bank
• Video Tape	Audio/visual (video methods)	Tape, cartridge	Converter, viewer	Video tape	Video masters
• Other Audio/Visual	Audio/visual (various methods)	Motion pictures, film strips, audio tape, etc.	Converter, viewer	Audio/video media	Audio/video masters

As with the microform medium, there is a requirement to provide a secondary medium for use where the viewing devices cannot be taken. This medium would be paper copies of pages of text and graphics prepared on the replication devices used in conjunction with the viewers. One page of text or one page unit of art would be reproduced on paper approximately 8-1/2 x 11 inches and only black and white images would be provided.

There are other potential media shown in Table 3-5. These include digital tape, video tape or other audio/visual media, and a deliverable digital memory. Although not considered to be leading candidates at this time, they all need to be continually assessed. Digital tape and the audio/visual devices are the familiar conventional media now in use. The only unique medium would be a deliverable digital memory such as the newly developed magnetic bubble memories. These are mass memory devices that would in the future hold all of the TMs on a ship or at a NARF in a memory that would fit into a shoe box.

All media being considered (see Table 3-5) are either dynamic (that is, use sound and/or motion) or static and can be used in either interactive and passive modes. Of the media described, only the video disc has capability for both static and dynamic action portrayals. Video tape and motion picture film can also provide action, such as a technician actually performing a disassembly accompanied by an audio description of what is taking place. An interactive application of media is the user device that provides an interaction between the user and the device. The device leads the user through a man/machine dialog of a troubleshooting routine or a training exercise. A visual display/keyboard terminal with processor and associated storage is the usual configuration for such an interactive device. The medium provided the user can be all digital (i.e., floppy disc) or a combination of digital and visual (i.e., video disc). Both are used in current interactive devices. The video disc systems can provide the added dynamics of sound and motion to maintenance routines or training exercises.

Most subsystems of NTIPS are affected by the medium/media utilized for delivery of the TM to the user. The TM specification function must develop the specifications and standards for TMs prepared for a specific medium, particularly the mechanical specifications for the medium itself. The content generators must respond differently if a medium is dynamic rather than static. For example, if a video disc was specified with a sound and action sequence showing a maintenance technician performing a part disassembly, the content generator would prepare a script, not a page for a book. The choice of medium has a significant impact on the publishing activities since technical information can change from one medium to another as it is processed through publishing operations and ultimately delivered. There are several different forms (or media) that technical information takes during the automated publishing cycle. First, in the preliminary system concept it is captured and processed by the publishing functions in digital form. It is then output, mastered, and replicated as a TM in a different form for delivery to the user. That form would be any one of the media described above and shown in Table 3-5. When delivered, in order for a medium to be used, there must be one or more devices which create a final use medium. For example, a viewer or viewer-printer is needed for microforms. This is true for all media but printed paper. Use of media in the user community is the subject of the following topic.

Finally, there is a need for storage. There are two basic storage requirements: that related to the processing of technical information into TMs, and that related to TM use in the user environment. Storage of media takes on importance when discussed in light of the amount of TMs to be processed, delivered, and used. With 3 to 4 million pages to be processed each year, many times that in delivery media (replicated copies of the output), and often over a hundred thousand pages at any one user location (on a ship or at a NARF), storage becomes a significant factor in the design process.

3.8 USE OF MEDIA IN THE USER COMMUNITY

Microforms and printed paper books are TM media that are used quite differently in the user environment. Microforms, and other similar candidate media require user reproduction and viewing devices, which appear to be negative aspects of the media.

The primary consideration in the analysis of a medium is effectiveness in the user environment. The media designated for the preliminary system concept, printed paper books and microforms, are presently in use and have been accepted, to some degree, as effective in the user environment. Other candidate media still need to be so evaluated.

All future candidate media require one or more devices to make them fully useful in the field. Devices are needed to provide (1) conversion of the media for viewing, (2) the actual viewing, and (3) replication of the viewed image, if desired. In addition, all media also require storage and containers (or devices) for storage. Pertinent considerations for use of media in the user community are provided in Table 3-6 and discussed below.

For all but printed paper books, the user must view the information (provided by some media) on a viewing device. The process begins with the user looking at an index or table of contents to determine where (in the media) the needed information can be found. The media must then be searched until the information is located. When located, it is presented on a viewer so that it can be read by the user. This satisfies the initial need for information, but there may be a subsequent need to take the information to another location. If a replication device is associated with the viewing device, such as the microform viewer/printer, then the user can make a paper copy of the needed information that can be taken and used where a viewer cannot be taken.

Viewing of these media, therefore, is the primary need. Replicating the viewed image is secondary because it may or may not be required. An example that does not require replication might be basic reference data such as parts lists. If paper copies cannot be made, the capability to have or be able to carry the viewer to where it is to be used is a considered alternative. This satisfies the requirement to support the often expressed user's need for TM information that can be carried to and used in environmentally difficult work areas, such as the remote areas of a ship or the tail section of an aircraft. Current technology microform viewer/printers presently in use by the Navy can provide the paper copies. The personal portable microform viewer being developed under contract to the NAVSUP R&D activity is aimed at meeting this need for a hand-carried viewer. Obviously, printed paper books do not have these problems.

Microforms, video discs, holograms, and direct digital are all media that require viewing, and the capability to "easily" load and locate the data contained in any of these media would be mandatory. It should be pointed out that there are several negative aspects of microforms that have been reported (including the NTIPP Fleet Survey[1]). User acceptance has been poor in the Navy's MIARS program, the Air Force has abandoned its Technical Order Microfilm 3ystem (TOMS) program, and the Army has diluted its microform program (see Task 1 Report Page 3-236). Since they all require similar handling and the same type of devices, the problems encountered with microforms can also be expected with digital video discs, digital holograms, and the direct digital media.

1. Hughes Aircraft Company, Review Draft, Special Report NTIPP Fleet Survey of Technical Manual Users, DTNSRDC, 5 March 1977.

As with the microform medium, there is a requirement to provide a secondary medium for use where the viewing devices cannot be taken. This medium would be paper copies of pages of text and graphics prepared on the replication devices used in conjunction with the viewers. One page of text or one page unit of art would be reproduced on paper approximately 8-1/2 x 11 inches and only black and white images would be provided.

There are other potential media shown in Table 3-5. These include digital tape, video tape or other audio/visual media, and a deliverable digital memory. Although not considered to be leading candidates at this time, they all need to be continually assessed. Digital tape and the audio/visual devices are the familiar conventional media now in use. The only unique medium would be a deliverable digital memory such as the newly developed magnetic bubble memories. These are mass memory devices that would in the future hold all of the TMs on a ship or at a NARF in a memory that would fit into a shoe box.

All media being considered (see Table 3-5) are either dynamic (that is, use sound and/or motion) or static and can be used in either interactive and passive modes. Of the media described, only the video disc has capability for both static and dynamic action portrayals. Video tape and motion picture film can also provide action, such as a technician actually performing a disassembly accompanied by an audio description of what is taking place. An interactive application of media is the user device that provides an interaction between the user and the device. The device leads the user through a man/machine dialog of a troubleshooting routine or a training exercise. A visual display/keyboard terminal with processor and associated storage is the usual configuration for such an interactive device. The medium provided the user can be all digital (i.e., floppy disc) or a combination of digital and visual (i.e., video disc). Both are used in current interactive devices. The video disc systems can provide the added dynamics of sound and motion to maintenance routines or training exercises.

Most subsystems of NTIPS are affected by the medium/media utilized for delivery of the TM to the user. The TM specification function must develop the specifications and standards for TMs prepared for a specific medium, particularly the mechanical specifications for the medium itself. The content generators must respond differently if a medium is dynamic rather than static. For example, if a video disc was specified with a sound and action sequence showing a maintenance technician performing a part disassembly, the content generator would prepare a script, not a page for a book. The choice of medium has a significant impact on the publishing activities since technical information can change from one medium to another as it is processed through publishing operations and ultimately delivered. There are several different forms (or media) that technical information takes during the automated publishing cycle. First, in the preliminary system concept it is captured and processed by the publishing functions in digital form. It is then output, mastered, and replicated as a TM in a different form for delivery to the user. That form would be any one of the media described above and shown in Table 3-5. When delivered, in order for a medium to be used, there must be one or more devices which create a final use medium. For example, a viewer or viewer-printer is needed for microforms. This is true for all media but printed paper. Use of media in the user community is the subject of the following topic.

Finally, there is a need for storage. There are two basic storage requirements: that related to the processing of technical information into TMs, and that related to TM use in the user environment. Storage of media takes on importance when discussed in light of the amount of TMs to be processed, delivered, and used. With 3 to 4 million pages to be processed each year, many times that in delivery media (replicated copies of the output), and often over a hundred thousand pages at any one user location (on a ship or at a NARF), storage becomes a significant factor in the design process.

3.8 USE OF MEDIA IN THE USER COMMUNITY

Microforms and printed paper books are TM media that are used quite differently in the user environment. Microforms, and other similar candidate media require user reproduction and viewing devices, which appear to be negative aspects of the media.

The primary consideration in the analysis of a medium is effectiveness in the user environment. The media designated for the preliminary system concept, printed paper books and microforms, are presently in use and have been accepted, to some degree, as effective in the user environment. Other candidate media still need to be so evaluated.

All future candidate media require one or more devices to make them fully useful in the field. Devices are needed to provide (1) conversion of the media for viewing, (2) the actual viewing, and (3) replication of the viewed image, if desired. In addition, all media also require storage and containers (or devices) for storage. Pertinent considerations for use of media in the user community are provided in Table 3-6 and discussed below.

For all but printed paper books, the user must view the information (provided by some media) on a viewing device. The process begins with the user looking at an index or table of contents to determine where (in the media) the needed information can be found. The media must then be searched until the information is located. When located, it is presented on a viewer so that it can be read by the user. This satisfies the initial need for information, but there may be a subsequent need to take the information to another location. If a replication device is associated with the viewing device, such as the microform viewer/printer, then the user can make a paper copy of the needed information that can be taken and used where a viewer cannot be taken.

Viewing of these media, therefore, is the primary need. Replicating the viewed image is secondary because it may or may not be required. An example that does not require replication might be basic reference data such as parts lists. If paper copies cannot be made, the capability to have or be able to carry the viewer to where it is to be used is a considered alternative. This satisfies the requirement to support the often expressed user's need for TM information that can be carried to and used in environmentally difficult work areas, such as the remote areas of a ship or the tail section of an aircraft. Current technology microform viewer/printers presently in use by the Navy can provide the paper copies. The personal portable microform viewer being developed under contract to the NAVSUP R&D activity is aimed at meeting this need for a hand-carried viewer. Obviously, printed paper books do not have these problems.

Microforms, video discs, holograms, and direct digital are all media that require viewing, and the capability to "easily" load and locate the data contained in any of these media would be mandatory. It should be pointed out that there are several negative aspects of microforms that have been reported (including the NTIPP Fleet Survey[1]). User acceptance has been poor in the Navy's MIARS program, the Air Force has abandoned its Technical Order Microfilm System (TOMS) program, and the Army has diluted its microform program (see Task 1 Report Page 3-236). Since they all require similar handling and the same type of devices, the problems encountered with microforms can also be expected with digital video discs, digital holograms, and the direct digital media.

1. Hughes Aircraft Company, Review Draft, Special Report NTIPP Fleet Survey of Technical Manual Users, DTNSRDC, 5 March 1977.

All media have to be stored by the user. The physical media (paper books, fiche, cartridges, discs, holograms) must be kept in some form of container. Even direct digital needs a storage device (a memory). Several candidate media also need storage for the paper, chemicals, or other supplies for the replication devices employed. The tradeoffs among media must consider, along with the usability criteria, the space needed for viewers, replicators, converters, and storage. With concern for the physical space required, the accessibility of stored TMs must be considered. How the file is structured, the library system, ease of access, and speed of retrieval are factors important to an effective storage method.

Except for storage, printed paper books delivered to the user do not need the special handling or equipment of other media. Since all other media are likely to be reconstituted as paper by the user, any replacement media must be carefully evaluated to verify its utility and the cost effectiveness of its selection. It must be kept in mind that the real value is in its use in the user community.

TABLE 3-6. USABILITY OF MEDIA IN THE USER COMMUNITY

Media	Access to Data in Medium	Viewing/ Transportability	Versatility	Storage
Printed Paper Books	Table of Contents, Index in document, Manual search.	Viewed as is – Can be taken anywhere.	Limited to pages of text and art bound together in volumes. Can be changed.	Needs large area. Files or bookcases.
Microforms	Table of Contents, Index. Can be automated.	Conventional viewer – Special lightweight viewer or paper copy of microforms is needed.	Limited to pages of text and art packaged together in a roll or on a fiche. Must be replaced to change.	Needs small containers for microforms. Needs large area for paper and supplies for printer if used.
Video Disc (Video)	Table of Contents, Index. Can be automated.	Conventional Television – Special lightweight viewer is needed.	Can display pages of text and art, or a combination of each. Must be replaced to change.	Needs small file for discs.
Video Disc (Digital)	Table of Contents, Index. Always automated.	CRT Viewer – Special lightweight viewer is needed.	Limited to pages of text and art packaged together. Must be replaced to change.	Needs small file for discs. Needs large area for paper and supplies for printer if used.
Digital Hologram	Table of Contents, Index. Always automated.	CRT Viewer – Special lightweight viewer is needed.	Limited to pages of text and art packaged together. Must be replaced to change.	Needs small file for hologram film. Needs large area for paper and supplies for printer if used.
Direct Digital	Table of Contents, Index. Always automated.	CRT Viewer – Special lightweight viewer is needed. Connection to data bank also needed.	Groups of pages of text and art can be modularized or data can be provided for mass storage device. Changes are made to data bank or storage devices.	Might need digital storage device. Needs large area for paper and supplies for printer if used.

3.9 TECHNICAL APPROACH TO DISTRIBUTION SUBSYSTEM

The Distribution Subsystem features a centralized NTIPS TM resupply function and dual archive, containing the digital TM data base combined with a totally automated decentralized distribution control function .

Navy distribution activity falls into several functional areas. First, the control elements for initial distribution of TMs of new equipment procurements, such as where the equipment is to be deployed, TM numbers, etc., must be established. This same control mechanism also needs to be extended for subsequent changes to the equipment and resulting revisions to TMs. Next, the physical delivery of these basic TMs and updates must be performed. In addition, extra copies of TMs and updates need to be stored for use as replacements when requested by the users. There is another type of storage requirement for the TM master copies to be used for subsequent processing. All of these functions, excluding delivery of new TMs and subsequent updates, are part of the Distribution Subsystem. Because it is operationally an adjunct to the replication function, the excluded delivery function is assigned to the Publishing Subsystem.

Presently, the distribution activity in the Navy appears to be performed acceptably since no major complaints have been uncovered in NTIPP research. However, certain problems have been identified, some of which appeared during development of the Initial Distribution Control function preliminary concept.

The preliminary concept is to have three functions to perform all distribution requirements: (1) a decentralized initial distribution control function working closely with the acquisition activities and using the automated Management Information System (MIS) for configuration and distribution control management to handle the over 30,000 yearly procurement actions, (2) a centralized TM resupply function to provide physical storage of paper and/or microform copies of the over 150,000 TMs in the Navy's inventory, and (3) a centralized dual archive function containing a 130-trillion-bit digital data base as a working archive for use in update programs and a historical archive which would initially contain over 30,000,000 TM pages and which would increase by 3 to 4 million pages each year as new TMs enter the system.

The Distribution Subsystem uses existing approaches where effective and incorporates new approaches where necessary. For example, the existing STEDMIS/STEPS approach is effective for configuration management and is used by two of the three principal major acquisition activities. It should be retained and its use considered for the third major acquisition activity. An example of a new approach is the digital data base needed for the working archive. The large quantity of TM pages to be stored in digital form will require application of mass memory devices, such as the newer charge-coupled devices or magnetic bubble memories.

The example of the application of STEDMIS/STEPS pertains to the distribution control function where it addresses a primary concern of matching the TMs to the hardware configurations at various user locations. Tracking and managing the configuration data, the locations and addresses, along with the publications identification, acquisition status, and general distribution requirements data, dictates the use of computer automation. STEDMIS/STEPS would be adapted and supplemented with programs to enable the NTIPS MIS to handle the initial distribution data for all active hardware/TM programs. These programs represent over 150,000 TMs, each one being used in as many as several hundred locations. Each TM could also exist in several different configurations to support different models or modifications of a particular piece of equipment. All this makes the data file and its

automation and control a complex operation. Since each major acquisition activity would have an initial distribution control function, there is the added need to insure each location has the same capability and operates similarly. One specific problem that has been identified by the Navy is that the actual user may not be receiving the TM or updates he needs although they have been shipped to his location. The magnitude of this problem is not known and should be determined before the type of action to correct the problem can be decided upon. Among the possible solutions would be a TM receipt system or some form of communications to the user activities.

TABLE 3-7. NTIPS APPROACHES TO PROBLEMS IN DISTRIBUTION

Problem	NTIPS Approach
Approaches to TM/equipment configuration management are inconsistent, and distribution control functions vary among the major acquisition activities.	Use STEDMIS/STEPS and supplement it with additional programs to provide total automation of all aspects of distribution control common to all Navy activities.
Distributed TMs occasionally do not get to the actual TM user although they do reach the ship, NARF, etc.	Problem requires further research to ascertain frequency of occurrence, whether it is limited to one area (shipboard, air station, etc.), and reasonable solutions.

3.9 TECHNICAL APPROACH TO DISTRIBUTION SUBSYSTEM (Continued)

The operation of a centralized TM resupply function is conceived as not too different from the existing operations of NPFC. However, warehousing and materiel management would be controlled through computer programs in the NTIPS MIS for inventory control, supply actions, and the like. In the initial concept, resupply of TMs in response to user requests would not be a part of the usual "hardware" supply system. It would be separated under NTIPS control in order to make it as responsive as possible to users' needs. A feature to be added in the future is on-demand replication of a copy in the medium requested (paper book, microform, digital hologram, etc.) from the digital data base of the working archive. This approach would greatly minimize and ultimately eliminate the need to keep a predetermined number of copies of each TM in the specified delivery medium until (if ever) requested.

Finally, the archive function, which today consists of various assortments of copies of printed books, photolithographic negatives, camera-ready repro, computer paper or magnetic tape, photographs, and line artwork, needs consideration. These items do not reside in any one location. They may be at an equipment contractor's facility, a publications service contractor's plant, a Cognizant Field Activity (CFA), a SYSCOM headquarters, or at NPFC. The latter organization does not usually receive their archive copy of a TM until the very end of a contract. This material is called replenishment material and usually consists of two copies of a printed book and glossy prints of photographs. This then becomes the historical archive, although the material stored could be replicated to replenish exhausted TM stocks or to create masters for subsequent updates. The NTIPS preliminary concept calls for a similar historical archive, but it must be structured and controlled by NTIPS. Initially the TMs would be stored as microforms; and digitally, ultimately, if and when determined to be cost effective.

The major difference in the NTIPS approach to an archive function is in having a working archive containing a digital data base of all active TMs. As discussed in the technical approach to Publishing, the digital data base is developed principally to provide a "TM master" that can be processed by the Navy after equipment transitions from in-production to out-of-production status. This approach is also dependent on affordable mass memory devices being available. Since graphics create the majority of digital storage requirements, an interim digital text, visual storage approach may be needed. The historical archive, particularly when it becomes digital, will serve as an effective backup for the working archive.

TABLE 3-7. NTIPS APPROACHS TO PROBLEMS IN DISTRIBUTION (Continued)

Problem	NTIPS Approach
TM resupply is part of the overall Navy supply system and is slow to respond to users needs.	Place TM resupply under NTIPS and develop automated materiel management into NTIPS MIS.
Physical storage of copies of all TMs for resupply purposes uses valuable space and is cumbersome to operate.	Develop capability for on-demand replication of TM in medium requested (from digital TM data base of Working Archive). No physical storage needed.
Present Archive consists of many types of TM masters (i.e., negs, repro, digital tape, etc.) in many different locations (i.e., contractors, CFA, NPFC, etc.)	Develop centralized archive consisting of master copies of all TMs as history and a digital data base of all active TMs to support Navy update requirements.

3.10 TECHNICAL APPROACH TO MANAGEMENT SUBSYSTEM

The main problem with TM management lies in each major acquisition activity controlling its TM operations independently with no thought being given to Navy-wide TM efforts. A two-tier management scheme is proposed to remedy this within the existing procurement framework.

The NTIPS Management Subsystem establishes a first-level, centralized NTIPS management function to coordinate R&D efforts, perform system design, and establish operating policies and quality assurance standards. A second-level NTIPS operations management function is established to control the TM procurement and production activities. This two-tiered management approach establishes both levels of management as parts of NTIPS, but dedicates the second-level NTIPS operations management function to the TM requirements of each of the major acquisition activities.

TM Funding – TM acquisition funds are a part of new equipment budgets but are rarely identified separately. By being hidden in the overall equipment funding, the acquisition project manager (PM) does not have to commit any specific amount of funds to TMs and may divert funds needed for TMs to hardware improvements or design changes.

The NTIPS method of funding will be to have the hardware acquisition PM coordinate with the second-level NTIPS Operations Management subfunction to establish the TMs needed along with the projected TM cost. This will be done as early as possible in the acquisition process and will be used by the PM to establish the overall TM budget. At program inception, the PM will receive the equipment funds, while the second-level NTIPS Operations management subfunction will receive the funds identified for TMs and will be responsible for disbursing the funds to support the TM procurement.

Systems Management Function – The first-level system/product improvement engineering subfunction performs an evaluation of the quality of the TM product. This subfunction also establishes Navy-wide TM quality assurance (QA) policies that are implemented by the second-level operations management function.

The cost analysis/forecasting subfunction performs a periodic in-depth analysis of system TM costs and operations to be used as a tool to evaluate NTIP System performance on a Navy-wide basis. This subfunction also is responsible for determining the impact of TMs on equipment life-cycle costs.

The research and development (R&D) subfunction coordinates all NTIPS-related R&D efforts and maintains contact with DoD and industry R&D efforts to preclude redundancy of efforts and utilize expertise of other services.

Management Information System – The NTIPS Management Information System (MIS) is established to support the operations of the NTIP System with cost reports that can aid daily operations and system evaluation by different NTIPS management levels. The MIS is used to maintain a data base that lists the TM requirements for each user.

Operations Management Function – The second-level management feedback/update subfunction provides the user with a reactive feedback point that is responsive to user comments. The subfunction also is responsible for reviewing out-of-production TMs, establishing update needs, and acting as the PM for the update effort.

TABLE 3-8. APPROACH TO NTIPS MANAGEMENT

Key Problems	Solutions
No Navy-wide coordination of TM efforts	Establish two-tiered NTIPS management subsystem that has a centralized first-level management function to control and coordinate second-level operations management functions.
No dedicated funds for TM efforts	All TM funds are identified in overall equipment budget and dedicated for NTIPS control at program inception.
No comprehensive product evaluation	Assigned to the first management level (system/product improvement engineering subfunction)
No consistent Navy-wide quality assurance	Assigned to the first mangement level (system/product improvement engineering subfunction)
No in-depth analysis of Navy TM costs or operations	Assigned to the first management level (cost analysis/forecasting subfunction)
No studies of impact of TMs on weapon life cycle costs	Assigned to first management level (cost analysis/forecasting subfunction)
No cohesive Navy-wide controlled R&D efforts	First management level R&D subfunction coordinates all NTIPS-related Navy R&D efforts
No comprehensive data base of Navy TM costs or operations	Establish the NTIPS Management Information System (MIS).
No Navy-wide TM configuration index	Implement Navy-wide configuration system and store data in the MIS.
No viable, reactive user feedback contact point	Assigned to the second management level (feedback/update subfunction)
No consistent plan for management of out-of-production TMs.	Assigned to the second management level (feedback/update subfunction)

3.10 METHOD FOR UPDATING TECHNICAL MANUALS

The same organizational structure is used to update TMs as that employed in the acquisition of the TMs. Hardware-related updates are initiated and funded by the equipment acquisition manager, while nonhardware-related or out-of-production updates are the responsibility of the NTIPS Management Subsystem (feedback/update subfunction).

Within the Navy, there are currently two approaches to technical manual updates: revisions and changes. A revision constitutes a complete new edition of an existing manual. This generally will occur as a result of one or more of the following:

- A major change in equipment configuration
- Existence of a high percentage of miscellaneous outstanding source data
- Issuance of another change package would tend to confuse rather than complement the document
- The intended accumulated changes will impact 50 to 60 percent of the total number of TM pages.

A change is issued when only relatively small parts of an existing manual are affected. The changed pages replace the correspondingly numbered pages, and all replaced pages must be removed and discarded. If a change contains material that cannot be fully included on a replacement page, additional pages are issued and inserted between or after the affected pages. Changes are prepared to include new models of equipment and to add new procedures, or to change existing equipment descriptions or procedures. Manuals of eight pages or less are normally replaced by a revision. Also, microform-compatible manuals of 30 pages or less are replaced by a revision rather than a change.

Updates can also be grouped into two other categories, depending upon how they are originated. Hardware-related updates are a consequence of modifications to the system/equipment configuration. These are generally originated in conjunction with scheduled hardware alterations (SHIPALTs and ORDALTs) or engineering change proposals (ECPs). Nonhardware-related updates are generally user-initiated in an attempt to correct technical inaccuracies, provide for the inclusion of additional information, or to clarify ineffective graphic presentations. These are initiated via fleet feedback reports (FBRs).

In the NTIPS preliminary system concept, the Management Subsystem is responsible for the control and funding of all TM updates. The funds required for hardware-related updates are appropriated by the equipment acquisition manager at the same time that the allocation of funds for the equipment modification is made. These update funds are then transferred to the Mangement Subsystem. Nonhardware-related updates are funded directly by the Management Subsystem (feedback/update subfunction). The Management Subsystem provides guidelines, to the Acquisition Subsystem, which establish the configuration control and quality assurance policies/procedures required to insure continuity and consistency between the original and updated TMs.

Another consideration regarding TM update involves the development of a digital data base containing all technical manuals used in the Navy. This is a part of the NTIPS preliminary system concept and would include the equipment contractor's TM data base (when initial/original issue TMs are delivered). These TMs would be stored in a structured digital data base containing all current TMs for in-production equipment, thus assuring archival availability. When equipment transitions from in-production to out-of-production status, it is assured that there would be a current data base to permit the Navy to update TMs for out-of-production equipment. The same data base could just as readily be used for Navy updating of TMs

for in-production manuals in the event of contractor default, emergency requirements, or other operational factors. This concept would provide for the internal Navy processing of TM updates in a rapid and efficient manner. The decision to implement this option (for in-production equipment updates by the Navy) would, however, remain a matter for policy decision and does not constitute a requirement for the preliminary system concept.

Processing the TM Update – Once the requirement for a TM update has been established, the procedures for acquisition, development, production, and distribution are the same for both hardware-related and nonhardware-related updates. The distinction between the two thus resides in the initiation of the update requirement.

Hardware-related update requirements can arise as a result of ECP, operational alteration (OPALT), or scheduled hardware changes. As illustrated in Figure 3-3, these requirements will generally originate with project/acquisition management, or a cognizant field/technical activity. Once the TM update cycle has been initiated, the Management Subsystem monitors the TM update status via the Management Information System (MIS).

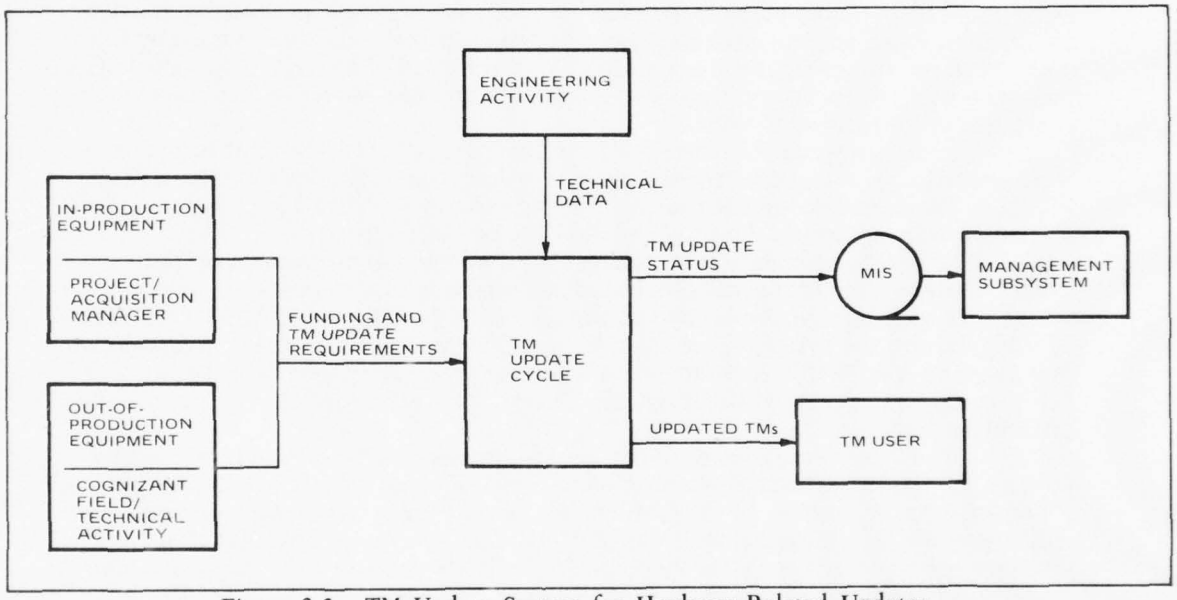


Figure 3-3. TM Update System for Hardware-Related Updates

3.11 METHOD FOR UPDATING TECHNICAL MANUALS (Continued)

As Figure 3-4 illustrates, nonhardware-related updates are generally initiated by the user. There are three approaches to feedback in the preliminary subsystem concept: these involve (1) the use of NTIPS field representatives, (2) an NTIPS on-going fleet survey, or (3) a feedback report (FBR) from the user.

The first of these approaches would involve the stationing of NTIPS representatives (who would be TM experts) at major Navy installations. These representatives would assist the TM user with data problems and assist in the preparation of the feedback reports. In this latter role, the field representative could serve to expedite the processing of the FBR by insuring the clear and accurate completion of the forms. Additionally the NTIPS representative would provide on-the-spot training in TM use, such as the application of maintenance dependence charts, logic state tables, etc.

The conduct of an on-going fleet survey would be established and maintained by the feedback/update subfunction within the NTIPS Management Subsystem. This would entail actively soliciting feedback from the user. Compiling this information for later analysis would aid in formulating solutions to TM problems.

Both of these approaches would provide data to the feedback/update subfunctions. Additionally, however, some advantages should be realized in providing for a method of collecting data that often is precluded by the use of paper work. Data would be obtained via face-to-face contact with the user, permitting clarification and (where appropriate) elaboration of the problem(s) being reported by the user. Such data would include more explicit information of the user's appraisal of such things as TM form, organization, and illustration techniques, and problems encountered while using the TM.

The third approach is the use of the feedback report. The FBR is a telecon, Navy message, or a standard form (for routine problems). The FBR standard form will be a TM-unique document that will be designed to expedite TM problem information flow from the user to the feedback/update subfunction.

The feedback/update subfunction logs the FBR and performs a preliminary review to determine if the problem presented warrants investigation. If it is determined that no investigation is needed, the user (who submitted the FBR) is notified of this fact and the rationale for the decision. If it is determined that investigation is warranted, the FBR is forwarded to the cognizant activity (equipment contractor for in-production equipment or cognizant Navy field/technical activity for out-of-production equipment).

To be responsive to user needs, all requirements are reviewed and categorized by the feedback/update subfunction into one of three priority classifications: (1) emergency, (2) urgent, or (3) routine. An emergency priority requires immediate correction to alleviate conditions that could cause injury to personnel, extensive damage to equipment or property, or an inability to maintain equipment in an operational condition. An urgent priority requires prompt correction to alleviate a condition that could result in damage to equipment or property, a reduction in equipment operational efficiency, or jeopardize the successful completion of a mission. A routine priority involves normal TM improvement (clarification, editorial, simplification), potential personnel/equipment hazards with prolonged use, or a reduced operational equipment life.

A requirement having an emergency priority will be responded to within three calendar days. Corrective action will be sent via Naval message to the reporting organization as well as all other organizations affected by the emergency.

Ten working days will be allowed for corrective action requirements having an "urgent" priority. Speed letters will be used to respond to the reporting organization and to communicate required corrective action to all affected organizations. For routine priorities, the reporting organization will receive an acknowledgement (feedback response) within 10 working days, and corrective action will be initiated within 60 working days of requirement receipt.

The cognizant activity performs a technical evaluation of the FBR and provides a solution to the problem as soon as possible, but always within the time constraints of the assigned priority. In the event no TM changes are necessary, the FBR response must contain the rationale for the decision. When a TM update is required, the TM update cycle is initiated by the cognizant activity.

The Management Subsystem will monitor, via the MIS, the status of both the FBR and the TM update cycle. Information contained in the MIS will be applied to improving the efficiency and cost effectiveness of the feedback/update process.

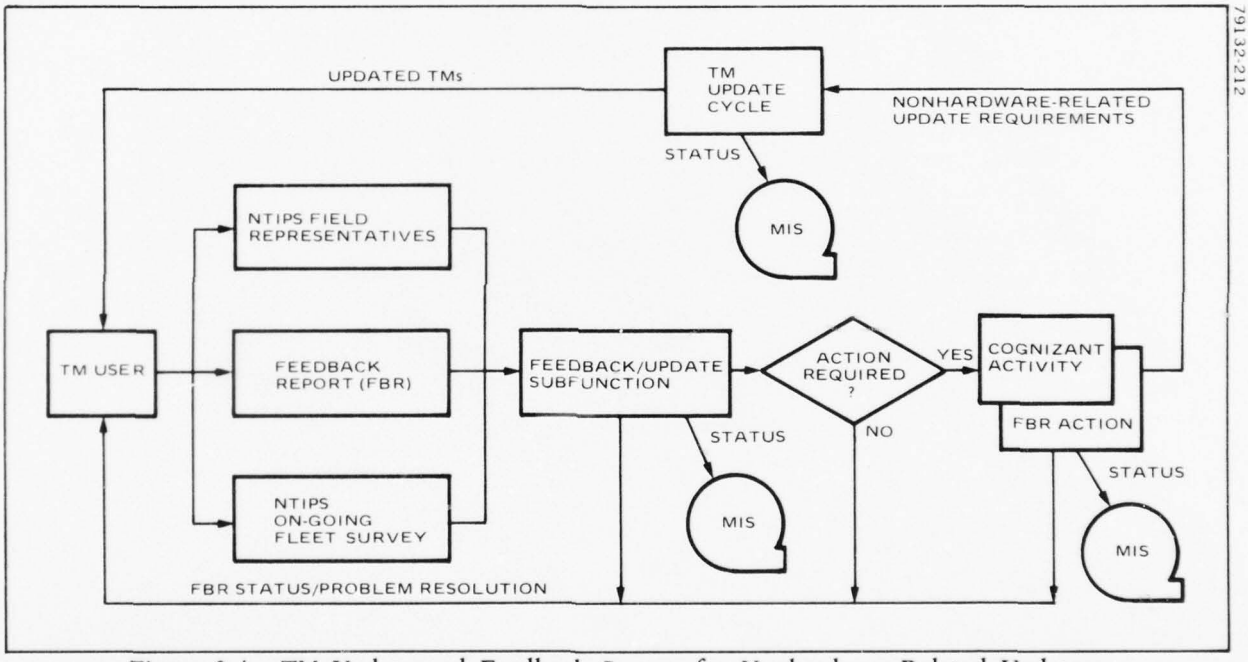


Figure 3-4. TM Update and Feedback System for Nonhardware-Related Updates

SECTION 4
SUBSYSTEM PRELIMINARY CONCEPTS AND ALTERNATIVES

SECTION 4
SUBSYSTEM PRELIMINARY CONCEPTS AND ALTERNATIVES

Subsection 4.1 – TM Acquisition Subsystem
4.1.1 Description of TM Acquisition Subsystem 4-0
4.1.2 Description of User-Data Match Function 4-2
4.1.3 Description of TM Specification Function 4-6
4.1.3.1 Description of Technical Content Specifications 4-10
4.1.3.2 Description of Presentation Technique Specifications 4-14
4.1.3.3 Preliminary Concept of Readability for NTIPS 4-16
4.1.3.4 Considerations for Setting the RGL Requirements 4-20
4.1.3.5 Description of Access Specifications 4-22
4.1.3.6 Description of Publishing Processes Specifications 4-24
4.1.3.7 Description of Quality Control Specifications 4-26
4.1.4 Description of the TM Procurement Function 4-28

Subsection 4.2 – Content Generation Subsystem
4.2.1 Description of Content Generation Subsystem 4-30
4.2.2 Description of Engineering/Manufacturing Data Base..... 4-34
4.2.3 Description of Estimating Function 4-38
4.2.4 Description of Product Planning Subfunction 4-42
4.2.5 Description of the Operational Planning Subfunction 4-46
4.2.6 Description of Writing Function 4-50
4.2.7 Purpose and Description of the TM Development Guide 4-54
4.2.8 NTIPS TM Writers Guide 4-56

Subsection 4.3 – Publishing Subsystem
4.3.1 Description of Publishing Subsystem 4-60
4.3.2 Description of Digital Production Function 4-64
4.3.3 Digital Production Function Alternatives 4-68
4.3.4 Description of Mastering, Replication, and TM Supply Functions 4-72
4.3.5 Mastering, Replication, and TM Supply Function Alternatives 4-76

Subsection 4.4 – Distribution Subsystem
4.4.1 Description of Distribution Subsystem Preliminary Concept 4-78
4.4.2 Description of Initial Distribution Control Function..... 4-80
4.4.3 Description of Initial Distribution Control Function Alternatives 4-82
4.4.4 Description of the Resupply Function 4-84
4.4.5 Description of Resupply Function Alternatives 4-88
4.4.6 Description of the Archive Function..... 4-90
4.4.7 Digital Archive Technology Considerations 4-92
4.4.8 Description of Archive Function Alternatives 4-94

Subsection 4.5 – Management Subsystem

4.5.1 Overview of Management Subsystem Preliminary Concept . . 4-96
4.5.2 Description of the NTIP System Management Function 4-98
4.5.3 Description of NTIPS Operations Management Function 4-100
4.5.4 Support of Operations through the NTIPS Management Information System (MIS) 4-102
4.5.5 Description of the Centralized NTIPS Management Subsystem Alternative 4-104
4.5.6 Description of Decentralized NTIPS Management Subsystem Alternative 4-106

4.1.1 DESCRIPTION OF TM ACQUISITION SUBSYSTEM

The preliminary concept for TM acquisition is that of decentralized subsystems within NTIPS that are dedicated to each major acquisition activity. These subsystems would specify precise data requirements for their particular users and implement procurement procedures to ensure timeliness and quality in TMs.

The TM Acquisition Subsystem analyzes the initial data requirements for a TM procurement, performs a user-data match, generates specifications to define the TM requirements, develops contract documents, and initiates the acquisition processes to purchase TMs from the content generators (see Figure 4-1).

New concepts for the TM Acquisition Subsystem would include: (1) formal matching of the data to the particular user, (2) automated, modular TM specifications, (3) TM procurement activities that are run by specialized "Navy TM Engineers," and (4) new TM funding structures. These new aspects to TM acquisition are considered critical to the mission effectiveness of the subsystem. TM acquisition is the place where many TM problems can be solved, long before TM production is initiated. Improper decisions on TM requirements and specifications in this subsystem will result in substandard TM products downstream, where corrections are costly or impossible.

User-Data Match Function – The user-data match function matches the tasks a specified user must perform on particular equipments in known environments to the information/presentation types he can best utilize to perform the tasks. A matrix model is employed in the matching process which interrelates information concerning user personnel characteristics, system conditions, environments, media types, and components of data presentation systems. The user-data match function is described more fully in the following topic.

The output of the matching process is a designation of presentation components and systems, e.g., tables, charts, text treatments, diagram types, etc., specifically matching a particular user rating to his types of tasks. If new presentation techniques have been identified for which no specification modules are available, then the specification function would generate new specifications for the procurement.

TM Specification Function – The TM specification function generates specifications that define to content generators the expected content, quality control provisions and standards that must be achieved in the development of TMs. The preliminary concept proposes a TM specification function within the NTIPS organizational structure that is dedicated to each major acquisition activity. Each of these functions would utilize an automated, modular, TM specification structure.

Using a modular specification concept, a complete TM specification would be built from a variety of many specification modules. Modules would be combined as necessary to describe the complete requirements for a particular TM procurement. Specification modules would describe different types of data and the requirements to which each type must conform, as well as publishing processes for various media, quality control guidelines, etc.

Specification modules would be prepared, maintained, and implemented for use by a computer-aided specification preparation system. The Navy TM engineer, who is a part of the TM procurement function, would access this automated specification system when all user information requirements have been identified. He would select from various module categories those modules that describe TM requirements for the identified user needs. He may select, for example, 50 or more specification modules from a much larger number of stored modules, to form the TM specification for a given procurement. The automated specification preparation

system would retrieve these modules and format and output them as a single specification document. It would also be possible to add or delete modules from those in storage and to perform continuous and rapid updates by means of this system.

TM Procurement Function – The TM procurement function is responsible for negotiating the purchase of the TM. In performing this function it develops TM contract documents, participates in negotiations with content generators, and provides quality control of the TM development process, all the way to the final buy-off. Each of the TM procurement functions within NTIPS, though dedicated to the purchase of TMs for a major acquisition activity, would be a part of the NTIPS organizational structure and operate within its management and operational guidelines. Other features of the preliminary concept include a Navy TM engineer who would oversee the operations of each function, and a funding structure that would prohibit other activities from dipping into funds that have been allocated for TMs.

Organizational Alternatives – A decentralized alternative would place the subsystem within the organizational structure of each major acquisition activity, but subject to guidelines, policies, and procedures from NTIPS. Another alternative is to centralize the subsystem within the NTIPS organizational structure. This single central activity would provide functional capabilities for all Navy major acquisition activities.

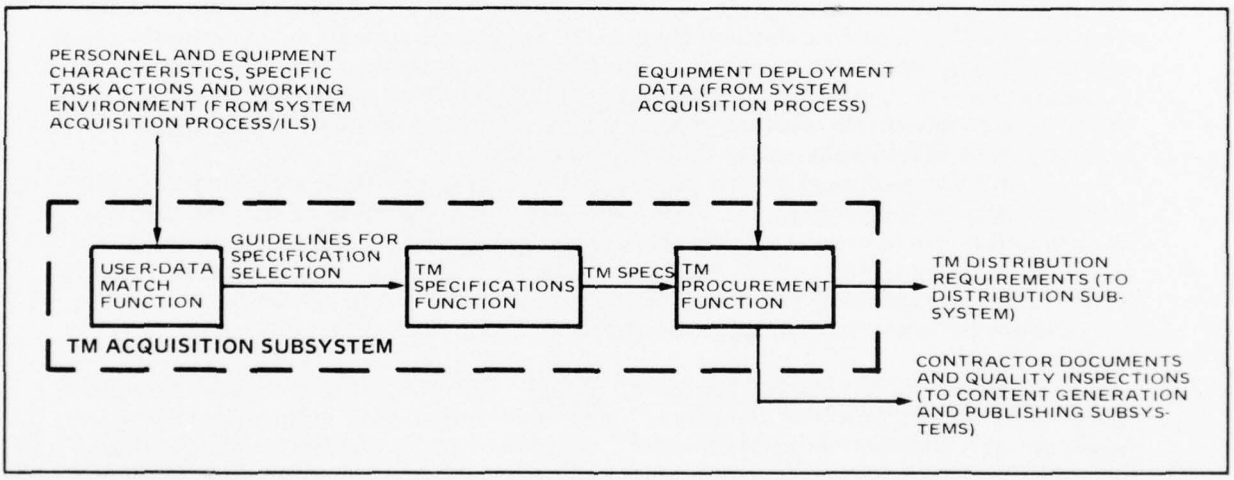


Figure 4-1. TM Acquisition Subsystem. The TM Acquisition Subsystem analyzes the broad spectrum of users, equipment, tasks, environments, and presentation techniques to generate TM specifications and to develop TM acquisition processes and procedures for supplying Navy users with quality technical manuals.

4.1.2 DESCRIPTION OF USER-DATA MATCH FUNCTION

The basic inadequacy of TM presentation methods has been due to their not being what the user needs to do his job. An NTIPS contribution to the solution is a user-data match model that would aid Navy personnel in matching the presentation techniques to the user before the data is procured.

Technical information provided to maintenance technicians who support fleet activities is cited in various surveys and research studies[1] as failing to present information uniquely suited to the needs of a particular user group. This failure substantially inhibits the timely and economical maintenance of operationally important equipment.

In order to alleviate this problem, the presentation techniques in TMs must be more closely matched to the unique characteristics of the user, the job tasks which the user will perform (using the TM), and the environment in which the user will perform these tasks. The purpose of the user-data match function is, therefore, to accomplish this match and provide user-data match recommendations to the TM specification function. These recommendations must clearly identify the TM presentation techniques and the media features which apply to the system/environment as a whole, and would therefore be useful as guidelines to the TM engineer in the development of TM bookplans.

The whole job of making a better user-data match includes the collection of information regarding the user and his needs, in the form of personnel characteristics, equipment characteristics, working environment, and the maintenance tasks. This information would be derived from data analyses of specific procurements which are provided by activities external to the NTIP System that perform the system acquisition process, and by integrated logistic support (ILS) activities. Such analyses continue throughout the content generation phase until a detailed TM design is achieved that effectively meets the reader's needs.

An important part of this process is the initial user-data matching that can be done early in the program by NTIPS to assist in the selection of the TM specifications. This would consist of determining the categories of maintenance tasks which correspond to the kind of equipment components involved in the procurement. From this, key aspects of the presentation methods and media can be determined long before detailed task analyses are available from external maintenance organizations.

Concept of the User-Data Match Model – The preliminary concept proposes a model for use in matching the presentation methods to Navy ratings. As shown in Figure 4-2, the user-data match model consists of three matrices. The matrix on equipment type and maintenance level vs. task action is unique to a particular Navy rating (or grouping of highly similar ratings). The matrix identifies the types of equipments that a rating may be expected to operate or maintain, and the task actions which are delegated to this rating. The second matrix identifies the presentation techniques or components which the rating can best utilize in performing the task actions identified on the previous matrix. These may be identified as types of schematic diagrams, text treatments, procedure formats, etc. This matrix, like the first, is unique to a particular rating or group of ratings. It then remains to use the third matrix to extract the physical characteristics of the medium for the environment of intended use.

---

[1] Hughes Aircraft Company; Special Report – NTIPP Fleet Survey of Technical Manual Users; 5 March 1977, David W. Taylor Naval Ship Research and Development Center.

STEP 1

- IDENTIFY SYSTEM/EQUIPMENT TYPE AND ITS USE
- IDENTIFY THE RATING(S) OF THE ASSOCIATED MAINTENANCE PERSONNEL
- IDENTIFY THE ENVIRONMENT FOR TASK PERFORMANCE

STEP 2

- PERFORM PRELIMINARY EQUIPMENT BREAKDOWN TO IDENTIFY MAIN COMPONENTS OF THE HARDWARE.

EQUIPMENT TYPE AND MAINTENANCE LEVEL	TASK ACTION		
	FILL	INSPECT	ISOLATE FAULTS
AFTER STEERING SYSTEM		•	•
AIR CONDITIONING CHILL WATER SYSTEM (SUBMARINE)	•	•	•
AIRCRAFT ELEVATORS		•	•
ATMOSPHERIC EXHAUST SYSTEM		•	•
AUXILIARY AIR EJECTOR SYSTEM		•	•
AUXILIARY EXHAUST STEAM SYSTEM		•	•
AUXILIARY GLAND EXHAUST SYSTEM		•	•
AUXILIARY MACHINERY COOLING WATER SYSTEM	•	•	•

TASK A

ADJUST
CALIBRA
INSPECT
INSTALL
ISOLATE
REMOVE
REPAIR
TEST
TUNE

STEP 3

DETERMINE EQUIPMENT TYPE AND MAINTENANCE LEVEL, IDENTIFY TASK ACTIONS TO BE PERFORMED

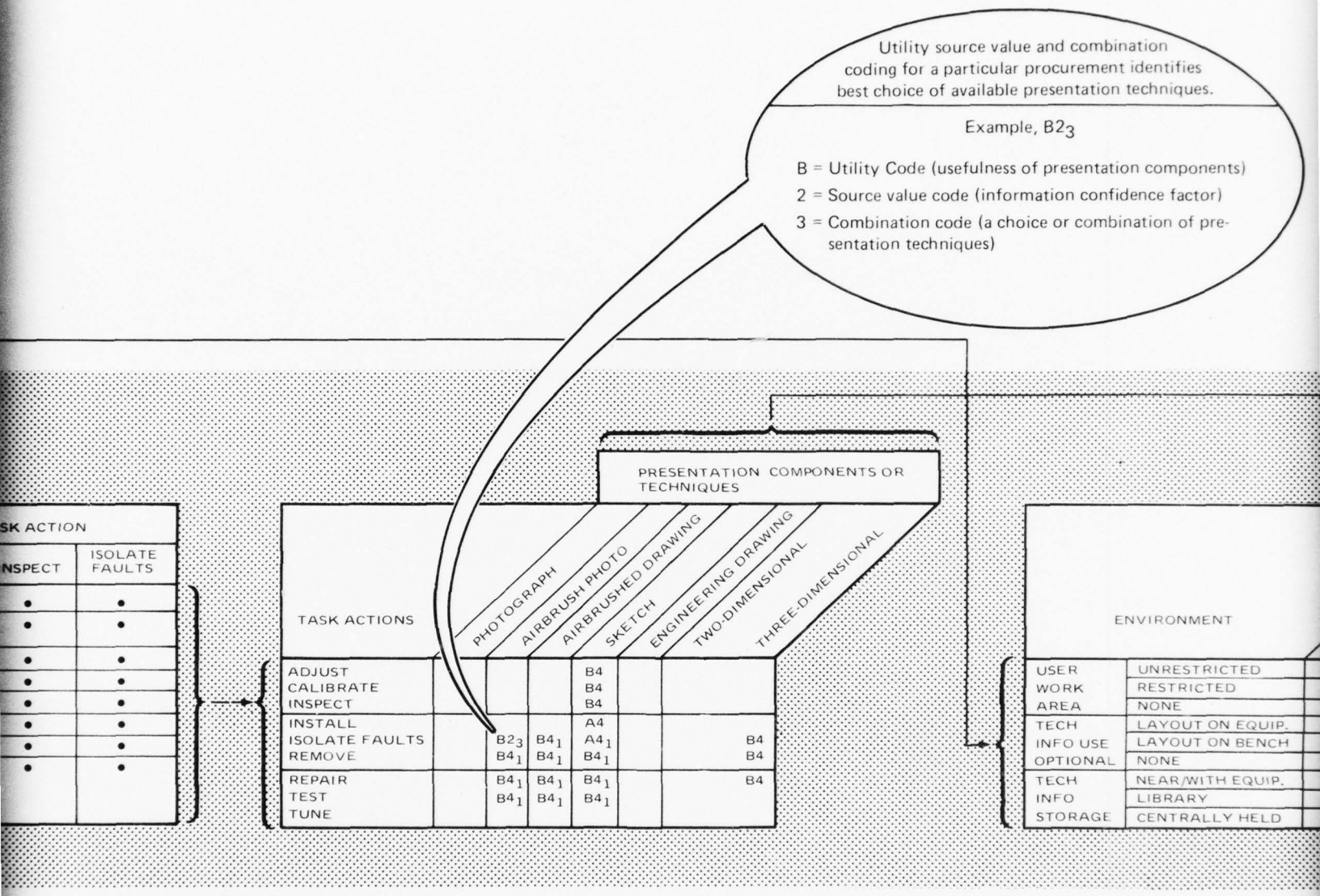


Figure 4-2. Procedure for
developed for all Navy ratin
Navy TM engineer of the b
intended user. Note: Matr
in its completed form.

79132127

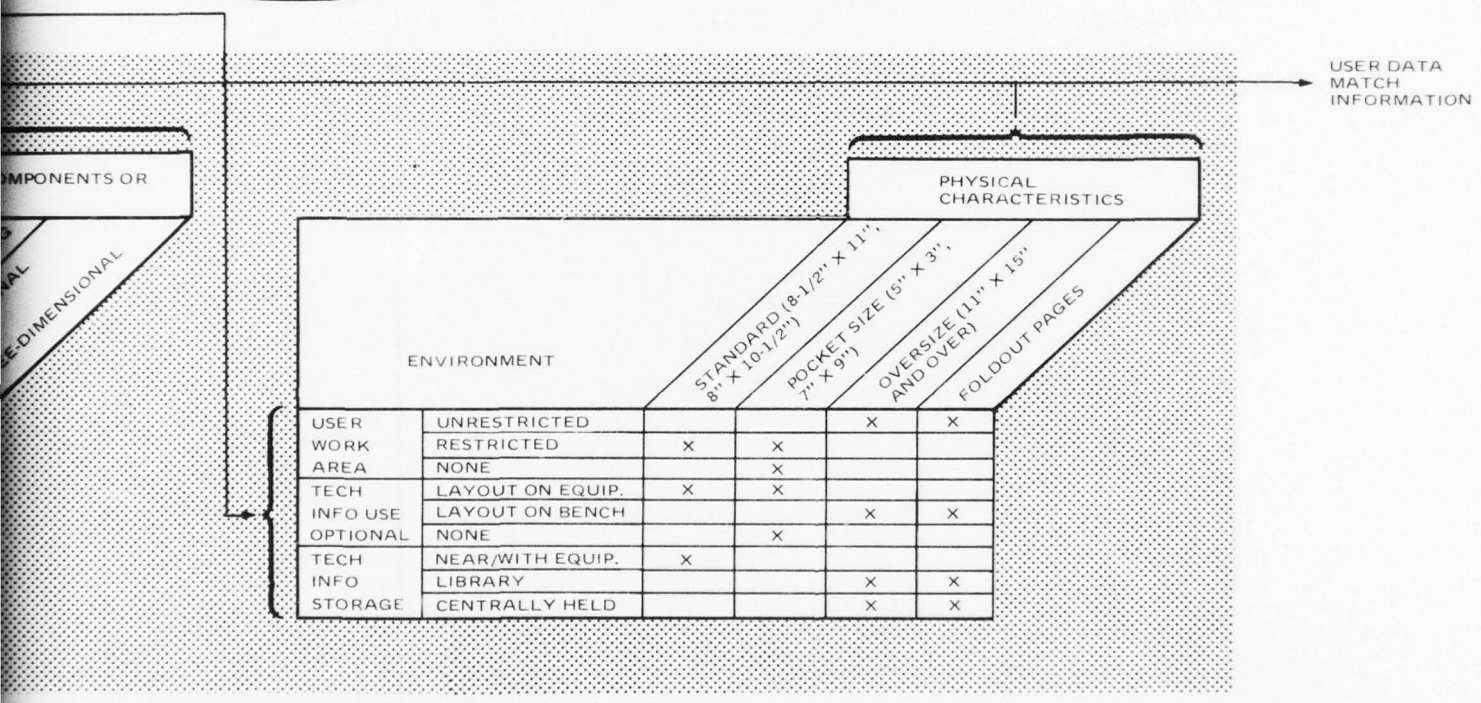
Utility source value and combination coding for a particular procurement identifies best choice of available presentation techniques.

Example, $B2_3$

B = Utility Code (usefulness of presentation components)

2 = Source value code (information confidence factor)

3 = Combination code (a choice or combination of presentation techniques)



STEP 6

DETERMINE PHYSICAL CHARACTERISTICS OF MEDIUM FOR IDENTIFIED ENVIRONMENTAL FACTORS

Figure 4-2. Procedure for Using the Matrices in the User-Data Match Model. When completely developed for all Navy ratings, this model would contain sufficient data to enable selection by the Navy TM engineer of the best presentation components and techniques for matching a TM to the intended user. Note: Matrices are for illustration purposes only, and do not represent the model in its completed form.

The output of the user-data matching process would consist of a prioritized list of recommendations concerning the media and presentation techniques to be employed in presenting technical information (for every task action) to the user. This information would then be forwarded to the Navy TM engineer within the TM procurement function. The Navy TM engineer would then select the presentation techniques and media features to be specified for the TM procurement. This selection would also be based upon the affordability of the requirements/recommendations for that procurement. Based upon the presentation technique and media selected, the TM specification function would compile the specification modules. These specification modules would then be sent to the TM procurement function as part of the TM specification package. Ultimately, this package would be used by the contractor TM engineer as the initial basis for the TM design.

Primary data sources for support of the model are the Navy Bureau of Personnel and the Navy Occupational Task Analysis Program. These sources provide the data base from which personnel characteristics and general equipment/task analysis information for the user-data match model are derived. Primary responsibilities of the NTIPS user-data match function include keeping the model current with data presentation technologies and exercising the model on demand to provide the TM specification function with the presentation recommendations.

A detailed discussion of the concept of the user-data match model will be found in the Task 3 Report Addendum.

Organization Alternatives – The preliminary concept is for each major acquisition activity to have its own user-data match function. Having selected the decentralized approach, a further organizational option is available. The function established for each major acquisition activity could be organizationally either part of that activity or part of the NTIP System but dedicated to the major acquisition activity's particular requirements. An additional alternative consists of acentralized function that has user-data match responsibility for all TM Procurements for all Navy major acquisition activities.

4.1.3 DESCRIPTION OF TM SPECIFICATION FUNCTION

Present specifications, written loosely to cover a large variety of equipments, do not provide sufficient guidance for content generators to produce a TM that satisfies the needs of a particular user. The preliminary concept corrects this by defining a modular specification system that enables a unique specification to be tailored to the specific TM procurement.

Due to the overgeneralization of specifications, contractors are often left to interpret detailed format and content requirements. Such interpretations differ from one contractor to another, and may also differ from what was intended by the procuring activity. For example, a single specification may be cited for the procurement of operation and maintenance manuals for a complex electronic system, an electromechanical assembly, and mechanical equipment. The contractor, in attempting to interpret how the specification can be applied to a TM, can decide on an approach that is other than that intended by the procuring activity, but is in compliance with specification requirements.

TM Specification Function – The TM specification function is responsible for developing specifications that dictate a complete spectrum of TM requirements. These requirements are encompassed in categories such as technical content, presentation techniques, quality control, access, readability, and publishing. What is specifically required in each of these categories is determined primarily by variables such as system and equipment types in use by the Navy, operational and maintenance philosophies, user personnel skill levels, and state-of-the-art in data presentation and media technologies. The user-data match model will identify a set of presentation methods to effect a good user-data match. This will provide guidance to the TM specification function for developing TM specification requirements that must be available for each of the categories listed above.

As new presentation methods are developed in the future, the TM specification function will propose and develop new specification requirements to incorporate them. This information will be obtained via the NTIPS Management Subsystem which maintains a constant data exchange liaison with other service branches. The NTIPS Management Subsystem research and development function will also provide guidance for specification development, especially in the area of quality control guidelines and new data presentation technologies.

Specifications can be generated by manual or automated methods. Current generation and update of Navy TM specifications is by manual methods. Many government agencies and commercial companies presently utilize automated techniques in the generation of various types of specifications. Both methods will be explored for application to NTIPS TM specifications.

The preliminary concept for the TM specification organization is for each major acquisition activity to have its own function. Having selected a decentralized approach a further organizational option is available. The function established for each major acquisition activity could be organizationally either part of that activity or part of the NTIP System but dedicated to the major acquisition activity.

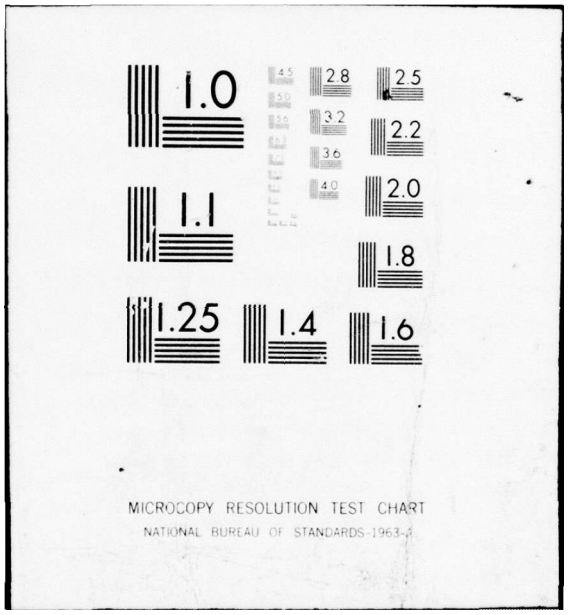
Modular Specification Approach – The preliminary concept for development of NTIPS TM specifications involves a modular structure for presentation of specifications requirements. Modular specifications are developed from modular parts of a master specification structure (see Figure 4-3). All the modules are organized into six different categories, which encompass the complete spectrum of requirements for TMs for a variety of equipments, users, and Navy maintenance philosophies. For example, modules in the technical content category will include site preparation instructions, system functional descriptions, functional/performance

AD-A051 311 HUGHES AIRCRAFT CO FULLERTON CALIF GROUND SYSTEMS GROUP F/G 5/9
PRELIMINARY NTIP SYSTEM CONCEPT AND ALTERNATIVE CONFIGURATIONS.(U)
JAN 78 J E CONNELL, J J GOLDBERG N00600-76-C-1352

UNCLASSIFIED FR-77-12-150 NL

2 OF 3
AD
A051311




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

tests, etc. Those contained in the presentation techniques category will include text, illustrations, tables and matrices, diagrams with supporting text, etc. Mo are developed to be compatible for use with each other in specifying total TM r quirements. The total specification requirements for a TM may be composed o one or more modules selected from each category. Generating a TM specificat by this technique permits custom tailoring of specifications to an individual dat procurement. In addition, those specification modules will contain detailed ste by-step instructions and examples, eliminating the need for a separate writers guide.

In developing a modular specification, the basic TM requirements of th user will be extracted from the user-data match model. These will include a ta versus-equipment analysis, presentation techniques the user will need to perfor his task, and media considerations for the user environment. Additional TM cri include: training requirements, available funding, and Navy maintenance requi ments for the system/equipment for which the TMs are being procured.

The TM procurement function will analyze these TM requirements and select modules from each category to define the complete TM specification. Some of the categories will be organized and capable of direct access once the specific TM requirements have been identified. For example, presentation

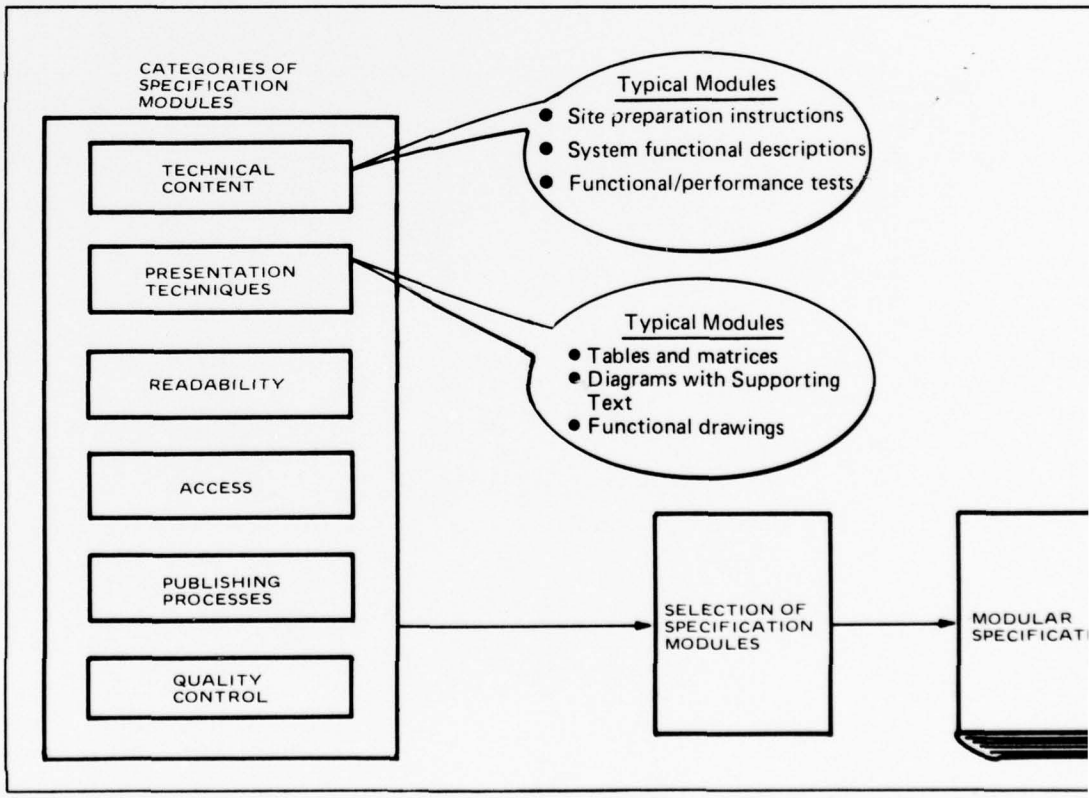


Figure 4-3. TM Specification Evolution Process. Modular TM specifications will be genera master file that contains sets of TM requirements in distinctive categories.

techniques modules will have direct correlation with those identified by the user-data match model. Readability modules may be accessed from a knowledge of user personnel characteristics, including reading grade level. Access and publishing process modules will be selected based on the type of manual and medium by which it is produced. Other module selections will be made drawing upon the expertise of the TM procurement personnel or by guidelines issued to these personnel from the NTIPS Management Subsystem, especially in the area of quality control. Individual modules may vary in size from one paragraph to many pages. For example, a module describing the step-by-step development of a type of illustration could be quite lengthy, whereas a module describing classification markings could be contained on one page or less.

Based on the large numbers of procurements and quantities of modules, many manipulations of the various modules will be required to develop a unique specification package for a given procurement. Consequently, the capability to input the unique procurement requirements into a programmed processor which would then select and output the appropriate specifications is considered as part of the preliminary concept. In addition, automation would enhance updating the specification system, providing the capability to keep the modules current with state-of-the-art innovations in data presentation techniques.

Monolithic Specification Alternative – Monolithic specifications are general application type specifications that list TM requirements for a class of Navy equipments, or particular type of TM, or a particular Navy operation or maintenance activity. As general specifications, their broad coverage enables them to be used without respect to discipline (i.e., mechanical, electrical, etc.). An undesirable feature of this type of specification is that it must be "force fit" to some TM procurements. This is presently done with tailoring documents that must be prepared as a part of the contract document for each TM procurement action. In some cases several of these general purpose specifications are necessary to describe the complete TM, with liberal referencing from one specification to another to cover all TM requirements. This also causes a tailoring operation to invoke, exclude, or supersede parts of some of the specifications for a particular TM procurement.

To remedy this problem, NTIPS monolithic specifications would be built around specific system/equipment categories and special groups of users (e.g., operator and maintenance personnel). For example, the monolithic specification for communications systems would include requirements for all Navy users who would operate or repair communications-related equipment (e.g., radio transmitters, receivers, multiplexing, etc.) at organizational, intermediate or depot facilities. Thus, NTIPS monolithic specifications would contain no external referencing for primary technical content, i.e., each monolithic specification would contain requirements for complete operation and maintenance data.

Organizational Alternatives – Organizational alternatives are important because they impact cost and performance effectiveness of the function as well as the effectiveness of the specification itself in doing the job for which it is intended. The TM specification function can be decentralized as in the preliminary concept, i.e., each major acquisition activity can have its own function and individualized TM specifications, or the function can be centralized. Centralization of the function offers potential cost savings in combining redundant operations. It also allows better central control for standardization of the specification product. On the other hand, a decentralized TM specification function favors each major acquisition activity's dedication to its particular requirements.

4.1.3.1 DESCRIPTION OF TECHNICAL CONTENT SPECIFICATIONS

In modular specifications, the TM content requirements are related to one user's need and presented in terms of specific system/equipment characteristics and Navy maintenance levels. The result is a custom-tailored TM specification that precisely defines technical content requirements, such as equipment operation and functional description.

Technical content requirements encompass the type and depth of user information necessary to perform operational and maintenance functions on Navy system/equipments. Information types may consist of procedures such as corrective and preventive maintenance, operation, installation, and overhaul, and functional descriptions of the system, equipment, basic circuits and assemblies, etc. The depth of the information is dependent upon the complexity of the system/equipment and the Navy maintenance philosophy that determines to what degree the system/equipment is to be repaired at various Navy maintenance levels, i.e., organizational, intermediate, and depot. For example, circuit card removal and replacement may be the maintenance philosophy at the organizational repair level for a particular piece of equipment. In this case, organizational personnel will need a type of troubleshooting information that enables isolation and replacement of the defective circuit card, but will require no depth of coverage beyond this for the circuit card. The type of troubleshooting information that is required to locate the defective card could be simple or sophisticated depending on the type of equipment. For example, troubleshooting information for a magnetic tape transport with a complement of ten circuit cards would be much simpler than troubleshooting information for a large signal processor with a hundred or more circuit cards.

Present Navy TM specifications attempt to cover technical content requirements for all equipment types in a single primary content specification. Most of the technical content requirements of the specification are not sufficiently explicit for application to all equipment types. In many cases, it is up to the contractor to decide which type of technical content is applicable to which type of equipment, or to invent his own in many cases. Because of the broad coverage of the primary content specifications, unique technical content requirements are not provided for unique equipment types. For example, specifications that describe specific technical content requirements for digital electronic equipments are almost nonexistent.

The process by which TM specifications are reviewed, updated, and changed by the Navy is quite lengthy. Before TMs employing new specification requirements reach the user, several years may have elapsed. For this reason, the majority of existing TM specifications describing technical content requirements are based on out-of-date physical or psychological knowledge with regard to user information needs. During Task 1 of this effort, 26 Navy TM specifications were evaluated for requirements governing TM style, format, technical content, readability, and quality control. The evaluation showed these specifications were not highly effective in describing requirements for technical content. These same TM specifications are used in over 90 percent of current Navy TM procurements.

Technical content specifications are needed that are responsive to user information requirements for various system/equipment types, (e.g., mechanical, electrical, electronic, hydraulic, pneumatic) as well as Navy operation and maintenance levels (e.g., organizational, intermediate, and depot). Furthermore, the structure of the specifications should be such that they can be easily modified to reflect state-of-the-art equipment changes. To be responsive to these requirements, the preliminary system concept proposes a modular technical content specification structure (see Figure 4-4) that provides specific technical content modules which are

tailored to operation and maintenance requirements for each system/equipment type. Each module would contain instructions for the content generators to follow in the development of the type of technical information required. Technical content modules will be designed around user information types (e.g., installation, functional descriptions, corrective maintenance, etc.) and will describe what is required in each information type for different system/equipment types and different Navy maintenance levels.

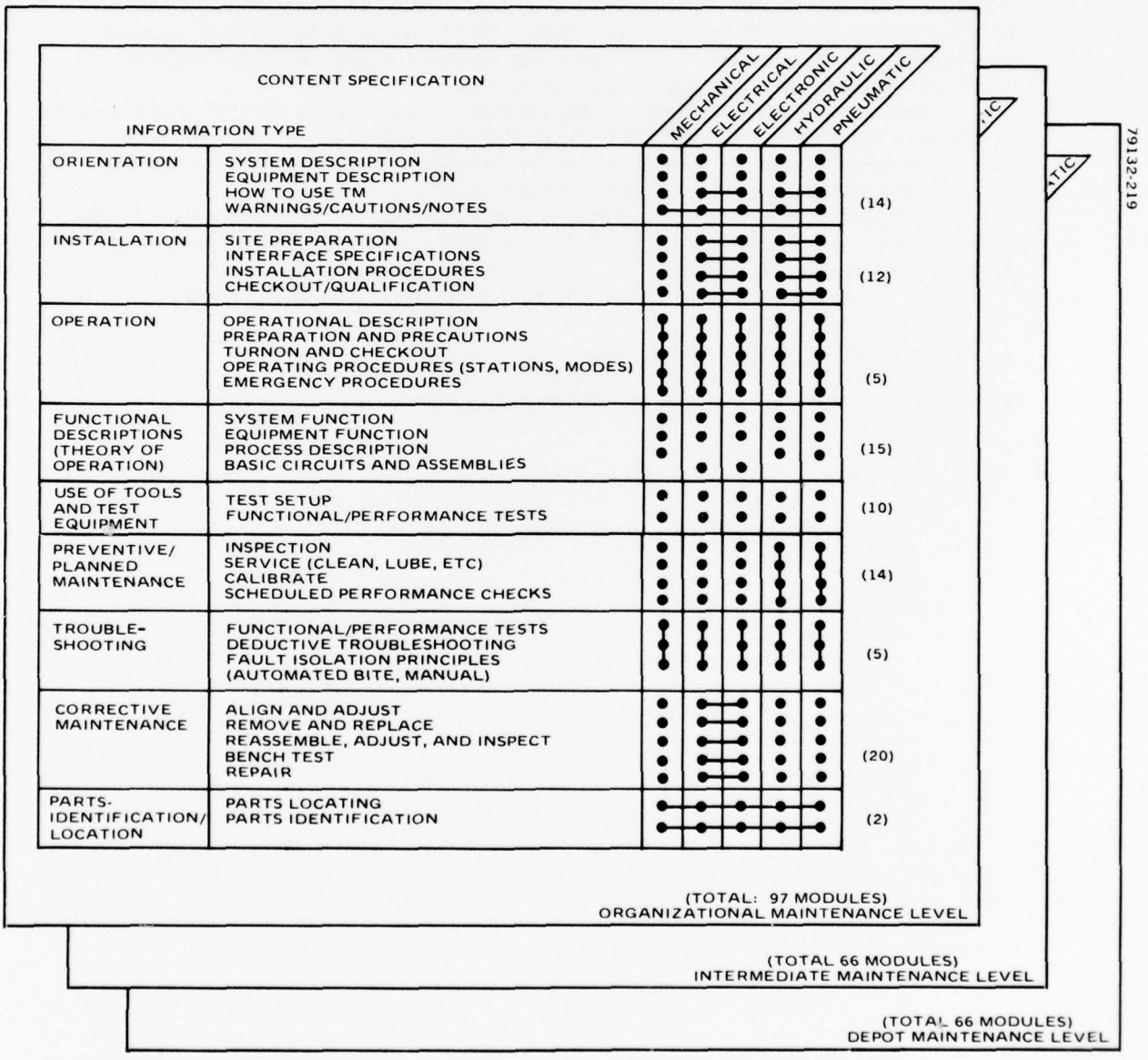


Figure 4-4. Proposed Technical Content Specification Modules. Specification modules provide the flexibility to customize the TM technical content specification to fit the requirements peculiar to a specific system/equipment type and maintenance level.

4.1.3.1 DESCRIPTION OF TECHNICAL CONTENT SPECIFICATIONS (Continued)

The preliminary system concept proposes 97 technical content modules to cover organizational maintenance for all types of systems/equipments (see Figure 4-4). This includes 5 modules covering operational information.

For intermediate maintenance, all information types except installation and operation and portions of orientation are provided in 61 modules. Depot maintenance is also covered by 66 modules tailored for depot requirements. A total of 229 technical content modules are thus provided based on preliminary analysis, to satisfy the operation and maintenance technical content requirements. Detailed analysis during the NTIP design phase could yield some reduction in this number due to possible commonality in certain areas between organizational/intermediate or intermediate/depot information requirements.

Providing individual modules allows the TM engineer in the TM procurement function to customize the technical content of a specific type of manual (operational TM; organizational, intermediate, depot maintenance TM; or combination TM) to a specific system/equipment and user need.

A hypothetical set of content modules for both an organizational and depot maintenance manual is listed in Table 4-1. A small electronic unit is assumed, such as a crypto device, which

- Will be repaired at the depot except for fuse and power supply replacement.
- Has no operator function.
- Requires periodic checkout and alignment.

All modules listed are from the electronic category.

TABLE 4-1. TYPICAL TECHNICAL CONTENT MODULE SELECTIONS

Information Type	Content Modules for Organizational TM	Content Modules for Depot TM
Orientation	• Equipment description • Warnings/cautions/notes	• How to use TM • Warnings/cautions/notes
Installation	• Installation procedure • Checkout/qualification	
Functional Description	• Equipment function	• Basic circuits and assemblies
Use of Tools and Test Equipment	• Functional/performance tests	• Test set-up (bench)
Preventive/Planned Maintenance	• Scheduled performance checks	• Inspection • Calibrate
Troubleshooting	• Fault isolation principles	• Functional/performance tests • Deductive troubleshooting
Corrective Maintenance	• Remove and replace	• Remove and replace • Reassemble, adjust, and inspect • Bench test • Repair
Overhaul		• Inspect and repair as necessary (IRAN) • Refurbishment
Parts Identification Location	• Parts Identification	• Parts locating • Parts identification

4.1.3.2 DESCRIPTION OF PRESENTATION TECHNIQUE SPECIFICATIONS

The concept of designing the TM by selecting particular presentation components and systems in advance affords a method of tailoring the TM content so that it will be highly compatible with specific user needs.

Presentation specifications are needed at the presentation component level, at the combination level, and at the presentation system level. Presentation components are basic methods of organizing and conveying information, such as types of text discussions, types of diagrams and schematics, methods of using photographs, etc. A presentation combination is a merging of the basic text and graphic components to meet a special user need, such as understanding a function, troubleshooting an equipment, or making an adjustment. A presentation system is unique in that it organizes combinations of text and graphic components to form a cohesive TM presentation approach. Examples of current TM approaches using unique presentation systems are FOMM and JPA.

TM specifications that currently describe presentation components, combinations, and systems are generally based upon a categorical approach to system or equipment types. This "cover the world" approach does not always best define what is really needed in a particular system/equipment TM to satisfy its unique user's needs. Data requirements are constantly changing because equipment types that compose a system, the complexity of the methods for implementing systems, and their functions are constantly changing. As a result, outdated TM specifications are being used to design presentation techniques that are not always compatible with user requirements and system conditions. Modular specifications could be utilized to compensate for different presentation techniques that are required by constant state-of-the-art changes in system/equipments. The modularity feature makes for ease of addition in keeping up with state-of-the-art advances in presentation techniques.

The preliminary concept proposes modules (see Table 4-2) that would accommodate data presentation components, combinations, and systems that now exist. These modules would describe complete text and illustration requirements for a TM and provide instructions and examples for their implementation. The presentation technique modules will be developed to cover all categories of Navy equipment, including electronic, hull, mechanical, and electrical. Each module will contain the principles and rationale behind the presentation technique and address the mechanics of structure, style, and/or symbology in its development.

The table shows modules for which presentation technique specifications would be developed. Specifications created within each module will be generated as self-contained entities. These modules are based on a preliminary Hughes study of basic presentation components and combinations. The preliminary concept proposes 29 basic presentation components and 7 combinations that can be used to organize TM data into 12 presentation systems.

When the user-data match model is completely developed, new presentation techniques may be identified. Specifications for these new techniques will be generated by adding to existing modules or creating a new module.

Presentation technique modules would be selected, in most cases, using the techniques identified in the user-data match model. For example, a TM procurement may be in process to buy a TM for a display console for an electronic technician (ET) rating. The user-data match model will identify the task actions

that the rating (ET) must perform at the defined equipment level (system, component, or piece part) and the best presentation components for his assigned tasks. The presentation systems, in this case, may be: (1) text with supporting figures, (2) functional diagrams with supporting text/tables/illustrations, and (3) proceduralized diagrams with supporting text. Presentation technique modules would then be selected that give the rationale and step-by-step procedures for the development of the technical information. These modules would be combined with modules from other specification categories in the design of the complete TM specification.

TABLE 4-2. PROPOSED PRESENTATION TECHNIQUE SPECIFICATION MODULES

Basic Component Modules	Component Combination Modules
Text • Deductive and narrative • Directive, procedural Tables, Charts, Matrices • Maintenancy dependency charts • Fault isolation flow charts • Periodic maintenance tables • Troubleshooting matrices • Wire lists (manual/ADP) • Parts lists (manual/ADP) Diagrams • Schematic • Connection/wiring/cabling • Logic (single flow/stick) • Mechanical schematic • Piping • Block (functional/detailed/flow) • Timing • Fluid power Drawings • Assembly (mono/multi) • Interface • Interface • Installation, outline, mounting • Plan, elevation • Optical (element/system) • Wiring harness • Exploded/assembled/cut away view Pictorial Drawings • Cartoons • Sketches Miscellaneous • Photographs • Waveform diagrams • Graphs, plots	• Text with supporting figures, tables, or pictorials • Modular text with supporting illustrations • Text keyed to or integrated with illustrations or diagrams • Tables/matrices with supporting text/illustrations • Illustrated parts lists • Illustrations with keyed procedures • Diagrams or pictorials with supporting captions/text procedures Presentation System Modules • Job Performance Aids (JPA) – procedure-keyed/integrated diagrams • Planned Maintenance System (PMS) – formatted procedures on cards • Condensed Service Data (CONSD) – fault cues, data, and diagrams for troubleshooting • Graphic Operations Manual (GOM) – tables with supporting illustrations • Maintenance Data System (MDS) – flow charts and procedures with supporting illustrations • Simplified Operations Manual (SOM) – combined GOM-JPA and conventional approaches • Binary Fault Isolation Chart (BFIC) – digital computer flow chart • Functionally Oriented Maintenance Manual (FOMM) – functional diagrams with integrated text • Pyramid of Diagrams (PYRAGRAM) – modular diagrams with supporting text • Graphically Proceduralized Aids for Maintenance (GPAM) – illustrations with supporting text • Work Packages (WP) – packages containing all data necessary to accomplish a functionally complete maintenance task. • Sequential Thematic Organization of Publications (STOP) – topical modular text, supported with thesis sentences and illustrations

4.1.3.3 PRELIMINARY CONCEPT OF READABILITY FOR NTIPS

The preliminary concept on readability proposes methodology to both predict and produce readable text. It would be implemented by specifications using existing formulas for the prediction of readability, and by writers guides that would aid the production of more readable text.

Kincaid, et al (1975), provides a concise review of the need for improved readability:

> "Studies conducted by all three military services have verified that TM material that must be comprehended to do the maintenance job is written at a level of difficulty above the reading ability of the maintenance technician (Kincaid, 1967; Smith and Kincaid, 1970; Klare, 1963; Caylor, Sticht, Fox, and Ford, 1972; Carver, 1973; Duffy and Nugent, 1974). One recent Air Force study (Johnson, Relova, and Stafford, 1972) has traced many costly errors to the reading difficulty level of the instructions that are to be followed in manuals. The more difficult the material, the more mistakes were made."

Since there is a high correlation between readability and comprehension, the use of predictive formulas to aid in lowering the readability scores seems to be the most practical approach. Per Kincaid:

> "Remedial reading instruction would require a great deal of effort for significant gains in reading ability to be achieved. Similarly, selecting personnel with high reading abilities is getting progressively more difficult, both because the average high school graduate is not reading as well as ten years ago and because of the new all-volunteer concept in the military services. Carver (1973) estimates that the average reading ability of Navy enlisted personnel is about the ninth grade. Pinning (1974) estimates this ability to be 10.0 and projected that it would fall to 9.0 by the 1979-82 time frame."

New TM specifications (e.g., MIL-M-38784) and guides currently under development by the military services specify an RGL of about nine, and utilize Flesch, ARI, or versions of the Fog formula in calculating readability. The new NAVAIR writers guide, NAVAIR 00-25-700, requires RGLs of 9 to 10 and specifies the use of the Fog index or Flesch Reading Ease formula as tools for measurement. A new NAVSEA TM specification under development has an average RGL requirement of 9, and specifies the use of Flesch or Automated Readability Index (ARI) formulas, recalculated for Navy use, as measurement tools.

Following this lead, the preliminary concept for predicting readability proposes the use of the Flesch and ARI formulas (see Table 4-3). The Fog formulas would be considered an alternative, since they may not be interchangeable with Flesch, yet might be even more suitable to the technical literature (see below) as a TM procurement specification. The Flesch formula is the most widely used and most heavily validated formula. The ARI formula, having an equivalent mathematical form, would be expected to be interchangeable with Flesch. ARI has the further advantage of being implementable by counters attached to electric typewriters. (Though such measurement methods would probably be replaced eventually by computer services or the Contractor's text processing facilities.)

Based on studies of sample TM material at Hughes, the Fog formulas may not be interchangeable with Kincaid's new Flesch RGL formula. The new Flesch

that the rating (ET) must perform at the defined equipment level (system, component, or piece part) and the best presentation components for his assigned tasks. The presentation systems, in this case, may be: (1) text with supporting figures, (2) functional diagrams with supporting text/tables/illustrations, and (3) proceduralized diagrams with supporting text. Presentation technique modules would then be selected that give the rationale and step-by-step procedures for the development of the technical information. These modules would be combined with modules from other specification categories in the design of the complete TM specification.

TABLE 4-2. PROPOSED PRESENTATION TECHNIQUE SPECIFICATION MODULES

Basic Component Modules	Component Combination Modules
Text • Deductive and narrative • Directive, procedural Tables, Charts, Matrices • Maintenancy dependency charts • Fault isolation flow charts • Periodic maintenance tables • Troubleshooting matrices • Wire lists (manual/ADP) • Parts lists (manual/ADP) Diagrams • Schematic • Connection/wiring/cabling • Logic (single flow/stick) • Mechanical schematic • Piping • Block (functional/detailed/flow) • Timing • Fluid power Drawings • Assembly (mono/multi) • Interface • Interface • Installation, outline, mounting • Plan, elevation • Optical (element/system) • Wiring harness • Exploded/assembled/cut away view Pictorial Drawings • Cartoons • Sketches Miscellaneous • Photographs • Waveform diagrams • Graphs, plots	• Text with supporting figures, tables, or pictorials • Modular text with supporting illustrations • Text keyed to or integrated with illustrations or diagrams • Tables/matrices with supporting text/illustrations • Illustrated parts lists • Illustrations with keyed procedures • Diagrams or pictorials with supporting captions/text procedures Presentation System Modules • Job Performance Aids (JPA) – procedure-keyed/integrated diagrams • Planned Maintenance System (PMS) – formatted procedures on cards • Condensed Service Data (CONSD) – fault cues, data, and diagrams for troubleshooting • Graphic Operations Manual (GOM) – tables with supporting illustrations • Maintenance Data System (MDS) – flow charts and procedures with supporting illustrations • Simplified Operations Manual (SOM) – combined GOM-JPA and conventional approaches • Binary Fault Isolation Chart (BFIC) – digital computer flow chart • Functionally Oriented Maintenance Manual (FOMM) – functional diagrams with integrated text • Pyramid of Diagrams (PYRAGRAM) – modular diagrams with supporting text • Graphically Proceduralized Aids for Maintenance (GPAM) – illustrations with supporting text • Work Packages (WP) – packages containing all data necessary to accomplish a functionally complete maintenance task. • Sequential Thematic Organization of Publications (STOP) – topical modular text, supported with thesis sentences and illustrations

4.1.3.3 PRELIMINARY CONCEPT OF READABILITY FOR NTIPS

The preliminary concept on readability proposes methodology to both predict and produce readable text. It would be implemented by specifications using existing formulas for the prediction of readability, and by writers guides that would aid the production of more readable text.

Kincaid, et al (1975), provides a concise review of the need for improved readability:

> "Studies conducted by all three military services have verified that TM material that must be comprehended to do the maintenance job is written at a level of difficulty above the reading ability of the maintenance technician (Kincaid, 1967; Smith and Kincaid, 1970; Klare, 1963; Caylor, Sticht, Fox, and Ford, 1972; Carver, 1973; Duffy and Nugent, 1974). One recent Air Force study (Johnson, Relova, and Stafford, 1972) has traced many costly errors to the reading difficulty level of the instructions that are to be followed in manuals. The more difficult the material, the more mistakes were made."

Since there is a high correlation between readability and comprehension, the use of predictive formulas to aid in lowering the readability scores seems to be the most practical approach. Per Kincaid:

> "Remedial reading instruction would require a great deal of effort for significant gains in reading ability to be achieved. Similarly, selecting personnel with high reading abilities is getting progressively more difficult, both because the average high school graduate is not reading as well as ten years ago and because of the new all-volunteer concept in the military services. Carver (1973) estimates that the average reading ability of Navy enlisted personnel is about the ninth grade. Pinning (1974) estimates this ability to be 10.0 and projected that it would fall to 9.0 by the 1979-82 time frame."

New TM specifications (e.g., MIL-M-38784) and guides currently under development by the military services specify an RGL of about nine, and utilize Flesch, ARI, or versions of the Fog formula in calculating readability. The new NAVAIR writers guide, NAVAIR 00-25-700, requires RGLs of 9 to 10 and specifies the use of the Fog index or Flesch Reading Ease formula as tools for measurement. A new NAVSEA TM specification under development has an average RGL requirement of 9, and specifies the use of Flesch or Automated Readability Index (ARI) formulas, recalculated for Navy use, as measurement tools.

Following this lead, the preliminary concept for predicting readability proposes the use of the Flesch and ARI formulas (see Table 4-3). The Fog formulas would be considered an alternative, since they may not be interchangeable with Flesch, yet might be even more suitable to the technical literature (see below) as a TM procurement specification. The Flesch formula is the most widely used and most heavily validated formula. The ARI formula, having an equivalent mathematical form, would be expected to be interchangeable with Flesch. ARI has the further advantage of being implementable by counters attached to electric typewriters. (Though such measurement methods would probably be replaced eventually by computer services or the Contractor's text processing facilities.)

Based on studies of sample TM material at Hughes, the Fog formulas may not be interchangeable with Kincaid's new Flesch RGL formula. The new Flesch

formula, like its predecessor, is weighted so that is is sensitive to word lengh compared to sentence length. It linearly penalizes words larger than three syllables. On the other hand, the Fog formulas ignore word lengths longer than three syllables and are more sensitive to average sentence length. Thus, when the sample material contains either a large percentage of big words over three syllables or short sentences, the measurements diverge.

For example, a study of 23 sample TM paragraphs at Hughes measured by both the new Flesch RGL formula and the NAVSEA Fog RGL formula shows a divergence that ranges up to 6.7 grade levels, averaging 1.99 RGLs (48 percent of the differences were between 2 and 6.9 RGLs). In many cases the biggest difference occurs for samples having a heavy proportion of words of more than three syllables or sentences shorter than average (e.g., the ASL for the paragraph in question is under 17 words/sentence, in a population of paragraphs having an ASL of 24.6 words/sentence). Using NAVAIR's Fog formula, the disparity is even larger, averaging 3.23 RGLs, where 60 percent of the differences lie between 3 and 6.1 RGLs. This appears to be a significant obstacle to interchangeability. Interchangeability is important because the concept of RGL as applied to a text is understood in practice as a universal standard of measurement.

The Flesch, ARI, and NAVSEA Fog formulas shown are those recalculated specifically for Navy use (by Kincaid, et al, 1975). The formulas were simplified in the process. The recalculated Flesch formula has different coefficients than the original Flesch Reading Ease Formula and is expressed directly in RGL. The ARI formula was rescaled to be more compatible with the reading ability of Navy personnel. The recalculated NAVSEA Fog index provides a single formula (now applicable across the entire readability range) and is scaled for Navy users.

TABLE 4-3. CANDIDATE READABILITY FORMULAS

Original Flesch:

- RE = 206.835 - 1.015 words/sentence - 84.6 syllables/word

Proposed Concept:

- Flesch RGL = 0.4 (words/sentence) +12 (syllables/word) -16
- ARI RGL = 0.4 (words/sentence) +6 (keystrokes/word) -27.4

Alternatives:

- Fog (NAVSEA) $RGL = 0.5 \left[\frac{\text{easy words}^* + 3 \text{ hard words}^{**}}{\text{(sentences)}} - 3 \right]$
- Fog (NAVAIR) $RGL = 0.4 \left[\frac{\text{total words}}{\text{total sentences}} + \%\ \text{hard words} \right]$

*Easy words are 1 and 2 syllable words
**Hard words are those having more than 2 syllables

4.1.3.3 PRELIMINARY CONCEPT OF READABILITY FOR NTIPS (Continued)

One reason the Fog formulas have become popular is that they are relatively easy to apply using manual counting methods. Perhaps an even more significant reason for adopting them on technical material would be that they do not penalize the larger big words that would be expected to characterize many kinds of TM material, but do "give credit" for a higher proportion of short sentences. TM material being prepared to meet RGL standards may be characterized by a higher proportion of short sentences, since the options in eliminating the technical vocabulary are somewhat limited. Thus, the Fog formulas might provide a more comfortable contracting standard, even though their validation would fall into question over the larger big word issue. This area is worthy of additional study. In addition, although manual calculations are not excluded, the preliminary concept would promote the computerizing of readability assessments wherever possible, to gain consistency of results, and Navy specification of the software mechanization to insure uniformity of measurement.

The promotion of computerized readability assessments is proposed because the manual calculation of readability on sample texts leads to inconsistent results. Manual calculations are difficult to perform because of human mistakes in counting syllables, doing the arithmetic, differing interpretations of the rules on how to handle abbreviations, acronyms, numbers, hyphenated words, semicolons, etc. Precise instruction guides for manual calculation of readability formulas will be necessary, but they will not assure uniform results. Promoting the computerization of the readability formulas would mitigate these problems and encourage more frequent sampling. Most contractors in the future will have access to computer services, and the cost of typing in the sample material is negligible.

However, Navy specification of the software would be necessary for computerized readability assessments, since content generators, left to their own devices, would mechanize the formulas in different ways. Differing algorithms for sentence recognition and syllable recognition produce different RGL scores on the same material. For example, some Flesch computerizations count semicolons as sentences, a somewhat questionable practice. One syllabification algorithm (based on counting nonconsecutive vowels) would identify "thereby," "wavelength," "movement," "elsewhere," etc., as 3-syllable words. Similary, the counting of hyphenated words as single words (e.g., "digital-to-analog," "phase-detected," "space-stabilized," "motor-generator," "noise-plus-signal," etc., is undoubtedly an inflation of the word length penalty. Developing the best algorithms for the TM application and adjusting any validation impact would require further study and coordination between the various authorities.

The Dale-Chall formula was not selected for use in NTIPS since the old list of 3,000 familiar words is largely exclusive of technical terms. Some writers in the education field prefer the Dale-Chall formula because of its reliance on a difficult word list rather than syllable count. But to apply the method more specifically to the TM field (e.g., adding technical words known by 80 percent of Navy operation and maintenance personnel), while not unfeasible, would undoubtedly require many disciplinary sections and pose additional development expense. The practicabiliity of the addition of specialized technical terms has not yet been explored. Furthermore, the Dale-Chall is more difficult to compute manually, as constant look-up in the list is required, and it has not been calibrated for Navy use as have the Flesch, Fog, and ARI formulas.

The assessment of readability is not an end in itself. Even more important is a program to educate TM writers on its importance and on methods of producing more readable writing to begin with. A definitive writers guide on the subject of both measuring and producing readable texts is sorely needed. Particularly, the

average TM writer needs to learn the various distinct style mechanisms at his disposal for varying the RGL of a given passage. Specific methods and ground rules for dividing sentences, disembedding clauses, substituting words, deleting words, avoiding circumlocutions, etc., are what is needed. This is a parametric discipline and needs to be learned in quantitative terms, as well as in terms of achieving clear writing in the "old fashioned" comprehensibility sense. Graphics readability is also a concern. The NTIPS readability concept would be incomplete without such a handbook (see topic 4.2.8).

The future evolution of quantitative readability assessment into quantitative comprehensibility assessment must also be accommodated by NTIPS. While readability is established as a good predictor of comprehension, it is not a good measure of comprehensibility in its widest sense (see definitions, Appendix C). A more direct approach to measuring comprehensibility, based on such factors as word familiarity and concreteness, syntactical structure, rhetorical clarity, logical continuity, etc., will eventually be possible based on research already completed or currently going on (e.g., "Application of Structure-of-Intellect and Psycholinguistic Concepts to Reading Comprehensibility Measurement," Siegel, et al, 1974). NTIPS should be prepared to coordinate and apply this discipline as it matures, through its educational influences over all TM contractors.

TABLE 4-4. FEATURES OF READABILITY CONCEPT

- Use of Flesch and ARI readability formulas
- Potential use of Fog formulas as alternative
- Promotion of computerized readability assessments
- Navy specification of software mechanization
- Preparation of writers guides for the production of readable text
- Accommodation of future comprehensibility factors

4.1.3.4 CONSIDERATIONS FOR SETTING THE RGL REQUIREMENTS

The present trend in TM specifications, which sets all readability requirements at a standard RGL of 9, may not be advisable from either an economic or comprehensibility viewpoint. An alternative is to adjust the required RGL according to the distribution of RGL performance across the ratings, and to differences in the types of conceptual content of the text.

The question of how to set the RGL requirement for TMs remains to be addressed. While the trend seems to be toward setting all TMs at the lowest conceivable level, it can be argued that the RGL requirement should be matched more equitably to the user in each procurement, to reduce the economic penalties, or that some compromise between cost and the lowest denominator be considered.

Most TM specifications in current use refer to MIL-M-38784 for readability requirements. The requirements of this specification dictate average sentence lengths of 17 to 20 words and average word lengths of 1.5 to 1.6 syllables. Depending on how converted, these will interpret into RGLs of about 9 to 10. The new NAVAIR writers guide, NAVAIR 00-25-700, requires RGLs of 8.7 to 11, and a new NAVSEA specification, not yet released, specifies an average RGL of 9 and a maximum of 10. Thus, military services that presently utilize MIL-M-38784 or other contract requirements to specify the RGL of TMs appear to be fixing on an average RGL of 9. This trend is based on studies (e.g., Carver, 1973) which show that the lowest RGL ability encountered in Navy technical personnel is about grade level 9. Hence, the assumption that all TMs should be written for this level could be called the "lowest denominator" approach.

The school of thought that would argue for a "matched" method of setting the RGL requirement would invoke the natural distribution of RGL performances, as illustrated in Figure 4-5. Basically, this figure plots 23 Navy ratings against General Classification Test (GCT) scores. These ratings were selected (by Anacapa Sciences) as most relevant to the Navy's TM problems. The chart shows that a significant range in RGL ability above 9 RGLs is predictable from a correlation of GCT scores to RGL performance (per Duffy; see Appendix E). The conversion formula, RGL = -1.95 +0.2396 (GCT), was developed by Duffy at NPRDC in 1974).

As based on Hughes studies, this argument would contend that the written RGL of a TM text is not independent of the conceptual nature of its content. Many TMs (particularly in the electronic field) manifest RGLs in the region of 17 to 19 (vs Biersner's findings of 11 to 15 RGLs, 1975), so they are well above the RGL of the rating (13). If this is true of most ratings, it could be expected that an economic penalty would be associated with lowering RGL requirements substantially below that of the natural GCT distribution. In other words, to drive a TM text from a current-practice 19 RGLs to a user-matched 13 RGLs would incur certain desirable reforms in writing practice, but driving it even lower to a required 9 RGLs would incur more costly editing and iterative revising procedures. Hence it would be better if a particular matched RGL were invoked for each TM procurement, as determined by a user-data matching procedure.

A modification of the "matched level" approach would be to lower the RGL requirement somewhat under the predicted RGL of each rating (by perhaps one or two standard errors), thus insuring a comfortable RGL for the rating in question, but avoiding the full measure of the economic penalty. On this point, it should be noted that a TM writer's style is probably not infinitely adjustable to changes in some external RGL goal. His internalization of the RGL goal will be limited by either habit, or certain newly adopted stylistic algorithms, so that the outcome of any one attempt will undoubtedly need assessment and revision, except for the

most trivial cases of conceptual content difficulty. Thus, as the RGL requirement is lowered, a progressive penalty will be incurred in terms of recalculations, vocabulary look-up, grammatical transformations, smoothing operations, to overcome "choppiness," etc.

A further application of this approach would permit the level of specified RGL to be adjusted according to the purposes of the information content. For example, a directive text would be placed under a more stringent requirement than a deductive or descriptive narration since it would be less likely to depend on a higher RGL to capture its conceptual "payload." Thus, the hypothesis is that the most difficult conceptual material found in a TM for a given Rating (e.g., theory of operation in electronics) would be understood best at the RGL inherent in the GCT of the Rating, even better than at some minimally lower RGL, due to the sacrifices in content incurred by overly severe lexical constraints. However, other conceptually less difficult material (e.g., installation) would be understood best at a correspondingly lower RGL. Such a constraint in setting the RGL requirement, applied thoughtfully for the circumstances of each procurement, has some appeal, considering that both economic and comprehensibility benefits might accrue. Consequently, a matched-adjustable RGL approach is proposed as an alternative to the fixed 9 RGL approach now gaining currency in the Services.

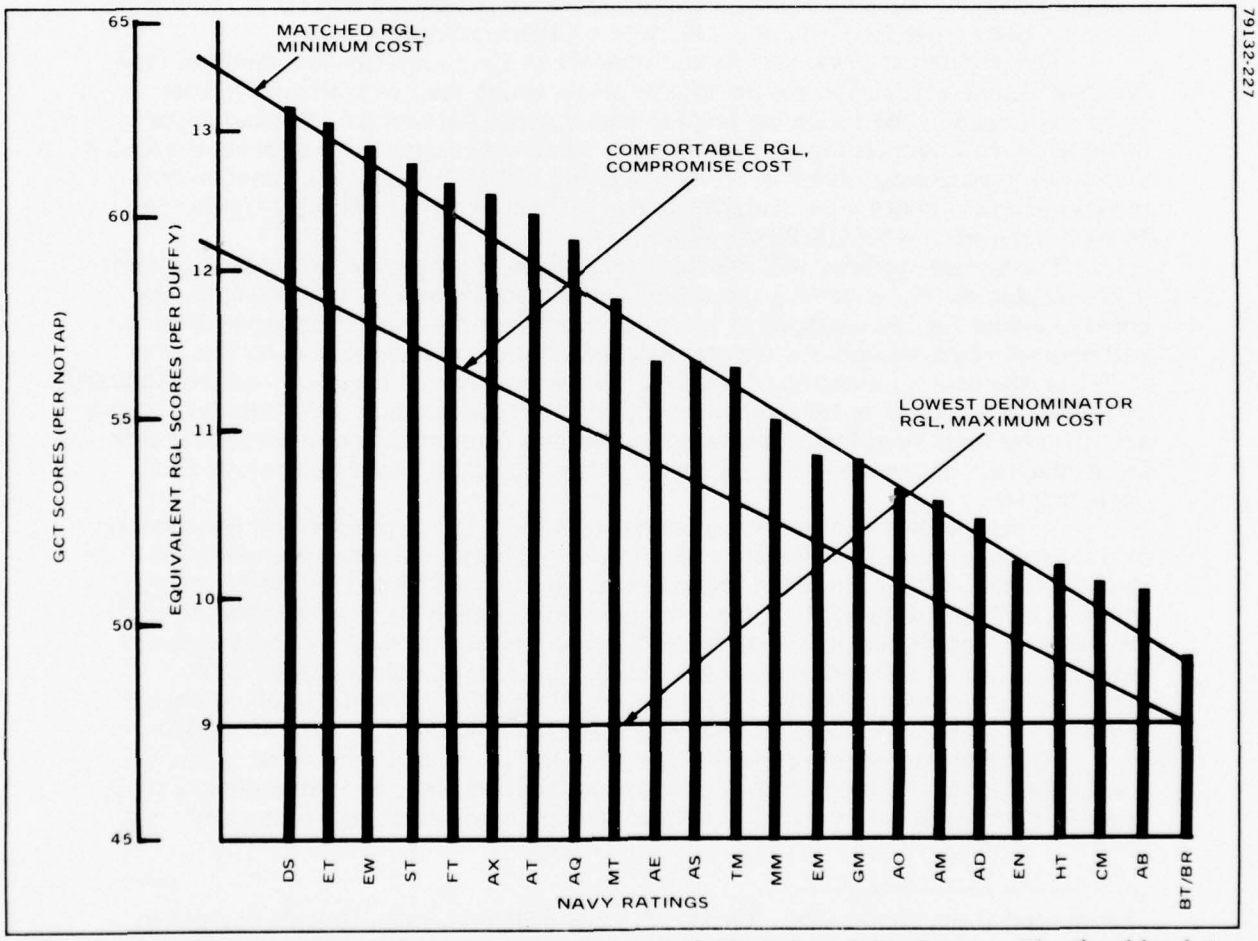


Figure 4-5. Ranking of Navy Ratings by GCT Scores and Equivalent RGL Scores. The fixed-level 9 RGLs requirement ignores the natural distribution of GCT levels between the ratings. The matched-adjustable RGL approach avoids the worst economic penalties in controlling the TM readability during the writing and editing processes.

4.1.3.5 DESCRIPTION OF ACCESS SPECIFICATIONS

The access specification modules will describe tailored entry, indexing and numbering schemes for a variety of TM types and media.

Poor accessibility of printed information is not a new complaint of technical manual users. Stroessler, et al (1957), reported[1] that most TM indexes were nothing more than alphabetized tables of contents. Most information required by the technician is not easily obtained by using such an index. The problem becomes more difficult when a TM is placed on microform with no additional thought given to the index. In this case, not only can the technician not find the information he needs by using the index, but thumbing through the TM, as would be done with a conventional manual, is not possible. In addition, if TMs are placed on video discs, location of poorly indexed information becomes a virtual impossibility.

To eliminate the difficulty experienced in finding information within TMs, the access specification category will provide modules which will define the accessibility requirements and recommended access methods to be used for various media. The problem is addressed in terms of access to a series of technical manuals, to a single technical manual, and to a paragraph or subparagraph level of a technical manual. Use of the term "access' refers to all these considerations.

The preliminary system concept consists of four specification modules (see Table 4-5) that will define access requirements which may be utilized for TMs to be developed in the following media: bound paper documents, unbound paper documents, roll microfilm, and microfiche. Each access module will provide requirements for partitioning, numbering, and indexing of TM information. Each access module will also contain practical tests and standards of accessibility similar to those described in NAVAIR 00-25-700.

The access modules will contain methods to be employed by content generators in developing or implementing the specification requirements. For example, the access module for the methods of indexing by subject for the bound paper document will contain requirements for the grouping of subjects that depend upon the type of TM or the user application of the TM. Operator manuals may have subject indexes arranged by modes of operation, and maintenance manuals may have subject indexes arranged by fault symptons. Where operation and maintenance are covered in different chapters of the same TM, different subject indexes would be specified for each chapter.

Access techniques that have been used widely in the private and commercial sectors are also useful for military application. For example, requirements for thumb indexes, which are often found in dictionaries and Bibles, would be included in the NTIPS specifications. Access modules will include many of the traditional solutions as well as requirements for additional approaches such as: leaf-through locators, block or colored boxes placed at the page edge, colored or oversized pages in front of each section, colored stock, simplified contents listed on cover, (cover page edge box), indented thumb indexes, and pictorial and keyword indexes.

Pictorial and keyword indexes are other methods that have been studied for application to military TMs. For example, the location of maintenance and operating procedures or various equipment descriptions could be graphically

[1] Stroessler, J.H., Clark, J.M., Martin, P.A., and Grimm, F.T., Human Factors in the Design and Utilization of Electronics Maintenance Information, Research Report No. 782; 31 May 1957; U.S. Navy Electronics Laboratory (BUSHIPS), San Diego, CA.

portrayed on exploded views of the equipment. Keyword indexes could be utilized for rapid access and retrieval of situation-specific TM information. These Keywords could be flagged by TM writers as the TM is developed or collected automatically if automated text processing machines are used in the production process. Equipment nomenclature and vocabulary specifications for the system/equipment would control the volume and types of keywords used.

TABLE 4-5. PROPOSED TM ACCESS SPECIFICATION MODULES

Specification Requirements and Descriptions	Bound Paper Documents Module	Unbound Paper Documents Module	Roll Microfilm Module	Microfiche Module
Methods of Partitioning				
• Volumes	✓	✓	✓	✓
• Parts	✓	✓	✓	✓
• Chapters	✓	✓	✓	✓
• Sections	✓	✓	✓	✓
• Topics	✓	✓	✓	✓
• Work units	✓	✓	-	-
Methods of Indexing				
• Subject	✓	✓	✓	✓
• Paragraph headings	✓	✓	✓	✓
• Illustration lists	✓	✓	✓	✓
• Tables lists	✓	✓	✓	✓
• Pictorials	✓	✓	✓	✓
• Keywords	✓	✓	✓	✓
• Indented thumb	✓	-	-	-
• Colored stock	✓	✓	-	✓
• Cover page edge box	✓	-	-	-
Methods of Numbering and Pagination				
• Chapters	✓	✓	✓	✓
• Sections	✓	✓	✓	✓
• Paragraphs	✓	✓	✓	✓
• Roll leader	-	-	-	✓
• Readable header	-	-	✓	-
• Illustrations	✓	✓	✓	✓
• Tables	✓	✓	✓	✓

4.1.3.6 DESCRIPTION OF PUBLISHING PROCESSES SPECIFICATIONS

New detailed publishing process specifications are required for the various media presently in use and for those contemplated for the future. The preliminary concept provides a family of specification modules to define each of the factors involved in the publishing processes required to support all contemplated media.

The evolution from paper to microforms and digital publishing and presentation must be supported by specifications concerning the new publishing processes. The publishing process subfunction would provide specifications that address multimedia presentation, including digital methods, for TM production, transmission and usage.

The Publishing Subsystem preliminary concept proposes an automated internal Navy capability for text and graphic input, edit, update, and output. The publishing processes specifications must accommodate these digital methods of publishing. If the contractor is required to deliver input to the publishing operation that needs to be entered into an automated system and reprocessed to a specified output medium master, then the medium for submittal of that contractor-generated material must be specified. If it is digital then, at least the form, language, and codes must be specified. If it is other than digital, at least its form must be specified. Table 4-6 lists the processing factors that impact text and graphic pages for different media. Media that would be used to deliver TMs in digital form are included since use of digital media is considered possible in the 1980-85 time frame.

The preliminary concept for TM publishing process specifications are modular specifications that would support a multi-media presentation. Analysis to date of both media and processing factors indicates that a complement of 35 modules could be used to specify all TM publishing process requirements. The modular aspect of these specifications would help TM acquisition activities to define a complete spectrum of publishing processes for a variety of media that could be easily included in custom-tailored TM specifications. TM specifications must be able to deal with images (pages) that are captured in one medium, transmitted in another, and used in a third. For example, the text and art could be produced in digital form, transmitted on a video disc, and viewed on display device (use No. 1) or replicated on paper for use in a remote area (use No. 2). It would have to be specified that a video disc presentation on a TV screen must use large type (at least 18 point) as compared to the smaller (10 point) type used on printed pages.

Specification development must be responsive to the media requirements of the system concept, namely paper and microforms. Information about new media being developed will also impact publishing process specifications, and must be accommodated. However, the specification content is only partly dependent upon the selection of a medium. A significant element of the specification would be the mechanical (format) structure of the page of text or artwork (graphic). What goes where, how big or small, what type style, etc., make up most of the specific items in the publishing process requirements. Thus, since the TM is constructed with pages in text, tables, and graphics arranged in books with sections, chapters, etc., regardless of the medium used to deliver it (or use it), the format of the product is the key element to consider in process operations.

TABLE 4-6. PROPOSED PUBLISHING PROCESS SPECIFICATION MODULES

Processing Factors \ Media	Paper	Microform		Digital/Optical		
		Microfilm (Cartridge or roll)	Microfiche	Hologram	Video Disc	Direct
Text Pages	(1)*	(2)	(3)	(4)	(5)	(6)
Page size	X	X	X	X	X	X
Image area	X	X	X	X	X	X
Type sizes	X	X	X	-	-	-
Type faces	X	X	X	-	-	-
Margins	X	X	X	X	X	X
Gutters	X	X	-	-	-	-
Indentions	X	X	X	X	X	X
Marginal copy	X	X	X	X	X	X
Classification markings	X	X	X	X	X	X
Illustrations	(7)	(8)	(9)	(10	(11)	(12)
Image area	X	X	X	X	X	X
Symbol type	X	X	X	X	X	X
Symbol size	X	X	X	X	X	X
Call-outs	X	X	X	X	X	X
Classification markings	X	X	X	X	X	X
Production	(13)	(14)	(15)	(16)	(17)	(18)
Front matter	X	X	X	X	X	X
Text and art integration	X	X	X	X	X	X
Foldout pages	X	-	-	-	-	-
Blank pages	X	-	-	-	-	-
Camera ready copy	X	X	X	X	X	-
Splices	-	X	-	-	-	-
Leaders/trailers/ title strips	-	X	X	-	-	-
Image resolution	X	X	X	X	X	X
Background density	-	X	X	X	X	X
Use of Color	(19) X	(20) X	(21) X	-	(22) X	-
Packaging	(23)	(24)	(25)	(26)	(27)	
Negatives	X	X	X	X	-	-
Repro	X	X	X	-	-	-
Cartridges	-	X	-	-	-	-
Disc	-	-	-	-	X	-
Replication	(28)	(29)	(30)	(31)	(32)	
Paper stock	X	-	-	-	-	-
Binding	X	-	-	-	-	-
Photolitho negatives	X	-	-	-	-	-
Covers	X	-	-	-	-	-
Material grades/types (for original)	-	X	X	X	X	-
Material grades/types (for copies)	-	X	X	X	X	-
Digital Media				(33)	(34)	(35)
Code	-	-	-	X	X	X
File structure	-	-	-	X	X	X
Storage density	-	-	-	X	X	X
Storage format	-	-	-	X	X	X

*Specification module number

4.1.3.7 DESCRIPTION OF QUALITY CONTROL SPECIFICATIONS

The preliminary concept for TM quality control specifications involves requirements for monitoring the TM inspection process of the contractors, and includes requirements for a higher concentration of quality control efforts during the earlier phases of TM development.

Current quality control specification requirements emphasize post hoc TM quality assurance (i.e., during the validation and verification phases). Thus, serious TM deficiencies are often discovered too late to be properly corrected. Present requirements for QA reviews of TMs call for the first review after the writer has completed his first draft. At this point, schedule and funding limitations often restrict proper correction of deficiencies, and the TMs are often accepted without being corrected. A redistribution of TM QA efforts and a redefinition of Navy and contractor responsibilities are needed.

The current Navy TM QA requirements, while basically sound in intent and purpose, are not completely manageable. The Navy does not have the resources to fully audit the total TM products from all its contractors. The NTIPS quality specifications concept redefines and redistributes the current QA efforts, both by the Navy and by the contractor. NTIPS QA personnel will be required to audit the contractor QA personnel, who in turn, will be required to monitor the TM development process. In addition, while past TM QA has concentrated 80 percent of the effort in the final phases of the TM development process, the proposed concept shifts this effort to the early phases. This approach for data base and content generation was recommended by Hageman Consulting Services[1] in conjunction with the NTIP Program. The resulting QA specification modules, together with the QA provision for publishing and distribution, are contained in three groups totaling 12 QA modules (see Table 4-7).

Data Base Generation – TM quality assurance programs generally provide for little or no activity during data base generation. Some QA plans provide for the necessary auditing of bookplans to assure compliance with contract specifications. A much greater emphasis on quality assurance during data base generation is required. In addition to assuring that content generators have the requirements and guidance data to comply with specified formats and styles, it is also essential that QA audits the data accumulated during the early phases of TM preparation, to assure its accuracy and timeliness.

All contractual materials such as statements of work and quoted specifications should be reviewed by QA to assemble a checklist of the imposed TM requirements. The next level of TM documentation, those items that provide guidance to content generators, writers and illustrators, also needs to be audited by QA. This includes style manuals, writers guides, illustrators guides, preferred word lists, etc., composed by government agencies or by the contractor. Again, checklists are generated by QA from the guidance requirements to augment the checklist mode during the review of contractual requirements.

Finally, QA makes spot checks of the long list of engineering/logistics data base items required by the content generator to produce the TM. This includes the schedule of availability for these items as established by the TM engineer in the estimating phase of the effort. Examples of these data items include task analysis and maintenance concept data, engineering reports, engineering change proposals (ECPs) and procurement test specifications.

[1] Hageman Consulting Services; Quality Assurance Program for Technical Documentation; 1977, Fort Worth, TX.

TM Content Generation – Current TM QA requirements generally stress post hoc TM quality assurance in the form of reviewing completed drafts and witnessing validations and verifications. In the NTIP preliminary system concept, the TM Content Generation QA mandates establishment of a QA program conducted by the content generator's QA team. In turn, the Management Subsystem QA function monitors the program by in-process reviews, in frequency and depth commensurate with program size.

Publishing – As with content generation, present publishing quality assurance requirements are limited to inspecting the finished product. (For example, in the case of printed books, inspection includes checks of completeness, proper margins, legibility, etc.) In the preliminary concept, the TM publishing QA specification mandates that a QA program be established within the Publishing Subsystem and monitored by the Management Subsystem QA function. The needs and types of inspection will vary depending on the product medium, but will include format, completeness, legibility and/or clarity of audio (as applicable), and proper distribution techniques.

TABLE 4-7. PROPOSED QUALITY CONTROL SPECIFICATION MODULES

Requirements Group	Module
Data Base Generation	• Requirements and guidance data (availability of style guides, preferred word lists, etc.) • Product (bookplan) compliance audit • Engineering/logistics data (availability of engineering report, test specifications, task analysis, etc.)
Content Generation	• Input data utilization (use of requirements and guidance data, use of correct engineering data, and extension of requirements to subcontractors) • Inspection records • In-process reviews • Preliminary and final validation • Verification
Publishing	• Paper • Microform • Audio/visual • Distribution

4.1.4 DESCRIPTION OF THE TM PROCUREMENT FUNCTION

The preliminary concept for TM procurement is a decentralized function within the NTIPS organization dedicated to each major acquisition activity. The function would be controlled by a "Navy TM engineer" and have a funding structure that would prevent TM procurement funds from being encroached upon by hardware acquisition activities.

Presently, TM acquisition is usually part of the overall responsibility of the system acquisition project office. The project office largely determines types and quantities of TMs procured, and TM budgets, often without the help of TM specialists. The quality and quantity of TMs procured are related to funding priorities as established (and re-established) by the hardware project. This results in a great diversity in TM procurement. For example, the money and manpower allocated for the procurement of TMs is dependent, in many cases, on how critical the particular hardware project office views the TMs to be to system/equipments success. Furthermore, those responsible for TM procurement do not always understand fully the importance of TMs to the ultimate user. In addition, system acquisition project offices are liable to be guarded in earmarking sufficient funds for TMs when they continually, over the years, hear the same problem stories about TMs. This may lead some of them to believe they are going to get the same inadequate TMs whether they allocate large or small amounts of money. Consequently, preserving more of the money for hardware becomes their goal and TMs receive less funding and importance in their minds.

The approach envisioned for NTIPS is one of shifting of responsibility and funding for TM procurement from the hardware project office to the NTIP TM procurement function. Funds would be channeled to the TM procurement function through the NTIP Management Subsystem. The procurement of TMs and budgeting of funds by a single, responsible expert activity should eliminate the problem of inconsistent requirements, and inappropriate funding priorities, and improve the resulting TM product.

The preliminary concept calls for a "Navy TM engineer," a counterpart to the contractor's TM engineer, to oversee and/or participate in the activities required for TM procurement. The Navy TM engineer would be a TM and quality assurance specialist who would ensure that TM objectives formalized by better TM specifications are being realized. He would also disperse "captured funds" for the initial procurement and update of TMs. These funds would be preserved for their original intent and purpose and would not revert to hardware acquisition, or be diverted to other logistic support activities.

The major responsibilities of the TM procurement function are: (1) development of TM requirements documents for proposals and subsequent contracts, (2) delivery scheduling, (3) determining distribution requirements, (4) product quality assurance, (5) budgeting and funding, and (6) contract administration. The TM procurement function would be staffed by a number of TM engineers, depending on the size of the major acquisition activity and the volume of systems/equipments for which TMs are required.

Organizational Alternatives – The preliminary concept is to have several TM procurement functions, organizationally a part of NTIPS, each dedicated to a major acquisition activity. Each function (see Figure 4-6) would be responsible for all matters relating to the respective major acquisition activity's TM procurements. One alternative consists of a centralized function that has responsibility over all TM procurements for all Navy major acquisition activities. A second alternative consists of having a separate TM procurement function for each major

acquisition activity and placing the function within the organizational structure of that activity, external to the NTIP System, but governed by policies and procedures from NTIPS.

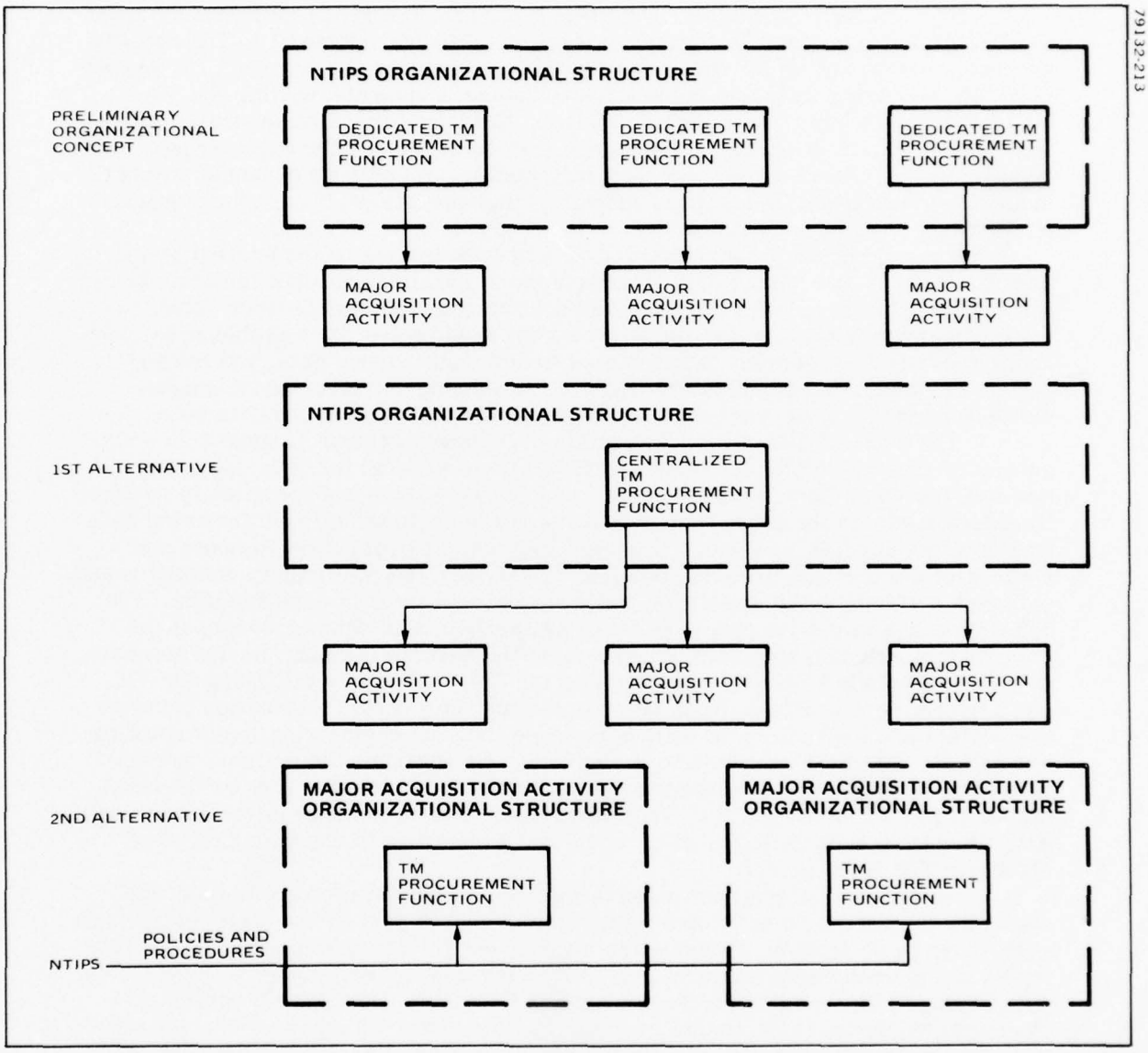


Figure 4-6. TM Procurement Function Organizational Alternatives. The TM procurement function will be centralized or decentralized within the organizational structure of NTIPS, responding to the needs of each major acquisition activity; or it will be a decentralized function within each major acquisition activity guided by policies and procedures from NTIPS.

4.2.1 DESCRIPTION OF CONTENT GENERATION SUBSYSTEM

The Content Generation Subsystem estimates, plans, and develops technical information in response to the TM acquisition requirements. The main challenge is to create technical data that is free from content generator inaccuracies and is adequate for specific user needs.

The Content Generation Subsystem is critical in that it represents the most significant and final point of impact on technical information quality. The content generator is responsible for collecting the data, estimating the proposed TM acquisition cost, preparing technical publications planning documents, writing the TM, critiquing the TM, and performing validation. Guided by the data acquisition rules, the content generator performs the human transformation of the engineering/manufacturing data base into technical information. As a result of human involvement, the transformation output is subject to interpretations, biases, inadequacies, and errors.

The engineering/manufacturing data base is critical to the content generator because it is the sole source of system/equipment descriptions. The major problems associated with the data base are limited content (e.g., no maintenance data), accuracy, and currency. The preliminary concept would solve these problems by modifying the data base content requirements to add maintenance data, and employ automated equipment to eliminate the time-consuming and error-prone manual methods for developing, checking, reproducing, and distributing the data base.

The Content Generation Subsystem preliminary concept (Figure 4-7) would consist of three functions (estimating, planning and writing) for developing new and updated TMs. Each function contains techniques which are specifically designed to reduce errors in the process of transforming the engineering/manufacturing data base into technical information. The functions apply to both Navy in-house and contractor content generation activities. In addition, the preliminary concept would establish a TM engineering position which impacts all tasks of each function. The TM engineer provides for proper planning and technical guidance throughout the TM program. He is responsible for collecting the data, developing the TM estimate, preparing a detailed TM book plan, writing the TM, technically critiquing the TM, and performing validation. He is also responsible for a cross fertilization between the writers and instructors, as well as ensuring that the engineering/manufacturing and logistic data base information is available. He confirms the optimum presentation methods identified by the user-data match model, he allocates writer tasks, and he ensures content quality. The TM engineer also establishes interrelationships with the design engineering activity and the ILS elements to ensure coordinated efforts in TM development.

To aid the TM engineer in performing his tasks, detailed guidance in the form of a TM Development Guide would be provided as part of the preliminary concept. This guide provides step-by-step instructions for the development of TM estimates and planning documents as well as for coordinating and supervising the actual TM development. Possible problem areas are identified and solutions presented to effectively reduce the number of difficulties that the TM engineer encounters in a TM acquisition program. This guide also encourages the TM engineer to seek out and apply innovative TM development and presentation techniques to meet technological advances in system/equipment design. The TM Development Guide is discussed in detail in Topic 4.2.7.

In the preliminary concept, provisions are made to institute and maintain a quality assurance program as an integral part of the technical information development process. This would assure that TM requirements are met during technical information development and validation.

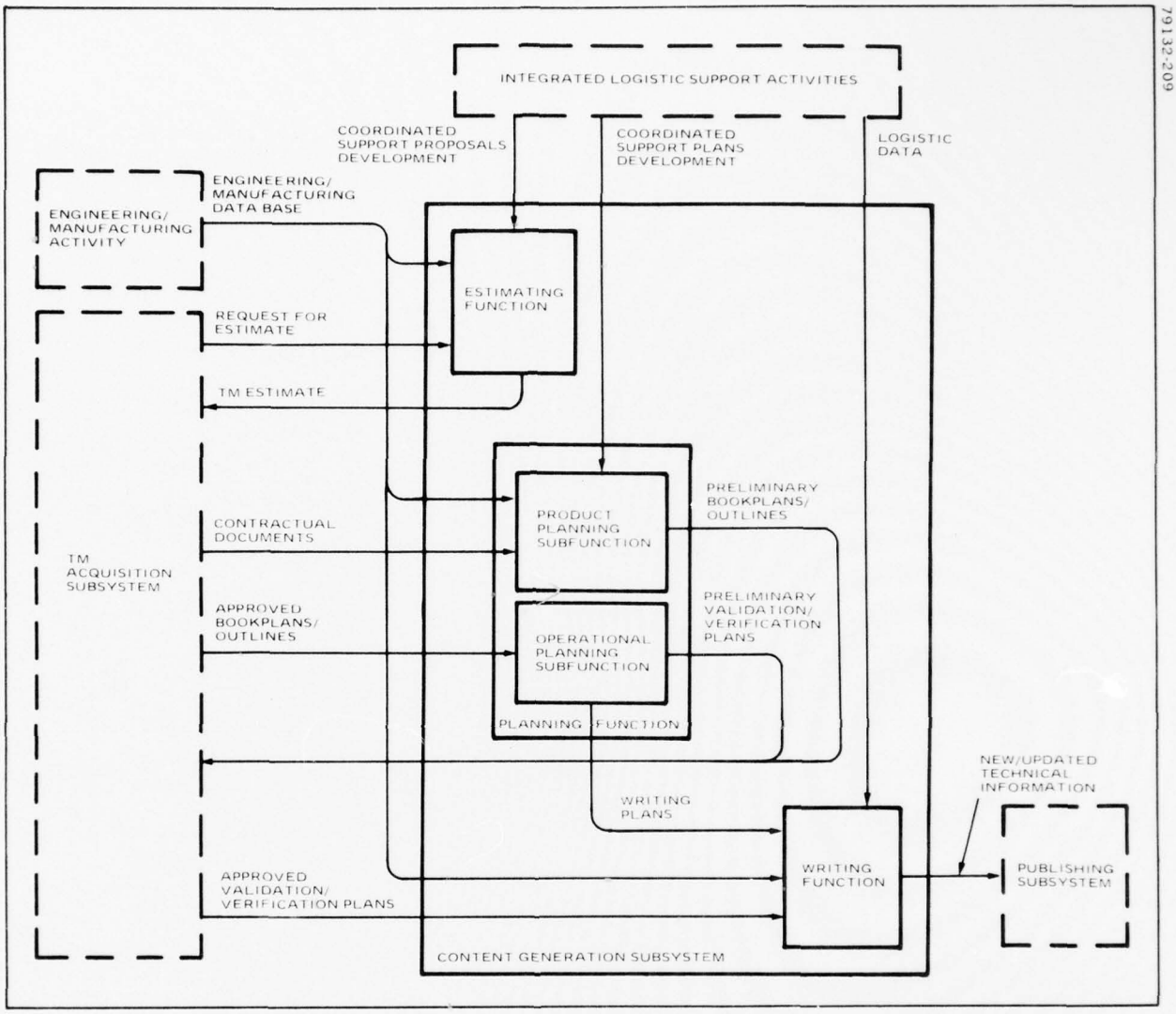


Figure 4-7. Content Generation Subsystem. The content generation subsystem preliminary concept contains all the functional elements necessary to estimate, plan, and perform the transformation of the engineering/manufacturing and logistic data bases into TM manuscripts.

Estimating Function – An estimate is developed for each TM preparation effort based on the results of the analysis of the TM requirements and system/equipment design information. The estimate provides the TM Acquisition Subsystem with a detailed description of the cost and effort that would be incurred for the proposed TM. Detailed cost data includes such items as labor, management, material, overhead, and profit where the content generator is a contractor. Included in the estimate is a detailed description of the effort such as text and illustration page counts for the paper medium.

As part of the effort to improve the quality and sufficiency of the overall support program, the technical information estimate development effort would be coordinated with the estimating efforts of the other ILS activities (such as training, provisioning, and maintenance engineering). This reduces or eliminates redundancies among the ILS activities and improves the total support package supplied to the using activities.

Planning Function– The planning function, which encompasses the content generator's total planning effort, is divided into its basic subfunctions, product planning and operational planning. Product planning deals exclusively with those tasks related to the development of accurate and detailed TM bookplans and outlines. Operational planning covers those tasks related to the actual technical data development: applying the content generator's capabilities in the most efficient manner to prepare accurate and adequate technical data.

In the product planning subfunction, the problem of vague and incomplete TM bookplans and outlines based on traditional generalized specifications is overcome. Detailed TM bookplans and outlines which accurately describe the TM to be developed are prepared from system/equipment descriptions in accordance with the detailed requirements contained in the modular specifications. The product planning is also coordinated with the planning efforts of the other ILS elements (e.g., training, logistic analysis, spare provisioning) to ensure a totally integrated support package is being provided to the user.

Operational planning includes development of writing schedules and milestones, preparation of preliminary validation and verification plans, and establishment of coordination with the content generation support activities (text processing, graphics, production). Improved writer accuracy and efficiency is ensured through the preparation of writer work packages based on the detailed bookplan and outlines and the establishment of a match between the writer's capabilities and the work package requirements. Plans for additional training are formulated where it is indicated that the writer's capabilities are limited.

Writing Function – The content generator prepares the technical information in accordance with the directives and instructions developed in the planning function. Any writer training plans, prepared during operational planning, are implemented to upgrade the writing staff's capabilities. In the traditional writing effort, conflicting comments that result from independent TM manuscript reviews by the TM acquisition, design engineering, and training activities cause severe problems. Resolving these problems can have serious adverse impact on the TM accuracy and/or adequacy. This is rectified in the preliminary concept by performing a concurrent review and validation, with all these activities and the user activity participating. Quality assurance personnel monitor the progress of the writing effort, review writer draft material, and generate and submit progress reports of the TM Acquisition Subsystem. Included in these reports are the technical information development problems that have been encountered and their solutions. Direct Navy participation in contractor writing efforts consists of performing in-process reviews (IPRs) of writer draft TM material and participating in the concurrent TM manuscript review and validation performed by the contractor.

4.2.2 DESCRIPTION OF ENGINEERING/MANUFACTURING DATA BASE

By adding maintenance information and applying automation technology to the engineering/manufacturing data base, it can be made more accessible and beneficial to the content generator.

The engineering/manufacturing data base is a critical input to the content generator, because it is the sole source of the system/equipment description. This data base is used by the content generator to develop technical information cost estimates and program planning documents (TM book plans/outlines). Additionally, the writing task consists largely of a transformation of the technical data contained in the data base into technical information.

At present, the engineering/manufacturing data base consists of engineering drawings, test specifications, wire lists, parts lists, engineering reports, design notebooks, memos and other documentation that is required to design and manufacture a specific product. This data base is developed by the engineering activity for delivery to the system procuring agency and/or for internal manufacturing use. The engineering/manufacturing data base is developed to disclose the engineering design concept for evaluation, demonstrate the suitability of the engineering design approach to support manufacture of a production prototype, and provide a sufficiently complete engineering definition to either enable in-house production or production by any competent manufacturer.

Because the engineering/manufacturing data base is developed to satisfy the requirements of those two disciplines, it does not adequately address the needs of the content generator. Engineering drawings and specifications are prepared with only the data necessary to build and test the hardware in a factory and do not contain the detail or emphasis that is needed in the technical manual. For example, testing, troubleshooting, and alignment procedures developed by the engineering activity for the factory environment may be totally inappropriate in the field environment due to differences in available support and test equipment. In addition, they often contain manufacturing process notes that are of no use to the TM developers or users. As a result, the transformation of this data base into usable technical information is often expensive and ineffective.

Improving the Data Base – The preliminary concept would improve the data base content by modifying content requirements to include the addition of maintenance data (wear tolerances, torque requirements, signal waveforms, and voltage levels, etc.) to the already existing design and manufacturing data. The addition of wear tolerances, for example, provides the source data to determine when an item has reached the point where its failure is imminent and repair or replacement is required. Voltage levels and waveforms are examples of electronic equipment maintenance data that enables the content generator to develop accurate maintenance and troubleshooting procedures. The addition of maintenance data to the design and manufacturing data already contained in the engineering/manufacturing data base is accomplished by the replacement or modification of MIL-STD-100 to fit the added data needs of the content generator.

Maintaining accuracy and currency of the engineering/manufacturing data base presents additional problems to the content generator. This is because of the present manual methods that are used to document and distribute the data base. The design is developed by the engineering staff, documented by draftsmen, checked by checkers, and then submitted to some form of document control system for storage, reproduction, and distribution to users. Any formal changes to the documentation that are prepared during hardware manufacture are valid for changing the manufacturing process the moment they are approved. An example of this

type of change is a manufacturing activity that generates an engineering order (floor EO). Since the EO satisfies the manufacturing process needs immediately, it is not critical to the engineering or manufacturing activity to have the affected drawings updated immediately. As a result of the delay caused by the normal processing time for document control, reproduction, and distribution of the EO, the content generator may not become aware of the change for several weeks or more. With the limited time available for developing TMs, any delay in the receipt of change information results in delayed rewrite efforts. This becomes especially critical near the end of the writing effort if incorporation of the change requires a major rewrite.

In the NTIPS preliminary concept, the present-day capabilities of computers and their peripheral equipments would be employed to provide the way for the manufacturer to improve data base accuracy and currency. This also would enable him to reduce his costs and improve his product by reducing or eliminating many repetitive, time-consuming tasks now required in the manual development of data bases. Table 4-8 defines the basic characteristics of the proposed concept. Included are the types of controlling documents, data types, and convertibility to TM characteristics, as well as the processing form with its data management method, presentation medium, and accessibility and availability characteristics.

Methods for Generating Data Base – In order to meet the needs of large, medium, and small engineering activities, various methods of generating the engineering/manufacturing data base are accommodated in the preliminary concept. As shown in the table, the methods vary from automating all or part of the data base development process (fully automated and semiautomated systems for large and medium sized activities) to manual means for small activities.

The fully automated generation system consists of a computer, interactive graphic terminals, and output devices for developing and maintaining the data base. In this system, the design engineer develops his design and performs the drawing checks directly on an interactive graphic terminal. This results in the engineering drawings, specifications, and all other pertinent design data being processed and stored in digital form in the computer. Output devices convert the digital data to: (1) forms that manufacturing requires (numeric controlled tapes, planning documents, drawings, etc.) to produce and test the system, equipment, or hardware product; (2) forms required to meet the contract data requirements (CDRLs); and (3) forms to meet the needs of the content generator. Some data (such as mechanical and schematic diagrams) is directly usable as technical information while other data (e.g., system test procedures, acceptance test specifications, and equipment descriptions) has to be reviewed and analyzed before transformation. The time-consuming tasks of data reproduction and distribution associated with a manually generated data base, as well as the accompanying human errors and controls required to reduce those errors, are eliminated. Validity of the data base is maintained by the inherent data management and control feature of the computer program which grants permission for an update only to authorized engineering personnel. Any design errors in the data base are readily corrected by the design engineer using his interactive graphic terminal.

To the content generator, the automated data base provides immediate access through interactive graphic terminals eliminating the time delays associated with manually reproduced and distributed data. For example, when a writer requires a specific diagram, he uses his interactive graphic terminal to call it up for display. If he needs a copy, he then uses an output device (x-y plotter) to produce the diagram. The elimination of the time delay also increases the data base as far as the

4.2.2 DESCRIPTION OF ENGINEERING/MANUFACTURING DATA BASE (Continued)

content generator is concerned because the diagram he sees is the same diagram the designer just entered into the system.

For a semiautomated system, the same type of data processing equipment is used, but to a limited extent. The size of the engineering activity, the type of system/equipment manufactured, and available capital for equipment investment are the basic criteria that determine the automation level. In a design activity with a limited number of interactive graphic terminals, for example, the design data is manually generated and checked by the design engineer. A draftsman or clerk then enters the design data into the computer through his interactive graphic terminal. Access to this data base is also limited by the number of terminals available and user demands. Any part of the data base that is manually generated, updated, stored, reproduced or distributed will continue to suffer from the same problems that plague any manually developed data base. Manual generation is limited to small activities with limited funds which prohibit purchase of data processing equipment.

Data Base Alternatives – A limited automated capability alternative provides an engineering/manufacturing data base in which only the graphic information (i.e., all types of diagrams and schematics) is generated, processed, stored, and reproduced in the same manner as the preliminary concept. All text information (test specifications, equipment descriptions, etc.) is manually generated, duplicated, and distributed. Data base content requirements (including maintenance data) remain the same as for the preliminary concept. This alternative would suffice in most cases where the manufactured product is strictly mechanical in nature.

A second alternative (limited in automated capability and content) is similar to the first in its method of implementation. The difference is that only engineering/manufacturing data is developed by the design engineering activity, as is done today. That is, no maintenance data is included in the data base content requirements.

TABLE 4-8. NTIPS ENGINEERING/MANU

Engineering Activity Size	Generation Method	Content Requirements	Controlling Documents	Data Types	Convertibility to Technical Information
					NTIPS PRELIMINARY
Large	Automated text and illustrations	Design, manufacturing and maintenance data	MIL-STDs, MIL-SPECs, CDRLs	Formal (deliverable) and informal (non-deliverable)	Direct and indirect
Medium	Semi-automated text and illustrations	Same	Same	Same	Same
Small	Manual text and illustrations	Same	Same	Same	Same
					LIMITED AUTOMATED C
Large	Automated illustrations and manual text	Design, manufacturing and maintenance data	MIL-STDs, MIL-SPECs, CDRLs	Formal (deliverable) and informal (non-deliverable)	Direct and indirect
Medium	Semi-automated illustrations and manual text	Same	Same	Same	Same
Small	Manual illustrations and text	Same	Same	Same	Same
					LIMITED AUTOMATED CAPABILITY
Large	Automated illustrations and manual text	Design and manufacturing data	MIL-STDs, MIL-SPECs, CDRLs	Formal (deliverable and informal (non-deliverable)	Indirect
Medium	Semi-automated illustrations and manual text	Same	Same	Same	Same
Small	Manual illustrations and text	Same	Same	Same	Same

RING/MANUFACTURING DATA BASE CHARACTERISTICS

nvertibility to Technical formation	Processing Form	Data Management and Control	Revision Status	Presentation Medium	Accessibility	Availability	Storage
PRELIMINARY DATA BASE CONCEPT							
rect and direct	Digital	Computer program	Current	Intelligent terminal, paper	Immediate	On demand	Disc, mag tape, paper and microform
me	Digital/ paper	Computer program for automated aspect; document control for paper	Current (digital); delayed (paper)	Same	Immediate (digital); delayed (paper)	On demand (digital); by request (paper)	On demand (digital); by request (paper)
me	Paper	Document control	Delayed	Paper	Delayed	By request	Paper and microform
UTOMATED CAPABILITY ALTERNATIVE							
rect and direct	Digital/ paper	Computer program for automated aspect; document control for paper	Current (digital); delayed (paper)	Intelligent terminal, paper	Immediate (digital); delayed (paper)	On demand (digital); by request (paper)	Disc, mag tape, paper and microform
me	Same	Same	Same	Same	Same	Same	Same
me	Paper	Document control	Delayed	Paper	Delayed	By request	Paper and microform
CAPABILITY AND LIMITED CONTENT ALTERNATIVE							
direct	Digital/ paper	Computer program for automated aspect; document control for paper	Current (digital); delayed (paper)	Intelligent terminal, paper	Immediate (digital); delayed (paper)	On demand (digital); by request (paper)	Disc, mag tape, paper and microform
me	Same	Same	Same	Same	Same	Same	Same
me	Paper	Document control	Delayed	Paper	Delayed	By request	Paper and microform

4.2.3 DESCRIPTION OF ESTIMATING FUNCTION

The TM engineer will provide improved coordination between content generation, and the design engineering, ILS, and quality assurance activities, to ensure development of realistic and integrated TM estimates.

The estimating function of the Content Generation Subsystem is the initial point at which the content generating activity becomes involved in the TM development cycle for new system/equipment procurements or a TM update effort for incorporating changes and modifications. The content generator uses the data acquisition rules specified in the request for estimate, in conjunction with the minimal engineering/manufacturing data bases available at this time, to develop a TM estimate package.

A coordination problem exists because the interrelationships between the TM activity, the design engineering activity, and the ILS elements (training, LSA engineering, and spares provisioning) are not normally established until the TM planning efforts are initiated. As a result, the content generator is forced to base the TM estimate on the initial design data furnished by the design activity. Additionally, without coordination with the other ILS elements, the compatibility of the TM estimate with the total support package is severely limited.

An additional coordination problem exists because the interrelationship between the TM activity and the quality assurance activity is not normally established until the TMs are fully developed. Lacking QA guidance, the TM activity may not be fully aware of the QA requirements which must be met to achieve customer acceptance of the TMs. Gaining this knowledge at the end of a program may result in a costly rewriting effort or may surface as a TM revision or change package.

The TM Estimating Process – In the preliminary concept, the TM engineer would be responsible for designing the content and usability of the technical manual. This process is started during the precontract award phase of content generation when the TM engineer, functioning as TM Proposal Technical Manager, analyzes the request for estimate. He then reviews hardware specifications, design disclosure documents, data base requirements, and maintenance philosophy. Schedules and milestones are developed dealing with availability of TM critical items, such as portions of the deliverable and nondeliverable data base. Additionally, tentative plans are made for TM developer interrelationships with the design activity and for access to initial-delivery equipment. Working closely with the hardware proposal management team, ILS elements and the QA activity, the TM engineer then develops the TM estimate based on inputs from these activities, resulting in a realistic and totally integrated response to the request for estimate. Guidance for developing the TM estimate would be provided to the TM engineer by the NTIPS TM Development Guide. (See topic 4.2.7.)

Initially, the TM estimating effort (Figure 4-8) involves identification of (1) TM requirements, Contract Data Requirements List (CDRL) and Technical Manual Contract Requirements (TMCR); (2) system/equipment descriptions, including vendor items; (3) schedules, statement of work, pricing instructions, etc.; and (4) the maintenance concept. The specific QA requirements are identified and combined with the activity's basic TM program requirements to form the basis for the proposed TM acquisition QA program.

Based on the above information, preliminary estimates of the TM package size and content, and TM milestones and schedules are developed. The TM engineer evaluates the proposed engineering/manufacturing data base against the technical information development needs identified by the TM requirements to determine if additional data is needed. These needs, in today's world, are not determined until after

the hardware acquisition contract, which includes the data base content, has been awarded. It then becomes very difficult for the TM developer to obtain the data he needs. Some of the reasons are the design engineer is not contractually covered to develop the data, or his time is so limited he cannot generate the data when needed. This forces the content generator either to develop the data himself or leave it out of the TM. Placing the data needs on design engineering during the estimating phase enables them to obtain contractual coverage, thus ensuring data availability to the content generator.

The preliminary TM estimate package, including any additional engineering/manufacturing data base requirements, forms the TM input to an ILS estimate review board. The review team composed of the TM engineer, hardware program manager, design engineers, and other ILS element personnel, review all ILS element estimates. Each ILS element's input is individually reviewed for impact upon other ILS elements and design engineering. As problems are identified, solutions with their attendent risks are proposed and analyzed. A final, approved TM estimate package is then prepared and delivered to the TM Acquisition Subsystem.

Estimating Function Alternatives – The first alternative deals with the problem of the lack of a complete and well-defined engineering/manufacturing data base when the TM proposal is developed. Since the TM estimate is required by the procuring activity early in the hardware development cycle, only an incomplete, relatively undefined engineering/manufacturing data base is available for review. This forces the estimator into a series of creative guesses as to equipment complexity and difficulty of presentation development, often resulting in inaccurate estimates of TM page counts and man-hours. The consequences can be particularly acute when dealing in high-technology areas where the state-of-the-art is extremely dynamic. The tendency to compensate by overestimating is tempered by the realization that an unrealistic estimate will probably not result in a contract. Since the aim of the content generator is to stay within budget, the only variable which can be manipulated after contract award is TM quality, in the form of depth of coverage, with a resultant impact on page count. Compromises and shortcuts in the development cycle often cause ineffective TMs to be deployed in the field. Ultimately, higher equipment life-cycle costs result due to the increased maintenance time necessitated by TM deficiencies.

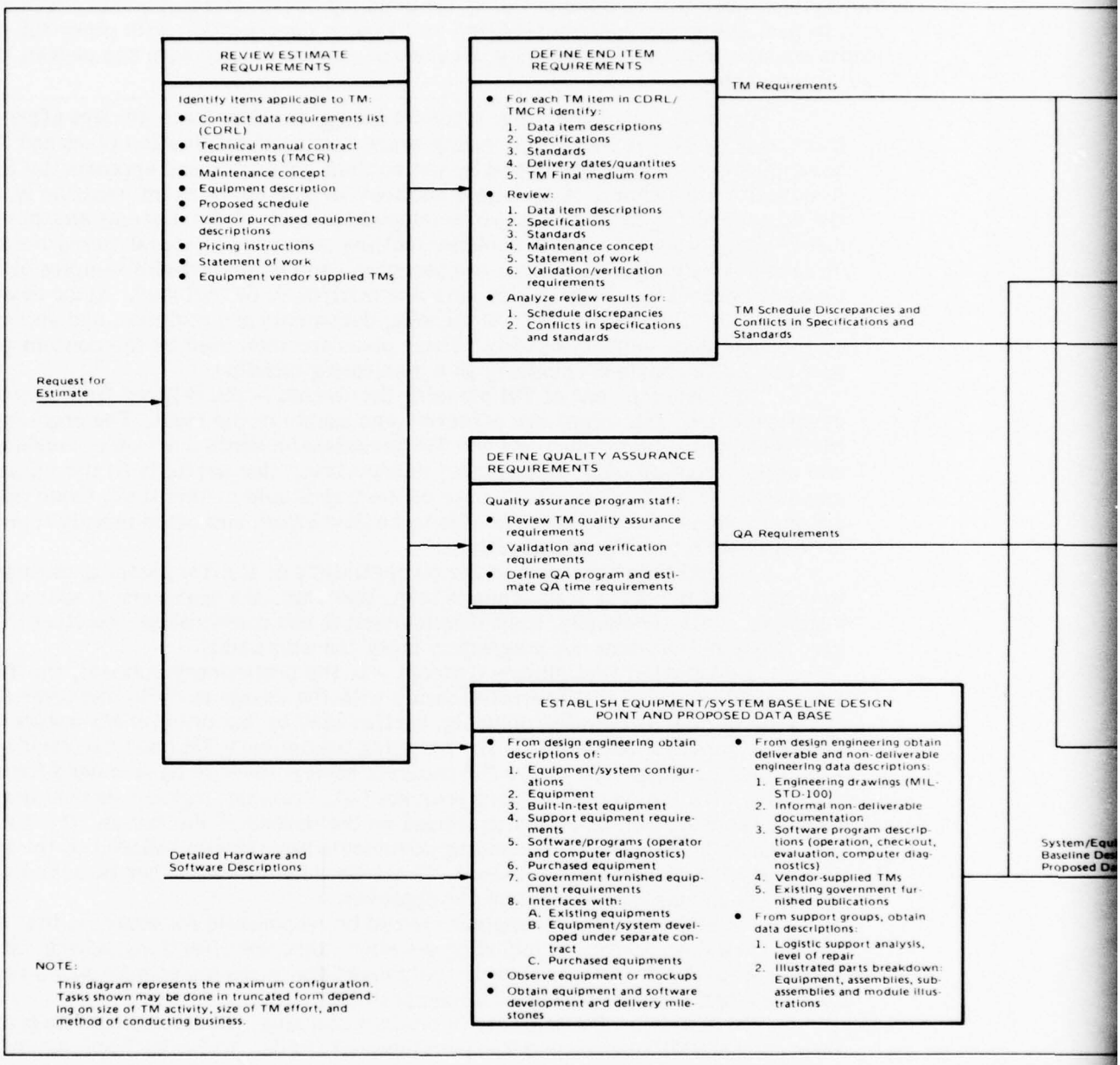
The alternative approach in this type of situation is to release the request for estimate at a point in time which more closely corresponds to actual TM development. At this stage of the program, the engineering concept is firm, hardware modifications resulting from equipment checkout and testing are fewer, and a large percentage of the data base is available. As a result, the content generator is now able to more realistically evaluate the task and develop an accurate TM estimate.

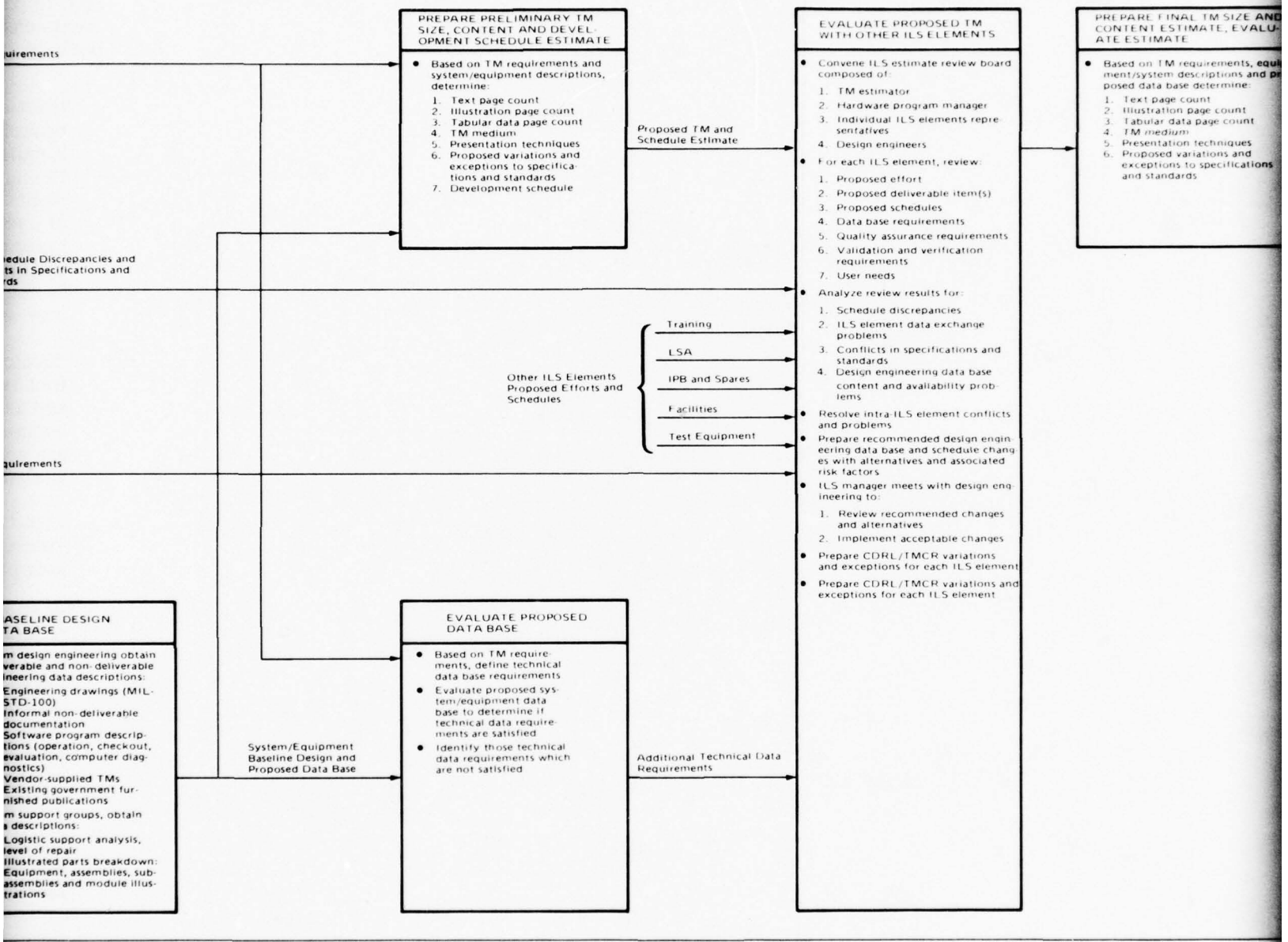
The second alternative is concerned with the problem of "estimating guesses" that make it extremely difficult to determine the adequacy of TM estimating procedures because of the lack of traceable underlying rationale. This problem is compounded by the fact that while actual costs may correspond to estimated costs, this is often a forced fit, more attributable to manipulations of TM quality rather than to the accuracy of the estimate.

The alternative approach to this problem is to use a computer and a special program for developing the TM estimate. The computer performs the actual estimating effort based on input data and internally stored reference information. Inputs consist of the TM requirements, system/equipment descriptions and

4.2.3 DESCRIPTION OF ESTIMATING FUNCTION (Continued)

development schedules, TM development schedules, and the TM development labor rates and material costs. Stored in the computer is a TM historical data file that contains all the same type of information describing previously developed TMs. The computer compares the input data with the stored data and attempts to establish a match. When a match is made, the computer then develops the final estimate with supporting rationale. If only a near match is achieved, the computer identifies the differences, establishes the difference factors, and then uses these factors to develop the final estimate and rationale.


REVIEW ESTIMATE REQUIREMENTS
Identify items applicable to TM:
• Contract data requirements list (CDRL)
• Technical manual contract requirements (TMCR)
• Maintenance concept
• Equipment description
• Proposed schedule
• Vendor purchased equipment descriptions
• Pricing instructions
• Statement of work
• Equipment vendor supplied TMs
DEFINE END ITEM REQUIREMENTS
• For each TM item in CDRL/TMCR identify:
1. Data item descriptions
2. Specifications
3. Standards
4. Delivery dates/quantities
5. TM Final medium form
• Review:
1. Data item descriptions
2. Specifications
3. Standards
4. Maintenance concept
5. Statement of work
6. Validation/verification requirements
• Analyze review results for:
1. Schedule discrepancies
2. Conflicts in specifications and standards
TM Requirements
TM Schedule Discrepancies and Conflicts in Specifications and Standards
Request for Estimate
DEFINE QUALITY ASSURANCE REQUIREMENTS
Quality assurance program staff:
• Review TM quality assurance requirements
• Validation and verification requirements
• Define QA program and estimate QA time requirements
QA Requirements
ESTABLISH EQUIPMENT/SYSTEM BASELINE DESIGN POINT AND PROPOSED DATA BASE
• From design engineering obtain descriptions of:
1. Equipment/system configurations
2. Equipment
3. Built-In-test equipment
4. Support equipment requirements
5. Software/programs (operator and computer diagnostics)
6. Purchased equipment
7. Government furnished equipment requirements
8. Interfaces with:
A. Existing equipments
B. Equipment/system developed under separate contract
C. Purchased equipments
• Observe equipment or mockups
• Obtain equipment and software development and delivery milestones
• From design engineering obtain deliverable and non-deliverable engineering data descriptions:
1. Engineering drawings (MIL-STD-100)
2. Informal non-deliverable documentation
3. Software program descriptions (operation, checkout, evaluation, computer diagnostics)
4. Vendor-supplied TMs
5. Existing government furnished publications
• From support groups, obtain data descriptions:
1. Logistic support analysis, level of repair
2. Illustrated parts breakdown: Equipment, assemblies, subassemblies and module illustrations
Detailed Hardware and Software Descriptions
NOTE:
This diagram represents the maximum configuration. Tasks shown may be done in truncated form depending on size of TM activity, size of TM effort, and method of conducting business.


uirements
edule Discrepancies and
ts in Specifications and
rds
quirements
ASELINE DESIGN
TA BASE
m design engineering obtain
verable and non-deliverable
ineering data descriptions:
Engineering drawings (MIL-STD-100)
Informal non-deliverable documentation
Software program descriptions (operation, checkout, evaluation, computer diagnostics)
Vendor-supplied TMs
Existing government furnished publications
m support groups, obtain
descriptions:
Logistic support analysis, level of repair
Illustrated parts breakdown: Equipment, assemblies, subassemblies and module illustrations
System/Equipment Baseline Design and Proposed Data Base
PREPARE PRELIMINARY TM SIZE, CONTENT AND DEVELOPMENT SCHEDULE ESTIMATE
Based on TM requirements and system/equipment descriptions, determine:
1. Text page count
2. Illustration page count
3. Tabular data page count
4. TM medium
5. Presentation techniques
6. Proposed variations and exceptions to specifications and standards
7. Development schedule
Proposed TM and Schedule Estimate
EVALUATE PROPOSED DATA BASE
Based on TM requirements, define technical data base requirements
Evaluate proposed system/equipment data base to determine if technical data requirements are satisfied
Identify those technical data requirements which are not satisfied
Additional Technical Data Requirements
Other ILS Elements Proposed Efforts and Schedules
Training
LSA
IPB and Spares
Facilities
Test Equipment
EVALUATE PROPOSED TM WITH OTHER ILS ELEMENTS
Convene ILS estimate review board composed of:
1. TM estimator
2. Hardware program manager
3. Individual ILS elements representatives
4. Design engineers
For each ILS element, review:
1. Proposed effort
2. Proposed deliverable item(s)
3. Proposed schedules
4. Data base requirements
5. Quality assurance requirements
6. Validation and verification requirements
7. User needs
Analyze review results for:
1. Schedule discrepancies
2. ILS element data exchange problems
3. Conflicts in specifications and standards
4. Design engineering data base content and availability problems
Resolve intra-ILS element conflicts and problems
Prepare recommended design engineering data base and schedule changes with alternatives and associated risk factors
ILS manager meets with design engineering to:
1. Review recommended changes and alternatives
2. Implement acceptable changes
Prepare CDRL/TMCR variations and exceptions for each ILS element
Prepare CDRL/TMCR variations and exceptions for each ILS element
PREPARE FINAL TM SIZE AND CONTENT ESTIMATE, EVALUATE ESTIMATE
Based on TM requirements, equipment/system descriptions and proposed data base determine:
1. Text page count
2. Illustration page count
3. Tabular data page count
4. TM medium
5. Presentation techniques
6. Proposed variations and exceptions to specifications and standards

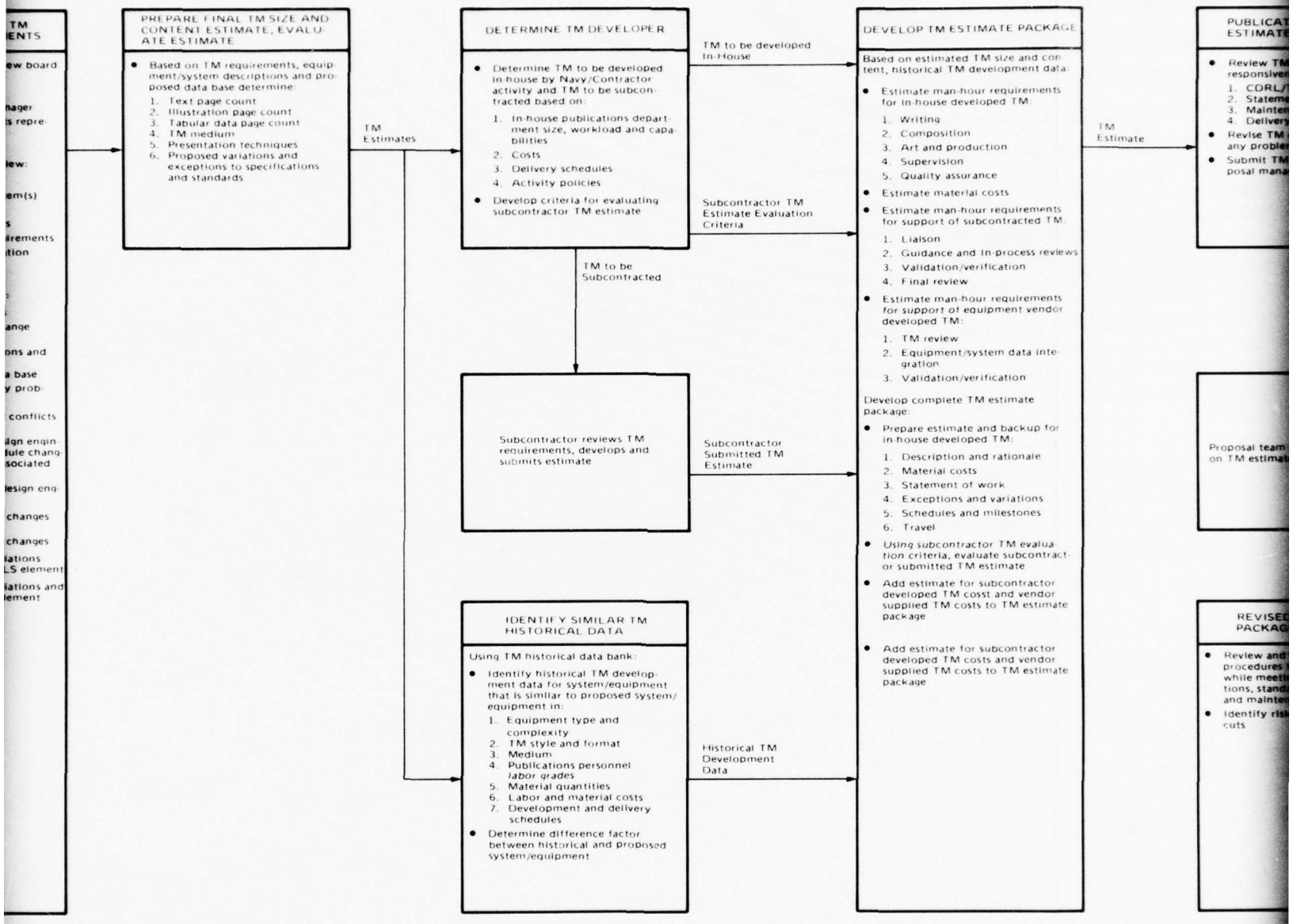
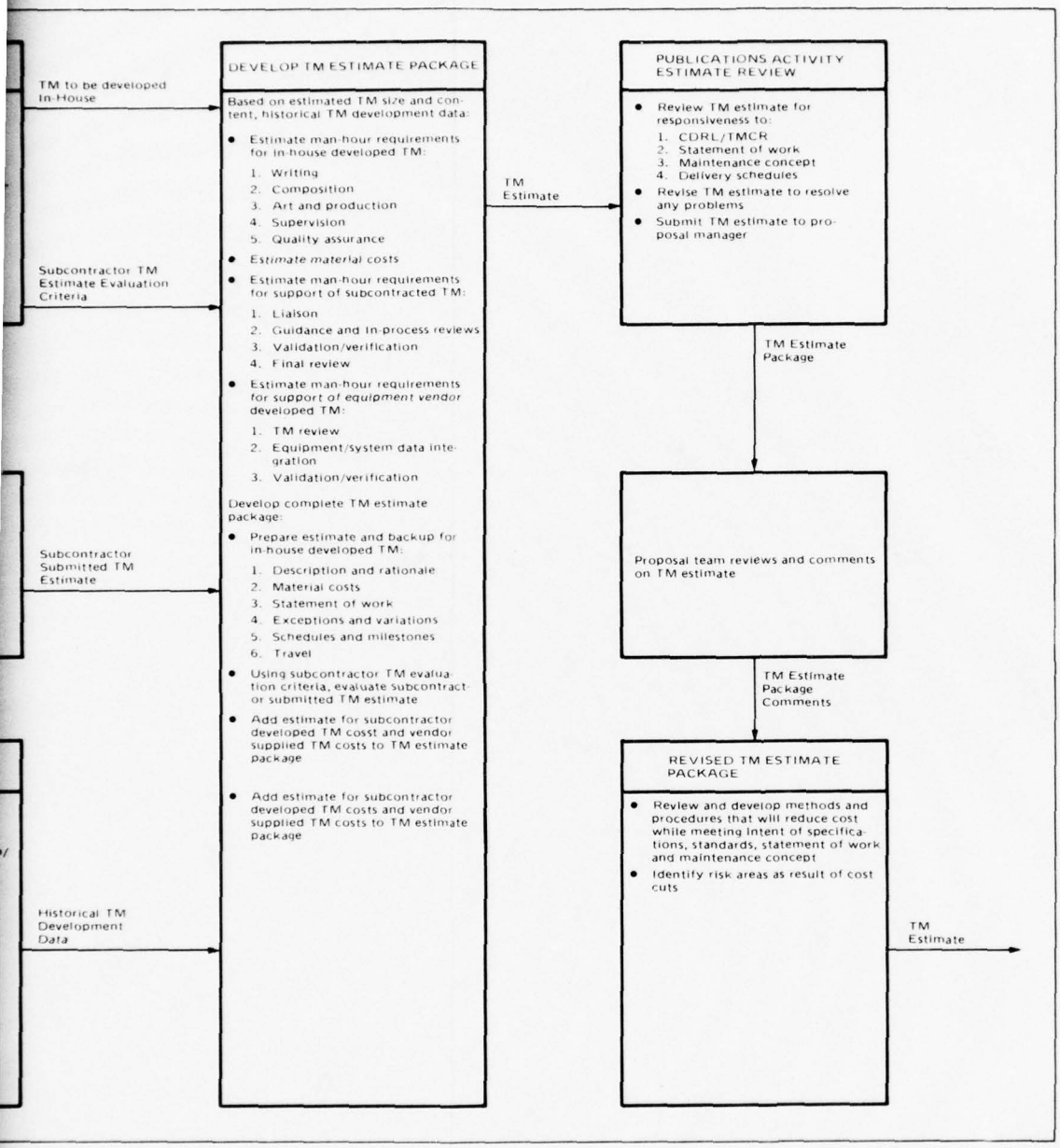


Figure 4-8. Estimating Function. These procedures, with minor exce
Navy in-house and contractor activities generating TM estimates.



re 4-8. *Estimating Function.* These procedures, with minor exceptions, are applicable to both in-house and contractor activities generating TM estimates.

4.2.4 DESCRIPTION OF PRODUCT PLANNING SUBFUNCTION

The TM engineer will develop detailed TM planning documents (e.g., bookplans) customized to particular systems/equipments. In addition, coordination with other ILS elements ensures that the TM planning documents are compatible with the overall ILS package planning.

Product planning normally occurs during the first 30 to 60 days after contract award. This is the period during which technical publication plans and TM bookplans/outlines are developed by the content generator and approved by the TM Acquisition Subsystem. A technical publication plan contains information as to the number and type of TMs to be developed for each of the systems and/or equipments being procured. A TM bookplan/outline presents in general terms the contents of each TM by chapter, section, and paragraph and often includes samples of the types of procedures, descriptions, and illustrations to be included. After development by the content generator, the TM planning documents are reviewed and approved by the cognizant military agency. These plans are then used by the content generator and by the reviewing agency as a monitoring baseline.

The development of TM planning documents is the critical first step in the development of TMs which are effective and usable in the field. The problem is that technical publication plans and TM bookplans/outlines are vague, nondetailed, and usually contain only "boilerplate" information. Due partially to the minimal engineering/manufacturing data base content available at this time, these documents are not designed for the specific TMs to be developed, and often merely repeat what is contained in the TM specification.

An additional problem is the compatibility of the TM planning documents with those of the other ILS elements (e.g., training, LSA engineering, spares provisioning, etc.). Presently, their development is not coordinated, resulting in a support package that does not adequately meet the user needs.

Subfunction Preliminary Concept – In the preliminary concept, the TM engineer would establish the interrelationship with the design activity and prepare a "first-order cut" at detailed planning, limited only by the preliminary nature of the system/equipment definitions. The resulting preliminary TM bookplan requirements would then be submitted to the ILS program review team to be reviewed for compatibility with the overall support program (i.e., training, logistic support analysis, and spares provisioning) planning. Based on the results of the review, the TM engineer would develop detailed planning documents specifically tailored to the hardware and support package being acquired. These documents would then be submitted to the TM Acquisition Subsystem for approval.

Additionally the TM engineer would be responsible for ensuring that all the engineering documentation including drawings, test specifications, wiring lists, etc., will be prepared in formats that not only meet the minimum requirements for manufacturing and test but also are TM-compatible.

To assist the TM engineer in product planning, guidance would be provided through the NTIPS-developed TM Development Guide. Refer to Topic 4.2.7 for a detailed discussion of this guide.

Product Planning Activities – Figure 4-9 illustrates the tasks involved in the preliminary concept for product planning. The initial step in the process is the identification, based upon contractual information, of the TM bookplan data items, validation/verification requirements, vendor TMs, and GFP to be supplied. From this information the TM bookplan requirements are defined. In parallel with this activity, the engineering/manufacturing and LSA data base requirements are evaluated for TM compatibility and maintenance data coverage.

Given all of the information generated thus far, an ILS program review team (composed of the TM engineer and representatives from each ILS element) is convened. This team is responsible for coordinating all ILS planning in order to generate a complete support package (e.g., TMs, user training and training aids, logistic support analysis, and spares provisioning) that meets the system/equipment operational and maintenance requirements. In the event of conflict between ILS elements, the program review team will evaluate the point(s) of contention and provide a joint resolution of the problem(s).

The ILS review team will identify any inadequacies in the engineering/manufacturing and LSA data bases, such as missing maintenance data, instructions, or procedures which were not possible to identify during the TM estimating process, as well as any problems associated with hardware availability. Recommended solutions will be formulated for all problems identified (e.g., redundancies in TMs and training data, incompatible schedules, conflicting specifications, differences in maintenance level and spares provisioning, data base inadequacies, etc.) as well as assessment of the risks (to TM developers and other ILS elements) inherent in implementing these recommendations. The recommendations and associated risks related to the engineering/manufacturing data base are then submitted to design engineering for review and action. The results of any tradeoffs that impact contractual requirements are forwarded to the ILS manager for subsequent negotiations with the TM Acquisition Subsystem. Based upon the results of design engineering action and, as applicable, contract changes, finalized requirements for TMs and other ILS products are established.

The TM engineer then prepares the detailed TM bookplan and outline based on these requirements. A component of these requirements, the NTIPS-developed modular specification, provides the TM engineer with the top level TM bookplan and outline down to a chapter or section. Additionally, the modular specification, based upon the user-data match model, identifies the technical content and presentation techniques for each chapter or section. Using this information and the system/equipment descriptions, the TM engineer develops the bookplan and outline detailed to the paragraph level. The modular specification provides the TM engineer with a major advantage over the traditional specifications in that it is custom-fitted to the specific system/equipment being procured. The various technical content and presentation techniques to be employed to meet the user's needs are defined by chapter or section. This is especially beneficial for a system employing multiple disciplines (e.g., mechanical, electrical, and electronic subsystems contained in an aircraft carrier's elevator or an automated propulsion plant).

For example, the technical content for the electronics portion of an elevator may require theory of operation, troubleshooting information, and repair data such as removal and replacement, alignment and adjustment procedures. In developing the TM bookplan and outline, the TM engineer is able to confirm the validity of the specifications against the hardware descriptions at this meaningful level. Should a problem arise, he can prepare recommended changes and submit the changes in specific modular terms as part of the final bookplan and outline submittal. The presentation techniques employed to support the technical content may consist of coded block diagrams for theory of operation, maintenance dependency charts for troubleshooting, and line drawings highlighting the item(s) associated with the repair procedure. Again, the TM engineer confirms the validity of these specifications and prepares recommended changes if necessary.

Although the technical content and presentation techniques required for the elevator's mechanical portion are different (for example, requiring only trouble-

4.2.4 DESCRIPTION OF PRODUCT PLANNING SUBFUNCTION (Continued)

shooting information with decision flow diagrams, and repair procedures with exploded view mechanical assembly diagrams), the TM engineer's bookplan and outline development, and specification validity confirmation tasks, are the same as for the electronics portion.

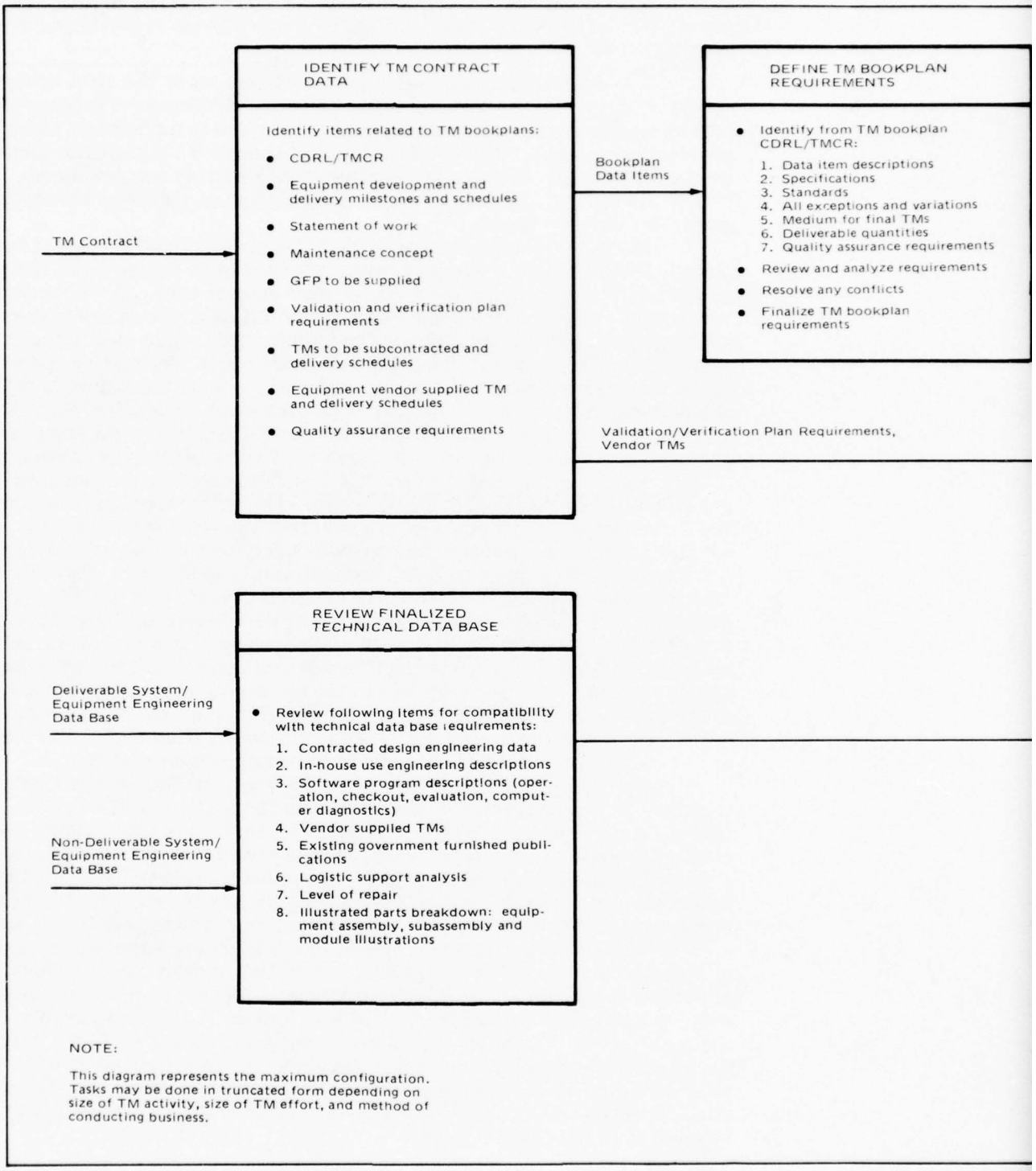
The result is a detailed TM bookplan and outline that is customized to a specific TM procurement, reflects real user needs, and provides explicit TM development direction with examples to the TM writer.

Product Planning Subfunction Alternatives – A viable alternative is the time-phased development of TM planning documents. This alternative is based on: (1) these documents are not needed until a short time (approximately 60 days) before the actual start of the writing effort, and (2) the engineering/manufacturing data base detailed information becomes available in increments as each step in the hardware design is completed.

A key ingredient in the development of TM bookplans and outlines is system/equipment knowledge. To tailor technical publication plans and TM bookplans and outlines to unique system/equipment characteristics, requires substantially firm equipment design data. This data is not available immediately after contract award, but becomes available in increments as the design progresses from contract award to the start of technical information generation. However, several methods of developing time-phased TM planning documents are available; the method selected depends on the size of TM program. For a relatively small program, the planner delays the start of planning until the majority of the design is complete and firm engineering data is available. The only restriction here is that the TM planning documents must be completed and submittted to the TM Acquisition Subsystem in sufficient time for review and approval prior to the actual start of the writing effort.

Another method available to the planner is to prepare and submit a preliminary TM bookplan, with a skeletal outline, within 60 days after contract award. This enables the TM Acquisition Subsystem to review, at an early date, the general approach, and the presentation techniques to be used. When the design engineering data becomes firm, the planner develops and submits the detailed TM outline. Any comments by the TM Acquisition Subsystem on the basic TM planning documents, and any modifications that result from design engineering changes are incorporated in this submittal. This second submittal is developed in sufficient time to allow for review and approval prior to the actual start of the writing effort. This method is applicable to medium and relatively large-scale TM acquisition programs.

In a variation of the above, incremental packages can be developed and submitted for review and approval as various parts of the engineering design are completed. This enables the TM outlines to be developed over a period of time, eliminating a big effort just prior to the start of the writing effort.


IDENTIFY TM CONTRACT DATA
Identify items related to TM bookplans:
• CDRL/TMCR
• Equipment development and delivery milestones and schedules
• Statement of work
• Maintenance concept
• GFP to be supplied
• Validation and verification plan requirements
• TMs to be subcontracted and delivery schedules
• Equipment vendor supplied TM and delivery schedules
• Quality assurance requirements
TM Contract
Bookplan Data Items
DEFINE TM BOOKPLAN REQUIREMENTS
• Identify from TM bookplan CDRL/TMCR:
1. Data item descriptions
2. Specifications
3. Standards
4. All exceptions and variations
5. Medium for final TMs
6. Deliverable quantities
7. Quality assurance requirements
• Review and analyze requirements
• Resolve any conflicts
• Finalize TM bookplan requirements
Validation/Verification Plan Requirements, Vendor TMs
REVIEW FINALIZED TECHNICAL DATA BASE
Deliverable System/ Equipment Engineering Data Base
Non-Deliverable System/ Equipment Engineering Data Base
• Review following items for compatibility with technical data base requirements:
1. Contracted design engineering data
2. In-house use engineering descriptions
3. Software program descriptions (operation, checkout, evaluation, computer diagnostics)
4. Vendor supplied TMs
5. Existing government furnished publications
6. Logistic support analysis
7. Level of repair
8. Illustrated parts breakdown: equipment assembly, subassembly and module illustrations
NOTE:
This diagram represents the maximum configuration. Tasks may be done in truncated form depending on size of TM activity, size of TM effort, and method of conducting business.

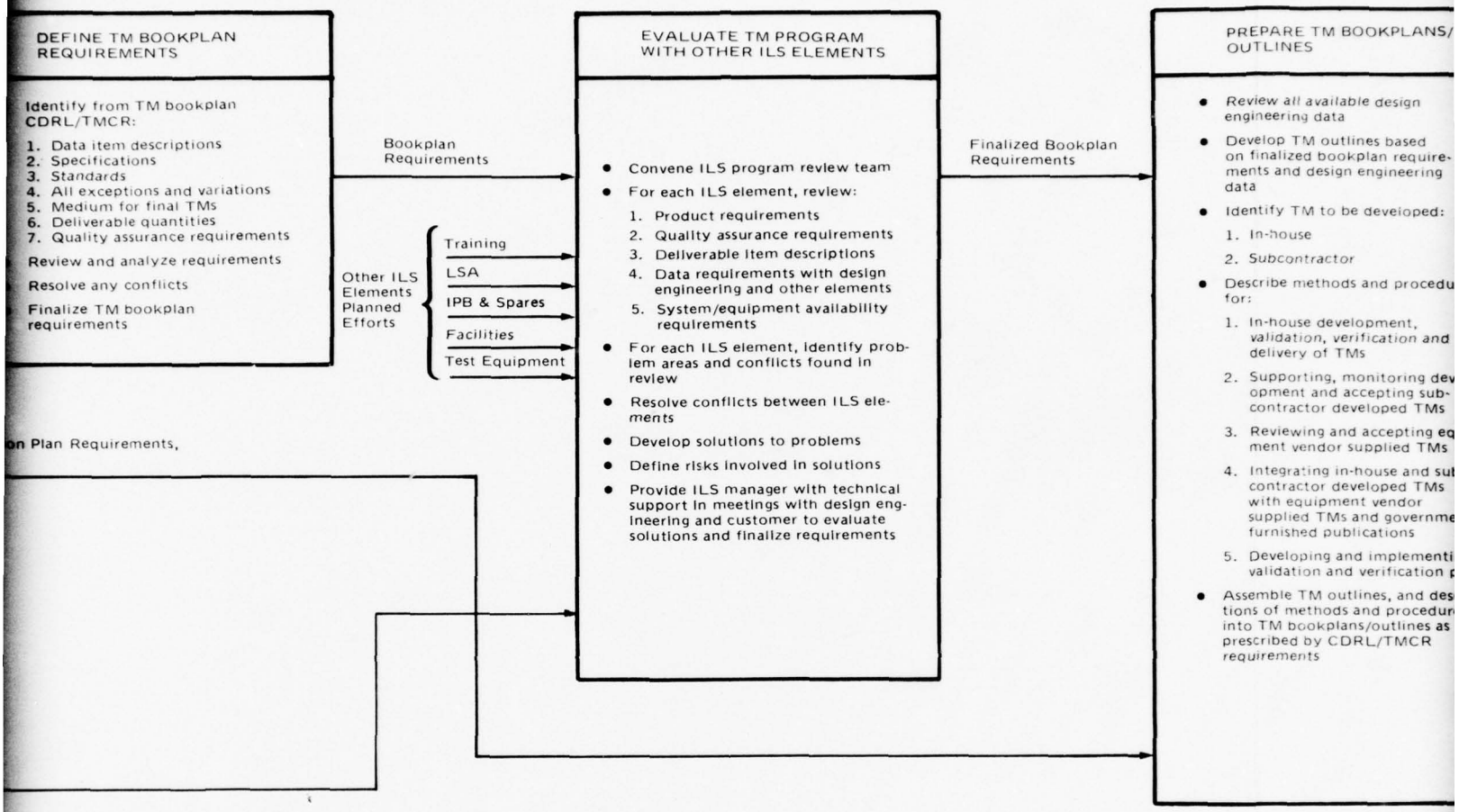


Figure 4-9. NTIPS Proc
and evaluated with othe

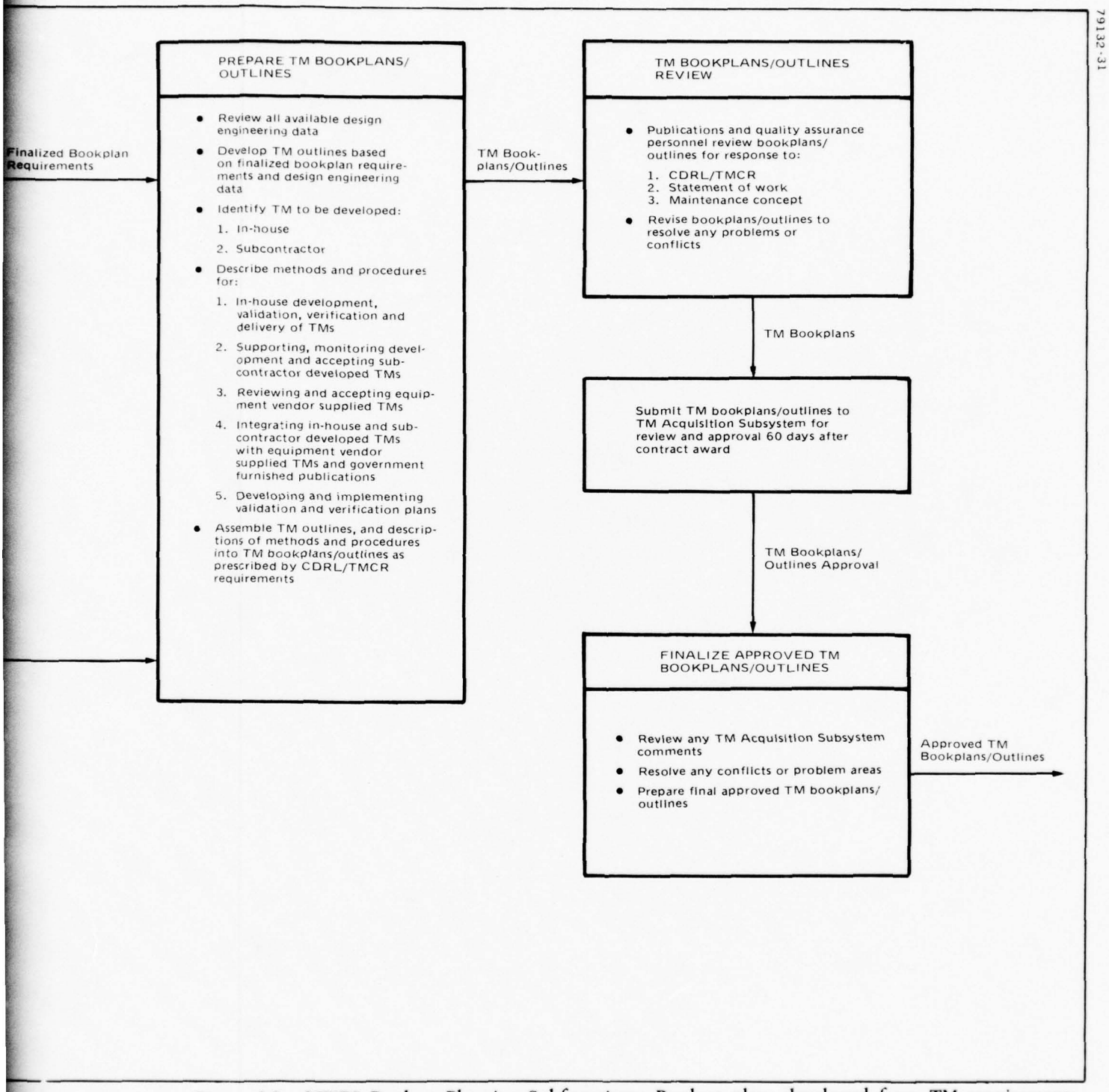


Figure 4-9. NTIPS Product Planning Subfunction. Product plans developed from TM requirements and evaluated with other ILS plans maintain the planning balance needed to meet the user needs.

4.2.5 DESCRIPTION OF THE OPERATIONAL PLANNING SUBFUNCTION

Tasking of the TM engineer to do a better job of upgrading the writing staff and matching the writers to the various work packages would provide major improvements to the writing effort.

The operational planning (Figure 4-10) occurs at the start of the actual TM development cycle. At this point, the hardware development process has evolved into an engineering/manufacturing data base which is sufficiently complete for TM generation purposes. During this phase, the approved TM planning documents (developed in product planning) are converted into writing work packages. Validation/verification plans, internal schedules and milestones, and program-unique writer's guides are also developed.

In the preliminary concept, the TM engineer would prepare a detailed bookplan that is itemized to the page level. This bookplan would detail the required content and presentation technique for each subject area. Development of this bookplan requires the active participation of TM supervisors and writers, training personnel, and logistic engineering disciplines. This would ensure that the material presented in the technical manual is compatible with the training data highlighted in the classroom/laboratory sessions, and that the maintenance data reflects the engineering analysis of the tasks to be performed at the established maintenance level. Operational planning guidance for the TM engineer would be provided in the TM Development Guide. Refer to Topic 4.2.7 for a detailed discussion of this guide.

Matching the Writer to the TM Work Package – A critical step in TM development is developing the match between the writer work package and the writing staff. Unfortunately, a problem exists in that the writing staff members are frequently assigned individual work packages solely on the basis of availability, with little consideration given to individual skills and experiences. Consequently, the quality of the technical information suffers as a result of a less than optimum transformation of the engineering/manufacturing data base into the technical manual. For example, a technical writer with a background in complex electronic systems has greater difficulty in preparing TMs for mechanical systems than does a mechanically oriented writer. Even within the same type of system, writers experienced in the development of more abstract information (e.g., theory of operation) are not equally effective in developing technical information that is more concrete, or mechanical, in nature (e.g., removal or installation procedures).

During operational planning, the TM engineer defines the work package technical writer requirements and identifies the writing staff capabilities and limitations. A preliminary match is performed to determine the adequacy of the writing staff's capabilities. If a need exists, several techniques are available to the TM engineer to upgrade the writing staff. Some have a rather limited effect, while others provide a broader impact. Requiring writers to be graduate engineers with degrees related to the field of endeavor (i.e., mechanical, electrical, electronic, etc.) is one technique. However, while this may improve the technical accuracy of descriptive material (e.g., theory of operation, system/equipment description), maintenance data (e.g., troubleshooting) may decrease in quality because of the writer's lack of hardware and/or field experience. A second technique is to provide the writers with "hands-on" equipment experience during hardware development. This would upgrade the accuracy of maintenance data, but the effect on the technical accuracy of descriptive material may be limited. However, combining these two techniques enables the writers to develop technically accurate TMs, which are responsive to the user's needs.

A third technique to improve the technical writers' capabilities is for the content generator to develop and conduct writer training courses. These courses consist of regularly scheduled sessions oriented toward improving present abilities and introducing new writing methods and techniques. Additional system/equipment familiarization courses would be conducted by the design engineering activity on an "as required" basis to acquaint the technical writing staff with the hardware for which they are developing the supporting technical information.

Coordination With Other Activities – As part of the operational planning effort, the TM engineer establishes interrelationships with support (i.e., illustration, composition, and production) and quality assurance activities. This ensures the plans developed by these activities are responsive to the TM requirements, milestones, and schedules. Early coordination with quality assurance personnel can minimize the problems encountered during TM development as a result of different interpretations of contract requirements, specifications, and standards.

During operational planning, the TM engineer interrelates with design engineering and the ILS elements to review hardware and ILS element development schedules. The purpose is to identify any schedule problems that would affect TM development. These problems result from: (1) delayed availability of engineering/manufacturing and logistic data bases; (2) delayed availability of hardware to writers during TM development; (3) limited availability of operational hardware during scheduled validation activities; or (4) limited accessibility to design engineers for consultation with writers. The TM engineer then will evaluate each potential problem thus identified and formulate a contingency plan to minimize the problem's impact on the TM development effort.

TM Writer's Instructions – Part of the operational planning is to supply the writing staff with detailed writing instructions and guidance in addition to that provided in the TM bookplans and outlines. These instructions are provided in a writer's guide developed by the TM engineer. This writer's guide is not to be confused with the TM Development Guide (discussed in topic 4.2.7), which is used exclusively by the TM engineer. The writer's guide, tailored to the TM acquisition, covers such items as writing style, use of specific terms and words, techniques for transforming material contained in the engineering/manufacturing data base to TM manuscript and participation in in-process reviews. The TM engineer prepares the guide by selecting applicable instructions from contractual documents (e.g., statement of work, exceptions and variations, CDRLs/TMCRs, data item descriptions, specifications, and standards), existing writer's guides from previous TM programs, and any standards, practices and directives peculiar to the TM developing activity. These instructions are then combined with those furnished by the TM Acquisition Subsystem to form a complete writer's guide (see topic 4.2.8 for details).

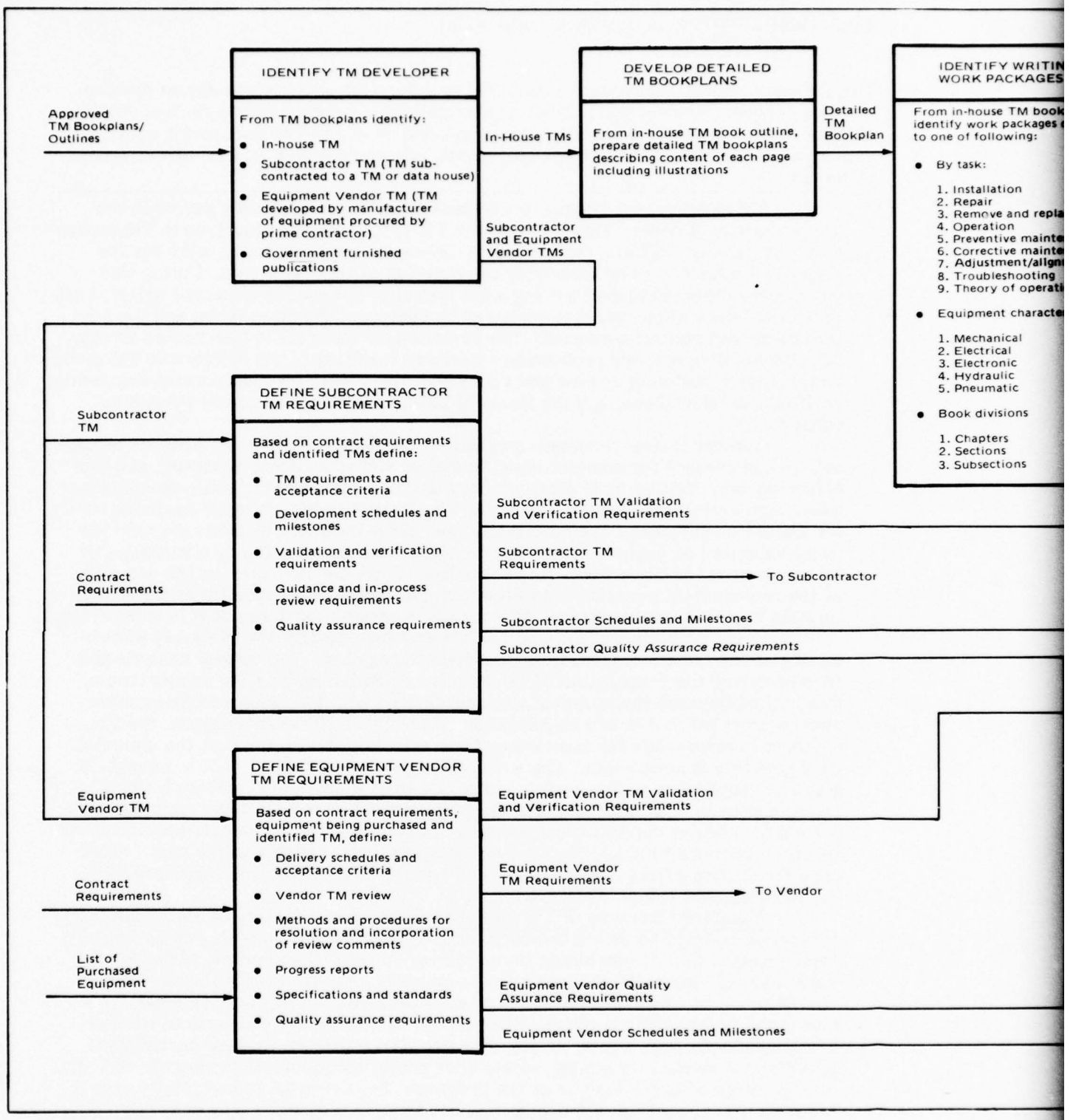
Operational Planning Subfunction Alternatives – Qualification of technical writers through an NTIPS – designed and developed certification program is an alternative to insure that technical writer capabilities meet the TM program requirements. Certifying a technical writer is similar to having a person complete an apprenticeship program before allowing him to become a journeyman in his specific trade. During his apprenticeship, the writer is trained in all facets of technical writing by experienced writers. For example, he learns how to: (1) review TM specifications to obtain descriptions of TM types, format, style and content; (2) analyze the engineering/manufacturing data base for applicability as technical information; (3) transform technical data to technical information in the different presentation techniques; and (4) participate in validation/verification exercises. This program

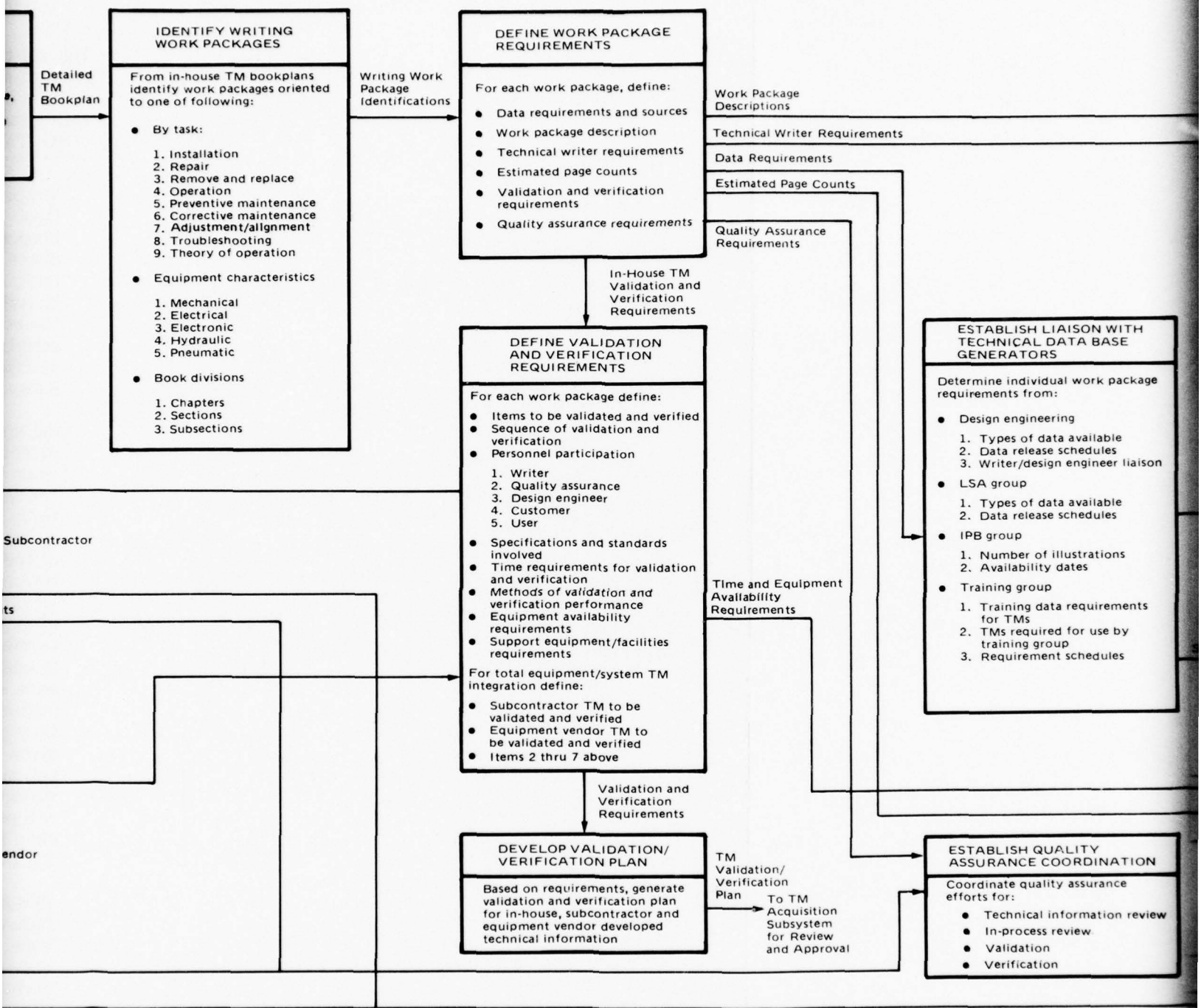
4.2.5 DESCRIPTION OF THE OPERATIONAL PLANNING SUBFUNCTION (Continued)

would verify that the writer has had the education, training, and experience necessary to meet the job requirements.

A second alternative is to subcontract all TM development to data houses, thereby reducing or in the case of a small Navy activity, eliminating the need for an in-house writing staff. The contractor's TM activities would be staffed by TM program management personnel only. In turn, these individuals evaluate the TM estimates submitted by approved data houses, and award contracts to the selected subcontractors. In addition, in-process reviews, validation/verification, and final TM acceptance are under the cognizance of the TM activity.

A variation of this alternative is to use data houses on a limited basis. This allows the TM activities to maintain their writing staffs at a constant level by subcontracting only the TM development programs which exceed in-house capabilities.


IDENTIFY TM DEVELOPER
From TM bookplans identify:
• In-house TM
• Subcontractor TM (TM sub-contracted to a TM or data house)
• Equipment Vendor TM (TM developed by manufacturer of equipment procured by prime contractor)
• Government furnished publications
Approved TM Bookplans/ Outlines
In-House TMs
Subcontractor and Equipment Vendor TMs
DEVELOP DETAILED TM BOOKPLANS
From in-house TM book outline, prepare detailed TM bookplans describing content of each page including illustrations
Detailed TM Bookplan
IDENTIFY WRITIN WORK PACKAGES
From in-house TM book identify work packages to one of following:
• By task:
1. Installation
2. Repair
3. Remove and repla
4. Operation
5. Preventive mainte
6. Corrective mainte
7. Adjustment/alignm
8. Troubleshooting
9. Theory of operati
• Equipment characte
1. Mechanical
2. Electrical
3. Electronic
4. Hydraulic
5. Pneumatic
• Book divisions
1. Chapters
2. Sections
3. Subsections
DEFINE SUBCONTRACTOR TM REQUIREMENTS
Based on contract requirements and identified TMs define:
• TM requirements and acceptance criteria
• Development schedules and milestones
• Validation and verification requirements
• Guidance and in-process review requirements
• Quality assurance requirements
Subcontractor TM
Contract Requirements
Subcontractor TM Validation and Verification Requirements
Subcontractor TM Requirements
To Subcontractor
Subcontractor Schedules and Milestones
Subcontractor Quality Assurance Requirements
DEFINE EQUIPMENT VENDOR TM REQUIREMENTS
Based on contract requirements, equipment being purchased and identified TM, define:
• Delivery schedules and acceptance criteria
• Vendor TM review
• Methods and procedures for resolution and incorporation of review comments
• Progress reports
• Specifications and standards
• Quality assurance requirements
Equipment Vendor TM
Contract Requirements
List of Purchased Equipment
Equipment Vendor TM Validation and Verification Requirements
Equipment Vendor TM Requirements
To Vendor
Equipment Vendor Quality Assurance Requirements
Equipment Vendor Schedules and Milestones


Detailed TM Bookplan
IDENTIFY WRITING WORK PACKAGES
From in-house TM bookplans identify work packages oriented to one of following:
• By task:
1. Installation
2. Repair
3. Remove and replace
4. Operation
5. Preventive maintenance
6. Corrective maintenance
7. Adjustment/alignment
8. Troubleshooting
9. Theory of operation
• Equipment characteristics
1. Mechanical
2. Electrical
3. Electronic
4. Hydraulic
5. Pneumatic
• Book divisions
1. Chapters
2. Sections
3. Subsections
Writing Work Package Identifications
DEFINE WORK PACKAGE REQUIREMENTS
For each work package, define:
• Data requirements and sources
• Work package description
• Technical writer requirements
• Estimated page counts
• Validation and verification requirements
• Quality assurance requirements
Work Package Descriptions
Technical Writer Requirements
Data Requirements
Estimated Page Counts
Quality Assurance Requirements
In-House TM Validation and Verification Requirements
DEFINE VALIDATION AND VERIFICATION REQUIREMENTS
For each work package define:
• Items to be validated and verified
• Sequence of validation and verification
• Personnel participation
1. Writer
2. Quality assurance
3. Design engineer
4. Customer
5. User
• Specifications and standards involved
• Time requirements for validation and verification
• Methods of validation and verification performance
• Equipment availability requirements
• Support equipment/facilities requirements
For total equipment/system TM integration define:
• Subcontractor TM to be validated and verified
• Equipment vendor TM to be validated and verified
• Items 2 thru 7 above
Time and Equipment Availability Requirements
ESTABLISH LIAISON WITH TECHNICAL DATA BASE GENERATORS
Determine individual work package requirements from:
• Design engineering
1. Types of data available
2. Data release schedules
3. Writer/design engineer liaison
• LSA group
1. Types of data available
2. Data release schedules
• IPB group
1. Number of illustrations
2. Availability dates
• Training group
1. Training data requirements for TMs
2. TMs required for use by training group
3. Requirement schedules
Validation and Verification Requirements
DEVELOP VALIDATION/ VERIFICATION PLAN
Based on requirements, generate validation and verification plan for in-house, subcontractor and equipment vendor developed technical information
TM Validation/ Verification Plan
To TM Acquisition Subsystem for Review and Approval
ESTABLISH QUALITY ASSURANCE COORDINATION
Coordinate quality assurance efforts for:
• Technical information review
• In-process review
• Validation
• Verification
Subcontractor
endor

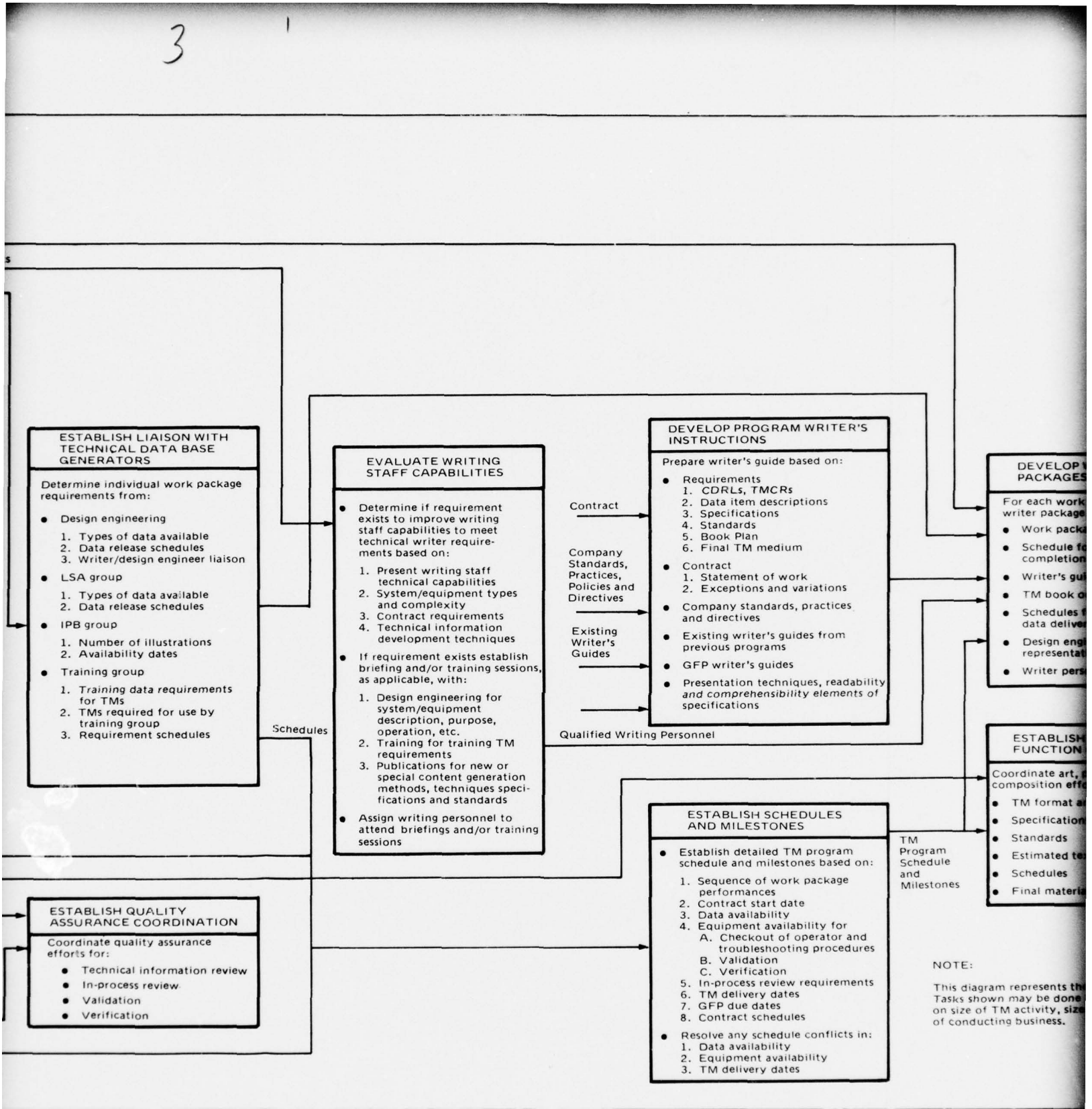
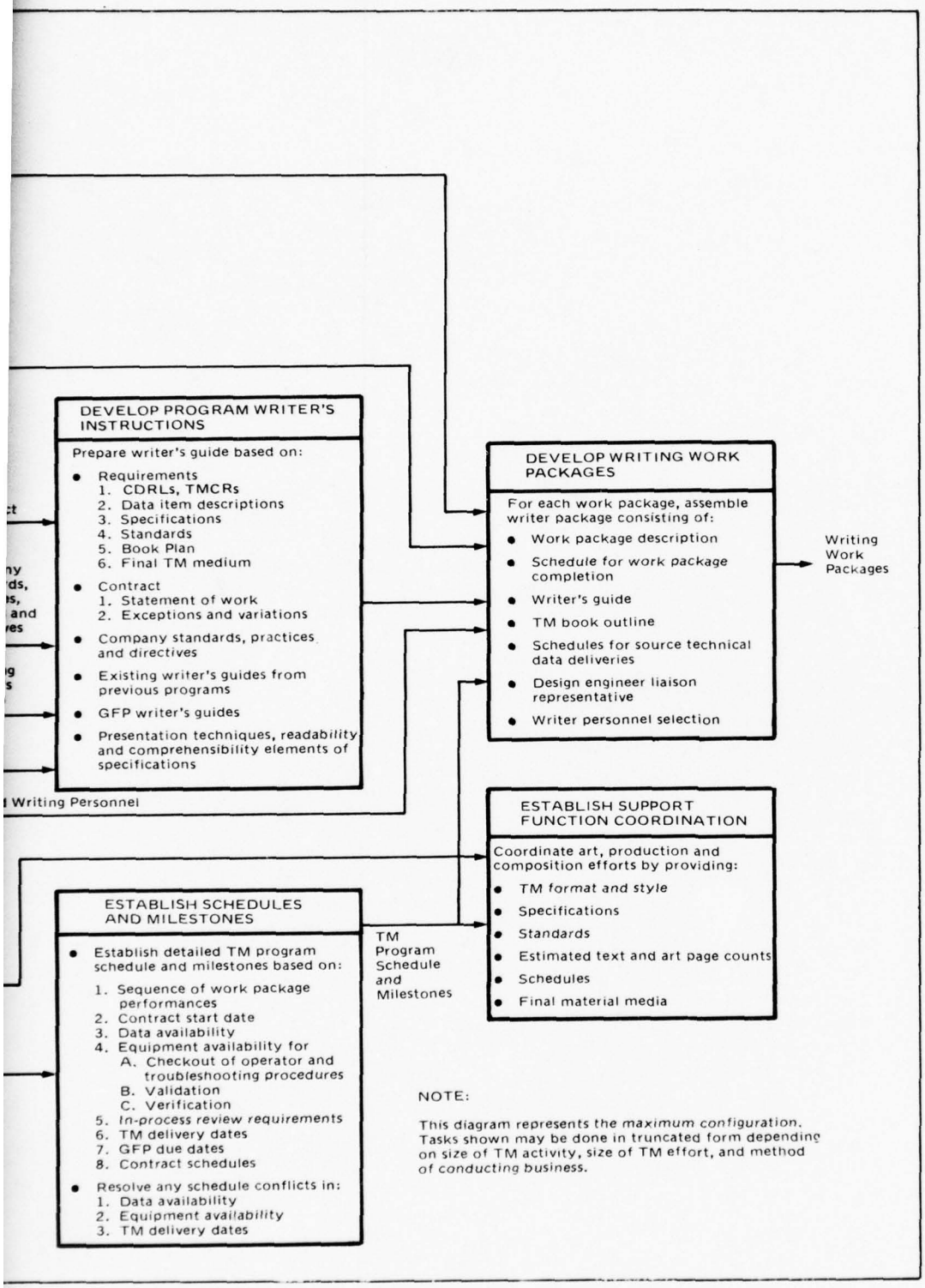


Figure 4-10. NTIPS Operational Planning Subfunction. The TM engin
work package and coordinates operational planning with support activi
and accuracy of the actual TM writing effort.



. NTIPS Operational Planning Subfunction. The TM engineer matches the writer to the ge and coordinates operational planning with support activities to improve the efficiency y of the actual TM writing effort.

4.2.6 DESCRIPTION OF WRITING FUNCTION

The TM engineer will apply the modular TM specification approach to assure development of adequate and accurate TMs. Combining the procuring activity's final review, and the design engineering activity's technical review of the TM manuscript with TM validation will ensure technical and operational accuracy as well as user effectiveness of the TM.

TM development (Figure 4-11) constitutes the largest time period in the TM production process. This is where the TM writer becomes involved in TM production. All previous efforts, performed by TM supervisory personnel, were for the purpose of expediting and enhancing the function of the TM writer. During this phase, previously developed writing work packages are used to generate writer draft technical information, which is reviewed by cognizant TM supervision and the activity's quality control personnel. The reviewed writer draft is then routed through the composition, art, and production activities, resulting in the deliverable TM manuscript. After customer review and validation, the TM writer incorporates comments, verification takes place, and the final TM product is delivered to the Publishing Subsystem.

Current review processes and validation, do not effectively measure technical manual content for completeness, technical and operational accuracy, and user effectiveness. Validation is often accomplished at a point in hardware development when engineering changes are in process. Equipment is seldom made available solely for validation purposes. The results are that many technical manuals are only partially validated on equipment, while the remainder are validated by simulation, or by comparison to source data. The validation effort concentrates on the accuracy of the technical information presented, but does not address specific criteria to determine if all required technical information is present, or if any of it is unnecessary.

In the preliminary concept, the TM engineer assures the adequacy and accuracy of the technical manual to the reviewing agency. The careful analysis performed during the preparation of the detailed bookplan assures TM completeness. In addition, because the bookplan was coordinated with the using activities, assurance is provided that it will be adequate. Once TM writers are assigned, the TM engineer is responsible for supervising their efforts and assuring that the material they generate is acceptable. The writers assigned to each portion of a manual are given the applicable writer work package, showing what is to be covered, the presentation approach to be used, and the depth of coverage for each topic assigned. The system of modular content specifications and presentation techniques specifications will provide more tutorial, "how to" information than available in the past. Guidance for writing effort management would be provided to the TM engineer by the TM Development Guide. (See topic 4.2.7.)

Combined Reviews of TM Manuscript – A unique feature of the preliminary subsystem concept to assure technical and operational accuracy as well as user effectiveness is that of combining the procuring activity final review, technical review, and validation efforts into a single exercise. The procuring activity's final review does not substitute for the regular in-process reviews that are conducted during the actual writing effort. The purpose of combining reviews is to resolve TM problems through a joint effort, thus permitting all TM program participants to achieve consensus as a body, rather than posing solutions which may not reflect consideration of other aspects of the program. For example, the training representative may feel that the TM manuscript coverage in a specific area does not meet his needs. The review team would analyze the coverage problem not only from his viewpoint, but also from the viewpoint of the user's needs, contract requirements, costs, schedules, engineering/manufacturing data base availability, etc. The resulting solution, having been influenced by all review team members, should reflect

agreement in principle concerning what is most equitable and practicable for all aspects of the program.

In order to implement this feature, the TM engineer will form a TM manuscript review team consisting of himself and the writer(s), the customer, representatives from the user and training communities, and design engineering personnel. If the system/equipment on which the TM is to be based is highly complex, representatives from design engineering will present a familiarization briefing to the review team. This briefing will cover such topics as description, function, and operation of the system/equipment.

The team will review all nonprocedural data for accuracy, adequacy, and usability. Subsequently, all validation will be performed using actual equipment, and having all team members in attendance. The TM engineer will coordinate the validation of narrative material accuracy with design engineering and the validation of procedural material on the equipment. Design engineering participation is critical at this time because they can assure the TM engineer, as a result of their review, that the latest design changes have been incorporated in the TM manuscript or identify which areas require rework to pick up unincorporated design changes. Additional validation is provided by the in-house activities that use the TM draft manuscript for assembly, test, checkout, and integration. During verification, the TM engineer will provide the support requested by the reviewing agency.

A post-program review is established for the purpose of evaluating each recently completed TM program to identify any future improvements in the development. The post-program review team is comprised of the TM engineer and his counterpart at the TM Acquisition Subsystem as well as representatives from the training, logistic analysis, quality assurance, and design engineering activities. This team is charged with the collection and analysis of all historical data associated with TM development programs. Included are all problems encountered, from TM estimating through final delivery, their causes and solutions, as well as user and customer comments. Particular emphasis is placed upon identifying those problems that occur repeatedly (or are common to several programs), and evaluating the solutions that were applied in each case. Typical of these problems are: (1) scheduling of TM writer "hands-on" equipment and validation times, (2) conflicts in TM specifications and other contractual documents, (3) development of TM outlines during TM planning, (4) implementation of TM planning during TM development, (5) engineering/manufacturing and/or LSA data base inaccuracies and unavailabilities, and (6) incomplete understanding between TM acquisition activity and the content generator as related to specifications and other contractual documents related to the TM procurement. As solutions are evaluated and one has been determined to be the most effective means of solving the common problem, it becomes a recommended policy/procedure applicable to future TM efforts.

Writing Function Alternatives – One alternative is to use design engineers to write the technical manuals. This alternative capitalizes on the technical knowledge of the equipment design engineers. Each design engineer would be selected for a specific technical writing assignment based on his equipment knowledge rather than on his known writing skill. The lack of writing skill is compensated for by using lower-priced technical writing personnel to edit and publish the TMs.

A second alternative is to automate suitable portions of the writing process. In this alternative, the use of automation in the transformation of the engineering/manufacturing and/or LSA data bases to TMs not only provides a more efficient transformation, but the transformation process is more responsive to a wide variety of TM presentation techniques. The keyboard on a three-dimensional interactive

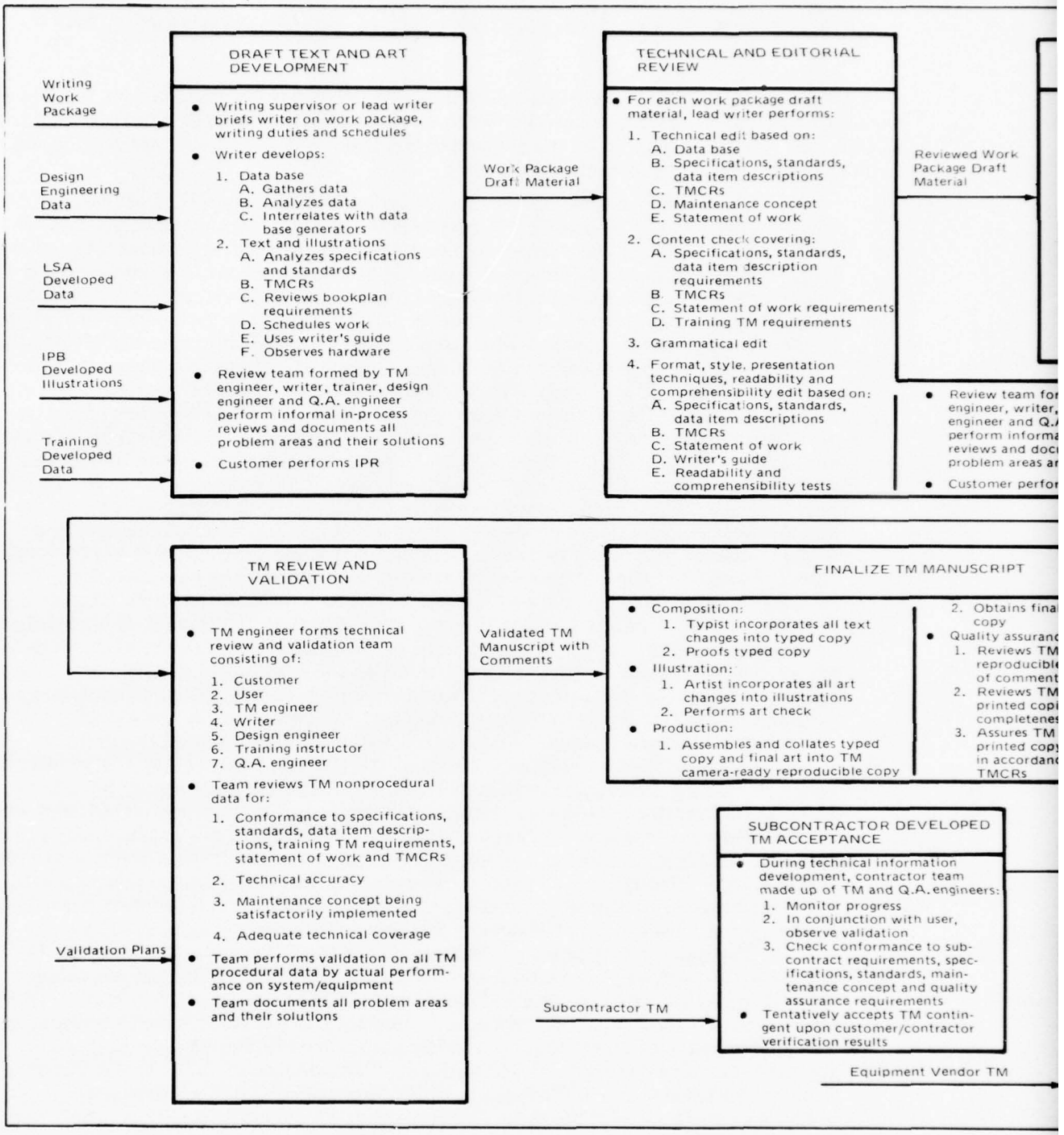
4.2.6 DESCRIPTION OF WRITING FUNCTION (Continued)

graphic display terminal provides the means for entering text or tabular information into a computer, withdrawing it for update with no rehandling of unchanged portions, or making it available for use at another terminal. Drawings can be entered into a computer by a combination of keyboarding and light-penciling on a CRT face at the same terminal, by an X-Y plotter through a digital processor, or by an optical scanner. Text information and drawings stored in digital form can be displayed on the terminal and hard copies (paper) obtained using a line printer for text and an X-Y plotter for drawings.

As an example, the content generator traditionally depends upon orthographic mechanical assembly drawings as well as access to the hardware for the development of removal and replacement procedures. However, in the automated system, he would use his interactive graphic display terminal to call up the specific drawing that contains the mechanical assembly information he needs to develop the procedure. This information is available to his terminal through the terminal's interface with the computer dedicated to the development and storage of the engineering/manufacturing data base. Using the keyboard and light-pen features of his terminal, he reworks the drawing until it conveys the information necessary to support the procedure. Once the drawing rework is completed, he commands it to be stored in the computer dedicated to the TM development.

Automation offers the writer various methods and aids in the development of text material. He can use the terminal to copyfit blocks of descriptive text to functional flow diagrams or make callouts fit the available space on schematics. He first calls up and displays the diagram, then uses the keyboard to add the text or callouts in the selected position on the diagram. In developing straight text he can use the terminal to ensure he is maintaining the correct readability level. He enters the text in question into the terminal and instructs the terminal to evaluate the reading level. The terminal's associated computer checks sentence length and word length against internally set standards and displays the results to the writer. He then can rework the text if necessary to bring it into conformance. The terminal's ability to present vocabulary assistance when requested enables the writer to prepare consistent and clear text. The terminal also offers quick information retrieval from an automated logistics support analysis data base. Maintenance data such as a removal and replacement procedure can be called up, reworked to meet the TM requirements for format and style, and then stored in the computer dedicated to TM development.

A third alternative employs writing staff assistance in the development of the engineering/manufacturing and/or LSA data bases. The primary objective of this alternative is to reduce the writing staff's required familiarization time for new systems/equipments and their associated data bases. Unfamiliarity with new hardware and/or data impedes a writer's initial productivity. This can be a particular detriment to TM programs having relatively short development cycles. As an example of employing this alternative, a group of writers would be assigned to the design engineering activity. They would prepare items of the engineering/manufacturing data base (such as equipment descriptions and functional flow diagrams) under the direction of the design engineer. Also, in the LSA data base, the writers could assist in the analysis of maintenance functions to determine the type of procedure (removal, replacement, adjustment, etc.) required and types of tools, test equipment, and facilities needed to support the procedure. Becoming familiar with this type of information prior to the start of the actual writing enables the writers to be more productive.


Writing Work Package
Design Engineering Data
LSA Developed Data
IPB Developed Illustrations
Training Developed Data
DRAFT TEXT AND ART DEVELOPMENT
• Writing supervisor or lead writer briefs writer on work package, writing duties and schedules
• Writer develops:
1. Data base
A. Gathers data
B. Analyzes data
C. Interrelates with data base generators
2. Text and illustrations
A. Analyzes specifications and standards
B. TMCRs
C. Reviews bookplan requirements
D. Schedules work
E. Uses writer's guide
F. Observes hardware
• Review team formed by TM engineer, writer, trainer, design engineer and Q.A. engineer perform informal in-process reviews and documents all problem areas and their solutions
• Customer performs IPR
Work Package Draft Material
TECHNICAL AND EDITORIAL REVIEW
• For each work package draft material, lead writer performs:
1. Technical edit based on:
A. Data base
B. Specifications, standards, data item descriptions
C. TMCRs
D. Maintenance concept
E. Statement of work
2. Content check covering:
A. Specifications, standards, data item description requirements
B. TMCRs
C. Statement of work requirements
D. Training TM requirements
3. Grammatical edit
4. Format, style, presentation techniques, readability and comprehensibility edit based on:
A. Specifications, standards, data item descriptions
B. TMCRs
C. Statement of work
D. Writer's guide
E. Readability and comprehensibility tests
Reviewed Work Package Draft Material
• Review team for
engineer, writer,
engineer and Q.A
perform informa
reviews and doc
problem areas ar
• Customer perfor
Validation Plans
TM REVIEW AND VALIDATION
• TM engineer forms technical review and validation team consisting of:
1. Customer
2. User
3. TM engineer
4. Writer
5. Design engineer
6. Training instructor
7. Q.A. engineer
• Team reviews TM nonprocedural data for:
1. Conformance to specifications, standards, data item descriptions, training TM requirements, statement of work and TMCRs
2. Technical accuracy
3. Maintenance concept being satisfactorily implemented
4. Adequate technical coverage
• Team performs validation on all TM procedural data by actual performance on system/equipment
• Team documents all problem areas and their solutions
Validated TM Manuscript with Comments
FINALIZE TM MANUSCRIPT
• Composition:
1. Typist incorporates all text changes into typed copy
2. Proofs typed copy
• Illustration:
1. Artist incorporates all art changes into illustrations
2. Performs art check
• Production:
1. Assembles and collates typed copy and final art into TM camera-ready reproducible copy
2. Obtains final copy
• Quality assurance
1. Reviews TM reproducible of comment
2. Reviews TM printed copi completenes
3. Assures TM printed copy in accordanc TMCRs
Subcontractor TM
SUBCONTRACTOR DEVELOPED TM ACCEPTANCE
• During technical information development, contractor team made up of TM and Q.A. engineers:
1. Monitor progress
2. In conjunction with user, observe validation
3. Check conformance to subcontract requirements, specifications, standards, maintenance concept and quality assurance requirements
• Tentatively accepts TM contingent upon customer/contractor verification results
Equipment Vendor TM

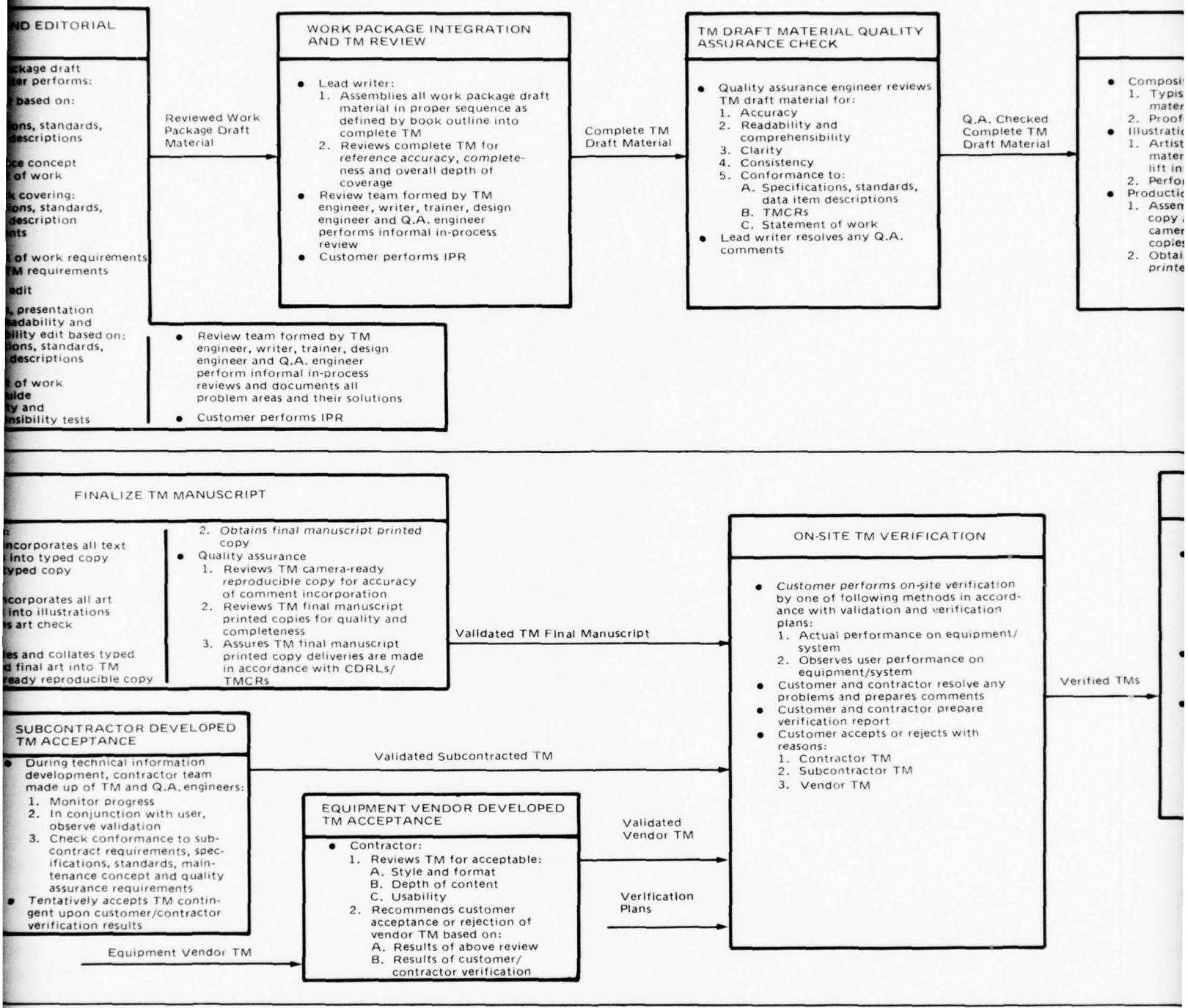


Figure 4-11. NT
supervision and c
oped. Combining
accurate and adeq

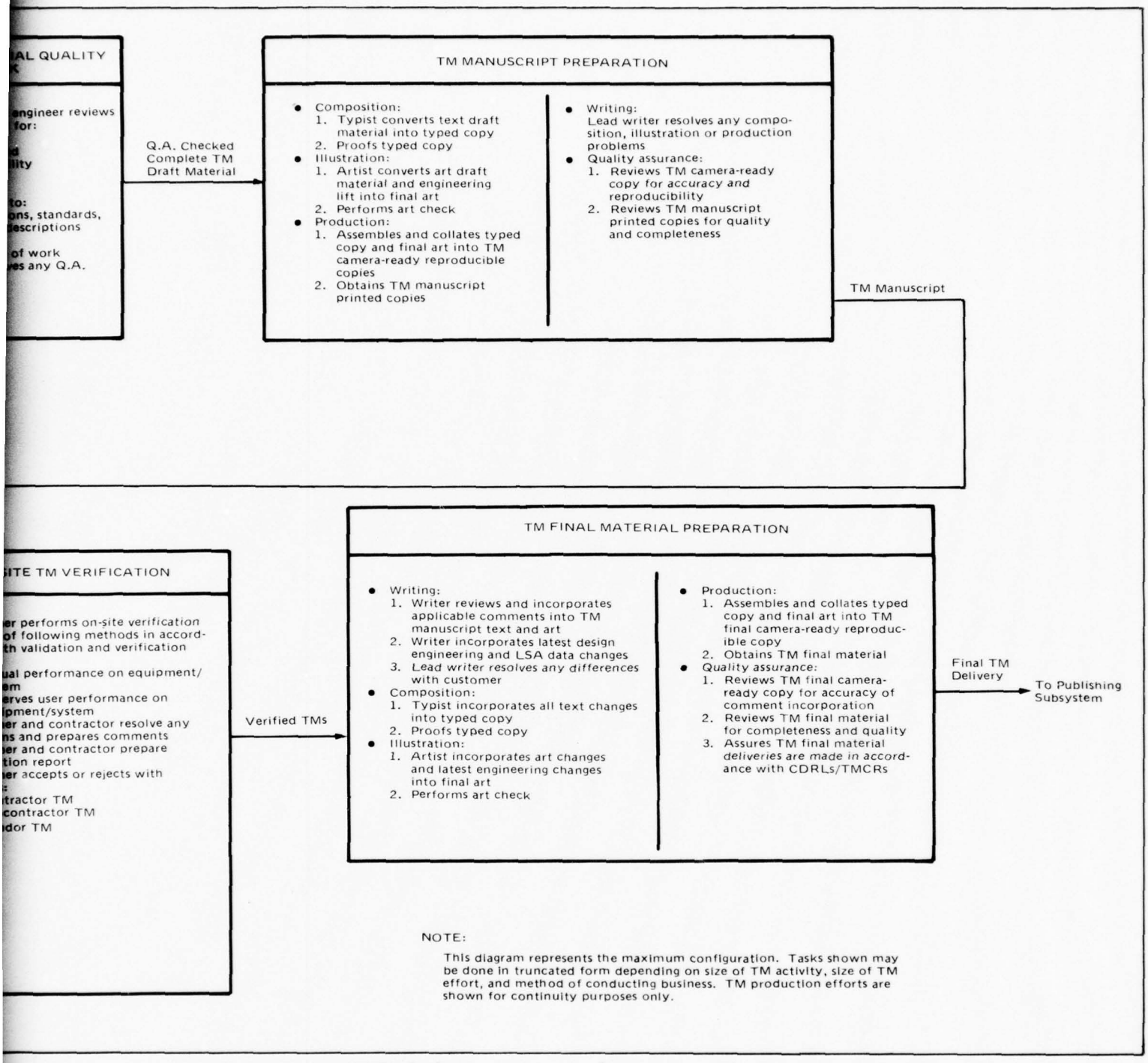


Figure 4-11. NTIPS Preliminary Concept for Writing. The TM engineer provides single-point guidance, supervision and coordination during TM development to assure accurate and adequate TMs are developed. Combining technical reviews and the procuring activity's final reviews with validation assures accurate and adequate TMs that will meet user needs.

4.2.7 – PURPOSE AND DESCRIPTION OF THE TM DEVELOPMENT GUIDE

A TM Development Guide would support the TM engineer in his planning for the Development of technical information. The Guide would supply the necessary instructions and guidance for the TM engineer to accomplish the tasks associated with estimating, planning, and developing technical information.

In current practice, requirements for estimating, as well as product planning and writing, for a specific TM acquisition are contained in the request for estimate and contractual documents such as statement of work, specifications and standards. These requirements cover all facets of TM development, including the TM type, style, format, content, maintenance philosophy, depth of coverage, method of validation, final medium, etc. However, no instruction or guidance is provided to the TM engineer on how and when to plan, initiate, and supervise the efforts that are necessary to accomplish the tasks associated with estimating, planning, and writing the TM. He must rely on his technical and managerial experience, and his knowledge gained from previous programs. This limits his performance effectiveness on a TM program with which he is not totally familiar. For example, a problem encountered by the TM engineer such as inconsistent use of nomenclature in text would place additional time requirements on his already busy schedule. He would have to suspend his regular activities while he identifies the cause which may be an unclear specification requirement or the lack of a standardized nomenclature/common names list. Then he has to develop a workable solution such as obtaining clarification from the TM procuring activity, or preparing the necessary list. But his solution may develop into another and even more difficult problem later in the TM development because he cannot completely visualize the impact of his solution until completion of the TM final product. In the case of the nomenclature/common names list, the use of common names simplifies the text but eliminates part number references, forcing the user to spend additional time locating the nomenclature/common names list to obtain the part number. This reduces TM usability.

The TM Development Guide (Table 4-9) would be designed to meet the detailed planning and management needs of the TM engineer for any TM acquisition program. This guidesupplements instructions contained in the request for estimate and contractual documents with detailed instructions and guidance on how and when to plan and supervise the TM development activity's efforts in the preparation of TM estimates, product and operational plans and TM manuscripts. The instructions would consist of step-by-step procedures detailing how and when to plan, initiate, and accomplish in the most efficient manner the tasks for each function described in the Content Generation Subsystem preliminary concept.

The guide would provide instructions for the TM engineer on how to: (1) estimate the number of personnel and define the specialty skills that are required for a specific TM task, (2) establish working schedules, (3) establish a status report system and develop reporting procedures, and (4) monitor and evaluate the progress and performance of each task. The guide would also tell the TM engineer when to: (1) establish interrelationships with activities outside of the Content Generation Subsystem and the NTIP System, (2) initiate specific task efforts, and (3) establish coordination with TM support activities (i.e., composition, illustration, production and quality assurance). In addition, the guide would identify possible problem areas in TM development and provide one or more suggested solutions. For example, slippage of the equipment availability for the TM manuscript validation is a big problem in content generation. Possible solutions are to: (1) perform validation on a three-shift (24-hour) schedule when the equipment becomes available, (2) perform normal (single-shift) validation when the equipment becomes available (with resultant

late or delayed TM delivery), or (3) perform incremental validations as portions of equipment become available. The guide also would provide the TM engineer with examples, where necessary, to clearly illustrate a point or instruction. Finally, the guide would remind the TM engineer that he should keep abreast of new and innovative TM development and presentation techniques. Because of his close involvement ina specific TM program, the TM engineer becomes aware of any peculiar presentation problems associated with new or advanced hardware technologies and/or maintenance approaches before the NTIPS TM acquisition activity becomes aware of it. He designs and develops a solution or evaluates the new techniques for their impact and application on the special problem. If his solution or new technique solves the problem, he would then submit his evaluation and recommendations to the NTIPS TM acquisition activity for review and approval prior to initiating action to incorporate the technique.

The NTIP System is the responsible organization for the design and development of the TM Development Guide. The guide would incorporate basic management principles, as applied to TM development, to guide the TM engineer in the performance of his duties. It would be based on and developed from the experience and knowledge gained through the research and evaluation of past and present TM development operations and the development of the NTIP System for the Navy. To keep the guide current, user-proposed additions and recommended changes, and new and innovative TM development and presentation techniques developed outside the Navy as well as the results of the NTIP System continuing research effort would be reviewed and evaluated by the guide development activity within NTIPS. Changes that improve the guide's accuracy, use, and applicability would be incorporated in the most expeditious manner to insure currency of all guides in use.

TABLE 4-9. TM DEVELOPMENT GUIDE AS AN AID TO TM ENGINEER

Purpose	• Support TM engineer in planning, initiating, supervising, and monitoring of TM estimating, planning and writing efforts. • Supplement directions contained in requests for estimates and contractual documents.
Content	• Step-by-step procedures for how and when to perform tasks associated with TM estimating, product and operational planning, and writing. • Examples of types of problems that may be encountered and suggested solutions that have been proven valid on previous TM programs. • Reminders for the TM engineer to keep abreast of new and innovative TM development and presentation techniques for possible application to his program.
Development	• Designed and prepared by NTIP System • Based on basic management principles, experience and knowledge gained from research of present TM development systems, and development of NTIP System for Navy. • Maintained current by incorporating user-recommended changes and results of on-going NTIPS research.

4.2.8 NTIPS TM WRITERS GUIDE

The NTIPS TM writers guide will be used to both instruct and motivate TM engineers and TM writers regarding the importance of their role in developing the new generation of User-Matched TMs.

The NTIPS writers guide would be a concise, informative tour through the world of what's good and bad about TMs, especially how to create the TM of today's Navy for real users in the field. It would be written entirely from the viewpoint of the junior TM writer who needs an overall view but also wants fast access to useful tools and hints (see Figure 4-12).

Introduction to NTIPS - The first chapter would introduce the objectives of NTIPS and describe the most important operations of the system and how they affect writing assignments. It would include a synopsis of the interactions of the NTIPS elements from TM program inception to delivery of the finished TM product to the user. To develop the TM writer's appreciation of NTIPS, the description will include the "why's" as well as the "how's". In this chapter of the guide and those that follow, every effort will be made to avoid the type of formal, laborious presentation which would discourage wide readership. Instead, the guide will be developed in an informal, easy-to-read style employing devices such as cartoons to motivate the reader.

Introduction to the Specifications System. If the NTIPS preliminary system concept of modular specifications were adopted, it would represent a major change to the current Navy TM specification structure, and to the TM writers who currently use these specifications. This chapter of the guide would fulfill the need for educating TM engineers and writers to the new specification structure. The benefits of specification modularity, its relationship to the user-data match model, and the application of the modules in TM development will be described. The unique tutorial or how-to aspects of the new modular specifications would be stressed. The writer would be motivated to perceive the specification system as practical aids to his work and professional growth.

Presentation Techniques - This chapter will introduce the TM writer to the different media and presentation techniques which NTIPS will employ to satisfy all special user requirements. A brief nontechnical description of the user-data match model will explain how presentation techniques for specific procurements are selected. Some examples will illustrate the kind of problems that led to the development of the model and the NTIPS presentation techniques and systems. The presentation techniques specification modules will be introduced and explained. For example this would cover NAVSEA's and NAVELEX's Functionally Oriented Maintenance Manuals (FOMM), NAVAIR's Work Package technique, the Air Force's Job Performance Aids (JPA) technique, the Army's Improved Technical Documentation and Training (ITDT) technique, and NSA's Diagram Oriented Documentation System (DIODS). The application of these specification modules, as well as their relationship to other module categories also will be covered.

Guide to Clear TM Writing - Over the years, many Clear Writing style guides have been prepared for business and military use. A good example of these is the Guide for Air Force Writing (AF Pamphlet 13-2) which covers basic principles in logical organization, choice of appropriate words, keeping sentence structure simple, using transitions, effective use of illustrations, etc. In recent years a new kind of writing guide strictly for the TM writer has appeared which covers these basic principles but also treats of the specific problems in building more comprehensible maintenance and operating manuals. Good examples of this are NAVSEA's "Requirements and Criteria for Improving Reading Comprehension of Technical Manuals" (Post

and Price, 1974), NAVAIR"s "TM Preparation Guide for Writers, Editors and Illustrators" (NAVAIR 00-25-700), and the Army's MIL-M-63038 (TM), especially Vol 3, "Technical Writing Style Guide" (MIL-HDBK-63038-2). Some of these guides, however, are prepared for a particular TM presentation system; some lack concision in coverage of their material.

What is needed for NTIPS is an introduction to the available guides for the new TM writer, followed by a very concise compilation of the best ideas from each. This compilation would cover general writing hints (active vs. passive construction, avoiding nominalizations, concrete vs. abstract words, parallelism, sentence variety, spelling out acronyms, defining terms, paragraph unity, topic sentences, continuity devices, giving examples, using redundance, etc.). It would also cover the specialties of writing TMs (styles appropriate to the main TM sections, getting the most out of text and figure units, limiting excessive narration, writing proceduralized material, developing troubleshooting data, layout of text and figures, special treatments of illustrations, etc.). This material would stress the universal techniques and basic human factors principles that apply to all types of TMs (e.g., correct use of foldouts, typography hints, highlighting, consistency, minimizing cross references, principles of graphic clearity, etc.). It would avoid duplicating the presentation techniques and systems specifictions, but would show how their ideas (such as work packaging, or putting text into diagrams, or pyramiding the systems diagrams, etc.) are useful in a variety of situations.

Readability - Readability, in the sense of a quantitative technique for predicting comprehension from lexical measurements, is still a new subject to many TM writers. The NTIPS guide would undertake to introduce the TM writer to this technique, explain its importance to the user in the field, and motivate the writer to apply the assessment process diligently. But even more important is to help the writer internalize the writing skills and style changes that are necessary to produce more readable writing in the first draft. To accomplish this, it is not sufficient to merely call for shorter words and sentences, clearer thinking, etc. as in the conventional "clear writing" guide. Guides which recognize the need for more practical instructions for the TM writer unfamiliar with readable writing include Klare's "A Manual for Readable Writing," 1975 and Kern's, et al, "Guide for Development of Army Training Literature," 1976.

The NTIPS guide would introduce the TM writer to these resources, and review the known do's and don'ts of readable writing. Of particular value would be specific guidance in making readability revisions on a step-by-step basis. The NTIPS guide would attempt to list the distinct mechanism which can be invoked

Figure 4-12. Approach to TM Writers Guide.

1. Introduction to NTIPS
2. Introduction to the Specifications System
3. Presentation Techniques
4. Guide to TM Writing
5. Readability
6. Comprehensibility
7. Vocabulary Controls

4.2.8 NTIPS TM WRITERS GUIDE (Continued)

during a revision to reduce RGL in a once written text, such as methods of substituting words, deleting words, dividing sentences, etc. When the writer learns these distinct mechanisms, as if he were an editor, then he will be in a position to internalize them as part of his repertoire of basic writing style options.

He would also learn how combinations of these mechanisms are appropriately selected to recast a text to various required levels so that ultimately he could write to a given level through unconscious adjustments. The NTIPS guide would attempt to provide a definitive treatment of specific mechanisms, including lexical methods of finding word substitutes, determining words to delete, recasting to bridge over deletions, breaking up adjective clusters, spotting needless circumlocations, avoiding nominalizations, guides for replacing technical with nontechnical words, deleting words by explaining them, etc. Syntactic mechanisms that would be defined include methods of dividing sentences on semicolons, conjunctions, relative clauses, verb phrases, prepositional phrases, etc. Rhetorical revisions having quantitative impacts, such as how to distinguish unnecessary information and "details", would also be addressed.

Most of us learn how to write in school gradually accumulating more and more structures into more complicated sentence patterns, using various grammatical transforms to enfold and embed the pieces, all more or less unconsciously. The proposed approach would reverse this process, teaching the TM writer to consciously manipulate his transforms in both directions, especially to "disassemble" his habitual thinking patterns into smaller progressive disclosures.

Implicit in this approach is the belief that a direct "frontal" attack on the readability requirement, by "mechanically" reducing word length and sentence length, is a salutary and effective means of improving the comprehension of the reader. It is sometimes argued to the contrary that one cannot write more readably by "juggling the measurement" factors directly, that the writer must conceptually rethink his story from a lower level and then recheck his results from the readability viewpoint later on, etc. But work at Hughes suggests that this fear of "cheating" is unfounded. In case after case, it has been shown that a direct reduction of big words and long sentences (without regard for the niceties of continuity, and "tone", but leaving technical vocabulary more or less untouched) will produce sizable improvements in both readability and comprehensibility. Hence, the "learn by editing" approach, where the TM writer internalizes a set of simple stylistic mechanisms, could be expected to provide meaningful results quickly under controllable training conditions.

Comprehensibility - Similar Guidelines are also needed for the comprehensibility factors that have been or can be quantified. The NTIPS writers guide would introduce the TM writer to existing and proven systems, such as the NAVAIR Comprehensibility Assurance Criteria (NAVAIR 00-25-700) for Work Package TMs, which covers many specific mechanisms under Access, Nonverbal Organization, "Chunking", Procedures, Consistency, Readability, Legibility, Pictorial Illustrations, Schematics, Wiring Diagrams, Functional Diagrams, and Tables. Quantitative measures to control the comprehensibility of graphics would be an important part of this guide.

In addition to quantitative criteria for readability and comprehensibility, the TM writer would be introduced to the notion of vocabulary aids and controls. The most important vocabulary aid would be big word substitution glossaries organized for the technical vocabulary of various Navy Ratings as well as for the nontechnical TM vocabulary in general. It is surprisingly hard to find acceptable synonyms for big words, even nontechnical big words. These glossaries would be of

great assistance in applying the readability discipline and could be automated so that the big words and their alternatives are listed out for the TM writer along with his readability assessment. A considerable investment would be required to build these glossaries, because of the tedious research and sticky semanties questions involved, but it would be a very wise investment considering the plight of both the user and TM writer if help is not made available.

Vocabulary Controls - One aspect of vocabulary controls that has received considerable attention has been the area of verb usage. One example is MIL-J-83302 (USAF), which provides a fairly extensive list of verbs to be used in the development of textual material for technical manuals. Included in this list are (for each verb): the definition, examples of the use of the word, a preference rank (indicating the standing of that verb compared to others with the same, or similar meaning), and synonyms (listed in order of preference).

This type of information should be incorporated into the specifications governing each procurement. In addition, a list of nouns should be developed for inclusion in TM specifications that contains information identical to that contained in the verb list. In particular, this list should contain generic nouns (i.e., those nouns that relate to a group or class of items, rather than to a specific item). Noun and verb lists developed for inclusion in TM specifications could serve a dual purpose. That is, they could also be used as supplemental data in support of TM writers guides. These lists could (with some revision/expansion) serve as a glossary of terms for use by the writer during the composition of text for the TM.

Currently, many vocabulary guides exist throughout the military and industry, a good example being found in the Army guide, MIL-M-63038 (TM). Also, a guide that is becoming increasingly popular in commercial applications is the Basic 800 system developed by Smart Communications, Inc. The TM writer should be introduced to these resources, and they should also be analyzed as inputs for standard vocabulary guides and preferred verb lists.

Similarly, a list of official nomenclature could be developed (during the TM writing phase) for each procurement. This list would serve as the official source of nomenclature for hardware items. Once again, such a list would serve to insure consistency in the writing and minimize the confusion that can result from referring to the same equipment item by more than one name. Also, guidelines should be developed that direct the use of coloquial nomenclature. Such nomenclature is commonly used within a maintenance instruction to identify an item of hardware by reference to its functions (e.g., adjustment screw), type(e.g., insulated washer), or location (e.g., motor brush or assembly vs. generator brush assembly).

Finally, guidelines for the use of standard statements could be developed and incorporated into the writers guide. Standard sentences should be used to describe maintenance actions where task steps are the same or highly similar. Each repetition of a similar task step would thus be written using the same sentence, with the exception of any unique data (e.g., expected indication, test point, or where-to-go-next).

4.3.1 DESCRIPTION OF PUBLISHING SUBSYSTEM

The preliminary concept for publishing provides decentralized internal Navy capabilities to accept the equipment contractor's digital output for processing through production, mastering, replication, and final delivery. A feature of this concept is automated facilities to process new and updated text and graphics.

The Publishing Subsystem accepts the technical information output of the content generator, processes it into TMs, and delivers it to the user. This is accomplished by four functions: digital production, mastering, replication, and TM supply.

The digital production function (Figure 4-13) contains the entry, processing, and storage subfunctions. The entry subfunction provides the capability to receive technical information generated both by equipment contractors and internal Navy content generation activities, and to edit, update, and process the technical information for mastering of TMs.

The mastering function converts the processed output to masters (making the master for replication such as: repro copy, negative, or video disc original recording). This function must be able to accommodate various media as medium/media selections are made. The replication function, also medium dependent, contains the subfunctions needed to replicate the medium selected.

The TM supply function provides the capability for packaging and shipping new and updated TMs in response to distribution requirements provided by the Distribution Subsystem.

Preliminary Subsystem Concept – The preliminary concept of Publishing is to have an internal Navy automated text and graphic processing system coupled to automated medium mastering and replication systems. This capability will be used to enter and edit technical information from equipment contractors as well as that generated within the Navy. It will also be used to update TMs.

The technical information output of equipment contractors for new TMs will be entered into the Navy Publishing Subsystem, not as repro copy or negatives, but as digital tape structured as TMs. This data will be processed by the Navy into the medium selected for delivery to the user. It will also be entered into the Navy TM data base for subsequent updating.

Since the Publishing Subsystem is structured to fully process text and graphics from Navy content generators, the technical information on the digital tape from equipment contractors can also be edited and updated by the Navy. Although the concept of having a current Navy TM data base is primarily to provide an effective means to perform TM updating when equipment transitions from in-production to out-of-production status, the data base will allow the Navy to also perform updates on in-production equipment TMs when expedient or economical.

Decentralization – The Publishing Subsystem would be decentralized among the major acquisition activities. The functions established for each major acquisition activity could be organizationally either part of that activity or part of the NTIP System but dedicated to the major acquisition activity. There is obviously a need to distribute functions on the basis of the amount of work to be processed annually (3 to 4 million pages) plus the size of the TM inventory (25 million TM pages). These divisions can be made by specific commodity to be supported, assigned missions, geographical locations, or similar factors.

The key factors in the decentralization are to provide the same capability at each location and to insure that they function with the same specifications and standards. In particular, the standards for automated interfaces must be consistent so any Navy Publishing activity can accept output from any equipment contractor and from each other.

Technology – Technology and industry development trends show that in the 1980-85 time frame, digital processing of text and graphics may reach full implementation throughout the publishing field. Those who support Navy TM requirements, including the very small Navy contractor, will either possess, or have access to, automated digital publishing capability. Therefore, any requirement for contractors to deliver machine readable (digital tape) technical information to the Navy can be met.

The Navy has progressed significantly in the area of automation as evidenced by ADPREPS and TRUMP. One approach to the Publishing Subsystem is to accommodate both of these systems by bringing them to a level of performance that meets the Navy/Contractor interface requirements and can handle the type and volume of work expected by NTIPS. An alternative would be to develop totally new systems. Since some additional capability is needed to meet the expanded internal workload, new systems using the latest technology are a consideration.

In addition to the above text and graphic processing, technology factors in all areas impacting the Publishing Subsystem, such as video disc and hologram development, advances in high capacity inexpensive computer memories, and work in data compaction and digital communications were considered in developing the preliminary concept. The research reported in the NTIPP Task 1 Report contains discussions of the availability and applicability of these technologies and how they relate to mastering and replication as well as digital production.

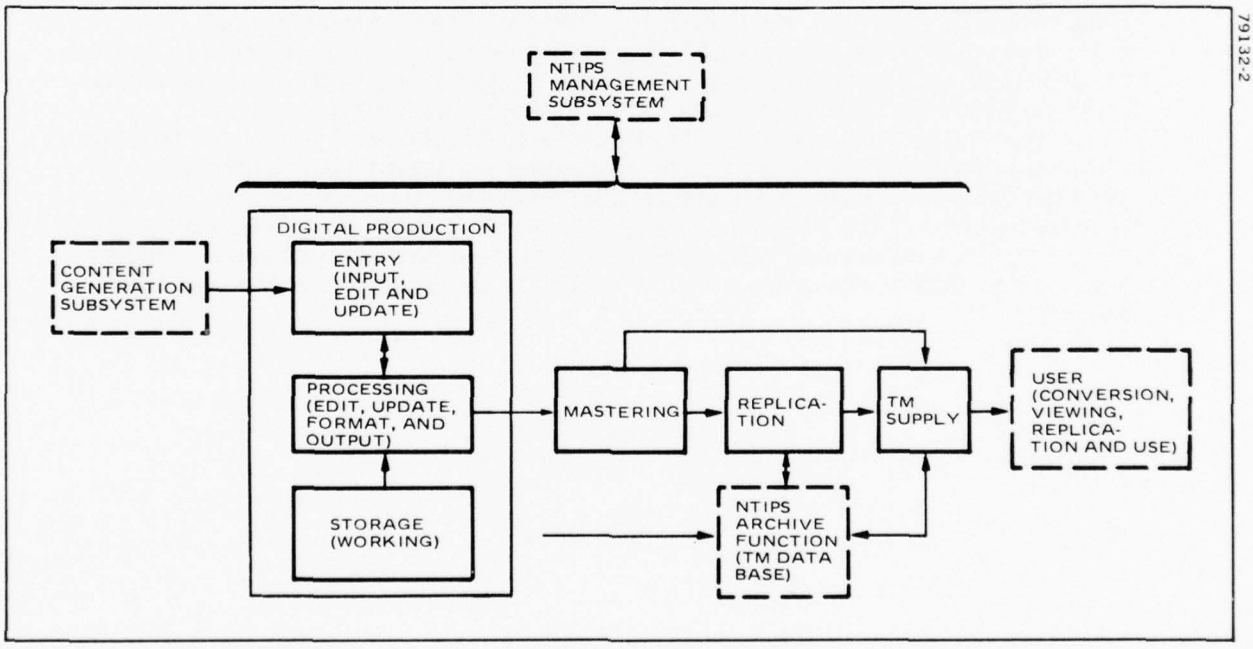


Figure 4-13. Publishing Subsystem. The functions shown provide the capability for digital processing of text and graphics.

4.3.1 DESCRIPTION OF PUBLISHING SUBSYSTEM (Continued)

Media – The NTIPS preliminary concept considers the currently used printed paper books and microforms (roll and fiche) as the primary media that Publishing must accommodate. Since other media (video discs, digital holograms, and digital data delivered directly to the user) must also be accommodated, the Publishing functions most affected by media must be set up as multimedia functions. Table 4-10 shows that mastering, replication and TM supply must perform their functions with a different methodology for each medium. Furthermore, mastering and replication also generally need different devices for each methodology.

Use of Publishing Services Contractors – The use of outside contractors for Publishing services is a considered alternative. One possibility would be the total performance of all Publishing functions by contractors. Currently, one function (TM printing) is totally contracted, and several others are partly done outside the Navy. Thus, total contracting for Publishing is basically feasible.

A key factor to be considered regarding contracting is the Office of Management and Budget circular A76 and, in addition for replication, the policy of the Joint Committee on Printing (JCP). OMB-A76 and the JCP policy both require that contractors should be considered for services such as performed by publishing functions. This one factor makes contracting of the Publishing Subsystem, or at least major parts of it, a very viable alternative.

Structuring the Engineering Data Base for Direct TM Production – Another subsystem alternative to be considered is the automation of the engineering data base to the extent that it could output TMs. The requirements for TM content generation would be applied to the development of engineering data to enable direct generation of usable TMs, thus eliminating the need for rewriting or redrawing. The content generator would perform any reprocessing and supplement the data as needed. The data would be created in digital form ready for mastering in the selected media, for entering into the NTIPS data bank, or for delivery directly to the user.

This concept would essentially eliminate a formal digital production function in Publishing except for updating out-of-production equipment TMs. There is no equipment contractor engineering effort after equipment transitions to the out-of-production status. If the Navy does not pick up the equipment contractor's data base and use the contractor's method of operation, then conventional content generation and publishing processes would be needed to update out-of-production equipment TMs.

TABLE 4-10. METHODOLOGY NEEDED FOR CANDIDATE MEDIA IN PUBLISHING FUNCTIONS

	Mastering	Replication	TM Supply
Printed Paper Books	Photocomposition/COM with Platemaking	Printing and Binding	Packaging and Delivery
Microforms	COM/Micro-Photo	Photo/Diazo/ Vesicular	Packaging and Delivery
Video Disc (Video)	Video/Computer Output to Video	Photo/Diazo/ Disc Pressing	Packaging and Delivery
Video Disc (Digital)	Computer Output to Video Disc	Photo/Diazo/ Disc Pressing	Packaging and Delivery
Digital Holograms	Computer Output to Hologram	Photo/Diazo/ Vesciular	Packaging and Delivery
Direct Digital	None	None	Data Communications

4.3.2 DESCRIPTION OF DIGITAL PRODUCTION FUNCTION

Digital production is text and art production and uses a (magnetic) digital tape for input of the contractor's TM information. Paper input from Navy content generators is converted for automatic processing by optical character recognition equipment.

Digital production is an internal Navy function that must accommodate TM technical information output from both contractors and internal Navy content generators. The function must also input, edit, and update to a prescribed format, and then must output for mastering and replication in a selected medium. Digital production consists of the entry, processing, and storage subfunctions.

Entry Subfunction – Accepting the contractor's output is a key feature of this subfunction. Since there are potentially hundreds of contractors who can be creating technical information, the relationship between the Navy and the contractor's operations needs controls to limit the number of different contractor output products. For the purpose of the preliminary subsystem concept, one product, digital tape in ASCII format with a predetermined format coding, has been selected. Figure 4-14 shows the contractor's output being fed only to a tape input component of the entry subfunction.

The requirement for the digital tape output assumes that contractors will have a publications automation capability or access to it in the 1980-85 time-frame. The automated publications systems employed will probably be functionally comparable to that presented in this report for the internal Navy operations. Therefore, formatted digital tape will be a feasible output. Alternatives such as optical character recognition (OCR) and graphic scanning should be considered and are discussed in the following topic.

The second feature of the entry subfunction is the fully automated capability to input, edit, and update technical information being received from Navy content generators using internal (Navy) components. These components are needed to accommodate both text and graphics and include both batch and interactive processing. They are:

- Batch Text Input – This component accepts text material prepared on "standard" typewriters and reads it into the processing subfunction with a special OCR device. This is discussed in the Task 1 Report, page 3-216. Although presented here as an internal Navy entry component, it is also an alternative for entry of contractor text output.
- Interactive Text Edit and Update – This component provides the capability for an operator to make copy changes using devices that utilize the processor's editing software. For example, such actions as copy deletions, additions, or relocations can be performed very efficiently using a device such as a video display terminal. Although an interactive device can be used for text input, it will not be used where batch input capability is available.
- Interactive Graphic Input, Edit, and Update – This component provides the capability to handle graphics in intelligent form and enables entry, manipulation, and changing of lines, symbols, and alphanumerics. (See Task 1 Report, page 3-218.)

This subfunction must be able to handle the total yearly volume of technical information from all content generators. With over 3 million pages of new TMs entering the system each year, an additional one-half million pages of updates, and several hundred thousand pages of other changes backlogged, the entry subfunction and the associated processing and storage subfunctions may have to be distributed. The capability would be decentralized within the major organization activities and

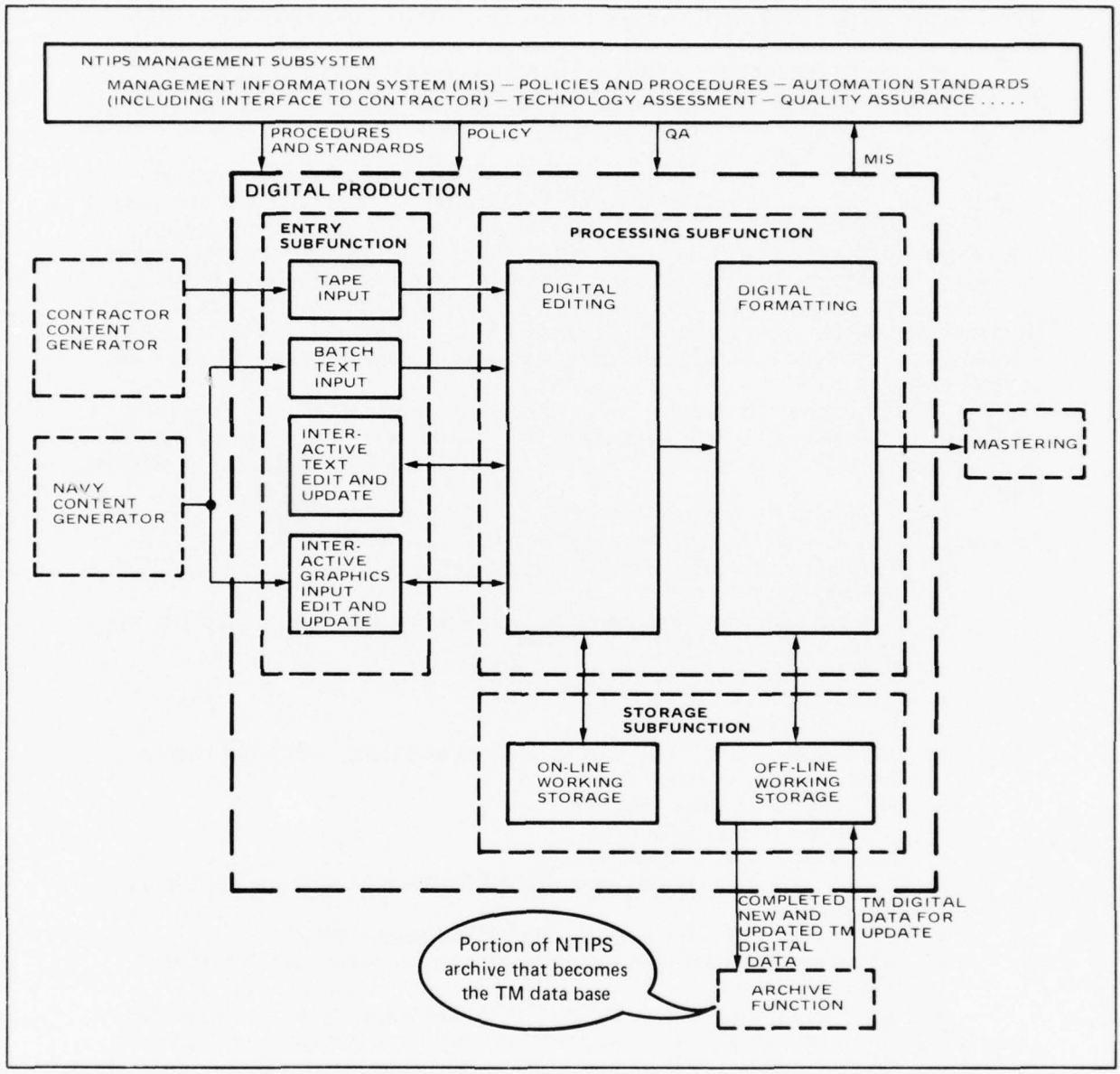


Figure 4-14. Subfunctions of the Digital Production Function. Shown is the interface to the NTIPS Management Subsystem and the functional support it provides.

4.3.2 DESCRIPTION OF DIGITAL PRODUCTION FUNCTION (Continued)

further distributed based on processing hardware capacity, geographical, or commodity considerations.

Processing Subfunction – This subfunction provides the computer power, including an adequate set of software, to accommodate the number of input-output functions (and devices) needed to support the workload. It consists of digital editing and digital formatting components.

The digital editing component controls and accommodates the text and graphic input, edit, and update modes. Digital editing includes the software needed to process the TI being entered and to reprocess it through edit or update cycles. Digital formatting provides format and output controls to produce the end product (in digital form) that is prescribed for conversion to the selected media for subsequent distribution to the user. Software provides for meeting the mechanical specifications that derive from the media selected for mastering and replication. Such format factors as type size, column width, line weight, and graphic symbology are controlled here.

The editing and formatting components will be colocated with the entry subfunction. Consideration will be given to netting the distributed processing subfunctions to provide for cross use of central data banks or for specialized processing needs.

Many computer programs will be necessary to provide the processing power for complete automation of text and graphics. The essential ones are:

- Input and edit – add, delete, move, scroll, change column width, line spacing, etc.
- Data manipulation extracting and storage – unit address, absolute reference system, variable relocation.
- Global operations – locate and replace.
- Nondistorted tabular editing.
- Text and graphic merge.
- Full character set – range of type faces and sizes, special characters, Greek letters, math symbols.
- Full range of graphic symbols.
- Horizontal and vertical rule.
- Hyphenation and justification.
- Output formatting (text) – pagination, extraction of front matter, marginal copy.
- Output formatting (graphics) – sizing and placement.
- Output simulation – high speed devices (for proofing batch text and graphics).

Storage Subfunction – This subfunction provides the working storage for technical information being processed in content capture. It has two components, on-line and off-line storage. The direct interface between the TM data base (archive function of the Distribution Subsystem) and the storage subfunction is through the off-line working storage component. This, in turn, is interfaced to the on-line working storage component, needed by the processing subfunction. The off-line working storage will contain the technical information to be processed in publishing – say 20 or 25 TMs being updated. The on-line working storage will contain only the data being worked on at that particular time by the operators. After an operator is finished with a file of data, it will be placed in off-line working storage if further work is to be done at a later time, or sent back to the TM data base (archive) if no further work is needed. The complete TM is also sent to the mastering subfunction for conversion to the selected media masters.

Working storage for the preliminary system concept is high-density magnetic tape for off-line storage and hard disc for the on-line storage. These are both currently good cost/performance storage media that with expected constant improvement will continue to be inexpensive and reliable storage methods for at least the next three to five years.

Two existing and evolving Navy systems, Automated Document Preparation Systems (ADPREPS) and Technical Review and Update of Manuals and Publications (TRUMP), both contain some of the basic components of entry and processing. Both are capable of growth to accommodate the added components required for NTIPS. However, these two systems can handle only a part of the Navy's total TM update needs (up to 800K pages per year). Conversely, the amount of new TMs generated internally by the Navy each year (less than 50K pages) could probably be handled by either system with both text and graphic capability. Both the ADPREPS and TRUMP systems were considered in developing the NTIPS preliminary system concept and will figure in the design of the Publishing Subsystem.

4.3.3 DIGITAL PRODUCTION FUNCTION ALTERNATIVES

The principal alternatives to the concept of automated digital production are the manual input, edit, and update methods, and the use of publishing contractors to perform selected production operations. The distribution of the processing subfunction among the cognizant field activities is an organizational alternative.

Viable alternatives for production operations are shown in Table 4-11. The first alternative is the use of manual methods of entry and processing. An example of this would be substituting manual graphic preparation for automated graphic preparation. In this case, the input mode would change from the interactive terminal/plotter to a digital scanner, and the processor (computer) would not need graphic character sets, plotting routines, and other graphic software. However, going from a vector graphic presentation (of automated graphics) to the raster scan graphic (of image only) would actually result in an increased need for both computer core and working storage. There is also some chain reaction to be considered because this approach would have some impact on the archive function and on the mastering function as it applies to some potential digital media types.

There are also combinations of manual and automated subfunctions that can be applied, such as automated text processing and manually prepared graphics. This is viable because automated graphics has not yet reached the advanced state of automated text. As alternatives, the manual methods need to be scrutinized in areas of cost, quality, and throughput. The major impact of manual methods would be to the archive, which, because it is digitally centered, would require further conversion before entry into storage.

Using Contractors to Perform Publishing Operations – The next major alternative is the use of contractors to perform selected publishing subfunctions. For example, all entry and processing could be done by contractor, or only text and graphic input could be contracted. This alternative addresses the AIA's concern[1] over the Navy's alleged departure from the Office of Management and Budget policy as stated in circular OMB-A76. This policy provides the guidelines for use of contractors for such services as publishing operations. Again, the principal area affected would be the archive because coordination and control of access to the data base would be more difficult if another level of operation (the contractor) were added. Using contractors for some subfunctions, such as text keyboarding for the batch input, would have minimal impact.

Entry and Processing – Within these subfunctions there are other viable alternative approaches:

- Contractor output of typewritten text pages and copies of graphics can be used in place of digital tape (as an input to the entry/processing subfunctions). To maintain the digital TM data base, both text and graphics would be scanned into the processor and stored digitally. There is a second alternative of text on tape with photo copies of graphics. Here, the text tape is read into the processor and the graphics digitally scanned into the processor. These alternatives impact the processor and working storage.
- Voice recognition is an alternative to keyboard/optical character recognition (OCR) for batch text input. This technique, discussed in the Task 1 report, page 3-216, is a developing technology that has a potential impact

1. Aerospace Industries Association. PUBS-100 Panel; Navy TRUMP System Activation Circumvents OMB-A76, October 1976.

TABLE 4-11. COMPARISON OF PRELIMINARY CONCEPT AND ALTERNATIVES FOR DIGITAL PRODUCTION

Basic Operations	Preliminary Concept (Automated)	Alternative (Manual)	Alternative (Contract)	Other Alternatives
Accepting input from contractor	Magnetic digital tape	Typewritten text pages and copies of graphics	Contractor obtains automated output (magnetic tape) by subcontract	Mix of automated and manual Mix of contract and internal
Input generated by internal content generation function	Typewritten text pages optically scanned and graphics created interactively by computer assistance	Typewritten text pages and manually prepared graphics	Either the manual or automated mode can be obtained by contract	Voice recognition text input Symbolless graphics using alphanumeric representation Mix of automated and manual Mix of contract and internal
Internal edit and update	Make changes interactively to text and graphics	Correct the typewritten text and manually prepared graphics using same methods as used for originals	Same as above	Mix of automated and manual Mix of contract and internal

4.3.3 DIGITAL PRODUCTION FUNCTION ALTERNATIVES (Continued)

on cost since the author's output (his dictated text) would be entered directly into working storage through the processor. Most applications could use a combination of voice input for text plus keyboard input for tabular material.

- In place of diagrams using conventional graphic symbols, a "symbolless graphics" presentation can be employed. This can be done using a slightly modified alphanumeric keyboard. Block diagrams, schematics, wiring layouts, flow diagrams, and other similar line drawings (but not many types of mechanical drawings) can be prepared without symbols. An example (a digital logic mechanization diagram) is shown in the Task 1 report, page 3-221. This alternative would significantly reduce digital storage requirements since a graphic prepared in this manner would have about the same number of digital bits to store as a full page of text. The conventional drawing in digital form has many times more digital bits than the text page.

Alternatives at the Component Level – Within the components of the subfunctions there are varying degrees of alternative approaches. Most relate to the manual vs. automated and the internal vs. contract factors discussed above. However, there are two unique subfunction alternatives:

- Using interactive input for text as well as edit and update as an alternative to the combined batch input and interactive edit and update. This could be cost effective in small operations that cannot support separate batch input.
- Using batch input of graphics, providing it can be read into the computer in intelligent forms (as separate symbols, lines, and callouts) as an alternative to the interactive graphic input. Some drawings would be prepared manually and then digitally scanned. There could be a cost impact on operations with large volumes.

Netted Processing of Data – At the component level, but relating directly to the processing subfunction, there is another significant alternative to be considered. It is the netting of the processors (computers) at the various locations performing publishing work as an alternative to the processors functioning independently. The netted publishing operations could then be structured to handle specialized TMs at designated locations. One processor could process only new illustrated parts manuals, another workcards, and a third updates of out-of-production equipment manuals. Another mode of distribution would be to have all capabilities at each location and distribute the volume of work as needed. Distributing the processing may cut across missions, commodities, or geographical boundaries and therefore be effective only on a limited basis. This alternative approach offers potential cost advantages and impacts both the Content Generation Subsystem and NTIPS Management Subsystem.

Storage Alternatives – Alternatives of the storage subfunction (Table 4-12) directly relate to the alternative approaches of the other subsystem functions. In the case of a manually implemented publishing subsystem, working storage for "on-line" storage would be visual media, such as the repro text copy and original artwork, while microform or even video disc could be used for "off-line" storage. The "off-line" storage would probably be in the same medium as used for storage in the archive. More likely, the processing and storage subfunctions will remain digital. Therefore, the alternatives become the newly developing media – bubble and CCD memories, for example. These could become candidates should their capabilities be broadened and their cost reduced. Physical size is not as much of a

concern in the working storage applications as in the archive function since working storage requires less capacity.

A continuing assessment of technology is needed in the field of storage media because the state of the art is continually changing. Along with delivery and user (presentation) media and text and graphics automation, there are sufficient promising developments and new approaches to warrant further investigations and evaluations throughout the design process of an NTIP System and beyond. This would fall within the charter of the R&D subfunction in the NTIPS Management Subsystem.

TABLE 4-12. COMPARATIVE SUMMARY OF STORAGE ALTERNATIVES

Basic Operations	Preliminary Concept (Automated)	Alternative (Automated)	Alternative (Manual)
On-line working storage	Hard discs	Non-Identified	Repro copy (text) Original artwork
Off-line working storage	Magnetic tape	Video disc (digital) Digital hologram Bubble memory Charged coupled device memory	Video disc (visual) Microform

4.3.4 DESCRIPTION OF MASTERING, REPLICATION, AND TM SUPPLY FUNCTIONS

The mastering, replication, and TM supply functions accommodate either paper or microform as the media for the TM delivered to the user. Each function therefore is designed to operate in two different modes.

The activities of the mastering, replication and TM supply functions (see Figure 4-15) are primarily media-oriented. The mastering function receives the TM in a digital form from the processing function and produces a master in the medium selected for replication. Replication produces copies of the master in the medium selected for delivery to the user. TM supply provides packaging and arranges shipment to the TM users, in the proper quantities, as designated in the shipping directive provided by the Distribution Subsystem.

For the NTIPS preliminary system concept, all the media currently employed to place the TM in the user's hands are considered feasible:

- Microforms – Presently two microforms are in use for TMs: microfiche and roll microfilm packaged in cartridges. Both require a viewer. See Task 1 report, page 3-240.
- Paper (Printed) Books – Presently the most used medium. As a replication medium for delivery to multiple users, printing is considered as interim. In the preliminary system concept it becomes a secondary medium. See Task 1 report, page 3.230.

Other user media considered viable for potential use in the post-1980s time frame are:

- Video Discs – New technology that provides either visual images or digital representations of TM text and graphics on a 12-inch disc. Can also provide video presentations of actions. Requires converter and viewer. See DTNSRDC video disc technology assessment[1] for full discussion.
- Hologram – New technology providing either a digital representation or a combined digital and visual (microform) presentation on a microfiche-size film. Needs converter and viewer. See Task 1 report, page 3-254.
- Direct Digital – Delivery of the TM in digital form via direct transmission to the user using telephone/telegraph lines or radio/microwave links. Requires storage, converter, and viewer at user's locale.

With the exception of paper books, utilization of most of the above media requires that TM users be provided with a means of producing paper copies. For example, in most microform applications the user has access to a viewer/printer. The subject of the viewer/printer in the user community and some of the problems encountered are discussed in Topic 3.8.

Mastering – The mastering function converts the digital stream of data from the processing subfunction into a physical entity. Mastering is such an integral part of the entire publishing process that it should be colocated with the entry and processing subfunctions. For any medium/media used in NTIPS, sufficient capability must exist to output masters for the nearly 4 million new or updated TM pages each year. As with entry and processing, mastering must accommodate both text and graphics. This requires output devices that can provide masters with the text and graphics merged. For media such as printed books and microforms,

---

1. Poe Engineering Services; Photographic Video Disc Technology Assessment; October 1976, David Taylor Naval Ship Research and Development Center.

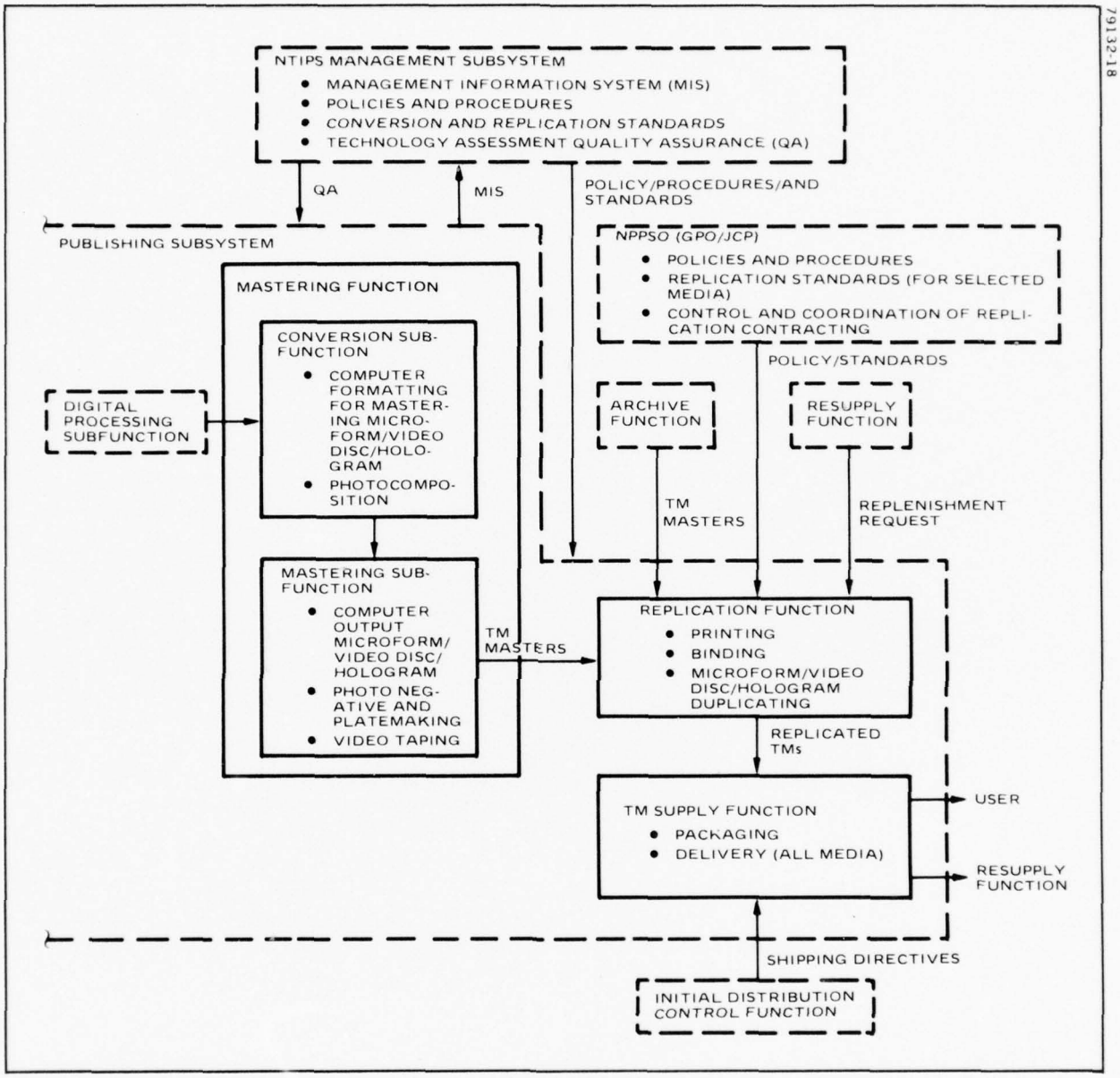


Figure 4-15. Mastering, Replication, and TM Supply Functions. The relationship to the Navy Publications and Printing Services Office (NPPSO) is shown.

the devices are photocomposition and computer output microform (COM). For digital video disc, digital hologram, or direct digital, there is no problem of text/graphics merge, but there is the problem of the significantly greater storage requirement when graphics are furnished in digital form along with text. For image video disc applications, there is no problem of merge or storage.

Mastering is comprised of two subfunctions, conversion and mastering. The first, conversion, takes the digital representation from the processing subfunction and converts it to provide the data structure and instructions needed for the mastering device. The mastering subfunction is the physical preparation of the media master.

Replication – The master for any media must be reproduced into the number of copies specified by the shipping directives in support of the system/equipment for which the information was generated. The particular medium will determine the specific methods to be employed. Basic replication methods and variations are discussed in the Task 1 report topics covering the Replication Research Issue. At present, paper book printing and microform duplication are essentially totally contracted functions. No change in this structure is anticipated. All replication activity for other media is considered an internal Navy function. It would be an integral element of the NTIPS publications functions distributed among various field activities.

The Distribution Subsystem archive function in coordination with NTIPS Management Subsystem activities processes TM replenishment requests (and appropriate TM masters) to the replication function. In this way, new supplies of out-of-stock TMs are provided to the resupply function.

A key factor in operation of the replication function is the Navy Publications and Printing Services Office (NPPSO). NPPSO is the replication arm of the Navy and is cognizant over existing media replication (paper and microforms). Should these media be replaced by video disc or hologram, it is anticipated their replication would be subject to the same control. Through NPPSO the policies of the Congressional Joint Committee on Printing (JCP) and the Government Printing Office (GPO) are also imposed.

TM Supply – The TM supply function distributes the output of the replication function. It packages TMs, affixes shipping labels, and arranges transportation. Instructions for distribution are issued by the Distribution Subsystem's initial distribution control function in the form of shipping directives. Based on this information, the required quantities of TMs are assembled for each addressee and shipping labels attached. Transportation will be based on the priority of need and bulk of material to be shipped. Here again, media selection has a significant impact on the type of packaging to be used and the amount of environmental protection required.

It might seem that TM supply should reside in the Distribution Subsystem, but the most efficient way to distribute new and updated TMs (from a time and cost standpoint) is from the source of replication. As with the mastering and replication functions, TM supply will reside physically as a working element of the replication function of the various publications field activities.

4.3.5 MASTERING, REPLICATION, AND TM SUPPLY FUNCTION ALTERNATIVES

Alternative concepts for the mastering, replication, and TM supply functions are concerned primarily with the tradeoffs between manual versus automated operations, and contracted versus internal Navy publishing methods.

The media presented in the previous topic must be accommodated in the preliminary system concept although the final decision to switch to some of them may not be made for a number of years. Alternatives, both manual vs. automated and internal Navy vs. contracted services, are compared in Table 4-13.

Manual vs Automated Operations – At the functional level, the first alternative is the use of manual in place of automated publishing methods. Should the digital production functions be performed without computer assistance, the mastering function would remain as presently structured, mostly manual with some automated assist. The output of content capture, typewritten pages and manually prepared drawings, would be processed into printing, microform, or visual image video disc masters. Generally, if content capture is totally automated, it follows that the output element (mastering) should also be totally automated.

For the replication and TM supply functions, the manual versus automated alternative has little impact. The printing and microform duplicating operations serving TM replication needs are generally semi-automated to the point that is cost effective. Further sophistication such as found in long-run, high-speed newspaper or periodical printing operations are not cost effective for TM publishing. One aspect of automation that would be effective is such devices as automated electromechanical collators or microform duplicators.

Contractor vs Internal Navy Operations – The contracting alternative has ramifications that should be considered. For mastering, replication, and delivery, contracting is a most viable alternative to the internal Navy capability. Contracting of the mastering and replication requirements of any medium (except direct digital) is feasible. Mastering is a device-oriented function, and contractors as well as Navy organizations could have the necessary mastering devices. The output from the processing function (most probably a digital magnetic tape) could be provided to a contractor to process on his device.

Replication is also device-oriented, and the same contractor mode of operation could be employed. The master would be supplied to a contractor for reproduction or copying on his replication devices. Likewise, most publishing contractors would be capable of packaging, labeling and shipping directly from their facility assuming they were provided the proper instructions. Direct digital is the exception since there is no "product" to be mastered or replicated and "shipment" would require transmission of the TMs through use of hardware not normally available to a publishing contractor.

An additional consideration in the contracting alternative is various mixes of internal and contracted. For example, mastering could be done internally, with replication and TM supply accomplishment by contractors. Also, some media may be better suited for contract because of high capital investment for devices that would have low utilization.

One other consideration in regard to contracting is the position of the Congressional Joint Committee on Printing (JCP) relative to the contracting of replication media. It is assumed, for example, should printed books and microforms be dropped in favor of video discs, that replication of the video discs would remain under JCP cognizance. If so, internal Navy replication may not be justified. This is because it is logical to assume that there will be sufficient contractors available to handle this or any other new replication medium.

TABLE 4-13. MASTERING, REPLICATION AND TM SUPPLY ALTERNATIVES

Basic Operation	Functional Concept	Functional Alternative (Manual)	Functional Alternative (Contracting)
Mastering (including conversion of content capture output)	Preparing master from digital form of TM structured for the medium selected	None - the output of manual entry and processing would be the medium for mastering – using conventional methods and current technology	High Potential – device entered
Replication	Reproducing or copying the masters	Not considered an alternative	Very viable (JCP impact)
TM Supply	Packaging, labeling and physical distribution	Not considered an alternative	Would be contracted along with replication function

4.4.1 DESCRIPTION OF DISTRIBUTION SUBSYSTEM PRELIMINARY CONCEPT

The Distribution Subsystem provides NTIPS with the capability to control deployment of Navy TMs from the time they are created until they become obsolete.

Technical manuals must be made available to equipment operators and maintainers when and where needed. Therefore the primary concern in development of a new or improved approach to TM distribution is to satisfy that need. The system must be capable of providing TMs to the appropriate Navy personnel in the quantities required throughout the life of the equipment. This requires directing the distribution of new TMs or changes and revisions to existing deployed TMs, providing a supply resource for TM users to obtain replacements for manuals they require, and maintaining a complete and accurate file of all TM masters in the Navy's inventory.

The approach taken in developing the preliminary concept is to have three functions that will satisfy all distribution requirements: (1) a decentralized initial distribution control function working closely with the acquisition activities and using the automated Management Information System (MIS) for configuration and distribution control management, (2) a centralized TM resupply function to provide physical storage of paper and/or microform copies of TMs in the Navy's inventory, and (3) a centralized dual archive function containing a digital data base as a working archive for use in update programs, and a historical archive for all Navy TMs.

Initial Distribution Control – FIrst-time or initial distribution of totally new technical manuals (and changes and revisions to existing deployed technical manuals) is accomplished as a result of this function. Its primary responsibility is to insure that shipping directives, usually in the form of address labels, are issued to the TM supply function of the Publishing Subsystem for physical deployment of newly procured technical data. To do this, the initial distribution function must communicate with various functions for collection of certain pertinent data. This data generally falls into one of three categories: (1) acquisition status (i.e., information pertinent to the delivery status of any particular technical data procurement action), (2) configuration (i.e., information pertinent to assignment of control numbers to changes, revisions, and new manuals), and (3) distribution requirements (i.e., the actual addresses of those activities that are to be "on distribution" for the data being procured). Most of this information will be obtained from the acquisition activities handling the hardware programs and the related ILS functions. The MIS will be used as the primary storage and retrieval device for the information. Once this data has been accumulated, the shipping directives are prepared and forwarded to the TM supply function.

Resupply – One-time issuance of any previously deployed technical documentation is the responsibility of the resupply function. Being a warehousing activity, it assumes a prime responsibility for receipt, storage, and retrieval of all resupply stock. Inventory control, reporting, replenishment forcasting, and printing of shipping directives will be automated through MIS.

A constraint in this design is that of media. Future technologies in the areas of media for storage or data usage could alter storage and retrieval techniques. For the preliminary concept, media has been considered a physically deliverable product, such as a video disc, hologram, microform, or paper.

Archive – Storage and retrieval of the TM master is the responsibility of the archive function. It consists of two subfunctions: (1) a historical archive for storage of TM masters for all TMs deployed by the Navy regardless of current configurations, and (2) a working archive in the form of a digital data base that is accessible by the major acquisition activities to be used to process TM updates. MIS will be used to control inventory accountability and to report archive status and activity to subsystem and system management.

The need for the Distribution Subsystem to accumulate, process, and report large amounts of information on various subjects, such as materiel management and configuration status, requires a high degree of automation for the subsystem to be effective. This is conceived to be via an extensive MIS designed to support all of the NTIP System.

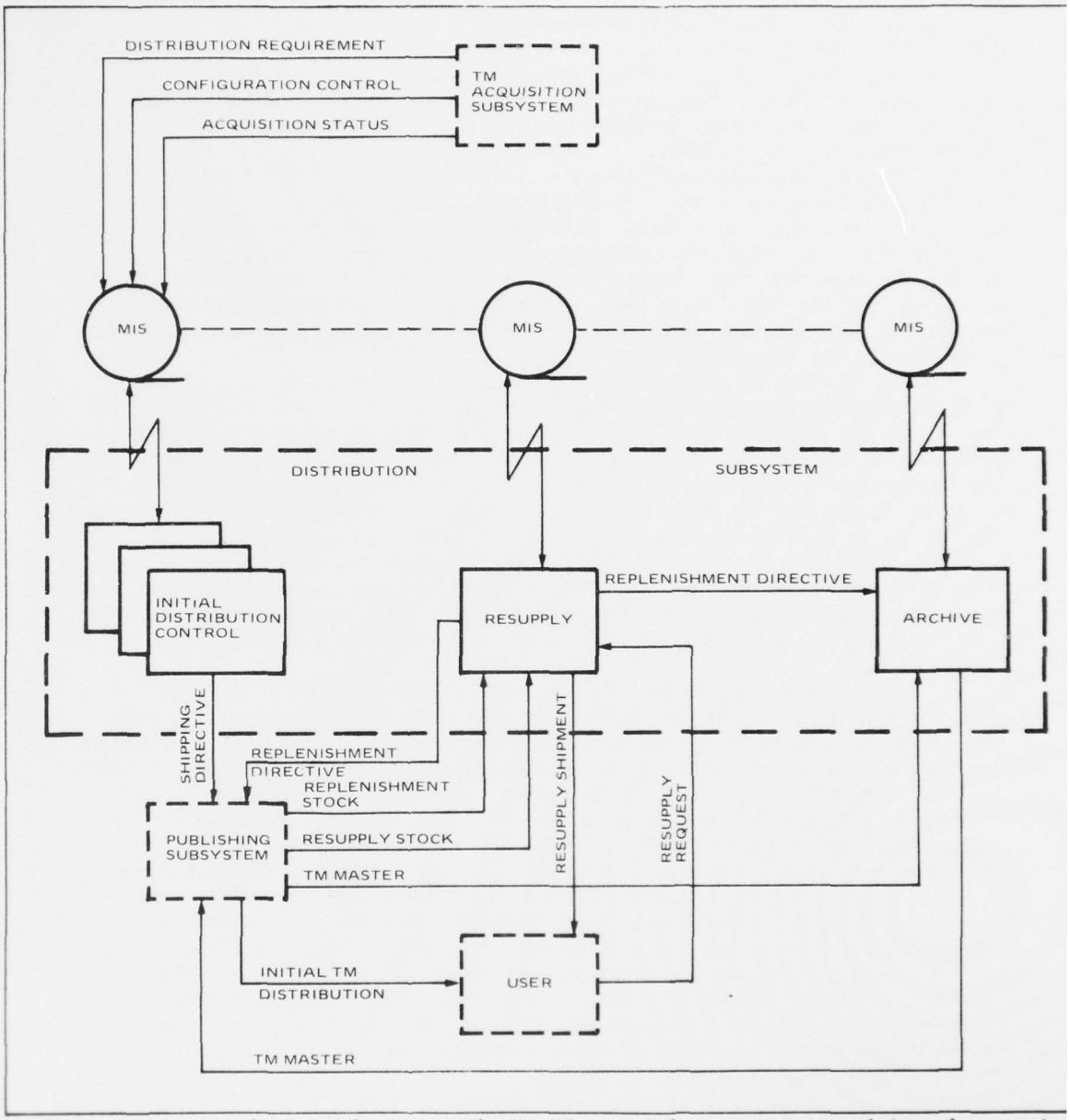


Figure 4-16. Distribution Subsystem. The Distribution Subsystem consists of three functional elements designed to be highly reactive, by utilizing MIS, to TM distribution requirements for new procurements and the supply of replacement TMs to users.

4.4.2 DESCRIPTION OF INITIAL DISTRIBUTION CONTROL FUNCTION

The preliminary concept of the initial distribution control function is that of a decentralized activity, utilizing a standardized, automated data base and control system for control of distribution requirements.

The task of the initial distribution control function is to collect the information necessary to create shipping directives for newly acquired TMs and TM changes and revisions. In the preliminary concept, initial distribution control is decentralized, with one NTIPS control function dedicated to each major acquisition activity. This eliminates the response problems inherent in a totally centralized system and utilizes existing Navy facilities.

A standardized approach to the collection of complete and accurate initial distribution information must be created if new TMs, changes, and revisions are to be delivered in a timely manner. Currently, the Navy acquires approximately 12,000 new TMs and 20,000 changes and revisions to existing TMs per year. All these require initial distribution action. These figures are not expected to change significantly in the next 5 to 10 years because as many systems leave the Navy's inventory as enter it each year, and the remainder are subject to constant modifications, causing TM changes and revisions.

The distribution cycle (Figure 4-17) begins when notification is received from the TM procurement function via the Management Information System (MIS) that a new TM number or revision/change number has been assigned to a specific equipment configuration. This provides notice that a potential distribution action is forthcoming. Acquisition status, delivery schedule, and preliminary distribution requirements would then also be obtained from the TM procurement function. This information is input to a distribution address file and maintained as a part of the MIS. This file is structured to provide a cross reference between TM (or change/revision) number, equipment, user location, and quantity required at each user location. Finally, TM procurement via MIS then outputs a TM shipping directive that tells the TM supply function where and in what quantity the preliminary data is to be shipped.

Distribution requirements for preliminary TMs differ from those for the final version. Normally, the preliminary manual will only be distributed to those organizations engaged in validation/verification of the data. Additional TM copies, produced for storage, are designated as limited issue, and approval of the acquisition program manager is required for their release. An exception is when an equipment is deployed without the final version of the TM being procured. In such cases, the preliminary TM will be distributed as if it were a final TM. When a final TM or change/revision is being procured, this initial distribution control process is repeated. Preliminary distribution requirements for a new TM would be revised to reflect final requirements and the distribution address file updated. Final distribution requirements for changes and revisions to existing deployed TMs would be obtained by accessing the distribution address file for current address and the quantity required for each user of the basic TM. This results in the "automatic" distribution of changes and revisions to all those users who are currently using the basic manual. Following the above action, the TM master would be sent to the archive function.

The key feature of this design concept is the creation and maintenance of the computerized distribution address/quantity file. With over 140,000 TMs in the Navy's inventory, and with as many as 30,000 new TMs, changes, and revisions being processed per year, it is estimated that this file will require approximately 2.8 billion bits of storage to hold the data on the number of TMs and addresses in the TM inventory.

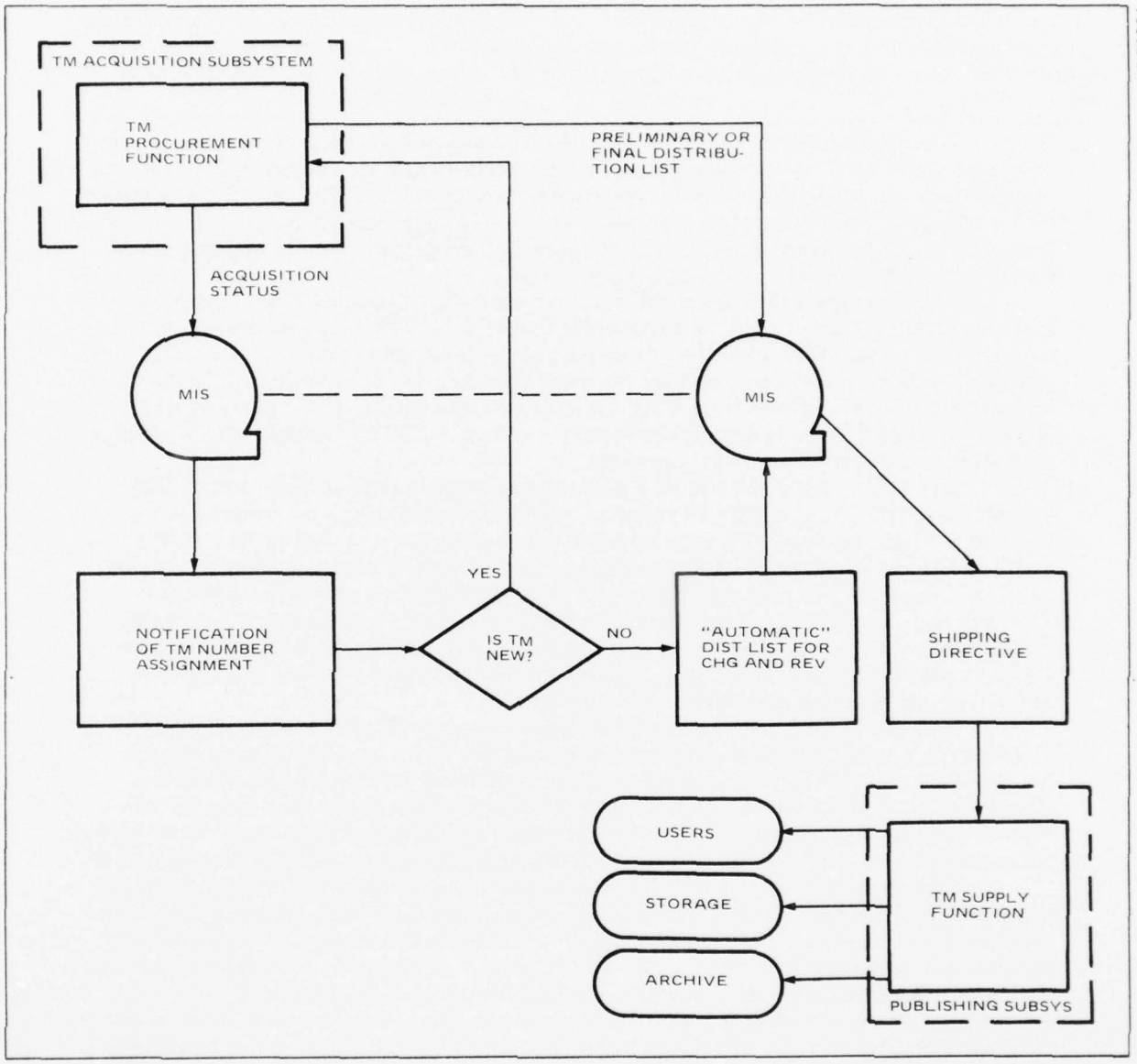


Figure 4-17. Control of TM Distribution. Having the ability to automatically access the distribution requirements for changes and revisions reduces the time and effort required to deploy the data.

4.4.3 DESCRIPTION OF INITIAL DISTRIBUTION CONTROL FUNCTION ALTERNATIVES

The primary alternative to the decentralized initial distribution control function is to go to a centralized organization. The selection of organizational approach has a direct impact on the method to be employed for gathering, processing, and reporting information.

The preliminary concept for initial distribution control would establish capabilities dedicated to each major acquisition activity for standardized information management methods that would be provided through the NTIPS management information system (MIS) computer network. Alternative approaches to this function concern variations in its organizational structure and methods of implementing an information management system (see Figure 4-18).

The organizational alternative to the preliminary concept is a single, centralized function directed by and reporting directly to NTIPS management. Such an approach could offer a number of advantages. It would concentrate activity into one location and make possible more precise management control through direct access to cost and performance information and observation of resource utilization. It would also eliminate redundant hardware systems required for collection, storage, and output of distribution requirements.

The major disadvantage of a centralized organizational structure is that it limits the function's ability to respond quickly by being farther removed from the acquisition organizations with which it must closely interrelate. One of the goals of the preliminary design process has been to assure that the function is capable of responding to requests for creation of shipping directives in accordance with the time constraints imposed by the materials delivery schedule. Although the high degree of data processing automation will in itself speed the process, initial distribution activities being in a different organization than the acquisition activities can produce communications delays.

It is estimated that there will be approximately 30,000 individual initial distribution actions per year, requiring the creation of an organization to handle the work load. Additionally, not all initial distribution actions will be identical. The different major acquisition activities have variations in the way data is collected, stored, and retrieved, or in the particular information collected. Such variations could reduce even more the centralized organization's ability to be responsive.

Distribution Addressee Files Alternative – As described in the preliminary concept, information management will be accomplished through creation and maintenance of distribution address files within the NTIPS MIS computer network. An alternative approach is to not use MIS, but create and maintain an independent management information system. Such an approach would be applicable to either a centralized or decentralized organizational structure. The advantage of using the MIS, particularly in a decentralized organization, is that it allows more flexibility in customizing the design of the files to meet the unique requirements of each major acquisition activity.

The disadvantage of the independent MIS is that by taking the files out of the NTIPS MIS computer network, the ability of other functions of NTIPP, such as management, to access this information has been eliminated. Also, while there is a need for a certain degree of flexibility in the structure, it must be tempered with a common approach, or initial distribution will end up with a totally unique approach for each major acquisition activity.

Mixed Files Alternative – An additional approach to information management is to maintain the existing file system (mixture of manual and automated files) for collection and control of distribution requirements. Although such an approach would be viable from an economic standpoint, it would also limit the function's capability to respond in a timely manner.

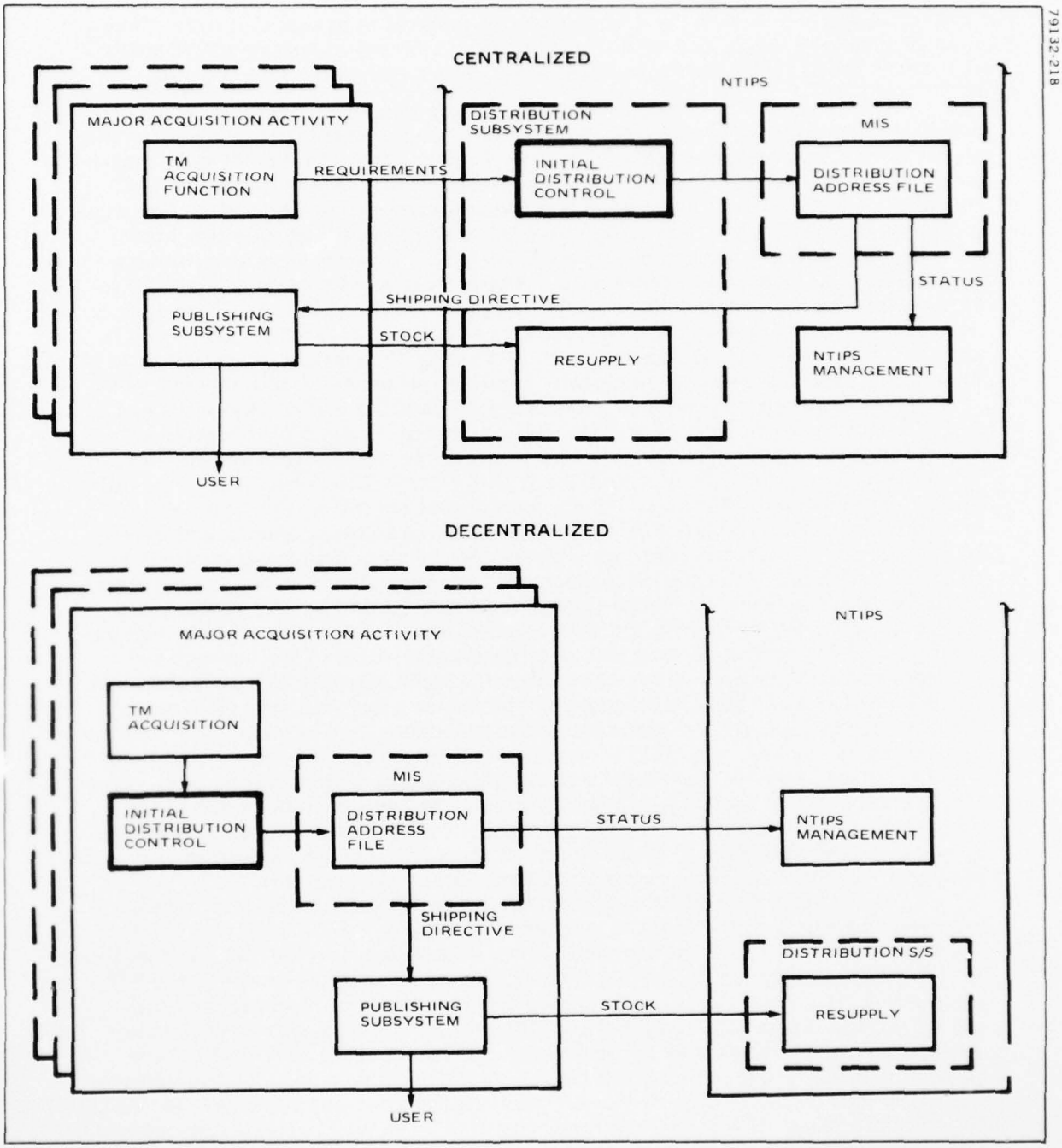


Figure 4-18. Comparison of Centralized and Decentralized Initial Distribution Control Function. Proximity to Acquisition activity, to which it must closely interrelate, is the key to successful initial distribution control.

4.4.4 DESCRIPTION OF THE RESUPPLY FUNCTION

The goal of resupply is to develop a system that is responsive to user demands. Taking TMs out of the Navy supply system and making them an integral part of NTIPS would provide more direct control and a more effective interrelationship with the user.

Resupply provides the capability to fill user requests to furnish copies of previously deployed TMs, changes, and revisions. This is currently done as a regular supply action, and responsiveness to the user is often slow. To the TM user, responsiveness is measured in terms of how long it takes to receive the manual he has requested. In the current practice, when a user prepares a TM requisition he assigns a priority designator to it. The designator tells the resupply function the latest calendar day by which the TM should be delivered. For example, priority designators 1 through 3 must be delivered within 8 days for domestic shipments and 12 to 13 days for overseas shipments. Priority designators 4 through 8 are 12 days for domestic and 16 to 17 days for overseas. Priority designators 9 through 15 are 31 days domestic and 60 to 90 days overseas, depending on location. It should be kept in mind that these are requested delivery priorities which are frequently not met.

The preliminary concept for the resupply function would establish it as a single, centralized TM supply activity. Unlike current methods of resupply, the method being proposed here would not be a part of the Navy supply system, but would instead be a functional part of the NTIPS Distribution Subsystem. This will allow the producers of TMs, i.e., NTIPS, more direct control of the supply of manuals to fleet users. It would provide central storage, retrieval, and control for all Navy TMs in a variety of media. As with the other functional elements of the Distribution Subsystem, information management, control, and reporting will be automated as an element of the NTIPS Management Information System (MIS). Specifically, it will provide the function with an automated system of materials management. Inventory control records will be structured to reflect TMs, changes and revisions received, issued, and on-hand balance. Stock balances will be maintained through utilization of demand forecasting techniques which will give management the visibility to replenish on-hand stock balances before they reach minimum levels. In addition, the system will provide reports on inventory status, stock utilization, and requisition activity. Such a centralized TM resupply system will be more effective in responding to user requests by being dedicated only to TMs, reducing the occurrence of back orders by having increased visibility of user demand trends and by lessening the confusion of where to send a request. This increased responsiveness should be especially apparent for priority designators 9 through 15.

As shown in the following work flow diagram (Figure 4-19), inventory is received as a result of the initial deployment of data by the TM supply function. Stock is received and inventory control information is input to the MIS. The method to be used for storage of the material depends upon the medium on which the TM is recorded. However, the storage facility will be capable of handling the paper and microform media selected for the NTIPS preliminary concept and of incorporating future media which may become viable within the 1980s time frame. The major exception to this is the direct digital transmission medium, which would significantly alter both the type of storage facilities required and the means for distribution. As a result, this medium will be presented as an alternative design approach in a subsequent topic.

All requests for resupply action are sent to one central location within the resupply function. The inventory is searched via access to the materials management system. If the item is in stock in its requested quantity, it is pulled from storage and sent to the requestor via the best available means of transportation. Again,

medium dictates the packaging method as well as the means of delivery. If an item is not in stock, the user is notified immediately and the request is placed on back order.

Back orders require that immediate action be taken to replenish stock to acceptable levels. In addition, the MIS will be designed to look at current stock on hand and past demand history to forecast minimum/maximum stock levels. Stocks reaching the minimum on-hand balance level cause replenishment action to be undertaken. Replenishment action involves issuing a directive to the archive function to pull the TM master from its files and forward it to a designated replication function. The replication function will be directed to produce TMs in a designated quantity and send them to the resupply function. The TM master will, if applicable, be returned to the archive function. Once replenishment stock is received, back orders will be filled in the most expedient manner.

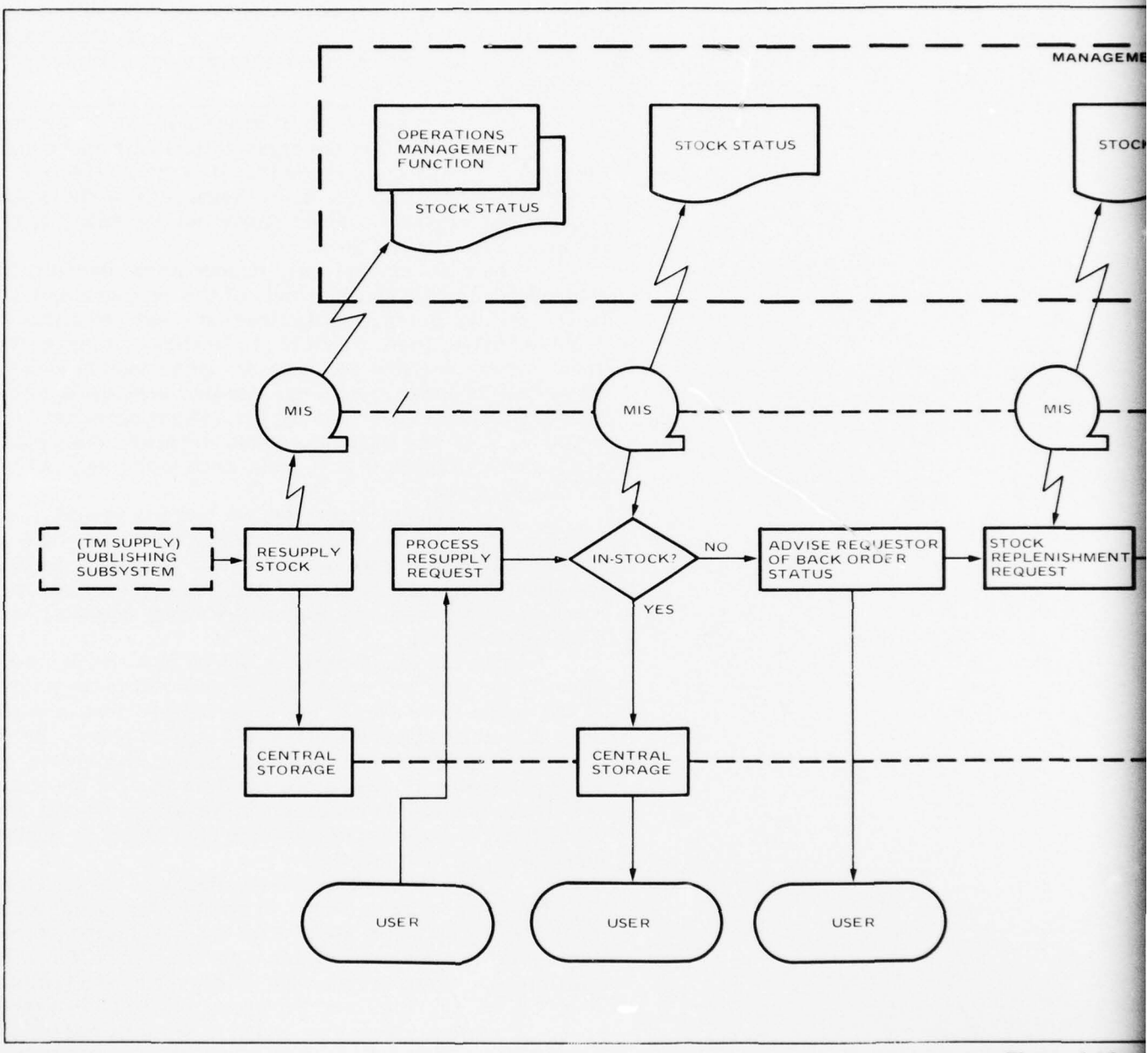


Figure 4-19.
responds quick

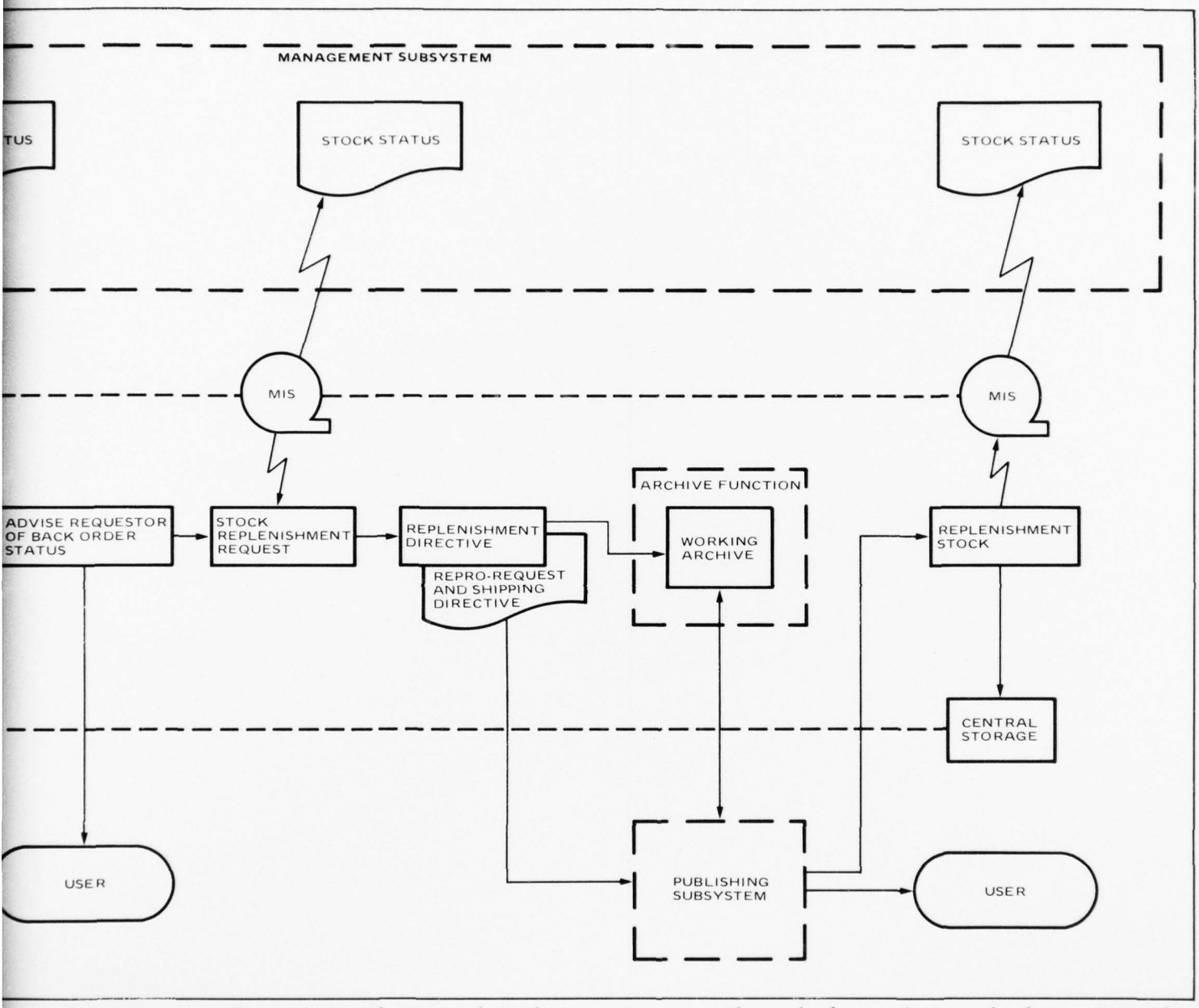


Figure 4-19. The Resupply Preliminary Concept. The goal of resupply is to develop a system that responds quickly and efficiently to user requests for TMs, changes, and revisions.

4.4.5 DESCRIPTION OF RESUPPLY FUNCTION ALTERNATIVES

Although the decentralization alternative could result in a more responsive resupply function with conventional printed paper TMs, its advantages are diminished as more advanced media are utilized and material movement becomes less of a critical consideration.

The two major areas of concern in the formulation of alternative approaches to the resupply function are organizational structure and media. The organizational question to be answered is whether it is more effective to have a centralized or decentralized resupply function. Regardless of the organizational structure, however, media can have a direct impact on the ability of the resupply function to be responsive to user requests.

There are several ways to accomplish decentralization of the resupply function. First, the TM requirements of the various major acquisition activities could be determined and the supply function separated along geographical demand lines. In this situation there would be, for instance, a major resupply function on each coast and in the Great Lakes area. Each would have the capability of supplying all of the TM needs in its area. Another consideration would be to divide the TM resupply responsibilities among the various equipment types. For instance, aviation would have its own supply, as would shipboard electronics, mechanical equipments, etc. Another approach is to make each major acquisition activity responsible for its own resupply.

If resupply is decentralized, there is an additional organizational decision which must be made. That is: whether these functions should be a part of the NTIPS organizational structure dedicated to a specific acquisition activity or a part of the acquisition activity itself. Additionally, consideration must be given to the resupply function being a part of the Naval supply system as it is now, even though it is decentralized.

With the use of paper as one of today's TM media, consideration must be given to the bulk and weight of the material to be moved. But current projections of the media to be used in the 1980s suggest that microforms, disc memory, video disc, and other advanced media will replace paper. As the end-products of these media are significantly smaller and lighter than paper, shipping becomes less of a critical problem. Hence, the need for placing the source of supply close to the user is diminished. In addition, decentralized storage facilities would require that all of the functions and capabilities of resupply be duplicated, both manpower and equipment, at each location.

A considered alternative is linked to the development of a digital TM data base for the working archive. Providing on-demand replication devices that are driven by digital tapes would effectively eliminate the need to physically store copies of TMs. When a request is received for a TM, a tape is made from the digital data in the working archive and used to drive the replication device (which is similar to a "Xerox" machine), and the copy would then be sent to the requester.

Another alternative, which would take full advantage of media advances, is to utilize a direct digital system of TM storage and retrieval. Such a system would involve putting all TMs in the Navy's inventory into mass memory storage, which would significantly alter the organization and operation of resupply (see Figure 4-20). Output from the content generator would be transmitted directly in digital form to a central storage facility through the entry and processing subfunctions of the Publishing Subsystem. The initial distribution function would remain basically the same, but instead of issuing shipping directives to a replication activity, it would issue transmission instructions to central storage. These instructions would tell

the central storage activity where to transmit the newly acquired TM. This would, of course, require digital receiving equipment at each user location as well as some sort of replication capability.

The major impact of the direct digital system on the Distribution Subsystem is that it does away with the need for the resupply and archive functions as they have been previously defined. Resupply becomes the central storage facility, thus eliminating the requirement for a working archive. There is no need for a replenishment activity because the TM master is stored in digital form and never leaves the facility. The historical archive would still be needed, but this would probably take the form of a backup memory used only in the event of failure in the central storage.

The ability to implement such a system is limited by the technical development of mass memory devices which are capable of handling the amount of storage required. It is estimated that such a file would be as large as 129 trillion bits. The subject of mass memory storage devices is discussed in more detail in a subsequent topic.

An additional alternative is to leave the resupply function as it is today, residing in one principal location as a part of the Naval supply system. This would take full advantage of existing resources and would cause very little disruption in resupply operation during the implementation of NTIPS.

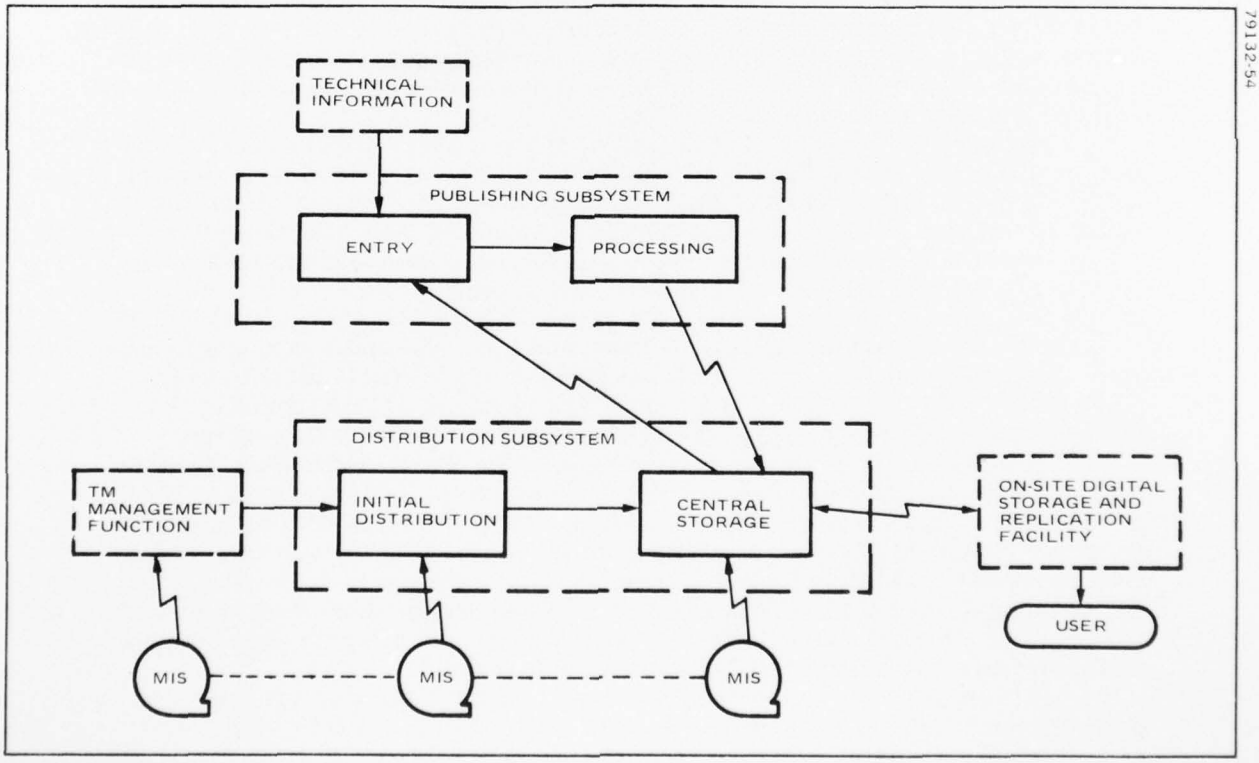


Figure 4-20. The Resupply Function in a Digital Environment. In the digital medium, the central storage function assumes the role of resupply and working storage.

4.4.6 DESCRIPTION OF THE ARCHIVE FUNCTION

A distributed working archive coupled to a centralized historical archive controlled through the MIS are combined for the archive function in the preliminary system concept.

The initial concept of the archive function would establish capabilities for the storage, retrieval, and control of all masters and master records of TMs deployed by the Navy. The archive function would consist of a historical and a working archive. The historical archive will provide for the storage and accountability of the physical TM masters for every new or updated TM. The working archive will be primarily a digital data base only for the active TMs in the Navy's inventory. It would be used for replenishment of resupply stock or update of existing TMs without disturbing the historical archive.

Since TMs are produced in somewhat limited quantities based on projected near future usage, TM resupply activities must be capable of replenishing their stock when the on-hand balance is near depletion. To speed reproduction, all the plans and specifications needed to reproduce a TM would be included with the TM master copy in the archive. Thus, all that will be needed to replenish stock is to retrieve the TM master copy and send it through a replication process. This would apply equally when changes or revisions are required. Since it is far more efficient to change or revise an existing master than to recreate it in its entirety, the ability to access archival data is critical to the design of a responsive system.

Organizationally, the two archives would be subfunctions of the Distribution Subsystem (see Figure 4-21). The historical archive would be placed in a single location with a centralized management structure directing its activities. The working archive would also be directed by a centralized management structure, but the actual data would be dispersed geographically, by commodity or other factor. Control would be provided through the NTIPS MIS.

Working Archive – The initial loading of the working archive data base with TMs received from contractor or prepared by Navy content generators is through the digital production function of the Publishing Subsystem. This input and any subsequent moving of TMs to be reprocessed between the Publishing Subsystem and the working archive is controlled through MIS. Not only does MIS coordinate the transfer and use of the TM data base, but MIS also provides NTIPS with access to an index of information on any active TM in the Navy. The index would cover TM type, equipment nomenclature, date of issue, and other relevant indexing information. This would include a cross-referencing capability to enable users to locate TMs by other than the official TM number. The technology to be applied in the preliminary concept for the working archive is discussed in the following topic.

Traditionally, the TM data base resides in the Navy. Although it would be distributed (by mission, commodity, etc.), it would still be within, as well as controlled by, the NTIPS organizational structure. Undoubtedly, when a contractor delivers a TM via digital tape, he would maintain his original TM data base to support subsequent work efforts. The contractor can anticipate update work on that TM, or utilizing the data base to support other customers or other similar products. The principal Navy subsequent effort is TM update which, under the data base concept, could be all updates after the original TM is issued.

It is essential for the working archive to work closely with the historical archive to maintain integrity of the two data bases and the TM data index. The prime example of interplay between the two archives is when TMs from the working archive are returned from an update processing by Publishing. That TM update package must immediately be entered into the historical archive and the index corrected.

Historical Archive – New TMs are sent to the historical archives from the Publishing Subsystem. As the subfunction is primarily a materials management activity, it is subject to the same type of control and requirements as the resupply function. Here, as in the resupply function, the NTIPS management information system (MIS) computer network will be used for creation and maintenance of records for control of the TM masters.

Physical storage procedures will depend upon the media in which the masters have been produced. If in a condensed form, such as microfiche or roll microfilm, the masters will be stored in that medium. If, however, the masters require bulk storage, such as reproducible masters for paper manuals, they will be converted to a more condensed medium for storage in the historical archive files. An additional concern of this function is the assurance that the materials are stored in a manner that will assure their protection. Consideration must be given to how the different media withstand storage for prolonged periods of time, including requirements for control of light, temperature, and humidity.

Since the historical archive is a record of Navy TMs, both active and inactive, it will be used as a backup source of information for the working archive. In the event such a need occurs, the historical archive master will be retrieved for transfer to the working archive and subsequent processing by the Publishing Subsystem.

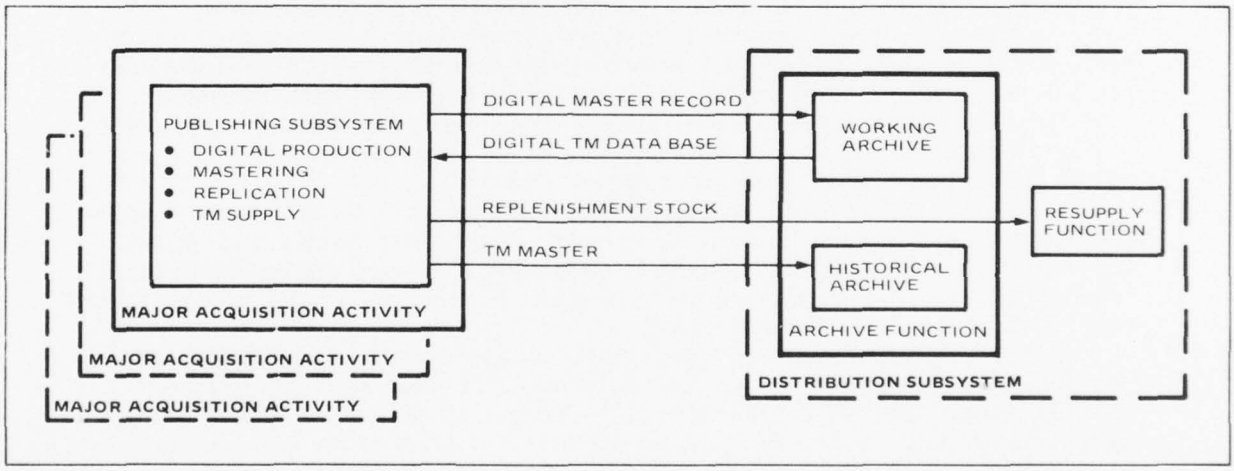


Figure 4-21. NTIPS Archive Function. The archive function would have two subfunctions: working and historical. Primarily digital, the working archive would store active TMs, while the historical archive would be the physical repository for all TM masters.

4.4.7 DIGITAL ARCHIVE TECHNOLOGY CONSIDERATIONS

To store the Navy TM data base in the working archive will require the development of a mass memory storage capability for up to 129 trillion bits. Current technological developments in memory storage devices show promise of the feasibility for storing such amounts of data within 5-10 years.

The preliminary concept of the archive function would establish a data base in the working archive subfunction, for all active TMs. The working archive would serve as the primary source of information for updating TMs and also be the source for TM masters for replenishing resupply stock. Functionally, the data base is all-digital, with automated control mechanisms provided through the NTIPS Management information system (MIS) computer network.

Storage methods and techniques are key considerations for the development of a usable working archive. Storage technology has been, and continues to be, a developmental area. A very large storage capacity is needed for the TM data base. For example, the present inventory of technical manuals would, as digital bits, need over one million hard discs. Although the potential amount of digital storage becomes very large when pages are converted to bits (see Table 4-14), the present technology indicates low-cost, high-capacity storage will be available in the 1980-1985 time frame. Chief among the viable digital storage candidates are the bubble memory, charge-coupled devices, video discs, and holograms.

The magnetic bubble memory is already being marketed with 10^5 bits per 6-centimeter square chip. Chips with 10^9 bit capacity will be available by 1980. Using bubble technology, the present inventory could be accommodated on 10,000 one-millimeter square 10^9 chips. Present per-bit cost is high, but significant cost reductions are projected as the higher density chips (up to 10^{12}) are developed. One significant attribute of magnetic bubble memories is that they are indestructable and transportable, making them a potential candidate for applications where digital hologram or digital video discs are considered.

The charged-coupled devices (CCDs), although a totally different technology, are similar to bubbles in their high storage capacity for small sizes. Again, the present cost is relatively high, but is continuing to come down as development effort increases. Unlike bubbles, the CCD is not permanent - in use, a power failure could destroy the data stored in a CCD.

The video disc used for digital storage is a relatively cheap (per bit) device, and the digital hologram is also in that category. The video disc is described in the DTNSRDC report[1] and holograms in the Task 1 report[2] page 3-254. These storage media are also candidate media for delivery of the TM to the user and for use in his environment. Another candidate for digital storage, which is similar to the video disc and will be considered along with it, is the metal film medium.

Further analysis may show that a continual assessment of technology will be needed in the field of storage media. As with delivery and user (presentation) media, there are sufficient developments to warrant continual in-depth investigations and evaluations through-out the design process of an NTIP System, and beyond. Choices will have to be made at certain points in the design process, but realistically some options must also remain open.

---

[1] Poe Engineering Services; Photographic Video Disc Technology Assessment; October 1976, David Taylor Naval Ship Research and Development Center.

[2] Hughes Aircraft Company; Task 1 Report (CDRL A001) – Analysis of Current and Proposed Technical Manual Systems; 24 March 1977, David W. Taylor Naval Ship Research and Development Center.

AD-A051 311 HUGHES AIRCRAFT CO FULLERTON CALIF GROUND SYSTEMS GROUP F/G 5/9
PRELIMINARY NTIP SYSTEM CONCEPT AND ALTERNATIVE CONFIGURATIONS.(U)
JAN 78 J E CONNELL, J J GOLDBERG N00600-76-C-1352

UNCLASSIFIED FR-77-12-150 NL

3 OF 3
AD
A051311



END
DATE
FILMED
4-78
DDC

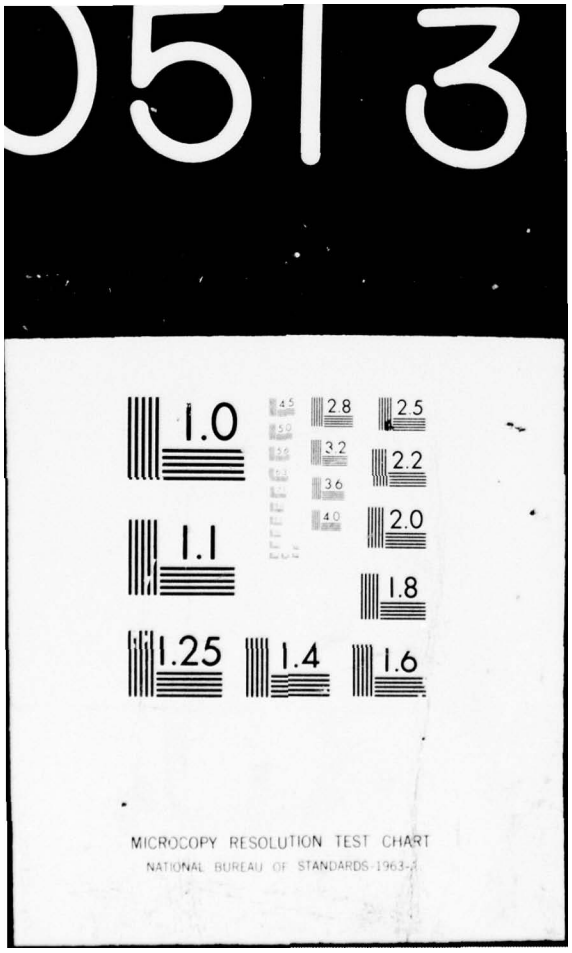

0513
1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 4-14. NAVY TMs CONVERTED FROM PAGES TO DIGITAL BITS

Basis for Conversion

Text Page = 20,000 to 40,000 Bits
Art Page (Uncompressed) = 1,000,000 to 16,000,000 Bits
Art Page (Compressed) = 100,000 to 1,600,000 Bits

Total TM Inventory

	Low Estimate		High Estimate	
Text	348,000,000,000	–	696,000,000,000	Bits
Art	800,000,000,000	–	128,000,000,000,000	Bits
	1,148,000,000,000	–	128,696,000,000,000	Bits

(Total = 1 Trillion to 129 Trillion Bits)

Yearly New TM Production

Text	42,000,000,000	–	84,000,000,000	Bits
Art	900,000,000,000	–	14,400,000,000,000	Bits
	942,000,000,000	–	14,484,000,000,000	Bits

(Total = 942 Billion to 15 Trillion Bits)

Yearly Update

Text	4,080,000,000	–	12,680,000,000	Bits
Art	12,600,000,000	–	3,168,000,000,000	Bits
	16,680,000,000	–	3,180,680,000,000	Bits

(Total = 17 Billion to 3 Trillion Bits)

4.4.8 DESCRIPTION OF ARCHIVE FUNCTION ALTERNATIVES

There are several alternative approaches to the archive that relate to various combinations of the two subfunctions (working and historical) as the result of centralized and decentralized options. All combinations are usable, but they are not equally effective.

Alternative approaches to the archive function are primarily a question of whether it would operate more effectivly in a centralized or decentralized mode. The preliminary concept is an organizationally centralized function with both the working and historical archive subfunction under the direction and control of the NTIPS Distribution Subsystem.

There are a number of viable alternatives to this approach. First, the entire function can be decentralized by either (a) combining the working and historical archives into a single archive, or (b) by utilizing the functions as they appear in the preliminary concept (see Figure 4-22, reference 1a and 1b). Another alternative (reference 2 in Figure 4-22) is to develop a combination approach, that is, a centralized historical archive and a decentralized working archive. The last alternative (reference 3 in Figure 4-22) would be to utilize the centralized approach, combining the working and historical archives into a single activity.

In the first alternative (reference 1a), the archive files would be split up and assigned to those major acquisition activities that have cognizance over the creation and maintenance of the basic manual and its subseqent revisions and changes. The need for a separate working archive would be eliminated since master copies of the TMs would be readily available for use at the activity's location. Any requirements for reporting activity or status of these individual files could still be accomplished through the NTIPS Management Information System (MIS) computer network.

In reference 1b of the first alternative, the working archive concept could be retained, but since there would be no central data base, each major acquisition activity would require all the hardware capability of every other activity. Both of the decentralized alternative approaches are redundant and subject to control problems from a system point of view.

The second alternative (reference 2) is to utilize a combination of the centralized and decentralized organization structures. In this approach, the historical archive would remain a centralized repository for all Navy TM masters and be under the direction and control of the NTIPS Distribution Subsystem. The working archive would then be decentralized under the control and direction of the major acquisition activities as described in the first alternative. Such an approach would have the effect of allowing the individual activities to design their TM archives to meet their own unique requirements, while still providing a central repository for information for all Navy TMs. Again, status and activity reporting of the various files could be maintained through MIS, which could provide the inventory control and accountability capabilities to the historical archive.

The last alternative (reference 3) would be to utilize a centralized structure, but eliminate the two subfunctions. In such an approach, the archive function would simply be a repository for all TM masters that could be accessed from one central location by any user who has a need for the material. Like a storage activity, it would essentially provide those capabilities necessary for the accurate control and accountability of archival material. It would be a most economical and simple approach to take.

The major problem with any approach that involves decentralization of the archive lies in the fact that by distributing the files into various locations the control and accountability becomes more complicated. Unless these files are netted

in some fashion, the ability to construct a cross-referenced data file is lost. This could result in a situation such as exists today wherein Navy TM masters are spread over a variety of physical locations, and no one organization or activity knows what is available or where it can be found. Additionally, any alternative that eliminates the need for a digital working archive data base will require the physical removal of TM master materials. Such removals complicate accountability controls and contribute to precious materials being misplaced, damaged, or destroyed.

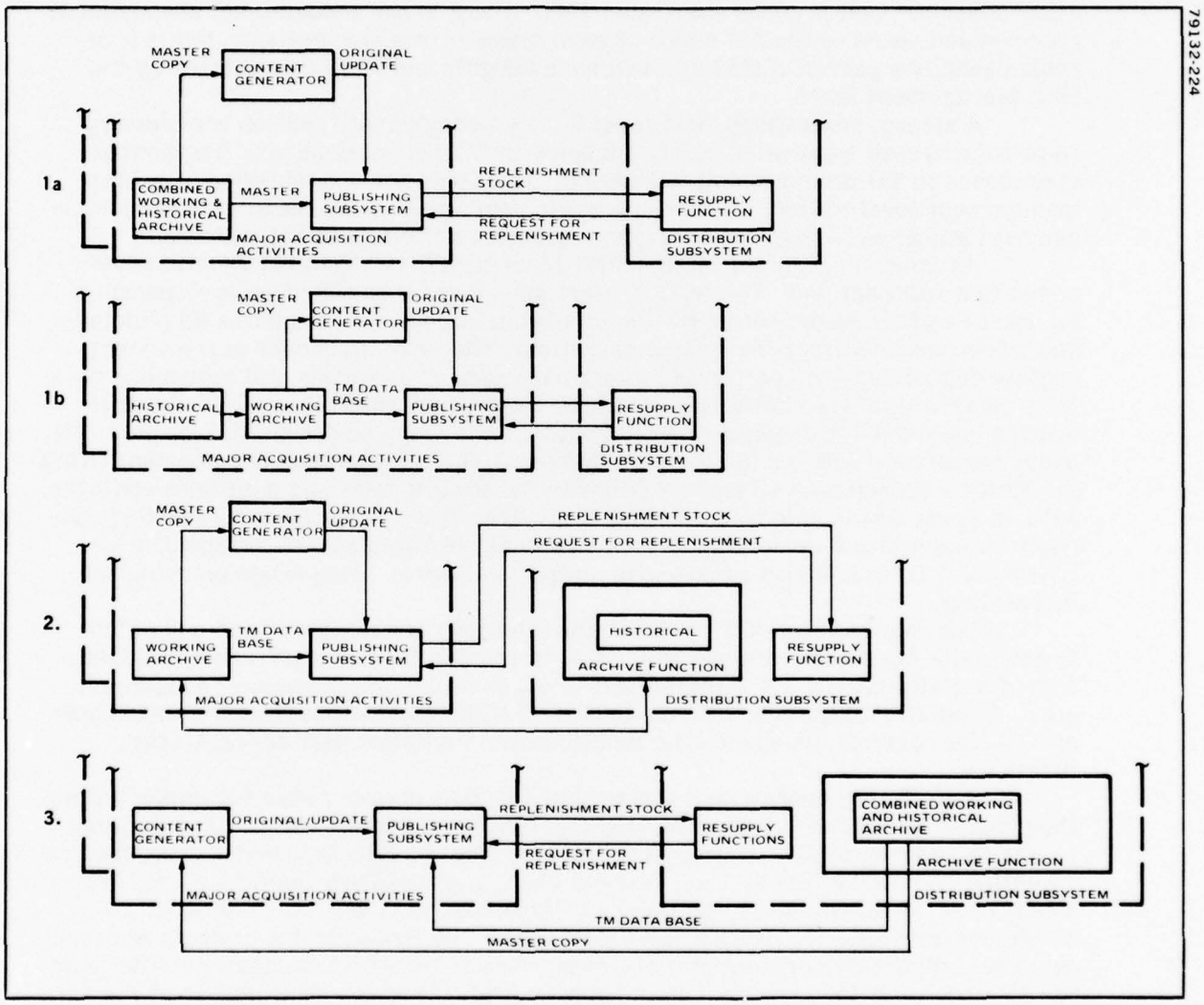


Figure 4-22. Alternative Organizational Placements of the Archive Function. In some alternative approaches the working and historical archive subfunctions are combined.

4.5.1 OVERVIEW OF MANAGEMENT SUBSYSTEM PRELIMINARY CONCEPT

The NTIPS Management Subsystem utilizes a central system management function to provide direction and guidance to decentralized operational management functions. To integrate these functions into the existing Navy structure, they are operated as part of NTIPS, but are dedicated to the TM requirements of the major acquisition activities.

The NTIPS Management Subsystem is analogous to a standard, two-level corporation structure. The first NTIPS management level operates as a "corporate management group" providing policies and directives for the overall operation of the system. The second management level resides at each of the "corporate operating divisions" that produce the actual TMs. There is one second-level management function dedicated to the TM needs of each major acquisition activity, but it is organizationally a part of NTIPS and will have budgets and staffing reviewed by the first management level.

A strong, centralized first-level NTIPS management function is necessary to provide overall Navy-wide policy guidance to NTIPS and eliminate fragmented approaches to TM procurement/production. This function is established at a first management level so that NTIPS has a single point from which uniform overall management guidance is provided to major acquisition activities in TM matters.

As shown in Figure 4-23, the first-level NTIPS management function comprises four subfunctions. The NTIP System management subfunction is responsible for the overall management of NTIPS, and establishes and promulgates all policies and directives necessary for system operation. The system/product improvement engineering subfunction performs in-depth analyses of budgeting and scheduling data from Navy-wide NTIPS activities, analyzes TM product quality, provides the engineering expertise for changes to NTIP System technology or design, and prepares all quality assurance policies for the NTIP System. The research and development (R&D) subfunction coordinates all Navy NTIPS-related R&D efforts and maintains contacts with on-going DoD and industry TM R&D efforts. The cost analysis/forecasting subfunction maintains a comprehensive data base of cost breakdowns for specific activities of NTIPS, and also assists with budget reviews and long range planning and forecasting.

The second-level NTIPS operations functions are separated and dedicated to the major acquisition activities in order to provide for more effective consideration of activity-unique TM requirements (e.g., environment, personnel, equipment, etc.). In addition, separating the second-level NTIPS operations functions into dedicated units controls the size of the functions and simplifies user access to the functions.

Each NTIPS operations management function is responsible for implementing the policies established by the first management level and for establishing detailed operating procedures that coordinate the remaining NTIPS subsystems during the procurement and production of TMs. Normal operating funds are routed via the first management level to the second level and thence to other activities assigned to NTIPS control (e.g., TM Acquisition Subsystem). The funds for TM projects are separated according to equipment status – in-production or out-of-production. The funds for in-production TMs are identified and budgeted during the early phases of the hardware acquisition process by the system acquisition process program manager (PM) and are transferred to the cognizant second-level NTIPS Operations Management subfunction at program inception. Out-of-production TM funds are used for updates that are initiated by the second-level feedback and update subfunction and budgeted from O&MN funds. The second-level NTIPS Operations Management subfunction receives this O&MN funding directly and is responsible for the TM efforts on out-of-production TMs.

As shown in Figure 4-23, the NTIPS operations management function comprises six subfunctions. The NTIPS Operations Management Subfunction is responsible for implementing the first-level policies and directives, promulgating detailed operating procedures to its NTIPS activities, and guiding the operations of the NTIPS activities within its purview The practices and procedures subfunction prepares the detailed operating procedures and maintains the manuals containing the procedures, and the first-level policies. The Management Information System (MIS) subfunction maintains a data base of pertinent information covering TM operations and costs, a TM configuration index of all assigned users, and a listing of user feedback action items. MIS also provides weekly cost and operations reports to support the daily operations of the NTIPS subsystems – TM Acquisition, Content Generation (Navy only), Publishing, and Distribution. MIS also supplies a periodic report for use by the Management Subsystem in evaluating the overall performance of NTIPS.

The configuration accounting subfunction manages the numbering of TMs and maintains the user configuration index. The feedback and update subfunction manages the user feedback network and initiates updates of out-of-production TMs. The cost monitor/evaluation subfunction periodically receives from MIS operational data concerning the NTIPS activities and evaluates the performance of specific TM projects.

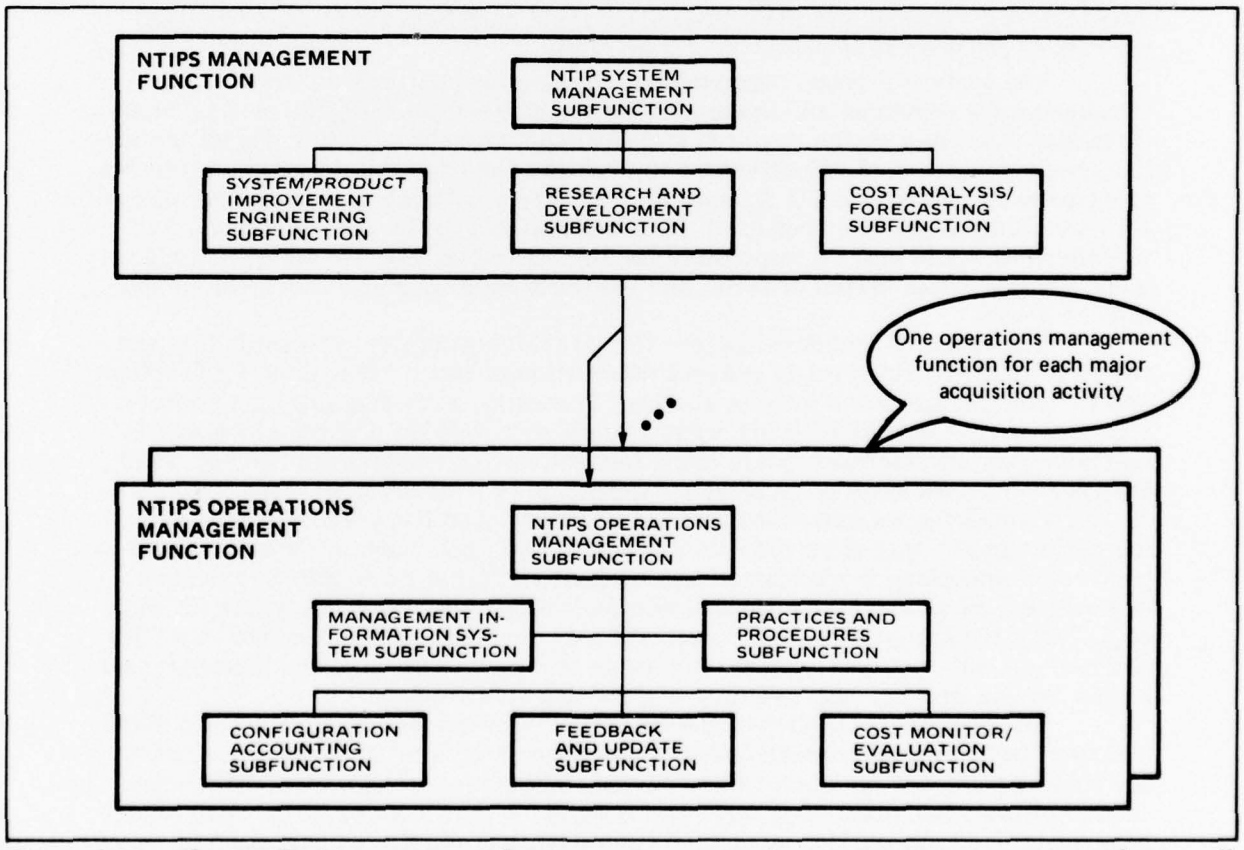


Figure 4-23. The NTIPS Management Subsystem. A two-tiered management structure provides overall management, policies, and directives from a centralized function and operational management from functions responsible to NTIPS but dedicated to the major acquisition activities.

4.5.2 DESCRIPTION OF THE NTIP SYSTEM MANAGEMENT FUNCTION

The overall direction of NTIPS is provided by policies and directives established by the NTIP System Management Subfunction.

The primary NTIPS coordinator is the NTIP System Management Subfunction, which also evaluates overall system performance and product quality. The subfunction establishes NTIPS goals, assures proper functioning of NTIPS, and provides long range planning. The subfunction will also maintain working relationships with high level representatives from Navy, DoD, and industry in order to coordinate NTIPS overall policy and doctrine with these activities. In addition, the System Management Subfunction will review all staffing and budgeting requests for the NTIP System and be responsible for distribution of operating funds. Table 4-15 lists the activities of the subfunction along with the other subfunctions and their activities, which are explained in more detail in the following paragraphs.

The system/product improvement engineering subfunction fills the need for a continuing check of the effectiveness of the system design and the quality of finished TMs. An analysis of the budgets and schedules of the TM operations of each major acquisition activity (input from the separate NTIPS operations management functions) would provide data that could be used to compare the operations of the major acquisition activities and to recommend possible changes in system design that could improve performance. TM quality would be reviewed based on user feedback reports, and the subfunction would modify quality assurance (QA) policies as required to improve the TM product.

The system/product improvement engineering subfunction would also be responsible for designing and implementing system changes based on new technologies found feasible by the research and development subfunction and would establish proper measures of effectiveness to evaluate the changes. In addition, the subfunction would assist the TM Acquisition Subsystem with specification development for new products or, when required, for modifications to the system design. The subfunctions would also be responsible for the control of new TM element design, update of user-data match criteria, and the tradeoff of training/technical manual requirements.

The research and development (R&D) subfunction would be established at the first management level to prevent duplication of Navy TM-related R&D efforts and to establish goals and initiate studies. Presently, individual projects are initiated by activities outside R&D organizations with varying degrees of resources and management attention, while many innovations have been developed by other DoD services with little or no Navy participation or consideration. The R&D subfunction would review and coordinate all NTIPS-related Navy R&D efforts, and maintain contact with R&D efforts of industry and DoD. This subfunction would perform a continuing investigation and assessment of the R&D efforts in human engineering, hardware technology, media technology, and logistic support technology. The R&D subfunction would evaluate new developments applicable to NTIPS and recommend cost/performance-effective technologies for system incorporation by the system/product improvement engineering subfunction.

The cost analysis/forecasting subfunction would provide cost data to allow auditing the TM costs incurred during a system acquisition. At present, TM costs are seldom budgeted as separate line items, making any submission of TM budget data unreliable and precluding any valid tradeoff decision between TMs and other programs. This subfunction would maintain a valid product cost data base, including a breakdown of specific facets of each NTIPS activity. Cost information would be input from the NTIPS operations functions at the different major acquisition

activities. In-depth analysis of the cost data would establish the impact of TMs on weapon system life-cycle costs and assist in evaluating system operations.

TABLE 4-15. NTIP SYSTEM MANAGEMENT FUNCTION

NTIP System Management Subfunction

- o Overall Manager of NTIPS
- o Evaluator of NTIPS Performance
- • Coordinator of NTIPS Elements
- • Coordinator of NTIPS with Navy/DoD/Industry
- • Long Range Planning
- • NTIPS Budgeting and Staffing Review
- • Controller of NTIPS Policies/Directives

System/Product Improvement Engineering Subfunction

- • NTIPS Design Control
- • Implementation Design of New Technology
- • Establish Quality Assurance Policies
- • Coordinate TM Element Design, User-Data Match Update, Tradeoff of Technical Data/Training Needs
- • Assist with New Specifications

Research and Development Subfunction

- • Coordinate Navy NTIPS-Related R&D Efforts
- • Maintain DoD/Industry R&D Contact
- • Evaluate Efforts in Human Engineering, Media Technology, Hardware Technology

Cost Analysis/Forecasting Subfunction

- • Upkeep of Navy-wide NTIPS Cost Data Base
- • Perform Cost In-Depth Analysis
- • Establish TM Impact on Weapon Life-Cycle Costs
- • Assist with NTIPS Cost Evaluation

4.5.3 DESCRIPTION OF NTIPS OPERATIONS MANAGEMENT FUNCTION

An NTIPS operations management function is dedicated to each major acquisition activity to provide guidance and support to the NTIPS activities procuring and producing TMs.

The NTIPS operations management function provides a dedicated, reactive management group that is established at the major acquisition activity level and is responsible for all the TM needs of that activity. This approach to TM management allows flexibility in the detailed planning and development of TMs dictated by the mission-unique combinations of personnel, equipment, and environment inherent to the activity. Although dedicated to its major acquisition activity, the operations management function is a part of NTIPS and is directly responsible to the first-level NTIPS management function.

NTIPS Operations Management Subfunction – This subfunction provides central management and guidance for the day-to-day operation of the NTIP System. Each NTIPS Operations Management Subfunction establishes and promulgates detailed operating procedures for the NTIPS subsystems [TM Acquisition, Content Generation (Navy only), Publishing, and Distribution] that have been tasked to provide TMs for its major acquisition activity. Each of these subfunctions has the responsibility of coordinating with the System Acquisition Process program manager to establish TM budget limits, and then for controlling and distributing the TM funds to NTIPS activities after program inception. Each management subfunction has overall responsibility for the delivered TM products as well as the operational efficiency and cost effectiveness of the NTIPS activities within its purview.

Management Information System Subfunction – The Management Information System (MIS) subfunction answers the need for a comprehensive data base that contains specific information about all facets of the NTIPS operation. Each operations management function maintains an MIS that contains data pertinent to the NTIPS operations of its particular major acquisition activity. MIS provides this information in report form to support daily TM operation within the activity. MIS also supplies reports to upper levels of the Management Subsystem to assist with system performance evaluation.

Additionally, MIS maintains a data base of operational and cost data pertinent to NTIPS activities, a configuration index describing the TM requirements for its activity, and a history file on user feedback report actions taken.

Practices and Procedures Subfunction – This subfunction provides for generating the practices and procedures of the operations function and for a library function to control and disseminate this type of information. These practices and procedures provide detailed operating instructions, based on the first-level policies, for use by the operations activity to procure and produce its TM products.

Feedback and Update Subfunction – This subfunction provides a viable, central feedback point close to the user that is reactive to all user feedback reports. This subfunction is also responsible for controlling out-of-production TM updates.

All user feedback reports (FBRs) are evaluated, prioritized, assigned to a responsible performing activity, and tracked until a solution is provided. The quality of delivered TMs is evaluated by analyzing all quality-related user FBRs.

In-production TM updates are initiated by the hardware acquisition manager, but because this position does not exist for out-of-production equipment, the feedback and update subfunction is responsible for initiating out-of-production TM updates. Once initiated, all TM updates use the same process as new TM acquisitions to provide the TM product.

Configuration Accounting Subfunction – This subfunction provides for a TM configuration index of the requirements for each major acquisition activity. The data base for configuration accounting will be a part of the information stored in MIS. This subfunction will compile and format the data so as to show the number of TMs needed, the requirements of each user, and the number of TMs stored for user TM replenishment.

The configuration accounting subfunction will assign control numbers to TMs in accordance with policies established by the first-level NTIPS management function. The subfunction will establish proper levels of user replenishment stock at the Distribution Subsystem to meet user needs. This subfunction also provides guidelines for storage and maintenance of the TM master file of all active and inactive TMs stored by the Distribution Subsystem.

Cost Monitor/Evaluation Subfunction – The cost monitor/evaluation subfunction provides a controlled, comprehensive monitoring system of NTIPS costs and operations. This subfunction establishes the requirements for monitoring the different activities of NTIPS. From these requirements, the practices and procedures subfunction prepares detailed monitoring procedures that are disseminated by the NTIPS Operations Management Subfunction to the various NTIPS subsystems.

This subfunction receives a quarterly report from MIS that provides a costs/operations summary of all in-process programs. This information is used to evaluate the progress of the TM program, identify any problem trends, and recommend any solutions to potential problems.

TABLE 4-16. NTIPS OPERATIONS MANAGEMENT FUNCTION

NTIPS Operation Management Subfunction	• Coordinate NTIPS activities • Evaluate NTIPS activities • Control TM funding • Review staffing and budgeting • Promulgate detailed operating procedures
Management Information System Subfunction	• Maintain cost data base • Maintain TM configuration index • Maintain feedback action data base • Prepare and distribute weekly management information reports • Respond to information requests
Practices and Procedures Subfunction	• Prepare detailed NTIPS procedures • Maintain practices and procedures manual • Maintain policies/directives manual
Configuration Accounting Subfunction	• Maintain TM configuration index • Establish user TM replenishment stock level • Manage TM numbering system • Guidance for TM master storage procedures
Feedback and Update Subfunction	• Manage user feedback systems • Initiate out-of-production TM updates • Evaluate quality of delivered TMs
Cost Monitor/Evaluation Subfunction	• Establish TM cost data base • Monitor schedule/budget of NTIPS activities • Evaluate TM cost/schedule performance • Recommend cost improvements

4.5.4 SUPPORT OF OPERATIONS THROUGH THE NTIPS MANAGEMENT INFORMATION SYSTEM (MIS)

The NTIPS Management Information System is an automated information repository that provides reports to three management levels to support the daily operations of NTIPS and to aid system performance evaluation

---

An MIS would be established in each of the dedicated NTIPS operations management functions that would contain information that pertains to only its own major acquisition activity. As shown in Figure 4-24, the NTIPS subsystems input cost and operational data directly into the MIS using procedures established by the cost monitor/evaluation subfunction.

Cost and performance information reports are required on three levels to operate an NTIP System. The MIS will prepare these reports and disseminate them according to procedures established by the NTIPS Operations Management Subfunction. The three reports, described below, will require differing amounts of processing to produce the levels of information needed.

The MIS reports that support the daily operations of the NTIP Subsystem are prepared and delivered weekly and contain the detailed information needed by the function (or subsystem) operators and managers. This information includes a breakdown of costs incurred versus budget dollars versus schedule milestones. This level of data is essential in the day-to-day management of an operation.

MIS sends a second report on a quarterly basis to the cost monitor/evaluation subfunction in the Operations Management Subfunction. This report provides a summary of all cost and performance information for the TM programs under contract for a major acquisition activity. These reports will be used to evaluate the progress of these programs, identify potential problem trends, and recommend problem solutions.

The third type of report is a semiannual (or annual) summary for the NTIP Systems management function. This report will summarize cost and performance of all TM programs and related activities of each major acquisition activity. These reports will be used for in-depth studies and overall evaluation of the performance of the NTIP System.

The MIS also will contain a TM configuration data base that is controlled by the configuration accounting subfunction. A listing of all the TMs stored in the Distribution Subsystem, plus a listing identifying the TMs assigned to and being used by each user will be maintained by MIS. This data base is used mainly by the TM Acquisition Subsystem and the Distribution Subsystem to establish distribution requirements and prepare shipping labels. A summary of operations will be sent annually to the first-level NTIPS management function.

MIS also would be used by the feedback/update subfunction to store a listing of all received user feedback reports. The information listed is the action taken on each report, the time required for any problem solution, and the disposition of the solution. An analysis of this user feedback data by the first-level NTIPS management function on an annual basis can reveal problems with TM quality and also provide an evaluation of the effectiveness of the user feedback system.

The MIS also would be used by the feedback/update subfunction to store a data base of TM update information. This information includes the status of all in-process TM change programs, a list of all TMs needing changes, and a priority file indicating the TMs most urgently needing updating. This information will be sent annually to the first-level management function and can be utilized to assist with long range planning and to evaluate the effectiveness of the TM updating system.

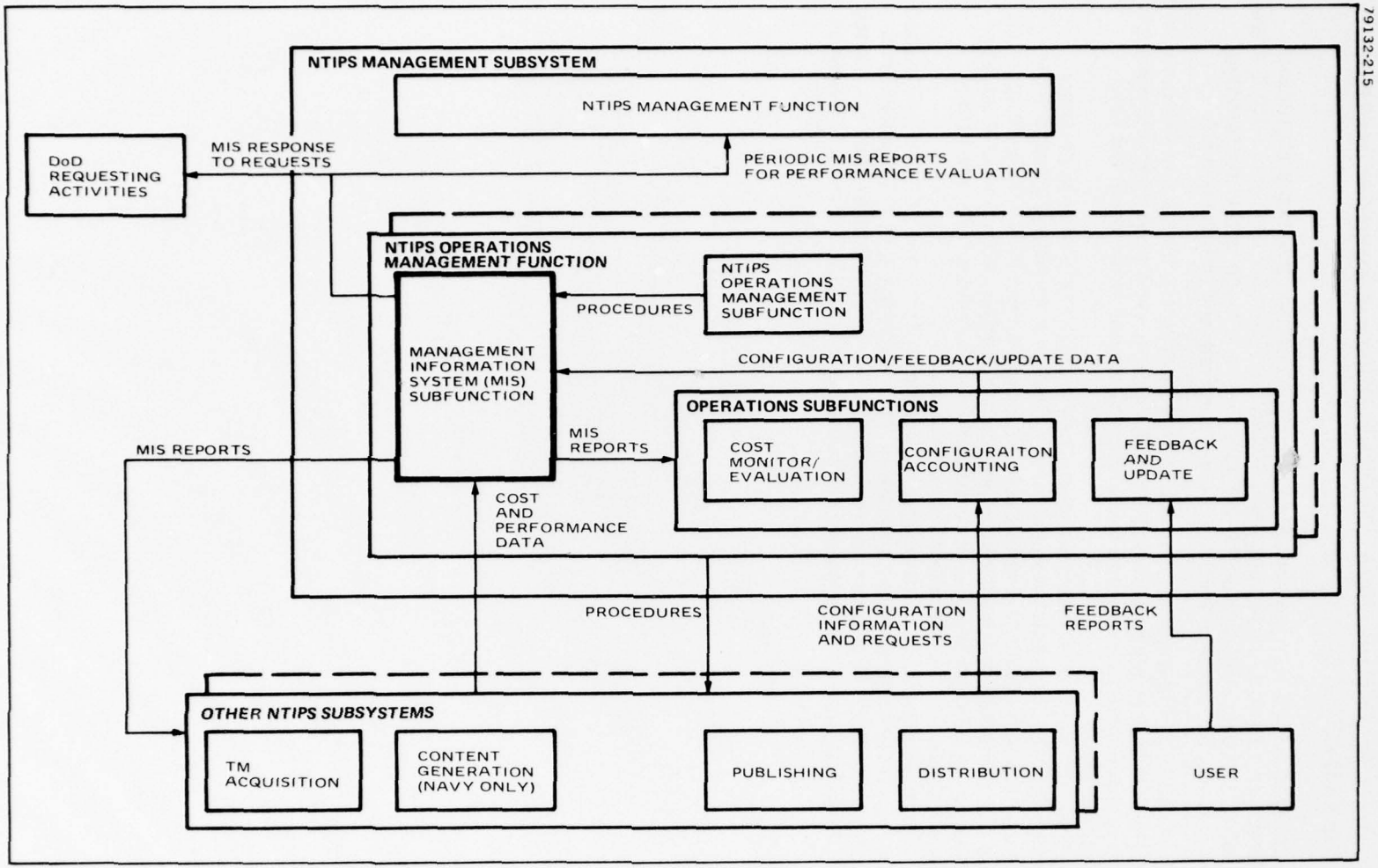


Figure 4-24. NTIPS Management Information System. This information data base would support daily NTIPS operations, provide a basis for performance evaluation, and enhance the NTIPS procurement and production capabilities.

4.5.5 DESCRIPTION OF THE CENTRALIZED NTIPS MANAGEMENT SUBSYSTEM ALTERNATIVE

In the Centralized NTIPS Management Subsystem alternative, policies and guidance are established at a first-management level NTIPS management function, with a single second-level NTIPS operations management function to provide detailed operating procedures and support to the NTIPS activities procuring and producing TMs.

As shown in Figure 4-25, the centralized alternative uses a two-level structure for the NTIPS Management Subsystem, as does the preliminary system concept. Also, the internal structure at each level of management is the same for both subsystem designs.

The only major difference between the two choices is with the number of second-level NTIPS operations management functions required to support the TM procurement and production activities. The centralized alternative design uses only one combined second-level management function, while the preliminary subsystem concept design provides a dedicated second-level NTIPS operations management function to each major acquisition activity.

The main advantage of using the centralized alternative is its simplification of the overall NTIPS management structure. The centralizing of the second-level management functions improves system performance by eliminating the redundancy of multiple management functions and the resulting dispersal of Navy TM management.

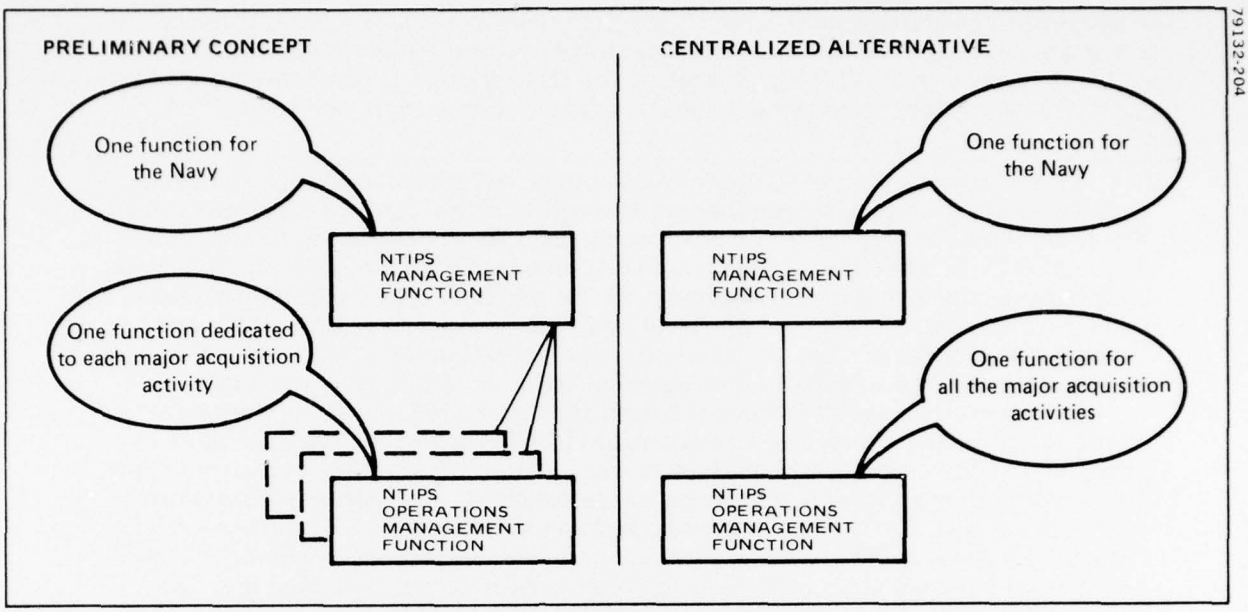


Figure 4-25. Centralized Management Structure Comparison. The real difference between the structures is that in the alternative only a single operations management function is needed to support the procurement and production of TMs for all major acquisition activities.

4.5.6 DESCRIPTION OF DECENTRALIZED NTIPS MANAGEMENT SUBSYSTEM ALTERNATIVE

The decentralized Management Subsystem alternative expands responsibilities of existing organizations and establishes a new NTIPS advisory function at the Navy-wide level. The responsibility for operating the NTIP System is distributed to second-level NTIPS operations management functions situated in each major acquisition activity.

As shown in Figure 4-26, one of the major differences between the decentralized alternative and the preliminary concept is at the first management level. The preliminary concept NTIPS management function is responsible for the operations of NTIPS, while the decentralized alternative NTIPS advisory function acts as an advisor to Navy-wide management on TM matters. The function would also serve as TM representative in high-level coordination with the Navy, DoD, and industry. This function also would monitor the operations of NTIPS and makes recommendations to Navy-wide management to assist with long-range planning.

A second major difference between the two NTIPS designs is the relocating of the research and development, system/product improvement engineering, and cost analysis/forecasting subfunctions to each of the second-level operations management functions. This shift reduces the responsibilities of these subfunctions from a Navy-wide basis to the major acquisition activity level. The other subfunctions at the decentralized second-level are the same as in the preliminary concept, except that the cost monitor/evaluation responsibilities are combined into the responsibilities of the cost analysis/forecasting subfunction.

The main advantage of the decentralized subsystem design is minimal organizational disruption during system implementation. This advantage is the result of being able to expand existing organizations instead of performing a major reorganization of existing structures.

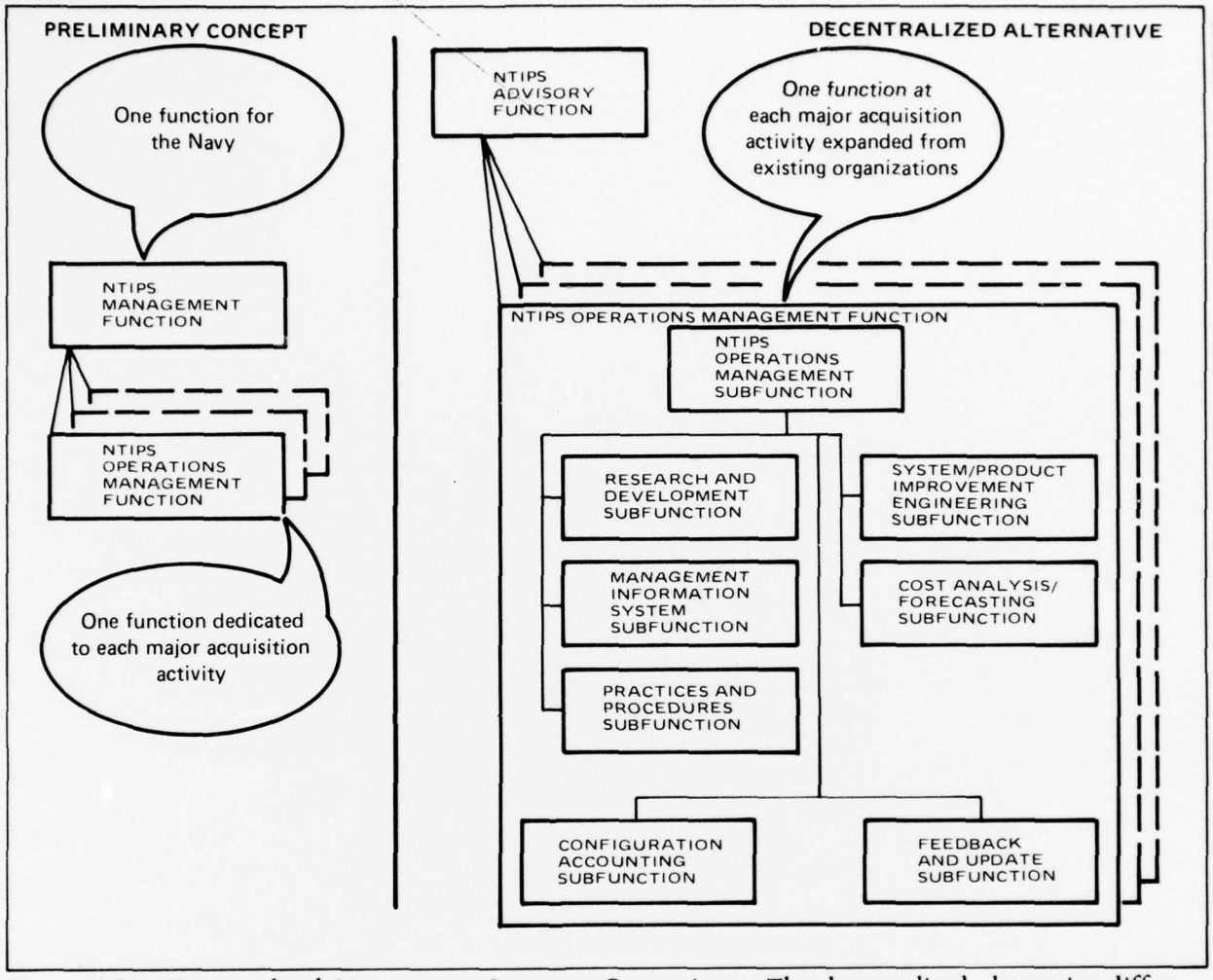


Figure 4-26. Decentralized Management Structure Comparison. The decentralized alternative differs from the preliminary concept in concentrating management functions at the major acquisition activity, leaving an advisory management function at the system level.

SECTION 5
APPROACH TO TASKS 4 AND 5

5.1 Plans for Performance Evaluations of Preliminary Concept and Alternatives 5-0
5.2 Plans for NTIPS Cost Analysis 5-2

5.1 PLANS FOR PERFORMANCE EVALUATIONS OF PRELIMINARY CONCEPT AND ALTERNATIVES

Task 4 will evaluate three system alternatives developed along cost/design risk guidelines. These alternatives will be evaluated in terms of performance of the main system functions.

The next tasks to be accomplished in NTIPP Phase I are the Concept Refinement and Performance Tradeoff Analysis (Task 4), and Cost/Effectiveness Analyses (Task 5). These tasks will examine the preliminary system concept and alternatives in light of currently available data concerning performance and cost.

The performance evaluation in Task 4 will consist of the following steps (see Figure 5-1):

- Perform subsystem/functional alternative tradeoffs.
- Synthesize three alternative cost/risk levels of the system concept.
- Conduct a functional performance analysis of each of the three versions of the concept.
- Document the results of the analysis in matrix form for ease of reference in subsequent cost effectiveness analysis.

The variety of possible NTIPS functional designs is large and complex, considering the entire process of creating a technical manual from the engineering and logistic data base through the distribution of the finished TM product. If one were to evaluate all the possible system combinations of alternatives identified in this report, the scope of an effectiveness and cost analysis would become enormous. The concept of constructing three system level alternatives using cost/risk guidelines provides a solution to this problem.

Prior to definition of the system cost/risk alternatives however, performance tradeoffs will be accomplished on the subsystem/functional alternatives, since most are independent of other system level considerations. This will help define an optimum performance system, and ensure that all functional alternatives are examined in terms of performance, whether or not they are utilized in one of the three alternative cost/risk level systems.

In defining alternative system versions, both cost levels and degree of design risk will be used as guidelines. Thus, the guideline for structuring the "bare bones" system will be that of a minimum-cost system meeting basic mission requirements. Because definitive system costs will not be developed until Task 5, minimum cost will be interpreted here as a relative rather than an absolute measure. The guideline used for developing a second system alternative will be that of maximized performance using available technology. The third system alternative will be constructed using maximized performance, with risk technology as the basic guideline. It should be noted here that the intent is not to select the ultimate NTIP System strictly from these three cost/risk alternatives. The cost/risk guidelines simply provide a context in which to conduct the system performance and cost evaluations.

The performance analysis in Task 4 will employ detailed effectiveness criteria at the function level. While hardware systems are evaluated largely in terms of measures of effectiveness (MOE), the NTIP System includes many nonparametric design concepts. Therefore, the NTIPS set of effectiveness criteria will include features of effectiveness (FOE) as well as MOE. Although the application of FOEs in matrix comparisons will not be quantitative in the sense that they will be weighted and summed, the FOEs will provide a basis for ordinal ranking of alternatives.

Rationale will be provided to support the performance evaluation matrices. This rationale will provide the data and logical processes leading to the results shown in the matrices.

In accomplishing the performance evaluation, significant gaps in the data base may be identified. Opportunities for capture of data needed for confirmation of the Phase I system tradeoffs during Phase II will be identified.

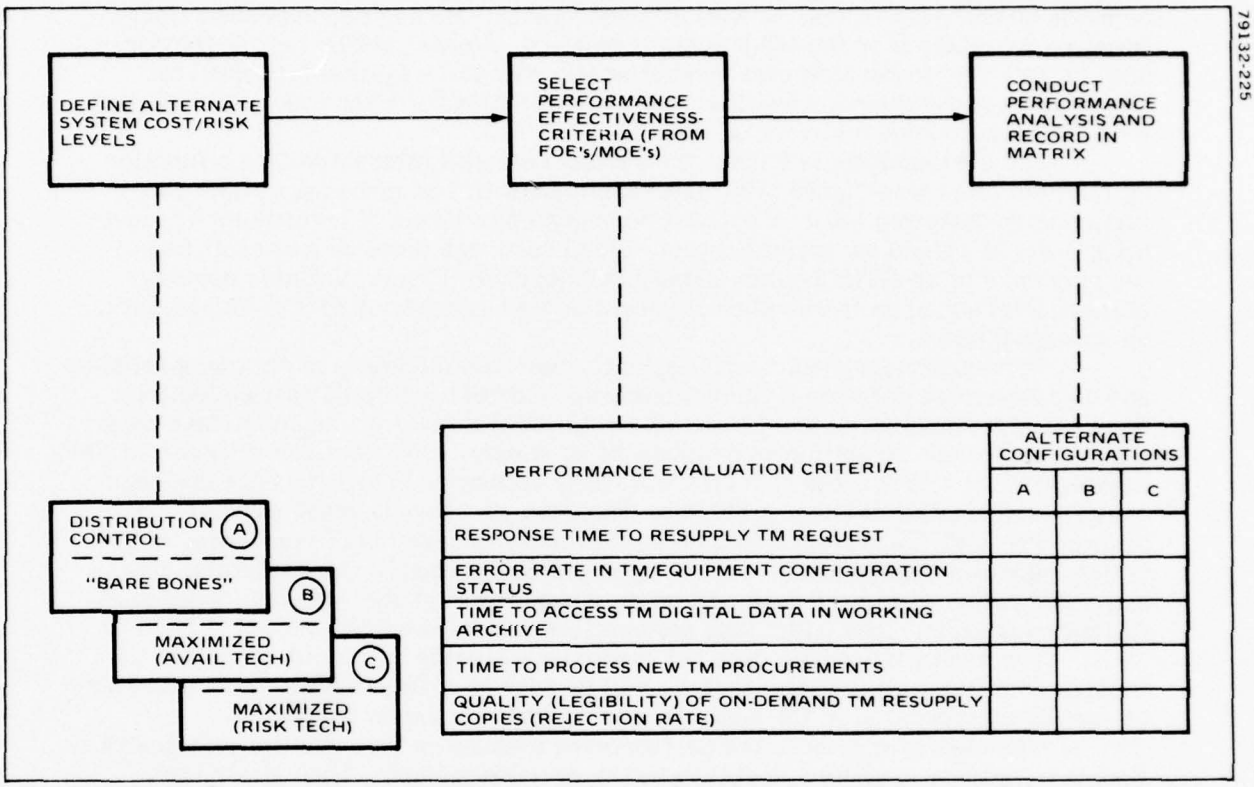


Figure 5-1. Performance Evaluation Process. The results of Task 4 will be recorded in matrix form at the function level to enable detailed comparisons between alternatives.

5.2 PLANS FOR NTIPS COST ANALYSIS

The critical subject of NTIPS costs requires careful analysis in order to develop conclusions regarding affordibility and cost-effectiveness. This cost analysis will be accomplished in NTIPP Task 5.

Intelligent decisions regarding selection of the NTIP System concept must be made on the basis of cost as well as performance. Having accomplished a performance evaluation of the NTIP System cost/risk alternatives in Task 4, the purpose of Task 5 is to develop cost comparisons of the three system alternatives. The resulting cost estimates will be recorded in matrix form for ease of comparison with the performance matrices of Task 4.

The cost analysis will treat the system cost/risk alternatives on a function by function basis (see Figure 5-2). Cost summaries will be provided at both the system and subsystem level. Cost will be analyzed in terms of investment vs. operating costs and fixed vs. variable costs. Fixed costs are those which result from the existence of an NTIP System and are independent of load. Variable costs are costs which depend on the number of procurements, number of TMs produced, etc., on an annual basis.

Previous researchers have frequently reported difficulty in obtaining reliable and objective cost data for technical manuals. Current means of cost collection do not lend themselves to generation of a reliable technical manual cost data base. Furthermore, cost collection techniques differ widely throughout the responsible Navy organizations. The success of NTIPP cost data collection efforts to date has been constrained because of these problems. The data problem is most evident in those areas of the system which do not normally involve major contractor efforts (TM Acquisition, Distribution, and Management Subsystems). Consequently, cost estimates rather than hard data will be used in portions of the analysis. When such estimates are made, the underlying assumptions will be provided.

The need for specific data not currently available will be identified in the report. The framework of the analysis will be such that future cost information may be readily incorporated in the analysis, and its impact quickly evaluated.

The objective of both the performance evaluation task and the cost analysis task is to provide maximum visibility to the decision makers. When these tasks are completed, matrices will be available which permit direct comparision of performance and cost of the three alternative NTIP Systems on a function-by-function basis. These matrices and their supporting rationale will contain the facts, knowledge, and clearly stated assumptions which are relevant to the decisions involved in selecting the ultimate NTIP System concept.

TM SPECIFICATIONS FUNCTION	INVESTMENT COST			OPERATING COST					
				FIXED			VARIABLE		
COST CATEGORIES	A	B	C	A	B	C	A	B	C
LABOR									
EQUIPMENT									
FACILITIES									
MATERIALS									
TRAINING									

79132-226

Figure 5-2. Cost Analysis Reporting Matrix. The Task 5 cost summaries will report estimated investment and operating costs for the function (shown above), subsystem, and system level for each of three system level alternatives.

APPENDIX A
REFERENCES

Appendix A

REFERENCES

Aerospace Industries Association, PUBS-100 Panel; Navy TRUMP System Activation Circumvents OMB-A76, October 1976.

Bialik, J.J., et al; Requirements and Alternative Designs for Automating the Publication of NAVSEA MOTD at the NSDSA; January 1977, Stanford Research Institute, Menlo Park, CA.

Braby, R.; Training Requirements for the Naval Technical Information Presentation Program – A Needs Assessment (Technical Memorandum 77-3); April 1977, U.S. Navy Training Analysis and Evaluation Group, Orlando, FL.

Curran, T.E., Thomas, G.S., and Duffy, T.M.; Review of Technical Manual Readability and Comprehensibility (Office Review Draft); July 1975, Navy Personnel Research and Development Center, San Diego, CA.

Chenzoff, A.P.; Aeronautical Requirements: Integrated Development of Training/Performance-Aid Requirements for Naval Air Maintenance Personnel; August 1973, Applied Science Associates, Valencia, PA.

David W. Taylor Naval Ship Research and Development Center; Data Item Description (DID) UDI-S-7060; 1 July 1975.

Department of the Navy; Navy Enlisted Manpower and Personnel Classification and Occupational Standards Manual, Section II – Navy Enlisted Classifications; NAVPERS 18068D; January 1977, Bureau of Naval Personnel, Washington, DC.

Flesch, R.F.; A New Readability Yardstick; June 1948, Journal of Applied Psychology.

Goode and Machol; Systems Engineering; 1957, McGraw-Hill Book Company, Inc., New York, NY.

Hageman Consulting Services; Quality Assurance Program for Technical Documentation; 1977, Hageman Consulting Services, Fort Worth, TX.

Hughes Aircraft Company; Special Report – NTIPP Fleet Survey of Technical Manual Users; 5 March 1977, David W. Taylor Naval Ship Research and Development Center.

Hughes Aircraft Company; Task 1 Report (CDRL A001) – Analysis of Current and Proposed Technical Manual Systems; 24 March 1977, David W. Taylor Naval Ship Research and Development Center.

Hughes Aircraft Company; Task 2 Report (CDRL A002) – Initial NTIPP Functional Requirements; 24 March 1977, David W. Taylor Naval Ship Research and Development Center.

Joyce, R.P., Chenzoff, A.P., and Mulligan, F.F.; Fully Proceduralized Job Performance Aids – Handbook for JPA Developers; August 1973, Applied Science Associates, Valencia, PA.

Kincaid, J.P., Rogers, R.L., Fishburne, R.P., Jr., and Chissom, B.S.; Derivation of New Readability Formulas (Automated Readability Index, Fog Count, and Flesch Reading Ease Formula) for Navy Enlisted Personnel, Research Branch Report 8-75 (AD/A 006 655); February 1975, Chief of Naval Technical Training, Naval Air Station, Memphis, TN.

Klare, G.R.; The Measurement of Readability; 1963, Iowa State University Press, Ames, IA.

Klare, G.R.; Assessing Readability; 1974-75, Reading Research Quarterly.

Office of Management and Budget; Policies for Acquiring Commercial or Industrial Products and Services for Government Use; Circular OMB-A76; 30 August 1967, Washington, DC.

Poe Engineering Services; Photographic Video Disc Technology Assessment; October 1976, David W. Taylor Naval Ship Research and Development Center.

Powers, Thomas E.; Selecting Presentation Modes According to Personnel Characteristics and the Nature of Job Tasks; January 1977, University of Maryland Baltimore County, Baltimore, MD.

Shafer, Robert A; Memory Explosion – The Pocket Computer, Other Electronic Gear may be Available Soon; 29 March 1977, The Wall Street Journal.

Siegel, Arthur I., et al; Application of Structure-of-Intellect and Psycholinguistic Concepts to Reading Comprehensibility Measurement, June 1976, Applied Psychological Services, Inc., Wayne, PA.

Sticht, Thomas G.; Literacy Demands of Publications in Selected Military Occupational Specialties; October 1970, Human Resources Research Organization, Alexandria, VA.

Sticht, Thomas G. and Zapf, Diana Welty; Reading and Readability Research in the Armed Services; September 1976, Human Resources Research Organization, Alexandria, VA.

Stroessler, J.H., Clark, J.M., Martin, P.A., and Grimm, F.T.; Human Factors in the Design and Utilization of Electronics Maintenance Information; Research Report No. 782; 31 May 1957, U.S. Navy Electronics Laboratory (BUSHIPS), San Diego, CA.

Sulit, R.A., et al; Navy Technical Manual System (NTMS) – Program Development Plan; November 1974, DTNSRDC.

Sulit, R.A., and Fuller, J.J.; Navy Technical Manual System (NTMS) – Implementation of Program Development Plan During FY 75; January 1975, DTNSRDC.

Sulit, R.A., and Fuller, J.J.; Navy Technical Manual System (NTMS) – Program Summary; March 1976, DTNSRDC.

Well, Hugh; Electronic Editors; 15 November 1975, Industrial Research.

APPENDIX B
GLOSSARY OF ABBREVIATIONS AND ACRONYMS

Appendix B

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Full Terminology
	A
ACFT	Aircraft
ACN	Advance Change Notice
ADP	Automatic Data Processing
ADPREPS	Automated Document Preparation System
AFT	Air Force Base
AFHRL	Air Force Human Resources Laboratory
AFIT	Air Force Institute of Technology
AFLC	Air Force Logistics Command
AFPRO	Air Force Plant Representative Office
AFSC	Air Force Systems Command
AGSP	Automated Graphic Science Program
AIA	Aerospace Industries Association
AIDUS	Automated Input and Document Update System
ALC	Air Logistics Center
ARI	Automated Reading Index
ARMCOM	Armament Command
ASCII	American Standard Code for Information Interchange
ASL	Average Sentence Length
ATE	Automatic Test Equipment
ATOS	Automated Technical Order System
ATS	(1) Administrative Terminal System (2) Aircraft Troubleshooting System
AUTODIN	Automatic Digital Information Network
AUTOTEC	Automated Text Composition
AVSCOM	Aviation System Command
AWL	Average Word Length
	B
BAMAGAT	Block-A-Matic, Block-A-Gram, Block-A-Text
BFIC	Binary Fault Isolation Chart
BITE	Built-In Test Equipment
BUMED	Bureau of Medicine
BUPERS	Bureau of Naval Personnel

Abbreviation of Acronym	Full Terminology
	C
CAD	Computer-Aided Design
CAM	Computer-Aided Manufacture
CCD	Charged-Coupled Device
CDRL	Contract Data Requirements List
CEM	Communications, Electronics, Meteorology
CFA	Cognizant Field Activity
CFAE	Contractor-Furnished Aeronautical Equipment
CF/TA	Cognizant Field/Technical Activity
CFE	Contractor-Furnished Equipment
CG	(1) Content Generation (2) Commanding General
CIC	Combat Information Center
CNET	Chief of Naval Education and Training
CNETSCPAC	Chief of Naval Education Training Service Support Center Pacific
CNM	Chief of Naval Materiel
CNTT	Chief of Naval Technical Training
COM	Computer Output Microform
COMSAT	Commercial Satellite System
CONSD	Condensed Service Data
CRC	Command and Reporting Center
CRT	Cathode Ray Tube
CTA	Cognizant Technical Activity
	D
DA	Department of the Army
DAPIL	Digital Assembly Parts Identification List
DAR	Data Automation Requirement
DARCOM	Development and Readiness Command
DCAS	Defense Contract Administration Service
DCS/LOG	Deputy Chief of Staff for Logistics
DDD	Direct Distance Dialing
DID	Data Item Description
DIODS	Diagram-Oriented Documentation System
DLAO	Defense Logistics Analysis Office
DMAAC	Defense Mapping Agency Aerospace Center
DMWR	Deferred Maintenance Work Request
DoD	Department of Defense
DR	(1) Deficiency Report (2) Discrepancy Report
DTNSRDC	David Taylor Naval Ship Research and Development Center
	E
ECN	Engineering Change Notice
ECOM	Electronics Command
ECP	Engineering Change Proposal
EPC	Editorial Processing Center
EO	Engineering Order
ETM	Extension Training Material

Abbreviation of Acronym	Full Terminology
	F
FBR	Feedback Report
FIPS	Federal Information Processing Standard
FLTSATCOM	Fleet Satellite Communications
FOE	Features of Effectiveness
FOMM	Functionally Oriented Maintenance Manual
FORCAST	Fox, FORd, CAylor, STicht
FPUPA	Fully Proceduralized Job Performance Aid
FPTA	Fully Proceduralized Troubleshooting Aid
	G
GAF	German Air Force
GAPFILLER	*DoD program name*
GATF	Graphic Arts Technical Foundation
GCT	General Classification Test
GL	Grade Level
GOCO	Government-Owned, Contractor-Operated
GOM	Graphic Operations Manual
GPAM	Graphically Proceduralized Aids for Maintenance
GPO	Government Printing Office
	H
HQ	*Headquarters*
HRMR	Human-Readable/Machine-Readable
	I
IBM	(1) Intermediate Ballistic Missile (2) International Business Machines
ICBM	Intercontinental Ballistic Missile
ID	Identification
ILS	Integrated Logistic Support
IPD	Illustrated Parts Breakdown
IPR	*In-Process Review*
ITDT	Improved Technical Documentation and Training
	J
JCP	Joint Committee on Printing
JPA	Job Performance Aid
JPM	Job Performance Manual
	L
LCC	Life Cycle Cost
LDM	Local Digital Message Exchange
LSA	Logistic Support Analysis

Abbreviation of Acronym	Full Terminology
	M
MA	Maintenance Action
MAC	Maintenance Allocation Chart
MARISAT	Maritime Mobile Satellite Communication System
MDC	Maintenance Dependency Chart
MDS	Maintenance Data System
MEA	Maintenance Engineering Analysis
MECH	Mechanical Comprehension
MIARS	Maintenance Information Automated Retrieval System
MICOM	Missile Command
MICROFORM	A process for reproducing printed matter in a much reduced size
MIP	(1) Maintenance Index Pages (2) Material Improvement Project
MIS	Management Information System
MMC	Maintenance Management Center
MOE	Measures of Effectiveness
MOS	Military Occupational Specialty
MPL	Maintenance Parts List
MRC	Maintenance Requirement Card
MT/SC	Magnetic Tape Selectric Composer
MT/ST	Magnetic Tape Selectric Typewriter
	N
NAMP	Naval Aviation Maintenance Program
NARF	Naval Air Rework Facility
NATSF	Naval Air Technical Services Facility
NAVAIR	Naval Air Systems Command
NAVCOMPARS	Naval Communication Processing and Routing System
NAVELEX	Naval Electronic Systems Command
NAVFAC	Naval Facilities Command
NAVMACS	Naval Modular Automated Communications System
NAVMAT	Naval Material Command
NAVSEA	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NC	Numerical Control
NDCP	Navy Decision Coordinating Paper
NEC	Navy Enlisted Classification
NEOCS	Navy Enlisted Occupational Classification System
NMA	National Micrographics Association
NOTAP	Navy Occupational Task Analysis Program
NPFC	Navy Publications and Forms Center
NPPSBO	Naval Publications and Printing Services Branch Office
NPPSO	Naval Publications and Printing Services Office
NPPSMO	Naval Publications and Printing Services Management Office
NPRDC	Naval Personnel Research and Development Center
NRL	Naval Research Laboratory
NSA	National Security Agency
NSDSA	Naval Ships Data Support Activity

Abbreviation of Acronym	Full Terminology
NSF	National Science Foundation
NSWSES	Naval Ship Weapon Systems Engineering Station
NTIP	Navy Technical Information Program
NTIPP	Navy Technical Information Presentation Program
NTIPS	Navy Technical Information Presentation System
NTMMO	Navy Technical Manual Management Organization
NTMS	Navy Technical Manual System
NWC	Naval Weapons Center
	O
OCALC	Oklahoma City Air Logistics Center
OCR	Optical Character Recognition
OJT	On-the-Job Training
OMB	Office of Management and Budget
O&MN	Operation and Maintenance, Navy (funding)
OPALT	Operational Alteration
OPNAV	Office of the Chief of Naval Operations
ORDALT	Ordnance Alteration
OSD	Operational Sequence Diagram
	P
PIA	Printing Industries of America
PIMO	Presentation of Information for Maintenance and Operation
PM	Program Manager, or Project Manager
PMS	Planned Maintenance System
PO	Program Office, or Project Office
PPS	Percent Personal Sentences
PPT	Punched Paper Tape
PQS	Personnel Qualifications Standard
PRAM	Programmable Random Access Memory
PRMIS	Printing Resources and Management Information System
PYRAGRAM	Pyramid of Diagrams
	Q
QA	Quality Assurance
QC	Quality Control
QRC	Quick Reaction Capability
QRTMMS	Quick Reaction Technical Manual Modification System
	R
RAC	Rapid Action Change
RCA	Radio Corporation of America
R&D	Research and Development
RDT&E	Research, Development, Test, and Evaluation
RE	Reading Ease
RGL	Reading Grade Level
RFP	Request for Proposal
RIDE	Reading Impact Difficulty Estimate

Abbreviation of Acronmy	Full Terminology
	S
SAP	System Acquisition Process
SECNAV	Secretary of the Navy
SECNAVINST	Secretary of the Navy Instruction
SFTOA	Systems and Feasibility Tradeoff Analysis
SIMM	Symbolic Integrated Maintenance Manual
SHIPALT	Ship Alteration
SMMD	Simplified Maintenance Manual Design
SMS	Surface Missile System
SOM	Simplified Operations Manual
SORTS	Shipboard Organizational Troubleshooting System
SOW	Statement of Work
SPO	System Program Office
SRI	Stanford Research Institute
STEDMIS	Ships Technical Data Management Information System
STEPS	Ships Technical Publications System
STOP	Sequential Thematic Organization of Publications
SURTASS	Surveillance Towed Array Sonar Segment
SYSCOM	Systems Command
	T
TACFIRE	Tactical Fire Direction System
TACSAT	Tactical Satellite
TAEG	Training Analysis and Evaluation Group
TAG	The Adjutant General
TAMMS	The Army Maintenance Management System
TCTO	Time Compliance Technical Order
TEC	Training Extension Course
TIM	Task Identification Matrix
TIP	Technical Information Presentation
TM	Technical Manual
TMCR	Technical Manual Contract Requirement
TMDER	Technical Manual Deficiency Evaluation Report
TMINS	Technical Manual Identification Numbering System
TMIP	Technical Manual Improvement Program
TMMP	Technical Manual Management Program
TMMPC	Technical Manual Management Program Council
TMSR	Technical Manual Seatask Requirement
TMSS	Technical Manual Specifications and Standards
TO	Technical Order
TOIRS	Technical Order Improvement Reporting System
TOMA	Technical Order Management Agency
TOMS	Technical Order Microfilm System
T/R	Troubleshooting and Repair
TRADOC	Training and Doctrine Command
TRUMP	Technical Review and Update of Manuals and Publications
T/TM	Training/Technical Manual (tradeoff)

Abbreviation of Acronmy	Full Terminology
	U
UR	Unsatisfactory Report
US	United States
USDA	United States Department of Agriculture
USAF	United States Air Force
USAMC	United States Army Materiel Command
USAMMC	United States Army Maintenance Management Center
USANDL	United States Army Nuclear Defense Laboratories
	V
VDT	Visual Display Terminal

APPENDIX C
DEFINITIONS OF NTIPP TERMS

Appendix C

DEFINITIONS OF NTIPP TERMS

Accessibility	The characteristics of a TM which enable the user to find the information he is seeking quickly. Methods of partitioning the TM, indexing its contents, and numbering and paginating are all subjects for accessibility improvements.
Archive	In the NTIPS concept, the repository for TM masters. The archive function has two subfunctions, historical and working, and would have capabilities for storage, retrieval, and control of the masters.
Comprehensibility	The property of textual information that permits it to be readily understood. No satisfactory means of measuring this property is available yet, since it is due to a complex mixture of little understood factors such as word familiarity and concreteness, complexity of syntactic structures, rhetorical devices, clarity of reasoning, courtesy of the author, etc.
Content Generation	Transformation of engineering/manufacturing/maintenance data bases into technical information. This includes collecting data, planning, writing, critiquing, and validating the TM.
Content Generator	Contractor, Navy activity, or data house that performs Content Generation activity.
Component	An indenture level of the NTIP System configuration that is below the subfunction level.
Dedicated Function	An NTIPS function that operates under the NTIPS organizational structure to provide customized TM services for a major acquisition activity.

Digital Production	In the NTIPS concept the Publishing function that processes the Contractor's delivered TM information (in the form of magnetic digital tape) for ultimate mastering and replication.
Distribution	An operational function of the entire TM life-cycle process that includes assignment of document numbers, distribution of TMs and updates, and archival storage.
Engineering/Manufacturing Data Base	The engineering drawings, reports, and related information created for the design and manufacture of a system/equipment. This information is also the traditional data base from which the TM is developed. In the NTIPS concept the data base would be augmented by requiring the addition of maintenance data.
Feature of Effectiveness (FOE)	Nonparametric design objective, such as information quality, task relevance, and comprehensibility.
Feedback	Information from the TM user indicating errors, omissions, ambiguities, or other deficiencies in TMs.
Function	An indenture level of the NTIP System configuration that is below the subsystem level.
Hard Copy	TMs printed on paper (as opposed, for example, to video disc).
In-Production	Equipment that is currently being manufactured.
Major Acquisition Activity	An activity that procures systems/equipments, for example, NAVSEA, NAVAIR, or major Program Office, such as TRIDENT (PMS 396) or (392) CVN, (393) SSN.
Management Information System (MIS)	An automated repository of NTIPS information covering costs and operational data, a configuration index of TM users, and a history of user feedback actions.
Mastering	The process that converts the TM information output of the content generator into the physical entity needed for replication of the TM.
Measure of Effectiveness (MOE)	A quantifiable assessment of effectiveness.
Media Evaluation Laboratory	A facility established and maintained for the purpose of evaluating the effectiveness and utility of media.

Medium (pl. Media)	A means of, or device used for, conveying or presenting information.
Microform	Any one of several applications of reduced-size, photographic images of hard copy. Microfiche, aperture cards, and roll (or cartridge) microfilm are the most common types of microforms.
Modular Specifications	An NTIPS concept that provides the means to custom-tailor a TM specification to a particular procurement and to reduce redundancy and extraneous information in the specification. Specification modules would contain precise requirements for the technical content, presentation techniques, readability, access, publishing processes, and quality control of TMs.
Out-of-Production	Equipment that is no longer being manufactured.
Production	Conversion of draft technical information into final TM format.
Publication Tree	A diagram illustrating the relationships among technical manuals which, collectively, cover a given system/equipment.
Publishing	The total process for taking technical information from content generators and recreating it as technical manuals, replicating it, and delivering the final product to the users.
Readability	(1) Often used synonymously with "Comprehensibility," the property of textual information that permits it to be readily understood and comprehended in the ordinary conceptual sense. Or, (2) The more narrow property of a text that permits it to be easily read in a grammatical sense, as measured by lexical factors such as word length and sentence length. Grammatical readability is known to be a good predictor of comprehension performance. Or, (3) The readability score or measurement of a given text as measured by some formula of various lexical-grammatical factors. The absolute value of this score can be calibrated against either genres of documents or school grade levels.

Reading Grade Level (RGL)	(1) The readability measurement of a text, expressed in terms of equivalent school grade levels. Or, (2) The reading performance level of a reader, expressed in terms of the RGL of a standard text that he has comprehended to a passable degree (usually 50-75% comprehension, depending on how the RGL equivalence of the readability formula is calibrated).
Replication	The process that provides the final output of the Publishing activity, i.e., the production of the TM in its final format (e.g., paper books, microform, video discs).
Resupply	A function of the distribution system that provides TMs in response to specific user requests to replace damaged or last TMs previously supplied.
Subfunction	An indenture level of the NTIP System configuration that is below the function level.
Subsystem	An indenture level of the NTIP System configuration that is below the system level.
Technical Data (TD)	The source data contained in the engineering/manufacturing and LSA data bases from which technical information is developed.
Technical Information (TI)	The writer-generated material developed from technical data. Technical information is subsequently converted into the TM by production.
Technical Manual (TM)	The product of the NTIP System which contains the operation, maintenance, and training information necessary to support the user activity.
TM Acquisition	The process of TM procurement. It involves user-data matching, specification selection, and the procurement process.
TM Bookplan	A detailed plan for development of the TM that goes through the projected TM outline at the paragraph level. The bookplan provides explicit direction to the TM writer, including examples of the technical content and presentation technique as required by the TM specification. The bookplan includes scheduling information and plans for quality assurance, validation, and verification of the resulting TM information.

TM Development Guide	An NTIPS concept for a TM engineer's guide, which supplements instructions contained in TM requirements, that would provide the TM engineer step-by-step instructions on how and when to accomplish TM development tasks.
TM Engineer	(1) Content Generation – A new position, created in NTIPS, that is assigned responsibility for planning, initiating and supervising all tasks associated with content generation. He plans, initiates and supervises TM development tasks and establishes interrelationships with design engineering, ILS, and QA activities. (2) TM Acquisition – A new position, created in NTIPS, that oversees development of TM requirements, delivery, scheduling, proposal and contract preparation, quality assurance, budgeting and funding, and contract administration.
Training/Technical Manual Tradeoff	Process whereby the determination is made as to whether information is to be presented to a user during training or via some form of TM.
User	Most often, the maintenance technician or system operator who will actually employ the TM within a job performance context.
User-Data Match	Process whereby the text contents and presentation techniques for technical information are matched to the characteristics and requirements of the intended user.
User-Data Match Model	The means by which user-optimized presentation techniques, related to his personnel characteristics, tasks, and working environment, are identified.
Validation	Process whereby the utility of technical information is established; generally performed by the content generation activity and witnessed by the procuring activity.
Verification	Process whereby the accuracy of technical information is certified in the field under simulated or actual job conditions; generally performed by procuring activity.
Work Package	The arrangement of technical data according to functional tasks.

Writers Guide	A guide for the TM writer to introduce him to the NTIPS system and provide "how to" instructions on new techniques of presentation and readability.

APPENDIX D
DESCRIPTION OF SYSTEM OPERATIONAL SEQUENCE

APPENDIX D

DESCRIPTION OF SYSTEM OPERATIONAL SEQUENCE

To identify and test the interactions between the major NTIP system elements, functional and operational sequence diagrams have been developed. These diagrams confirm the functional configuration and operability of the system.

The NTIPS functional sequence diagrams are reproduced in Figures D-1, D-2, and D-3. These diagrams provide a top level overview of the main interfaces and interdependencies among major NTIP system elements. Five main functional elements of the NTIP system are identified at the top of the diagrams. Action responsibilities are represented by coded symbols and descriptions in the vertical columns below each major function. System interaction and functional interfaces are traceable horizontally through the diagrams. The meaning of the symbols is defined in the key at the bottom of each diagram.

For example, a new system or equipment acquisition sequence is introduced on the first sheet of the functional sequence diagram, Figure D-1. A management action to allocate funds and pass responsibility for acquisition and procurement of technical manuals to the responsible system subelement is depicted in the first group of symbols. Definition of operational requirements and obtaining a detailed description of the new system are shown as preliminaries to preparation of contractual documents at the outset of the process.

Operational sequence diagrams describing the interplay in more detail are reproduced in Figures D-2 and D-3. Figure D-2 charts continual processes within NTIPS, while Figure D-3 details the operations directly involved in TM development. In these more detailed diagrams, brief explanations of the key operations performed in response to typical inputs to the NTIP system, are charted in the vertical columns. As in the functional sequence diagrams, symbols and descriptions of each operation explain the activities in the operational sequence. Communication links and interplay between subfunctional elements are traceable horizontally throughout this series of diagrams.

For example, a cycle involving technology developments impacting on the NTIP system is charted commencing on the first sheet Figure E-2. This is one to two recurring operational cycles depicted as continuing processes, to which the NTIP system must be responsive. New technology information originating in the military services or industry, is shown as a key input.

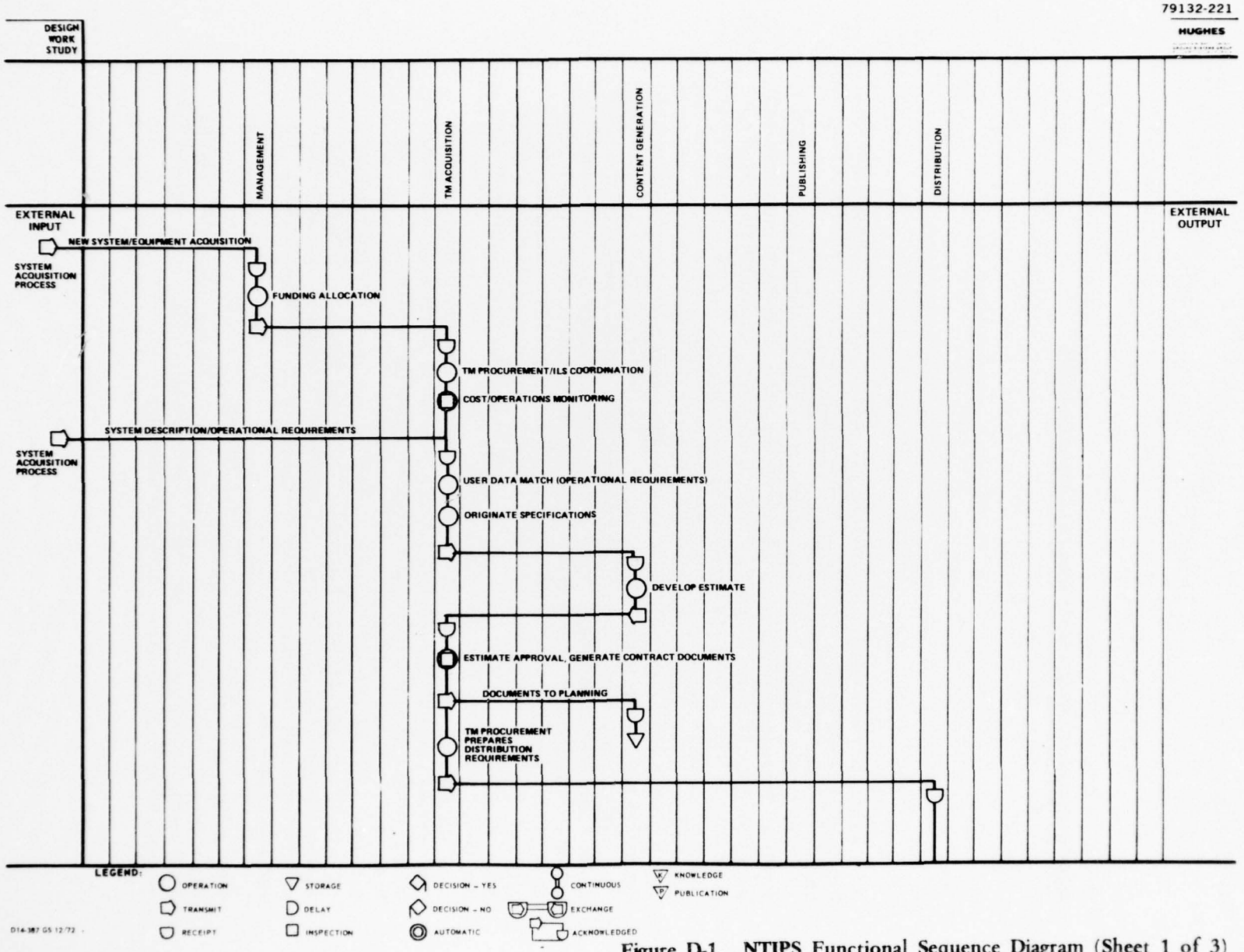


Figure D-1. NTIPS Functional Sequence Diagram (Sheet 1 of 3)

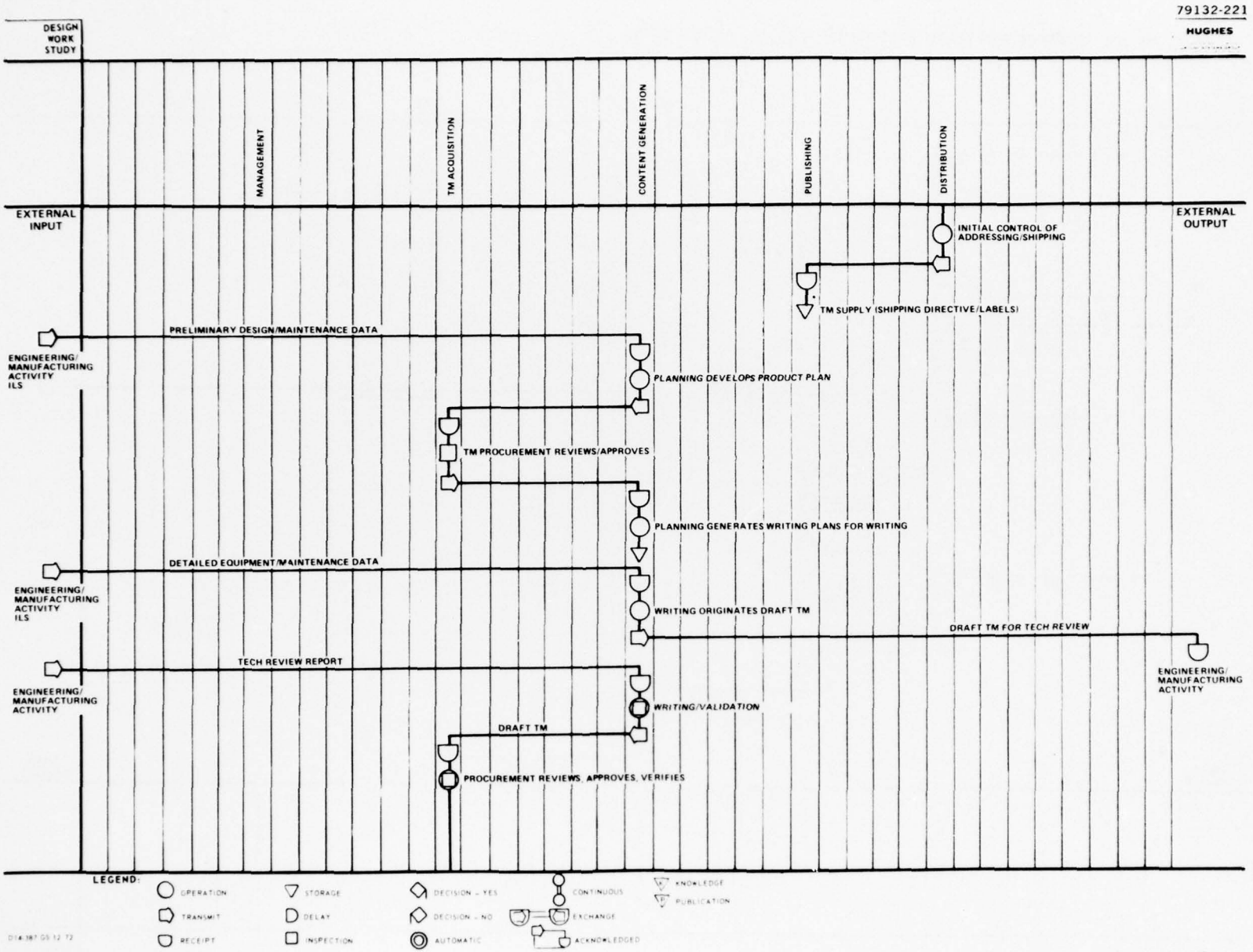


Figure D-1. NTIPS Functional Sequence Diagram (Sheet 2 of 3)

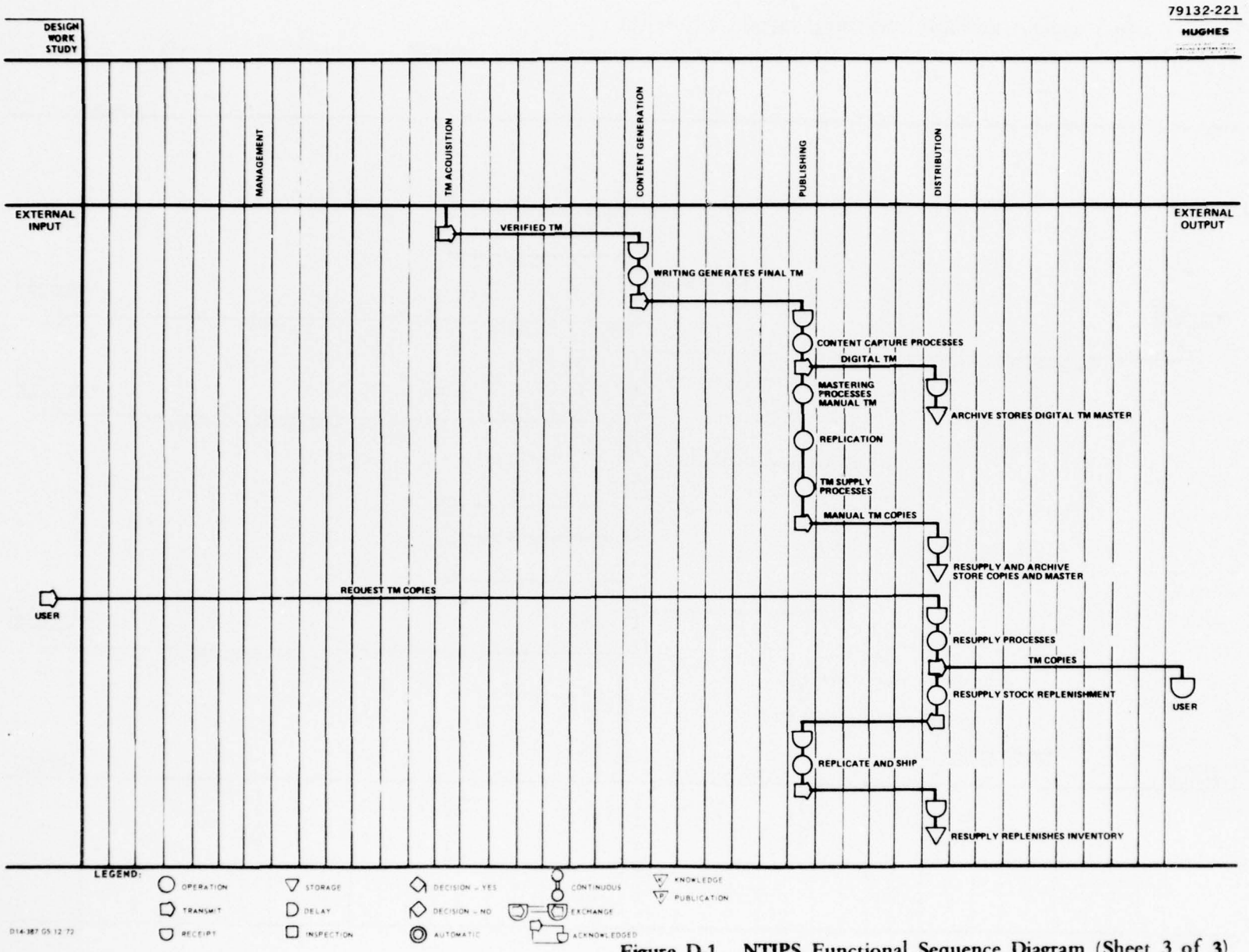


Figure D-1. NTIPS Functional Sequence Diagram (Sheet 3 of 3)

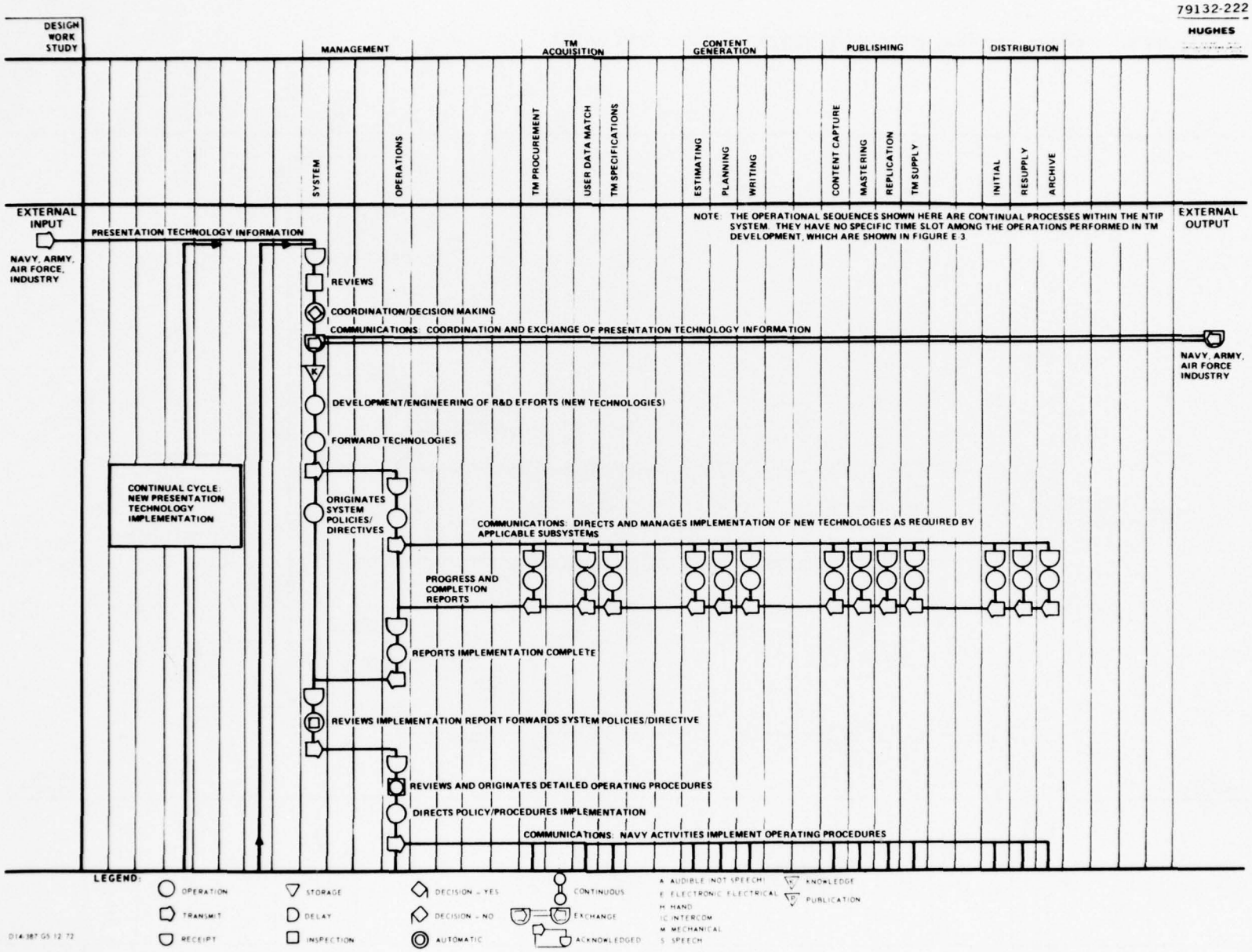


Figure D-2. General NTIPS Operational Sequence Diagram (Sheet 1 of 2)

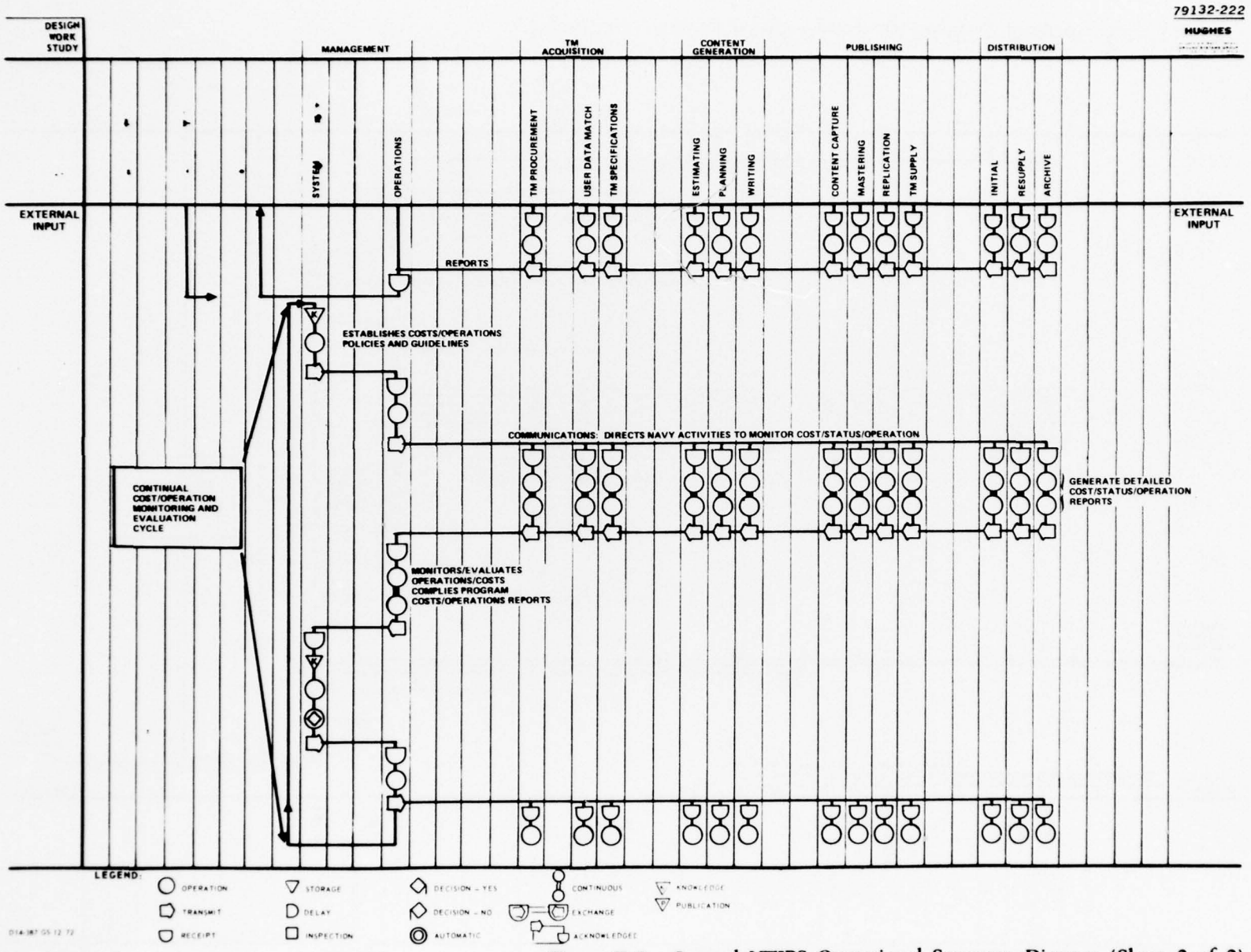


Figure D-2. General NTIPS Operational Sequence Diagram (Sheet 2 of 2)

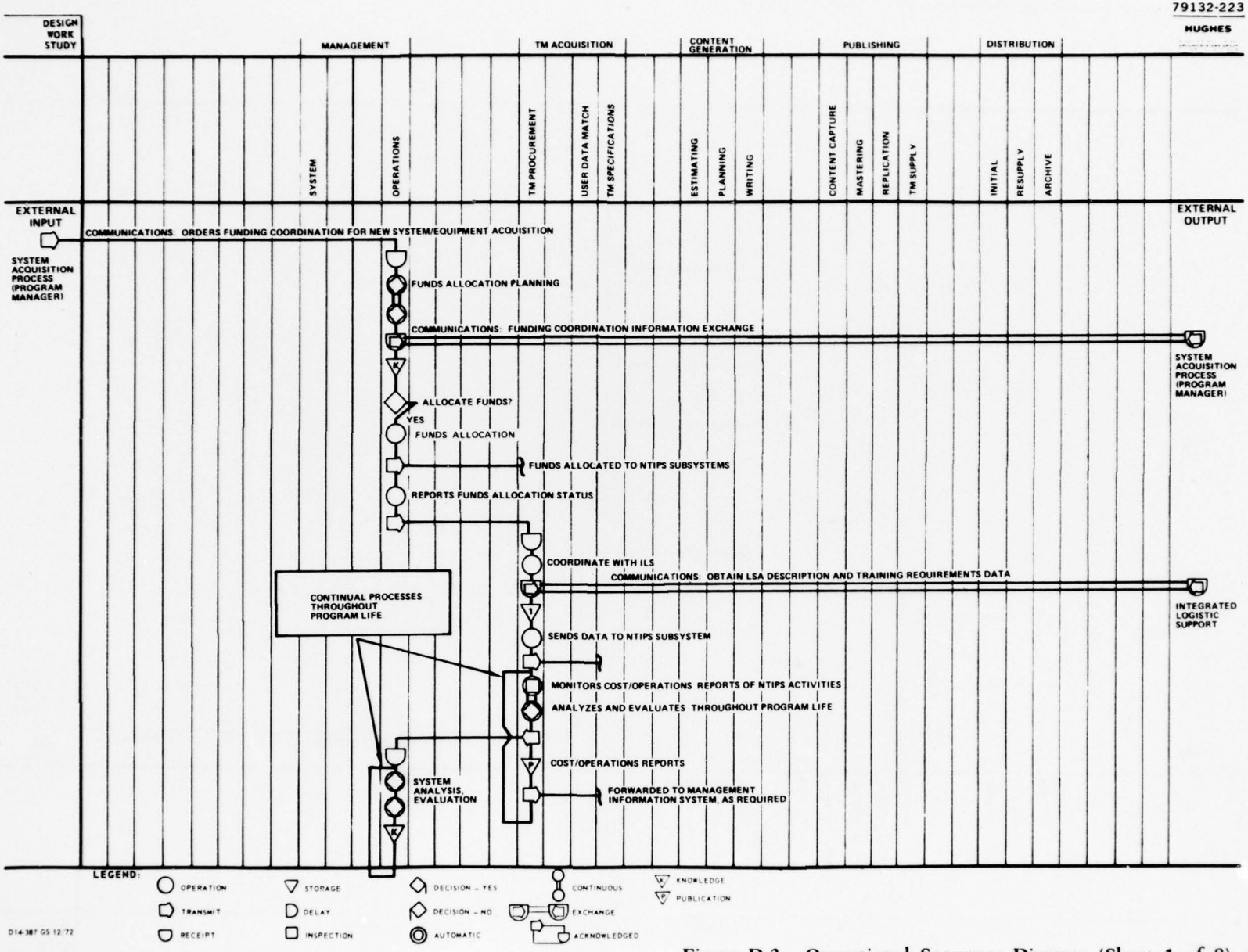


Figure D-3. Operational Sequence Diagram (Sheet 1 of 8)

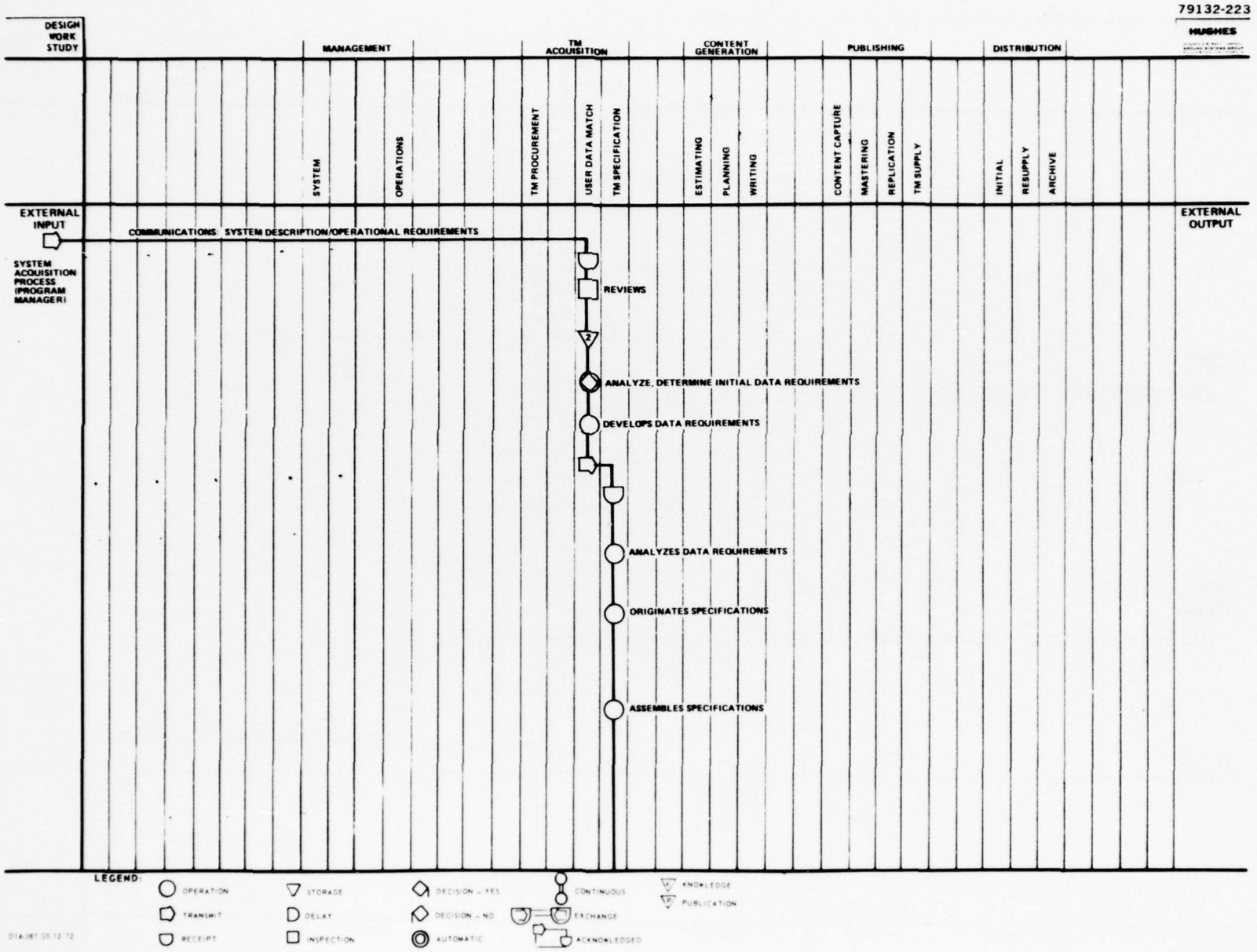


Figure D-3. Operational Sequence Diagram (Sheet 2 of 8)

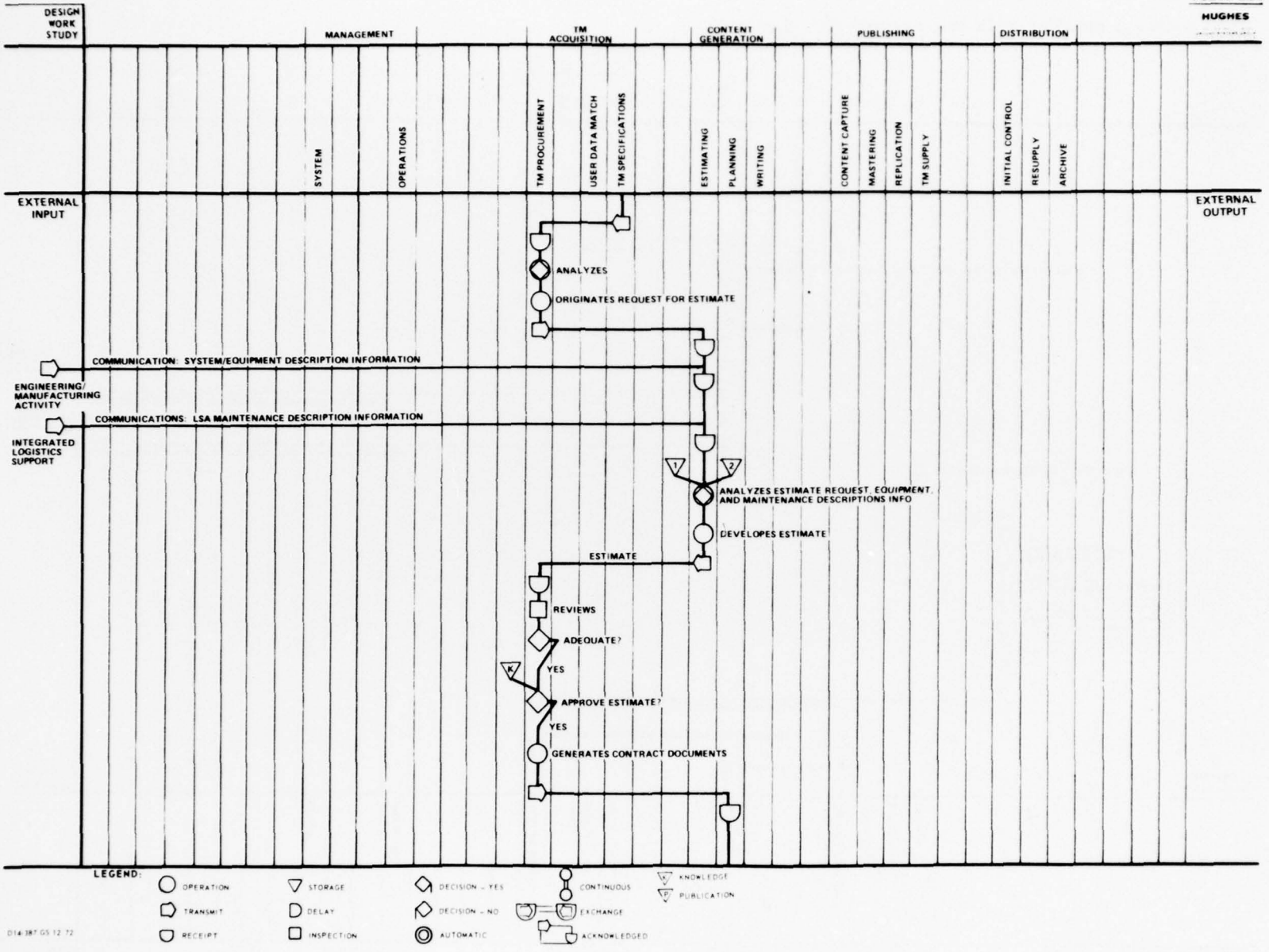


Figure D-3. Operational Sequence Diagram (Sheet 3 of 8)

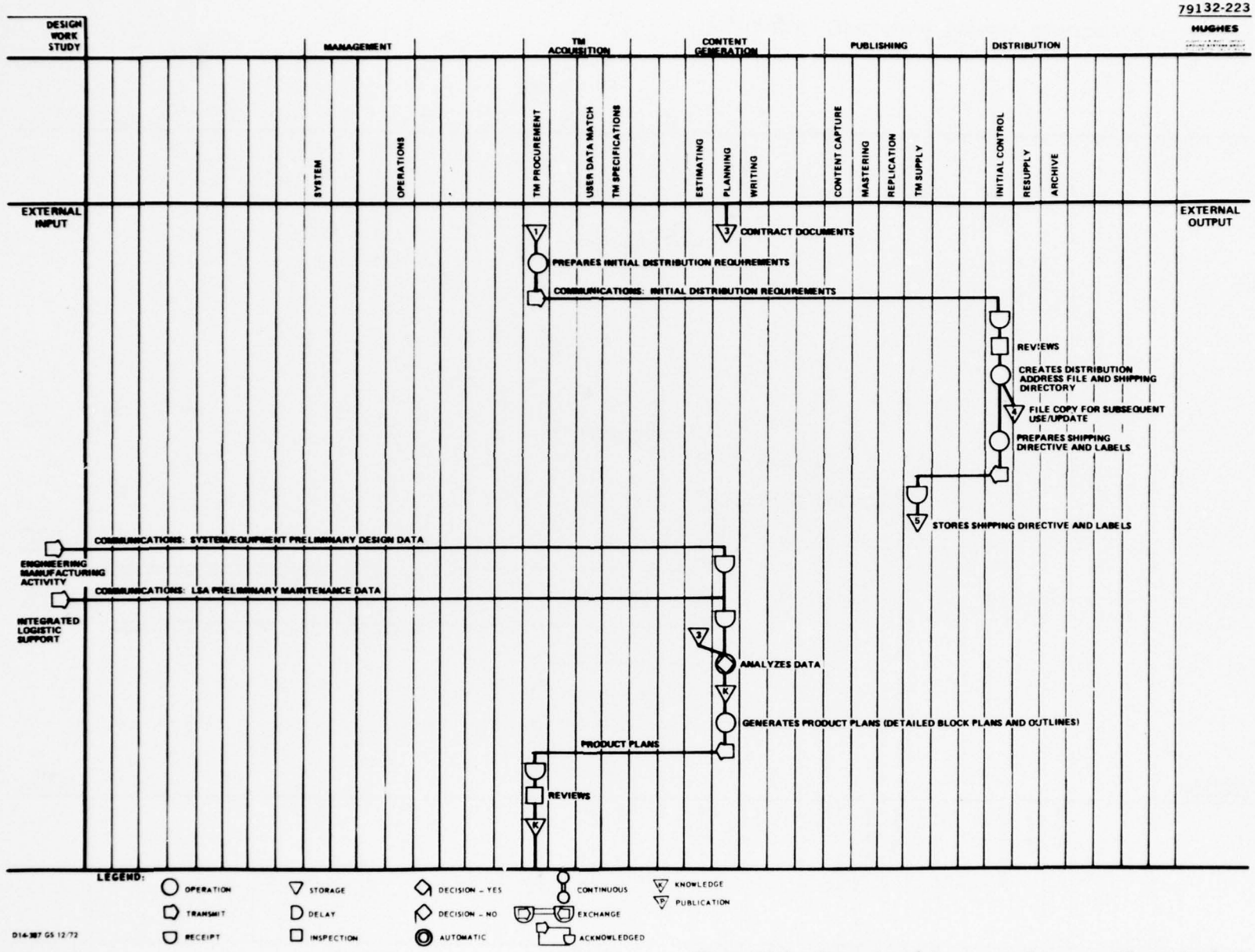


Figure D-3. Operational Sequence Diagram (Sheet 4 of 8)

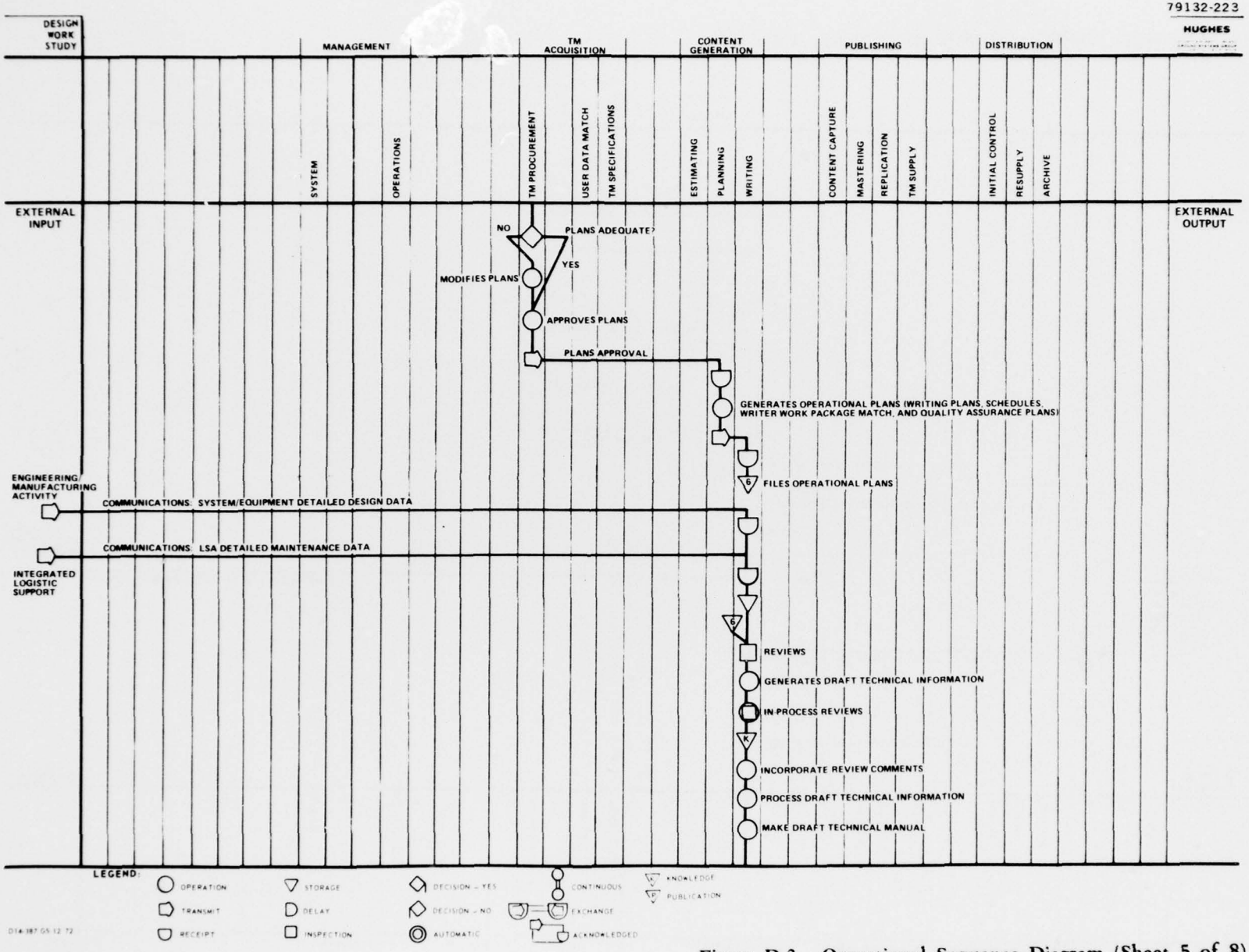


Figure D-3. Operational Sequence Diagram (Sheet 5 of 8)

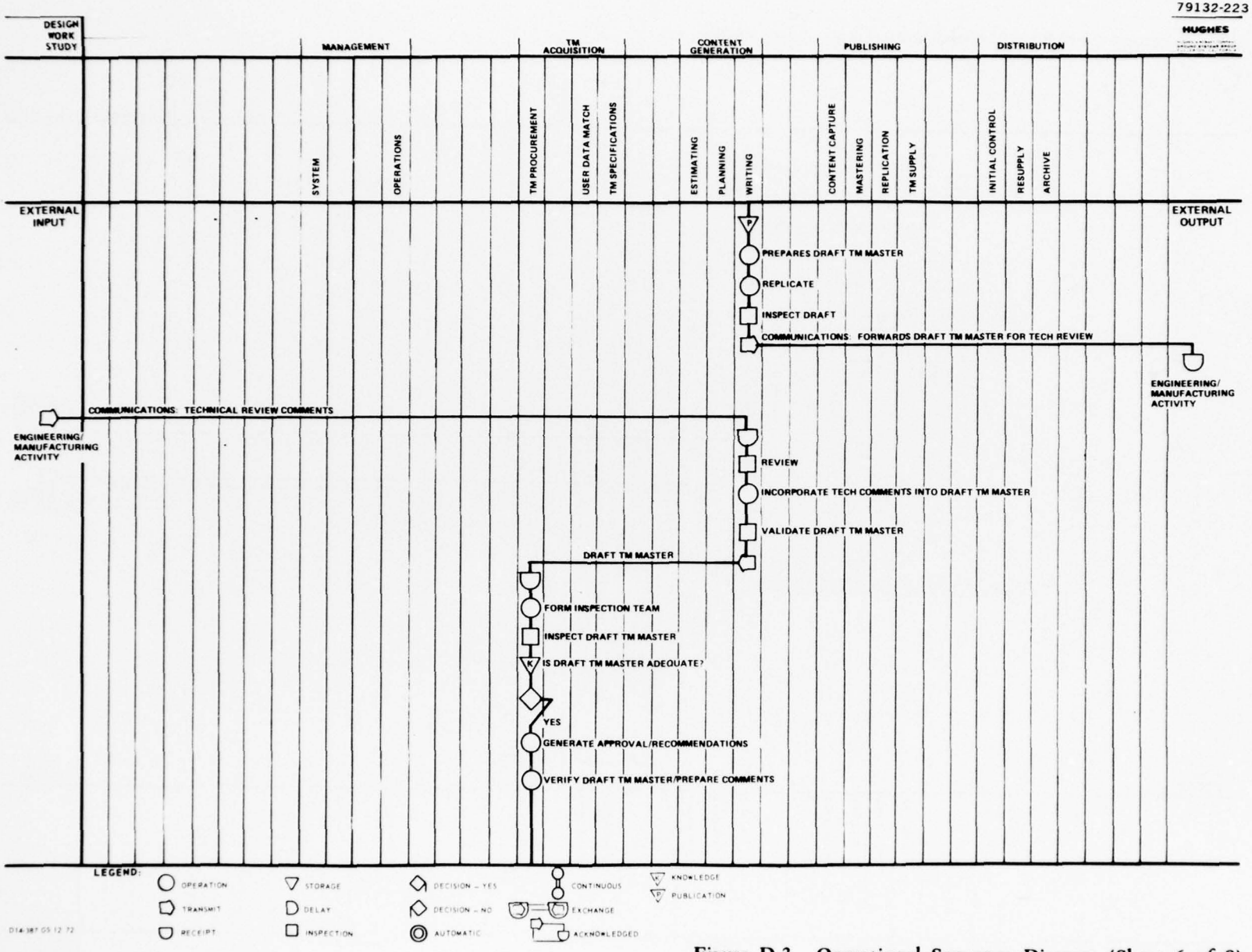


Figure D-3. Operational Sequence Diagram (Sheet 6 of 8)

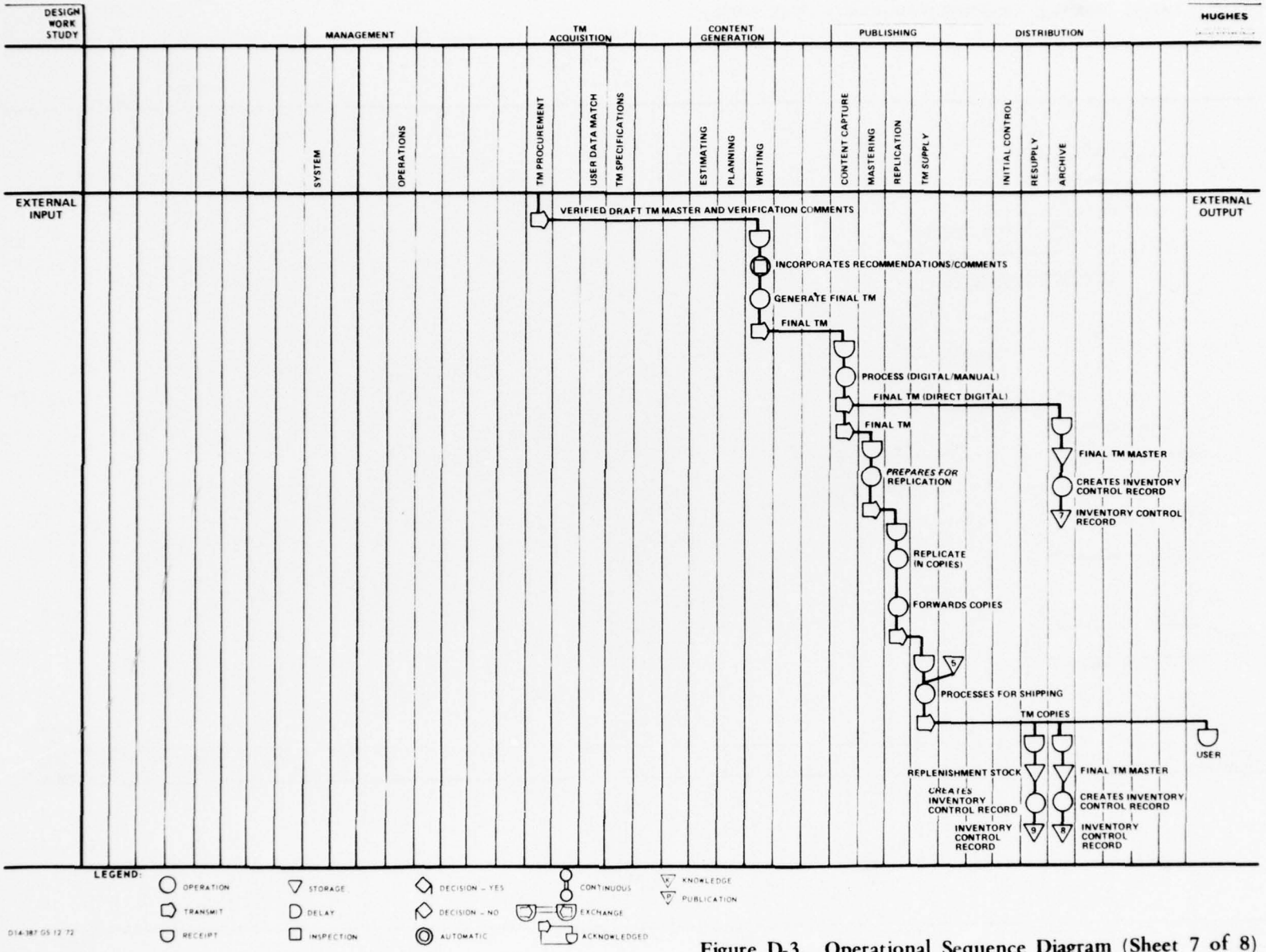


Figure D-3. Operational Sequence Diagram (Sheet 7 of 8)

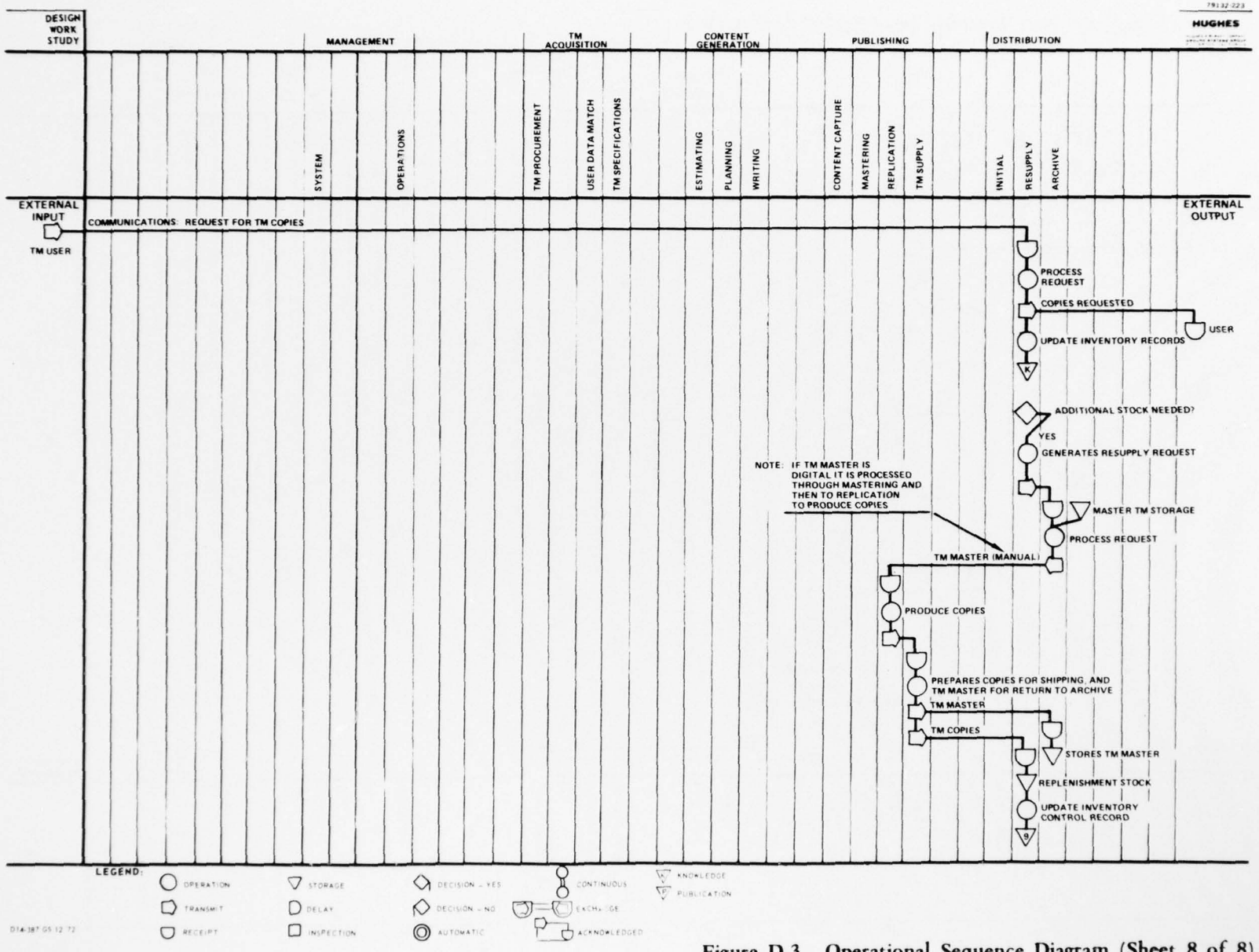


Figure D-3. Operational Sequence Diagram (Sheet 8 of 8)

