INTERACTIVE ELECTRONIC TRAINING MANUAL (IETM) GUIDE

First Edition

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PREFACE

The rapid integration of Interactive Electronic Technical Manuals (IETMs) into military workspaces throughout the Department of Defense has created a void in the otherwise comprehensive instruction provided to students at the Defense Systems Management College (DSMC). The swift pace of IETM development in the 1990s by each of the Services made preparation of a single guide on the subject a daunting task. We on the staff at DSMC wanted to provide a useful instructional tool and reference, but did not want to hinder the reader's understanding of the subject by providing outdated material.

We have designed this Guide primarily for use in DSMC courses and secondarily as an aid to acquisition managers. The text initially assumes little familiarity by the reader with IETMs. After presenting fundamental material, the text addresses issues of immediate concern to the acquisition manager from both the DoD and Service perspective.

DSMC will strive to make this a useful instructional resource and reference. Comments and recommendations relating to the overall text, Service specific information or technical developments are solicited. You are encouraged to mail such comments to us on the pre-addressed tear sheet located at the back of this Guide.

Paul T. McMahon

Department Chairman

Principles of Program Management

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CHAPTER 1
INTRODUCTION

1.1 Objective

This document is designed to be the primary desk reference for acquisition personnel who will be required to acquire, develop, deliver and/or manage IETMs now or in the future. It incorporates the status of existing/planned DoD and Service unique policy guidance, discusses current and projected technologies related to the production of IETMs, analyzes the relationship between IETMs and training, and addresses delivery vehicles including the World Wide Web (WWW).

1.1.1 Background

An emerging area of technology that has rapidly gained acceptance throughout all branches of the military is the acquisition, development, deployment and sustainment of electronic technical documentation and associated multimedia elements. The explosion in popularity of the Internet has produced an insatiable appetite for near real time information needs. The demand by todays computer literate society is for electronic media, not paper copy. Faced with shrinking defense budgets, weapon system managers have turned to one small corner of the information spectrum to meet its technology needs. The Interactive Electronic Technical Manual (IETM), first conceptualized in the1980s, became a reality by the early 1990s. In just the past few years, advances in computing power, increased functionality in IETM delivery software, portability of computers and reduced IETM development costs have paved the way for a successful electronic documentation delivery and sustainment program.

Simply put, an IETM is a technical manual that is prepared (authored) in digital form on a suitable medium, by means of an automated authoring system. It is designed for an electronic-window display to a user and in most cases possesses the following three characteristics:

- The format and style of the presented information are optimized for window presentation in an electronic form, either on a desktop PC, laptop PC, or other portable electronic display device. And, is designed to assure maximum comprehension. That is, the presentation format is "frame-oriented" not "page-oriented.”

- The elements of technical data constituting the IETM are so interrelated that a user's access to required information is facilitated to the greatest extent possible, and is achievable by a variety of paths.

- The computer-controlled IETM display device can function interactively (as a result of the user’s request and information input) in providing procedural guidance, navigational directions, and supplemental information. It can also provide assistance in carrying out logistic-support functions supplemental to maintenance.

Not all IETMs fit the three criteria stated above. IETMs can range from raster scanned images to sophisticated database management systems using expert systems and diagnostics. Using a strict definition of IETMs, some digitized manuals should be referred to as Electronic Technical Manuals (ETMs). The term electronic technical manual (ETM) generally describes all combinations of technical manual data in digital formats, stored in optical or magnetic media, and viewed through electronic display devices. To avoid confusion, the more commonly used term, IETM, will be used throughout the *DSMC IETM Guide* to describe all forms of digital technical manuals (TMs).

By the mid to late 1990s, pilot programs emerged that coupled IETMs with multimedia training elements. The combination of electronic documentation with a multimedia editing and delivery system established the building blocks necessary for an Electronic Classroom (EC) environment. Armed with these technologies, military trainers now had the opportunity to develop more effective classroom instruction that could be extended into the field and reused. CD ROMs containing entire technical manuals and lesson guides can now be provided to the user for just-in-time (JIT) refresher training upon returning to their duty station. The use of these Electronic Performance Support Systems (EPSS) where (IETM technology is integrated with training programs) provides the capability to improve individual performance and reduce costs. When implemented properly, streamlining of the training pipeline can be accomplished.

1.1.2 Scope

The *DSMC IETM Guide* is a guidance document that does not establish policy or procedures. Many IETM requirements are Service specific and have been identified within the *DSMC IETM Guide* for further investigation by the IETM acquisition manager. This guide should be used as a starting point for IETM development efforts and include consultation with the appropriate Service's IETM points of contact (identified in the Appendices) for further information and guidance. Due to the dynamic environment surrounding this subject matter, the contents and referenced requirements of this document will require periodic modification. Personnel are encouraged to access the latest version of the *DSMC IETM Guide* at:

http://www.dsmc.edu/IETM/guide.htm.

1.1.3 Organization of the Guide

The *IETM Guide* is presented as a series of building blocks to enhance your understanding of the IETM life-cycle.

Chapter 2 summarizes the benefits of IETMs and their impact on logistic support systems.

Chapter 3 summarizes the different classes of IETMs.

Chapter 4 provides overall IETM acquisition guidance.

Chapter 5 reviews pre-IETM development resources including the Government Concept of Operations (GCO) and IETM Concept of Operations (CONOPS).

Chapter 6 provides an overview of IETM development, including developing IETMs from legacy material and as a new program.

Chapter 7 presents a discussion on the future of IETMs from a development and delivery standpoint.

Appendix A reviews IETM software. It specifically discusses the foundation of many military IETMs: SGML (Standard Generalized Markup Language). The chapter introduces a structured document approach to the creation of technical data to permit the electronic interchange of information within a centralized DoD database.

Appendix B addresses the Continuous Acquisition and Life-cycle Support (CALS) philosophy and how it applies to IETMs. It also provides a discussion of the specifications underlying IETM development and delivery.

Appendix C addresses the training and IETM interface between products such as Interactive Courseware (ICW), Computer-based Training (CBT) and Computer Aided Instruction (CAI).

Appendix D contains Air Force specific IETM acquisition information.

Appendix E contains Navy specific IETM acquisition information.

Appendix F contains Army specific IETM acquisition information.

Appendix G contains USMC specific IETM acquisition information.

Appendix H presents a sample IETM Concept of Operations (CONOPS), which is defined earlier in the text. Additional supporting material is provided in subsequent appendices.

1.1.4 Roles and Responsibilities

The Program Manager and the respective project leaders are ultimately responsible for ensuring that requirements and missions are adequately supported. Each program should establish a team to research and develop an IETM Concept of Operations (see Chapters 4 and 5) to define system/equipment Operational & Maintenance (O&M) data requirements and functionality of IETMs. The Program Manager should ensure that the team contains adequate representation from program, logistic and engineering disciplines, design agents, training, and user activities. Their functions and requirements are described below.

- Program/Logistics Element Manager - The acquisition, technical, and functional managers are responsible for creating, reviewing, validating, delivering, maintaining, and updating TMs in any format and for implementation, execution and management of IETM processes supporting the weapon systems or equipment; provides the IETM developers with engineering and technical data.

- Logistics Support (LS) Manager - Responsible for ensuring that the program is supported with accurate TMs and training; leads the procurement of TMs, training and courseware materials (if applicable) and monitors the process and progress for any system under the manager's cognizance.

- Program/Maintenance Engineer - Defines technical requirements for the program system and assists in interpreting and validating technical information that will produce the TM and courseware; acts as the Government agent for technical issues and provides additional technical support functions.

- Design Agent (e.g. contractor) - Provides initial technical data for the program and may author the IETM content.

- Technical Writer - Verifies the parts of the TM and training using logistics input data and provides proposed changes and alterations to the deliverable products. Provides initial technical data for the program and may author IETM content.

- Training Agent - Provides and maintains the training facility and curriculum after a ready-for-training date has been reached.

- User - Personnel who use the TM to gather information or perform work (e.g., maintainer, trainer, operator).

CHAPTER 2
BENEFITS OF IETMS

2.1 Introduction

Ever since the Egyptians invented papyrus, paper has been used to deliver information. Although paper remains the preferred medium for certain types of information (novels, personalized correspondence, etc.), electronic alternatives are maturing. The average military inductee is computer savvy and experienced with the Internet and can easily adapt to computer delivered information.

Today's paper-based manuals are no longer the optimal choice for delivering information about complex machinery. Traditional paper manuals present a wealth of problems, including:

- Weight – Where mobility is a top priority (ships, ground based units), every area where a reduction in weight can be accomplished is scrutinized. One study determined that an Oliver Hazard Perry Class frigate (FFG 7) contained 21 tons of paper and containers for paper storage. An AEGIS Class cruiser (CG 47) had accumulated 37 tons.

- Volume – Paper takes up much needed space within a mobile unit. In the example presented above, assuming a density of 40 pounds per cubic foot, the frigate's 21 tons of paper would occupy 1050 cubic feet.

- Information Access –Technical manuals for complex equipment regularly extend across multiple volumes. The technical manuals for the LM2500 are contained in 11 volumes. In a typical maintenance action where the technician needs to diagnose and correct a problem, finding the correct information among the various maintenance volumes can take a considerable amount of time.

- Up-to-date Information – Rapid changes to military equipment through modifications and upgrades require supporting documentation to be updated just as often. Paper-based documents require a series of change pages to be methodically inserted, pen-and-ink annotations made where necessary, and superseded information discarded. The reduction of personnel within the military leaves little time to accurately incorporate and check changes. This can result in incomplete information, incorrect maintenance actions and possible safety problems.

- Printing – Paper is expensive compared to electronic documentation. Technical manual developers spend many hours formatting a document (page breaks, widow/orphans) to fit on 8 ½ x 11" paper. The costs of printing multiple copies, providing binders for the documents, and shipping to multiple destinations also have to be considered.

- Deterioration – The typical harsh military environment with daily handing by technicians, gradually deteriorates the paper technical manual.

2.2 Introduction of IETMs

The introduction of a new technology into the military is not accomplished without the completion of an extensive study. Early studies concluded that IETMs were significantly superior to the traditional paper-based technical manuals under operationally realistic conditions. IETMs solved or mitigated many of the problems identified in the previous paragraph as follows:

- Weight – Standard calculations assume that a CD can store approximately 3,400 pages of text, tables and graphics. This is about 20 pounds of paper-based information. Since a CD (with the jewel case) weighs less than two ounces, the AEGIS Class cruiser could reduce its 74,000 pounds of paper weight to less than 500 pounds if all information were to be placed on CDs. While some weight would need to be added to account for IETM viewing hardware, the reduction in weight for mobile units would in select instances increase maneuverability and reduce fuel consumption.

- Volume – Approximately 1,850 cubic feet of storage space is needed to store the 37 tons of paper aboard an AEGIS Class cruiser. The same documentation would only occupy 35 cubic feet if placed entirely on CD. Many facilities, which now receive duplicate copies of a single technical manual, operate in a networked environment. A single copy of an IETM on CD, would be sufficient for the initial IETM network installation and would serve as a backup.

- Information Access – At a minimum, even the most basic (Class I) IETMs provide a limited hyperlinking capability to allow the user to point, click, and quickly access desired information. The functionality of higher order classes permits word/phrase search capability, internal cross- reference links and links to other material (inventory, training, etc.). Northwest Airlines, using a prototype system, experienced a minimum 50% reduction in airline mechanics' time spent looking for the appropriate documents.

- Up-to-date Information – Once an IETM has been developed, a process for integrating and distributing updates should be implemented. The electronic "sticky notes" feature of many IETMs can be used as an interim solution between updates. These notes are simply folded into the source file and delivered as a complete revision on a periodic basis. More sophisticated IETMs, manuals, which may also include a "notes" feature, require the entire database to be delivered. A method known as "push technology" is now being evaluated for updating Web-based IETMs.

2.3 Military IETM Studies

The Naval Surface Warfare Center, Carderock Division (NSWC-CD) released a report in October 1996 entitled "Maintenance and Logistic System Support Benefits Resulting from Introduction of IETM Based Technology." The study group identified clear benefits to employing IETMs onboard operational units. Consider the following evaluation summaries from Commanding Officers of Navy ships after their personnel performed an onboard assessment of the Radio Communication Set (RCS) IETM:

CO, USS ANZIO

- "The IETM is light years ahead of the standard Tech Manuals of raster scanned pages and has become a critical part of the operation and maintenance of the RCS."

- "IETMs are an information multiplier. With IETM(s) as a tool/coach, junior personnel can perform complex technical tasks with nearly the same effectiveness as senior techs."

- "Utility is outstanding. Techs and operators are using IETMs exclusively because of speed and ease of technical access to data."

CO, USS SHILOH

- "RCS IETM program is outstanding. It works and has greatly enhanced communication readiness on Shiloh."

- "IETM approach should be applied to technical documentation for other AEGIS ship systems (e.g., CSOSS, CSTOMS, EOSS, NSTM, Interface information, etc.)"

- "Program should be expanded to include all new construction CG/DDGs."

- "This system is a winner and the sailors love it."

Overall, the results of limited introduction of the RCS IETM into the Navy are summarized as follows:

  - Sailor classroom feedback: Outstanding

  - 95% rated IETM features used as good or excellent

  - 93% preferred IETMs to equivalent paper technical documentation

  - Majority cited speed and ease of use as greatest advantages

As a point of reference, the RCS IETM was a more capable (Class IV) system. Generally speaking, the benefits obtained from lower class IETMs are space/weight savings, quicker access/hyperlinked access to desired information, and lower distribution costs. When IETMs are linked to the entire enterprise (e.g., training, supply, maintenance reporting systems), other benefits will also be realized.

The NSWC-CD report highlighted a number of logistical areas where real cost savings could be realized through deployment of IETMs. The remainder of this chapter discusses the findings of this report.

2.4 Maintenance Improvements

The corrective maintenance process begins with discovering and reporting a system malfunction. It proceeds to completion when the unit is brought back online. In between, various procedures are conducted to verify the fault, identify and repair the faulty component, and operationally check out the performance of the equipment. Every step of the process is vulnerable to human error. Automation of the corrective maintenance process, through the introduction of IETM technology, can greatly increase operational availability and reduce the logistic support burden throughout DoD.

Below are a few of the areas where maintenance process improvements can be realized with increased use of IETMs:

- Reduced false alarms
- Increased percentage of successful fault isolation
- Reduced fault isolation times
- Reduced maintenance time
- Reductions in false removal rates
- Greater effectiveness of inexperienced technician
- Improved personnel and equipment safety
- Reduction in turn-around time for reporting and correcting technical manual discrepancies
- Reduction in technician time spent completing maintenance reporting forms

2.5 Fault Reporting and Fault Isolation Improvement

2.5.1 Reduction in False Alarm Rate

Characteristically, a fraction of all fault reports consists of false alarms. If a maintenance technician cannot verify a fault, the problem is reported as a CND (Cannot Duplicate) or similar designation. An aircraft, for example, will be removed from operational service for further tests or will be tentatively returned to service. This can be a serious matter if the fault really exists.
Tests have demonstrated that use of IETMs greatly reduces such occurrences. The Naval Air Systems Command conducted a series of tests during the Aircraft Maintenance Integrated Diagnostics Demonstration (AMIDD), with an integrated IETM system in an F/A-18 C/D squadron. The AMIDD Project Office stated that in going from paper TMs to IETMs, CNDs could be reduced by approximately 50 percent.

2.5.2 Increased Fault Isolation Success Rate

When a technician has verified that a reported fault exists, he or she must locate the faulty component using Built-in Test Equipment (BITE) information or an operator's statement of the malfunction. With complex systems, fault isolation is probably the most difficult step in any maintenance sequence. Paper-manual fault-isolation procedures are cumbersome and static (non-interactive). Often, possible fault sequences cannot be covered in a reasonable period of time. (The limitation is often with the paper medium and not the engineering content.) Consequently, the process of troubleshooting, based on step-by-step sequence through a fault tree, can end in failure. In such a case, the process is repeated, or the whole problem is referred to a higher maintenance level (e.g., O-level to I-level). A field test using the AN/SPA-25D radar repeater showed an increase in the fault isolation success rate from 64% to 100% for experienced technicians and from 54% to 100% for inexperienced technicians. Note that in this instance, inexperienced technicians became as proficient as experienced technicians. In a similar case, an F-14A test showed an improvement from 42% successful fault isolation with conventional technical manuals to 100% successful fault isolation with IETMs.

2.5.3 Fault Isolation Time Reduction

The time required for fault isolation is also reduced through the use of IETMs. For example, Navy field tests on the AN/SPA-25D showed a decrease in fault-isolation time of 24% for various inserted faults when IETMs were used in the corrective maintenance process. Other tests have provided similar results. The Air Force reported that Integrated Maintenance Information System (IMIS) tests on the F/A-18 aircraft resulted in fault-isolation time reduction by 37 percent. The Naval Personnel Research and Development Center (NPRDC) documented a decrease in fault-isolation time of 56.8% while conducting tests on a set of communication equipment IETMs. The magnitude of the cited improvements, including improved performance of less experienced technicians, has been repeatedly verified in independent tests.

The fact that an IETM significantly shortens the time required to perform troubleshooting is due largely to its interactive functions. A technician enters a test result and the IETM can automatically and immediately advance to the next appropriate test. This process continues until the cause of the problem is isolated. Electronically displayed information-format improvements contribute to the effectiveness of the IETMs. For example, using the IETM, text and relevant graphics can be presented in a side-by-side format to save the technician from having to search for locator information. In paper manuals, the text is frequently not co-located with relevant graphics, forcing the technician to search for the required information. Finally, IETMs provide "how to" instructions, whereas the steps in paper manuals merely state "what to do" (assuming the technician knows how).

2.6 Maintenance Procedure Improvements

2.6.1 Reduced Maintenance Time

After troubleshooting has identified the cause of a deficiency, technicians need to perform correction tasks. These are usually repairs (straighten pins, splice wiring, calibrate, adjust), or remove-and-replace (R&R) actions. Hughes Aircraft conducted an investigation of the Navy Technical Information Presentation System (NTIPS), centering on the benefits of replacing paper manuals with IETMs.

NTIPS tests on the AN/SPA-25D system showed a decrease in repair time for both experienced technicians (by 16-28%) and inexperienced technicians (by 22-30%).

2.6.2 Reduced False Removal Rates

Once a faulty component is identified, it is either repaired (when the maintenance procedures for the system so indicate) or is removed and replaced. Removed components are usually forwarded from an O-level maintenance facility to an I-level Maintenance Activity (IMA) for evaluation. Typically, a large fraction of removed parts have been found not to be defective, indicating false removals.

The USAF F-16 tests with IMIS (Integrated Management Information Systems) showed a reduction of 26% in false-removal rates by specialists, and 37% by non-specialists. A briefing on the results of the AMIDD tests reported a reduction in false-removal rates of 60 percent.

2.7 Greater Effectiveness of Inexperienced Technicians with IETMs

As indicated in the previous paragraphs, the performance of inexperienced technicians using IETMs has shown striking improvement relative to that of technicians of the same level of experience using paper TMs. This improvement has been particularly noticeable in troubleshooting success. Early F-14A IETM tests revealed inexperienced technicians were unable to locate a fault inserted into an operational F-14A using paper TMs. When an IETM was used, all of the technicians tested successfully located the fault. In general, inexperienced technicians perform on a level equivalent to that of experienced technicians when an IETM is utilized. The IETM can be expected to compensate in some measure for both a shorter training program and less experience among technicians.

2.8 Improved Personnel and Equipment Safety

TMs include numerous WARNINGs (which point out situations involving danger to personnel), CAUTIONs (which identify situations involving possible damage to equipment), and NOTEs (pointing out possible errors in procedure). With paper manuals, problems resulting from a technician ignoring or misunderstanding these instructions are not uncommon. In an IETM procedure, the technician cannot continue without explicitly acknowledging his/her observation of WARNINGs and CAUTIONs**.** Moreover, WARNINGs, CAUTIONs, and NOTEs are more effectively displayed, via popup dialog boxes and/or in color, to the technician than in the case of paper manuals. "HELP", through an online hypertext system, or “coach”, may be available if he/she does not understand the information presented.

The capability of IETMs to be automatically updated, via electronic sticky notes or e-mail, means that safety-related messages and updates will appear far more rapidly in the electronic technical data package than in paper TMs.

2.9 Reduction in Cycle Time for Reporting Technical Manual Discrepancies

With establishment of direct interaction of an on-board maintenance Local Area Network (LAN) with a management information system, response time for the submission of IETM deficiencies in technical information can be reduced from weeks to hours by the use of direct electronic-trouble reporting. The user in many cases may receive a same-day response to verify receipt of his/her trouble report. Corrections involving issues related to personnel or ship safety can be routed to the responsible activity within hours of receipt, in lieu of a longer period required to route paper. The Naval Sea Systems Command (NAVSEA) has been working on the Technical Information Deficiency Evaluation System (TIDES) to achieve this goal.

2.10 Reduction in Technician Time Required for Maintenance Reporting

As a part of each maintenance action, a technician must fill out a standard maintenance report form, which differs somewhat between services and for different types of systems. Tests based on the actual conduct of the specific maintenance action, as reflected by the interaction of the technician and the IETM, have shown that automation of this process can substantially reduce the time required for this procedure. Similarly, ordering a required part can be accomplished quickly on an IETM display of IPB information. This replaces the time-consuming process of locating parts data in a paper manual, filling out a form, and delivering the form to the supply chain. With an IETM, parts inventories can be instantly adjusted as a result of each parts-ordering action. The Air Force has shown that the time required to order necessary parts can be reduced by 94% using IETMs.

2.11 Features of IETMs that Improve Maintenance

2.11.1 Access to Technical Information

One of the key elements involved in effective troubleshooting and repairing of equipment is having immediate multipath access to all the needed technical information. With IETMs, all of the required information can be at the technician's fingertips. For example, IETMs can incorporate maintenance aids such as a Fault Lookup Mode. When the maintainer receives a BITE fault code for a piece of equipment, he/she can access the IETM and enter the fault code. The IETM will then lead the maintainer immediately into the troubleshooting procedure for that fault code, and send him/her directly to the proper corrective maintenance procedure and IPB (Illustrated Parts Breakdown) to enter the data into the supply system. Sailors using the AEGIS Radio Communications System IETM retrieved information up to four times faster than with the paper documentation that it replaced.

2.11.2 Greater Display Effectiveness Due to Multimedia Technology

The interactive visual presentation of complex procedures by using animations, video clips, virtual reality technology, and expert system modules can provide the maintainer with improved comprehension of technical information. The benefits of audio, in addition to visual notification windows, can improve the delivery of WARNINGs, CAUTIONs, and NOTEs in troubleshooting and maintenance procedures.

2.11.3 Integration of IETMs with Other Management Information Systems

The Navy has already integrated the IETM with the Advanced Technical Information System (ATIS). This provides the maintainer with access to all of the technical documentation normally stored in disparate locations. This resource includes the entire ship's library, Ships Service Manuals (SSMs), Engineering Drawings, Maintenance Requirement Cards (MRCs), and Standard Operating Procedures (SOPs). As other “islands of information” come online within the services, integration, through middleware applications, will become a priority. Only when the information systems of each service are tied into a DoD wide network, will the benefits of automation (e.g., parts ordering from a centralized DoD facility) be fully realized.

2.12 Improvements in Life-cycle Support

Although reliable quantitative estimates are as yet generally unavailable, it is clear that life-cycle costs of maintaining IETMs will be a fraction of the cost required to maintain conventional paper manuals. It has been estimated that a reduction of 20% in ownership costs (life-cycle support costs) for the LM2500 Gas Turbine will result from the introduction of an IETM to support its training and Fleet maintenance.

An evaluation of the effectiveness of the LM2500 Gas Turbine IETM effort carried out by the NPRDC stated:

"The elimination of seven training weeks from the GSE training pipeline and three training weeks from the GSM pipeline results in a reduction in student training costs of over $1,900,000 in FY 95 and FY 96. The cost savings in avoiding reproduction of the paper-based technical manuals used in the GSE/GSM courses were estimated at $96,000 for FY 96."

2.12.1 Reduction in Time and Errors for Technical Information Update/Modification

Correcting and updating electronic media can be more thoroughly and effectively performed by the use of key text-searching capabilities. Global find and replace actions for paper legacy data require a hit-or-miss visual scan of the entire paper-based product, often resulting in failures to correct all instances of the desired changes. Significant time is currently spent to generate and maintain conventionally based paper products. This includes the time required to review for potential errors in technical information updates. Automatic referencing of the electronically stored tables and figures ensures absolute and correct updates to numbering changes created by revisions to the source material. Electronic media also enables the automatic generation of the table of contents, list of figures, list of tables and indexes.

Changes are made to the entire IETM at once instead of producing a separate change package for each stand-alone paper TM. Changes that ripple through the entire set of manuals could be quickly and effectively located and corrected by the use of the search features available with electronic media, a function not available for paper-based products. Advance Change Notices (ACNs) can be delivered as annotated files to supplement the IETM, thus reducing ACN printing, shipping, and storage costs.

2.12.2 Reduction in Costs of Technical Information Printing and Publishing

Printing costs can be eliminated by the replacement of paper-based manuals with electronically generated media. The cost of mastering and reproducing a CD is less than the setup costs of reproducing a paper-based set of manuals. The cost of procuring and storing binders can also be eliminated.

2.12.3 Reduction in Storage Space Required for Technical Information

Storage space requirements can be substantially reduced with the elimination of paper technical manuals. This space requirement can be reduced to a single filing cabinet for the storage of the equivalent magnetic material. It has always been anticipated that IETM display equipment would not be purchased solely to view IETMs. Thus, IETMs may take advantage of existing computer display systems.

2.12.4 Reduction in Shipping Costs

Shipping costs can be reduced for conventional shipment of routine initial distribution material and routine updates. The cost of distributing emergent changes to paper manuals will be reduced to a few pounds of the electronic equivalent. This expense could drop further as changes/updates are made using satellite links.

2.12.5 Automation and Integration of Logistic Support Technical Information

The use of automated techniques to create, manage, deliver and update technical information documentation via an easily revisable database across hardware and software neutral platforms will greatly reduce the life-cycle costs of technical information and improve the quantity and functional integration of information for end-user use. The IETM and its associated database will be the repository for all deliverable technical information relating to the documented system; information which can be extracted easily and quickly.

An IETM production process should electronically integrate those areas of the logistics discipline that support the development and organization of technical information for system operation, maintenance and training. In addition to training, these functions include logistics support analysis, human factor engineering, reliability/maintainability and maintenance planning. In the process of forming an integrated end-user product, the IETM will make maximum use of existing electronic data to lower cost, maximize consistency and provide a medium for user inputs.

2.12.6 Supply Support

Implementation of IETMs reduces the weight and storage requirements associated with paper-based manuals. As a result, weapons platforms are able to carry additional mission-critical equipment or stores. Supply support costs will be decreased because there will be less mis-ordering of parts. This will be a direct result of improved fault localization/identification via the expert-system troubleshooting routines available in IETM technology. This translates directly into reduced weapon-system maintenance costs and decreased time to repair.

CHAPTER 3
CLASSES OF IETMS

3.1 IETM Definitions

As IETMs began to proliferate, so did the methods for converting and presenting digital data. While careful not to inhibit innovation, the military did not want contractor proprietary solutions either. NSWC, Carderock Division, released a document titled “DoD Classes of Electronic Technical Manuals,” which addressed five classes (Class I through Class V) of IETMs based on the source data format of the IETM and its functionality.

The Classes are defined in fairly general terms that necessarily overlap. They facilitate discussion of options and differences, but they are insufficient to serve as a basis for contractual use (e.g., direct the contractor to prepare a “Class III” manual). The Statement of Work (SOW) or Technical Manual Contract Requirements (TMCR) should specify exact functionality requirements without referring to this set of definitions. The structure of each class is illustrated in Figure 3-1. Table 3-1, found at the end of this chapter, summarizes the key points of each class of IETM, for ready reference.

3.1.1 Class I - Electronically Indexed Page Images

These IETMs include digital page images obtained from raster scanning, using the Navy Implementation of Raster Scanning/Navy Image File Format (NIRS/NIFF). They are intelligently indexed, based on the front matter (i.e., table of contents, list of figures/fold-outs/tables etc.) and rear index using MIL-M-29532. This indexing allows the user to select a topic from front matter and have the corresponding raster page, from the body of the TM, automatically displayed or to create an automatic collation of page changes. Page orientation is retained and can be directly printed.

3.1.2 Class II - Electronic Scrolling Documents

Most of these ASCII-based IETMs conform to Standard Generalized Markup Language (SGML), per MIL-PRF-28001, and link front matter to corresponding material in the body of the TM. (Refer to Appendix A for additional information relating to SGML). They may have additional links to cross-references, tables, figures, etc. and to voice, video, expert systems, or other special external applications. They generally have word search and bookmark capabilities, electronic sticky notes, and may contain raster or vector graphics. The linked manual can be viewed electronically or be printed in compliance with existing military style and format specifications. While MIL-PRF-28001 is the preferred format at this time, other SGML formats (e.g., HyperText Markup Language, HTML) are emerging and provide similar benefits. A second format, Adobe’s Portable Document Format, PDF, is also being used for basic conversions. As discussed in detail in Appendix A, PDF is based on Adobe’s Postscript printer language and allows Class II interactivity. However, the PDF file cannot currently be edited. Consequently, if the Government chooses to maintain the TM data through PDF files, it must first own or have access to the publishing system that generated those files before it can ensure that data maintenance and update responsibilities can be transferred between technical manual

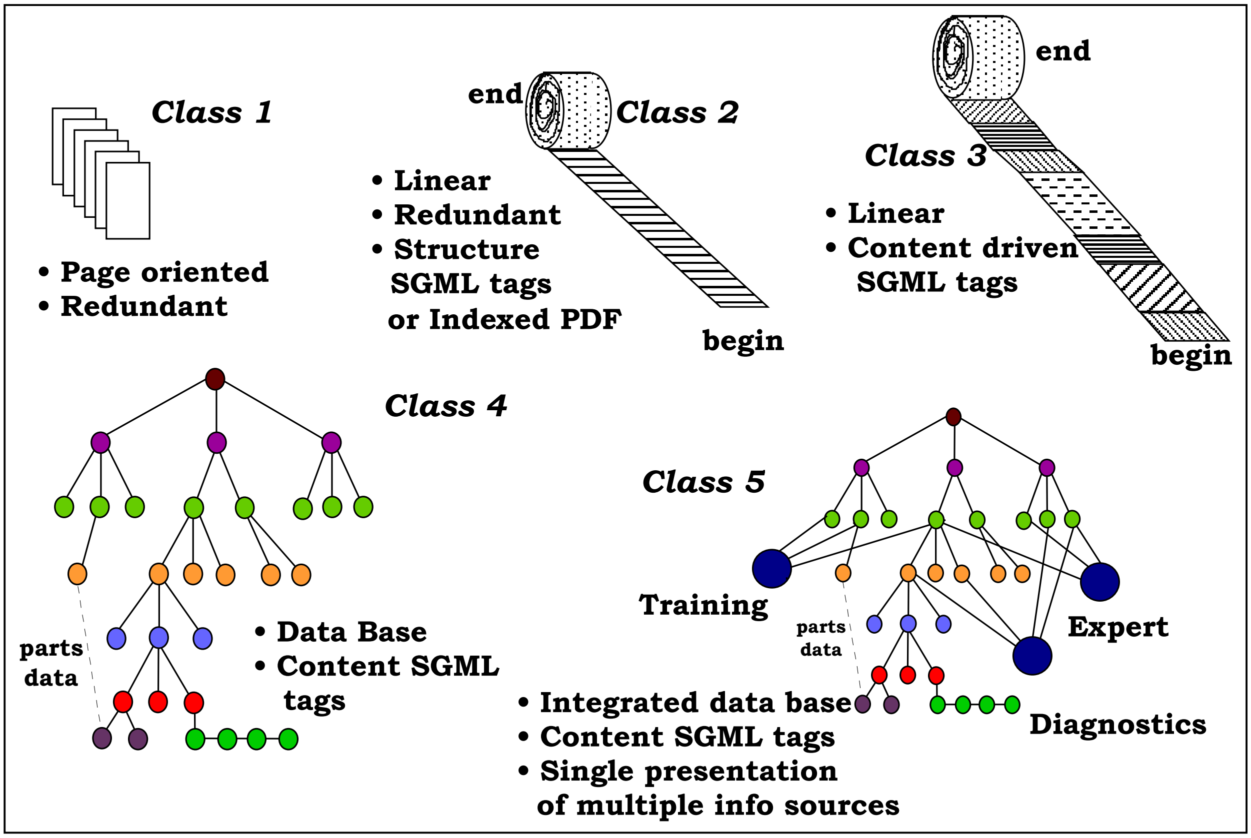


Figure 3-1. Graphical Representation of IETM Classes

maintenance activities. Disagreements exist both within and between the services, about classifying PDF as a Class I or Class II document.

3.1.3 Class III - Linearly Structured IETMs

These IETMs have enhanced functionality over Class II. They may have MIL-PRF-28001 or MIL-PRF-87269 SGML tags applied to the ASCII text to allow user interaction through "view packages." View package requirements can be developed to emphasize functional subjects, such as training, maintenance, and system overview. Being linearly structured, Class III IETM files can be used to print hard-copy TMs. But while all of the data will appear in the proper sequence, the printed copy will not necessarily be in the same format as the traditional "MIL SPEC" manual. Class III IETMs can include optional linkages, such as voice, video, expert systems or special applications. Some caution and planning are required, however, if a single database is intended to produce the IETM and publish the hard-copy TM.

3.1.4 Class IV - Hierarchically Structured IETMs

Class IV is a complete departure from the previous classes in which data is structured to support a classical publishing environment based upon sentences, paragraphs, chapters, pages, etc. Class IV data is created or re-authored and then rebuilt into a database. It is then managed as hierarchical objects within a database. In acquisition, Class IV technical data is built into a structured database, using Logistic Support Analysis (LSA) disciplines and formats to create the database. Data is only created once with no duplication. For legacy TMs, two types of duplicate data are found:

- Identical data is exactly repeated each time it is found. Examples include WARNINGs, CAUTIONs, NOTEs, common procedural steps, graphics, etc.

- Redundant data sets convey the same information, but cannot be substituted for one another. Examples include paragraphs containing essentially the same steps, but which must be managed as individual data sets, because the words within the paragraph provide a different context for each occurrence (e.g., refer to different figures or different preceding paragraphs).

With Class III, identical data can be eliminated. Because re-authoring is avoided to minimize cost or to preserve the ability to print hard-copy, much redundancy remains. For conversion of legacy data to Class IV, data is re-authored to remove its formatting and to rebuild the data into a structured database. Paragraphs or information can be decomposed to simple statements that approximate Logistic Support Analysis Record (LSAR) type of entries at the step level. As the new structure eliminates previous need for duplicate data, the redundant data also is eliminated. The application (view) program then provides the necessary context and transition. The total amount of data being stored and managed is significantly reduced and multiple updates within the IETM are eliminated. Other SGML based databases found in Class II and III IETMs also have the ability to store data once and apply it many times. They, however, can only share these information objects within a single IETM.

Data linkages in Classes I through III rely on application programs such as scripting or hyperlinks to define the linkages between data. Their Data Base Management System (DBMS) manages the objects, if applicable, but not the structure. For Class IV, building a hierarchical database structure (typically following an LSAR) provides the inherent logic and the linkages among and between data. This principle greatly simplifies the processing of change data and the use of application programs. IETM data modules are structured in conformance with MIL-PRF-87269 and may be represented as SGML-tagged files. All item links are built into the structure of the DBMS. The availability of modules (e.g., figures, text, tables, video, voice clips) enables the user to access information in a highly interactive manner and from a variety of paths. The text is created or edited to have the same "look and feel" as the steps in LSAR entries. IETMs have user interfaces developed in accordance with MIL-PRF-87268 and provide "frame-," rather than "page-" oriented displays. The Class IV IETM can prompt the user or may directly receive fault code information from which the IETM software determines the appropriate path to display through the database. As its contents are contained in a hierarchically structured database, a Class IV IETM cannot be printed as a unit for distribution in hard-copy form.

A third primary difference between Class IV and the first three IETM classes is that the Class IV product is not bound by a predetermined sequence of presentation. While the sequencing of data may be different for different view packages, Class II and III would have to establish the sequenced data files for each view package; Class IV would create it directly. Class IV IETMs (and Class V IETMs that use Class IVs as a base) have the ability to naturally apply precondition and applicability statements within the IETM database and to "branch on condition found." The program analyzes each condition and brings in the necessary data. This process continues through to a logical conclusion. By using these features, a Class IV IETM can display only "user specific" data from the database and can tailor presentations based on several input criteria. For example, it may only present certain maintenance choices to a trainee, but present additional choices to a journeyman working with the same equipment configuration and fault indicators. Class IV IETMs can share data sets among users, thereby making data maintenance even more efficient.

Program Offices may encounter contractors with significant investments in legacy publishing systems, legacy IETM software tools, and lack of work force training in or understanding of Class IV production processes. These factors tend to weigh IETM recommendations away from Class IV functionality and toward the "status quo." The persistent comparison of sunk costs in existing systems with investments needed to execute new technology generally fails to consider all costs involved in product creation and review or of the potential savings to be achieved throughout the life-cycle. Nonetheless, the acquisition of SGML tagged "linear databases" can provide many of the end-user features and some of the advantages found in maintaining object oriented databases through different strategies of use. Whether object oriented or linear, SGML tagged databases support the longer term goal of the CALS data integration philosophy.

3.1.5 Class V - Integrated Database IETMs

The Class V IETM combines the functionality and capabilities of an expert system with a technical database to allow the user to perform tasks more quickly and accurately. This *DSMC IETM Guide* does not address the requirements of expert systems or the efforts needed to achieve the full integration of a multi-functional Class V system. It does address the IETM component of a Class V manual and the interface to an expert system. Class V IETMs allow the subject matter experts (SMEs), in all areas (e.g., troubleshooting, fault isolation, accomplishing repairs, establishing alternate repair paths), to bring their knowledge to the maintenance unit and apply it in a specific situation. The system and equipment diagnostic programs can "talk" directly to the user through the IETM; relatively unskilled technicians can be led through complex procedures. Seldom-used processes and procedures (e.g., annual inspections) can be properly planned and executed without significant research. Programs will also typically analyze the data received and add it to the knowledge base to allow the software to "learn" and apply the knowledge to future analytical processes.

Table 3-1. IETM Classes

	Basic ETMs	IETMs			
	Class I	Class II	Class III	Class IV	Class V
	Electronically Indexed Pages	Electronic Scrolling Documents	Linearly Structured IETMs	Hierarchically Structured IETMs	Integrated Database
DISPLAY	• Full page viewing • Page-turner/Next function • Intelligent index for user access to page images • Page integrity preserved	• Primary view is scrolling text window • Hot-spot access (Hyper-links) to other text or graphics • User selection and navigation aids (key-word search, on-line indices) • Minimal text-formatting for display • User selectable call to (launch) another process	• View smaller logical blocks of text - less use of scrolling • Interaction through dialog boxes • Interaction per Mil-PRF-87268 to extent possible • Text and graphics simultaneously displayed in separate window when keyed together	• View smaller logical blocks of text - very limited use of scrolling • Interaction through dialog boxes with user prompts • Interaction per Mil-PRF-87268 • Text and graphics simultaneously displayed in separate window when keyed together	• Class IV IETM functions • Interactive electronic display per Mil-PRF-87268 • Multi-function display session • Expert system allows same display session and view system to provide simultaneous access to many differing functions (e.g., supply, training, troubleshooting)
DATA FORMAT	• Bit Map (raster) • Indexing and header files (Navy Mil-29532) • MIL-PRF-28001 or Postscript • Generic: C/NDI imaging system formats	• Text - ASCII or PDF • Graphics - whatever viewer supports - e.g., BMP or CALS • Can be SGML tagged - no page breaks (browser) • Access/index often C/NDI dependent with HyperText browser • Generic: C/NDI with HyperText browser	• Linear ASCII with SGML tags • SGML with content vice format tags • Maximum use of Mil-PRF-87269 • Generic: SGML tags equivalent to Mil-PRF-87269 tags	• Fully attributed database elements (Mil-PRF-87269) • Mil-PRF-87269 content tags with full conformance with Generic Level Object Out-lines (architectural forms) • Authored directly to DB for interactive electronic output • Data managed by a DBMS • Interactive features authored-in vice added-on • Generic: C/NDI has Mil-PRF-87269 data definition/tags	• IETM info integrated at the data level with other application info • Does not use separate databases for other application data • Identical to Class IV standards for IETM applications data per Mil-PRF-87269 • Coding for Expert Systems and AI modules when used • Generic: C/NDI has Mil-PRF-87269 data definition/tags
FUNCTIONALITY	• Access pages by intelligent index/ header info • View page with pan, zoom, etc tools • Limited use of hot-spots • Useful for library or reference use	• Browse through scrolling info • User selection of graphics or hot-spot reference to more text • Hot-spot and cross-reference usually added after original authoring	• Dialog-driven interaction • Logical display of data in accordance with content • Logical NEXT and BACK functions • Useful as interactive maintenance aid • User-selectable cross-refs and indices • Content specific help available	• Dialog-driven interaction • Logical display of data in accordance with content • Logical NEXT and BACK functions • Useful as interactive maintenance aid • User-selectable cross-refs and indices • Content specific help available	• Single viewing system for simultaneous access to multiple info sources • Same as Class IV for IETM functions • Expert system to assist in NEXT functions, based on info gathered in session

CHAPTER 4
ACQUISITION OF IETMS

4.1 Introduction

The general philosophy of IETM acquisition is to procure, as a minimum, a Class II IETM in a format such as SGML or Indexed PDF. (Refer to Appendix A for detailed information about SGML and PDF.) The preferred option is to procure standard SGML tagged IETM data that are optimally structured to create survivable data in revisable and economically maintained databases by sharing common objects. This philosophy is a key element in the migration toward the DoD's Integrated Data Environment (IDE). The IDE is a dynamic data environment in which all users draw from a common virtual database containing data maintained by an unlimited number of Government or commercial service providers. A shared information environment providing immediate access to digital data supports the IDE. An IETM may also be procured as a logistic support product under a major weapon system or equipment buy, as a separate item under its own contract to support new equipment, or as a conversion.

4.2 IETM Acquisition Process Phases

Figure 4-1 shows the general phases involved in the IETM acquisition process.

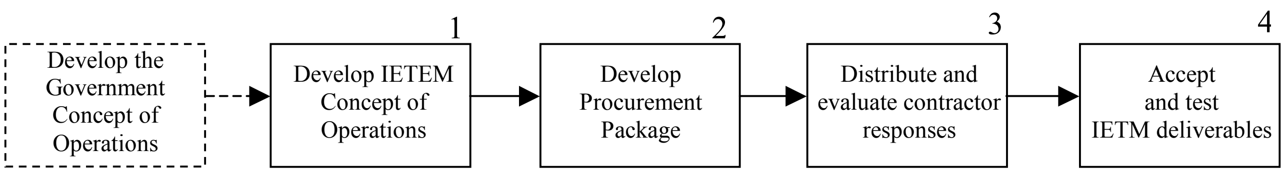


Figure 4-1. IETM Acquisition Phases

Criteria for the digital data infrastructure and implementation strategy of an acquisition program are included in the Government Concept of Operations (GCO). This document is a necessary precursor for the subsequent phases of IETM development. Both the GCO and the CONOPS (referred to below) are presented in detail in the next chapter.

4.2.1 Phase 1: Develop an IETM Concept of Operations (CONOPS)

Chapter 5 discusses the IETM CONOPS in detail. The document provides potential offerors with anticipated IETM support requirements of the proposed system. Users and the issuing program can evaluate the proposed IETM solutions against the support requirements. The CONOPS provides a common language, set of assumptions and point-of-departure for all Government and contractor participants in the process. It assists the program in ensuring that needed IETM resources are in place or that deficiencies are identified.

Even with new acquisitions, much of the technical data supporting the system already exists. The program decision to convert this data, usually to a standard digital format, involves a commitment of resources to accomplish one or more objectives to reduce costs and improve availability, productivity and quality. However, each of the Services is either involved in or has completed major conversion efforts that have involved digitization of existing TMs. Many of these are Class II IETMs in the form of Indexed PDF files or linearly structured SGML files. Prior to deciding to convert data, the Program Manager needs to determine whether the data has already been converted as part of these digitization efforts. The decision on the type of IETM to select is critical. Selection impacts cost of conversion, available functionality ability to maintain and update data, ability to interface and interact with other data files, and the ability, cost, and effort to migrate in the future to newer technology. A functionality decision model is presented in Figure 5-2 to assist the Program Manager in selecting the best conversion model for his or her program. Development of an IETM CONOPS is a critical first step in establishing the conditions within and under which the IETM will be expected to function. The act of preparing the CONOPS should raise and clarify issues and establish parameters. It is important to document the conditions and assumptions that were used to make the IETM selection decision and to help formulate an implementation strategy.

4.2.2 Phase 2: Develop Procurement Package

The IETM procurement process varies between Services. However, there is agreement that an IETM CONOPS must be developed prior to solicitation to ensure programs have properly planned for IETM definition, implementation and ongoing maintenance. Upon development of a program-specific IETM CONOPS, the Program Office will follow procurement guidance for its service.

4.2.2.1 Sample List of IETM Deliverables

The list of deliverables will vary depending on the Class of IETM being acquired. The following is provided as guidance only and is not intended to be a complete or approved list:

a. Technical Manual Schedules and Status Reports. In-Process Reviews (IPRs) should be held at the 30%, 75% and 100% completion milestones to ensure all parties have a common understanding of the final product.
b. Outline Book Plan or equivalent (will apply to either the hard-copy TM or IETM and defines the content and the structure of the TM).
c. Quality Assurance Program Plan.
d. Software Development Plan. This plan should specify all software, including the utilities procured or developed to convert, develop, test or verify the IETM being delivered. Examples of software include conversion filters, Java applets or ActiveX controls that increase IETM functionality, and helper applications that may connect the IETM to training modules.
e. The DTD (as accepted) and its final SGML tagged file, including:

   - Graphic images in MIL-PRF-28002 Raster

   - or -

   - Graphic images in conformance with MIL-PRF-28000 IGES

   - or -

- MIL-PRF-28003 Computer Graphic Metafile (CGM) series of performance specifications (note: audio, video, Expert Systems, and other externally linked files used within the Class IIIII IETM, or these same file types found within Class IV or V IETMs, are delivered in the runtime version of the IETM, as noted in item (h) below).

f. Any graphics that exist in vector format (vendor format).
g. Source publishing system file (vendor format) if other than that as described in item (e) above. This could be a Microsoft Word, Interleaf or PageMaker file.
h. Runtime version of the IETM. The file that has been processed through the IETM application software that would reside on media to be viewed by the user. This is to include all linked files in their compiled runtime format. This deliverable is not required if the runtime version is the same SGML used as described in item (e).
i. CD in accordance with the SOW.
j. Hard-copy fold-outs bound in a Supplemental Manual (if required).
k. Audio and video materials in mutually accepted formats and media. Popular file formats for video are .AVI and .MOV; animation files are typically .FLI or .FLC; audio files are either .WAV or .MID.
l. A PDF file (only for those IETMs that are able to provide hard-copy products for distribution).
m. Contractor IETM cost data.
n. Configuration Management Plan for the software and/or the data, as necessary.
o. Software Licensing Costs (for distribution in the user environment).

4.2.3 Phase 3: Distribute Procurement Package and Evaluate Contractor Response

Figure 4-2, the IETM Acquisition Process Model, illustrates the process of distributing an RFP and evaluating contractors' IETM proposals. The figure also illustrates what the Government and contractor must provide in the acquisition of IETMs.

The IETM Acquisition Process Model below contains two acquisition process scenarios. Steps 1 through 6 plus 16 and 17 identify the process of acquiring an IETM only. Steps 1 through 17 identify the overall IETM acquisition process when it is included as part of a larger system procurement.

Step 1: An IETM CONOPS is developed by conducting a data call in accordance with DoD 5010.12M during the acquisition planning process. The data call is used to gather and define the IETM requirements from the appropriate Logistic Managers. Note that the IETM CONOPS will include a list (including the scope) of all relevant software licensed for use by the program. It will also require that the contractor stipulate the software packages selected and the anticipated total costs, including procurement of additional licenses for Government technical management, reviewing activities and users. Note also that IETM requirements are a small portion of the total system Request for Proposal (RFP) (refer to Chapter 5 for more information on IETM CONOPS.)

Step 2: The RFP and IETM CONOPS are released to bidders.

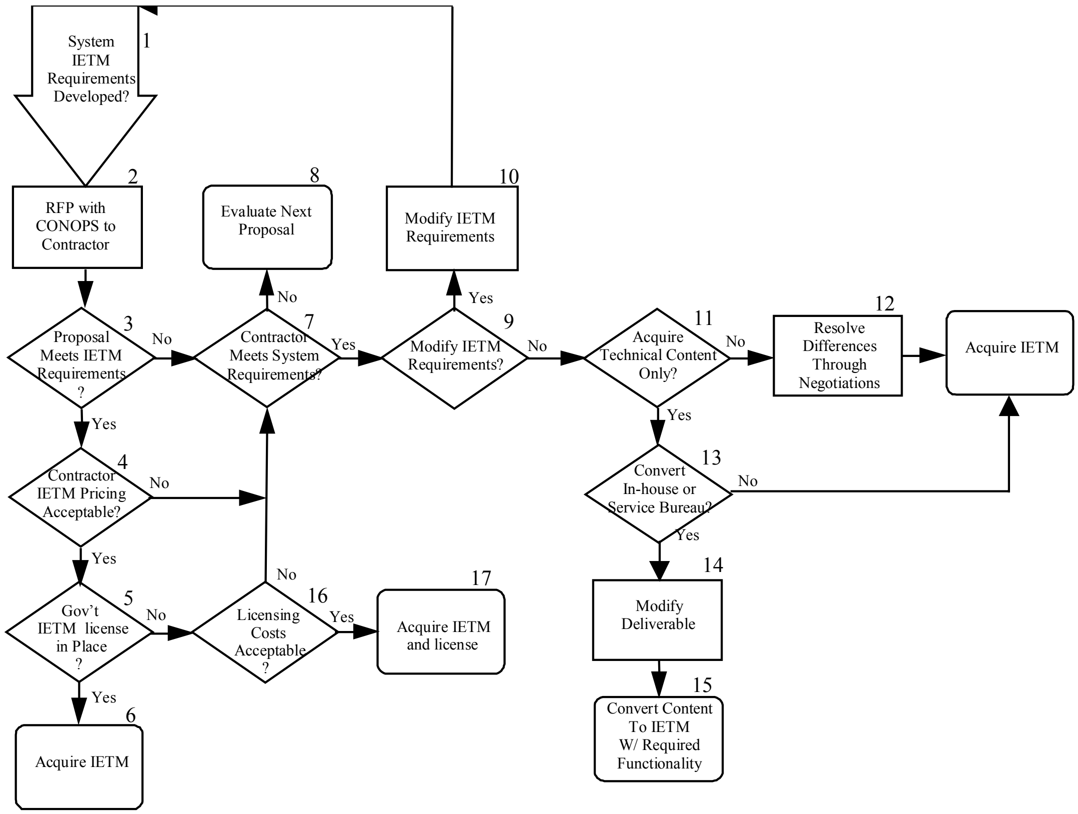


Figure 4-2. IETM Acquisition Process Model

Step 3: Contractors' proposals are received and evaluated against the IETM requirements.

Step 4: If a contractor’s proposal meets all IETM functional requirements, determine whether the IETM development costs are acceptable.

Step 5: If proposed IETM costs are acceptable, determine whether the contractor has addressed using IETM software that is currently licensed to the program. The contractor may select IETM development software that is currently licensed by the program or a specific Service. If not, the contractor shall determine and acknowledge the costs to the program to obtain appropriate licenses for the contractor’s selected IETM software. This should specify costs for acquisition and life-cycle use by users identified in the IETM CONOPS.

Step 6: Acquire the IETM.

Step 7: The program must evaluate whether the contractor satisfies minimum hardware system requirements prior to proceeding further within these steps.

Step 8: If the contractor does not satisfy proposed system requirements, note this appropriately and evaluate the next proposal.

Step 9: If the contractor does not satisfy IETM requirements but does meet system requirements, the program may consider whether IETM requirements are reasonable and justified or warrant modification.

Step 10: If the IETM requirements are to be changed, modify the RFP to incorporate the new IETM requirements with a modified CONOPS and distribute to the bidders.

Step 11: If negotiations fail to identify an acceptable IETM solution, the program can decide to acquire only the technical content in a non-IETM format.

Step 12: If the IETM requirements are not met and technical content only is not desired, resolve any differences through negotiations.

Step 13: If in-house or Service Bureau conversion of content into the required IETM is not desired, the contractor proposed IETM should be acquired.

Step 14: The program must delete the IETM runtime and possibly modify the other deliverables. If these delivery requirements are dropped, the contractor will be responsible for developing and delivering the technical content and providing the source and SGML files, but not developing the IETM end product.

Step 15: Once the content is acquired by the program, it can be converted (in-house or by Service Bureaus) into an IETM having the required functionality. SGML should be the data format in which the content is received. If not, both program and contractor should mutually agree to the format.

Step 16: Determine whether the IETM software licensing costs are acceptable, whether the software contractor's proposal meets program needs or provides significant features beyond those IETM tools currently in use; endorse the request to procure the IETM software.

Step 17: Acquire IETM and IETM software license. Acknowledge new IETM software licensing with appropriate Licensing Coordinator as identified in Appendices D, E, F or G. The central tracking of the various IETM software packages used throughout the Service can assist in achieving economies of scale with IETM vendors as well as helping identify what IETM software may be available to the program at no charge.

4.3 Phase 4: Acceptance and Testing of IETM Products

The TMCR describes the QA responsibilities of the acquiring program and of the contractor preparing the IETM. Included in the TMCR are the detailed descriptions of the QA products and processes to be performed in developing and accepting an IETM deliverable. Verify that the contractor has met all of the IETM functionality requirements through IPRs up to and including the final deliverable. Representatives from the user community (sailors, mechanics, technicians, subject matter experts) should be invited to review the product. Engaging the user throughout the IETM development process provides ample time for IETM product improvement.

CHAPTER 5
PRE-IETM DEVELOPMENT ISSUES

5.1 Introduction

Today's PMs face a dizzying array of issues when undertaking an IETM development program. Fortunately, processes exist which can assist the PM in determining the appropriate characteristics for the Program's IETMs. Two major processes (and resulting products), the Government Concept of Operations (GCO) and the IETM Concept of Operations (CONOPS), are addressed in this chapter.

5.2 GCO Development Process

The Defense Acquisition University has developed a GCO template, the GCO Generator, which is downloadable at http://www.acq.osd.mil/log/lro/toolkit/gco/gcointro.html, to provide a step-by-step tool that assists managers in selecting digital data for their defense systems. The GCO is a Government document that is used to provide information to potential offerors about the Government infrastructure and Integrated Data Environment (IDE) implementation strategy for defense systems.

The GCO planning process should start as early as possible in the acquisition process. This Government document is prepared during the acquisition planning stage for each procurement. Development of a GCO will help ensure that the Government can access or receive, via the IDE, the correct version and formats of digital data products needed to acquire and support a defense system.

The GCO can assist the Program Manager in determining:

a. Hardware and software systems the Government has, or is developing, to manage and use the data.
b. Data users, types of data, frequency of use, and timeliness of data access or delivery to each user.
c. Data use and the review/approval processes to support life-cycle functions.
d. User locations and their primary functions in support of the defense system.
e. Data interchange requirements including format, media, applicable standards, and existing telecommunications capabilities.
f. Access authorizations and restrictions.
g. Data acceptance requirements including data format, content, and the Government processes for accepting product data, processable data, or Contractor Integrated Technical Information Service (CITIS) data.

The GCO is developed by the Government acquisition team with input from other supporting Government activities involved in the life-cycle support of the defense system. The GCO should be included in the RFP (Section J) as Government Furnished Information (GFI).

5.3 About the Tool

The tool requires extensive input of program information dealing with the following:

- Program's supporting activities
- Data use and how it is used
- Infrastructure in place at each activity
- Activities' experience with the CALS standards and automated information systems

For a greater understanding of CALS, Joint Continuous Acquisition and Life-cycle Support (JCALS), and IDE, refer to Appendix B. This information can be analyzed by the software and used by the Program Manager to determine the requirements and data environment that will be described in the GCO. The GCO document is generated from a database of text based on actual GCOs, which is then tailored by the Program Manager to suit the program's requirements. The final output is either a digital or hard-copy version of the GCO document, including both the text and selected data tables.

The GCO Generator was originally developed in 1995 as a Navy software tool (version 1.0). The new version 2.0 is a DoD version that incorporates information from all of the services. Version 2.0 is not readily compatible with 1.0 because of many changes made to the GCO text database. Since a rewrite of the 1.0 version has been completed, any previously developed data should be regenerated with version 2.0 to produce the GCO text sections.

5.4 The GCO Process

The steps shown below are performed as part of the data collection, input, and analysis steps in the GCO Generator. This information is presented in MIL-HDBK-59B.

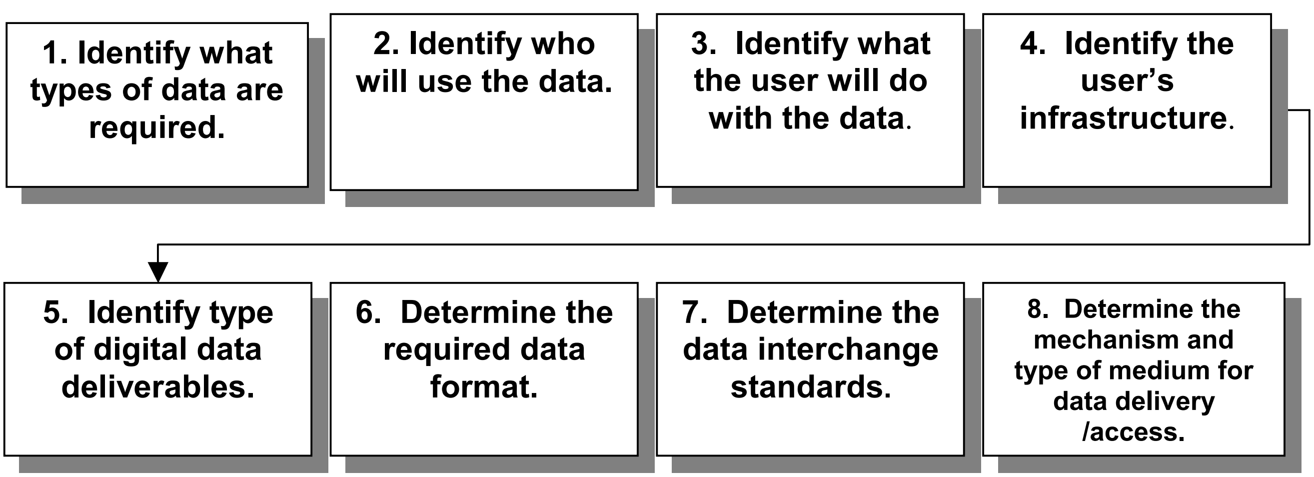


Figure 5-1. GCO Development Process

1. Identify what types of data are required
    - Product description data
    - Logistics plans and reports
    - Publications
    - Management and administrative data

2. Identify who will use the data
    - Management
    - Engineering/Design
    - Supply
    - Training
    - Manufacturing
    - Maintenance
3. Identify what the user will do with the data
    - View only
    - Comment/annotate
    - Update/maintain
    - Extract/process/ transform
    - Archive
4. Identify the user's infrastructure
    - Hardware
    - Software
    - Networks
5. Identify the type of digital data deliverables
    - Composed products
    - Processable data files
6. Determine the required data format
    - Document image file
    - Text file
    - Graphics file
    - Alphanumeric file
    - Audio/visual file
    - Integrated data file
7. Determine what data interchange standards are required
    - Document image standards
    - Text standards
    - Graphics standards
    - Application unique/data standards
8. Determine the mechanisms and type of media for data delivery/access
    - Hard-copy
    - Physical (magnetic tape, optical disk)
    - Online (CITIS)
    - Telecommunications (DISN, OSI, contractor specific)

5.5 Generator Process

This GCO Generator tool is designed to lead the Program Manager through the GCO development process, encompassing the following five steps:

- Data Collection. This step involves creation of a data collection survey that is distributed to supporting activities, preferably along with the normal data call information. This survey will gather information regarding the activities' infrastructure, data use requirements, IDE requirements, and experience with CALS standards and Automated Information Systems (AISs).

- Data Input. Once the surveys have been distributed, completed, and returned, all the data they contain is entered into a series of data tables. There is no requirement that data be entered into all the tables – only those that are needed by the program.

- Data Analysis. Data from the surveys is now analyzed to help determine the most common data formats and the overall experience with AISs (plus which ones to select for use by the program).

- CITIS Decision. Once the data has been analyzed, the Program Manager can determine whether or not and to what extent a CITIS should be implemented for the program.

- GCO Creation. After all the data is analyzed, writing the text of the GCO begins. The text contains five sections:

    1. Introduction

    2. CALS Implementation

    3. Data Requirements

    4. IDE Requirements

    5. IDE Infrastructure

After all these tasks are complete, the GCO Generator allows the preparer to view all the GCO text assembled on one form for final changes and then print the final, complete GCO.

5.6 Selection of IETM Functionality

Where the GCO assists the Program Manager in identifying the types (IETM, drawing packages, etc.) and the interchange standards (SGML, PDF) of digital deliverables, the IETM CONOPS assists the PM in determining IETM functionality. Therefore, after the decision to procure an IETM has been made, the IETM CONOPS should be developed. Whether acquiring new data or converting existing data for use in an IETM, the program must make key decisions in three areas:

a. Functionality - The features and capabilities that are desired to support users.
b. Standards - Government, commercial, performance or other specifications, standards, conventions, etc. that will be used to establish hardware/software interfaces and to ensure data neutrality, transportability, and survivability.
c. Data structure - The method for creating or assembling the data and effectively and affordably managing it throughout its life-cycle.

Each decision acts as an enabler, facilitator, or constraint on other decisions. The selection of functionality has critical impact on:

- Cost and time required for conversion
- Functionality available to the users
- Costs and ability to maintain and update the data
- Ability to interface and interact with other data files
- Ability, cost, and effort to migrate to newer technology in the future.

5.7 Concept of Operations (CONOPS) Acquisition and Support Planning Process

The first step in defining IETM functionality is to develop an IETM CONOPS. It is vital that the PM team preparing this document the many interacting factors, assumptions, and considerations that formulate an implementation strategy. This is done in the IETM CONOPS, which establishes the conditions within and under which the IETM will function. Preparing the CONOPS should clarify issues and establish parameters to help a manager select optimal IETM functionality levels consistent with program requirements. If IETM development is to be contracted out, the CONOPS provides key information to the bidders. Whether an IETM is being acquired as part of a new hardware system, or being converted under contract, the resulting CONOPS will be referenced in the Request for Proposal (RFP), Statement of Work (SOW), Statement of Objectives (SOO), or Work Order along with the environment within which the IETM will be developed, fielded, and used. Additionally, the SOO/SOW should include other information as required to help bidders prepare their proposals and assist the program staff in evaluating the responses to required and desired functionality requirements.

The decision on the optimum class of IETM can result from the accumulation of information from all of the factors in the CONOPS or from any single factor (e.g. remaining service life, complexity of the system). The decision also may be made solely to satisfy external factors (such as direction from higher authority, required interface with other systems or manning). Consequently, the CONOPS is not intended to be a “score sheet” with a weighted quantitative value for each factor and a “right” answer. Instead, it provides a “check list” of items to be included in the deliberative process to ensure that the cognizant manager is assisted in selecting the highest level of automation and best class of IETM for his or her program. New conditions, such as changes in training philosophy, budget reductions, program phasing, evolving functionality requirements, emerging technologies, etc., may require that the CONOPS and its associated decisions be reviewed and changed.

5.8 Role of the CONOPS

The IETM CONOPS guides the program in identifying and projecting the characteristics of the hardware system (whether already in the field or in process of acquisition) which the IETM will support. (A sample CONOPS for the fictional "Sagittarius System" is included as Appendix H). This helps to define the functionality of the supporting IETM.

- The IETM CONOPS helps programs define/plan the processes required for the life-cycle support of the IETM. The IETM Functionality Determination Model (Figure 5-2) uses system attributes data to determine the functionality required to support the intended IETM users. Interplay between items in the CONOPS and the decisions of this model may result in a number of iterations before the plan is finalized.

- Completion of the CONOPS provides a tailored document that highlights processes, issues, and considerations related to the successful implementation of IETMs in both program and DoD terms. When complete, the CONOPS will provide a common structured document that describes the anticipated factors and environment that affect IETM development and use.

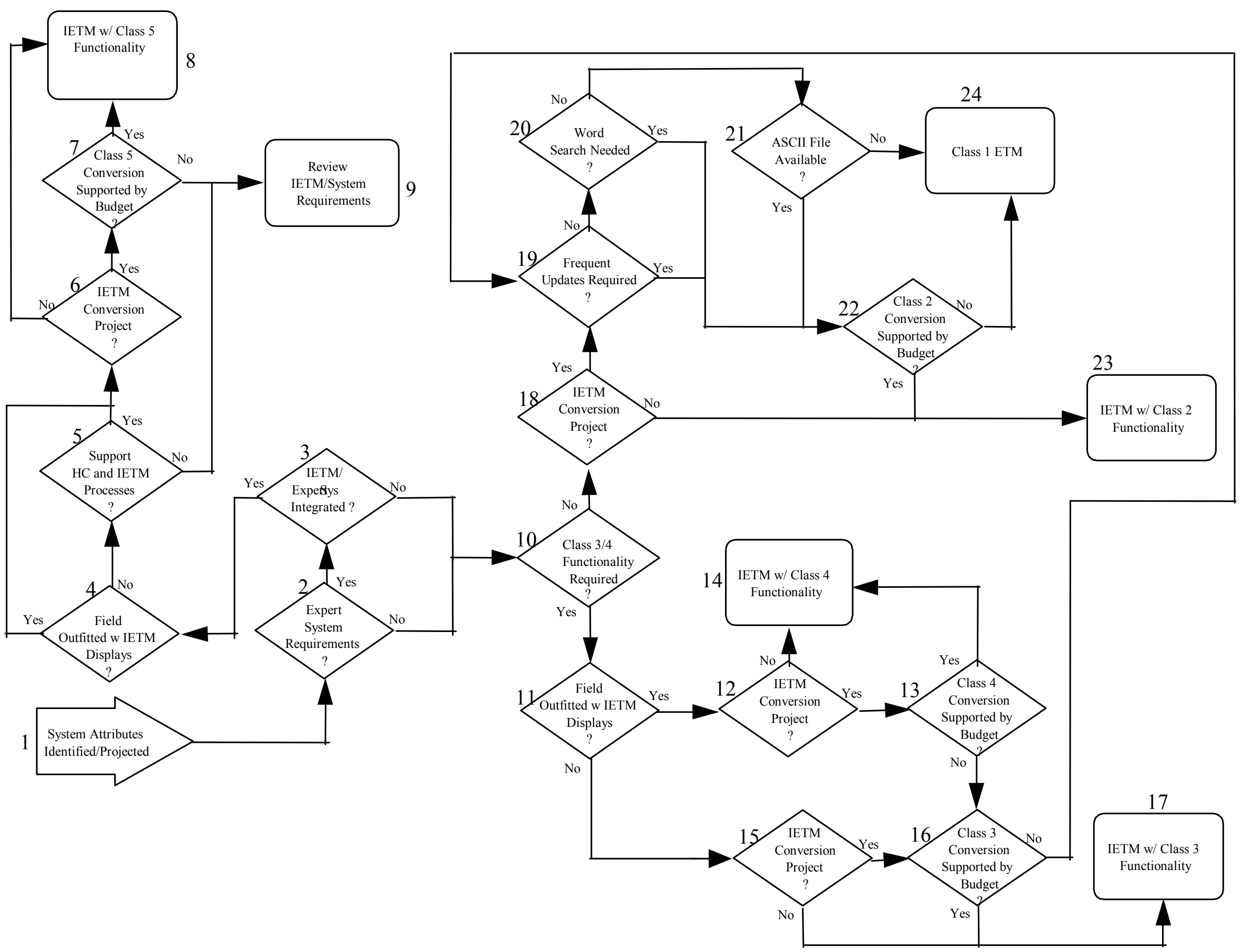


Figure 5-2. IETM Functionality Determination Model

- The IETM CONOPS will provide program personnel and bidders with a broad perspective of the range of factors and issues affecting their proposed IETM solution. The Government also will use the CONOPS to evaluate how well a bidder has understood and met the program's IETM needs. Development may be iterative. New conditions such as budget reductions, program phasing, emerging technologies and evolving functionality requirements may necessitate a review of the CONOPS and a reevaluation of some or all decisions.

- Finally, a key benefit of developing a CONOPS is that change is discussed as a part of the IETM development process. Factors critical to IETM success are highlighted in the CONOPS and monitored so that changes which impact IETMs can be quickly noted. This helps to ensure that a proposed solution is not overtaken or overwhelmed by events or technology. Decision processes are revisited and parameters adjusted, if necessary, to ensure continued success.

<u>Instructions for Figure 5-2</u>

Step 1: The program identifies or projects the attributes of the system or equipment as they relate to the IETM, as the first step in developing the IETM CONOPS.

Step 2: Does the user require an expert system? Expert systems capture and broadly share technical support, where minimal levels of technical support may be available. They provide the user with subject matter expertise that expands user levels of knowledge and detail, augments skills, and improves diagnostic and maintenance procedure accomplishment for complex systems. Training and foreign military support requirements should also be considered when evaluating expert system requirements. The following lists some examples of system characteristics that may require the use of expert systems:

- In a new design where the diagnostics and processes are clearly laid-out and ready for incorporation with an expert system.
- A highly complex system with complex troubleshooting or fault isolation procedures. The expert system keeps track of what has been done, what is next, other possibilities, etc.
- Critical systems needing reduced time from diagnostics to repair (e.g., flight line download and processing, online sensors connected to the expert system).
- Reduced maintenance cost from higher quality repair, reduced false return rates, “smarter” maintenance from system “learning,” more concise and accurate parts orders.
- Systems requiring supplemental training of all types.

Step 3: Is the IETM and/or the expert system to be integrated into the weapon system? Some systems have the operating systems available that can support the processing of IETM viewing software. This efficient use of computer processing capability minimizes the computer components required to support the IETM. Is it intended that the expert system be embedded within the IETM. If so, this may present additional hardware, software, and interface requirements. If integration of the IETM and/or expert system with the weapon system or embedding of the expert system within the IETM is not a requirement, Class V functionality can be achieved through an independent system interface. If the IETM does not need to be integrated, it can have a linearly structured database as found in Class I-III IETMs, which allows the entire TM to be printed for field and other users until all are outfitted with display hardware. The IETM display infrastructure must also consider any potential training and foreign military display support requirements.

Step 4: Is the user outfitted with display hardware, and are the display hardware maintenance processes in place to support these displays?

Step 5: If the user is not or has no current plans to be outfitted with the IETM display hardware needed, the program may adopt a less capable strategy that allows for continued production of hard-copy (HC) TMs.

Step 6: Is the IETM application a new acquisition or conversion of existing legacy TMs?

Step 7: The costs for conversion to Class I and II IETMs are fairly well understood because of each Service's TM digitization efforts, while the cost of conversion to the higher level Classes is still evolving. Management decisions on the granularity and level of indenture needed, will also significantly impact these costs. The Program Manager must decide whether the relatively high conversion costs for Class IV and V IETMs are offset by improvements in task performance and savings achieved in maintaining the database.

In addition to the system or equipment attributes discussed above, the following factors should be considered or emphasized:

- Periodicity of updates - More frequent updates will result in substantially more savings (cost avoidance) as compared with other IETM update processes.

- Configuration volatility – Object-oriented databases are very efficient in managing data in support of multiple configurations of complex systems. For fairly static systems, the advantages are less significant.

- Quantity of legacy data involved in support of the system - If a large amount of legacy data exists (e.g., greater than 500 pages), there is typically a lot of repeated data (e.g., WARNINGs, CAUTIONs, NOTEs, procedures, descriptions). Redundant data can also be significantly reduced with re-authoring. An object-oriented database provides the most efficient method to store, maintain, update and use this data.

- Cost reduction – With new IETM authoring tools being implemented in applications that require a significant reuse of data, it has been proven that IETM changes can be produced at 50% of the cost incurred in producing hard-copy changes using traditional publishing processes.

- Maturation – Object-oriented database strategy planning is a new field, with only a limited number of applications. There are still only a few Class IV and V IETM tools currently available commercially.

Step 8: Create an IETM with Class V functionality.

Step 9: If a Class V conversion is not cost effective when considering its benefits over the life-cycle, then the program must reevaluate the IETM/system requirements and optimize them to meet budgeting requirements. Programs should also consider implementing IETMs in a phased approach, which helps lower cost impacts over time.

Step 10: Do the contents of the manual(s) and the attributes of the hardware system support Class III and IV functionality? Several factors need to be considered to determine whether Class III or IV functionality is the most cost effective in support of the system. The following factors should be considered:

- quality of the data
- complexity of the system/equipment
- conversion costs
- system maintenance levels
- configuration volatility
- manning requirements
- training levels
- contractor and Government infrastructure

Step 11: Are there plans to deploy the IETM in the field? In particular, if the IETM is to be Class IV (object database), "print screen" may be the only printing option. As all data will be conveyed via the display hardware, it is imperative that the field have the appropriate display hardware and the support processes needed to maintain the IETM and IETM hardware in place. The IETM display infrastructure must consider any potential training and Foreign Military display support needs.

Step 12: Is the IETM application a new acquisition or a conversion of existing legacy TMs?

Step 13: Using the factors in Step 10, determine the costs and benefits of Class III and IV IETMs, and whether the budget will support a Class IV IETM conversion process.

Step 14: If program budgets support the conversion effort, convert the legacy data into a Class IV IETM by creating an hierarchical structure within an object-oriented DBMS using MIL-PRF-87269.

Step 15: Is the IETM application a new acquisition or a conversion of existing legacy TMs?

Step 16: If a Class IV functionality is not required, conversion is not cost effective, or the field will not be outfitted with display hardware in an appropriate time, then the program should determine whether converting legacy TMs into an IETM having Class III functionality is cost effective and affordable. The primary element of Class III IETMs is the use of view packages, which can emphasize specific subject matter content within the IETM and only present the user with data pertaining to the subject controlled by the view package. An IETM can have several view packages, each emphasizing a different subject (e.g., operator training, overhaul procedures, system overview). The user might also be able to select view packages for novice, intermediate, and expert levels that present or emphasize the data differently.

Step 17: If view packages are needed and affordable, convert the legacy TM into a Class III IETM.

Step 18: Is the IETM application a new acquisition or conversion of existing legacy TMs? If it is a new acquisition, the minimum functionality that should be procured is Class II.

Step 19: Determine if frequent updates to the TM are required. If so, an IETM having Class II functionality is preferred over Class I.

Step 20: Determine whether the ability to perform "word searches" would significantly benefit the user. This benefit must be weighed against the cost to convert the hard-copy into ASCII or other neutral format such as PDF, plus the cost of proofing the resultant file to ensure that it accurately represents the hard-copy. If it is determined to be cost effective, an IETM having Class II functionality is preferred.

Step 21: If a digital file of the legacy TM is available, the program should convert the legacy data into an IETM having Class II functionality. The cost to convert existing digital files into IETMs having Class II functionality is well worth the expense, by being able to use an automated publishing system to update information, as well as giving better navigational features (word search, links, etc.) to the user. Note that each of the Services has already completed major TM digitization efforts that have resulted in either Class II IETMs or files easily convertible to Class II.

Step 22: If Class II IETM cost of conversion can be supported, convert the data into an IETM having Class II functionality.

Step 23: Convert the legacy data into, or acquire the IETM having Class II IETM functionality.

Step 24: If Class II IETM cost of conversion cannot be supported, convert the legacy TM into a Class I IETM.

5.9 Inclusion in the Statement of Work/Objectives (SOW/SOO)

The information presented in the CONOPS is not intended to be exhaustive, but should include the primary management considerations when deciding a program's optimal IETM level. Whether an IETM is being acquired as part of a new hardware system or being converted under contract, the resulting CONOPS will be referenced in the SOW/SOO along with the environment within which the IETM will be developed, fielded, and used. Additionally, the CONOPS should indicate other information that helps bidders propose their systems and, in addition, helps the program staff evaluate the responses to the required and desired functionality requirements. Do not substitute detailed descriptions and/or "laundry lists" of highly desirable or mandatory features for firm requirements. This may restrict all bidders to a solution that may or may not be optimal or that unnecessarily drives up the cost of the proposed solution. Where the program has decided on specific features, functionality or characteristics that are required to support various aspects of the system, they should be reflected in the SOW/SOO and Technical Manual Contract Requirements (TMCR).

5.10 CONOPS Development

Development of the CONOPS involves analysis of the hardware or weapon system being supported, determination of the functionality required by the users of the system, and consideration of a variety of other factors that will be documented in separate paragraphs of the CONOPS. The following paragraphs suggest a sequence in which applicable subjects are covered in the CONOPS and describe what those paragraphs need to contain. Other paragraphs or information that are deemed relevant to the common understanding of the system and its operating environment, the IETM and its operating environment, and/or any unique conditions may be added. Use the outline below as a guide to develop your CONOPS.

1. Weapon System/Equipment Attributes and Factors Influencing or Dictating Functionality
2. IETM Functionality Determination
3. IETM Implementation Schedule
4. Urgency and Frequency of Information Update
5. DTDs and FOSIs
6. Graphics
7. Links to Other Information Resources
8. Security
9. IETM Licenses
10. Development of IETM View Package Requirements
11. Technical Manual Identification Number
12. Deficiency Reporting Process
13. Media Identification Labels
14. Building CD-ROM Deliverables
15. Display Hardware, Operating Systems and Networks
16. Environmental Conditionals and IETM Display Hardware
17. Display Hardware, and Software Maintenance and Support

CHAPTER 6
CLASS CONVERSION MODELS AND PROCESSES

6.1 Introduction

Although it is not incumbent upon acquisition managers to understand the intricate details involved in developing an IETM, they should become familiar at a top level with the decision making process required to field an IETM. This section has been extracted from the Draft IETM Process Plan as a guide through the steps to convert legacy data to IETM format or to prepare for a new IETM development program.

6.2 Conversion Decisions

The program decision to convert data, usually from hard-copy to a digital format, involves a commitment of resources to reduce costs and to improve availability, productivity, and quality. Although the IETM CONOPS is generally associated with a new acquisition, many of the issues and decisions confronting a manager are the same for a conversion project. This section provides information and considerations on converting data from an existing legacy (generally hard-copy or basic word processing format) to an acceptable digital format with functionality that will benefit the user. It also presents a functionality decision model that will assist the cognizant manager in selecting the best conversion model for his or her program. This is the critical first step in developing an IETM CONOPS, which will establish the conditions in which the IETM will be expected to function.

While reading this section, keep in mind that each of the Services is either involved in or has already completed major technical data conversion efforts. These efforts primarily encompass conversion from hard-copy (paper or aperture cards) to either Class I (raster) or Class II (Indexed PDF) formats. Therefore, any conversion required by the program would typically be from one of these formats to a higher level of IETM and not from the original data format; e.g., instead of having to convert from paper to a Class IV IETM, the data would be converted from a Class II to a Class IV IETM with an associated reduction in conversion cost.

Figure 6-1 provides a general overview of the process for converting legacy TMs into IETMs. The decision on what type of IETM to select is critical, as it impacts cost of conversion, functionality available to the user, costs and ability to maintain and update data, ability to interface and interact with other data files, and the ability, cost, and effort to migrate to newer technology. Note that Figure 6-1 represents the IETM phases for conversion to the preferred SGML-based IETM. However, if the data is to be converted to PDF/IPDF (Indexed Portable Document Format) format, the only relevant question is whether the legacy data is in digital or hard-copy format. The two options are:

a. Data in digital format (e.g., ASCII or native file format) - Output directly to PDF format.
b. Hard-copy - Scan in the data and then either run the Adobe Acrobat Capture program to convert directly to PDF format, or run an Optical Character Recognition (OCR) program to convert it to a format that can be processed (e.g., word-processing). At this point, convert it to PDF/IPDF.

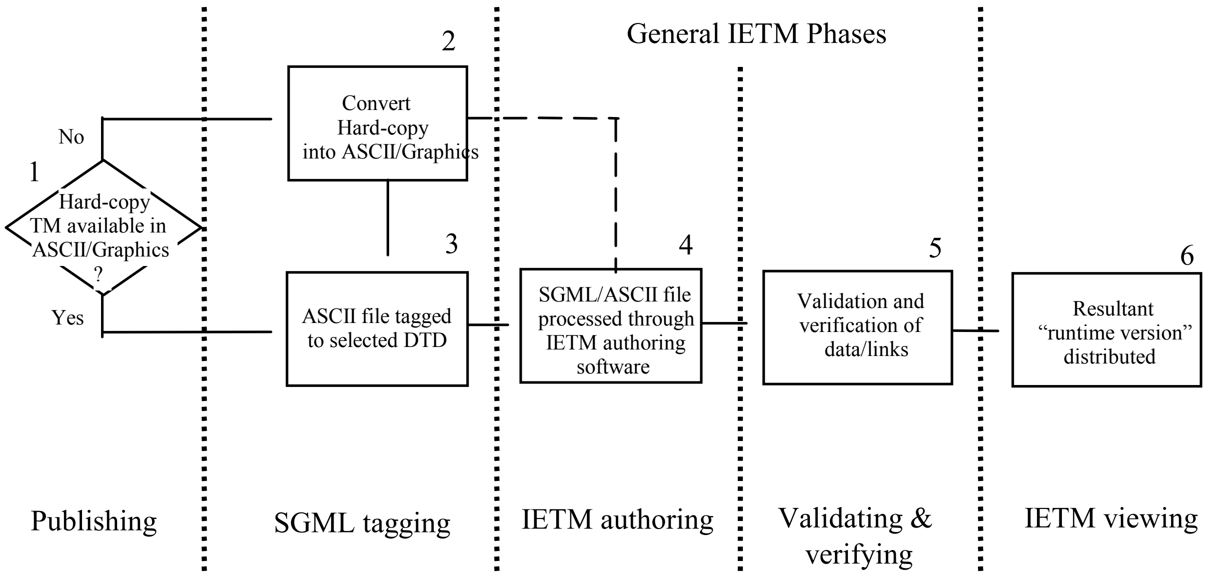


Figure 6-1. IETM Conversion Process

Step 1: If the ASCII file including digital graphics (typically from a publishing or word processing system) of the TM can be obtained, the cost of converting and proofing can be avoided.

Step 2: If ASCII is not available, the existing TMs must be converted from hard-copy into ASCII text using OCR software, and graphics can be taken in various vector or raster formats. In some cases the capability exists to go directly from the ASCII files into the authoring software, as indicated by the dashed line from box 2 to 4 in Figure 6-1 above.

Step 3: When IETM development is contracted out, SGML tagged data should be acquired to provide the program with the benefits described in the CONOPS. Most IETM software tools allow commercial publishing formats to be processed directly through the IETM authoring software. Programs acquiring the data in this manner must be careful not to become locked into a single contractor or vendor product as the only source capable of maintaining the IETM database.

Step 4: The SGML/ASCII data is processed through an "IETM authoring software" to provide the features that the program determined it needs to support its system.

Step 5: Conversion may result in data errors. The data must be revalidated and reverified to ensure that the converted data file is an accurate representation of the original. Where the conversion is from hard-copy to ASCII, the verification is straight-forward. However, where the conversion includes linking, processing, dividing, re-authoring or replacing data (e.g., with video), an engineering certification must occur. It will follow the normal TM validation and verification processes.

Step 6: The result of IETM authoring software, a "runtime" version, may be a proprietary file that can be viewed only through vendor proprietary software. To avoid this problem, the acquiring program should obtain an SGML or commercial format file which is compatible with its own TM support infrastructure. There are some IETM viewing software packages that use the native SGML file in the viewer and therefore eliminate any proprietary concerns. Distribution may be on CD, other electronic media or across the Internet.

6.3 Legacy Conversion Processes

6.3.1 Raster Conversion Process

While some conversion from hard-copy to raster may continue to be required to update existing raster manuals, it is being phased out for new conversion efforts.

6.3.2 Service Conversion Efforts

All of the Services are currently involved in the conversion of drawings and documents into digital formats. Descriptions of Air Force, Navy, Army and Marine Corps efforts are provided in Appendices D, E, F and G.

6.3.3 Class II Conversion Model

Figure 6-2 describes the general process involved in converting a hard-copy TM into a Class II IETM. TMs can be converted to Class II from existing legacy hard-copy TMs or they can be acquired as Class II source data from the authoring contractor or Government activity. Acquisition involves a slightly different decision-making process than conversion and has been described in detail in Chapter 4 of this document. As with Class I, development processes exists that may relieve the program of many conversion costs.

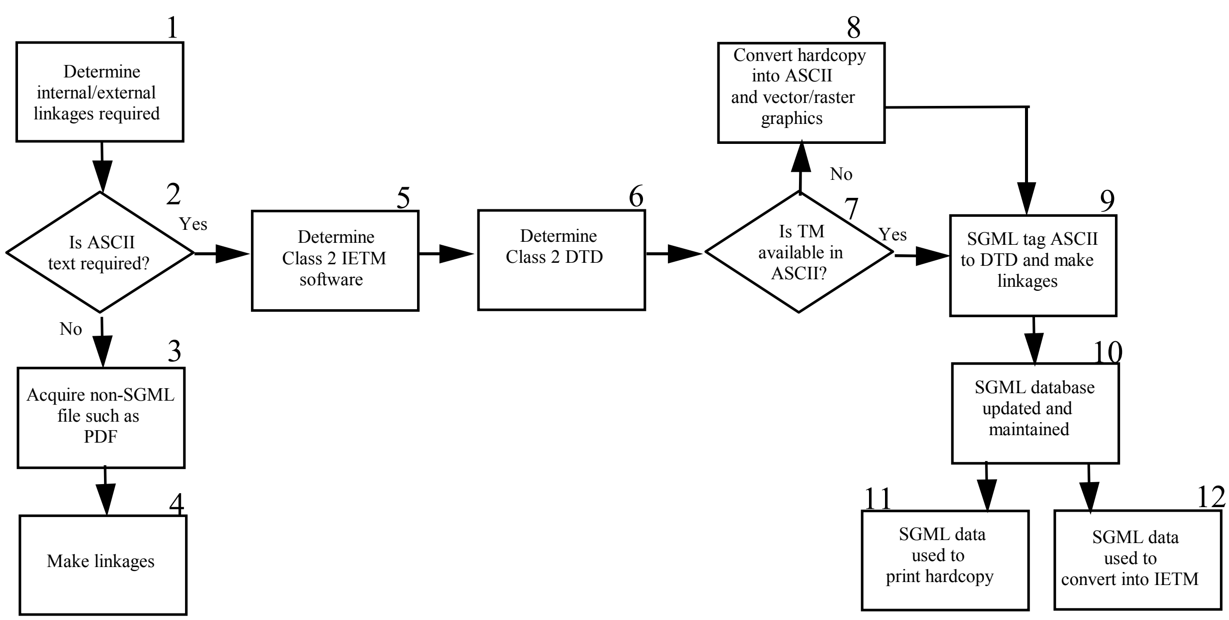


Figure 6-2. Class II IETM Conversion Process

Step 1: Determine required linkages. They enable the user to select a desired item of data by having the IETM locate and present data to the user. The front matter (e.g., table of contents, lists of figures or tables) are examples of specific items of data that are linked with their respective location in the body of the IETM. Other examples are: parts lists that can be linked to the IPB; hazardous chemicals that can be linked to warning statements; and textual references that can be linked to tables, figures, and drawings. Evaluate which optional linkages best support the user in accessing information from the IETM. Optional linkages can be initiated by the user selecting an item within the IETM that links to external programs such as audio, video, an expert system or special applications. The CONOPS contains a table that allows the program to identify the type of linkages that are to be applied to a given subject.

Step 2: Is ASCII text required? If the TM has significant change activity, then the cost of an Optical Character Recognition (OCR) can be offset by the savings incurred by being able to update and change an ASCII file.

Step 3: If ASCII text is not required, arrange to convert to a non-SGML format such as PDF which can be further processed into an IETM having the functionality of a Class II IETM by adding an index and hyperlinks. Note that PDF cannot be edited; therefore, the activity producing the PDF file has the only files that can be edited. Programs should always have an editing capability by acquiring PDF files with the source files that produced the PDF. PDF files can either be created from the word processing or other software used to create the original TM or they can be generated as an output of the scanning process.

Step 4: Incorporate the required and optional linkages determined in Step 1 into the PDF or other selected file format.

Step 5: Determine which software licenses are held at the implementing activity and whether any experts are available to advise on how to properly implement the IETM software. If software has not been licensed for use by the implementing activity, the acquisition of software should be initiated. Chapter 4 outlines the steps to be followed in procuring IETM software.

Step 6: Determine which Document Type Definition (DTD) will be used by evaluating the structure and the content of the data that is to be SGML tagged. DTDs and the software selected must also be compatible. Existing DTDs must be used whenever possible. Appendices D, E, F, and G explain how to obtain those official DTDs that are registered with each Service.

Step 7: Determine the availability of the TM in ASCII and the graphics in raster or vector format.

Step 8: If an ASCII file of the TM does not already exist, the hard-copy TM should be converted into ASCII. The hard-copy graphics should be converted into raster or vector formats depending on whether they need to be modified. Raster graphics can be edited using "draw" type programs. Complex or precise drawings become more difficult to raster edit and benefit from conversion to a vector format using vector graphics software. The cost of conversion or redrafting to vector formats may be significant and the use of the software requires more training, but subsequent costs of updating the drawings and graphics will be greatly reduced. Most IETM software tools allow commercial publishing formats to be processed directly through the IETM authoring software. Note that all conversions should be validated or certified by the appropriate authority.

Step 9: The selected DTD and defined linkage requirements can be used to SGML tag the ASCII and graphic files. Where the SGML tagged file is to be used to produce the hard-copy TM, any supplemental data that is presented as audio or video enhancements to the IETM must also be tagged and provided for the printed text. Optional linkages must also provide a textual identification of the destination link (e.g., a reference TM, program, database). Paragraph numbers must be consistent in both the hard-copy and IETM to facilitate easy user reference between the two products. If this is done, the SGML file can be processed into a hard-copy publishing system that ignores all audio and video tagged files when composing and printing.

Step 10: The resultant SGML tagged database is the source file. All changes are made to this single source file to keep configuration control as simple as possible. Using the SGML file as the source file requires an SGML authoring system or an SGML input/output filter to an existing publishing system.

Step 11: The SGML data is composed into a publishing system for hard-copy printing. There is no Formatting Output Specification Instance (FOSI) used in this process. The printed hard-copy will contain the same information, but may not have page integrity to the IETM.

Step 12: Foresight in developing the SGML file will allow the same SGML file to be used for both hard-copy printing and electronic display. The SGML file is processed through "IETM authoring software" that produces an IETM runtime file, which is then distributed via CD, other digital media or the Internet.

6.3.4 Class III Conversion Model

The Class III conversion process, Figure 6-3, is the same as the Class II process with one notable difference: Class III IETMs have view packages that enable the viewer to present only selected data from the IETM to the user. It should also be noted that an object-oriented database can be used here without having it integrated into the IETM itself. The creation of view packages is accomplished after the conversion and SGML tagging of the data. As with Class II, foresight must be used in generating the SGML tagged data to ensure that any audio or video information is represented by text and graphics in the hard-copy TM. Note that PDF files are not currently appropriate for use as Class III IETMs because they cannot utilize view packages.

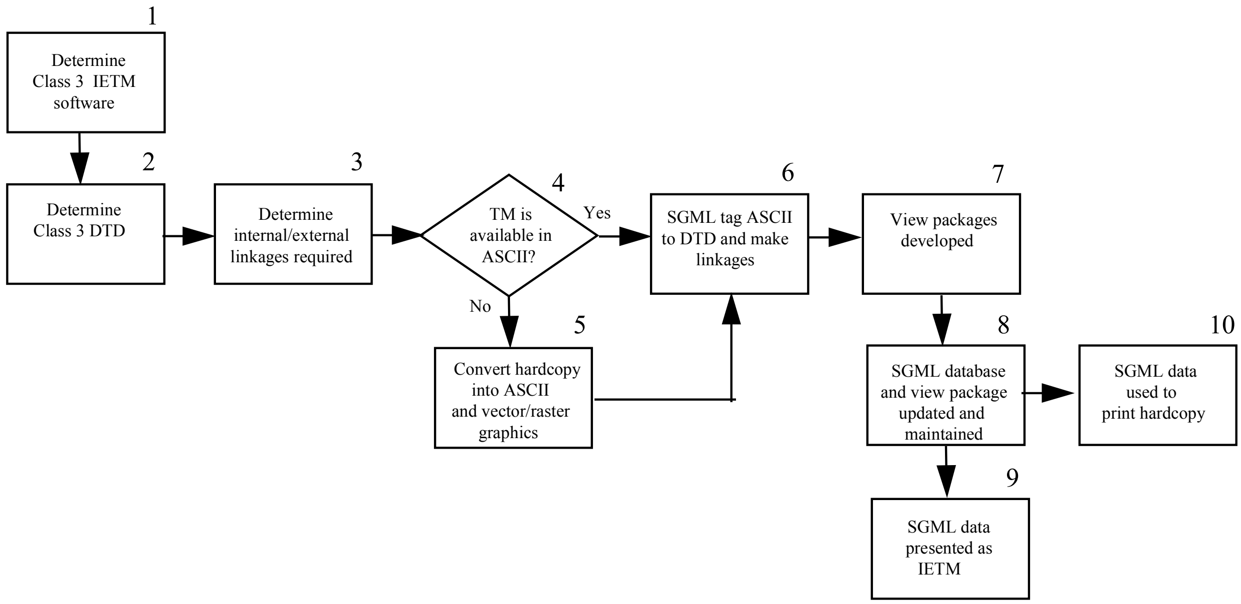


Figure 6-3. Class III IETM Conversion Process

Steps 1-6 Same instructions as the corresponding steps 1-2 and 5-9 found in paragraph 6.3.3 Class II Conversion Model.

Step 7: View packages are developed using IETM software tools.

Step 8: The resultant SGML tagged database is the source file. All changes are made to this single source file to keep configuration control as simple as possible. Using the SGML file as the source file requires an SGML authoring system or an SGML input/output filter to an existing publishing system. All changes to the source data must be validated to determine whether they affect primary, secondary or even tertiary linkages in the view packages.

Step 9: Foresight in developing the SGML file will allow the same SGML file to be used for both hard-copy printing and electronic display. The SGML file would be processed through "IETM authoring software" that produces an IETM runtime file. The runtime file along with other files are then written to distribution media.

Step 10: The SGML file can be used to print hard-copy TMs by processing it into a publishing system. As the SGML file will have surrogate text and graphics that represent the audio and video material used, the publishing system should be set up to ignore all audio and video tagged files when composing and printing.

6.3.5 Class IV Conversion Model

Figure 6-4 shows the process for converting legacy data into a Class IV revisable database format. While Class IV IETMs provide significant savings in maintaining and updating the data, the costs of conversion are currently high. These costs are due to the re-authoring of the legacy data to take advantage of Class IV functionality. The major costs of conversion are based on the following required tasks:

a. Developing the hierarchical structure
b. Re-authoring the legacy TM to prepare data for use in a database
c. Selecting the level of granularity and indenture for decomposing each section
d. Re-authoring and clean-up to eliminate repetition and redundancy
e. Adding photographs, animations, movies, verbal instructions, and other supplemental enhancements
f. Naming common and unique data objects and linking them into a logical presentation
g. Validation of the re-authored information

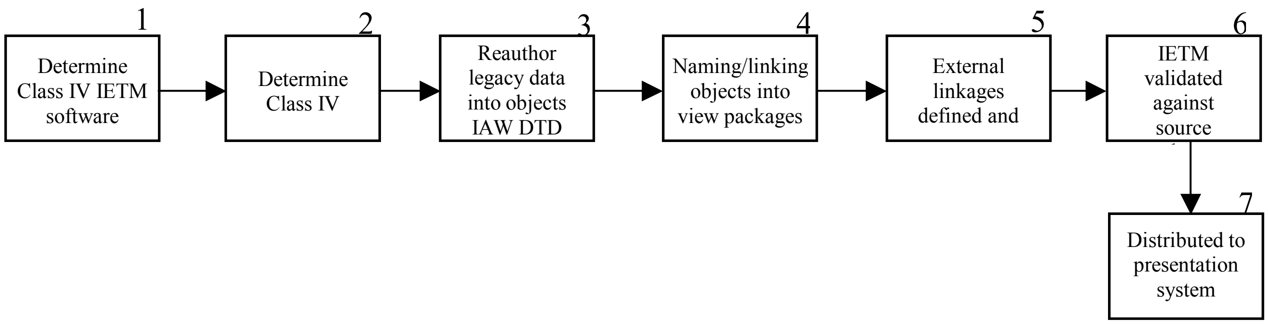


Figure 6-4. Class IV IETM Conversion Process

When Class IV IETMs are created from scratch, the level of indenture and granularity of the data is optimized at the lowest or smallest level (i.e., individual steps). For conversions, the costs of driving all TM data down to this optimal level may be prohibitively high. However, this is not the only logical option. Class IV IETMs can be developed with the objects being roughly the same size as comparable objects in Class III IETMs (e.g., one paragraph or a procedure). By minimizing the handling of the objects and substantially reducing the re-authoring desired or required, the conversion costs can be reduced to the same range as Class III. This IETM would have the presentation features found in a normal Class IV IETM, but would not be as robust. This compromise retains some redundant data, sacrifices some database maintenance efficiency, requires more update effort, and reduces some flexibility. While some of the data may always remain in its initial conversion state, the program has the option of incrementally re-authoring specific sections of the TM (e.g., troubleshooting) down to the appropriate level of indenture (e.g., step). These decisions can be made on the basis of specific maintenance needs, and funds available.

Step 1: Determine what authoring and presentation software licenses are held at the implementing activity and whether experts are available to assist in implementing the IETM software. If software is not licensed for use by the implementing activity, the acquisition of software should be initiated.

Step 2: Determine the DTD to be used by evaluating the structure and the content of the data to be SGML tagged. Existing DTDs must be used whenever possible.

Step 3: Reauthor source data, creating objects of information in accordance to the selected DTD. Eliminate repeated and redundant data. Create objects and linkages that allow these objects to be referred to many times. Complex or precise drawings become more difficult to raster edit and would benefit from conversion to a vector format, using vector graphics software. The cost of conversion or redrafting to vector formats may be significant and the use of the software requires more training, but subsequent costs of updating the drawings and graphics will be greatly reduced. Some common hybrid processes allow vector overlays of changes to raster graphics, thereby allowing the use of vector graphic tools and precision without the cost of complete drawing conversion. Note that all conversions must be verified by the appropriate authority.

Step 4: Name these objects to enable the authors to identify the object subject matter content. The named objects are used to create and tailor presentations (view packages) to subject matter requirements. Tailoring can be done to many presentation criteria such as training, user knowledge levels, system configuration, subject emphasis and overviews.

Step 5: Determine the linkages that best support the user in accessing information from the IETM. Internal linkages enable the user to select a desired item of data and have the IETM locate it from within the IETM data file and present it to the user. Some examples of linkage are: parts lists to the Illustrated Parts Breakdown, chemical names to warning statements, and text references to tables, figures and drawings. Desired external linkages should also be identified. External linkages can be initiated by the user selecting an item within the IETM that links to external programs such as audio, video, an expert system or special applications.

Step 6: Have the appropriate authority validate the complete IETM against the source data to ensure that the same content has been conveyed using the Class IV IETM functionality.

Step 7: Once validated, the IETM can be written to the distribution media with associated files as required.

6.3.6 Class V IETM Migration

The formal Class V IETM consists of a Class IV IETM which shares an integrated database with other associated applications. Consideration should be given to the data configuration issues entailed when multiple logistics databases are integrated into a single database. The decision tree in the CONOPS provides the model for determining whether formal Class V functionality is needed.

CHAPTER 7
THE FUTURE OF IETMS

7.1 Introduction

Since the advancement of technology does not stand still, neither will the development or application of IETMs. New, more cost effective methods for legacy conversion will be developed, faster computers and better monitors will permit a wider range of multimedia use, and users will demand real time access to data. As more and more information systems are fielded by the military, the user will eventually have access to a completely integrated operation that includes training, parts ordering/requisitioning and expert systems.

Responding to an increasingly likely scenario that future military operations will consist of joint missions and in which one Service might be required to repair another Service's equipment, DoD formed the Tri-Service IETM Interoperability Committee. The committee was tasked by the Joint Commanders Group for Communication and Electronics (JCG-CE) to develop guidance and policy to accomplish the following:

- Develop a uniform approach for electronically communicating and accessing technical data throughout DoD

- Maximize the use of C/NDI technology in the process

- Develop a common user information interface for field delivery systems

The committee is composed of representatives responsible for IETM policy from each of the services, and contractors with extensive experience with IETM development. It is important to point out that the committee is concerned in user interoperability, not data interoperability. (Data interoperability, basically implementation of MIL-PRF-87269, is being addressed by another IETM committee.) The committee meets on a bi-monthly basis and is conducting a DoD study to develop a solution for the JCG-CE and other IETM development and delivery issues.

7.2 Objective of the Study

The objective of the DoD study has been to create a high-level Joint IETM Architecture (JIA) to guide and standardize IETM acquisition, management, and display. This architecture will:

a. Enable maximum interoperability in the use of technical information to meet the needs of the Defense Logistics community in supporting the material readiness of the military.
b. Serve as the basis for a formal DoD-wide adoption of the proposed approach in promulgating the required acquisition and field-support policy. To reduce the risk of implementation and to demonstrate utility of the approach, the policy recommendations are based on a series of FY99 pilot demonstration programs that will show the applicability of the Architecture to support IETMs for the whole spectrum of military systems.

7.3 Goal for the Architecture

The primary goal for the JIA is to establish a technical framework for acquisition and deployment of the whole spectrum of ETMs. When completed, the user will be able to view and utilize technical information distributed to the work location through a common user interface, no matter what the authoring source or data format. In so doing, the DoD will be able to establish a unified approach to the acquisition, management, and use of existing and newly procured IETMs.

To meet this goal, the overall approach will be based on maximum use of existing Commercial/Non Developmental Items (C/NDI), the Internet and World Wide Web technology. Another goal is to achieve end-user-level interoperability of the IETMs delivered to and used by the entire DoD Operational Community. In this context, an ETM or IETM is defined as having end-user interoperability when it can enable a user with one common, commercially available display device, (such as a portable personal computer) to:

- View and interact with technical information from any source and of any internal format.
- Automatically access and view, by means of an electronic-link reference in the displayed technical information, additional information in any other ETM or IETM.

7.4 Technical Approach

The overall concept of this JIA effort is to utilize the group of emerging technologies that the commercial marketplace is rapidly adopting as the standard for distributable electronic documents, which are, in general, based on the technology of the Internet and the World Wide Web. For security and operational reasons, the DoD will not utilize the public Internet or the World Wide Web, but will employ essentially the same technology and C/NDI products in a private and dedicated DoD intranet environment. Such an approach is becoming the de facto standard for corporate information distribution systems worldwide. Once this approach has been proven effective, a set of implementation-guidance documents and performance specifications will be developed within this comprehensive, DoD-wide, commercially supported framework.

A major objective of the JIA effort is to demonstrate user interoperability of proprietary and legacy IETMs. This will be accomplished by encapsulating them into a common view package format, which can be electronically distributed to DoD intranets and eventually viewed by a user employing a single interface (i.e., browser). This process is referred to as "object encapsulation." Such a demonstration will require the establishment of the following technical capabilities:

- An authoring framework to effectively create and manage IETM view packages for delivery to the Government, regardless of which authoring tools are used.
- An infrastructure that permits a military agency to distribute, manage, and deliver these IETM view packages.
- A methodology for the user to access and view the required technical information and to retrieve relevant data from other IETMs, including those of other Services, as necessary.

In order to achieve interoperability, the interface requirements recommended for the JIA will be specific, but they will be constructed so as to encourage innovative and effective solutions, especially in light of the constantly expanding technology base. Achieving this balance has required some decisions that may need to be reexamined over time. Whenever possible, the design will adhere to open standards and/or de facto Internet standards widely implemented by multiple vendors, with clear intent to maximize the use of commercially available software products.

7.5 Overview of the Architecture

The JIA is firmly based on proven and widely accepted Internet and World Wide Web technology, implemented as a private Web on a contained intranet. This intranet can be configured as a private DoD World-wide network (e.g., the Global Combat Support System – GCSS), as a combat-capable, unit-wide local intranet, or simply as a group of computers in close proximity hard-wired in a local Ethernet configuration. It can also be configured in a single display device (portable or workstation personal computer) which operates as both a client browser and a personal single-user Web server. The technology for implementing such an intranet is low-risk, easily implemented, and widely understood. The proposed Architecture is based entirely on C/NDI technology. The Architecture is based on a dedicated Web intranet that has at least one Web-browser client and at least one Web server (more precisely, an HTTP (Hypertext Transfer Protocol) server and its included file-based store), as well as a network to connect them if they are not contained in the same computer. The specific implementation of the network, which is typically a TCP/IP (Transmission Control Protocol/Internet Protocol)-based network when more than one device is involved, will typically vary from one implementation to another. As will be described more fully below, the intranet may include other optional database servers and application servers in addition to the principal HTTP Web server.

7.6 JTA Compliance

The Joint IETM Architecture will be compliant with the DoD Joint Technical Architecture (JTA). Individual services or programs may define the operating environments for their IETM applications, but neither the JIA nor the JTA require a specific operating system. In technical terms, the "glue" (i.e., the communication protocol) that holds intranet Webs together is the Web protocol HTTP operating over the communications protocol TCP/IP, not the requirement for common operating systems. A TCP/IP network (e.g., an intranet) can easily accommodate multiple operating systems on its server and client computers.

7.7 JIA Use of Internet and World Wide Web Technology

The approach to developing a solution for this interoperability problem has been to adapt commercial and industry applications involving electronic documentation for which there is widespread vendor product support. A JIA-compliant IETM product will apply the vendor software and standards being developed for the World Wide Web and the Internet in a dedicated and private intranet environment. Following the rapid change trend in Internet technology, the JIA has been designed to be extensible, flexible, and able to accommodate the predictable rapid growth in technology for all aspects of the Internet, the Web, and emerging electronic documentation applications.

The Web is, by its nature, a client/server architecture and there is one area on the client/server spectrum in which JIA-compliant IETM applications may differ in emphasis from a major "server-centric" trend that is emerging for many commercial enterprise applications. The recommendations for implementation of the JIA are intentionally biased towards a model employing encapsulated objects that are downloaded to a portable device for use. In this approach, the server is preferred as a utility electronic bookshelf for IETM view packages (i.e., the package of encapsulated IETM objects). By analogy, these digital books are designed so they can easily be moved to another electronic bookshelf at another physical library site, reflecting the operational reality of the military unit itself. On the other hand, commercial Web sites tend to be permanently located corporate resource centers at which both the servers and the information providers are located. For these commercial activities, the mobile and less controlled entity is the user client. In these applications, the preference is towards server-centric computing and the use of server-oriented, Web-object components. The corporate personnel resources for maintaining both the Web server and the content are located at the Web site. In military applications, the server sites resemble a technical library rather than a computer information center. Technical expertise lies with the content creator or the user and not the administrator of the server. This situation, at this time, dictates total object-encapsulation and "client-centric" computing as the primary emphasis of the JIA.

Progress in Web-oriented technology and the availability of secure, affordable military intranets offering global connectivity may change this in the future. Thus, the JIA is intentionally designed not to preclude other solutions should such a change occur. It is important to emphasize that any implementing policy for the JIA must include some specific guidance on how to apply the Architecture, as well as the requirement to conform to the Architecture. The use of custom servers is an important issue for which guidance must mature. Guidance documents for the acquisition of JIA-compliant IETMs must be continually updated. Updates must be based on a continuing study of emerging military requirements, as compared with the current state of commercial technology and available C/NDI commercial products.

7.8 Proposed Requirement Documents for Implementation of the Architecture

This section summarizes initial recommendations for the baseline requirement documents for the JIA, development of JIA-compatible IETMs, and infrastructure capability.

In addition to requiring the HTTP and TCP/IP networking protocols used by the Internet and commercial Web-based intranet products, the JIA will be specified in the following areas:

- Object Encapsulation and Component Interface. This specification is needed for definition of the delivery, transport, and structure of the integrated collection of software components and data contained in the IETM view packages. This specification include the interface between multiple components when they exist, and the automated mechanisms for placing the IETM on the targeted intranet. It will also include requirements for the capability to automatically install these components on a user device in a manner sufficiently simple so that no professional system administrator is needed. It will include a primary specification to tell the IETM developers in what form they are to deliver the IETM view package.

- Intranet Server and Database Interface. For those IETMs that require the services of an application server and/or a database server, the IETM supplier must provide the proper software extensions to the basic JIA intranet Web server if they are not already in place. This specification outlines cooperation between the developers of the user intranet infrastructure and the IETM provider, and the interfaces and protocols involved. The JIA is designed to recognize the fact that it will be necessary to install software using conventional system administration practices on fielded servers in order to achieve needed functionality. (This is not to be the case for the components fielded on JIA-conforming user browsers.) This specification/guidance document will provide the requirements that an IETM provider must take into account when proposing or delivering such a capability for a JIA intranet.

- Common Browser. The immediate target for this specification will be the procurers of user PEDDs (Portable Electronic Delivery Devices) and workstations, since the installation of this standard browser will be required for these devices. The browser software component must be pre-installed on the PEDD since it is not included in the IETM view package. IETM source will also be affected by this specification since the IETM must be formed and viewed using any JIA-compliant browser. Two products dominate the Web-browser commercial marketplace at present, Microsoft Internet Explorer and Netscape Navigator, and the thrust of this specification is to specify the configuration of each so that they will be functionally equivalent in any JIA intranet. This will involve some extensions to the commercially-released products via plug-ins and controls. There would be viewing capabilities common in military IETMs such as CGMs or the common PDF used for legacy TMs.

- Electronic Addressing and Library Model. This is the overarching specification that holds the enterprise collection of IETM information together by means of digitally encoded and executable-link references. The specification itself will define the syntax and mechanism for building and executing the automated links to the IETM content and the IETM presentation software. Two additional areas regarding administration and enforcement of the recommendations are needed so that the enterprise-wide addressing concept will work. The Electronic Addressing and Library Model specification will discuss these aspects, which includes the actual bureaucratic administration and allocation of the DoD-wide IETM "address space." This is the indexing or Uniform Resource Locator (URL)-based electronically processed numbering system to which the services and their suppliers must subscribe. The specification will also discuss the area of the library model which can be used to perform an intelligent content-based access to another IETM when the exact specific locator is not known. To support the proposed Library Search functionality, the specification will also specify and require metadata files, encoded in eXtensible Markup Language (XML), which will serve as the primary search index files.

The Object Encapsulation and Component Interface, Intranet Server and Database Interface, Common Browser, and Electronic Addressing and Library Model technical descriptions are all needed to effect interoperability of disparate IETMs in the field. The specific DoD form of these technical descriptions (i.e., whether they all should be formal DoD Performance Functional Specifications or some other type of guidance document) will be determined at the time the final recommendations are formulated at the end of the DoD Interoperability Project.

The overall interoperability goal is the ability to view any IETM with any browser that conforms to the JIA Common Browser technical description. It also requires that all cross-references by one IETM, to another IETM, be encoded in a standard manner (i.e., in conformance with the Electronic Addressing technical descriptions) so that the IETM browser will be able to access the referenced IETM by a simple user selection (e.g., a mouse click). The other two specification areas are subordinate to these two user requirements, but are very important to ensure that contractor-delivered IETM view packages and the DoD infrastructure provide the needed user interoperability.

The following paragraphs contain a short summary of the concept and philosophy embodied in each technical description.

7.8.1 Object Encapsulation and Component Interface Technical Description

A core philosophy underlying this architecture is that developers of IETMs can deliver, as a single view package, all capability in the form of data and software contents needed to install and use an IETM on a standard DoD intranet. This technical description provides the IETM suppliers with the form in which they are to package and deliver the digitally encoded IETM. This view package may contain both content data and software components that have been combined into encapsulated objects and delivered as a contract package for electronic archiving or subsequent store-and-forward management. There is no provision for separately delivering an IETM player or piece of viewer software for installation onto the user device. The view package will contain the capability to be automatically installed onto the user intranet upon arrival.

The encapsulated data and software objects will eventually be delivered by the operational infrastructure to the field user as though they were simple binary data packages. These packages will be treated by the infrastructure as file-oriented data destined for an agency intranet Web server. The packages will appear simply as a generic “bucket of sequenced bits” that make sense to the server. The infrastructure activity need only make certain that these bits remain packaged together. The view package is a set of industry standard binary files, each of which is assigned a JIA notional locator (e.g., a URL [Universal Resource Locator] conforming to the JIA addressing model) that contains sufficient information to support its installation as data in the intranet server file system.

The complexity and degree of integration of these view packages will vary greatly among differing IETMs. Some will simply be a two-part collection of one software component and one data set. The simplest form will be a single set with all of the needed software contained in the standard JIA browser. In other forms, a system of software components and possible multiple data sets will spread out among several servers and the browser device when the IETM is operational. This would be the case when there are background software agents operating that might be performing diagnostics and system monitoring. Another emerging technology requiring complex IETM objects entails the use of software agents (acting as mentors) inserting training aids into the job-aiding presentation when the agent (a computer program) determines that they are needed. In between there is a spectrum of complexity, each level requiring a different object-encapsulation approach. The “object” nature of these view packages is that all the intelligence to construct the operational IETM on the target intranet is contained within the view package objects themselves. There is no standard for the internal constructs of the view package in the JIA. This is the characteristic of the object-oriented approach utilized by the JIA.

Until the point of receipt by the intranet server, the view package is processed as a single object. There are a variety of mature approaches for bundling a set of files with headers into a single data set (e.g., Internet MIME [Multiservice Internal Mail Extensions] Standards). The Architecture may use any of them, requiring only that the view package can be installed as a set of files on the intranet server(s). With this approach, no overt man-in-the-loop software-installation processes are required other than the automatic capability built into Web-capable browsers and servers. Many technical options exist for encapsulating view packages; however, this requirement for automated software-component installation using Industry-Standard Web practices is critical to determining the extent to which an encapsulation approach is satisfactory.

7.8.2 Server and Data-Base Interface Technical Description

The simplest way for the JIA to achieve IETM interoperability for the DoD is to utilize only generic Web servers. This approach will not require additional software to be installed on either the servers or the browser device. However, some legacy systems and some highly innovative new IETM applications may require custom server extensions and database interface components. For complex IETMs, which require extended services operating on an intranet server, installation will likely involve two phases. One phase will be to "extend" the intranet, a process governed by the Server and Database Interface Technical Description, and the other will be to install the data and required browser components, a process governed by the Object Encapsulation Technical Description.

Final recommendations on the use and encapsulation of server extensions will require additional technical investigations, since the technology and marketplace need to mature before the development of specific recommendations can be accomplished.

7.8.3 Browser Technical Description

In line with the philosophy of this Architecture to use de facto Industry Standards, the browser requirements are established by the two particular commercial products, which together have captured essentially the entire Web browser market. While it is possible to develop, assess, and evaluate a long list of needed and desirable requirements for the IETM browser, such an exercise would serve little purpose in light of economic and marketplace realities. New Web browsers are software products that are very complex and expensive to develop. Furthermore, the current products are being offered in the marketplace free of charge, effectively precluding the development of additional commercial general-purpose browser products. At this writing, these two products are Microsoft Internet Explorer and Netscape Navigator. Except for a few (but very important) capabilities discussed below, these two products are functionally identical. For existing Web pages, they perform in a similar fashion.

The Browser Technical Description will specify the appropriate version of the commercial browser products and a set of standard extensions (i.e., controls and/or plug-ins) to these browsers. These extensions will include common DoD data viewers for file formats such as PDF, SGML/XML, CGM Version 4 Graphics, and CALS raster images. Since an XML capability will be in the basic functional set, the Version 5 release of these two products will probably serve as the baseline. These will be the first versions of both browsers to support XML and both companies (Microsoft and Netscape) have aggressive plans to add this capability. The inherent capabilities of the JIA-compliant browser will include basic presentation methods, either native to the commercial browser or added to meet JIA requirement, so that the component portion of the encapsulated object can be assumed to be preinstalled on the user device. In most cases, these particular components need not be included in the view package. Native browser support includes components such as HTML layout, GIF (Graphics Interchange Format) viewers, and JPEG (Joint Photographic Experts Group) displays.

One major area of difference between the two browsers lies in the area of object brokering and the automatic downloading of components. Ideally, it would be desirable to require that IETMs operate with either browser in its out-of-the-box form; however, the JIA Study Team has concluded that such a policy would restrict some very needed capabilities regarding the "downloadable" components needed for the JIA object-encapsulation concept. The differences are due to the lack of cooperation on the part of the two competing companies (Netscape and Microsoft) to provide compatible solutions for the marketplace. The generic capability to automatically download and install software components is essential to the JIA, so it may be necessary to chose one over the other for a specific implementation. To support users of Microsoft Windows 95, 98, or NT-based devices (which includes the vast majority of portable devices available), it is desirable to utilize products supporting the Microsoft Distributed Component Object Model (DCOM) object standards that provide turnkey support of this feature. For communities employing Microsoft software, it is strongly recommended that both browser products be enhanced (by third party plug-ins if necessary) to support DCOM objects (especially the downloadable ActiveX controls). These are the most efficient formats for executable programs running in a Microsoft 32-bit operating system.

There is also a marked degree of difference in the way the two products handle Dynamic HTML (DHTML), an emerging technology for putting intelligence into actual Web pages. However, because of the lack of consensus in the vendor community on DHTML standards and the fact that there are options for this functionality, the JIA Study Team has not yet establish this requirement as part of the minimal baseline and currently discourages its use in DoD programs. The eventual goal is that all valid DoD IETMs be compatible with both the Internet Explorer and Netscape products. This may require some installed extensions to make the two products interchangeable to the maximum extent possible.

7.8.4 Electronic Addressing and Library Model Technical Description

The syntax for JIA electronic addressing will be based on the URL standard for the World Wide Web because it is widely implemented in virtually all Web-enabled vendor products. Any occurrence of a legitimate URL string of characters is automatically made "hot" in the vendor application, and a "mouse click" or two, on the hot spot, will launch a Web browser search which will locate the file referenced by the URL and display it on the screen. In addition to requiring a standard syntax, the Electronic Addressing and Library Model Technical Description will also require that all of the Services maintain and publish a permanent registry of all valid references to the IETMs issued by that Service. Once published, a valid URL must not be changed. This type of URL is called a persistent URL. In order to ensure that URLs are indeed persistent URLs, the JIA recommends the use of virtual URLs (vURLs). These are URLs that use an administratively assigned server reference, notated by URL syntax; however, the referenced server exists in name only. That is, it does not actually exist on a network and is used for data management purposes only. When the IETM is installed on a network, the vURL is remapped to the server on which the IETM data resides. (This is easily accomplished in practice using what are called Host files and/or Domain Name Services (DNS) in accordance with standard World Wide Web practice.)

The specification will address the requirement for the remapping of these vURLs (which reference a hypothetical server on the World Wide Web) into the actual server and file system locations on the intranet. The Specification will also outline an on-line, search-oriented Library Model and identify the requirement for a standard metadata package to support on-line searches. This metadata package will be encoded in XML and attached to each IETM view package, which will contain indexing information useful for automated search engines in identifying an IETM reference.

7.9 Basic JIA Operational Flow Diagram

Figure 7-1 shows the flow of IETMs through the JIA. It illustrates the employment of the JIA by the original IETM developer, the management infrastructure repository, the user-site intranet server, and the user who selects the next object to view via a point-and-click Web-browser interface. The presentation components referred to can be either client or s erver components or implied (i.e., omitted) in the cases in which they are preinstalled in the standard browser.

7.10 Benefits of Employing the Architecture

Although implementation of the JIA produces a number of significant benefits, it will primarily benefit the end user, the IETM developer and the DoD IETM Distribution Infrastructure.

7.10.1 Benefits from the User Perspective

The principal benefit of the JIA is that the user will be able to utilize a single device to read any DoD IETM, no matter which Service originated it. To accomplish this, the user accesses and views the IETMs with either a workstation personal computer in a shop environment or a PEDD. The portable device will be configured either as a network client attached to the unit intranet or it will be reconfigured to operate in stand-alone or detached mode. In either case, the display of the information on the user interface is identical, and the user cannot determine from the look-and-feel of a screen display the mode in which the device is operating.

A major benefit of the JIA to the user is that all information is viewed through a common and very familiar Web-browser interface. To access an IETM, the user will select a URL reference using one of the many access-screens or menu-select options available (e.g., favorites list, explicit entry, a preassembled list of active IETMs on a unit Home Page, a hot-spotted index graphic, or a Web page job assignment form listing the needed technical references). All of these are common practices borrowed directly from the World Wide Web community. From the user's perspective, the referenced IETM content simply appears in the browser window.

A major benefit to the user organization is that no explicit software installations are required to utilize an IETM even on a new out-of-the-box JIA-conforming browser device. Depending on the browser security level set, the user may, need to accept software components that require installation by an acknowledgment but for which no explicit installation action is needed; the browser installs the components automatically. This is an essential user-friendly feature of the JIA. Thus, there is no need for a trained and certified system administrator to install user software.

Another key benefit of the JIA is that the Web-based access methodology is a proven "point and click" user interface. If one IETM contains a reference to another IETM, the user can "click" on the highlighted reference and that referenced IETM will appear in the browser window (assuming, of course, the referenced IETM exists on the user's intranet). This second IETM can in turn reference a third IETM. To return to the original IETM, the user simply uses the "back" arrow on the browser interface, effectively reversing the references. Modern Web browsers can handle many levels of such nested referencing with no performance degradation. From the user perspective, the JIA is thus intended to make the use of disparate IETMs as easy and "seamless" as possible with modern technology. Because of the nature of the Web browser technology employed, the user experiences a great deal of common "look-and-feel" in the interactive (navigation-control) area, even if the individual IETM user-interface for the content varies.

A common practice on the World Wide Web is the use of search engines such as those employed by Yahoo and Excite. The JIA Library Model and the required standard XML-encoded metadata package are specifically designed to facilitate the inclusion of search engines on a JIA-conforming intranet. In these search engines, the user will enter a list of key words or reference designators and the search engine will identify possible IETM references available on the user's intranet. The JIA will not specify the search engine, but a rich selection of commercially available search engines, which build their indices from XML- and HTML-encoded sources and can easily be employed on a JIA intranet, is expected. The ability to get all the information needed to perform a task in a timely and convenient manner has, from the beginning of the IETM concept, been one of the promised performance-enhancing capabilities of IETMs. This JIA implementation, using low cost commercially available technology, will permit realization of this capability.

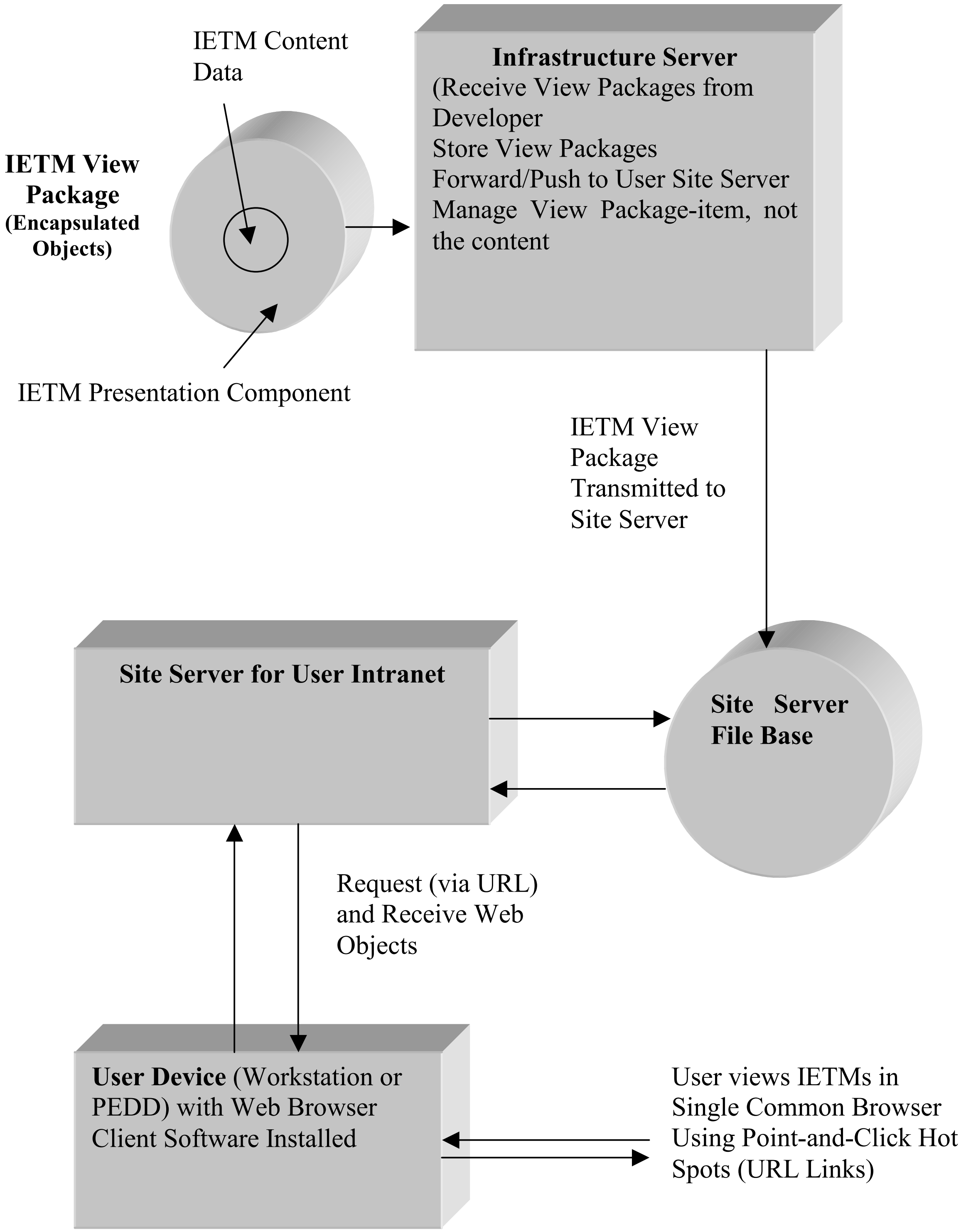


Figure 7-1. Flow of IETMs Through the JIA

7.10.2 Benefits for the IETM Developer

The principal emphasis of the JIA from the IETM-developer perspective is that all software components and data needed to make an IETM accessible on the JIA display device are bundled into a single digital product (i.e., the encapsulated object), which can be easily installed as a set of data files onto an intranet-server file system. The primary benefit to the IETM developer of that object-oriented concept is that he/she is free to choose whatever authoring and development environment is preferred. The JIA does not dictate how the IETM is to be developed nor what the internal format of the IETM object must be. External interfaces are in accordance with electronic-document authoring environments which are being adapted to operate on the World Wide Web and, as such, should operate equally well on a JIA-compliant intranet. Proofing tools for IETM objects are also easy to set up as a JIA-compliant intranet and JIA browsers are made up of available software products which the authoring activity can procure. Again, the design philosophy for the JIA is to use the best readily available commercial practices for developing and deploying IETM products.

While the technology needed to bundle all of the IETM components into a single digital package is complex, it is readily available in C/NDI products. These are inexpensive, relative to traditional IETM products, and easy to obtain. There has been an unprecedented rush by suppliers to get competitive products into the commercial market. A fundamental principal of the JIA is that the products developed for the Internet can be used to develop IETM products for a JIA-compliant intranet. This process is in contrast to current practice, where the IETM product is delivered as two separate items, the IETM content data and the IETM presentation system software program.

7.10.3 Benefits to the DoD IETM Distribution Infrastructure

The primary benefit of the JIA to the DoD IETM digital distribution infrastructure is that encapsulated IETM objects can be distributed without requiring that the distributing system know what is inside the electronic capsules. The infrastructure activities can therefore be simple distribution centers, for which the DoD has substantial experience, and not data-processing centers, which would be much more difficult to operate and staff.

The specific design of and development of a specific DoD component infrastructure is not within the scope of the JIA effort. This infrastructure design will undoubtedly be a complex task that will be further complicated by the impact it will have on many existing business practices. However, the JIA element which enables the objects to be processed as an item of supply (with no requirement to manage the internal content or structure of the object), should make this task more manageable.

7.11 Architecture Types

In practice, the implementation of an IETM intranet may be simpler (as is the case with basic HTML pages) or more complex (as is the case with most custom servers) than the baseline Operational Flow described in the previous section. The following breakdown of anticipated IETM view packages by architecture type is presented to categorize variants and to provide implementation guidance. Any particular IETM intranet implementation will typically contain a mixture of these types. The four types of categories represent a continuous spectrum of variation (i.e., some applications will be difficult to categorize precisely). However, identifying the types will make it easier to present guidance in the JIA, particularly regarding the Server and Database Interface Specification. Definitions of these Architecture types are given in Table 7-1.

Type definitions are grouped into two categories:

1. The baseline architecture, IETM Architecture Types C1 and C2. Definition of these two client-centric Architecture types has essentially been completed. These types require only a browser and a generic HTTP server.

2. The extended architecture, Architecture Types S1 and S2. For these server-centric types, the technology for employing the additional servers in the Web environment is less mature and more diverse. This segment of the marketplace is emerging and it is still dominated by proprietary products. This situation is in large part due to the fact that vendors have opened the browser products to the public domain (a market in which there is little money to be made) and have kept the server market proprietary (where vendors see profit potential and seek competitive advantage).

7.12 Characteristics of Architecture Types

Architecture Types C1 and C2 share common important characteristics in that they do not require installation or operation of unique software on the server. Thus, the server can be treated as an electronic bookshelf. As far as the server is concerned, the two parts of an encapsulated object (the data and the associated software components) are simply treated as files. Additionally, any contemporary HTTP server can be employed and it does not matter what operating system is utilized. Thus, for Type C1 and C2 IETM applications, interoperability is very low-risk in the sense that, any IETM view package can be accessed using any server. Only a generic server is required for Types C1 and C2 and no JIA-specific server specification is required. Both types are considered pure encapsulated-object types; however for Type C1, the component part of the object can be implied (i.e., omitted), as its presence can be assumed as preinstalled on any JIA-compliant browser and need not be included in the transported IETM view package.

The Type C1 definition is closely tied to the specific versions of HTML and XML, a factor which needs further clarification. For planning purposes, it is recommended that emerging standards (and not current standards) for both HTML and XML be used to define the JIA requirement. In this light, HTML/XML is herein specified as employing both HTML version 4.0 and XML version 1.0 (including the associated XSL style and XLL linking specifications), when these two International W3C (World Wide Web Consortium) standards are formally approved. HTML 4.0 is a mature specification and should soon be approved, while the XML family of standards is still a year or two away. There are several reasons for this recommendation. The future standards will almost certainly be relevant in the time frame when most applications are developed according to the proposed architecture, so the best estimate as to what will be applicable should be used. Vendor implementations of the draft standards are available now for test purposes.

Another important consideration is that there has been written commitment by many major software vendors to support future standards, whereas there is no complete agreement on the delivered-product support of the current standard (i.e., HTML 3.2). In particular, vendors have indicated support of the emerging HTML 4.0 standard. Additionally the XML standard has elicited widespread vendor promise of support as a user-extensible expansion of HTML. XML lags behind HTML 4.0 in maturity, but is sufficiently complete so that prototype software exists from major vendors, and shows promise of becoming a Web-based tagging standard that is more suited to complex IETMs than HTML. In particular, it will be much easier to convert the large DoD inventory of SGML-tagged source data to XML for a run-time object than it is to convert it to HTML for presentation.

For Type S1 and S2 IETM applications, the situation for ascertaining de facto industry practices is much more complex. Several approaches are available for standardizing many issues such as Microsoft's design-time controls, Active Server Pages (ASP), and Front Page server extensions, and a variety of third-party middle-ware products; but they are all proprietary and not universally accepted. The technology of C/NDI are not sufficiently mature at this time to propose any one of them as a DoD standard so that all IETMs can operate on a single server. There are two possible approaches for a working solution to operational interoperability with a particular server in the short term:

1. The various IETM providers must put their own physical server(s) plus the IETM view packages on the shared user intranet. This is very feasible with the state of the art and capacity of today's portable computers and plug-in network standards; or

2. Require that all IETM creators use the same sets of server components and that the standard components be installed on all intranets employed in the community throughout which the IETMs are interoperable. However, for multi-service operations, this alternative is not practical.

Table 7-1. Proposed IETM Architecture Types

Type	Characteristics	Examples
Type C1: Basic HTML/ XML Pages	HTML/ XML page(s) with only browser-resident components. Requires no component licensing. Most will work on any browser. Includes HTML 4.0 scripts. Client processing only. "Basic" HTTP server.	HTML with Java script, GIF, JPEG, frames XML + XSL Style Sheets
	Note: HTML/ XML pages may be used to include one or more Type C2 custom components. If the HTML/XML tags no displayed content, it is considered Type C2. If it does contain tagged data, it is a combination C1/C2.	C1/C2 examples: HTML file plus Java "bean(s)" HTML file plus plug-in HTML file plus ActiveX control(s)
Type C2: Simple Component	One data set plus one custom automatically downloaded non-HTML component	.pdf plus Acrobat reader control .doc plus WordView control
	May be nested Type C2 data-set/component pairs ("encapsulated objects"). First component loaded into browser shell/container has capability to access another client component and associated data set under control of original component. Requires component licensing. Not recommended for new applications. Client processing only. Uses "basic" HTTP server.	Legacy systems reprogrammed as custom browser or presentation system operating inside a standard browser shell/container.
Type S1: HTML Plus Application Server	Two-tier architecture in which Web page includes reference to server application(s), which must operate before page is delivered to client as Type 2 HTML/ XML. Data and components managed on server. May utilize database collocated on server, but most content is in Web page files. Requires HTTP server with components for server-side computations. Requires client *and* server processing.	MS Front Page Webs MS Design-time Controls CGI Server Apps DynaWeb
Type S2: HTML with Database Server	Three-tier architecture that includes a Web page server with pages functioning like a template; e.g., for calls to a database, which contains most of the IETM content. Can include server and components for custom functions. Requires a database server (e.g., Oracle) in addition to the HTTP server. Can use MIL-PRF-87269 Data model for database on server. Permits both Client *and S*erver processing.	AIMSS 4.0 (planned) GD TechSight Web MS ASP w/ODBC Calls

7.13 Elements Diagrams for Architecture Types

The core Architecture (Types C1 and C2) requires two kinds of software elements: client browsers and Web servers, as illustrated in Figure 7-2. In general these are hosted on separate devices connected by a TCP/IP network. However, an intranet can also be set up in a single display device without a network. In the case of IETM Architecture Types C1 and C2, these two kinds of elements are all that is needed. In the case of Type S1 (Figure 7-3), a requirement exists for an additional element, the application server, sometimes referred to as a Web server extension, since it effectively operates in the same operating system as, and is an extension of, the HTTP server. In the case of Architecture Type S2 (Figure 7-4), there is the additional requirement for a database server which hosts most of the IETM content, which may or may not be hosted in the same device as the Web server. A Type S2 application usually includes aspects of a Type S1, since it requires an application server to process the data access and request dialog between the Web server and the separate database server. Note that while the line between these two types may not be clear, in general they differ in where the primary data content is stored (i.e., in the server files or database server).

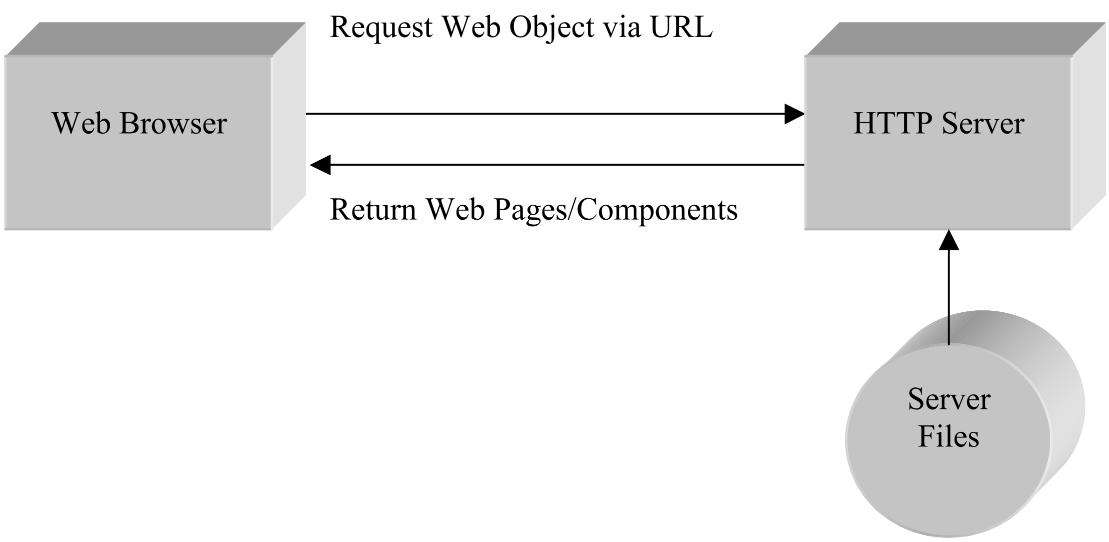


Figure 7-2. Elements for Architecture Types C1 and C2

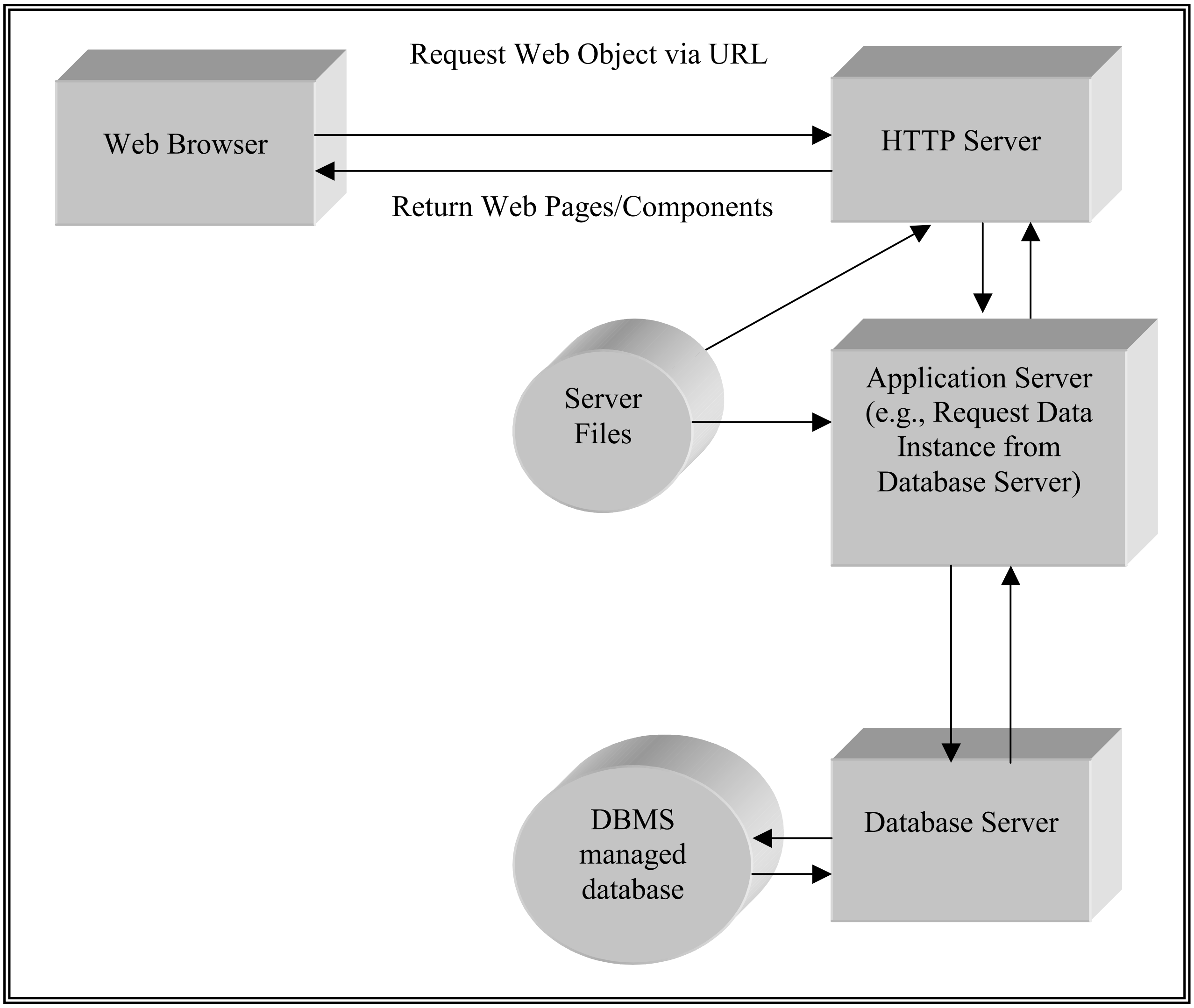


Figure 7-3. Elements for Architecture Type S1

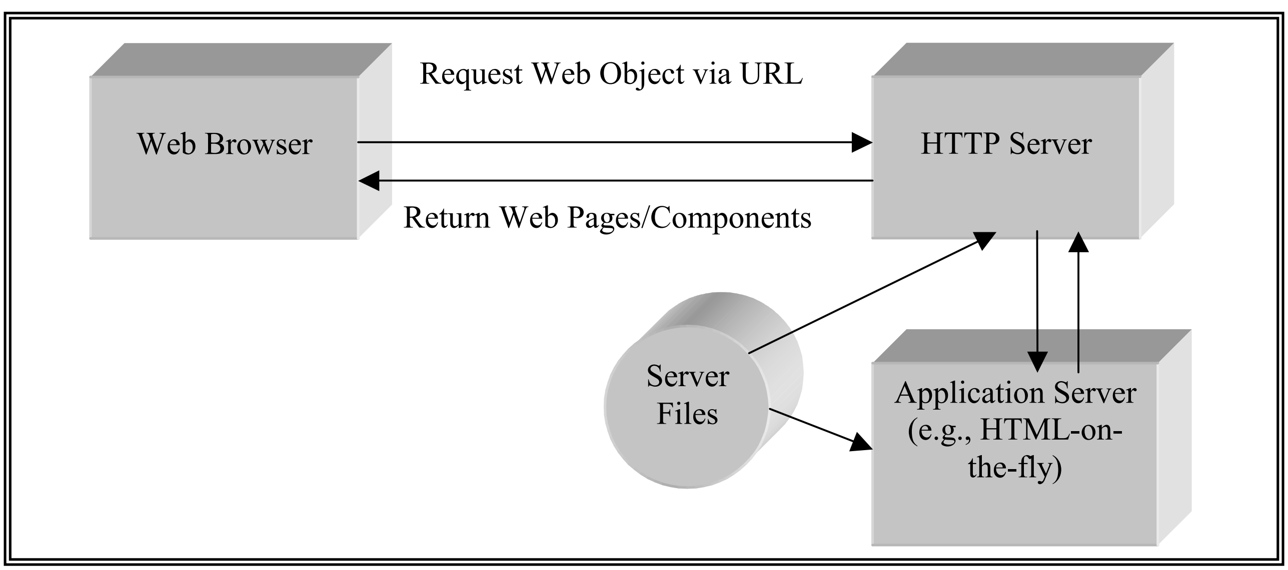


Figure 7-4. Elements for Architecture Type S2

7.14 Pilot Programs

Each of the services selected pilot programs to test the JIA goals and objectives (Table 7-2) The selection encompassed each of the architecture types previously described. During the October 1998 CALS '98 Expo in Long Beach, CA, the conceptual JIA was successfully demonstrated. The pilot programs were hyperlinked to demonstrate that regardless of architecture type, authoring system or service, the IETMs could be viewed using a Web browser.

Table 7-2. JIA Pilot Programs

Service	Program	Technology Demonstration	Architecture Type
NAVY	LM-2500	SGML to HTML	Type C1
	LINK-16	SGML to HTML	Type C1/C2
	F-18	Quill to Web-based	Type S2
	ATIS-AIR	PDF to Web-based	Type C2
	NSSN Library	SGML to HTML/XML	Type C1
USMC	Diode Test Set	PDF to Web-based	Type C2
	TAOM	MediaLynk to Web-based	Type S1
	AAAV	TechSight to Web-based	Type S2
	Sweep Function Generator	PDF to Web-based	Type C2
AIR FORCE	MPTO	PDF to Web-based	Type C2
	F-22	Paper study	N/A
ARMY	PPS-5	PDF to Web-based	Type C2
	EPLRS	SGML to Web-based	Type S1

APPENDIX A
SGML, HTML, XML AND IETM SOFTWARE

A.1 Introduction

Selecting IETM software is dependent upon many factors, but mainly upon the class of IETM that is to be developed. This appendix discusses the role of SGML and DTDs (Document Type Definition) in the development process for IETMs. It also provides information on software available to accomplish an IETM development program. Discussion of software products in this section in no way implies endorsement by DoD.

IETM software falls into four distinct categories:

- Development and editing software
- Parsers (an application that checks conformance to a DTD)
- Display or viewing software
- Data management software

A.2 SGML

In 1986, the SGML became an ISO standard [ISO 8879, Information Processing - Text and Office Systems]. ISO 8879 defines a method (set of rules) and a “language” for document representation. SGML provides a formal markup procedure used to “tag” or identify elements of document text. This tagging is machine processable and independent of system and output environments. SGML provides the grammar and syntax rules for the language used to describe both document content and structure regardless of the type of document or the nature of document text.

A.2.1 Background

SGML was adopted as the format for delivery of technical documentation as part of the CALS initiative in the mid-1980s. All DoD technical manuals are required to be delivered in SGML format according to a Service's DTD. SGML was designed to provide a flexible, yet structured, open approach to documentation development and management. Any document, including technical documentation, typically contains three characteristics: content, presentation and structure. Most commercially available word processors, and to a lesser extent desktop publishing programs, are categorized as WYSIWYG (what-you-see-is-what-you-get) programs. Editors and authors using these programs are usually more concerned with the presentation of the content than with the structure. Many authors spend inordinate amounts of time formatting a document for an aesthetically pleasing display (usually paper). This presents a problem when data needs to be shared across the enterprise but is inconsistent because various authors applied their own interpretation of "what looks good." If authors could spend their valuable time creating content with a structurally sound guide (or template), and leave the presentation of the content up to a predefined style, all documents conforming to the template could share elements while maintaining a consistent look and feel.

This is the underlying philosophy behind the CALS initiative; to have many different authors (contractors), creating reusable chunks of information (technical data), according to a standard set of structure rules (DTD), to share across the enterprise (DoD). Formatting of the resulting SGML instance is accomplished by application of a stylesheet(s) permitting output of the data to various display devices (paper, CD ROM, Web). In short, SGML separates a document's content and presentation from its structure. Publishing SGML for electronic display is typically more cost effective than publishing on paper.

```
Document
  ├─Front Matter (Foreword, Safety Summary)
  ├─Body (Chapters, Sections, and Paragraphs)
  └─Rear Matter (Appendices, Glossary)
```

Figure A-1. Military Manual Structure

SGML documents can be visualized as a series of parent-child relationships residing in containers. In the military, technical manuals are structured as indicated in Figure A-1. The document is the "root element", and also the "parent", that contains the front matter, body and rear matter "child" elements. This analogy can be extended to the entire manual, resulting in the visual tree structure of the Body element shown in Figure A-2. The Chapter elements are the children of the Body element and also contain children of their own. The structure of Chapter X is representative of the structure found in a procedural (corrective maintenance) chapter of a military technical manual. Chapter Y reflects a general information (description of operation) chapter and Chapter Z is indicative of an IPB chapter. Figure A-2 is a simple example of the main structural elements of military technical manuals. Many manuals can contain sophisticated structures requiring extensive document analysis to completely describe the parent-child relationships.

The military is not the only organization to adopt SGML as a standard for the exchange of technical data. Many industries have recognized the benefits SGML provides over proprietary authoring programs, including:

Industry	**Common SGML Reference**
Automotive	J2008
Airlines	ATA
Semiconductor	Pinnacle (PCIS)
Financial	EDGAR
Literature	Text Encoding Initiative (TEI)
Publishing	AAP

A.2.2 DTDs

The content of a technical manual may be considered unformatted source data. In order for the source data to be processable, it must be marked-up (tagged) in some way with respect to its structure or content. The tagging rules that apply to standardized technical manuals are defined by the DTDs. A DTD is a file that identifies the elements within an SGML tagged manual, as well as the hierarchical relationship between the elements. Other than MIL-PRF-28001, DTDs exist for a number of military specifications as represented by the below chart.

DTD	Used by
MIL-STD-38784	All services
Quest	Navy
NAVSEAC2	Navy
MIL-STD-2361	Army
Workpackage	Navy (aircraft)
SSM	Navy (submarine)
MIL-PRF-87269	All services

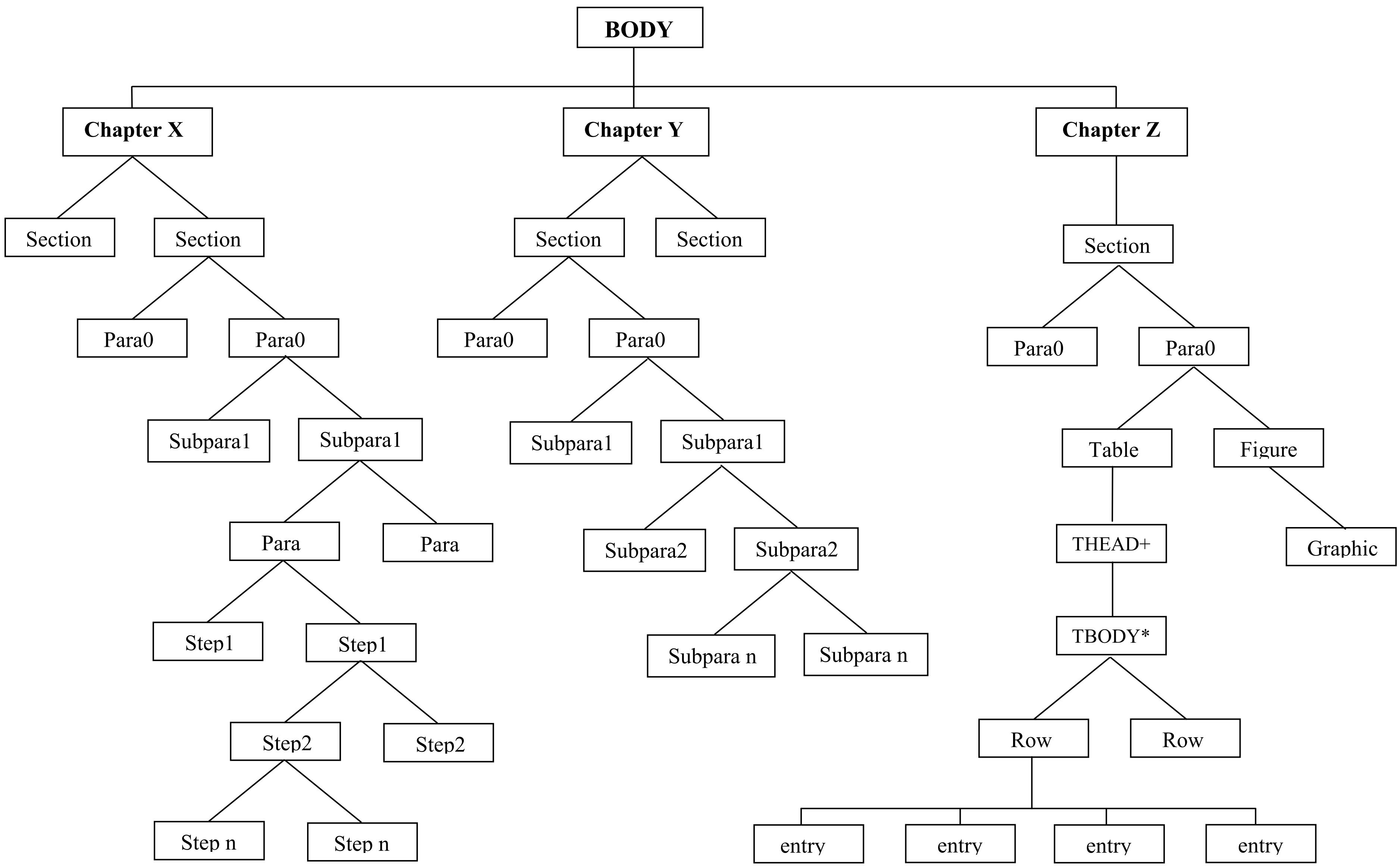
An example of the partial DTD for a technical manual containing a Body element described in Figure A-2 is as follows:

```
<!DOCTYPE DOC [
<!ELEMENT doc - - (front, body, rear)>
<!ATTLIST doc secure (uc|c|ts)#REQUIRED>
<!ELEMENT body - - (chapter+)>
<!ELEMENT chapter - - (title, section)>
<!ELEMENT section - - (title, para0+)>
<!ELEMENT para0 - - (title, subpara1, figure, table)
<!ELEMENT subpara1 - - (para+)
<!ELEMENT para - - (#PCDATA)
]>
```

The actual DTD is contained within the open "[" and close "]" square brackets. The first line <!DOCTYPE DOC, begins the document type definition, and indicates the DTD will be defined for documents of type "DOC." The <!ELEMENTS statements identify what structural objects are permitted within the document and also their hierarchical relationship. The **<!ELEMENT doc - - (front, body, rear)>** statement identifies **doc** as the root element that must contain a front element, a body element, and a rear element. The body element must contain one or more chapters, which must contain at least one section. Notice the addition of the <!ATTLIST statement. An attribute is a method of modifying an ELEMENT's SGML tag. In this example, the **doc** ELEMENT has an attribute "secure" indicating its security classification status. Our document can either be unclassified (uc), classified (c), or top secret (ts). While some attributes are optional, the secure attribute on the doc tag is required (#REQUIRED). Also note the term #PCDATA which stands for parseable character data, meaning source data (text and characters).

A.2.3 FOSIs and Stylesheets

Publishing tagged instances on paper relies upon Formatting Output Specification Instances (FOSIs) to describe the format or how the printed document will be presented on paper. FOSIs control such things as location of footer information, page numbers, headings, font size, etc., on a printed page.



+ Table Heading
* Body of the Table (columns rows, entries)

Figure A-2. SGML Tree Example

A FOSI is merely an instance of a DTD. It provides specific values, chosen from the options defined in the MIL SPEC, for formatting the SGML document. Multiple FOSIs for the same DTD can be developed to produce different presentation formats for the same instance. By selecting different values for the style characteristics, a FOSI may be developed that creates a page-oriented single column output format or a two-column output format.

Electronic publishing of tagged instances for IETM displays generally rely on application specific stylesheets. Within a stylesheet authoring environment, an IETM developer specifies the formatting characteristics, such as font size, color, space before, indentation, etc., of elements in the IETM. Fortunately, SGML elements can, within stylesheets, possess an inheritance property. This means that if the IETM author desires the para0 element to be 12 point, left justified and arial font, all children of para0 (subpara1, steps, etc.) will inherit the parent's formatting characteristics. Stylesheet formatting typically starts at the root element and continues through to the lowest level of the SGML tree structure. In this manner, the look and feel of the IETM displayed on a computer monitor is developed. Like FOSIs, multiple stylesheets may be built for a single SGML tagged instance.

A.3 SGML and HTML

SGML is the parent language of the Hypertext Markup Language , the popular format for developing Web pages on the WWW. Sometimes referred to as "SGML-lite" or "dumbed down SGML", HTML was designed to be easy to understand and therefore to be used by the general public. The HTML DTD contains a limited number of available elements to produce a Web page. The same general concept of structured documentation applies to HTML. However, HTML browsers are more forgiving in the presentation of an HTML tagged document. An example of an HTML document is as follows:

```
<!doctype html public "-//w3c//dtd html 4.0 transitional//en">
<html>
<head>
   <meta name="GENERATOR" content="Mozilla/4.5 [en] (Win95; I) “>
</head>
<body>

<h1>HANDY’s has Bikes for Sale!</h1>
<h2>Manufacturer: Thrasher</h2>
<h3>Model - The Zoomer 2 Wheeler</h3>
<p>We have a <i>Monster Bike</i> sale going on!</p>

<table BORDER >
<tr>
   <td>Men</td><td>Women</td><td>Children</td>
</tr>

<tr>
   <td>$109.99</td><td>$105.99</td><td>$99.99</td>
</tr>
<tr>
   <td>$99.99</td><td>$89.99</td>
```

```
</tr>
</table>

</body>
</html>
```

In this simple example, the HTML document structure consists of <head> and <body> elements. The <H1> is the first level heading; similar to a chapter title or <para0> element in military SGML documents. The three column table structure consists of rows <tr> and table data <td>. Formatting codes <i> can be added to emphasize words or characters. The display of the individual HTML elements are interpreted by the browser's built-in stylesheet. Rendering of the above example in Internet Explorer yields Figure A-3.

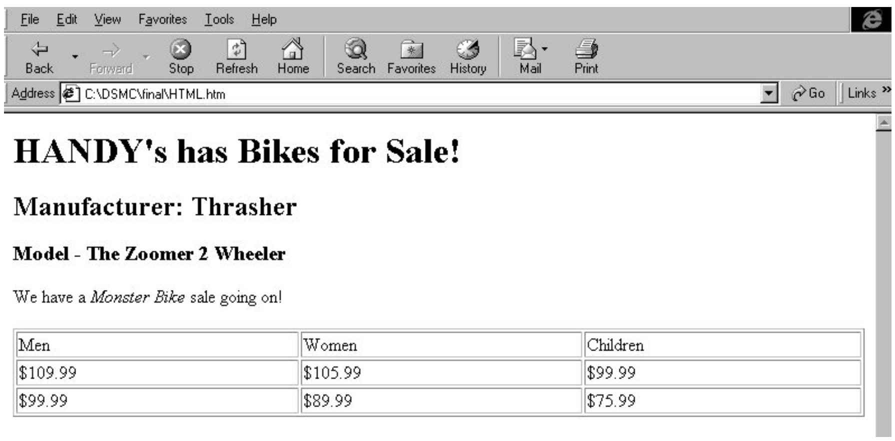


Figure A-3. HTML Display Within Internet Explorer

A.4 SGML and XML

The limitations of HTML prompted the World Wide Web Consortium (W3C [a organization combining a mixture of industry and Government experts]) to proposed a more definitive language for describing Web documents. The eXentsible Markup Language (XML version 1.0) was accepted in 1998 as a standard by the W3C. XML is only in its infancy, but the advantages of using XML (versus HTML) to describe the contents of a document are readily apparent. XML is an example of content tagging versus many DTDs that implement the structure tagging approach. Compare the XML example shown below with the HTML example previously discussed.

```
<?XML version 1.0">
<!DOCTYPE bikes SYSTEM bikes.dtd>

<bikes>
<company>HANDY's has Bikes for Sale!</company>
<manufacturer>Thrasher</manufacturer>
<model>The Zoomer 2 Wheeler</model>
<announce>We have a <i>Monster Bike</i> sale going on!</announce>
```

```
<bikeinfo>
<biketype>Men</biketype>
<biketype>Women</biketype>
<biketype>Children</biketype>
</bikeinfo>

<bikeprice>
   <regprice>$109.99</regprice>
   <regprice>$105.99</regprice>
   <regprice>$99.99</regprice>
</bikeprice>

<sale>
   <saleprice>$99.99</saleprice>
   <saleprice>$89.99</saleprice>
   <saleprice>$75.99</saleprice>
</sale>
</bikes>
```

Notice that the tags describe the information contained between the tags. The XML document inside an XML capable Web browser will be displayed identically to the HTML document.

A.5 SGML and PDF

Before the explosion in popularity of the WWW, the Adobe Corporation recognized the need for electronic documents that retained the look and feel of the printed version. Also highly desirable was a platform independent file with powerful hyperlinking capabilities. Utilizing their Postscript printing language, Adobe developed a Portable Document Format (PDF) that permits the user to quickly navigate an electronic document via a key word search, hyperlinked table of contents, or by clicking on "thumbnail" images of electronic pages (see Figure A-4). This capability is available to the user from the same source file regardless of the viewing platform (PC, Mac or Unix). The user only needs to have installed the freely distributable Adobe Acrobat Reader. When the Internet became a popular distribution medium for electronic documents, Adobe reconditioned Acrobat to work with either Microsoft's Internet Explorer or Netscape's Navigator. This permitted thousands of pages of documents already in PDF format to be displayed from within a Web browser without further modification (i.e. converted to HTML). Since most word processing files or desktop publishing files could already output a Postscript file, it gave large numbers of potential Web publishers a relatively inexpensive method of converting their electronic files for Web display.

Probably the greatest advantage PDF has over SGML is its simplicity. Typically, novice electronic publishers already have all the required tools installed on their computer and can quickly begin developing PDF. SGML, on the other hand, requires specialized software tools and has a steep learning curve associated with DTDs, the concept of structured documents, and FOSIs. Another benefit of PDF files, is the fact that licensing fees are not required for viewing IETMs delivered in PDF format. All current SGML browsing software applications have a licensing fee associated with the distribution of SGML based IETMs.

PDF files, however, do have some drawbacks. Technically, PDF files are a proprietary format, Adobe's Acrobat Reader is the only application that can view a PDF file while maintaining internal functionality. The PDF file itself cannot be edited, only the source file can be modified and remade into a PDF. Adobe is addressing these issues by providing updates to the functionality of the Acrobat Reader. Acrobat can be downloaded at www.adobe.com.

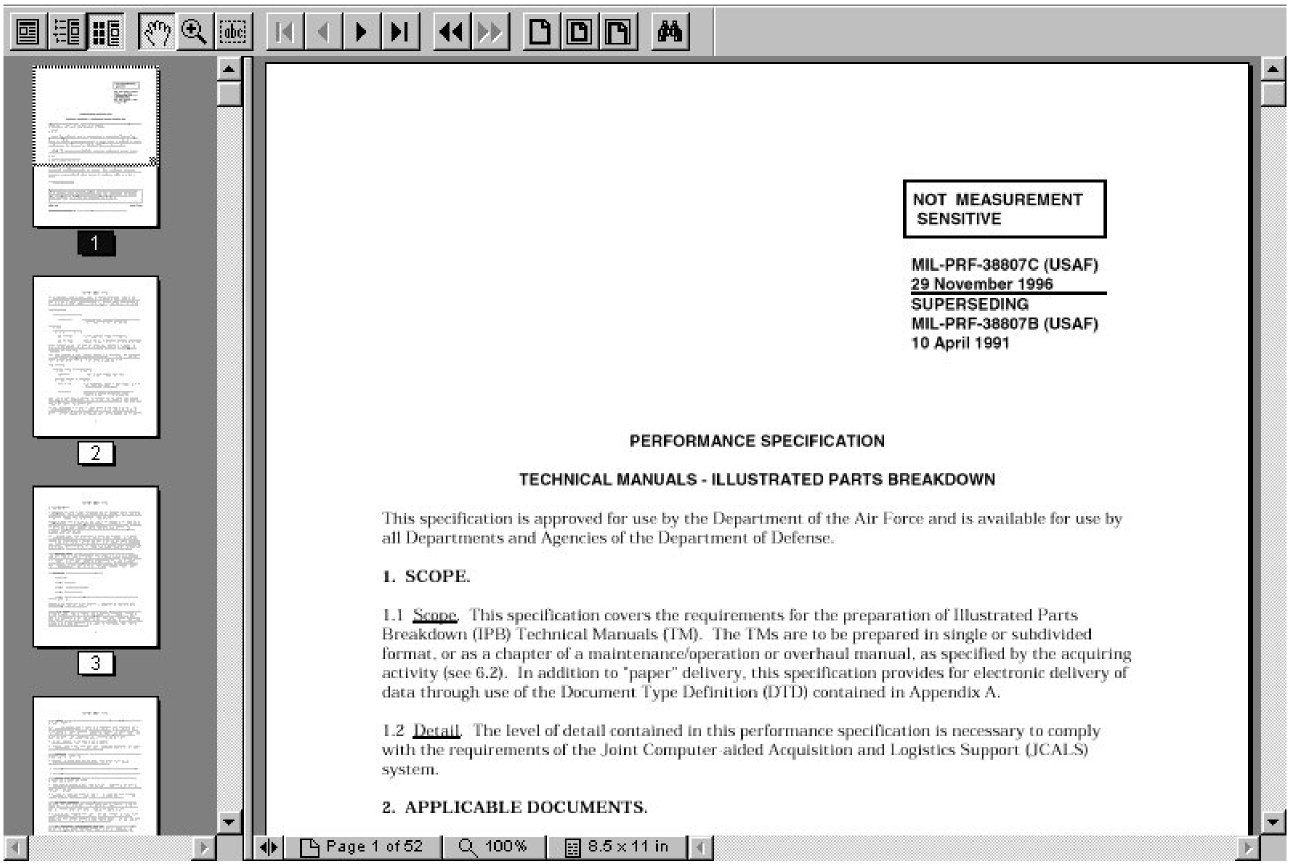


Figure A-4. Electronic Page in Adobe Acrobat Reader

A.6 Developing and Editing Software - Class II and III

A.6.1 ASCII Editors

Since SGML is an ASCII file, any text editor can develop or modify an SGML instance. This approach is not recommended for large SGML files or for SGML novices. Those authors unfamiliar with structured documents or the target DTD can introduce too many structural mistakes. The most common process when using a text editor is to edit a previously developed instance, run the SGML through a parser and then correct the errors until the instance parses. Common text editors include:

- Notepad
- Wordpad

- Textpad
- Program File Editor (PFE)
- Emacs
- Word
- WordPerfect

A.6.2 ADEPT*Editor

A product of Arbortext in Ann Arbor, Michigan, ADEPT was the first widely distributed SGML development/editor software program on the market. It combined the ease of a word processing/desktop publishing environment with a SGML tagging environment. ADEPT is an SGML development tool and not an IETM development program. It produces SGML that can be used as the source data for IETM viewers. An ADEPT session (Figure A-5) typically consists of:

- Opening a new Arbortext document.
- Selecting a precompiled DTD. The program reads the DTD and stores it in memory.

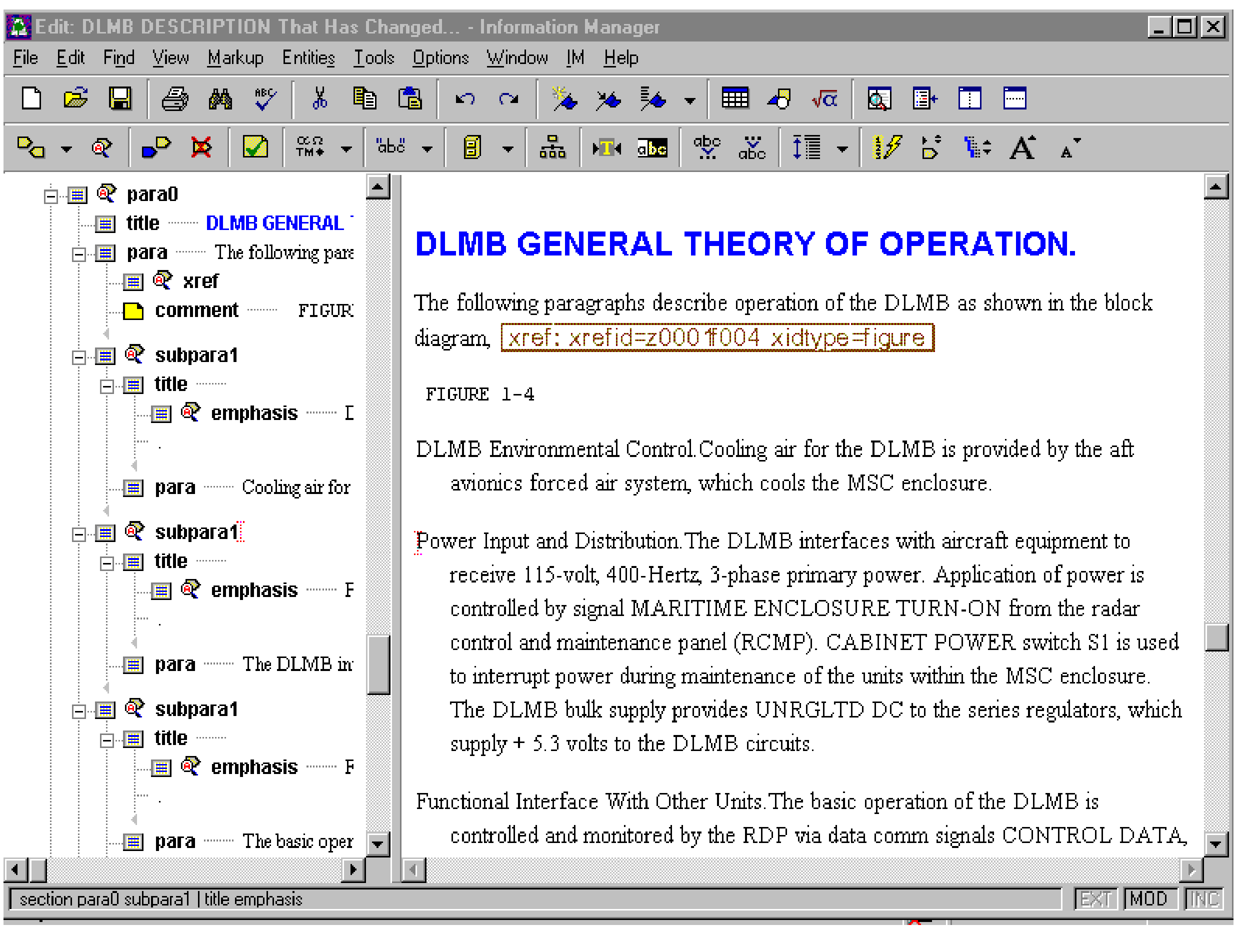


Figure A-5. Arbortext's ADEPT*Editor Interface

- Begin developing your document.

Whereas an inappropriate element could be introduced at any point within the SGML by a text editor, the ADEPT development environment permits the author to only create elements that conform to the structure defined by the DTD. A "quick tag" feature displays a list of structural elements that can be created at a particular location within the document.

A screen FOSI and a print FOSI (if necessary), conforming to the target DTD, need to be developed prior to authoring. Fortunately, many of the Services have already developed these FOSIs for popular DTDs. The graphical user interface of Arbortext can be customized using a program known as the ADEPT Command Language (ACL) which is available separately. As long as a document conforms to the DTD loaded into memory, ADEPT will accept pre-tagged SGML files. ADEPT will parse the file upon loading and ADEPT will reject the file if errors are encountered. All known SGML errors should be corrected before importing an SGML-tagged file into ADEPT.

A.6.3 FrameMaker+SGML (FM+SGML)

FM+SGML is an Adobe System product and is based upon their popular FrameMaker desktop publishing software. FM+SGML is an SGML development tool and not an IETM development program. It produces SGML that can be used as the source data for IETM viewers. The FM+SGML authoring environment (Figure A-6) provides both a WYSIWYG and an SGML view of the data during author and edit. The approach to development of SGML files is very similar to that of ADEPT. Instead of FOSIs, Adobe substitutes Electronic Display Definitions, read/write rules and SGML application support files. Through the development of filters and scripts, FM+SGML files can be exported to HTML and/or PDF for Web display. FM+SGML treats non-conforming SGML files as unstructured documents. SGML construction errors can be corrected by traversing the document and correcting as required.

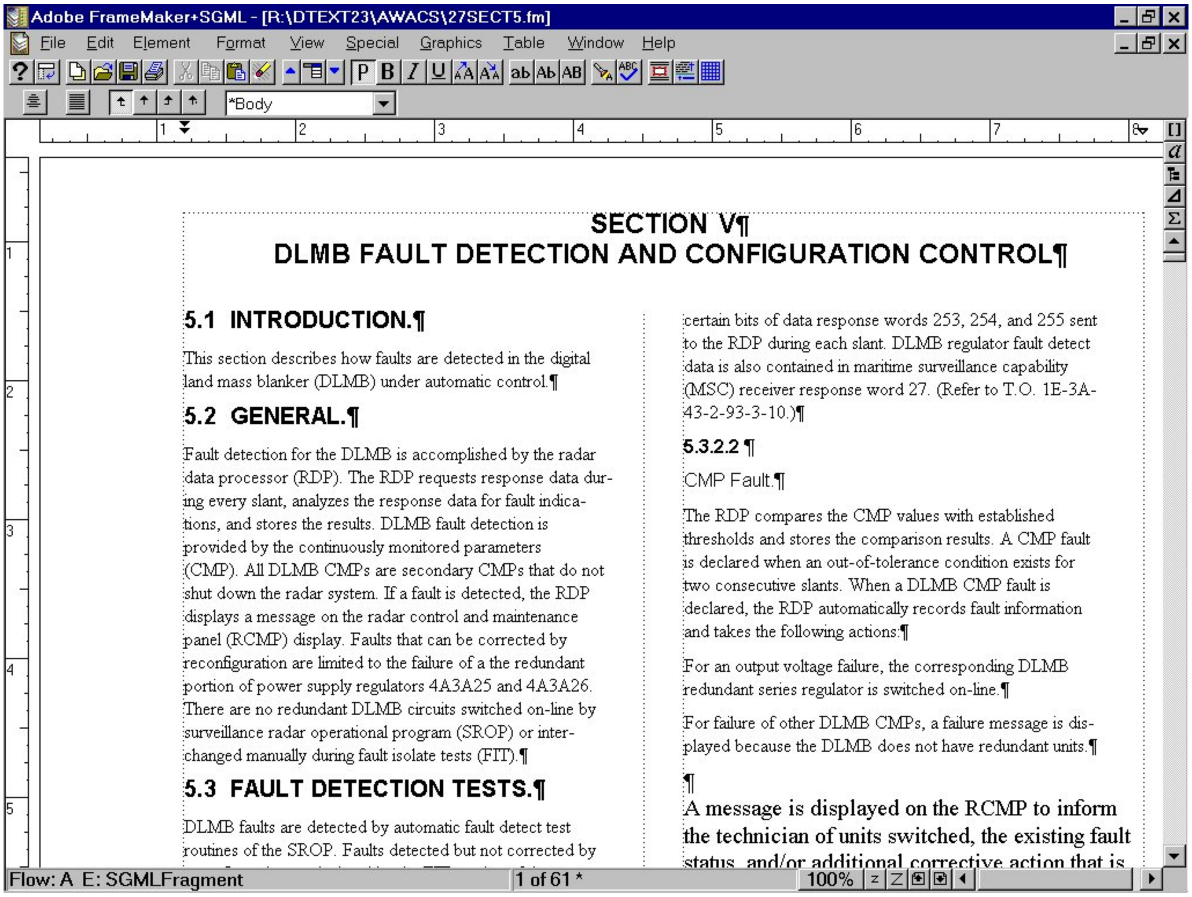


Figure A-6. FrameMaker+SGML Authoring Environment

A.6.4 IADS

The Interactive Authoring and Display System (IADS) was developed at the Army's Redstone Arsenal in response to many Army Program Manager's requests for an IETM viewing software free of licensing requirements. IADS also releases DoD from committing to any one proprietary method of displaying IETMs. It uses SGML as the source data but requires the data to be chunked, or separated into frames of logical topics. A first level paragraph can be a frame, table, or figure. The frames are given specific ID attributes and then hyperlinked based on the ID value. The resulting file is delivered with the IADS reader to view (Figure A-7) on a standard PC.

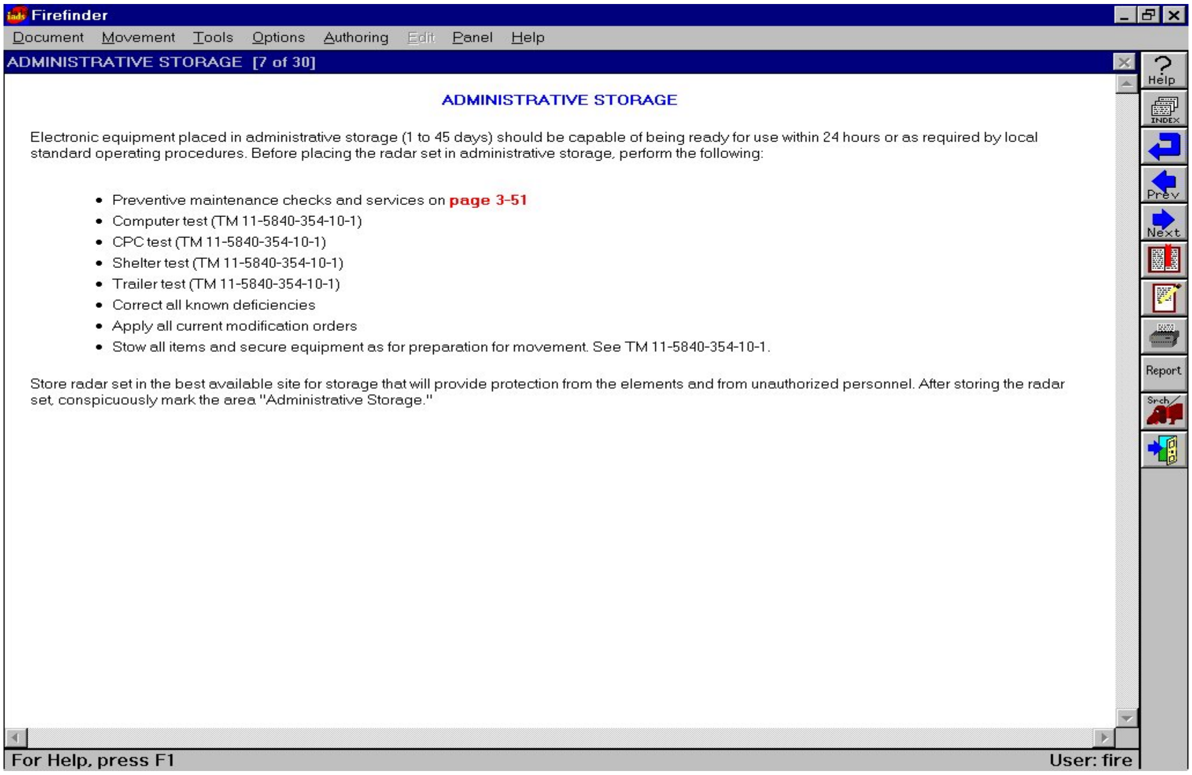


Figure A-7. IADS Reader

A.7 Developing and Editing Software - Class IV

A.7.1 TechSight

The TechSight Developer's Kit was developed for the Armed Forces as a MIL-PRF-87268/87269 compliant authoring program that provides the necessary tools to create Class IV IETMs, either as a single IETM or as part of a collection of documents which supports cross referencing and data object sharing. The TechSight database structure separates information by data type for ease of maintenance and minimum redundancy of common objects. Users have complete flexibility in authoring tools and can readily transform TechSight data to other DTDs or formats using C/NDI tools, providing data portability and durability. TechSight integrates with FM+SGML to provide SGML editing features. The TechSight Viewer provides the capability to view hierarchical illustrated repair parts, navigate procedures with complex branching, and link to integrated training modules. It also permits a feature which automatically requires the user to log-in upon accessing the ITEM. In addition to the normal views of text, tables, and graphics, TechSight provides a procedure execution mode that can be authored to show procedures (Figure A-8) either as step-by-step, or with multiple steps shown with the active step highlighted. The table viewer supports complex tables as allowed by MIL-PRF-87269, and permits the replication of complex tables that are frequently used in legacy documentation. Within a single IETM, a user can view data in multiple windows simultaneously (e.g. descriptive text in one window, an associated graphic in another, a procedure in a third, and repair part sparing and ordering information in another). The viewer also provides full navigation and search capabilities, and the ability to include notes, bookmarks and directed change notations. TechSight was developed by General Dynamics.

A.7.2 Quill

The Quill[21] system (Figure A-9) consists of an authoring system, a database and presentation tool. The authoring system is a C++ X-Windows application that populates an object-oriented database (based on the Versant engine). MIL-PRF-87269 compliant SGML is generated for the object-oriented database and parsed into a relational database for presentation. The presentation tool is a cross platform application that displays dynamically constructed panes of data. All user activity through the IETM is captured in an audit log that can be downloaded into the customer's maintenance network. The presentation system runs on the Windows 95/NT, SCO Unix, Solaris and HP operating systems using Oracle, Informix or Sybase relational database management systems. Quill[21] was developed by Boeing.