Evaluation and Recommendations for Technology Insertion into Technical Order Maintenance

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PDSS Information Management Project

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Table of Contents

Evaluation and Recommendations for Technology Insertion into Technical Order Maintenance

Abstract: As the need for mission-critical software systems increases, Post Deployment Software Support (PDSS) activities will require increased priority in planning. PDSS is "the sum of all activities required to ensure that, during the production/deployment phase of a mission-critical computer system's life, the implemented and fielded software/system continues to support its original missions, and subsequent mission modifications and product improvements."[1] PDSS, therefore, includes not only software "maintenance" but also the activities required for overall system support.

The Software Engineering Institute (SEI) recognizes the importance of PDSS activities in the life cycle of mission-critical systems. In March 1986, SEI personnel met with representatives of the Air Force Logistics Command (AFLC) at Ogden Air Logistics Center (OO-ALC), Hill Air Force Base, Utah, to determine if there were areas in PDSS that the SEI could address. The AFLC representatives described the activities performed at Air Logistics Centers and problems encountered in those activities. As a result of this meeting, the SEI authorized a feasibility study to determine how it might best interact with the PDSS community.

Between April 1986 and July 1986, SEI staff members investigated PDSS activities through documentation reviews and interviews with key Department of Defense (DoD) personnel. One common theme that emerged from all the interviews is that PDSS facilities are experiencing difficulties developing and delivering Technical Orders (TOs), which are documents that accompany software releases. Some of the reasons offered were inadequate staff, insufficient support equipment, government regulations, and reliance upon contractors. Since the management of the TO modification process presents a significant challenge and directly relates to the availability of mission-critical systems, the SEI initiated the PDSS Information Management Project. This project involves two major tasks 1) determine problem areas related to the production of TOs and 2) apply technology to the PDSS process to make it more effective. In March of 1987, members of the PDSS Information Management Project completed a milestone report that described the TO modification (or maintenance) process. The report included an analysis of that process and two major categories of recommendations for process improvement: changes to the methods and procedures, and applications of technology to TO maintenance. Project members also evaluated applicable technology and selected a documentation workstation to use in a pilot study at Ogden ALC. The evaluation and selection was completed in July 1987. This report, written in August 1987, describes the evaluation process and the ensuing recommendations for technology insertion into technical order maintenance.

1. Introduction

This report describes the evaluation process used to select an electronic publishing system for the TO maintenance pilot study conducted by the PDSS Information Management Project and includes:

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[1]Final Report of the Joint Logistics Commanders Workshop on PDSS for Mission-Critical Computer Software, June 1984

- Evaluation of the essential criteria used to establish requirements.

- Definition of the requirements for a system that will improve TO maintenance based on current technology.

- Evaluations of four commercially available systems in terms of their application to TO maintenance.

- Discussion of the impact of emerging technologies and recommendations for future action.

- Recommendation for a commercially available system to be used in the TO maintenance pilot study.

The pilot study will measure the effect of applying technology to the TO maintenance process and analyze this application in terms of productivity, quality, user acceptance, and suitability of the technology, methods, and procedures. A future report will include these findings and make additional recommendations for technology application to TO maintenance.

1.1. Scope

The evaluation and recommendations for technology insertion are based on an analysis of the TO maintenance process conducted for OO-ALC in March 1987 by the SEI[2]. The analysis is limited to F-16 A/B avionics Operational Flight Program (OFP) block changes and their effect on the following TOs:

- Flight Manual, TO 1F-16A-1

- Non-nuclear Munitions Basic Information, TO 1F-16A-33-1

- Non-nuclear Munitions Delivery, TO 1F-16A-34

1.2. Objectives

An objective of the PDSS Information Management Project was to evaluate and recommend technology for the TO maintenance process.

The TO maintenance analysis recommended three activities where technology could be employed: drafting TO changes, reviewing these changes, and preparing TO changes for printing. To meet the objective for these three activities, the following task list was developed:

- Determine technology requirements for drafting, reviewing, and publishing TO changes.

- Develop a minimal systems requirements list and evaluate selected commercially available off-the-shelf systems that meet these minimal needs.

- Establish a detailed features list to be used for developing a weighted requirements list and a weighted functional capabilities list for use in an evaluation matrix.

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[2]CMU/SEI-87-MR-8

- Evaluate selected systems and compare their capabilities to the detailed requirements lists.

- Recommend a system for use in a pilot study.

1.3. Strategy

The project used the following strategy to achieve these objectives:

- Conducted interviews with personnel involved in TO maintenance.

- Reviewed regulations and standards affecting TOs such as ISO 8879, MIL-STD 38784, MIL-STD 1840, and various waivers applicable to F-16 technical publications.

- Reviewed capabilities of state-of-the-art systems and emerging technologies in workstation and desktop publishing; text and document management database technology; and laser imaging devices; and developed a comprehensive list of capabilities available in off-the-shelf commercial systems and devices.

- Developed a weighted requirements list from the list of commercially available features.

- Selected systems for evaluation and prepared a weighted capabilities list for each system.

- Evaluated selected systems.

2. Development of Technology Requirements for TO Maintenance

The acquisition process, the format, and the content of TOs are controlled by Military Standards (MIL-STDs) and Air Force Regulations (AFRs) that are designed to enforce standardization and improve quality. An understanding of the process, standards, and regulations is necessary to evaluate the application of technology to TO maintenance.

2.1. Process Overview

TOs are one of the deliverables contracted for and developed during the acquisition phase of weapons system procurement. The System Program Office (SPO), which is responsible for acquisition, manages the TO development effort through in-progress reviews, conducted at 20%, 40%, and 80% design completion milestones. When completed, and prior to deployment, the TOs are validated by the Air Force Plant Responsibility Office (AFPRO) and the prime contractor. The validated TOs are then released for printing to a Government Printing Office GPO authorized printer, and a preliminary version is verified by the using command. Once verified, the TO is released for general distribution. After acquisition is completed, the SPO typically maintains responsibility for the system and the TOs until the number of outstanding residual tasks is reduced to some satisfactory level, at which time Program Management Responsibility Transfer (PMRT) to an Air Logistics Center (ALC) occurs.

After PMRT, the System Program Management (SPM) office at the designated ALC is responsible for TO maintenance, validation, and verification. However, PMRT may occur before the completion of all residual tasks, resulting in multiple management centers for the TOs. The responsibilities of the SPM towards the TOs include maintenance resulting from enhancements, corrective measures, or content and format errors, validation, and verification. The validation and verification of TOS as performed at the ALC is not as thorough as that conducted during acquisition, due to the limited impact to the TOs of a typical maintenance effort. These "reviews" may consist of desktop reviews conducted before and after flight test, or review during Time Compliance Technical Order (TCTO) "kitproofing".

2.2. Standards and Regulations

As in any other area of weapons system procurement, TOs are acquired and maintained according to regulations and standards that describe the content, format, and process used to create the deliverable and maintain it. This body of standards and regulations is designed to ensure the quality, consistency, usability, and maintainability of the TOs by specifying features such as:

- Page design, typesetting considerations, and presentation structure such as sectioning levels and list structures, standardization of warnings, notes, cautions, etc.

- Description of the types of material to be provided in each type of publication, description of the intended audience and reading levels, etc.

- Conformance with digital interchange requirements.

These standards had an impact on the evaluation of technologies to be used in the pilot study, since specific capabilities are mandated.

2.3. Information Design for Content, Format, and Structure

Several key issues emerged as the PDSS Information Management Project determined how technology might be applied to the maintenance of TOs. These issues include: information design and its impact on document maintenance; recognition of the information maintainer's perspective and role (especially engineering) in the TO maintenance process; and the emergence of TO specific requirements, not generally encountered in other technical documentation environments.

Information design is a term employed by the project members to describe the process of developing a model or schema (or an instantiation of a model or schema) that defines classes and instances of the information content of technical documentation from contextual, structural, and presentational perspectives. No such model or schema has been developed. Rather, project members have used the concept to describe an abstraction for the purpose of focusing attention on the impact of additional document structures relative to document maintenance.

Many of the commercially available electronic publishing systems employ a document data structure that is essentially a serial stream of formatted text and graphics. This is not an effective way to represent certain types of technical documentation. TOs are representative of technical documentation for which a more complex data structure is advantageous. Consisting of maintenance and operational manuals, their information content and format are well defined, highly structured, and repetitive, with significant shared information. By using a data representation that considers these characteristics, the maintainability of the information may be enhanced.

Enhanced maintainability could be achieved by using an information design that provides an interface to database-oriented data management techniques that are known to have significant information maintenance advantages. For example, content-oriented information design will allow repetitive information to be recognized and shared. When combined with database management architecture, such an approach allows redundant data to be eliminated. This reduces storage requirements, enhances data integrity, and improves configuration management and version control (CMVC) by allowing an instance of an object in the database to represent all occurrences of that version within the TO library. Other advantages include enhanced information retrieval through the information relationships represented in the database and the ability to provide highly granular concurrent access to the TO library.

As an example of the application of these techniques to the F-16, consider some of the graphic elements contained in operational TOs. Most of these graphics represent information displays within the cockpit of the F-16 such as the Head Up Display (HUD), Radar Electro-Optical display (REO), and the Stores Control Panel (SCP). For one such display, the same graphic, or a similar version, is repeated more than 100 times within a single TO. When effecting a change to this graphic using an unstructured digital document representation, a manually oriented procedure is required. Each instance of the graphic within the TO library must be located and changed. By

contrast, using a structured representation of the document, each graphic would be represented by a single data object, or as a collection of data objects. In this case, the data object to be changed can be located and changed once, resulting in implied propagation of the change to all related data objects.

2.4. Information Maintainer Perspective

The analysis of the TO maintenance process that was conducted by the PDSS Information Management Project revealed that new technology initiatives should be directed at the information maintenance process as viewed from the information maintainer's perspective of the TO, that is, the engineer's view. As represented in the OO-ALC TO maintenance process model, and more generally in most technical documentation environments, an engineer or an individual with engineering background is responsible for drafting, reviewing, and approving modifications to the TOs or technical documents. In many instances a similarly trained individual edits the document as well. Due to their largely manual, paper-intensive characteristics, these activities provide a good opportunity for cost-effective technology insertion and a base for future expansion into other activities such as distribution.

At OO-ALC two engineering groups participate in the TO maintenance process when changes are the result of software modifications. During the TO maintenance cycle, both groups assume the role of information maintainer. A software engineering group assumes responsibility for initiating change and are, therefore, responsible for the work-in-progress version of the TO. Equipment specialists, item managers, and other engineering staff, under the direction of the SPM, form the second group and assume responsibility for the review and approval of changes to the TOs. They, therefore, assume the information maintainer role for the current approved version of the TO. Drafting, review, approval, and technical editing of the TO are maintenance activities the information maintainer performs. Although the responsibility for performance of these activities may vary depending on the amount of contractor support (some of these activities may be performed by the contractor), these TO maintenance tasks are still performed by personnel with similar training, background, and responsibilities.

Previous automation efforts within the Air Force have not addressed TO maintenance that results from software maintenance from this perspective. Instead, efforts have been largely focused on automating the document preparation and distribution activities. However, by moving the automation of TO maintenance further upstream in the process, the information required for this maintenance can be captured at the source—engineering. By providing electronic access to the document during the drafting, reviewing, and approval of changes to the TOs, improvements in efficiency and control can be realized.

As an example, consider the TO maintenance resulting from a modification to weapons systems munitions. Such changes generally involve software modifications that would impact Stores Management Systems (SMS) and Fire Control Computer (FCC), and the maintenance and operational TOs that are affected by these systems. These would typically include the Flight Manual, Munitions Delivery, and Munitions Loading operational TOs as well as related maintenance TOs,

Illustrated Parts Breakdowns (IPBs), and Fault Isolation (FI) TOs. In each of the affected TOs, changes will be made to the text, tables, and graphics that describe the operation and maintenance of this munition. As the software engineer prepares to make the required changes, the design specifications would generally include the information that will be used to modify this TO data, such as the changes to be effected to cockpit displays and munitions tables.

The existing TO maintenance process, being entirely unautomated from the engineering or information maintainer's view, requires a manual search through the TO library to locate all affected areas, preparation of forms for the implementation of the review and approval process for each change, subsequent editing of this data, and conversion of this information to electronic format for the production of operational supplements and change pages. Obviously, the automation of these activities will have positive impact on the TO maintenance process, from the engineering perspective, by improving productivity and control.

An analysis of these activities for the purpose of developing TO maintenance requirements suggests that document maintenance features will have greater potential for process improvement than less used general publishing features. Capabilities such as configuration management and version control, multi-author/editor access, concurrency control and data integrity, nondestructive editing and annotating capability, and information representation/structure are essential document maintenance requirements. Although useful, publishing features such as document design, formatting, composition, hyphenation, and pagination are generally not as important in a maintenance environment. Document maintenance is the primary activity of the information maintainer's in this process, and the evaluation matrix requirements weighting is designed to reflect this.

2.5. TO Specific Publishing Requirements

Another issue that must be considered when establishing TO publishing requirements is the differences between technical publishing requirements that are specific to TO maintenance and technical publishing requirements in general. This comparison revealed several distinguishing features due to the considerable differences between the complexity and lifespan of the systems described by TOs (weapons systems) versus the type of system described by a typical technical publication.

Weapons systems represent some of the most complex and sophisticated systems in the world. This complexity affects the associated TOs by increasing the textual, tabular, and graphical data required to operate and maintain the system. A modern weapon systems TO library can consist of several thousand TOs, totaling a million pages of operational and maintenance information. TOs are designed to be used in combat conditions, possibly by relatively inexperienced personnel who may have minimal pre-military training, and potentially transient job responsibilities. In addition, the TOs themselves are subject to continual and significant change.

The constant change to TO content is, in part, due to the combined effect of:

- Weapon system lifetimes exceeding 35 years, resulting in decades of maintenance.
- Rapid technology advances leading to a desire for retrofit of new capabilities on existing systems.

- Lead time and cost of developing new weapons systems, which encourages the redesign of existing systems.

- Mission-critical nature of weapons systems requiring accurate, easy to use, and understandable TOs.

- Impact of multiple user groups such as USAF, EPAF, and FMS, each having different and changing requirements.

These factors create an environment of continual change due to retrofitting new armaments, changes to electronic counter measures, addition of new mission capabilities, updates to improve usability of the TOs, etc. Many of these modifications have a significant effect on OFP software and the TOs that are affected by OFP modifications.

Configuration management and version control requirements are also more critical in weapons systems due to the above factors. While CMVC can be issues in other areas of technical publishing, weapons system lifetime, the needs of multiple users, and the impact of multiple management centers make these features critical for TO maintenance. The F-16 A/B can be configured differently for each of the user groups—USAF, EPAF, and FMS. These multiple configurations are tailored to specific needs and allowable options. While responsibility for maintaining and coordinating TOs for USAF, EPAF, and FMS users lies with the prime contractor, the Air Force PMRT process and its effect on the TO must be considered. The F-16 A/B, perhaps an atypical example, has had at one point in its life cycle at least three centers of management for TOs—the F-16 A/B SPO; Ogden ALC; and the prime contractor, General Dynamics. To effectively handle concurrent TO maintenance in this environment, an integrated database that supports CMVC is necessary.

An additional aspect of extended weapons system lifetime is the indirect effect on logistics support equipment such as Automated Training Devices (ATD), Automated Test Equipment (ATE), etc. As the weapons system will be extended to realize the potential of new technology, it would be desirable to allow support systems to take advantage of similar advances. An automated TO system, containing complete TOs in digital format, can be assumed to be part of such weapons system support equipment. As advances may be expected in logistics support technologies and methodologies over the weapons system lifetime, migration potential must be considered. In addition, current USAF and DoD initiatives such as Computer Aided Logistics Support (CALS), Integrated Design Support (IDS), Improved Technical Documentation System (ITDS), and Integrated Maintenance Information System (IMIS) are proposing significant changes in the structure, content, and usage of TOs. These continuing efforts to integrate acquisition and logistics engineering data (CALS and IDS), and to develop new methods of presentation (ITDS and IMIS) will require that the future acquisitions accurately specify the digital information/data interchange requirements between the Air Force and the prime contractor.

Emerging document definition standards and information management concepts will provide improved methods of information design for capturing and representing the information content and structures within TOs. Specifically, the use of object-oriented database technology, Hypertext systems, and the use of Standard Generalized Markup Language (SGML) (International Organization for Standards (ISO) 8879) to define document content, structure, version, and format all

show promise for improvement over existing methods. Through the use of these information management, storage, and definition capabilities, documents can be structured to represent different usages and user views, content, components, functions, and their relationships. Including this information in the TO database enhances current capabilities and provides the mechanism for enabling future methods and technologies.

As stated, the development and maintenance of TOs places additional emphasis on a specific set of technical publishing capabilities found in commercially available systems. While many of the features of commercial systems will provide some improvements in the TO maintenance process, it is these TO specific issues that have the most impact. These issues were prime considerations during the development of the minimal and detailed requirements lists used as selection criteria for vendor evaluation.

3. Requirements

3.1. Minimal Requirements

The minimal requirements for the publishing system were designed to accomplish two objectives: to provide a general framework for developing detailed requirements; and to restrict the scope of the evaluation, making it more manageable. These minimal requirements are:

- "Workstation" type computer platform.
- Interactive WYSIWYG (what you see is what you get) capabilities with mixed text and graphics.
- Document size capabilities in excess of 5000 pages.
- Visible installed customer base.
- Off-the-shelf components.
- Optical character reader and graphic scanner input capability.
- Laser printer output capability.

While these requirements tend to eliminate from consideration one of the fastest growing fields in electronic publishing, "desktop publishing," such restrictions were justifiable given the state of the art at the time of initial inquiry. Based on expected developments in the near future, a follow-up study to explore the potential in desktop publishing would be advisable at the conclusion of the project.

3.2. Detailed Requirements

The detailed requirements evaluation matrix in Appendix A was developed from: the evaluation of the specific needs of TO maintenance as described in Section 2; prior knowledge of the publishing industry; and from data gathered during the initial selection process using the minimal requirements list. The detailed requirements contains a broad range of commercially available features and application-specific needs. When used for evaluation, specific detailed requirements were weighted based on application needs. Each system evaluated was similarly weighted based on capability, then the weighted needs and capabilities lists were compared to determine the best match.

The evaluation matrix is divided into sections to assist in the analysis. Each section focuses on a particular aspect of automated electronic publishing systems. The following describes each section and provides some insight into its objectives.

3.2.1. User Interface
While all of the systems that met the minimal requirements have similar high-quality user interfaces, there are some subtle differences that can have an impact on acceptance and usability. Of particular importance is the ability of the system to meet the needs of both novice and expert users. Features such as online help, online error reporting, icons, pull-down and pop-up menus,

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graphics mouse, graphics tablet, and typewriter style keyboard all assist the new user to quickly assimilate system operation. After experience is gained, efficiency is increased and fatigue reduced by user-defined command sequences and macros bound to function keys; menus or icons; editable and executable command historys; tailored or default menu traversal; and similar customized user interface features.

Also of interest, as a publishing system user interface criteria, are WYSIWYG displays and their ability to accurately represent the final output. Due to differences in screen and output resolution, the actual position of elements on a page cannot always be accurately displayed. This can make it difficult for an operator to position adjacent elements in close proximity. Similar issues are the method used to represent typefaces and the accuracy of width values used for justification pur-poses. The advantages of WYSIWYG systems are lost when hardcopy page proofs must be created to assess the effect of composition, pagination, and the positioning of elements on the page.

3.2.2. Input Devices, Formats, and Filters

To build a TO database as required for TO maintenance, the textual, tabular, and graphical data must be used as input to the electronic publishing system. While it would be possible to recreate this data, capturing existing paper or digital data is preferred. The evaluation matrix identifies the ability of the electronic publishing system to accept data from a variety of sources, and any specific TO maintenance requirements or specific device or input format compatibility. The list of input devices and formats is far from comprehensive, but does contain a representative sampling of a few commonly used devices and formats for textual, tabular, and graphical input.

The existence of standards for the representation of textual, tabular and graphical data has yet to have significant impact on the ability to transfer these items in a digital format between different systems. In fact, even where standards are used, incompatibilities exist. To enhance intercon-nectivity, many vendors provide filters to assist in the conversion of data from various external formats into one compatible with the vendor's system. Logistics limitations did not permit a detailed evaluation of these capabilities.

3.2.3. Output Devices, Formats, and Filters

The evaluation matrix contains evaluation criteria that identify the ability of the electronic publish-ing system to output textual, tabular, and graphical data to specific devices and in specific for-mats, and identifies any TO maintenance specific requirements, devices, or formats. Output re-quirements for TO pages are in part dictated by MIL-STDs and AFRs. MIL-STD 38784 dictates that output be in "camera-ready" format. During the analysis of the TO maintenance process, project members determined that, in addition to the phototypesetting technology currently employed, laser printers would satisfy this requirement. For this reason both phototypesetter and laser printer devices and formats are included.

As a gauge of system interconnectivity, the ability to output data in standard digital formats is also evaluated. Logistics limitations did not permit a detailed evaluation of these capabilities.

3.2.4. Creating and Editing Text, Tables, and Graphics

The evaluation matrix includes evaluation criteria for system features that aid the user in creating and editing the content of the document after it has been entered into the system. These are primarily interactive features that the operator uses during document maintenance. To facilitate the evaluation, the matrix is subdivided into sections for creating and editing text and tables using both a vendor supplied text editor capability and in interactive WYSIWYG mode; and creating and editing graphics in interactive WYSIWYG mode.

The matrix also contains specific requirements that address the document maintenance features described in Section 2. Features such as annotation and nondestructive editing provide document maintenance operations with a system-maintained audit trail.

Other requirements included to determine the ability of electronic publishing systems to create and edit texts and tables are: batch and interactive spell checking with user expandable dictionary; exclusion dictionary and interactive assistance; interactive thesaurus; usage alert for the recognition of repeated and improper phrases; and a readability index to assist in automatic testing of compliance with readability guidelines defined in MIL-STD 38784, etc.

Technical publications generally contain data that is best communicated through the use of tables. Operational TOs contain tables that describe F-16 flight and weapons operational characteristics. Since these tables are frequently changed during modifications to OFP software, extensive requirements for table maintenance are included in the evaluation matrix.

Finally, a list of requirements for creating and editing graphics is included. The F-16 operational TOs contain some graphics that are directly affected by OFP software. In particular, electronic displays such as the HUD are driven by OFP software, and significant changes to these graphics can result from an OFP software change.

3.2.5. Document Design, Composition, and Pagination

The evaluation matrix also addresses the ability of the electronic publishing system to meet the requirements of maintaining and publishing structured documents in accordance with AFRs and MIL-STDs. To facilitate the document formatting and publishing functions and simplify these details for the information maintainer, the electronic publishing system must be capable of managing these functions automatically once the document structure has been defined The evaluation matrix establishes the document element types that can be defined, and the attributes that can be specified for each. Attributes include items such as composition, pagination, and document assembly parameters. Also included are document design, composition, and pagination features such as interactive design, design inheritance, hyphenation dictionary and control options, pagination options, auto-numbering, auto-referencing, auto-indexing automatic table of contents, multilevel indices, effective page lists, itemized and enumerated lists, etc.

3.2.6. File and Database Management and CMVC

The data management capabilities of an electronic publishing system will determine its ability to represent the underlying structure of TOs, manage multiuser access, and provide system security and archiving. These capabilities are assessed in the evaluation matrix. Of particular importance is the capability of the system to support a segmented document. The system should allow a document to be decomposed into separate elements that can be accessed individually and also accessed as a logically merged set of elements that comprise the document. Pointers within the document to included elements should be logical pointers that are resolved upon reference. The system should include the ability to support libraries of textual, tabular, and graphical elements. The system should provide access to document elements and library elements and manually and automatically merge these components at document assembly. The system should include CMVC features such as parallel versions, version status, and consideration of version when merging document and library elements.

3.2.7. Communications and Networking

As the minimal requirements specify a workstation environment, communications and networking capabilities are necessary to maintain common document elements such as libraries. The matrix evaluates these features and assesses connectivity between workstations, file servers, and input/output devices.

3.2.8. System Management and Job Control

Basic system management and application job control features are included to determine system maintainability.

3.2.9. Hardware

Hardware evaluation criteria included in the matrix address the issue of standard, commercially available, off-the-shelf hardware. While these features represent a logistics requirement for the pilot study, they are also a good predictor of a systems ability to enable new technology. Hardware of this type is designed and built to provide a base for expansion to meet users' needs and generally is easily interfaced to previous and future generations of the vendors product line. By specifying common hardware platforms, flexibility and system useful lifetime are enhanced.

Basic hardware specifications such as memory capacity, disk storage, etc, are also included.

4. Evaluation

The evaluations consist of narrative descriptions of system features and a matrix analysis in Appendix A that compares system features and TO maintenance requirements. The narratives provide additional background for the evaluation matrix and describe specific vendor features that are required for TO maintenance in greater detail.

It is important to understand that the evaluations were based on the suitability of the systems for the TO maintenance process that was described in the PDSS project's previous milestone report [3]. The systems chosen for detailed evaluation met the minimal requirements, and were considered to be among the best systems available for general use in technical and nontechnical publishing environments. The systems that were selected for detailed evaluation were Context, Interleaf, Texet, and Xerox. An RFI was sent to NBI systems, which was selected for detailed evaluation. However, a more detailed review was not conducted after it was determined that the NBI system was based on proprietary hardware.

4.1. Context

4.1.1. Summary

Context Corporation is a recently formed subsidiary of Mentor Graphics. The Context system emphasizes a team approach to the development of documentation. The system is based on knowledge gained from Context's association with Mentor Graphics and major manufacturing companies in aerospace, computers, and electronics. Context offers several interrelated products that are targeted towards the individual members of a documentation development team. These products (including Documentor, Context Editor, Context Engineering Writer Plus, and PicED) operate in a shared distributed database environment referred to as a Documentation Network. The members of the documentation team—writers, editors, illustrators, engineers, and document designers—can access a document simultaneously for review and annotation. For concurrent editing, a structured document may be accessed by multiple authors/editors on a component basis. The system manages version control for each of the elements included by reference (i.e., a pointer to the component is included in the document) to ensure that changes to a component are correctly propagated to the parent document.

Context has excellent CMVC control features, a powerful editing capability, and excellent documentation data structuring techniques. Context also provides an audit trail of changes to documents. The system is weak, however, in actual page layout and typesetting features. Since the concerns of the PDSS project were more in the area of documentation development rather than publishing, Context was considered to be a very good candidate.

Also evaluated were the Context table package and the Context change control feature, new offerings that are currently in beta test and available for release to qualified customers.

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[3]SEI-87-MR-8

4.1.2. User Interface

The Context system user interface consists of a 19" high-resolution color monitor, with full page display capabilities, keyboard, and a mouse. Icons, menus, function keys, an editable command history window, and the keyboard provide the operational interface to the system. Commands may be bound to keys or menu items, and a macro language is provided for the creation of more powerful command sequences. Information is displayed in interactive WYSIWYG mode, and text and graphics representations are accurate.

4.1.3. Input Devices, Formats, and Filters

Context supports the Scantek graphics scanner and the Kurzweil optical character reader. Various word processing formats are supported through a text filter. The Context system includes a text formatting interface (DOC Metafile (DMF)) and a graphics formatting interface (PicED MetaFile (PMF)), which are provided to vendors as a text or graphics import language. Autotrol and Mentor Graphics have developed translators that convert their native formats into PMF.

4.1.4. Output Devices, Formats, and Filters

The Context system supports laser printers and phototypesetters as output devices. Postscript, imPRESS, and DDL output formats are available.

4.1.5. Creating and Editing Text, Tables, and Graphics

Text and graphics may be created and edited at the Context workstation. The PicED software provides sophisticated graphics functionality. The Table Generator package supports the creation and editing of complex tables. Text editing features such as search/replace, interactive spell checker, and a macro language for processing text files are also available.

The Context system also includes a "change control" feature (currently in beta test) that enhances the ability to edit text through the use of a nondestructive editor with an annotation feature for including referenced comments in the document. Users editing or reviewing a document perform their edits in a nondestructive mode that retains both the original and the edited text, table, or graphic. Inserted or deleted elements are highlighted using assigned colors or background shading. Deletions are indicated by a strike-thru line in addition to the color or background shading. Either the original text or edits may be edited without conflict. The system links all change segments to a user defined change name that includes the user's id, time and date created, time and date last modified, and two optional user defined fields. The user may also add an annotation that describes or provides justification for the edit. During review, edits from one or more users may be selected for display. The reviewer can then include or exclude any edit, creating a new document from the original and the reviewer's selected changes. When the review process is complete, the document may be baselined to "freeze" these edits in place and prevent further editing.

4.1.6. Document Design, Composition, and Pagination

The Context system provides interactive document design and supports structured documents. Templates are used to specify the attributes of a specific document structure and are referenced through template formatcodes contained in the document.

4.1.7. File and Database Management and CMVC

The Context data management provides automatic inclusion of document components through reference. A pointer is maintained within the document to the component to be included, providing automatic updates whenever components are revised. Context automatically keeps two versions of each component, a user defined configuration parameter allows for more than two versions within the limitations of available disk space.

4.1.8. Communications and Networking

The Context system was designed to support a network of users who comprise the documentation team. Through the Apollo Domain network or Ethernet link provided, users may share documents in a distributed environment. One Context customer utilizes satellite links in their Documentation Network.

4.1.9. System Management and Job Control

Support for system management and job control are provided through the operating system. Operating system access is provided through a window.

4.1.10. Hardware

The Context system uses an Apollo workstation platform. The evaluation matrix provides further details.

4.2. Interleaf

4.2.1. Summary

Interleaf Inc., established in 1981, provides electronic publishing systems for many types of publishing environments. Interleaf offers workstation publishing systems that are targeted towards specific environments. For this study, their Technical Publishing Software (TPS) release 3.0 was evaluated. Information on release 4.0 was also made available to determine what features future releases might provide.

Interleaf was found to have a good base package with excellent support of graphics. The company also had plans to support the Standard Generalized Markup Language (SGML), which is being proposed as a standard for all Technical Order development. However, project members did not feel that the data structuring, editing, and annotation features provided by Interleaf were strong enough to be used in the TO modification process that had been defined for the project.

4.2.2. User Interface

The Interleaf system user interface consists of a 19" high-resolution monitor capable of displaying full-page documents in interactive WYSIWYG mode, a keyboard, a mouse, and a graphics tablet. Functional interface to the TPS software is through the use of the mouse and keyboard to manipulate icons and menus on the display. Graphics elements may be entered by tracing on a graphics tablet. Text and graphics presentation in WYSIWYG were accurate. New releases of the Interleaf software will allow the user to bind icons to operating system commands.

4.2.3. Input Devices, Formats, and Filters

Interleaf accepts graphics input from an interleaf image scanner and various industry standard graphics formats such as Calcomp 925 and 960, IGES, HPGL, MacDraw, and MacPaint. Text may be input from various word processors and personal computers in various formats such as Digital DX, Wang, WordStar, nroff, troff, and Scribe. An ASCII filter program is provided to convert files for which a specific filter is not available. Interleaf plans to provide compatibility with SGML in a future release.

4.2.4. Output Devices, Formats, and Filters

Laser printer and phototypesetter outputs are available. This data is contained in the evaluation matrix and is largely self-explanatory.

4.2.5. Creating and Editing Text, Tables, and Graphics

An interactive WYSIWYG mode provides powerful facilities for creating and editing text and graphics. As text is entered and edited, composition, pagination, and document assembly occur simultaneously. An extensive set of features is provided for manipulating graphics images in both vector and raster format. No capabilities for document annotation or nondestructive editing are available, but future revisions will include this capability.

4.2.6. Document Design, Composition, and Pagination

The Interleaf system provides a publishing/word processing interface for creating text. A document is created or recalled using icons corresponding to office filing system components. Each document consists of components that are named and defined by the user. A variety of attributes may be defined for each component. A set of documents may be organized into a book using the book icon. This feature provides segmentation of a book document into subordinate documents, thereby allowing merging of separate document elements.

4.2.7. File and Database Management and CMVC

The Interleaf system does not provide automatic inclusion by reference features to merge documents except through the book feature, which is designed to support segmentation at the chapter level. The file structure used to represent a document is generally flat and does not contain a hierarchical structure. Access controls provided are dependent on the operating system platform.

4.2.8. Communications and Networking

Interleaf provides networking through the communications facilities of the specific operating system/hardware platform selected. Local area networks capabilities are available.

4.2.9. System Management and Job Control

Interleaf provides access to the operating system through a terminal emulation window and icons, which will be user definable in future revisions.

4.2.10. Hardware

Interleaf is a multiplatform software application. The TPS software runs on Apollo, Sun, and VAX workstations.

4.3. Texet

4.3.1. Summary

Texet was formed in 1982 to solve the problems of corporate publishing: high volume, quality sensitive, merged text and graphics, pagination capability, document structure, and user interface. Texet offers two publishing systems, one based on proprietary architecture and a second based on the Sun workstation. From a user's functional perspective these systems are nearly identical and represent two generations of the Texet system.

Texet, in the opinion of the evaluators, was found to be more of a publishing system than a documentation development workstation, in that the interactive editing and annotation features were inadequate for TO modification process. Texet does support, to a degree, SGML and IGES, which could make it compatible with other systems in the Air Force inventory.

4.3.2. User Interface

The Texet system offers 19" and 20" high-resolution monitors that display full-page documents in interactive WYSIWYG mode. A keyboard and mouse are included for user input into the system. Texet uses a menu displayed in a window at the right side of the screen for access to system functions. Text, displayed in actual size and position using representative fonts, is integrated with graphics on the display, and the presentation appears accurate with respect to dimensions and position. User programmable function keys are provided for frequently accessed mouse or keyboard sequences.

4.3.3. Input Devices, Formats, and Filters

Texet accepts graphics input from the Texet ImagiTex and ECRM Autokon graphics scanners, and from CAD systems in IGES, HGL, MacDraw, and MacPaint formats. Text may be input from the Texet Live Copy 6000 Crystal Writer Plus system; Optical Character Readers including Kurzweil, AT&T, DEC, Wang, and Quadex word processing systems; and in Digital Standard Runoff (DSR), UNIX mm, UNIX tbl, and Scribe formats. An ASCII filter program, Wildcard, is provided for creating other text translations. Texet also supports SGML using a vendor defined DTD.

4.3.4. Output Devices, Formats, and Filters

Laser printer and phototypesetter outputs are available. A variety of formats are supported as represented in the evaluation matrix.

4.3.5. Creating and Editing Text, Tables, and Graphics

Texet provides an interactive WYSIWYG mode for creating and editing text, tables, and graphics. The tabular capabilities are very comprehensive. Raster and vector graphics are supported. Callouts or labels within graphics can be composed as regular text. A variety of graphics editing features are provided as specified in the evaluation matrix. The text and tables of a document can be output to a flat file with embedded formatting codes. This file can be edited using the Texet Live Copy 6000 editing system.

4.3.6. Document Design, Composition, and Pagination

Document design is performed using The Designer. The Designer utilizes the document window and a document design checklist that allows the user to define the document elements and their attributes. Text is tagged with formatting codes that reference a document element to provide the composition and pagination software with the correct attributes. Several versions of the same document may be created by defining different design specifications. The user may override attributes within the text when required.

The Texet composition software includes hyphenation, word spacing, and kerning to produce high-quality typographic composition. The tabular composition features are extensive.

Texet pagination includes automatic and interactive modes. Extensive automated pagination features are provided as depicted in the evaluation matrix.

4.3.7. File and Database Management and CMVC

The Texet system allows textual, tabular and graphical data to be included in a document file by reference, but these references are resolved at the time the document is formatted for WYSIWYG display. To provide document segmentation with automatic inclusion by reference to information from libraries, etc, it would be necessary to "flatten" the document file by converting it into an ASCII file with embedded format codes, then "rebuild" the document by converting back to WYSIWYG mode.

Access controls are dependent on the operating system platform.

4.3.8. Communications and Networking

The Texet system uses Ethernet to provide networking support for multiple workstations. Features supported are described in the evaluation matrix.

4.3.9. System Management and Job Control

In addition to system management features available through the operating system platform, Texet provides a composition report that lists the position, of loose lines, paragraph widows, and algorithm-generated hyphenation.

4.3.10. Hardware

Texet provides two hardware platforms: the Texet Live Page 9000 system based on proprietary bit-slice logic, and the Live Page 3000 operating on a Sun workstation platform. The two systems should be seen as different generations of the same system, with the current offering being the Sun system.

4.4. Xerox

4.4.1. Summary

Xerox Corporation is a well established vendor of reproduction and computer-based publishing systems. Xerox contributions to the workstation environment, such as the Xerox Star system, were the foundation for WYSIWYG, icon, and mouse-based interactive systems. Xerox offers a variety of interactive and batch electronic publishing systems that operate on proprietary Xerox hardware as well as a variety of host systems including Apollo, Data General, Dec, Honeywell, IBM, Perkin Elmer, Prime, Univac, and Wang. The Xerox XPS-701 system was chosen for this evaluation.

4.4.2. User Interface

The XPS-701 system includes a 19" high-resolution monitor, keyboard, and a mouse. The keyboard, mouse, icons, and menus displayed on the terminal are the user's interface to the system. User-defined function keys are provided for the entry of repetitive sequences of keystrokes. The Fast Path User interface allows the user to specify default menu sequences for quick access to repetitive menu operations.

4.4.3. Input Devices, Formats, and Filters

Input sources include magnetic tape, text and scanners, and terminals/computers through RS232 interface or Xerox Ethernet. Xerox recommends a separate graphics workstation for creating and editing graphics. Graphics data prepared on this system is then passed to the XPS-701 system for inclusion in a document. Xerox provides an ASCII filter program for translating text created in other formats to the format required by the XPS-701.

4.4.4. Output Devices, Formats, and Filters

Xerox supports laser printer and phototypesetter output in the Interpress page description language. Other formats are available.

4.4.5. Creating and Editing Text, Tables, and Graphics

Text, tables, and graphics may be created and edited at the XPS-701 workstation, but a separate graphics workstation is necessary for sophisticated manipulation of graphical data. A feature for creating and editing forms is also provided.

4.4.6. Document Design, Composition, and Pagination

A document design facility is included that provides for the definition of document attributes and document element attributes that are associated with generic copymarks in the text. This association provides access to the attribute definitions of a particular element, simplifying markup.

The XPS-701 composition software includes logical and dictionary hyphenation, table composition, and other composition features based on the Xerox Integrated Composition System (XICS) command set.

Both automatic and interactive pagination/document composition are provided as part of XICS. Table of contents, footnote, and paragraph numbering are provided. Graphics elements are merged and vertical page justification occurs during this process.

4.4.7. File and Database Management and CMVC

The XPS-701 system allows graphics to be included in the document file by references that are resolved at document assembly time. Automatic inclusion by reference would be possible by converting the file to a XICS file, then converting back to a WYSIWYG format.

4.4.8. Communications and Networking

The XPS-701 supports the Xerox Ethernet network for interconnection between workstations and other systems in the Xerox family of publishing systems.

4.4.9. System Management and Job Control

The XPS-701 provides several system management and job control features that assist the system manager in defining the file structures, controlling access to it, and reporting on document and user status. Integrated into the XPS-701 software environment is the ability to create and manipulate user accounts and file structures, and to assign user file and operational access privileges. A reporting feature enables the system manager to generate a report detailing user, account, project, job, operation, and activity within a given time and date range. Backup and recovery operations are also available.

The XPS-701 does not provide a user interface to the operating system.

4.4.10. Hardware

The XPS-701 was demonstrated on a VAXstation platform. The evaluation matrix provides further details.

4.5. NBI Office Automation Systems

Prior to formalizing the minimal requirements, a preliminary RFI was sent to NBI. A cursory evaluation of their system was conducted at their facility. Due to the proprietary nature of their hardware, NBI was not considered for a detailed evaluation. Consequently, there was insufficient data to allow their system to be included in the matrix analysis or evaluation narrative.

5. Recommendations

At this time, only the Context system satisfies most of the emphasized requirements. For this reason it represents the best choice for the pilot study. The emphasis Context places on document maintenance is reflected in the capabilities of their system. Document maintenance is only now being recognized by other vendors as a critical requirement for electronic publishing systems that address the entire life cycle of a technical document.

6. Evaluation Matrix

The evaluation process used by the PDSS Information Management Project to select an electronic publishing system for the TO maintenance pilot study produced the following matrix analysis. The columns to the right of the features' list indicate the weighted requirement of the feature to meet the specific needs of TO maintenance (Column 1), the weighted capability of the system to meet that feature requirement (Column 2), and whether or not the feature is present in the system (Column 3).

The value of the weighted requirement ranges from 0 - 3. A feature that is essential for an electronic publishing system for TO maintenance has a value of 3. In Column 3, 1 indicates that the feature is present in the system, 0 indicates that it is not.

The totals at the bottom of the list indicate the sum of the weighted requirements (Column 1), the overall score of the system to meet TO maintenance requirements (Column 2), and the total number of features that the system has (Column 3). Although a system may have many features and a high score in Column 3, Column 2 determines the suitability of the system for the TO maintenance application.

Appendix A: Evaluation Matrix

Electronic Publishing System Matrix Analysis

CONTEXT

Features	Tech Ordr Reqrments	Context Req * Val	Val
--			
1. **User Interface**			
1. icons	2	2	1
2. pop-up/pull-down menus	2	2	1
3. mouse	3	3	1
4. graphics tablet	2	2	1
5. keyboard w/function keys	3	3	1
6. 19" monitor	3	3	1
7. WYSIWYG display	3	3	1
8. full page display size	3	3	1
9. accurate text presentation	3	3	1
10. accurate graphics presentation	3	3	1
11. user defined macros	3	3	1
12. user defined menus	3	3	1
13. user defined function keys	3	3	1
14. bind macro to function key	3	3	1
15. bind macro to menu item	3	3	1
16. bind macro to icon	3	3	1
2. **Input Devices, Formats, Filters**			
1. graphics scanners and formats	3	3	1
1. Scantek	0	0	1
2. Palantier	0	0	1
3. Hewlett Packard	0	0	0
4. other scanner	0	0	0
5. Autotrol format	2	2	1
6. IGES format	1	0	0
7. other format	1	1	1
8. line art capability	3	3	1
9. continuous tone capability	0	0	0
2. text scanners and formats	3	3	1
1. Kurzweil	2	2	1
2. Compuscan	0	0	0
3. ECRM	0	0	0
4. Palantier	0	0	1
5. trainable font capability	1	1	1
6. other font capability	0	0	1
3. other input sources/formats			
1. PC interface	0	0	1
2. word processor interface	0	0	1
3. SGML (user defined DTD)	0	0	0
4. SGML (vendor defined DTD)	0	0	0
5. SGML (MIL-STD 1840a DTD)	1	0	0
6. LAN Ethernet	0	0	1

7. LAN other	0	0	1
8. magnetic tape	3	3	1
4. text conversion/filter programs	3	3	1

3. **Output Devices, Formats, Filters**

1. laser printer	3	3	1
1. Apple Laser Writer	3	3	1
2. Hewlett Packard	0	0	0
3. Varityper	0	0	1
4. Tegra Genesis	0	0	0
5. drs Laser-Scribe	0	0	0
6. Printware 720 IQ	0	0	0
7. Xerox	0	0	0
8. other	0	0	1
2. page description languages			
1. PostScript	3	3	1
2. Interpress	0	0	0
3. imPRESS	0	0	0
4. RIPrint	0	0	0
5. Imagen DDL	0	0	1
6. other PDL	0	0	0
3. output resolution			
1. < 300 dpi	0	0	0
2. 300 dpi	2	2	1
3. 600dpi	2	2	1
4. 800 dpi	0	0	0
5. 1000dpi	0	0	0
6. > 1000 dpi	0	0	0
7. other	0	0	0
4. throughput requirements			
1. 8pg/min	0	0	1
2. 8-20 pg/min	0	0	1
3. 20-100 pg/min	0	0	0
4. > 100 pg/min	0	0	0
5. other	0	0	0
5. phototypesetter	2	0	0
1. Autologics	0	0	0
2. Compugraphic	0	0	0
3. Linotron	0	0	0
4. III Video Comp	2	0	0
5. other	0	0	0
6. other output devices/formats			
1. graphics in Autotrol format	0	0	0
2. graphics in IGES format	0	0	0
3. text in SGML (user DTD)	0	0	0
4. text in SGML (vendor DTD)	0	0	0
5. text in SGML (1840a DTD)	0	0	0
6. LAN Ethernet	0	0	1
7. LAN other	0	0	1

8. magnetic tape	0	0	1
4. **Create/Edit Text, Tables & Graphics**			
1. conventional text editor	1	1	1
2. interactive WYSIWYG text editor	3	3	1
3. text search function	3	3	1
1. text in documents	3	3	1
2. included text	0	0	1
3. text in tables	2	0	0
4. callouts/labels in graphics	2	0	0
5. annotations	3	3	1
6. deleted text	3	3	1
7. user tags/x-references	3	3	1
8. changed pages	3	3	1
4. replace function	1	1	1
5. nondestructive edit	3	3	1
1. option to display	3	3	1
2. option to print	3	3	1
3. includes user id	3	3	1
4. includes timestamp	3	3	1
5. can be edited	3	3	1
6. annotation feature	3	3	1
1. option to display	3	3	1
2. option to print	3	3	1
3. includes user id	3	3	1
4. includes timestamp	3	3	1
5. can be edited	3	3	1
7. spell checker	3	3	1
1. text files	3	3	1
2. document files	3	3	1
3. text within graphics	2	0	0
4. text within tables	2	0	0
5. interactive alternates list	1	0	0
6. user expandable dictionary	3	3	1
7. multiple user dictionaries	1	0	0
8. exclusion dictionary	1	0	0
8. Thesaurus	0	0	0
9. usage alert	0	0	0
10. readability index program	1	0	0
11. create/edit tables in WYSIWYG mode	3	3	1
1. move table as an entity	2	2	1
2. can contain text	3	3	1
3. can contain graphics	3	0	0
4. adj. rule weights	2	2	1
5. adj. rule styles	2	2	1
6. table titles	3	3	1
7. table headers	2	2	1
8. table footers	2	2	1
9. table column head	2	2	1
10. table row head	2	2	1
11. straddle heads	2	2	1
12. straddle text	2	2	1

13. floating table position	2	2	1
14. fixed table position	2	2	1
15. position linked to reference	0	0	0
16. cell content alignment	2	2	1
1. top	2	2	1
2. centered	2	2	1
3. bottom	2	2	1
17. automatic continuation+header	2	2	1
18. fixed column width	2	2	1
19. proportional column width	2	2	1
20. fixed row height	2	2	1
21. proportional row height	2	2	1
22. insert rows or columns	2	2	1
23. delete rows or columns	2	2	1
24. transpose rows and columns	2	2	1
25. portrait and landscape format	3	3	1
26. specify typestyle	3	3	1
27. specify typesize	3	3	1
28. specify line space/leading	2	2	1
29. specify justification parameters	1	0	0
30. specify hyphenation parameters	1	0	0
31. specify line endings	1	1	1
32. specify indents	1	0	0
12. create/edit graphics in WYSIWYG mode	3	3	1
1. rectangles	3	3	1
2. circles	3	3	1
3. ellipses	3	3	1
4. vectors	3	3	1
5. horizontal lines	3	3	1
6. vertical lines	3	3	1
7. arcs	3	3	1
8. polylines	3	3	1
9. arrowheads	1	0	0
10. user libraries	3	3	1
11. free hand drawings	1	1	1
12. isometric drawings	2	2	1
13. adj. line weights/styles	3	3	1
14. copy	3	3	1
15. cut	3	3	1
16. paste	3	3	1
17. rotate	3	3	1
18. crop	2	2	1
19. scale	3	3	1
20. stretch	2	2	1
21. fill	3	3	1
22. align	3	3	1
23. pixel edit	0	0	0
24. painting	0	0	0
25. blending	0	0	0
26. fading	0	0	0
5. Document Design, Composition & Pagination			
1. interactive document design	2	2	1
2. structured documents	3	3	1

3. accommodates MIL-STDS and regulations	2	0	0
4. element type attribute definition	2	2	1
1. composition attributes	2	2	1
2. pagination attributes	3	3	1
3. document assembly attributes	3	3	1
4. page format	3	3	1
5. typestyles	3	3	1
6. typesizes	3	3	1
7. document elements			
1. front matter	3	3	1
2. title page	3	3	1
3. effective page list	3	0	0
4. table of contents	3	3	1
5. body matter	3	3	1
6. chapters	1	1	1
7. section heads/paragraphs	3	3	1
8. enumerated lists	3	3	1
9. references	1	1	1
10. tables	3	3	1
11. illustrations	3	3	1
12. footnotes	1	1	1
13. warnings	3	3	1
14. page headings	2	2	1
15. page footings	2	2	1
16. rear matter	3	3	1
5. user defined justification values			
1. character spacing	1	0	0
2. word spacing	1	0	0
3. kerning	1	0	0
4. justified copy	3	3	1
5. ragged copy	3	3	1
6. flush left copy	3	3	1
7. flush right copy	3	3	1
8. centered copy	3	3	1
6. hyphenation	2	2	1
1. manual	1	1	1
2. automatic	1	0	0
3. expandable dictionary	1	0	0
4. user defined hyphenation values	0	0	0
5. consecutive hyphenated lines	0	0	0
6. characters before/after hyphen	0	0	0
7. hyphenation fence	0	0	0
8. word begin/end characters	0	0	0
7. interactive pagination	2	2	1
8. user defined pagination region	2	2	1
9. pagination/document assembly values			
1. by page type	2	2	1
2. widow prevention	2	2	1
3. orphan prevention	2	2	1
4. vertical justification	3	0	0
5. multiple columns	3	3	1
6. column balancing	3	3	1

7. page fidelity	3	3	1
8. position anchors	3	3	1
9. page rules	2	2	1
10. page headers	3	3	1
11. page header position	3	3	1
12. page footers	3	3	1
13. page footer position	3	3	1
14. footnote position	2	2	1
15. left hand/right hand page	3	3	1
10. auto-numbering/referencing/indexing			
1. chapter	2	2	1
2. page	3	3	1
3. section	3	3	1
4. subsection	3	3	1
5. paragraph	2	2	1
6. list	3	3	1
7. table	3	3	1
8. figure	3	3	1
9. footnote	2	0	0
10. cross references to sections	3	3	1
11. figures references	3	3	1
12. user defined references/tags	1	1	1
13. table of contents	3	3	1
14. effective page list	3	0	0
15. multi-level index	3	3	1
16. user defined sort parameters	2	0	0
17. index of changed pages.	3	0	0

6. File/Database Management & CMVC

1. concurrent access w/controls	3	3	1
2. large documents > 5000 pages	3	3	1
3. division of documents into sections	3	3	1
4. merge sections into a single document	3	3	1
5. retrieve section by reference for			
1. editing	3	3	1
2. composition	3	3	1
3. pagination	3	3	1
6. libraries of graphics	2	2	1
7. libraries of tables	2	2	1
8. libraries of text	2	2	1
9. libraries of documents	2	2	1
10. merge external elements	2	2	1
11. auto-merge external elements	2	2	1
12. file security	3	3	1
13. per user access controls	3	3	1
14. archiving procedure-backup/restore	2	2	1
15. configuration management	3	3	1
16. version control	3	3	1
1. multiple versions of document	3	3	1
2. document version status	3	3	1
3. inclusion considers version	3	3	1

7. **Communications & Networking**

1. LAN	0	0	1
2. interconnect workstations	0	0	1
3. interconnect file servers	0	0	1
4. interconnect input/output devices	0	0	1
5. LAN supports full document access	0	0	1

8. **System & Job Control**

1. system generation	0	0	1
2. system configuration	0	0	1
3. system maintenance	0	0	1
4. system control	0	0	1
5. network configuration	0	0	1
6. network maintenance	0	0	1
7. network control	0	0	1
8. application configuration	0	0	1
9. application maintenance	0	0	1
10. application control	0	0	1
11. management job control reporting	0	0	0

9. **Hardware**

1. standard off-the-shelf components	3	3	1
2. hardware platforms			
1. Apollo	0	0	1
2. Sun	0	0	0
3. VAX	0	0	0
4. other	0	0	0
Total	540	492	223

Electronic Publishing System Matrix Analysis

INTERLEAF

Features	Tech Ordr Reqrments	Interleaf Req * Val	Val
--			
1. **User Interface**			
1. icons	2	2	1
2. pop-up/pull-down menus	2	2	1
3. mouse	3	3	1
4. graphics tablet	2	2	1
5. keyboard w/function keys	3	3	1
6. 19" monitor	3	3	1
7. WYSIWYG display	3	3	1
8. full page display size	3	3	1
9. accurate text presentation	3	3	1
10. accurate graphics presentation	3	3	1
11. user defined macros	3	0	0
12. user defined menus	3	0	0
13. user defined function keys	3	0	0
14. bind macro to function key	3	0	0
15. bind macro to menu item	3	0	0
16. bind macro to icon	3	0	0
2. **Input Devices, Formats, Filters**			
1. graphics scanners and formats	3	3	1
1. Scantek	0	0	0
2. Palantier	0	0	0
3. Hewlett Packard	0	0	1
4. other scanner	0	0	1
5. Autotrol format	2	2	1
6. IGES format	1	1	1
7. other format	1	1	1
8. line art capability	3	3	1
9. continuous tone capability	0	0	1
2. text scanners and formats	3	3	1
1. Kurzweil	2	2	1
2. Compuscan	0	0	1
3. ECRM	0	0	0
4. Palantier	0	0	0
5. trainable font capability	1	1	1
6. other font capability	0	0	1
3. other input sources/formats			
1. PC interface	0	0	1
2. word processor interface	0	0	1
3. SGML (user defined DTD)	0	0	0
4. SGML (vendor defined DTD)	0	0	0
5. SGML (MIL-STD 1840a DTD)	1	0	0
6. LAN Ethernet	0	0	0
7. LAN other	0	0	0
8. magnetic tape	3	3	1

4. text conversion/filter programs	3	3	1
3. Output Devices, Formats, Filters			
1. laser printer	3	3	1
1. Apple Laser Writer	3	3	1
2. Hewlett Packard	0	0	1
3. Varityper	0	0	1
4. Tegra Genesis	0	0	1
5. drs Laser-Scribe	0	0	1
6. Printware 720 IQ	0	0	1
7. Xerox	0	0	1
8. other	0	0	1
2. page description languages			
1. PostScript	3	3	1
2. Interpress	0	0	1
3. imPRESS	0	0	1
4. RIPrint	0	0	1
5. Imagen DDL	0	0	0
6. other PDL	0	0	0
3. output resolution			
1. < 300 dpi	0	0	0
2. 300 dpi	2	2	1
3. 600dpi	2	2	1
4. 800 dpi	0	0	1
5. 1000dpi	0	0	1
6. > 1000 dpi	0	0	0
7. other	0	0	0
4. throughput requirements			
1. 8pg/min	0	0	1
2. 8-20 pg/min	0	0	1
3. 20-100 pg/min	0	0	1
4. > 100 pg/min	0	0	0
5. other	0	0	0
5. phototypesetter	2	0	0
1. Autologics	0	0	0
2. Compugraphic	0	0	1
3. Linotron	0	0	1
4. III Video Comp	2	0	0
5. other	0	0	0
6. other output devices/formats			
1. graphics in Autotrol format	0	0	0
2. graphics in IGES format	0	0	0
3. text in SGML (user DTD)	0	0	0
4. text in SGML (vendor DTD)	0	0	0
5. text in SGML (1840a DTD)	0	0	0
6. LAN Ethernet	0	0	0
7. LAN other	0	0	0
8. magnetic tape	0	0	1

4. Create/Edit Text, Tables & Graphics

1. conventional text editor	1	1	1
2. interactive WYSIWYG text editor	3	3	1
3. text search function	3	3	1
1. text in documents	3	3	1
2. included text	0	0	0
3. text in tables	2	0	0
4. callouts/labels in graphics	2	0	0
5. annotations	3	0	0
6. deleted text	3	0	0
7. user tags/x-references	3	3	1
8. changed pages	3	3	1
4. replace function	1	1	1
5. nondestructive edit	3	0	0
1. option to display	3	0	0
2. option to print	3	0	0
3. includes user id	3	0	0
4. includes timestamp	3	0	0
5. can be edited	3	0	0
6. annotation feature	3	0	0
1. option to display	3	0	0
2. option to print	3	0	0
3. includes user id	3	0	0
4. includes timestamp	3	0	0
5. can be edited	3	0	0
7. spell checker	3	3	1
1. text files	3	3	1
2. document files	3	3	1
3. text within graphics	2	0	0
4. text within tables	2	2	1
5. interactive alternates list	1	1	1
6. user expandable dictionary	3	3	1
7. multiple user dictionaries	1	1	1
8. exclusion dictionary	1	0	0
8. Thesaurus	0	0	0
9. usage alert	0	0	0
10. readability index program	1	0	0
11. create/edit tables in WYSIWYG mode	3	3	1
1. move table as an entity	2	2	1
2. can contain text	3	3	1
3. can contain graphics	3	3	1
4. adj. rule weights	2	2	1
5. adj. rule styles	2	2	1
6. table titles	3	3	1
7. table headers	2	2	1
8. table footers	2	2	1
9. table column head	2	2	1
10. table row head	2	2	1
11. straddle heads	2	2	1
12. straddle text	2	2	1
13. floating table position	2	2	1

14. fixed table position	2	2	1
15. position linked to reference	0	0	0
16. cell content alignment	2	2	1
1. top	2	2	1
2. centered	2	2	1
3. bottom	2	2	1
17. automatic continuation+header	2	2	1
18. fixed column width	2	2	1
19. proportional column width	2	2	1
20. fixed row height	2	2	1
21. proportional row height	2	2	1
22. insert rows or columns	2	2	1
23. delete rows or columns	2	2	1
24. transpose rows and columns	2	2	1
25. portrait and landscape format	3	3	1
26. specify typestyle	3	3	1
27. specify typesize	3	3	1
28. specify line space/leading	2	2	1
29. specify justification parameters	1	1	1
30. specify hyphenation parameters	1	1	1
31. specify line endings	1	1	1
32. specify indents	1	1	1
12. create/edit graphics in WYSIWYG mode	3	3	1
1. rectangles	3	3	1
2. circles	3	3	1
3. ellipses	3	3	1
4. vectors	3	3	1
5. horizontal lines	3	3	1
6. vertical lines	3	3	1
7. arcs	3	3	1
8. polylines	3	3	1
9. arrowheads	1	1	1
10. user libraries	3	3	1
11. free hand drawings	1	1	1
12. isometric drawings	2	2	1
13. adj. line weights/styles	3	3	1
14. copy	3	3	1
15. cut	3	3	1
16. paste	3	3	1
17. rotate	3	3	1
18. crop	2	2	1
19. scale	3	3	1
20. stretch	2	2	1
21. fill	3	3	1
22. align	3	3	1
23. pixel edit	0	0	1
24. painting	0	0	1
25. blending	0	0	1
26. fading	0	0	1

5. Document Design, Composition & Pagination

1. interactive document design	2	2	1
2. structured documents	3	3	1
3. accommodates MIL-STDS and regulations	2	0	0
4. element type attribute definition	2	2	1
1. composition attributes	2	2	1
2. pagination attributes	3	3	1
3. document assembly attributes	3	3	1
4. page format	3	3	1
5. typestyles	3	3	1
6. typesizes	3	3	1
7. document elements			
1. front matter	3	3	1
2. title page	3	3	1
3. effective page list	3	0	0
4. table of contents	3	3	1
5. body matter	3	3	1
6. chapters	1	1	1
7. section heads/paragraphs	3	3	1
8. enumerated lists	3	3	1
9. references	1	1	1
10. tables	3	3	1
11. illustrations	3	3	1
12. footnotes	1	1	1
13. warnings	3	3	1
14. page headings	2	2	1
15. page footings	2	2	1
16. rear matter	3	3	1
5. user defined justification values			
1. character spacing	1	1	1
2. word spacing	1	1	1
3. kerning	1	1	1
4. justified copy	3	3	1
5. ragged copy	3	3	1
6. flush left copy	3	3	1
7. flush right copy	3	3	1
8. centered copy	3	3	1
6. hyphenation	2	2	1
1. manual	1	1	1
2. automatic	1	1	1
3. expandable dictionary	1	1	1
4. user defined hyphenation values	0	0	1
5. consecutive hyphenated lines	0	0	1
6. characters before/after hyphen	0	0	1
7. hyphenation fence	0	0	0
8. word begin/end characters	0	0	0
7. interactive pagination	2	2	1
8. user defined pagination region	2	2	1
9. pagination/document assembly values			
1. by page type	2	2	1
2. widow prevention	2	2	1
3. orphan prevention	2	2	1

4. vertical justification	3	3	1
5. multiple columns	3	3	1
6. column balancing	3	3	1
7. page fidelity	3	3	1
8. position anchors	3	3	1
9. page rules	2	2	1
10. page headers	3	3	1
11. page header position	3	3	1
12. page footers	3	3	1
13. page footer position	3	3	1
14. footnote position	2	2	1
15. left hand/right hand page	3	3	1
10. auto-numbering/referencing/indexing			
1. chapter	2	2	1
2. page	3	3	1
3. section	3	3	1
4. subsection	3	3	1
5. paragraph	2	2	1
6. list	3	3	1
7. table	3	3	1
8. figure	3	3	1
9. footnote	2	2	1
10. cross references to sections	3	3	1
11. figures references	3	3	1
12. user defined references/tags	1	1	1
13. table of contents	3	3	1
14. effective page list	3	0	0
15. multi-level index	3	0	0
16. user defined sort parameters	2	0	0
17. index of changed pages.	3	0	0

6. File/Database Management & CMVC

1. concurrent access w/controls	3	0	0
2. large documents > 5000 pages	3	3	1
3. division of documents into sections	3	3	1
4. merge sections into a single document	3	3	1
5. retrieve section by reference for			
1. editing	3	3	1
2. composition	3	3	1
3. pagination	3	3	1
6. libraries of graphics	2	2	1
7. libraries of tables	2	2	1
8. libraries of text	2	2	1
9. libraries of documents	2	2	1
10. merge external elements	2	2	1
11. auto-merge external elements	2	0	0
12. file security	3	3	1
13. per user access controls	3	3	1
14. archiving procedure-backup/restore	2	2	1
15. configuration management	3	0	0
16. version control	3	0	0
1. multiple versions of document	3	0	0
2. document version status	3	0	0

3. inclusion considers version	3	0	0
7. Communications & Networking			
1. LAN	0	0	1
2. interconnect workstations	0	0	1
3. interconnect file servers	0	0	1
4. interconnect input/output devices	0	0	1
5. LAN supports full document access	0	0	0
8. System & Job Control			
1. system generation	0	0	1
2. system configuration	0	0	1
3. system maintenance	0	0	1
4. system control	0	0	1
5. network configuration	0	0	1
6. network maintenance	0	0	1
7. network control	0	0	1
8. application configuration	0	0	1
9. application maintenance	0	0	1
10. application control	0	0	1
11. management job control reporting	0	0	0
9. Hardware			
1. standard off-the-shelf components	3	3	1
2. hardware platforms			
1. Apollo	0	0	1
2. Sun	0	0	1
3. VAX	0	0	1
4. other	0	0	1
Total	540	431	228

Electronic Publishing System Matrix Analysis

TEXET

Features	Tech Ordr Reqrments	Texet Req * Val	Val
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1. **User Interface**			
1. icons	2	2	1
2. pop-up/pull-down menus	2	2	1
3. mouse	3	3	1
4. graphics tablet	2	2	1
5. keyboard w/function keys	3	3	1
6. 19" monitor	3	3	1
7. WYSIWYG display	3	3	1
8. full page display size	3	3	1
9. accurate text presentation	3	3	1
10. accurate graphics presentation	3	3	1
11. user defined macros	3	3	1
12. user defined menus	3	0	0
13. user defined function keys	3	3	1
14. bind macro to function key	3	3	1
15. bind macro to menu item	3	0	0
16. bind macro to icon	3	0	0
2. **Input Devices, Formats, Filters**			
1. graphics scanners and formats	3	3	1
1. Scantek	0	0	0
2. Palantier	0	0	0
3. Hewlett Packard	0	0	0
4. other scanner	0	0	1
5. Autotrol format	2	2	1
6. IGES format	1	1	1
7. other format	1	1	1
8. line art capability	3	3	1
9. continuous tone capability	0	0	0
2. text scanners and formats	3	3	1
1. Kurzweil	2	2	1
2. Compuscan	0	0	1
3. ECRM	0	0	1
4. Palantier	0	0	0
5. trainable font capability	1	1	1
6. other font capability	0	0	1
3. other input sources/formats			
1. PC interface	0	0	1
2. word processor interface	0	0	1
3. SGML (user defined DTD)	0	0	0
4. SGML (vendor defined DTD)	0	0	0
5. SGML (MIL-STD 1840a DTD)	1	0	0
6. LAN Ethernet	0	0	1
7. LAN other	0	0	1
8. magnetic tape	3	3	1

4. text conversion/filter programs	3	3	1

3. **Output Devices, Formats, Filters**

1. laser printer	3	3	1
1. Apple Laser Writer	3	3	1
2. Hewlett Packard	0	0	0
3. Varityper	0	0	1
4. Tegra Genesis	0	0	1
5. drs Laser-Scribe	0	0	0
6. Printware 720 IQ	0	0	0
7. Xerox	0	0	1
8. other	0	0	1

2. page description languages			
1. PostScript	3	3	1
2. Interpress	0	0	1
3. imPRESS	0	0	0
4. RIPrint	0	0	0
5. Imagen DDL	0	0	0
6. other PDL	0	0	0

3. output resolution			
1. < 300 dpi	0	0	0
2. 300 dpi	2	2	1
3. 600dpi	2	2	1
4. 800 dpi	0	0	0
5. 1000dpi	0	0	0
6. > 1000 dpi	0	0	0
7. other	0	0	0

4. throughput requirements			
1. 8pg/min	0	0	1
2. 8-20 pg/min	0	0	1
3. 20-100 pg/min	0	0	1
4. > 100 pg/min	0	0	0
5. other	0	0	0

5. phototypesetter	2	0	0
1. Autologics	0	0	1
2. Compugraphic	0	0	1
3. Linotron	0	0	1
4. III Video Comp	2	2	1
5. other	0	0	1

6. other output devices/formats			
1. graphics in Autotrol format	0	0	0
2. graphics in IGES format	0	0	0
3. text in SGML (user DTD)	0	0	0
4. text in SGML (vendor DTD)	0	0	0
5. text in SGML (1840a DTD)	0	0	0
6. LAN Ethernet	0	0	1
7. LAN other	0	0	1
8. magnetic tape	0	0	1

4. **Create/Edit Text, Tables & Graphics**

1. conventional text editor	1	1	1
2. interactive WYSIWYG text editor	3	3	1
3. text search function	3	3	1
1. text in documents	3	3	1
2. included text	0	0	1
3. text in tables	2	0	0
4. callouts/labels in graphics	2	0	0
5. annotations	3	0	0
6. deleted text	3	0	0
7. user tags/x-references	3	3	1
8. changed pages	3	3	1
4. replace function	1	1	1
5. nondestructive edit	3	0	0
1. option to display	3	0	0
2. option to print	3	0	0
3. includes user id	3	0	0
4. includes timestamp	3	0	0
5. can be edited	3	0	0
6. annotation feature	3	0	0
1. option to display	3	0	0
2. option to print	3	0	0
3. includes user id	3	0	0
4. includes timestamp	3	0	0
5. can be edited	3	0	0
7. spell checker	3	3	1
1. text files	3	3	1
2. document files	3	0	0
3. text within graphics	2	0	0
4. text within tables	2	0	0
5. interactive alternates list	1	0	0
6. user expandable dictionary	3	3	1
7. multiple user dictionaries	1	0	0
8. exclusion dictionary	1	0	0
8. Thesaurus	0	0	0
9. usage alert	0	0	0
10. readability index program	1	0	0
11. create/edit tables in WYSIWYG mode	3	3	1
1. move table as an entity	2	2	1
2. can contain text	3	3	1
3. can contain graphics	3	3	1
4. adj. rule weights	2	2	1
5. adj. rule styles	2	2	1
6. table titles	3	3	1
7. table headers	2	2	1
8. table footers	2	2	1
9. table column head	2	2	1
10. table row head	2	2	1
11. straddle heads	2	2	1
12. straddle text	2	2	1
13. floating table position	2	2	1

14. fixed table position	2	2	1
15. position linked to reference	0	0	1
16. cell content alignment	2	2	1
1. top	2	2	1
2. centered	2	2	1
3. bottom	2	2	1
17. automatic continuation+header	2	2	1
18. fixed column width	2	2	1
19. proportional column width	2	2	1
20. fixed row height	2	2	1
21. proportional row height	2	2	1
22. insert rows or columns	2	2	1
23. delete rows or columns	2	2	1
24. transpose rows and columns	2	2	1
25. portrait and landscape format	3	3	1
26. specify typestyle	3	3	1
27. specify typesize	3	3	1
28. specify line space/leading	2	2	1
29. specify justification parameters	1	1	1
30. specify hyphenation parameters	1	1	1
31. specify line endings	1	1	1
32. specify indents	1	1	1
12. create/edit graphics in WYSIWYG mode	3	3	1
1. rectangles	3	3	1
2. circles	3	3	1
3. ellipses	3	3	1
4. vectors	3	3	1
5. horizontal lines	3	3	1
6. vertical lines	3	3	1
7. arcs	3	3	1
8. polylines	3	3	1
9. arrowheads	1	1	1
10. user libraries	3	3	1
11. free hand drawings	1	1	1
12. isometric drawings	2	2	1
13. adj. line weights/styles	3	3	1
14. copy	3	3	1
15. cut	3	3	1
16. paste	3	3	1
17. rotate	3	3	1
18. crop	2	2	1
19. scale	3	3	1
20. stretch	2	2	1
21. fill	3	3	1
22. align	3	3	1
23. pixel edit	0	0	1
24. painting	0	0	1
25. blending	0	0	0
26. fading	0	0	0

5. **Document Design, Composition & Pagination**

1. interactive document design	2	2	1
2. structured documents	3	3	1
3. accommodates MIL-STDS and regulations	2	0	0
4. element type attribute definition	2	2	1
1. composition attributes	2	2	1
2. pagination attributes	3	3	1
3. document assembly attributes	3	3	1
4. page format	3	3	1
5. typestyles	3	3	1
6. typesizes	3	3	1
7. document elements			
1. front matter	3	3	1
2. title page	3	3	1
3. effective page list	3	0	0
4. table of contents	3	3	1
5. body matter	3	3	1
6. chapters	1	1	1
7. section heads/paragraphs	3	3	1
8. enumerated lists	3	3	1
9. references	1	1	1
10. tables	3	3	1
11. illustrations	3	3	1
12. footnotes	1	1	1
13. warnings	3	3	1
14. page headings	2	2	1
15. page footings	2	2	1
16. rear matter	3	3	1
5. user defined justification values			
1. character spacing	1	1	1
2. word spacing	1	1	1
3. kerning	1	1	1
4. justified copy	3	3	1
5. ragged copy	3	3	1
6. flush left copy	3	3	1
7. flush right copy	3	3	1
8. centered copy	3	3	1
6. hyphenation	2	2	1
1. manual	1	1	1
2. automatic	1	1	1
3. expandable dictionary	1	1	1
4. user defined hyphenation values	0	0	1
5. consecutive hyphenated lines	0	0	1
6. characters before/after hyphen	0	0	1
7. hyphenation fence	0	0	0
8. word begin/end characters	0	0	0
7. interactive pagination	2	2	1
8. user defined pagination region	2	2	1
9. pagination/document assembly values			
1. by page type	2	2	1
2. widow prevention	2	2	1
3. orphan prevention	2	2	1

4. vertical justification	3	3	1
5. multiple columns	3	3	1
6. column balancing	3	3	1
7. page fidelity	3	3	1
8. position anchors	3	3	1
9. page rules	2	2	1
10. page headers	3	3	1
11. page header position	3	3	1
12. page footers	3	3	1
13. page footer position	3	3	1
14. footnote position	2	2	1
15. left hand/right hand page	3	3	1
10. auto-numbering/referencing/indexing			
1. chapter	2	2	1
2. page	3	3	1
3. section	3	3	1
4. subsection	3	3	1
5. paragraph	2	2	1
6. list	3	3	1
7. table	3	3	1
8. figure	3	3	1
9. footnote	2	2	1
10. cross references to sections	3	3	1
11. figures references	3	3	1
12. user defined references/tags	1	1	1
13. table of contents	3	3	1
14. effective page list	3	0	0
15. multi-level index	3	3	1
16. user defined sort parameters	2	2	1
17. index of changed pages.	3	0	0

6. File/Database Management & CMVC

1. concurrent access w/controls	3	0	0
2. large documents > 5000 pages	3	3	1
3. division of documents into sections	3	3	1
4. merge sections into a single document	3	3	1
5. retrieve section by reference for			
1. editing	3	3	1
2. composition	3	3	1
3. pagination	3	3	1
6. libraries of graphics	2	2	1
7. libraries of tables	2	2	1
8. libraries of text	2	2	1
9. libraries of documents	2	2	1
10. merge external elements	2	2	1
11. auto-merge external elements	2	0	0
12. file security	3	3	1
13. per user access controls	3	3	1
14. archiving procedure-backup/restore	2	2	1
15. configuration management	3	0	0
16. version control	3	0	0
1. multiple versions of document	3	0	0
2. document version status	3	0	0

3. inclusion considers version	3	0	0
7. **Communications & Networking**			
1. LAN	0	0	1
2. interconnect workstations	0	0	1
3. interconnect file servers	0	0	1
4. interconnect input/output devices	0	0	1
5. LAN supports full document access	0	0	0
8. **System & Job Control**			
1. system generation	0	0	1
2. system configuration	0	0	1
3. system maintenance	0	0	1
4. system control	0	0	1
5. network configuration	0	0	1
6. network maintenance	0	0	1
7. network control	0	0	1
8. application configuration	0	0	1
9. application maintenance	0	0	1
10. application control	0	0	1
11. management job control reporting	0	0	0
9. **Hardware**			
1. standard off-the-shelf components	3	3	1
2. hardware platforms			
1. Apollo	0	0	0
2. Sun	0	0	1
3. VAX	0	0	0
4. other	0	0	1
Total	540	440	226

Electronic Publishing System Matrix Analysis

XEROX

Features	Tech Ordr Reqrments	Xerox Req * Val	Val
1. User Interface			
1. icons	2	2	1
2. pop-up/pull-down menus	2	0	0
3. mouse	3	3	1
4. graphics tablet	2	2	1
5. keyboard w/function keys	3	3	1
6. 19" monitor	3	3	1
7. WYSIWYG display	3	3	1
8. full page display size	3	3	1
9. accurate text presentation	3	3	1
10. accurate graphics presentation	3	3	1
11. user defined macros	3	3	1
12. user defined menus	3	0	0
13. user defined function keys	3	3	1
14. bind macro to function key	3	3	1
15. bind macro to menu item	3	0	0
16. bind macro to icon	3	0	0
2. Input Devices, Formats, Filters			
1. graphics scanners and formats	3	3	1
1. Scantek	0	0	0
2. Palantier	0	0	0
3. Hewlett Packard	0	0	0
4. other scanner	0	0	1
5. Autotrol format	2	0	0
6. IGES format	1	0	0
7. other format	1	1	1
8. line art capability	3	3	1
9. continuous tone capability	0	0	0
2. text scanners and formats	3	3	1
1. Kurzweil	2	2	1
2. Compuscan	0	0	0
3. ECRM	0	0	0
4. Palantier	0	0	0
5. trainable font capability	1	1	1
6. other font capability	0	0	1
3. other input sources/formats			
1. PC interface	0	0	1
2. word processor interface	0	0	1
3. SGML (user defined DTD)	0	0	0
4. SGML (vendor defined DTD)	0	0	0
5. SGML (MIL-STD 1840a DTD)	1	0	0
6. LAN Ethernet	0	0	1
7. LAN other	0	0	0
8. magnetic tape	3	3	1

4. text conversion/filter programs	3	3	1

3. **Output Devices, Formats, Filters**

1. laser printer	3	3	1
1. Apple Laser Writer	3	0	0
2. Hewlett Packard	0	0	0
3. Varityper	0	0	0
4. Tegra Genesis	0	0	0
5. drs Laser-Scribe	0	0	0
6. Printware 720 IQ	0	0	0
7. Xerox	0	0	1
8. other	0	0	0
2. page description languages			
1. PostScript	3	0	0
2. Interpress	0	0	1
3. imPRESS	0	0	0
4. RIPrint	0	0	0
5. Imagen DDL	0	0	0
6. other PDL	0	0	0
3. output resolution			
1. < 300 dpi	0	0	0
2. 300 dpi	2	2	1
3. 600dpi	2	0	0
4. 800 dpi	0	0	0
5. 1000dpi	0	0	0
6. > 1000 dpi	0	0	0
7. other	0	0	0
4. throughput requirements			
1. 8pg/min	0	0	1
2. 8-20 pg/min	0	0	1
3. 20-100 pg/min	0	0	1
4. > 100 pg/min	0	0	0
5. other	0	0	0
5. phototypesetter	2	0	0
1. Autologics	0	0	1
2. Compugraphic	0	0	1
3. Linotron	0	0	1
4. III Video Comp	2	2	1
5. other	0	0	0
6. other output devices/formats			
1. graphics in Autotrol format	0	0	0
2. graphics in IGES format	0	0	0
3. text in SGML (user DTD)	0	0	0
4. text in SGML (vendor DTD)	0	0	0
5. text in SGML (1840a DTD)	0	0	0
6. LAN Ethernet	0	0	1
7. LAN other	0	0	0
8. magnetic tape	0	0	1

4. Create/Edit Text, Tables & Graphics

1. conventional text editor	1	1	1
2. interactive WYSIWYG text editor	3	3	1
3. text search function	3	3	1
1. text in documents	3	3	1
2. included text	0	0	1
3. text in tables	2	0	0
4. callouts/labels in graphics	2	0	0
5. annotations	3	0	0
6. deleted text	3	0	0
7. user tags/x-references	3	3	1
8. changed pages	3	0	0
4. replace function	1	1	1
5. nondestructive edit	3	0	0
1. option to display	3	0	0
2. option to print	3	0	0
3. includes user id	3	0	0
4. includes timestamp	3	0	0
5. can be edited	3	0	0
6. annotation feature	3	0	0
1. option to display	3	0	0
2. option to print	3	0	0
3. includes user id	3	0	0
4. includes timestamp	3	0	0
5. can be edited	3	0	0
7. spell checker	3	3	1
1. text files	3	3	1
2. document files	3	0	0
3. text within graphics	2	0	0
4. text within tables	2	0	0
5. interactive alternates list	1	0	0
6. user expandable dictionary	3	3	1
7. multiple user dictionaries	1	0	0
8. exclusion dictionary	1	0	0
8. Thesaurus	0	0	0
9. usage alert	0	0	0
10. readability index program	1	0	0
11. create/edit tables in WYSIWYG mode	3	0	0
1. move table as an entity	2	0	0
2. can contain text	3	0	0
3. can contain graphics	3	0	0
4. adj. rule weights	2	0	0
5. adj. rule styles	2	0	0
6. table titles	3	0	0
7. table headers	2	0	0
8. table footers	2	0	0
9. table column head	2	0	0
10. table row head	2	0	0
11. straddle heads	2	0	0
12. straddle text	2	0	0
13. floating table position	2	0	0

14. fixed table position	2	0	0
15. position linked to reference	0	0	0
16. cell content alignment	2	0	0
1. top	2	0	0
2. centered	2	0	0
3. bottom	2	0	0
17. automatic continuation+header	2	0	0
18. fixed column width	2	0	0
19. proportional column width	2	0	0
20. fixed row height	2	0	0
21. proportional row height	2	0	0
22. insert rows or columns	2	0	0
23. delete rows or columns	2	0	0
24. transpose rows and columns	2	0	0
25. portrait and landscape format	3	0	0
26. specify typestyle	3	0	0
27. specify typesize	3	0	0
28. specify line space/leading	2	0	0
29. specify justification parameters	1	0	0
30. specify hyphenation parameters	1	0	0
31. specify line endings	1	0	0
32. specify indents	1	0	0
12. create/edit graphics in WYSIWYG mode	3	0	0
1. rectangles	3	0	0
2. circles	3	0	0
3. ellipses	3	0	0
4. vectors	3	0	0
5. horizontal lines	3	0	0
6. vertical lines	3	0	0
7. arcs	3	0	0
8. polylines	3	0	0
9. arrowheads	1	0	0
10. user libraries	3	0	0
11. free hand drawings	1	0	0
12. isometric drawings	2	0	0
13. adj. line weights/styles	3	0	0
14. copy	3	0	0
15. cut	3	0	0
16. paste	3	0	0
17. rotate	3	0	0
18. crop	2	0	0
19. scale	3	0	0
20. stretch	2	0	0
21. fill	3	0	0
22. align	3	0	0
23. pixel edit	0	0	0
24. painting	0	0	0
25. blending	0	0	0
26. fading	0	0	0

5. Document Design, Composition & Pagination

1. interactive document design	2	2	1
2. structured documents	3	3	1
3. accommodates MIL-STDS and regulations	2	0	0
4. element type attribute definition	2	2	1
1. composition attributes	2	2	1
2. pagination attributes	3	3	1
3. document assembly attributes	3	3	1
4. page format	3	3	1
5. typestyles	3	3	1
6. typesizes	3	3	1
7. document elements			
1. front matter	3	3	1
2. title page	3	3	1
3. effective page list	3	0	0
4. table of contents	3	3	1
5. body matter	3	3	1
6. chapters	1	1	1
7. section heads/paragraphs	3	3	1
8. enumerated lists	3	3	1
9. references	1	1	1
10. tables	3	3	1
11. illustrations	3	3	1
12. footnotes	1	1	1
13. warnings	3	3	1
14. page headings	2	2	1
15. page footings	2	2	1
16. rear matter	3	3	1
5. user defined justification values			
1. character spacing	1	1	1
2. word spacing	1	1	1
3. kerning	1	1	1
4. justified copy	3	3	1
5. ragged copy	3	3	1
6. flush left copy	3	3	1
7. flush right copy	3	3	1
8. centered copy	3	3	1
6. hyphenation	2	2	1
1. manual	1	1	1
2. automatic	1	1	1
3. expandable dictionary	1	1	1
4. user defined hyphenation values	0	0	1
5. consecutive hyphenated lines	0	0	1
6. characters before/after hyphen	0	0	1
7. hyphenation fence	0	0	0
8. word begin/end characters	0	0	0
7. interactive pagination	2	2	1
8. user defined pagination region	2	2	1
9. pagination/document assembly values			
1. by page type	2	2	1
2. widow prevention	2	2	1
3. orphan prevention	2	2	1

4. vertical justification	3	3	1
5. multiple columns	3	3	1
6. column balancing	3	3	1
7. page fidelity	3	3	1
8. position anchors	3	3	1
9. page rules	2	2	1
10. page headers	3	3	1
11. page header position	3	3	1
12. page footers	3	3	1
13. page footer position	3	3	1
14. footnote position	2	2	1
15. left hand/right hand page	3	3	1
10. auto-numbering/referencing/indexing			
1. chapter	2	2	1
2. page	3	3	1
3. section	3	3	1
4. subsection	3	3	1
5. paragraph	2	2	1
6. list	3	3	1
7. table	3	3	1
8. figure	3	3	1
9. footnote	2	0	0
10. cross references to sections	3	3	1
11. figures references	3	3	1
12. user defined references/tags	1	1	1
13. table of contents	3	3	1
14. effective page list	3	0	0
15. multi-level index	3	0	0
16. user defined sort parameters	2	0	0
17. index of changed pages.	3	0	0

6. **File/Database Management & CMVC**

1. concurrent access w/controls	3	0	0
2. large documents > 5000 pages	3	3	1
3. division of documents into sections	3	3	1
4. merge sections into a single document	3	3	1
5. retrieve section by reference for			
1. editing	3	3	1
2. composition	3	3	1
3. pagination	3	3	1
6. libraries of graphics	2	2	1
7. libraries of tables	2	2	1
8. libraries of text	2	2	1
9. libraries of documents	2	2	1
10. merge external elements	2	2	1
11. auto-merge external elements	2	0	0
12. file security	3	3	1
13. per user access controls	3	3	1
14. archiving procedure-backup/restore	2	2	1
15. configuration management	3	0	0
16. version control	3	0	0
1. multiple versions of document	3	0	0
2. document version status	3	0	0

3. inclusion considers version	3	0	0
7. Communications & Networking			
1. LAN	0	0	1
2. interconnect workstations	0	0	1
3. interconnect file servers	0	0	1
4. interconnect input/output devices	0	0	1
5. LAN supports full document access	0	0	0
8. System & Job Control			
1. system generation	0	0	1
2. system configuration	0	0	1
3. system maintenance	0	0	1
4. system control	0	0	1
5. network configuration	0	0	1
6. network maintenance	0	0	1
7. network control	0	0	1
8. application configuration	0	0	1
9. application maintenance	0	0	1
10. application control	0	0	1
11. management job control reporting	0	0	1
9. Hardware			
1. standard off-the-shelf components	3	3	1
2. hardware platforms			
1. Apollo	0	0	0
2. Sun	0	0	0
3. VAX	0	0	1
4. other	0	0	0
Total	540	282	147