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This document addresses the USAF's approach to the Technical Order(TO) System. The Air Force is studying a concept that will link many automated systems and provide a single interface to the maintenance technician. This article addresses the problem, DOD initiatives, the USAF TO System, goals, advanced concepts, and what the Air Force plans for the year 2000.

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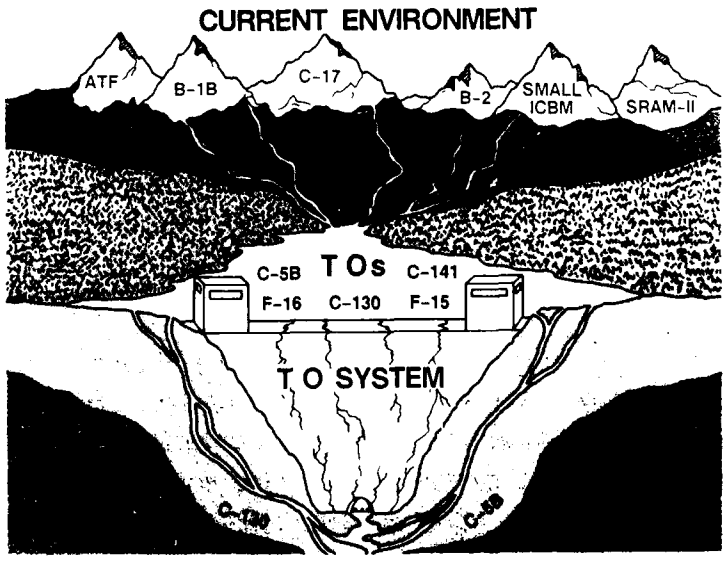
TECHNICAL DATA
YEAR 2000

YEAR 2000 — While returning from Space Station Alpha, the space vehicle's onboard computer senses a problem in the number 3 warp-drive. A preliminary diagnosis of the problem and recommended trouble-shooting procedures are automatically relayed to ground-based computers. The computers perform an assessment and determine that repairs can be accomplished at the proposed landing site. Meanwhile, on the ground, the maintenance technician loads a hand-held computer with the latest technical data, grabs a tool kit, and proceeds to the landing pad to meet the vehicle. Once there, the technician plugs the computer into the vehicle's onboard computer and receives an updated assessment of the situation. The technician reads trouble-shooting procedures on the computer display and confirms the problem and proposed solution. Then, with a single keystroke, the spare parts are ordered and arrangements are made for them to be delivered. Shortly, the vehicle is repaired and ready to fly again.

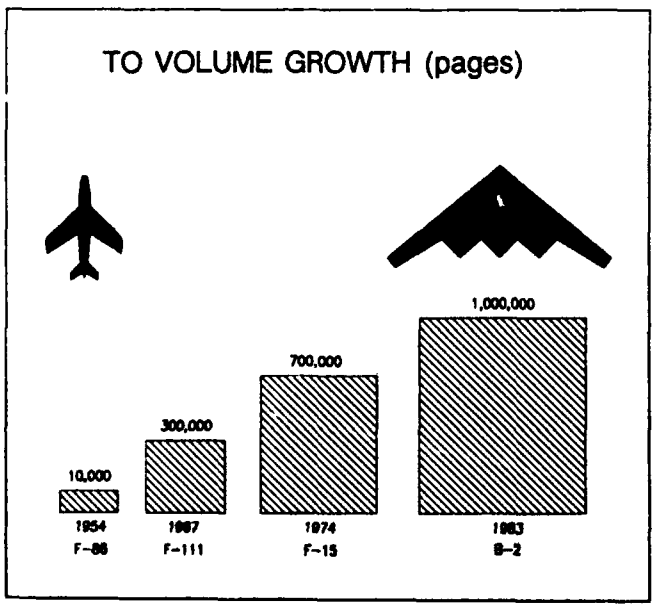
This may sound far-fetched, but by the year 2000, many parts of this scenario will be routine. The U.S. Air Force (USAF) is studying a concept that will link many automated systems and provide a single interface to the maintenance technician. In practice, this concept will provide the technician with direct access to several information systems and maintenance data bases while interrogating aircraft onboard built-in-test information and battle damage assessment aids. It will also review aircraft in-flight and historical data. The display presents intelligent diagnostic and corrective advice, and graphically supplemented technical instructions. Technicians will use this latest technology to perform everyday duties. New initiatives are in progress to make this happen, thereby avoiding an impending serious problem.

THE PROBLEM

The rapidly growing number of technical orders (TO) is becoming unmanageable. The "river" is rising fast and the "dam" is about to break! The approaching flood of TOs will overwhelm the TO management system unless remedial action is taken immediately. Paper-based methods used today to create, change, and manage TOs are too expensive and slow. Acquiring, storing, distributing, maintaining, and changing TOs for new, sophisticated weapons systems will be an impossible task. If weapon system readiness is to be maintained at an acceptable level, improved means for performing these TO management functions must be developed. The rapid evolution of digital text processing provides an opportunity to improve our effectiveness in performing these functions. We are capitalizing on these advances to make this happen.



The U.S. Air Force's paper TO system was established during World War II, nearly 50 years ago. During the 1950s, a typical weapon system, such as the F-86, could be operated and maintained with approximately 10,000 pages of paper technical data. The number of pages required for a new weapon system, such as the B-2, will be approximately 1,000,000. Managing this increasing volume of paper will introduce a host of complex problems. Costs will skyrocket. Almost every USAF organization and contractor will be affected. These management problems and costs are driven by key elements, such as huge printing, storage, update, and distribution requirements for paper TOs. Also, the user could encounter out-of-date technical data and waste precious time searching for information and maintaining paper TOs. To make matters worse, the current USAF TO management system, a 1960s-era batch processing system hampered by slow, antiquated technology, processed more than 7 million transactions in 1987. It is rapidly exceeding design limits.



Today's TO users face numerous problems, many of which are caused by the inefficiency and complexity of the TO system. Approximately 25 to 30 percent of a maintenance technician's time is spent searching for needed information. This often requires obtaining information from several volumes. Also, much time is spent inserting change pages in shop TOs. The result is reduced productivity, which degrades readiness. In addition, TO changes take six to nine months. These problems could result in use of outdated information, a potentially dangerous and costly situation. Fortunately, along with increases in weapon system complexity, there are advances in information handling that are being applied to these problems. Interactive computer-based technologies are available and can be used to integrate and automate many of the processes necessary to create, update, distribute, and use TOs.

Paper-based methods used today to create, change, and manage TOs are too expensive and slow.

TOs prescribe step-by-step procedures and provide information needed for operating and maintaining USAF systems and equipment. They must be accurate and readily available to users. These requirements cannot be satisfied with the circumstances just described. Source data from which TOs are prepared are developed as part of the same venture that produces new USAF systems and equipment. TOs are developed using engineering drawings, schematics, sketches, and Logistics Support Analysis Records (LSAR). The Logistics Support Analysis (LSA) process transforms engineering and task analysis data into the maintenance and support information that is documented in TOs. Automation of the LSA program provides defense contractors the capability to develop, store, and deliver supply and maintenance information for new systems, including TOs, without using paper. However, because of the absence of appropriate specifications and TO management infrastructure to support digital data, TOs must be distributed and used in paper form.

DoD INITIATIVES

The USAF has undertaken programs to institutionalize the use of digital technical information for weapon system acquisition, design, manufacture, and support. These programs employ Department of Defense (DoD) Computer-Aided Acquisition and Logistics Support (CALS) strategies. They will provide for an effective transition from current paper-intensive weapon system life-cycle processes to the efficient use of digital information technologies. The immediate effect will be to improve DoD productivity and quality and thus increase the supportability, readiness, and combat effectiveness of our military forces.

Computer-based technologies are available and can be used to integrate and automate many of the processes necessary to create, update, distribute, and use TOs.

A 5 Aug 88 memorandum from Deputy Secretary of Defense William H. Taft, IV, to the Secretaries of the Military Departments has set the stage for delivery of weapon system technical data in digital form. This memorandum requires that weapon systems now in full-scale development or production be reviewed for opportunities to lower costs by purchase of digital technical information. The memorandum also requires that proposals for new systems being developed after September 1988 include certain provisions. These proposals must provide for integration of contractor technical information systems and processes. They must also allow for government access to contractor data bases and delivery of digital technical data in compliance with CALS standards.

THE U.S. AIR FORCE TO SYSTEM

Currently, USAF TOs are created, stored, and distributed as paper documents. Conversion to a totally digital system will allow the display and manipulation of TO data in a variety of ways. Page-oriented TOs will evolve into "pageless" data bases. These data bases will integrate diagnostic, historical, procedural, supply, and LSA information. Meanwhile, digital data will be presented to the user in page-oriented formats, using either paper or digital displays.

Total elimination of paper TOs remains a goal; however, it may not be practical to totally eliminate paper. Paper documentation may still be required for various situations, e.g., legal considerations, user environment (confined work space), weapon systems about to be phased out, or need for paper back-up for a critical onboard display device. Realistically, presentation devices may be unavailable or incapable of displaying digital information in all situations. There may be times when it is more effective to use paper. Also, the U.S. Air Force has commitments to non-U.S. Air Force users (Security Assistance Program and Consortium Program countries) to deliver TOs in paper form.

Total elimination of paper TOs remains a goal; however, it may not be practical to totally eliminate paper.

Today, a variety of automated, but incompatible systems are used by contractor teams to enter, update, manage, and retrieve data from data bases built for specific acquisition programs. These systems provide extraordinary capabilities. However, these capabilities are not integrated. Data created in one functional process often have to be manually re-entered or re-created in subsequent functional processes, allowing the potential for errors and increasing costs.

A-1

U.S. AIR FORCE GOALS

One near-term goal for USAF programs is to increase the compatibility of data base functional capabilities. Another goal is to gain either unlimited access to purchased contractor technical data bases, or to have technical data delivered in digital form. Programs are in progress to acquire digital data to support the operation and maintenance of weapon systems being developed. The Office of Secretary of Defense has introduced and is updating a military standard providing direction for the digital transmission and delivery of digital technical information.

Four military specifications have been published providing standardization for TO text and graphics. As of September 1989, the CALS standards and specifications addressed digital preparation, transmission, and delivery of TO data. However, these standards do not address digital presentation of technical data. Approaches to digital presentation have yet to be standardized.

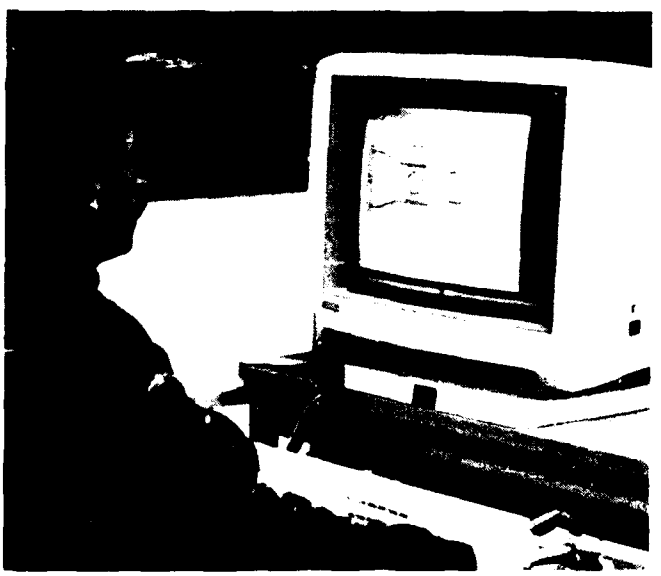
An additional goal of USAF programs is the linking of industry and USAF data bases to share common weapon system data. Requirements for data deliverables or access to specified segments of contractor data will be explicitly defined in future contracts, and these data will be developed using CALS standards and procedures. Benefits of this goal include more complete integration of contractor and USAF data bases, and near real-time updates of TOs. This goal will also foster optimization of product design during acquisition through the integration of engineering programs, such as Reliability & Maintainability, so that they become an on-line part of design processes.

Programs are in progress to acquire digital data to support the operation and maintenance of weapon systems being developed.

One of many steps Air Force Logistics Command (AFLC) has taken to achieve these goals is an aggressive program to update and combine USAF Technical Manual Specifications and Standards (TMSS). This includes the incorporation of specification language required to allow procurement of digital technical data. A complete TMSS package will include the total guidance needed to produce either paper or electronic displays of USAF TOs using digital source data. As other USAF and DoD efforts progress, TMSS will include authoring, transmission, and storage, and ultimately the electronic display of information to the user.

U.S. AIR FORCE INITIATIVES

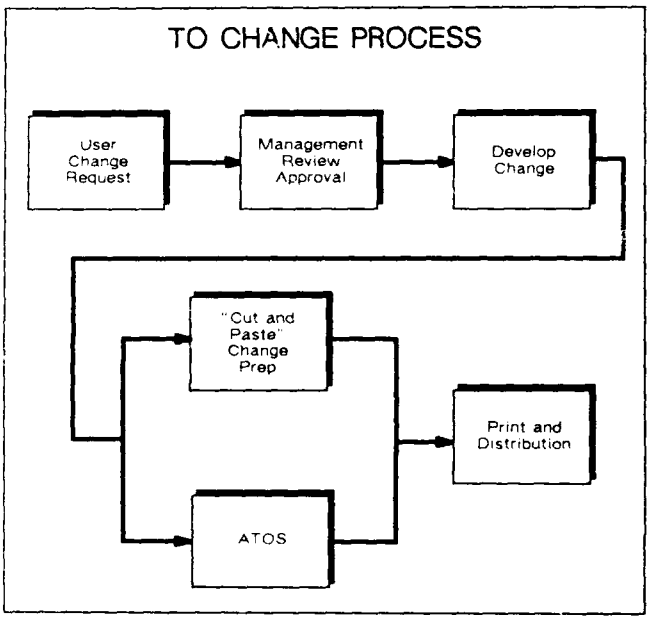
The Automated Technical Order System (ATOS), implemented in March 1987, is a recent effort to improve TO management. The ATOS automates the manual drafting and "cut and paste" actions involved in making TO changes for those items whose engineering support is accomplished by AFLC.



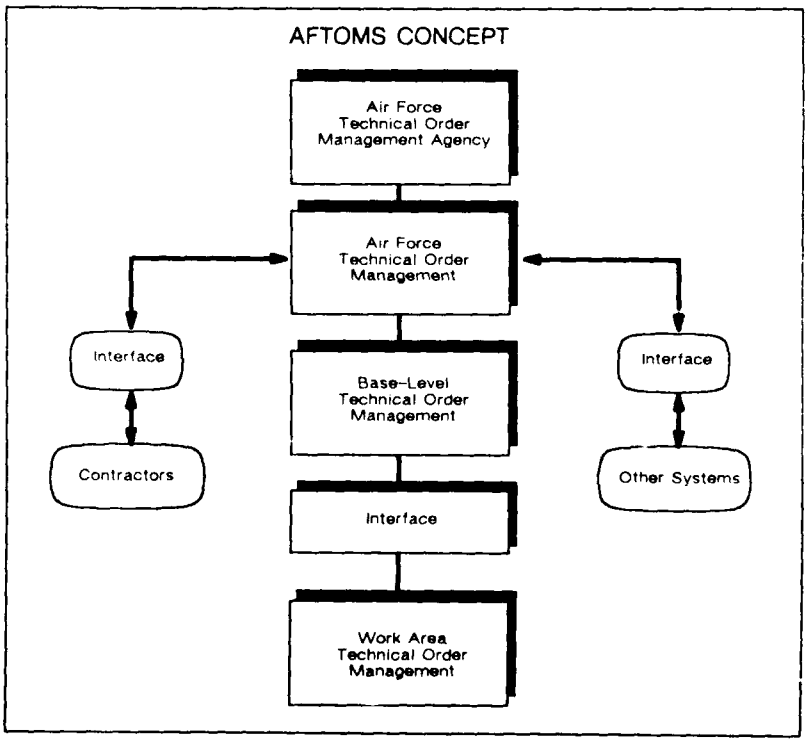
The ATOS operator can scan, key in, or import text and graphics from a variety of sources. The result is a photo-ready paper master copy. The USAF acquired ATOS for use

in making changes to paper TOs. A system that can accept, store, distribute, and manage digital TO data still is required.

The most recent initiative to modernize the existing TO system is the Air Force Technical Order Management System (AFTOMS) program. AFTOMS is a completely new concept for the management of TO data, which will manage the flow of TOs and management information, including personnel, policies, procedures, directives, standards, specifications, manual processes, and automated systems. Bringing AFTOMS into being will require direct major command involvement. AFTOMS functions will handle TOs and TO management information through all phases of the TO life cycle. TOs will be acquired, managed, and distributed in digital form. Changes to organizations and operating procedures will be necessary. AFTOMS will use the new state-of-the-art information technologies to acquire, manage, and distribute TOs. By implementing AFTOMS, the USAF will be significantly more mission and cost effective.

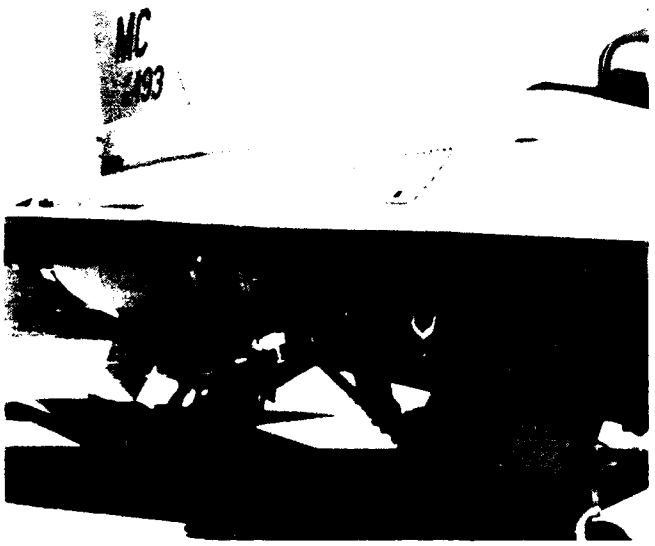


Many benefits can be gained by adopting a digitally based, AFTOMS-like TO management system. Tangible benefits will include such things as the improved work force productivity, which will result from the improved efficiency of USAF maintenance technicians. This productivity increase will contribute to increased aircraft mission capable and availability rates. Eliminating paper will decrease TO storage and distribution costs. There are also many intangible benefits. TOs will become more current because of the reduced update time. User efficiencies will improve because of increased familiarization resulting from standardized, user-friendly formats. Also, onboard aircraft TO weight will be reduced drastically. These benefits will all contribute to increased readiness, reduced printing time and cost, less nonproductive paperwork, more accurate maintenance data collection, and the potential for improved spares management.



ADVANCED CONCEPTS

New concepts for using digital data for equipment operations and maintenance are being considered for several systems under development. Successful test programs have demonstrated the use of portable electronic display devices presenting data to the user interactively. The first digital data intended for depot use on a major weapon system will be delivered in 1991. Manuals will be printed for use in the field. Other systems using display stations in maintenance shops and portable display devices for use on the flight line may reach users as early as 1993.

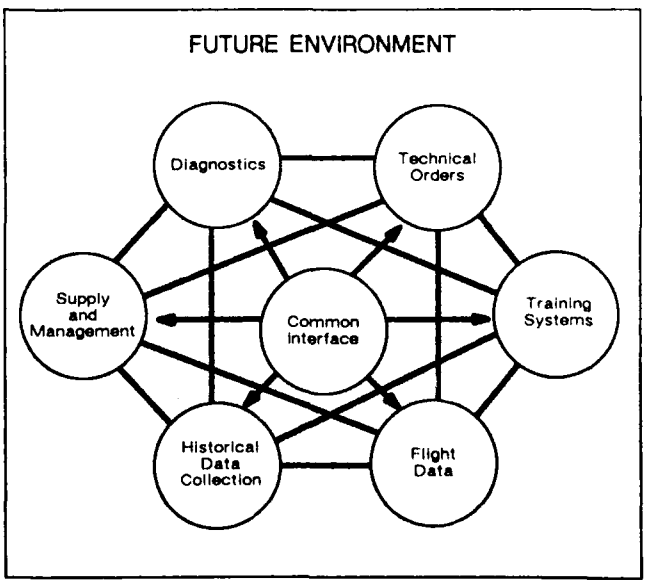


As systems using digital data become more advanced, benefits to users will continue to increase. Use of digital systems, such as ATOS, to publish and change TOs has already affected users in several ways. Changes to TOs can be created and distributed to users more quickly. The presentation of technical data is more consistent and concise because of the inherent structured format of digital systems. A major change will take place when computer-based display devices come into use. The use of integrated data base technologies will change maintenance processes and the skills required to accomplish them. Since the data will be updated in the central computer and available on-line, many mundane chores will be eliminated. Going to libraries to pick up TOs, determining the proper volume and page, and posting changes are examples of activities that no longer will have to be performed. Prompts on display devices will interrogate users for information about the tasks to be accomplished, then use this information to display appropriate technical information.

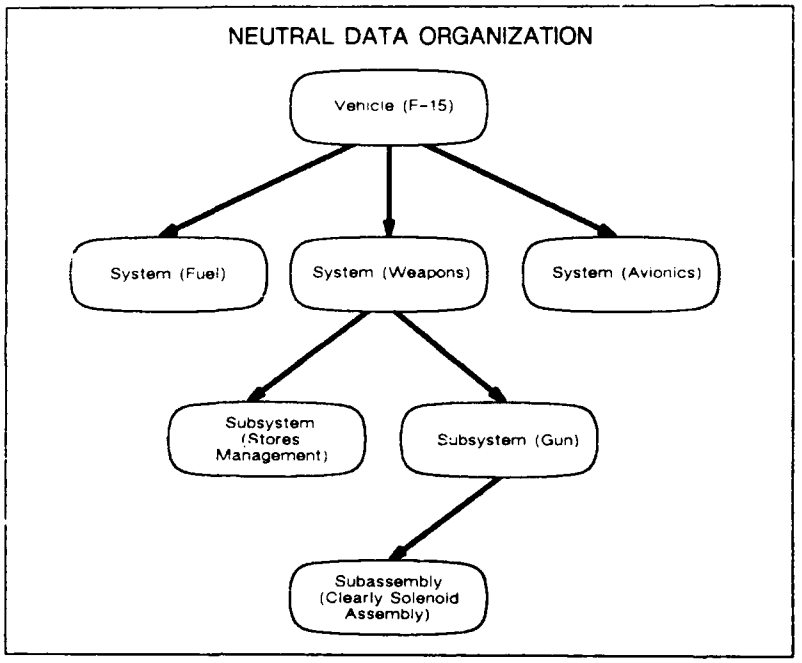
The use of integrated data base technologies will change maintenance processes and the skills required to accomplish them.

In addition, portable maintenance aids will be able to interact with other automated systems, such as built-in-test equipment, ground-based automated test equipment, supply systems, and work control and reporting systems. Users will no longer have to manually complete maintenance data collection forms since information will be obtained automatically by interfacing and integrating systems.

In traditional, printed TOs, content, structure, and format of technical information are determined by authors and publishers of the manuals at the time TOs are written. With the advent of digital technical information, content, structure,



and format aspects will be handled separately. When information is requested by users, the data will be tailored to meet user needs. To make this new approach possible, we will establish neutral data bases. Neutral data is not stored in the traditional page-oriented format but uses a free-form modular structure devoid of format. Neutral data is built around a hierarchical structure, which can be extracted from the data base and tailored for the task at hand. Therefore, there is no need for the technician to search through nonapplicable information to find an appropriate procedure or piece of information necessary to perform a task.

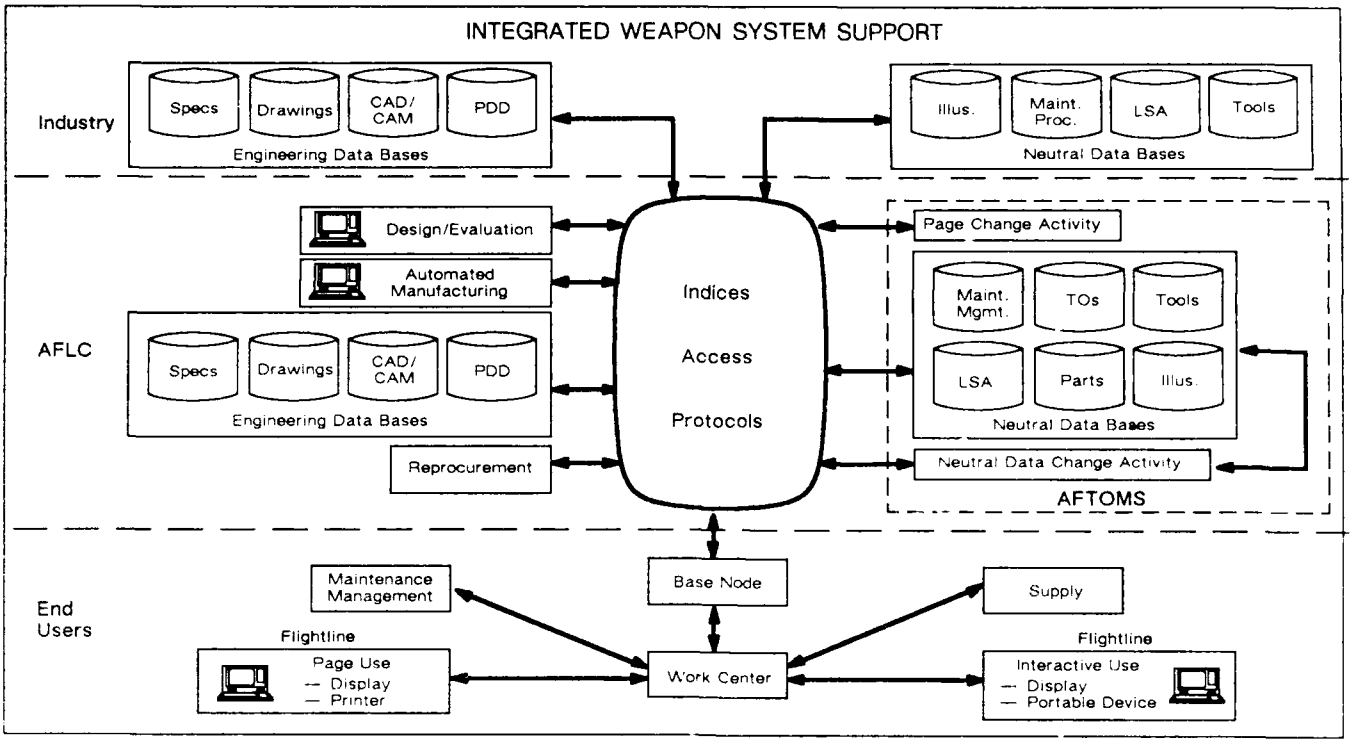


Each level of tailored data has the following five kinds of information associated with it: descriptive, procedural, operating, trouble-shooting, and parts data. These kinds of information are complex groupings of primitive data elements. Cross-references between the elements are used to establish the relationships needed to create text and graphics.

Neutral data is a key mechanism for achieving a near-paperless environment. The use of neutral data provides benefits to both users and maintainers of technical data. A data element only appears in the data base once, even though it is used for several purposes. This reduces redundancy, and therefore size, of the data base. If the information contained in the data element changes, it only has to be changed in one location. For this reason, changes can be incorporated more quickly and at less cost. Nonredundant storage should also improve the accuracy and consistency of data by eliminating multiple sources for the same information. Information presented to users can be tailored at the time of use to accommodate equipment configuration, technician's level of experience, nature of the task, and symptoms of the equipment malfunction. Finally, the nature of neutral data allows it to be used in future applications not even considered at the time it was originally acquired.

YEAR 2000

By the year 2000, the U.S. Air Force and industry will have implemented a mixture of current and emerging technologies and made significant progress toward a near-paperless TO environment. The integration of all TO processes will pull together USAF's management and use of TOs into a cohesive, unified process, yielding improved supportability, military readiness, and combat effectiveness. Future maintenance concepts call for technicians with general skills who are capable of maintaining diverse subsystems. These "generalists" need operating and maintenance information from a variety of sources. This information can be made available through integrated automation. The implementation of the concept of portable display devices for interfacing with on-aircraft and ground-based computer systems will make this future maintenance concept a reality.

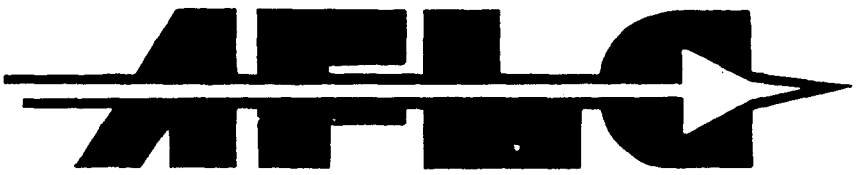


AFLC is providing the guidance necessary to ensure that systems, data, and personnel skills are in place to effectively use digital data to support weapon system operation and maintenance. Development and deployment of the systems required to acquire, manage, update, publish, stock, and distribute TOs has begun. TO specifications and standards required to support development and use of digitized TOs require a central USAF office of responsibility which, under the concept of AFTOMS, will be staffed with AFLC resources. This will mean changes to the way AFLC does business. The main difference between today's activities and what will be required in the future is the additional employee skills necessary to do the job. Training to develop these skills will be accomplished during implementation of AFTOMS.

Implementation of the systems and infrastructure required to support the TO system throughout the U.S. Air Force of the future is a function that will be spearheaded by the AFLC management team with participation of the U.S. Air Force Major Commands. Planning is in progress. By laying out a sound program that allows the TO organizational structure to change with the deployment of systems and grow with the acquisition of digitized data, the TO flood threat will be eliminated. Future technical data requirements will be met.

AFLC is providing the guidance necessary to ensure that systems, data, and personnel skills are in place to effectively use digital data to support weapon system operation and maintenance.

In pursuing the common goal of improving weapon system readiness through the use of the latest technology, everyone must participate. The year 2000 is imminent and immediate action is critical. AFTOMS is a necessary beginning. Use of state-of-the-art information technologies to acquire, manage, and distribute TOs will achieve significantly increased mission effectiveness and reduce costs. Direct major command involvement is crucial to develop and implement a fully coordinated AFTOMS management structure. Teamwork through all phases is the answer.



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