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REPORT TO THE
COMMITTEES ON APPROPRIATIONS
OF THE
UNITED STATES HOUSE OF REPRESENTATIVES
AND THE
UNITED STATES SENATE

AUTOMATED LOGISTIC SYSTEMS

PART I - COMPUTER AIDED LOGISTIC SUPPORT (CALS)

PART II - AUTOMATION OF TECHNICAL MANUALS AND ORDERS

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
(ACQUISITION AND LOGISTICS)

WASHINGTON, D.C.

MARCH 28, 1986

REPORT TO THE
COMMITTEES ON APPROPRIATIONS
OF THE
UNITED STATES HOUSE OF REPRESENTATIVES
AND THE
UNITED STATES SENATE

AUTOMATED LOGISTIC SYSTEMS

EXECUTIVE SUMMARY

ES.1 PURPOSE

This document reports on DoD's plans for and progress toward--

- Automating the creation and distribution of logistic data and
- Reducing the amount of technical paperwork required for weapon system procurement and logistic support.

The Committee on Appropriations of the House of Representatives, in its Report on the FY 1986 Defense Appropriations Act, directed the Department of Defense to report on efforts to automate logistic support and reduce paper-based technical documentation. The Senate Committee on Appropriations also requested a report on reducing paper-based technical manuals and technical orders.

Part I of this report responds to both requests and considers the total issue. Part II focuses specifically on technical manuals and technical orders.

ES.2 DEFINITION AND SCOPE

Computer Aided Logistic Support (CALS) is a program established by the Department of Defense. CALS will--

- Apply both existing and emerging communications and computer aided technologies to improve the productivity, quality, and timeliness of logistic support.
- Focus specifically on integrating automated processes to create, store, retrieve, use, and exchange weapon system logistic technical information by--
  - Actively influencing the design process to produce weapon systems that are more reliable and easier to support and maintain;
  - Automating the development, delivery, maintenance, and distribution of logistic support products; and
  - Reducing the quantity of technical paperwork needed to develop, acquire, support, and maintain military weapon systems.

Cost savings and other important benefits will repay CALS investments. Benefits include: quicker, more efficient procurement of spare parts; better, more efficient maintenance on operational weapon systems; and more effective logistic planning and management for new weapon systems.

Because industry creates most of the logistic support information that DoD uses, CALS development and implementation must be a joint industry-DoD process. CALS will include the interfaces that link (1) prime contractors to their suppliers and (2) industry to the Military Departments and Defense Agencies. These interfaces will be defined by contractual requirements that can be satisfied by industry integration and improvement of automated data processes. Interfaces will also be defined by data interchange specifications that will facilitate communications among a variety of dissimilar hardware systems.

CALS will span the program life cycle of weapon systems from pre-concept planning, through development and support, to product disposal. CALS will be implemented across all weapon systems and throughout the Department of Defense. The transition from paper to digital-based systems involves many government organizations and industrial firms. It will mean fundamental changes in creating, acquiring, and managing technical information. To be efficient, however, CALS implementation must be evolutionary, not revolutionary. CALS will be gradually implemented as new weapon systems are developed and selectively backfitted to incorporate existing weapon systems where cost-effective.

ES.3 OVERVIEW

Over the past 5 to 10 years, DoD components have undertaken numerous data automation efforts responding to both user needs and Congressional direction. At the same time, industry has rapidly implemented such new technologies as computer aided design (CAD), computer aided engineering (CAE), computer integrated manufacturing (CIM), and automated authoring and publishing systems.

ES.3.1 Islands of Automation

DoD and industry initiatives have led to "islands of automation" in the midst of what is largely a paper-based acquisition and logistic support environment. These islands tend to be functionally oriented and often cannot communicate with one another electronically. In many cases, the need for data interchange is being met by paper output and data re-entry, to the detriment of efficiency, timeliness, and accuracy. Both DoD and industry recognize the problem and have identified the need for integration.

ES.3.2 Joint Industry-DoD Task Force

In 1985, a Joint Industry-DoD Task Force on Computer Aided Logistic Support recommended that DoD initiate a program to integrate and accelerate its use of automated logistic support technologies. The Task Force further recommended that DoD adopt or develop a set of interface standards for interchanging logistic technical information within and among DoD and industry systems. To implement the recommendations, DoD established the CALS program.

The Task Force also recommended that DoD provide a common, across-the-Services interface with industry. The DoD initiative incorporates this feature. As a central objective, CALS will establish compatible systems to facilitate interfaces with industry and among DoD elements. Common DoD data interchange standards and, in some cases, common hardware systems will be needed to achieve this objective.

ES.3.3 Deputy Secretary's Memorandum

The Deputy Secretary of Defense has established a top level CALS management organization and has directed the Military Departments and Defense Agencies to implement the CALS program. This report summarizes the overall DoD plan. The DoD components are now developing CALS implementation plans. These plans address standards development and validation, research and development demonstrations, and information system modernization within an integrated architecture.

The DoD components have a number of automation efforts under way that form the starting point for CALS. The components are now developing prototypes and test bed programs for CALS integration.

DoD has set a goal to make the transition from current paper-intensive logistic support processes to a largely automated and integrated mode of operation for weapon systems entering production in 1990 and beyond. DoD will apply CALS automation and integration to data in existing systems on a case-by-case basis when implementation will be cost-effective.

Figure ES.1 shows milestones for implementing CALS. Initial improvements will occur in the 1986-1988 period, primarily through automating engineering data repositories and technical manual processing. By 1988, DoD will have demonstrated capabilities to receive data from defense contractors in digital form using industry exchange standards. From 1987 to 1990, DoD will develop and validate specifications to acquire logistic technical information in digital form through lead weapon system programs. Routine acquisition of digital data during weapon system acquisitions will begin in the early 1990s. If a concerted planning and management effort gains impetus now, the large scale transition to a CALS environment will be completed by the mid-1990s.

ES.3.4 Funding

Table ES.1 shows FY 1986-1988 funding as of the FY 1987 President's Budget. It includes: (1) initial funds to establish automated DoD repositories, automated technical manual processing systems, and computerized design engineering installations; (2) funds to develop and demonstrate subsystem elements such as user terminals for paperless delivery of logistic and maintenance information; (3) funds for system designs, architectures, and demonstration projects to verify the designs; and (4) funds to develop and verify data interchange standards to permit data to flow between diverse systems.

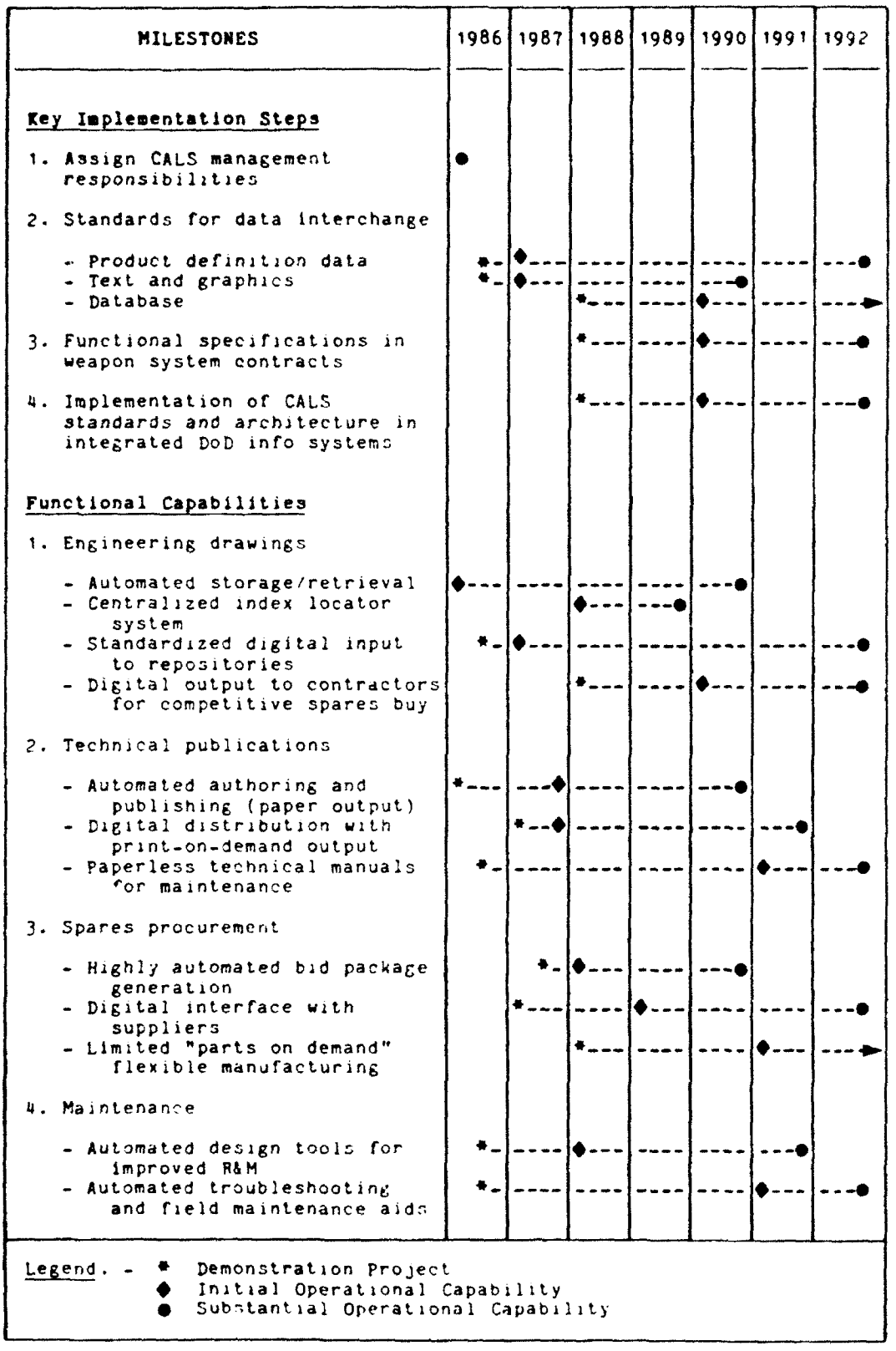

Figure ES.1. CALS Milestones

Table ES.1

Funding for CALS ($ millions)
(As of FY 1987 President's Budget)

DoD Component	FY 1986	FY 1987	FY 1988
OSD	0.0	14.8	14.8
Army	33.8	23.6	41.2
Navy	52.9	73.0	75.0
Air Force	70.6	69.4	64.9
DLA	0.0	0.0	22.4
DoD total	157.3	180.8	218.3

The Military Departments and Defense Agencies are now developing implementation plans that will include funds for program work in FY 1988 and beyond and will identify unfunded requirements for FY 87. The FY 1988-1992 program review (summer 1986) will be the first opportunity for a corporate DoD review of CALS funding.

The OSD funding shown in table ES.1 is a new program element for CALS (PE63736D) starting in FY 1987. It supports the development of data interchange standards and near term demonstrations. This funding is essential to achieving compatibility among DoD systems and a unified interface with industry--without these efforts there would be no CALS integration program.

The funds shown in table ES.1 exclude the substantial investment required by industry to integrate and automate its

processing systems to achieve improved and less costly logistic data. As a major task, CALS will develop contractor incentive approaches to foster industry investment in CALS modernization.

ES.4 BENEFITS EXPECTED FROM CALS

The CALS initiative will result in benefits that justify the cost and effort expended. These benefits include--

- Improving the design and the reliability and maintainability of weapon systems, making them easier to support and allowing them to be produced more rapidly;
- Saving an estimated 20 to 30 percent in the cost of obtaining technical information and logistic data from industry when acquiring weapon systems;
- Shortening administrative lead times for assembling competitive procurement data packages for spare parts;
- Enhancing the timeliness and increasing the accuracy of information provided for maintenance and supply functions;
- Reducing the use, distribution, and storage of paper products; and
- Reducing the costs of logistic support through improved planning.

ES.5 PROBLEMS AND ISSUES

The benefits noted above, however, cannot be expected immediately. Implementing CALS requires solving complex and difficult problems. Production of logistic technical data involves many government organizations and industrial corporations, ranging from the largest to smallest producers. These organizations use many different kinds of hardware and software for a wide variety of applications--from word processing and accounting, to engineering drawing preparation and inventory control, to computer aided design and computer integrated manufacturing.

In this environment, developing and implementing standards to exchange digital data and to solve computer interface problems poses a substantial challenge. Developing and implementing an integrated approach to modernize the DoD logistic infrastructure poses an equal challenge.

To achieve the potential benefits requires that DoD and industry address a number of problems and issues:

- DoD must rethink current paper-based logistic processes and implement an architecture for distributing and using digital data. This is a substantial system design and management problem.
- Integration of automated design processes must incorporate reliability and maintainability design rules and procedures for a number of product classes. This capability must be rapidly implemented throughout industry.
- Existing and proposed industry standards for data exchange must be refined, developed, and verified to cover additional DoD needs. Industry must implement these standards on an accelerated basis.
- The Military Departments and Defense Agencies must determine the best mix of delivery media for different user environments. They must also program funds for acquiring information processing and delivery equipment.
- DoD must develop contractual requirements for selective access to contractor data systems and for contractor delivery of digital data.

These elements must all be supported by management and adequately funded before CALS can be effectively implemented. Failure to implement CALS will predictably result in increased incompatibility among DoD system elements and continued difficulty in interfacing with industry.

ES.6 MANAGEMENT

CALS integration objectives cut across numerous functional and programmatic lines. CALS projects require R&D, procurement, and operating funds. They concern diverse technical issues in integrated system design and data exchange conventions. Also, the projects involve numerous DoD and industry organizations.

Management problems include maintaining a unified interface with industry across DoD, ensuring compatibility within and among the Services, and making maximum use of common equipment and software to avoid redundant developments. To address these concerns DoD--

- Has established an OSD CALS office that will oversee DoD system integration and address compatibility issues;
- Has required each Military Department and DLA to designate a senior CALS executive and establish a CALS office to coordinate CALS implementation efforts; and
- Has asked the National Bureau of Standards to provide major support for developing data interchange standards.

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REPORT TO THE

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PART I

COMPUTER AIDED LOGISTIC SUPPORT (CALS)

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
(ACQUISITION AND LOGISTICS)

WASHINGTON, D.C.

MARCH 28, 1986

Appendices

Part II
Automation of Technical Manuals and Orders

Glossary

CHAPTER I

INTRODUCTION AND BACKGROUND

1.1 PURPOSE

This is Part I of a two part report to Congress required by the Committees on Appropriations in their reports on the FY 1986 Defense Authorization Act. This part of the report records DoD's plans for, and progress toward --

- Automating the creation and distribution of logistic data and
- Reducing the amount of technical paperwork required for weapon system procurement and logistic support.

1.2 REPORT ORGANIZATION

Part I is organized into five chapters and four appendices.

Chapter I introduces the report and provides a brief overview of Congressional interest and current DoD efforts. Chapter II discusses the DoD plan to develop and implement CALS and make the transition from paper based to digital logistic technical information processes. Chapter III summarizes the emerging implementation plans of the DoD Components. Chapter IV discusses imperatives for success. The final chapter summarizes the benefits that can be derived from CALS, the potential problems DoD faces in implementing CALS, and the conclusions reached to date.

The report stands on its own, but appendices convey additional detail and supporting documentation.

1.3 DEFINITION

Computer Aided Logistic Support (CALS) is the program established by the Department of Defense to --

- o Apply both existing and emerging communications and computer aided technologies to improve the productivity, quality, and timeliness of logistic support.
- o Focus specifically on integrating automated processes to create, store, retrieve, use, and exchange weapon system logistic technical information by --
  - Actively influencing the design process to produce weapon systems that are more reliable and easier to support and maintain;
  - Automating the development, delivery, maintenance, and distribution of logistic support products; and
  - Reducing the quantity of technical paperwork needed to develop, acquire, support, and maintain military weapon systems.

1.4 SCOPE

The CALS program is broad-based. Because industry creates most of the logistic support information that DoD uses, CALS improvements must be a joint industry-DoD process. CALS includes the interfaces that link (1) prime contractors to their suppliers and (2) industry to the Military Departments and Defense Agencies. Industrial associations have been asked to serve as an integrating mechanism.

Although certain logistic modernization activities that involve neither the industry-DoD interface nor the distribution of logistic technical information may be CALS related, they are not a formal part of the DoD CALS program. Such DoD internal activities as modernization of supply and transportation data

systems have interfaces with the CALS program but are not addressed in this report.

1.5 NEW OPPORTUNITIES TO SOLVE OLD PROBLEMS

The logistic support environment has changed dramatically in the last few years. New technologies have emerged that offer considerable potential for more efficiency through improved weapon system design and increased automation of logistic technical information. Logistic problems associated with supporting our highly sophisticated and technically complex military weapon systems have also increased. The way DoD and industry create, acquire, and manage logistic technical information has not kept pace with the technology available to perform these functions.

1.5.1 Problems Addressed By CALS

DoD faces major problems in acquiring and using logistic technical information because the data are almost entirely paper-based and are rapidly becoming unmanageable. Requirements for logistic technical information to support new weapon programs -- drawings, specifications, manuals, and other logistic support data -- are growing exponentially. Figure 1.1, for example, shows the growth in technical manuals for operating and maintaining tanks.

The burden of creating, delivering, updating, managing, and using this volume of data in hard copy is becoming intolerable. As weapon systems have become more complex, these problems have not only added to weapon system acquisition and support costs but have also increased the potential for degrading system operational readiness and safety.

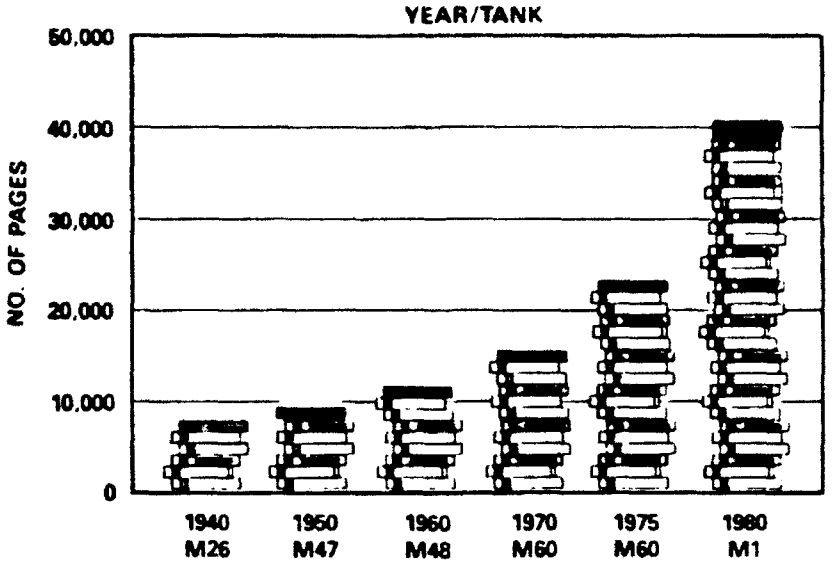

Figure 1.1 The Growth in Weapon System Technical Documentation

These problems can lead to --

- Technical manuals and training materials that are out-of-date and difficult to use and maintain;
- Engineering drawings that are incomplete, illegible, and impossible to control;
- Configuration management information that is inadequately documented and difficult to maintain;
- Logistic support data that are voluminous, redundant, and excessive, yet not readily available to users; and
- Reprocurement technical data packages for spare parts replenishment that are inaccurate and incomplete, and that take too long to prepare;

Industry, DoD, and Congress have recognized these problems and have identified the need to work together to take full advantage of emerging technologies.

1.5.2 Opportunities

Through CALS, DoD and industry will use emerging technology to: (1) design weapon systems that are easier to support, (2) make the transition from paper-based to digital logistic technical information, and (3) routinely acquire and distribute that information in digital form for new weapon systems.

CALS will span the program life cycle of weapon systems from pre-concept exploration through development, production, and support to product disposal. CALS will be implemented across all weapon systems and throughout the Department of Defense. This transition involves many government organizations and industrial firms. To be efficient, CALS implementation must be evolutionary, not revolutionary. CALS will be progressively implemented as new weapon systems are developed, and selectively backfitted where cost-effective.

1.5.3 Need For Integration

Because of the evolutionary nature of technological improvement and the long standing nature of the problems, various DoD components and industrial firms have already initiated modernization efforts. As a result, there now are "islands of automation" in a paper-based sea.

To achieve its full potential, the modernization of technical support information must occur across industry and DoD component boundaries. This requires close cooperation and continuous coordination. These efforts must involve all of the Services, appropriate Defense Agencies, the Office of the Secretary of Defense (OSD), and, most importantly, industry. As the need for major improvements became clear, the Department of Defense established a Joint Industry-DoD Task Force in 1984 to address Computer Aided Logistic Support needs.

The Joint Task Force made a comprehensive analysis of the problems and potential improvements. Its five volume report[1], published in June 1985, addressed policy and legal issues, information requirements, system architecture, and technology. It not only provided the basis for the DoD CALS program, but also served as a catalyst for future joint DoD and industry action.

Among its recommendations, two especially bear on this report to Congress. One calls for DoD to initiate a program to integrate and accelerate DoD and industry use of automated logistic support technologies. The second advises DoD to adopt a set of common DoD-industry interface standards for interchanging technical information on military weapon system acquisition and support. The DoD CALS plan, discussed in chapter 2, implements the recommendations of the Joint Task Force report.

Many forces have vested interests in an infrastructure that has remained essentially the same since the early 1950s. In spite of considerable inertia opposing major changes, the time has come to shift from a paper-based technical information environment to an integrated and automated joint DoD-industry logistic technical information environment. The new technologies associated with CALS require fundamental changes in the way logistic technical information is created, acquired, and managed. Those changes may bring with them major, still undefined changes in logistic support functions and processes. The future environment of CALS needs to evolve from the current system. It also must be developed and implemented while the support process for existing weapon systems continues.

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[1] IDA Report R-285, Report of the Joint Industry-DoD Task Force on Computer Aided Logistic Support (June 1985), available from the Institute of Defense Analyses and the Defense Technical Information Center.

The CALS plan calls for an evolutionary transition that moves forward steadily and surely. CALS will begin by integrating the "islands of automation" and by demonstrating and prototyping the required technology on selected lead weapon systems. The CALS program will be applied to new systems that come on line in 1990 and beyond. The program will incorporate technical data on existing weapon systems when and where it makes sense to do so.

1.6 LEGISLATIVE INTEREST

The most extensive statement of legislative interest in the issues addressed by CALS is the House Appropriations Committee Report on the 1986 Defense Appropriations Act. It requires that DoD provide a report on technical documentation initiatives. The Senate Appropriations Committee Report also directs a DoD report. The Conference Committee Report (C. 99-450) re-affirmed those statements. This report responds to those requests.

1.6.1 House Appropriations Committee Report

The House Appropriations Committee has been extremely interested in the concepts that the CALS program addresses. The Committee held hearings on the subject including witnesses from the Office of the Secretary of Defense, the Military Departments, and Defense Agencies. The Committee's report (H.R. 99-332) addressed automation in general and technical documentation enhancements specifically. It also directed a report addressing DoD efforts to acquire and distribute automated logistic support information.

The House Appropriations Committee's Report charged the Assistant Secretary of Defense (Acquisition and Logistics) to take the lead policy role to ensure maximum compatibility among the Services' logistic systems by developing and promulgating minimum standards. The House Appropriations Committee's report

noted DoD's 10-point plan to end spare parts pricing abuse but suggested that additional savings could be realized by using automated distribution of logistic technical data within and among the various DoD components.

The House Appropriations Committee specifically directed that DoD submit this report to Congress. The Committee praised the Services' technical documentation initiatives but expressed concern that the projects needed Department-level oversight to ensure that they will be compatible and efficient. The Committee directed that DOD--

- Develop common electronic publishing standards and specifications;
- Prepare a plan for compatible, totally automated, digital electronic systems; and
- Establish a goal of 50 percent reduction in the use of paper for technical documentation.

The committee also requested that DoD report on its efforts to acquire and distribute automated logistic information in future weapon system acquisitions.

1.6.2 Senate Appropriations Committee Report

The Senate Appropriations Committee was more general in its comments. However, its report (S. 99-176) reinforced the House report. The Committee also was concerned about the quality and growing cost of DoD technical publications. Its report supported use of advanced computer technology for texts, engineering drawings, and other graphics but expressed concern that current efforts are unilateral, lack OSD oversight, and are in danger of resulting in incompatible and excessively expensive systems. The SAC directed a report to Congress similar to that required by the House Appropriations Committee.

1.7 THE CALS INITIATIVE

To respond to the Congressional mandate and to user needs, DoD has initiated efforts to develop a joint DoD-industry approach to the problems of automating logistic support processes. The Office of the Secretary of Defense and the Military Departments have taken initiatives that lay the foundation for implementing the CALS program.

1.7.1 CALS Policy Memorandum

On September 24, 1985, the Deputy Secretary of Defense signed a policy memorandum[2] that endorsed the recommendations of the CALS Task Force and committed DoD to the objective of making the transition from current paper-intensive design and logistic processes to a largely automated and integrated mode of operation for weapon systems entering production in the 1990s. The memorandum formally established the CALS program to integrate and manage logistic automation efforts toward this objective.

The CALS Program has three high payoff goals:

- Accelerating the integration of reliability and maintainability (R&M) design tools into industry computer aided design and engineering (CAD/CAE) systems;
- Accelerating the automation of processes used by contractors to generate logistic technical information; and
- Rapidly increasing DoD capability to receive, distribute, and use logistic technical information in digital form for spare parts management, training, and maintenance.

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[2] See appendix A.

1.7.2 Implementation Guidance

To achieve the CALS objectives, the Deputy Secretary of Defense memorandum directs the Military Departments and Defense Agencies to accomplish a set of implementing tasks. These include requirements to --

- Establish an organization within each affected DoD Component to manage CALS implementation;
- Develop a plan for modernizing DoD information processing capabilities to access, process, and distribute contractor logistic technical information;
- Establish a schedule for revising applicable military specifications and standards for acquiring logistic technical information in digital form;
- Conduct demonstration projects using data integration technologies to evaluate advances in the performance of logistic functions, and validate user requirements for future system design;
- Review new weapon system acquisition programs to determine automation opportunities for producing, delivering, and using digital product definition data and other logistic technical information;
- Determine long-haul communication and wide area networking requirements for CALS implementation;
- Establish a research and development program to meet CALS technology needs;
- Set priorities among technological issues;
- Implement industry investment incentives, contract requirements, and source selection criteria to support CALS objectives; and
- Develop and promulgate policies to foster rapid integration of weapon support systems.

Military Department and Defense Agency implementation plans are currently in the "initial draft" stage but will be available in final form for review by July 1, 1986. Key aspects of the draft plans are summarized in Chapter III.

1.7.3 Objectives

The CALS program will integrate ongoing and proposed initiatives to automate technical information in DoD and industry. The approach to this integration effort is to draw upon functional requirements to establish architectural guidelines and interface standards. These guidelines and standards will allow separate hardware and software systems to be functionally and technically compatible. They will facilitate the exchange of data in digital form between and among Defense prime contractors, their suppliers, and DoD components.

DoD will structure incentive programs, set contract requirements, and establish source selection criteria to accelerate industry implementation of CALS. Each of the Military Departments and Agencies will develop and implement the necessary data systems and interfaces to--

- Receive, distribute, and process logistic technical information and
- Provide secure access to authorized users.

1.7.4 CALS Target Capabilities

The CALS program will link a number of industry and government stand-alone systems, including:

- Computer aided design (CAD);
- Computer aided engineering (CAE);
- Computer aided manufacturing (CAM);
- Associated product definition data bases;
- Automated acquisition support systems; and

- Production of technical manuals, training data, and engineering drawing packages.

CALS will also provide an automated capability to transfer technical data between and among major government nodes (such as engineering data repositories) and other authorized users throughout the DoD and industry logistic communities. This does not imply design of a single central system. However, it does require that specifications for user systems conform to the common architectural guidelines and interface standards needed for system compatibility.

CALS target capabilities for the mid-1990s include:

- The capability to maintain weapon system configuration data on a near-real-time basis through the use of electronically distributed data bases.

  Integrated data bases of product definition and support information will be created during weapon system design. The data bases will be maintained and distributed electronically throughout the operational life of the weapon system.

- The capability to store, retrieve, distribute, and process logistic technical information in paperless form.

  Weapon contractors and subcontractors, who are the sources of design-related logistic technical information, will be coupled to DoD nodes and users for the electronic exchange of information, including the ability to produce hard copy where needed. This new paperless distribution capability will greatly improve the timeliness and accuracy of technical information. Attendant benefits will accrue in shorter down times for weapon systems, reduced manpower, and lower production and maintenance costs.

- The capability to integrate logistic technical information from a variety of interconnected data bases.

  For example, the logistic community will be able to access CAD and CAE design data bases to extract product definition data for spare parts procurement. It will also be able to produce technical manuals, maintain

configuration control, and create logistic planning and analysis products. The CALS environment will have an automated "ripple through" capability to achieve rapid and accurate updates of logistic technical information. A single "functional data base," as seen by the user, will avoid redundant generation and processing of data.

- The capability to integrate design and design analysis processes by incorporating supportability objectives (e.g., reliability and maintainability) as quantitative design inputs and by providing both on-line design analysis and more complex off-line analysis of R&M characteristics.

  This includes the design of built-in and external test logic and software. It also includes analysis of fault detection and isolation capability.

- The capability to interface with flexible manufacturing systems to allow competitive parts production by a maximum number of automated facilities with much shortened lead times.

- The capability to provide DoD users with distributed systems that allow transparent access to required logistic technical data, are secure where needed, allow for automated updating based on design changes, and take advantage of decision support and expert system aids.

The CALS architectural concept appears in figure 1.2 (industry "front end") and figure 1.3 (long term objective for DoD interface with industry).

1.7.5 Congressional Mandate to Reduce Technical Manual Paper

The House Committee on Appropriations directed DoD to report on plans for automating its technical manual processes with the goal of reducing the use of paper by 50 percent. The DoD response, entitled "Automation of Technical Manuals and Orders," is Part II of this report.

The DoD effort to automate technical manuals and reduce dependency on paper-based technical support information makes up an integral part of the CALS effort.

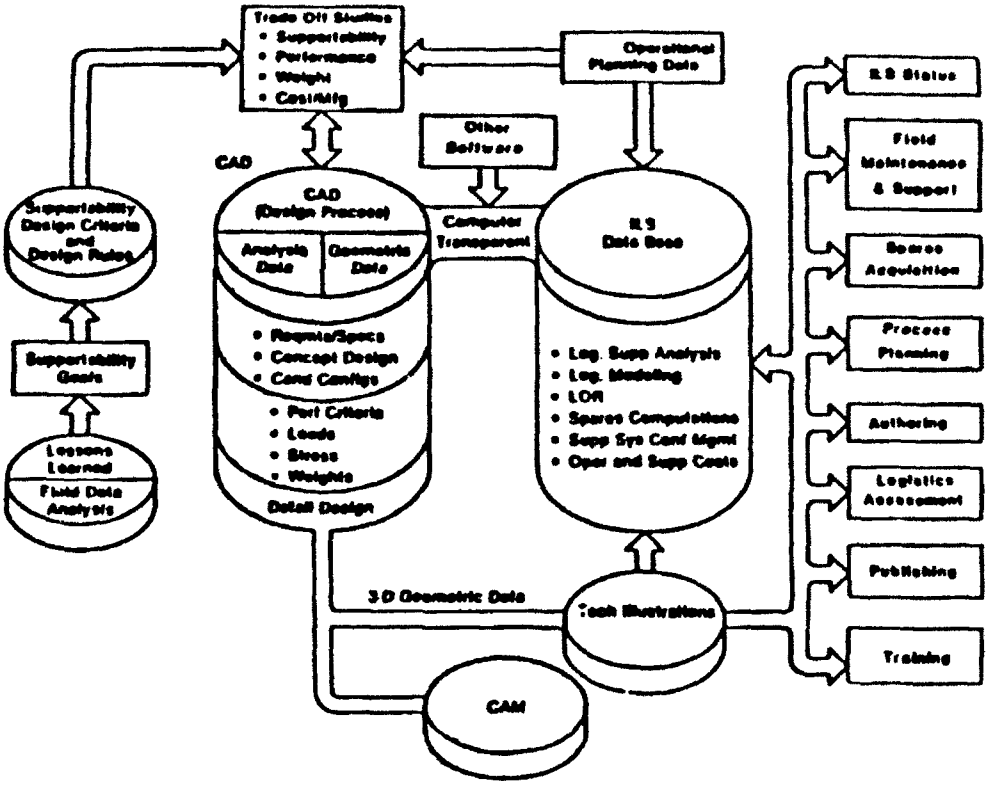

Figure 1.2 Computer Aided Logistic Support

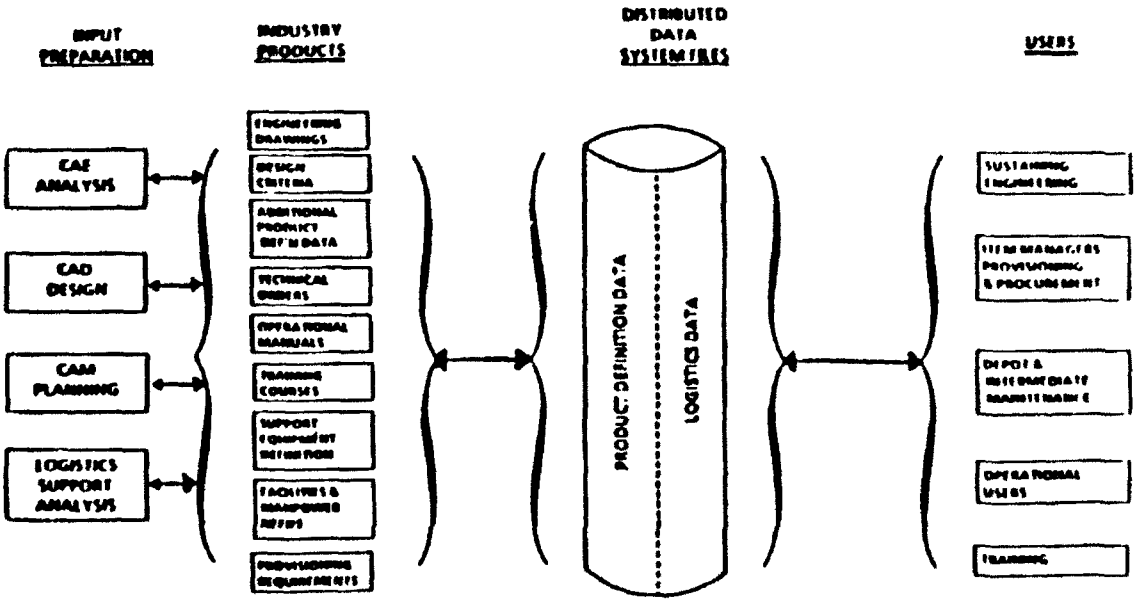

Figure 1.3 Long Term CALS Objective: Automated Life Cycle Logistic Data

1.8 COST EFFECTIVENESS

CALS will require cost effective investments by both DoD and industry. Investment decisions must consider (1) the immediate payoffs that occur from automating a particular weapon system support function, (2) the less easily quantified benefits that accrue in other areas of logistics when a specific automation project is integrated into a complete support process, and (3) the improvements in performance that may accrue from the new capability. An example of the first consideration is the reduced cost of publishing technical manuals. An example of the second is the savings in competitive spares reprocurement cost that will result from using digital product definition data generated by automating the weapon system design function. An example of the third is the improved safety that results from using up-to-date technical manuals for maintenance. The argument for cost effectiveness must be applied to three categories of investments: industry modernization, government modernization, and R&D investments.

1.8.1 Industry Modernization

Industry investments are already being made in areas that (1) demonstrate obvious economic payoffs or (2) offer the company a competitive advantage. Examples are CAD, CAM, and automated text and graphics composition systems. Most contractors already use some level of automation to prepare technical manuals. Reductions of 20 to 30 percent are being realized in the cost of producing technical publications, which will offset initial industry investments within 3 to 5 years, and result in data acquisition savings by the government. Contractor internal investment strategies have already focused on the cost effectiveness of such automation programs, and industry will continue to make these investments wherever direct cost savings can be identified. Other benefits, however, such as increased

timeliness and accuracy of technical information by integrating design, engineering, and logistic planning accrue to the government but do not necessarily result in tangible benefits to the contractor. Some prime contractors are implementing integrated systems to provide these capabilities, but the scope and pace of the effort needs to be accelerated. For this reason, contract incentives may be needed in some cases to encourage industry to increase the priority of automation investments to meet CALS objectives.

1.8.2 Government Modernization

DoD investments will be made on the basis of both projected savings in operational costs, and performance benefits such as improved maintenance effectiveness or improved supply and procurement effectiveness. Initial DoD investments have been made in the two areas having the greatest near term payoffs: automated engineering data repositories and automated publishing and distribution systems. Savings on the order of those projected for industry systems (20 to 30 percent) are anticipated, along with major improvements in the management and use of technical data. Table 1.1 presents examples of the costs and benefits for these systems. Future CALS studies will seek to quantify the performance improvements of these and other elements of CALS integrated information systems. The principle remains, however, that priorities for funding individual modernization efforts will be based on their estimated benefits.

1.8.3 CALS Integration and Demonstration Projects

This category includes R&D investments to create the environment in which future industry and DoD modernization investments will occur. R&D efforts here include developing interchange standards and functional specifications for delivering data in digital form, lead weapon system demonstration projects, and supporting projects (such as

Table 1.1

Examples of Costs and Benefits of the CALS Program

Automation of Engineering Drawing Repositories

All three Services and DLA have efforts under way to automate repositories. The technology used for the Army Digital Storage and Retrieval of Engineering Drawing System (DSREDS) has been adopted by the Air Force and is being considered by the Navy and DLA.

	($ millions)			
Investment Cost	Army	Navy	Air Force	DLA
	34.8	45.4	21.3	12.0

Benefits

The Army DSREDS cost benefit study is typical. It shows that the investment is paid back in less than 4 years based on annual savings of $9.5 million in drawing revisions.

Automated Publishing Systems

The Army 600S system is a contractor operated service for automated publishing. No captial investment by the government is planned.

Investment Cost: None

Benefits

The annual operating cost ($15 million the first year of limited operations, growing to an estimated $100 million by the fifth year) represents a 25 to 30 percent saving compared to current printing costs.

Air Force Automated Technical Order System (ATOS)

ATOS is an in-house authoring, publishing, and distribution system to be installed in depot level facilities. Outputs to the base level will be in paper form. The Air Force is evaluating further automation at the base level (electronic distribution and "paperless manuals") as potential follow-on phases of ATOS.

Investment Cost: $63.6 million

Benefits

Annual savings do not offset the investment cost within 5 years. However, the Air Force significantly benefits from the investment by reducing the cycle for technical order change and distribution from about 240 days for an average change to a few weeks, with concommitant benefits in maintenance and safety.

distributed data base technology demonstrations). The payoff from these R&D investments will occur partly from reducing acquisition and support costs of lead weapon systems, but to a much greater extent through broad implementation in weapon system acquisitions and logistic system improvements in the 1990s.

CHAPTER II

OVERALL DOD PLAN

2.1 CHAPTER INTRODUCTION

This chapter describes DoD's plan to implement the recommendations of the Joint Industry-DoD Task Force on Computer Aided Logistics Support. The plan provides a strategy for step-by-step improvements in the capabilities of industry and DoD to (1) apply data automation technology to the problems of weapon system development and support and (2) acquire and use logistic technical information in digital form. The potential benefits are high in terms of improving support for weapon systems and increasing accuracy and reducing costs of technical data.

The Congressional mandate to reduce the use of paper as a medium for logistic technical information will be met in carrying out DoD's plan. Congress should be mindful, however, of the magnitude of this task. The paper-based logistic infrastructure that has existed in DoD and the defense industry in much the same form since the 1950s is extremely large and highly institutionalized. The technologies for integrated data automation are still evolving. The DoD plan aggressively pursues the objective of rapidly demonstrating and implementing these new technologies and capitalizing on them for support of new weapon systems. It also plots an evolutionary course for transforming DoD logistic technical information processes from paper to digital media.

2.2 CALS DEVELOPMENT STRATEGY

The development of CALS capabilities will be an evolutionary process. The starting point for the design and implementation of CALS consists of--

- Industry systems for computer aided design and engineering (CAD/CAE) that are in the process of being combined with those for computer integrated manufacturing (CIM); these systems currently perform few logistic functions and have very limited on-line R&M design input or analysis capabilities and inadequate data exchange capabilities.
- Industry logistic data automation efforts that have been largely self contained and heavily oriented toward satisfying multiple government requirements for paper products in unique formats.
- Government technical information repositories and distribution nodes that are in the process of transition to digital media.
- Government logistic management systems that employ largely paper-based input and output to perform a variety of highly compartmentalized functions.

To build from this baseline toward the required CALS capabilities, DoD will (1) review developmental projects already underway, and accelerate those with the highest leverage; (2) initiate new projects or modify current projects to fill gaps in capability; and (3) functionally integrate and network the resulting systems to gain large advantages over current separate and paper-intensive processes.

To achieve CALS capabilities requires development of data exchange standards and functional specifications, functional prototypes, technology demonstrations, and information system modernization in both DoD and industry. The Military Departments and Defense Agencies will manage their technical information system modernization programs in accordance with established policy and acquisition procedures. The DoD

Component and OSD CALS steering groups and management offices (see section 2.4) will review these modernization programs for compliance with CALS standards, schedules, and objectives. In addition, they will provide policy direction that will be incorporated into Department and Agency CALS implementation plans.

As noted, DoD and industry CALS applications will build from existing technology and data exchange standards. The Military Departments and Agencies will undertake additional technology development, demonstrations, and prototyping efforts, based on needs identified in the CALS implementation plans. DoD will develop, test, and demonstrate CALS data exchange standards with support from the National Bureau of Standards.

Initial architectural guidelines for evolving DoD and industry information systems are summarized in appendix B.

2.3 DoD CALS PLAN

The CALS program will be phased to accomplish a smooth and orderly transition from paper-based to automated logistic processes. Key implementation steps have been identified to carry out the guidance of the Deputy Secretary's policy memorandum. In addition, DoD has defined a progressive series of actions to achieve specific logistic functional capabilities in the future automated mode of operation.

2.3.1 Schedule and Milestones

A summary schedule is presented in figure 2.1. Detailed implementation schedules will be included in the Military Department/Agency implementation plans.

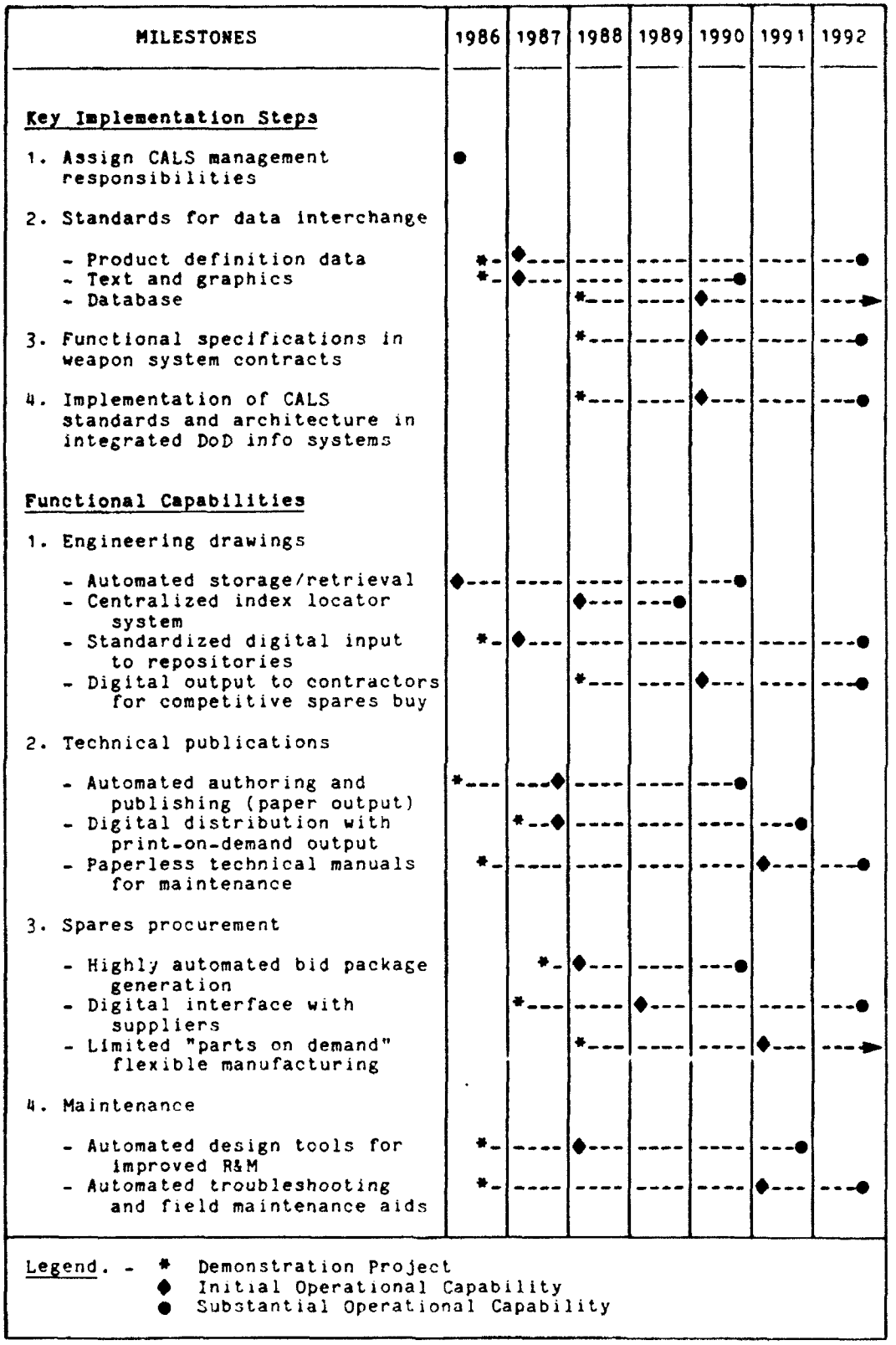

Figure 2.1. CALS Milestones

2.3.2 Schedule Objectives

Broad CALS objectives (keyed to the milestones in figure 2.1) are to:

1. Assign CALS management responsibilities within OSD and the Military Departments and Defense Agencies in 1986.

2. Develop and demonstrate a set of data interchange standards and validation approaches in 1986-1988. These will make engineering data repositories and automated technical manual systems work effectively by allowing direct input of contractor digital data.

3. Use lead weapon system programs in 1987-1989 to demonstrate contractor integration approaches and develop functional specifications for digital data acquisition in future contracts.

4. Implement these standards and specifications in weapon system contracts commencing in 1990.

As shown in figure 2.1, DoD will develop and implement functional capabilities for:

1. Engineering drawings and specifications (implementation of automated storage and retrieval in 1986-1990); digital inputs to and outputs from repositories demonstrated by 1988 and implemented in a phased manner thereafter.

2. Technical publications (print on demand by 1991).

3. Spares procurement (highly automated generation by 1990 of bid packages using digital product information, with optional digital outputs to bidders).

4. Maintenance (electronic maintenance data at depots in 1988 and at dispersed locations in a phased manner thereafter).[3]

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[3] Additional discussion of the scheduled milestones appears in appendix C.

2.3.3 CALS Demonstrations

DoD will sponsor comprehensive demonstrations of technical feasibility using Service and Agency test beds. The test beds will include a range of industry and government nodes for high-leverage logistic functional applications.[4] DoD and industry will use these demonstrations to establish and validate CALS technical specifications.

Functional user involvement and feedback will be a prime element of these demonstrations. Capabilities to be demonstrated include automation of--

- Diagnostics logic in design;
- R&M design rules and design analysis for a range of product classes;
- Production of technical manual text and graphics using CAD/CAE product definition data and updates in response to configuration changes;
- Production and update of logistic configuration and technical data used in procurement packages and automated procurement systems;
- Authorized access from remote terminals to contractor integrated logistic support databases;
- Maintenance troubleshooting assistance through user-friendly terminals with accurate configuration data; and
- Ordering and production of parts on demand through interfaces with flexible manufacturing cells in the industrial base.

Weapon system integration prototypes will integrate the discrete functional demonstrations performed on Service test beds into total programs for automation of logistic support

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[4] Examples include industry CAD/CAE systems, integrated databases, flexible manufacturing cells, intelligent gateways, DDN and wide-area communications, government technical data repositories and automated publishing systems, and distributed government functional ADP systems and user terminals.

planning and technical data development. These prototypes will apply R&M design tools at supplier and subcontractor levels as well as at the prime contractor level. They also will provide standardized digital linkages for product definition and logistic support data between suppliers and prime contractors and will provide complete digital technical data for DoD users.

DoD weapon system integration prototypes, or "lead weapon system programs," will demonstrate exportable R&M design tools, data exchange standards, software, and functional design specifications for implementing CALS concepts on weapon system production programs in 1990 and beyond. A principal output will be the validated functional specifications, data item descriptions, and lists of contract data requirements to be used contractually on post-1990 weapon system acquisitions.

In general, the DoD test sites and development of specifications will be R&D-funded. Lead weapon system programs will provide funding for demonstrating system integration. Additional DOD CALS funding will be provided where required.

2.4 MANAGEMENT APPROACH

Each of the Services and the Defense Logistics Agency has either a senior (Flag Rank) CALS executive or an Executive Steering Group with broad responsibilities for implementation planning, approval of CALS programs, CALS implementation in weapon programs, funding coordination of CALS efforts, R&D planning, and CALS execution. Industry advisory groups are being established to coordinate industry CALS planning and implementation. (See Section 4.2.)

Figure 2.2 illustrates the CALS organization, which includes both industry and DoD participation.

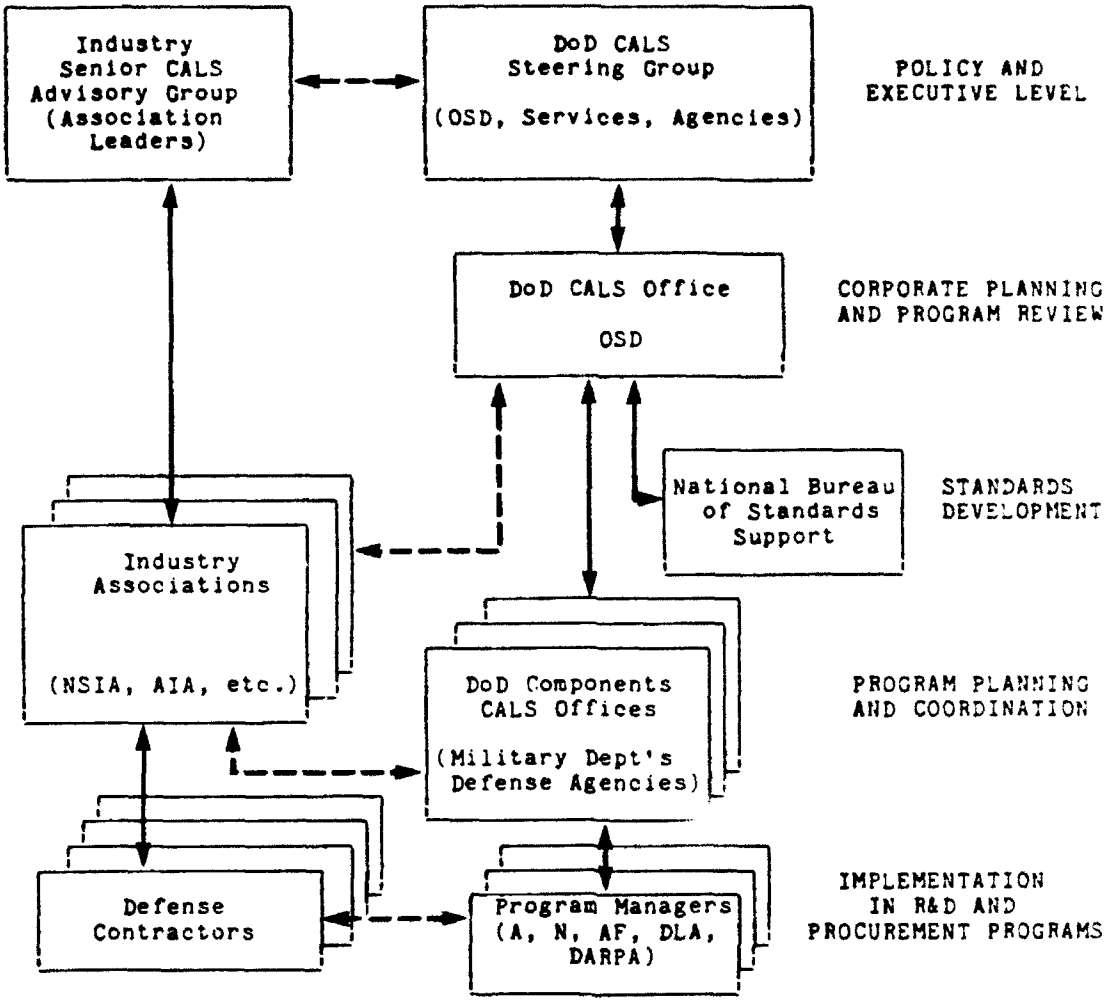

Figure 2.2. DoD CALS Organization

The DoD CALS Steering Group receives technical support from staff elements of the Office of the Secretary of Defense, the Services, the Defense Logistics Agency, the Defense Communications Agency, and the Joint Logistics Commanders.

The OSD CALS office, under the direction of the chairman of the DoD CALS Steering Group: (1) coordinates CALS integration efforts; (2) coordinates development of common data interchange standards; (3) develops evaluation documentation for Service

program compatibility, commonality, and consistency; (4) provides an interface with industry; and (5) responds to Congressional interest in the DoD CALS program.

Each Service will establish an element responsible for overall funding coordination for all CALS activities and funding changes. The activities include: (1) compatible Service CALS nodes such as technical information repositories and automated publishing systems, (2) development and prototyping efforts for CALS elements and techniques, (3) test bed operations and analysis, (4) architecture planning, and (5) lead weapon system demonstrations. Funding requirements will be identified initially in the Service and Agency implementation plans. The Services and Agencies will update and submit funding requirements to the DoD CALS Steering Group every 6 months. The OSD CALS office will maintain files of all funding requirements and updates and other information relevant to the DoD CALS program.

In parallel with Service efforts to integrate and demonstrate current technology, DARPA will manage a technology demonstration program of high-payoff, higher-risk areas. This effort will initially consist of designing and testing software systems to provide a "parts on demand" interface with flexible manufacturing cells and procurement sources in the industrial base. Additionally, DARPA will support demonstration projects of Artificial Intelligence applications to item manager support, diagnostics development, and integration of R&M into CAD/CAE/CAM.

2.5 FUNDING

The President's Budget for FY 1987 included funding for a number of development and implementation projects that form the starting point for CALS. The Deputy Secretary's policy guidance on CALS, however, came late in the FY 1987 budgeting cycle.

Therefore, the FY 1988-1992 programming and budgeting cycle will be the first opportunity for a full DoD review of the CALS funding requirements that will be identified in the completed Service and agency implementation plans. Table 2.1 presents the funding for CALS projects included in the FY 1987 President's Budget. Footnotes are provided where additional CALS requirements are to be addressed in DoD's FY 1988-1992 programming and budgeting cycle; additional high priority needs will also be considered in FY 1986-87.

The OSD funding line shown in table 2.1 is for a new RDT&E-funded program element established in FY 1987 to support research, development, test, and evaluation of data exchange standards and architectural guidelines for CALS, as well as for integration demonstration projects. The OSD CALS office will manage this program, which is initially funded at $14.8 million annually. These funds will support efforts by the National Bureau of Standards to accelerate development and validation of CALS standards. They will also provide seed money for highly leveraged technology development and demonstration projects. Candidate programs for FY 1987 include establishment of an institute or consortium for integration of R&M tools into CAD/CAE design processes and several prime contractor demonstrations of CALS system integration.

Military Department and Defense Agency CALS funding in table 2.1 covers two major categories: (1) the development, demonstration, and prototyping of CALS integration technologies, and (2) the modernization of information systems to implement CALS.

The first category is funded primarily through RDT&E and O&M appropriations. Funds are allocated to develop CALS standards, systems architecture and integration, and functional demonstrations on CALS test beds and lead weapon systems. These

Table 2.1

CALS Funding
($ Millions)

DoD Component	FY-86	FY-87	FY-88
OSD	.0	14.8	14.8
ARMY			
CALS Development[1]	7.9	8.2	8.7
CALS Implementation[2]	25.9	15.4	32.5
NAVY			
CALS Development[3]	17.5	28.7	34.6
CALS Implementation[4]	35.4	44.3	40.4
AIR FORCE			
CALS Development[5]	21.1	33.3	35.5
CALS Implementation[6]	49.5	36.1	29.4
DLA			
CALS Development[7]	0.0	0.0	0.3
CALS Implementation[8]	0.0	0.0	22.1

Notes: (See Glossary, Appendix D)

1. Includes funds for the MEIDS, PEAM, JPAPS, APPS, and EMPS programs. Estimated additional requirements for the TD/CMS, EMPS, and CALS/TIMS programs would bring the total CALS funding requirements for this line in FY 86, 87, and 88 to $15.1M, 20.7M and 30.8M, respectively.

2. Includes funds for the DSREDS and 600S programs. Estimated additional DSREDS requirements would bring the total CALS funding requirements for this line in FY 86, 87, and 88 to $25.9M, 16.0M, and 34.6M, respectively.

3. Includes funds for the PEAM, CATIS, CBAT, RAMP, FEEDS, VLSI, CALSA, CAE Testability, IDSS, SSN-21, V-22, and SHARP programs. Estimated additional requirements for these programs would bring the total CALS funding requirements for this line in FY 86, 87, and 88 to $18.3M, 43.4M, and 58.0M, respectively.

4. Includes funds for the NAPPS, NTIPS, NSTIS, Ship CAD/CAM, Air CAD/CAM, GEMS, APADE, PED, SPLICE, EDMICS, NPODS, and TLRN programs. Estimated additional requirements for these programs would bring the CALS total requirements for this line in FY 86, 87, and 88 to $39.5M, 68.9M, and 112.1M, respectively.

5. Includes funds for the IDS, CMAS, UDB, IMIS, Reliability of Detection Models, GIMADS, MLCAD, IISS, GMAP, PDDI, ATI DEMO, CADBIT, SMARTBIT, RADC Testability Tools, and Testability Decision Tools programs. Estimated additional requirements for these programs would bring the total CALS requirements for this line in FY 86, 87, and 88 to $21.1M, 33.9M, and 44.3M, respectively.

6. Includes funds for the ATOS, EDCARS, LIMSS, and CALS MIO programs. Estimated additional requirements for these programs would bring the total CALS funding requirements for this line in FY 86, 87, and 88 to $50.6M, 39.6M, and 100.8M, respectively.

7. Estimated additional requirements for the DGIS program would bring the total CALS requirements for this line in FY 86, 87, and 88 to $0.0M, 0.3M, and 0.3M, respectively.

8. Estimated additional requirements for the CADESS, EDASRE, MPCASS, CADOSS, MEDALS, and CADQAD programs would bring the total CALS requirements for this line in FY 86, 87, and 88 to $0.0M, 0.3M, and 22.1M, respectively.

efforts are being coordinated by the OSD CALS office and its counterparts in the Services and Agencies.

The second category is funded primarily through procurement and O&M programs. Funds are allocated for acquisition and operation of the modernized information processing systems or services needed in an integrated CALS environment. Normal DoD automated system acquisition and management procedures will be followed in these modernization efforts.

2.6 REDUCING THE USE OF PAPER FOR TECHNICAL DOCUMENTATION

Support of weapon systems today relies on voluminous paper and microform images of paper pages as the primary information media. For example, DoD engineering data repositories currently hold an estimated 200 million engineering drawings, mostly in the form of 35-mm aperture cards. New weapon systems have shown exponential growth in the number of pages of technical manuals. Modern combat aircraft, for example, now require hundreds of thousands of pages of technical manuals. These two categories (engineering drawings and technical manuals) are the primary near-term targets of the Services' CALS automation efforts.

The transition from hard copy to digital media involves three major functions:

- Automating and integrating the production of data (e.g., through computer aided design or automated authoring systems);
- Storing and retrieving the data in digital form; and
- Distributing and using the data in digital form.

Automation of these functions typically will occur in four stages, as shown in table 2.2.

Table 2.2

Automation Stages

STAGE	PRODUCTION	STORAGE	USE
0	Paper	Paper	Paper
I	Paper	Digital*	Paper
II	Digital	Digital	Paper
III	Digital	Digital	Digital

* Scanned in from paper copy.

These four stages will coexist during the transition to full CALS implementation. Some applications may retain paper outputs indefinitely. Also, some small defense contractors may be unable to transition to a wholly digital environment. Reductions in the use of paper will be realized initially when a "print on demand" capability is acquired during Stages I and II. It will occur on a much larger scale when Stage III is implemented. For example, the Air Force estimates a 20 percent reduction in technical manual paper associated with ATOS automation of technical orders at the depot level, and a further 67 percent reduction when digital maintenance aids replace technical orders at the base level. Total elimination of paper, however, is unlikely. For many years to come, small manufacturing industries will require engineering drawings in paper or microform copy if they are to continue to participate in the DoD competitive bidding process. Similarly, until paperless technologies are proven in maintenance applications, users will continue to rely on hard copy technical manuals.[5]

[5] Previous attempts to eliminate paper manuals by using microfiche and microfilm have proved unsuccessful.

CHAPTER III

DOD COMPONENT IMPLEMENTING PLANS

3.1 CHAPTER INTRODUCTION

This chapter previews the emerging CALS implementation plans of the DoD Components. Military Department and Defense Agency CALS implementation plans will be completed by July 1, 1986.

3.2 ARMY CALS PROGRAM

The Army has established the CALS/ATI Office as the Department of the Army (DA) Manager for CALS. This office will: (1) coordinate the existing Army Automated Technical Information (ATI) program; (2) continue with the development of an architecture for the CALS/TIMS (Technical Information Management System); and (3) establish a program to integrate Army initiatives in the development of reliability and maintainability (R&M) design tools.

The CALS/TIMS program represents the Army's foundation for implementing the DoD CALS program. It will integrate current and planned initiatives for automating logistic support technical information within the Army. CALS/TIMS development will be an evolutionary process to update the current Army system for acquiring, validating, storing, and disseminating logistic support technical information.

The initial phase of the effort, currently in progress, is documenting the current paper-based logistic support information system by surveying Army users to establish data flow patterns, demand rates, storage requirements, and usability criteria. This data collection and requirements analysis has produced a

conceptual architecture for the implementation of CALS in the Army.

This effort is also currently developing specifications and a statement of work for the detailed design and implementation of a limited number of prototype CALS nodes and for demonstration of the Army's CALS/TIMS architecture. This initial implementation of the CALS/TIMS conceptual architecture will serve as a baseline and evaluation vehicle to guide the evolutionary implementation of a total integrated Army CALS capability.

The CALS/TIMS concept is a hierarchy of data bases, computers, and communications processors that are geographically distributed and capable of being accessed by multiple users performing multiple tasks. Information will be available, as required for real-time access on demand. The major thrusts of the Army CALS/TIMS program are--

- Implementing a near paperless logistic support technical information system;
- Providing a highly automated, functionally integrated capability for generating and processing logistic support information;
- Providing the distributed Army user with real-time, on line, transparent access to needed logistic support data;
- Networking and modernization of existing automated logistics support data bases;
- Converting high payoff paper-based systems to electronic formats and media.

The Army CALS program builds on the foundation of the Army Integrated Publishing and Printing Service (600S) and Digital Storage and Retrieval Engineering Data System (DSREDS) programs, both of which will begin to be implemented in 1986. The 600S program will establish centralized digital databases for the

production and update of Army technical publications to eliminate the need for posting page-for-page changes in the field. High speed electronic updating capabilities will be employed to publish regularly scheduled revisions. The program will be implemented through contractor services so equipment will be neither purchased nor leased directly. DSREDS and its Air Force counterpart, EDCARS, will be implemented through a joint Army/Air Force acquisition program. The DSREDS/EDCARS program will --

- Provide repositories for digitally storing, retrieving, and reproducing engineering drawings and engineering documentation;
- Assemble drawings and other technical documents into technical data packages for procurement; and
- Provide technical data support to engineering and maintenance personnel.

The implementation of CALS initiatives within the Army falls within the guidelines of the Army Information Management Program (IMP). IMP is the Army's management process for identifying existing information resources, validating known information requirements, and providing a systematic approach for acquiring future resources. It includes both manual and automated systems. It also integrates and systematizes the information functions (applications, communication, data, equipment, and presentation) to provide Army decisionmakers at all levels with the best decision support system possible.

The Deputy Chief of Staff for Logistics (DCSLOG) has the Army Staff lead for CALS and serves as the Army functional proponent for CALS development. Prior to the CALS initiative, the Commanding General of the Army Materiel Command established the Communications-Electronics Command (CECOM) at Fort Monmouth, New Jersey, as the lead command to develop the Army's Technical Information Management System. The Army has expanded the CECOM role to cover the broader requirements of CALS.

The Army CALS program builds around the concept of maximum user participation to identify and evaluate potential technical data automation opportunities. Under the direction of the Army CALS Office, high leverage opportunities for automating technical information will be identified by functional user working groups. These opportunities will be evaluated by the working groups, and those offering the greatest payoff in both time and resources will be selected for full implementation in ongoing weapon system development programs.

Each candidate automation effort will be subjected to multiple levels of test and evaluation during the development process. The first level of test will be in the Army CALS R&D test bed, whose central node is planned to be located at CECOM.

Once this initial test and evaluation has been successfully completed, the automation candidate will be tested and evaluated on a mature or developing weapon system. Here, existing paper-based technical information will be converted to electronic media and processed in parallel with the nonautomated, paper-based system. On completing this phase, the Army will select an emerging weapon system and will conduct an additional evaluation throughout the development of this system.

The Army CALS implementation philosophy also includes continuous state-of-the-art upgrades and enhancements through technology insertion. The Army CALS architecture approach uses a modular design concept that facilitates these technology upgrades. The Army will provide incentives and otherwise encourage contractors to participate in a total Army CALS implementation effort. Because most technical information is generated by industry, it is very important that contractors be part of and actively participate in the Army CALS program.

3.3 NAVY CALS PROGRAM

The Navy has established a Senior Navy Steering Board for CALS implementation and has designated the Spares Competition and Logistics Technology Program Office (PML 550) of the Naval Supply Systems Command as CALS Coordination Office.

Navy programs already exist or are under development for automating logistic technical information, and for introducing advanced computer technologies to specific logistic functional applications. One of the foremost purposes of CALS is to integrate these programs for enhanced weapon systems acquisition and support.

Navy near-term CALS objectives include the development and execution of individual projects and programs to: (1) demonstrate technical feasibility and (2) determine the degree of standardization and integration required among the various efforts. The initial demonstrations are intended to exploit the increased use of computer technology in the following areas:

- Automating the generation, storage, indexing, distribution, and delivery of Navy logistic technical data.
- Developing and implementing a CALS information system architecture, including system and data standards, to integrate multiple initiatives.
- Automating low-volume spares manufacturing, including integration of flexible manufacturing cells in industrial environments.
- Coordinating and integrating computer-based tools for performing R&M analysis up front in the weapon system design process.
- Automating the engineering design process to provide weapon systems and facilities design engineers with on-line access to CAD/CAM data bases.

- Automating diagnostics and testing support by developing expert systems and standard hardware modules.

- Automating contracting and contract management processes to provide on-line access to multiple contract-related and logistic data bases, and reduce labor-intensive document preparation.

Near-term CALS demonstration projects include: (1) generic demonstrations to address common technology issues and (2) application demonstrations that focus on specific logistic functions. Existing Navy contracts for weapon systems and facilities will be used as vehicles for coordinating initial CALS demonstration efforts. This approach will leverage available financial resources by capitalizing on and exploiting contractor-generated digital information.

The SSN-21 attack submarine will be the lead platform for developing and demonstrating major portions of a total Navy CALS system. It reflects the full range of technology issues and diversity of industry capability associated with the shipbuilding environment. Ship design will incorporate advanced sensors, improved quieting, advanced combat systems, and weapon systems that provide a step improvement in combat effectiveness as compared with earlier classes of submarines. The SSN-21 is currently planned to be the largest dollar value ship class effort under Navy contract well into the 1990s. Moreover, the SSN-21 is the first submarine for which the Navy has tasked contractors to introduce producibility and enhanced maintainability as major considerations during the design process. The Navy intends to work closely with the Ship Production Committee of the Society of Naval Architects and Marine Engineers (SNAME) to integrate Navy-industry stand-alone systems during the demonstration and to produce validated generic functional specifications, interface standards, and architectural guidelines for expanded application. The effort includes front-end computer aided design, a complete system of technical information in digital form, and digital products for

life cycle use in manufacturing, procuring spares, and preparing technical documentation (i.e., technical manuals, engineering drawings, and configuration control information).

Additional candidate acquisitions being reviewed for potential implementation of CALS include the DDG-51 and FFG-7 ship acquisitions, the V-22 aircraft acquisition, the CASS ATE acquisition, and standard facility and building designs such as TOMAHAWK magazines.

3.4 AIR FORCE CALS PROGRAM

The Air Force has created a CALS/ATI Management Integration Office (MIO) within the Air Force Systems Command. The MIO will provide a central mechanism for planning and coordinating the development and implementation of all projects directed toward automation of logistic technical information. Policy and guidance will be provided by and through the HQ USAF Deputy Chief of Staff for Research, Development and Acquisition, and Deputy Chief of Staff for Logistics and Engineering.

Authority to implement programs necessary to meet CALS objectives exists within the Office of the Secretary of the Air Force and Headquarters staff. This authority is expressly delegated to the MIO, including representing the Air Force in DoD-wide coordination activities and in the development of CALS specifications and standards. The present plan is to continue delegation of authority for project development and implementation to the commands that are principal users or have appropriate technical resources.

The current overall Air Force project for Computer Aided Logistic Support is divided into three major categories of effort: (1) implementation initiatives, (2) R&D initiatives, and (3) integration initiatives.

The first category consists of technical information management systems that are firmly committed and scheduled for installation or are already in the process of installation. These programs are now directly affecting the evolution of operational systems. Included are the EDCARS system for digital storage, retrieval, and distribution of engineering drawings and specifications. ATOS is included for automated storage, publication, distribution, and update of technical orders.

The second category consists of projects that are expected to lead to full-scale development, either to relieve current problems or to take advantage of emerging information and communication technologies. These projects range from technology assessments and directed experiments to "proof of concept" studies and demonstrations. The approach here differs from the traditional information system development process in that the outcome is dependent as much on the practical constraints of state-of-the-art technologies as on user needs. Additional requirements and constraints are imposed by the use of commercial hardware, development of communications networks, and evolution of automation within the defense industry.

The third category of projects has been initiated by the Air Force to develop specifications and standards and to establish architectural plans for future systems. These integration projects are intended to achieve a maximum practical level of interchange among systems. They support the ongoing evolution of systems with essential interchange rules and formats, and they also establish objectives for compatibility of hardware, software, and communication protocols in future systems.

3.5 DEFENSE AGENCY CALS PROGRAMS

3.5.1 Defense Logistics Agency (DLA)

DLA is establishing a CALS Office within its Office of Telecommunications and Information Systems that will coordinate the planning of all special projects associated with the DoD CALS Program. The office will also oversee other specially assigned projects for automating and distributing technical information within the Agency.

In addition, a DLA CALS Steering Group is being established to:

- Provide oversight and guidance in the planning, programming, budgeting, and development of DLA CALS projects;
- Evaluate proposals for new programs/projects or changes in supporting CALS services, operational policy, priorities, funding, and organization; and
- Evaluate the resource implications of proposed CALS programs and recommend appropriate actions to the Director, DLA, Headquarters Principal Staff Elements, and the DLA Systems Automation Center to ensure continuity of system development and implementation.

Several factors will make DLA's role in meeting readiness and sustainability goals for the U.S. Military more critical than in the past. One such factor is the advance in the technology and complexity of weapons systems. Another is the anticipated increase in the number of weapon systems and component items supported by the DLA logistic system. A third is the trend toward more standardization and interoperability between the U.S. and its military allies, especially NATO members.

Extensive, up-to-date logistic technical information will be required from multiple systems in and outside of DLA.

Current high-cost manual activities requiring long lead times to cross check information between the Military Services and DLA and between DLA and vendors before updates are made must be replaced by high-speed, real-time data/information processing capabilities.

The DLA CALS Program, together with the DLA Logistics System Modernization Program, will play a vital role in improving DLA's capability to manage logistic items and exchange information with other elements of the U.S. logistic community and the allies.

The DLA Logistics Systems Modernization Program (LSMP) will stress the use of standard functional modules to eliminate system duplication, improve reliability and maintenance, support interfaces and interoperabilities, and expedite implementation schedules. Databases will be designed and developed to meet multiple user requirements.

The DLA CALS architecture will interface with and interconnect existing and future automated technical information systems through the use of current and improved DoD telecommunication resources. Existing systems and data repositories will be served by a modern array of CALS telecommunication capabilities. This array includes the Engineering Drawing Automated Storage & Retrieval Equipment project and modernization projects such as the Parts Control Automated Support System and the DLA Minicomputer System. These telecommunication components are included within the overall DLA architecture for the Logistics Systems Modernization Program and will provide an interoperable processing environment for DLA in support of the Military Services and industry.

3.5.2 Defense Communications Agency (DCA)

The DCA-managed Defense Data Network (DDN) will be used as the basic data communications base for CALS. DCA will help ensure that appropriate communication capacity is available to support CALS development and will advise the CALS Steering Group on the most efficient and effective ways to support CALS communication requirements.

CHAPTER IV

IMPERATIVES FOR SUCCESS

4.1 CHAPTER INTRODUCTION

This chapter discusses issues that are likely to influence the success of the CALS initiative. These include the interface with industry, data exchange standards for system compatibility, reliability and maintainability integration into CAD/CAE, and cost.

4.2 INDUSTRY INTERFACE

Achieving the objectives of the CALS program will require concerted planning and investment by both government and industry. The DoD's CALS program is based on a joint Industry-DoD study of common opportunities and concerns. Success depends not only on integrating initiatives bearing on government logistic technical information initiatives but also on creating a unified DoD interface with industry. This interface can best be achieved by establishing relationships between the DoD CALS Steering Group and industry associations such as the National Security Industrial Association and the Aerospace Industries Association. The Chairman of the DoD CALS Steering Group has requested that the National Security Industrial Association provide the leadership and coordination effort for an Industry Association Working Group.

Beyond formal DoD-industry interfaces such as this, the DoD CALS program seeks the widest possible dialogue with industry. This dialogue must include both large and small contractors--primes, subcontractors, suppliers, and vendors.

DoD intends to pursue the widest possible dialogue on CALS with interested parties in industry, and the broadest participation of industry in developing, testing, and implementing CALS concepts.

4.3 STANDARDS FOR SYSTEM INTERFACING AND COMPATIBILITY

The computer technology explosion over the last several years has created such a wide range of incompatible systems that data interfacing is a major problem for both industry and government. There is widespread recognition of this problem, and many private and public groups are already working to deal with it. Developing, testing, and validating standards in the private sector, however, is a slow, voluntary, ad hoc process. Industry implementation of the standards is also voluntary. The size and scope of DoD's weapon system acquisition program gives the government substantial leverage to accelerate this important process to bring about industry standards that meet the technical and schedule needs of CALS.

DoD is committed to developing a capability to exchange data among heterogeneous systems. This requires intensive management. Capability for fully automated transfer of product definition data and other logistic technical information without manual intervention will take several years to develop and implement.

The CALS program will develop, validate, and implement neutral interface standards for a spectrum of data types and logistic applications.[6] Implementation of data translators between internal system formats and the standard format is a

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6 "Neutral interface" implies an open-ended arrangement that allows individual user systems to function in their own peculiar hardware and software environments so long as data can be transferred to other nodes in a standard format and with standard protocols. This creates system compatibility without requiring hardware or software standardization.

host system responsibility, but DoD actions will be needed to accelerate the development and validation of such translators.

DoD will use or adapt industry standards to the maximum extent feasible. Three such standards--the Initial Graphics Exchange Specification (IGES), The Consultative Committee on International Telephone and Telegraphy (CCITT) Group 4, and the Standard Generalized Markup Language (SGML)--have already been selected for initial application as CALS standards. IGES will be used for transfer of: CAD designs, engineering drawings, and vector graphic illustrations for technical publications; CCITT Group 4 for rasterized drawings and illustrations; and SGML for preparing and automatically publishing technical documentation text.

Initially, CALS demonstrations, using these industry standards, will test several approaches for interim data exchange. Tradeoffs to achieve the best economy and accuracy will be assessed using selected acquisition programs while the standards are refined and extended.

The National Bureau of Standards (NBS) has been given a statement of work and funding to support the DoD CALS program in two areas: (1) selecting and developing a complete set of data exchange standards, and (2) developing validation procedures for the complete range of graphics, text, and database applications in logistics. DoD and NBS have established a 4-year program to develop a complete set of data exchange standards to be implemented for weapon systems entering production in 1990 and beyond. Plans are also being developed for NBS to support DoD in developing an overall DoD architecture, functional specifications for information transfer, and information modeling technology.

Technical issues in standards development will be resolved through R&D-funded tests and demonstrations in each Service.

Concerted DoD, NBS, and industry efforts will be needed to accelerate the development of selected standards to meet the DoD schedule for production implementation. The Services and Agencies will develop specifications employing these standards that will, in turn, be coordinated with industry and reviewed by National Bureau of Standards. DoD CALS standards and validation approaches will be approved and adopted through the Defense Specifications and Standards Program.

4.4 RELIABILITY AND MAINTAINABILITY

The defense industry must be able to design complex weapon systems that are reliable and relatively easy to maintain. That objective is central to CALS.

One of the areas of greatest potential leverage in the CALS program is fostering the development of automated R&M design tools and their integration into computer aided design and engineering (CAD/CAE) processes and systems. At present, a significant portion of the defense industry is using some form of computerized R&M analysis in developing subsystems and equipments. These applications, however, are primarily collections of individual stand-alone techniques. Very few are integrated among themselves or with CAD/CAE, and fewer still are integrated with the preparation of logistic data. CAD/CAE systems also lack interfaces with the logistics environment that would facilitate use of experience data for performing R&M analysis; hence, data on R&M field performance of operational systems are difficult for designers to access for comparative analysis.

In addition to the obvious benefits of integrating R&M into CAD/CAE such as higher reliability and better maintainability, the use of digital techniques will produce cost benefits. A recent National Security Industrial Association study identified some of these that are directly related to early identification

of potential performance and assembly-line problems through use of R&M tools in CAD.

Several technical problems must be solved to facilitate integration of R&M into the automated design process, including: (1) establishing standard interfaces for R&M inputs to CAD, (2) providing access to multiple data sources, (3) transforming fielded system R&M data into appropriate design inputs, (4) developing design analysis tools and design rules for use with limited data, and (5) developing design interfaces with automated logistic processes. Resolving these problems is a large undertaking. DoD is evaluating alternative approaches to provide the required technical management and coordination.

CALS lead weapon system program prototypes (1986-1989) will apply design tools at prime and subcontractor levels and will link CAD/CAE to the generation of logistic technical information. Design tools and function specifications developed and refined during prototype development will be exportable to other weapon systems to quickly gain benefits from CALS implementation. Additionally, active consideration is being given to establishing a DoD institute or consortium as a vehicle for coordinating research and accelerating technology transfer.

4.5 COST

The funding levels discussed in Chapter II will not implement a full CALS program, but they will start the process. Some payoffs have already materialized through R&D demonstration projects and other automation efforts. Substantial payoffs, however, will require broad implementation throughout DoD and industry.

The major concern is that the program be completed. It would be easy to defer CALS resources to other pressing needs in a constrained budget environment. If CALS implementation is

delayed, the CALS payoff will be delayed. In a program of this nature, it is important to develop a long-range plan, and to continue working steadily throughout the implementation period.

Innovative approaches for leveraging available financial resources and industry interest need to be pursued to expedite CALS implementation. The need not only for rapid demonstration but also for transferring emerging technologies for R&M analysis, system integration, and data exchange suggest that some form of institute of consortium would be a vital force for accelerating the widespread dissemination of capability.

CHAPTER V

CONCLUSIONS

5.1 CHAPTER INTRODUCTION

This chapter summarizes the benefits and potential problems associated with CALS, emphasizes the need for Congressional assistance, and presents conclusions.

5.2 BENEFITS

DoD and Congressional reports have pointed out the significant payoffs to defense logistics through improved management of acquiring and using technical information. The Joint Industry-DoD CALS Task Force described how using new and emerging computer technology can improve weapon system support, from initial design to operational logistics.

Implementation of the CALS program will result in --

- Improving the ability of industry to design supportable weapon systems through integration of R&M design rules and design analysis in an on-line computer aided design and engineering (CAD/CAE) environment;
- Improving the ability of industry to produce weapon systems using computer aided technologies such as computer integrated manufacturing (CIM) by applying data exchange standards and system integration technologies;
- Improving the creation by industry and acquisition by DoD of logistic technical information by applying and integrating data automation techniques and standards;

- Improving the accuracy, timeliness, and utility of logistic technical information used for critical logistic processes; and

- Improving operational weapon system support as automated logistic technical information is used for configuration management, design change, maintenance, inventory control, and procurement.

These improvements will --

- Reduce weapon system acquisition costs;

- Increase productivity and reduce cost of logistic support throughout weapon system operational life; and

- Enhance operational readiness of military forces.

5.3 POTENTIAL PROBLEMS

The CALS initiative seeks to transform an immense paper-based infrastructure in DoD and industry. Decades of operational experience and billions of dollars are embedded in current modes of operation. These will not change overnight. Both technical and managerial challenges will be great.

The salient issues include standards, architecture, management, and funding priority.

5.3.1 Technical Issues

- Standards

  Developing a comprehensive set of standards for exchange of technical data in a heterogeneous automation environment will require intense, concerted management. DoD's requirement is for 100 percent transfer of a technical document with minimum manual intervention to verify the completeness of data exchange. In areas such as engineering drawings, this capability is at the leading edge of technology.

- Architecture

  Cost-effective choices must be made in defining the forms in which data will be used to perform logistic functions in the future, and in developing and interfacing heterogeneous database architectures and communication networks to fit those uses. The need to accommodate disparate hardware and rapid technological growth, and still provide a unified DoD-industry interface, is a challenge of substantial proportions. Although large-scale data bases are now being implemented by many defense contractors, as well as throughout DoD, the technology for compatible access and exchange of data among those data bases is still in its very early stages. Transparent query techniques, near real-time data retrieval and updating, and data management procedures require substantial additional research and development for CALS applications.

- Data security

  The concept underlying the CALS program is to integrate weapon system product definition and configuration management data using advanced distributed data processing and telecommunication technologies, with secure access for authorized users. Some of this data may be classified; some may be unclassified, but proprietary. Some of the data may be unclassified when considered on a data element by data element basis, but would become classified or sensitive when aggregated at the weapon system level. Whether unclassified, classified, or proprietary, there must be controls over who has authority to change, update, or release the data. Existing technology for these functions must be extended and validated before full-scale implementation. Use of industry standards may even be an

impediment here, since it may not be possible to incorporate some DoD communication security requirements in them.

5.3.2 Management Issues

- Functional management

  Hundreds of DoD and industry organizations will be involved in the CALS transition. New user-specific, incompatible data systems have been proliferating at an exponential rate. To impose CALS integration disciplines on these efforts without unduly delaying or degrading user responsiveness, to eliminate unnecessary redundancy, and to manage CALS investments prudently is a major challenge. To do so in DoD's decentralized management environment will require the continued attention of DoD's top management; the OSD CALS office is an essential element in this process.

- Data ownership and liability

  The more widespread data access becomes, the more important questions of ownership and custody become. The more data becomes available in processible form (e.g., a stream of text instead of a composed page), the more crucial become questions of responsibility, authority for change, and secondary data uses. Industry recognizes, and is voicing concern that emerging automation technology may outpace necessary changes in contracting procedures and management processes for electronic data. Use of electronic data and computer technology will affect the structure of the defense industry and the relationships of its various segments. Industry support for CALS depends on a balanced approach that rewards innovation, and at the

same time makes the appropriate data available for competitive purposes.

- Funding priority

The large scale transition to an automated and integrated mode of operation will require substantial investments by DoD and industry. A down payment has been made over the past ten years, but the rate of investment must increase in fiscal year 1987 and beyond to reach the target capabilities forecast for the 1990s. These investments will be evaluated on the basis of cost effectiveness, and will compete with other essential requirements in DoD's Planning, Programming, and Budgeting System (PPBS). Continued high priority and support by DoD's top management will be needed to realize the potential of CALS.

- Congressional support

Attainment of CALS objectives will depend, in large measure, on sustained congressional interest and support. During periods of increasingly tighter funding, long-range programs such as CALS sometimes fall casualty to short-term budget constraints. Sustained CALS funding is essential to achieving its program objectives. Cost savings and improved capability can be achieved only if the required investments are made and substantial changes are effected in defense logistic support processes.

APPENDIX A

MEMORANDUM FROM THE DEPUTY SECRETARY OF DEFENSE

SUBJECT: COMPUTER AIDED LOGISTICS SUPPORT

SEPTEMBER 24, 1985

THE DEPUTY SECRETARY OF DEFENSE

WASHINGTON, D C. 20301

24 SEP 1985

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
DIRECTOR, DEFENSE COMMUNICATIONS AGENCY
DIRECTOR, DEFENSE LOGISTICS AGENCY
DIRECTOR, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

SUBJECT: Computer Aided Logistic Support

The DoD-Industry Task Force on Computer Aided Logistic Support (CALS) has recommended action to achieve major improvements in supportable weapon system designs, and to improve the accuracy, timeliness, and use of logistic technical information. To effect these improvements, I have approved a strategy for transitioning from our current paper-intensive weapon system support processes to a largely automated and integrated mode of operation with substantial progress by the end of this decade. It is my goal that the Department of Defense (DoD) will establish plans to acquire, process, and use logistic technical information in digital form. Insofar as possible, this shall be accomplished for new major weapon systems entering production in 1990 and beyond. Major weapon system new starts, development, and modification programs should begin to develop this acquisition strategy immediately.

Our strategy requires concerted planning and investment by both government and industry. The objectives are to:

- Accelerate the integration of reliability and maintainability (R&M) design tools into contractor computer aided design and engineering (CAD/CAE) processes. DoD will encourage priority industry implementation through contract requirements, incentives for industry investments, competitive source selection criteria, and research and development (R&D) programs to develop and demonstrate improved on-line R&M design tools, including interfaces with automated supportability design criteria, standard parts lists, and other CAE tools.

- Accelerate the automation of contractor processes for generating logistic technical information products (technical manuals, training materials, reprocurement technical data packages, and other product definition data). This is primarily an industry responsibility that DoD will facilitate by implementing contract data requirements oriented toward the transition to automated technologies, and by exploring contractual arrangements that reward investments in cost-effective automation and integration technologies.

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- Rapidly increase Military Department and Agency capabilities to receive, distribute, and use logistic technical information in digital form to improve weapon system maintenance, training, and spare parts management. DoD will give high priority to the planning, management, standardization, technology, and data system modernization efforts needed to make substantial progress toward achieving this objective within five years.

I am establishing a steering group, with membership at the Deputy Assistant Secretary level within the Military Departments, to oversee implementation of this program. Further implementation guidance is enclosed. The steering group will report to the ASD(A&L) quarterly on the actions taken and progress made in fulfilling the program objectives. The ASD(A&L) has selected Mr. Russell R. Shorey, Director of the Weapon Support Improvement Group to chair the steering group. Please forward to Mr. Shorey within thirty days the names of your nominees for steering group membership, and provide an implementation plan within 120 days that includes assignment of overall coordination responsibility within your Department or Agency, and your schedule for program implementation.

William H. Taft, IV

Enclosure

CALS IMPLEMENTATION GUIDANCE

The CALS Implementation Steering Group will oversee the development of DoD, Military Department, and Agency implementation plans for establishing a unified interface with industry for the exchange of information in digital form, and will provide overall coordination of other implementation actions. Each DoD Component will develop implementation plans that best meet its needs within this coordinated framework.

1. Development of a Unified DoD Interface with Industry

Data exchange standards are critical to the implementation of the CALS recommendations. Long term and near term standardization efforts will be undertaken in parallel.

- The Defense Materiel Specifications and Standards Office (DMSSO) will prepare, within six months, a program plan for a DoD-wide integrated set of standards for exchange of logistic technical information in digital form. The program plan will provide the road map for development, adoption, validation, and implementation of an integrated set of standards to support transition to digital data across a broad range of user applications, including the need for data exchange standards applicable to electronics systems. DoD will work closely with the National Bureau of Standards, other Federal agencies, the American National Standards Institute, and industry and professional associations in this effort.

- The Air Force will lead a joint task group to define, within six months, the application of interim data exchange standards to all engineering drawing repositories and to automated publishing and distribution systems. Each Military Department and Agency will appoint a representative to this task group within 15 days. Interim standards will include, at a minimum:

  -- Initial Graphics Exchange Specification/Product Definition Exchange Specification (IGES/PDES)

  -- Standard Generalized Markup Language (SGML)

2. Military Department/Agency Implementation Tasks

The Military Departments and Agencies will develop implementation plans which include schedules, funding, and responsibilities for implementing the CALS objectives and applicable CALS Task Force recommendations. These plans will place particular emphasis on the following tasks:

- The designation or establishment within the Military Departments and Agencies of a central organization with broad responsibility for all aspects of CALS implementation, including information system architecture, information exchange standards,

and resource oversight of related data automation modernization and demonstration projects.

- Comprehensive plans for modernization of government information processing capabilities, commencing with key logistic technical information repositories, communication nodes, and publishing centers, to achieve an early capability to accept, process, access, and distribute contractor logistic technical information in electronic form.

- Establishment of a schedule with specific milestones for revising applicable military specifications and standards to provide for acquisition of logistic technical information in digital form. First priority during the next two years should be given to specifications and standards for engineering drawings and technical manuals. The interim data exchange standards identified above will be included in near term implementation of these specifications to facilitate hardware independence.

- Implementation of demonstration projects over the next four years in which engineering drawings, technical manuals, and logistic data for selected weapon systems and equipment will be eated, stored, distributed to DoD users, and updated using elec-.ronic formats. The demonstrations will emphasize data integration, and will be structured both to demonstrate the advances possible in the performance by government and industry of specific logistic functions, and to validate user requirements for future system design. Data exchange standards, common data element formats, component designation/reference numbering techniques, communication requirements, safeguards for classified and proprietary data, and other issues developed in the CALS recommendations should be explored through these demonstration projects.

- Review of current new weapon system acquisition programs to take advantage of near term and long term automation opportunities for the production, delivery, and use of product definition data and logistic technical information. All new major weapon systems approaching production by the end of this decade or beyond should be reviewed now, and plans and contract requirements should be structured for receipt and distribution of logistic technical information products in digital form. Less-than-major systems should follow this lead to the extent feasible.

- Identification of long haul communications and wide area networking requirements for CALS implementation. The Defense Communications Agency will review peace and wartime requirements with the Military Departments and Agencies, and will plan to include the necessary capabilities in the Defense Data Network (DDN).

- Establishment of a technology development program. The Defense Advanced Research Projects Agency will work with the Military Departments and Agencies to identify and prioritize technology issues associated with CALS implementation, including a Computer

Integrated Manufacturing (CIM) interface, and will develop a technology research and development program to support accelerated improvements in CALS capability.

3. Creating Incentives for Industry

Contractual arrangements, investment incentives, and additional funding that encourage and facilitate industry's adoption of new and emerging data automation technology for weapon system design and support are crucial. OASD(A&L), with Military Department support and industry involvement, will review existing investment incentives for both large and small companies, and develop recommendations for modification to support CALS objectives. Each Military Department will implement source selection criteria, contract requirements, and investment incentives that:

- Promote the modernization and integration of industry automated systems that generate logistic technical information to improve their efficiency, accuracy, and timeliness.

- Promote the integration of R&M design and analysis tools as on-line elements of the computer aided design and engineering process.

- Structure incentive programs, such as the Industrial Modernization Incentives Program (IMIP), to encourage industry investment and dissemination of capability in these areas.

Progress in contractual implementation will be evaluated in Defense Systems Acquisition Review Council (DSARC) and Military Department acquisition program reviews. Proposals for further technical advances in this area will be given priority in allocation of R&D resources and in independent research and development (IR&D) reviews.

APPENDIX B

CALS ARCHITECTURAL GUIDELINES

APPENDIX B

CALS ARCHITECTURAL GUIDELINES

The evolving DoD and industry system architectures for CALS must meet the following conditions:

a. Industry and government nodes must be able to communicate without restriction to specific hardware and application software. To achieve this degree of compatibility will require comprehensive data interchange standards that are only partially developed and implemented today. The DoD architecture for interfacing with industry will be defined by validating and implementing available standards and by rapidly developing and validating additional industry standards to meet CALS application needs.

b. Interim solutions must be implemented in such a manner as to make the transition to a fully automated hardware-independent mode cost-effective and expeditious.

c. Each Military Department and Defense Agency will develop an architecture to meet its specific user needs. However, these architectures must adhere to DoD approved data interchange standards and conventions to provide a common, compatible interface with industry. Service-peculiar functional requirements will be defined to take advantage of the availability of integrated, distributed data bases and integrated industry processes for developing and updating logistic information. In areas where multi-Service needs can be met by specifying common functional requirements, with advantages in the cost of data generation or support software, the Services will develop common functional specifications.

d. DoD (and industry) will determine which hardware and software approaches best fit application needs. Industry will rely primarily on its own software development for integrating R&M into CAD/CAE and for integrating logistic data processing with design and manufacturing. Government furnished or public domain software packages will be available for some functions. For common DoD-wide CALS functions, common hardware will be procured to minimize duplicative development overhead and to gain quantity pricing advantages. The need to maintain competition and to keep up with technological advances will be balanced against the advantages of common hardware. Options for neutral data exchange will be maintained to take into account both state-of-the-art improvements and the economics of user applications.

e. DoD component architectures will provide for neutral query formats and data base transparency. That is, an authorized user will not need to be aware of data base location(s) and structures in order to access required information. Building on the existing DoD data element standardization and Defense Specifications and Standards programs, DoD will define and standardize a logistic database dictionary that will be available to industry for structuring their systems.

f. An interface with flexible automated manufacturing will be provided through use of product definition standards that include sufficient data to compete, contract for, and manufacture operational product families.

g. The Defense Data Network (DDN) and Open System Interconnection (OSI) seven layer model will be used for communication standardization, and supplemented as needed. Bridges to industry networks such as the Manufacturing Automation Protocol (MAP) will be developed and implemented.

APPENDIX C

DISCUSSION OF CALS MILESTONES

APPENDIX C

DISCUSSION OF CALS MILESTONES

C.1 INTRODUCTION

This appendix provides additional information on the CALS milestones outlined in chapter II.

C.2 KEY IMPLEMENTATION STEPS

C.2.1 Develop Standards for Data Exchange

Interfacing operational DoD systems with the automated systems used by defense contractors to create engineering drawings and technical manuals is an essential step in establishing compatibility among the systems that process logistic technical information. The DoD engineering data repositories and publishing systems being implemented already incorporate a capability to handle digital contractor data. Where cost-effective, these system-unique digital interfaces will be implemented as soon as the systems themselves are operational. Concurrently, DoD-wide data exchange standards are being developed, demonstrated and validated, and implemented to provide common interfaces and create system capability.

The primary near-term data interchange activities required to achieve a unified DoD interface with industry involve:

- Designating interim standards for electronic publishing and technical data repositories (third quarter 1986);
- Selecting a more complete initial set of industry standards for product definition data, computer graphics, text, and database applications (first quarter 1987); and

- Refining interim standards and demonstration of the reduction of manual data validation requirements to near zero (fourth quarter 1987).

The interim standards will be demonstrated in test beds and lead weapon system programs during 1987-89. They will be implemented DoD-wide in new weapon system contracts beginning in 1990. Based on work in support of CALS by the National Bureau of Standards (NBS) and on lessons learned from the demonstrations and prototypes, the interim standards will continue to be refined and extended to support fully digital DoD product definition and configuration management databases in the early 1990s. These functional applications will require that DoD, with NBS advice and assistance, select a broad set of standards for accelerated development and implementation. These include (1) advanced text and graphics standards (1987-1990) for compatible processing of technical documentation, and (2) database and neutral query language standards (1988-1992) for interfacing with and access to distributed data bases of logistic technical information.

Use of these same standards as DoD output to industry is tied not only to the development process outlined in the preceding paragraph but also to the evolving capability of receiving systems in industry to accept data in those formats. For example, in today's environment, engineering drawings included in bid package sets are usually distributed in aperture card format. Initially, the principal output medium from automated engineering drawing repositories will continue to be aperture cards.

Many contractors will still convert these aperture card packages back to paper for in-plant use. Through the demonstrations and prototype development undertaken during 1987-1989, DoD will encourage defense contractors not only to create and deliver logistic technical information to DoD in digital form, but to accept it from DoD in that form as well.

An initial examination of needs and existing capability indicate that by 1990 the defense industry could implement rigorously defined and tested standards for product definition data. Comparable schedules are projected for standards needed for database applications and computer graphics, and for integration of numerous industry standards that are presently being developed by different user communities.

We expect to see meaningful amounts of digital technical information output from DoD to industry beginning in the 1989-1991 time frame. This data will be used initially for "traditional" functions, such as re-procurement bid packages, and then for design changes and flexible manufacturing functions as the decade progresses.

C.2.2 Implement CALS Standards and Architecture in Integrated DoD Information Systems

During 1986, the Army and Air Force will jointly implement an operational system[1] to store and retrieve digital engineering drawings that are presently stored in manual or semi-automated aperture card repositories. Digital interface standards for system compatibility and for contractor delivery of engineering drawings will be implemented as they are developed and demonstrated.

Navy and DLA automation programs will, in the initial phases, improve the management of aperture card repositories, and will acquire a fully digital capability similar to and compatible with the Army and Air Force approach by 1990. DoD's engineering drawing locator system will be implemented during this same period to provide DoD and industry users with improved visibility and control over the 200 million total engineering

[1] The Army Digital Storage and Retrieval of Engineering Drawings System (DSREDS) and the Air Force Engineering Drawing Computer Assisted Retrieval System (EDCARS).

drawings presently stored in DoD repositories.

Also during 1986-1990, the Military Departments are planning to establish automated technical manual and technical order systems[2], as described in Part II of this report. Both automated paper copy publishing capabilities and digital distribution with print-on-demand capability will improve the management of technical manual updates and serve as an initial step toward eventual near paperless technical documentation.

These systems incorporate capabilities such as optical character recognition and raster image scanners to capture hard copy input digitally. The data interchange standards being developed and demonstrated during this same period will provide a capability for automated publishing systems to accept contractor digital input directly in a form that can be used either to re-create a page image or to create tailored information for a variety of functional applications.

Implementation of automated publishing systems in DoD will make electronic distribution of page-image technical manuals to base-level maintenance technicians a reality by 1988 or 1989. However, the traditional page-image format may not be the best way to communicate information in an automated environment. Logistic research and development projects now under way will restructure the digital page-image manual into tailored job-guide format, and make that information transportable to maintenance personnel in the field. These projects will provide an operational capability between 1989 and 1992.

Actions to modernize DoD's technical data repositories and distribution systems were initiated before the CALS program was

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[2] Army AIPPS/600S, Navy NAPPS, and Air Force ATOS.

established. They represent the baseline from which the overall architecture for improved management of logistic technical information will evolve. Near-term CALS emphasis is being placed on the common data exchange standards that are the primary tools for creating fully compatible industry and DoD systems. Concurrently, as part of their CALS implementation planning, DoD components are defining how this system baseline will evolve into the architecture for integrated processing and use of logistic technical information. That architecture will be demonstrated and implemented concurrently with the incorporation of CALS concepts in new weapon system programs.

Although individual CALS capabilities will be implemented as quickly as technical feasibility can be demonstrated, the acquisition strategy of CALS is to incorporate the production and use of digital logistic technical information as an integral part of new weapon system programs. Based on the prototype efforts undertaken in 1987-1989, these capabilities will be incorporated in a substantial number of weapon system production programs commencing in 1990. Logistic technical information delivered to DoD (or maintained by industry for DoD) under these production programs will be structured into digital configuration management databases, and will be distributed and used in digital form within DoD in lieu of paper-based data beginning in the early 1990s.

C.3 FUNCTIONAL CAPABILITIES

As data exchange standards mature and communication networks for electronic data distribution are extended, digital technical information will be used more and more extensively by both DoD and industry. This use will improve the productivity of logistic functions now severely constrained by paper-based weapon system support processes. Functional uses of CALS (such as for highly automated provisioning and procurement) will be demonstrated as part of CALS weapon system integration

prototypes in 1987-1989. They will be progressively extended to other weapon system production programs based on functional specifications developed as part of the prototype efforts.

A fundamental objective of converting from paper-based to digital weapon system support processes, in addition to improving the productivity of internal DoD logistic functions, is to enhance follow-on support functions performed by industry with the use of digital technical information. The Navy currently has a research and development project under way that will demonstrate the feasibility of integrating "flexible on-demand manufacturing of spare parts" technologies through the use of digital product definition design models.

Demonstrations of these technologies during the late 1980s, supported by concurrent development and demonstration of product definition data standards, will provide the baseline for using digital media for re-procurement and flexible manufacturing of spare parts beginning in the early 1990s. Source data for this application--the digital product definition design models of spare parts--will be acquired by DoD as the implementation of CALS concepts occurs in post-1990 weapon system production programs.

Engineering design changes and modification programs for current weapon systems will also rely on implementation of CALS concepts. Near-term CALS objectives include digital delivery from defense contractors to DoD of design change technical data. Longer-term CALS objectives (post-1990) include using digital product definition and logistic technical information in either DoD or industry configuration management databases as source data for accomplishing design changes and modifications. This includes on-line R&M analysis, design models of standard parts, and performance and maintenance experience data. Similarly,

future generations of weapon systems will be able to use current system technical data in digital form for such purposes as trade studies, comparative analysis, and lessons learned.

C.3.1 Demonstration Programs

Each of the operational capabilities to be implemented as a part of CALS requires testing, demonstration of technical feasibility, and prototypes. This section describes the conceptual schedule for these efforts. It explains how CALS capabilities will first be demonstrated individually then merged into a fully integrated process.

During 1986 and 1987, initial phased demonstrations will focus on the capability to exchange and access logistic data between industry databases and government nodes to perform selected logistic functions. These demonstrations will include operational tests with computer aided design (CAD) and automated systems from several vendors.

From 1987 through 1990, there will be progressively more integrated demonstrations and prototypes involving prime contractors and subcontractors on designated lead weapon systems. These will include functional demonstrations of the integration of R&M into CAD/CAE, and of increased automation of logistic data products. Specific examples include configuration data, procurement data packages, maintenance data, and training data. The functional requirements for these demonstrations will be initiated during 1986 and early 1987.

Through these lead weapon system programs (weapon system integration prototypes), CALS capabilities will be developed and extended. In addition to enhancing capability, these demonstrations will verify the value of digital logistic

information products across a wide range of functions and increase basic knowledge and understanding of the new technologies and their applications.

The most important product of these prototype efforts will be the generic functional specifications through which CALS capabilities will be implemented in weapon system production contracts in 1990 and beyond.

C.3.2 Interfaces Within and Among the DoD Components

The important benefits to be gained from current Military Department and Agency initiatives to automate technical data repositories, and from logistics applications of that data, can be significantly increased through integration and data exchange. As Department and Agency CALS architectures are established, networking will be undertaken. The purpose of this networking is to establish a fully automated infrastructure for logistic technical information to support inventory control points, engineering functions, maintenance depots, and users in the field. Activities that will benefit from this capability include spare parts reprocurement, configuration management, modification/design change planning, maintenance, and training. By the early 1990s, this infrastructure will effectively create configuration management databases for substantially improved configuration control of major end items, subsystems and installed components, software for embedded computers, and other needs.

Advanced distributed data processing techniques, wide area electronic networking and gateways, expert systems, and decision support aids will make logistic databases accessible to users regardless of their physical location. Security safeguards will limit such access to authorized users in both DoD and industry. Through proper planning for such a capability, logistic

technical information will be current and accurate, tailored to the user's specific requirements, and available when and where needed.

Maintenance technicians will benefit by having up-to-date technical data, operational performance data, and prior maintenance experience available in a form tailored to the particular end item configuration on which they are working. On-line data bases, supported by expert system technology, will provide diagnostic and repair assistance for both the skilled technician and newly trained mechanic. Some of these tools are already being developed and tested for demonstration over the next two years, with implementation in the field beginning in the late 1980s.

Competitive spares procurement will be significantly enhanced as CALS capabilities are implemented. The automated engineering drawing repositories being implemented throughout DoD over the next four years will greatly facilitate technical data bid package preparation. As these repositories are interfaced using the common data exchange standards that will be demonstrated beginning in 1987, and as digital interfaces between these DoD repositories and defense industry suppliers are implemented, lead time for re-procurement will be significantly reduced from current averages.

C.3.3 Linkage to Computer Aided Manufacturing

One of the most important and far-reaching results of moving from paper-based to digital weapon system support processes is the opportunity to develop the interfaces that will enable the use of flexible manufacturing techniques for reprocurement of spare parts. Tnis is the objective of the Navy's Rapid Acquisition of Manufactured Parts (RAMP) research and development program.

Between 1987 and 1990, hardware and software will be assembled at the South Carolina Research Authority for a demonstration of on-demand manufacturing of spare parts. Small mechanical parts and printed wiring assemblies will be produced using digital product descriptions delivered via data exchange capabilities. In a parallel effort, capabilities will be demonstrated for DoD interface with flexible cells in the industrial base, and the potential for "hands off" acquisition capabilities will be evaluated. As this technology proves successful, it will begin to be implemented selectively during the early 1990s. It will use as source data the digital product definition part models acquired by DoD as CALS capabilities are incorporated into weapon system production programs.

REPORT TO THE

COMMITTEES ON APPROPRIATIONS

OF THE

UNITED STATES HOUSE OF REPRESENTATIVES

AND THE

UNITED STATES SENATE

PART II

AUTOMATION OF TECHNICAL MANUALS AND ORDERS

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
(ACQUISITION AND LOGISTICS)

WASHINGTON, D.C.

MARCH 28, 1986

1. Requirement for the Report

This report is issued in compliance with the Report on the Committee on Appropriations, Report 99-332, Department of Defense Appropriation Bill, 1986. Report 99-332 directs that the Department of Defense:

- develop common electronic publishing standards and specifications for all Services.

- develop a plan for compatible, totally automated, digital electronic systems for use within the Defense Department and for the goal of reducing the use of paper as a technical documentation medium to 50% by the Services.

- report not later than April 1, 1986 on its plans for expeditiously achieving these objectives.

A primary thrust of these requirements, as indicated in the Report, is the technical manual process.

2. Background

Technical manuals and technical orders (Air Force) are acquired to be utilized in the operation and maintenance of weapons systems and associated support equipment. Additionally, they are utilized in the training of equipment operators and maintenance personnel.

The technical manuals have always been distributed in paper copy with the exception of a microform medium primarily utilized in the Navy. Approximately, 60 percent of Naval Aviation Weapon Systems technical manuals are distributed in 16mm roll microfilm. Over 18,000 microfilm readers and reader/printers were acquired to permit utilization of microfilm as a technical manual distribution medium.

After years of experiencing the many problems associated with use of the paper copy and microfilm medium, the military services equipment operators, maintenance technicians, logisticians, educators, and other users are ready for an improvement over the manual-intensive and often inefficient processes, paper copy or microfilm requires. Additionally, a new breed of computer-literate armed services personnel coming into the ranks, have provided further impetus for the Services to move out in the area of digitizing technical support data. Offices, classrooms and depot maintenance shops appear logical areas for transition from paper copy with a minimum of user problems. Other user environments (certain shipboard areas, flight lines, organization level maintenance, etc.) will require careful development of the role of new media, as well as demonstration of mixes of papercopy and other media to determine the best approach for various user environments.

3. Technical Manual Preparation

Technical manuals and associated changes and revisions are authored and composed by the weapons systems and support equipment contractor during the production phase of a weapons system. Many of these contractors have made investments in computer technology to perform these functions. However, investment is only beginning in the authoring function to permit use of data generated by CAE/CAD. At the end of weapons system production, responsibility for continued changes and revisions to manuals is transitioned from the contractor to the military services. The majority of this effort is accomplished "in-house" at various Army, Navy, Air Force and Marine Corps depots. Some of the change/revision effort (approximately 20%) is contracted out to small business support contractors.

The Military Services, as funding permits, are automating the preparation of changes and revisions to manuals accomplished "in-house." In addition to increased efficiency and productivity, the Services should realize approximately the same preparation cost reduction (25-30%) experienced by contractors through use of computer technology.

The Technical Manual automation initiatives are as follows:

Army: The Army, in conjunction with the Government Printing Office, has developed an automation initiative (The 600S project) for preparation of Army publications and technical manuals. This initiative, utilizes contractor supplied hardware/software installed at all Army publication preparation offices. The 600S Systems are scheduled for installation in FY 86-88.

Navy: The Navy depends primarily on contractor support for required technical manual changes and revisions. As such it does not have an existing major automation initiative for in-house maintenance of technical manuals. However, in areas where changes are prepared in-house, the Navy utilizes existing limited computer technology. The Navy is considering continuation of contractor support for technical manual changes/revisions in lieu of establishing a major in-house preparation initiative due to the human resources (engineers, writers, editors, illustrators) that would be required.

Air Force: The Air Force is currently installing the Automated Technical Order System (ATOS) for automation of in-house preparation of technical order changes/revisions. An ATOS system will be installed at each logistics support center during FY 86-87.

4. Technical Manual Printing/Distribution

The printing and initial distribution of technical manuals is currently accomplished by a Government Printing Office contractor or authorized Service print shops. A quantity of manuals are also printed and stocked in Service supply centers for additional distribution upon request and many of the requests are received from the public, including military support contractors.

The manual preparer (contractor or military service) provides a master copy of the manual, manual change or revision, to the printer for mass replication and distribution. Significant time is lost in arranging for printing and in getting the master copy to the printer (moves from one contractor to another), and scheduling printing. Often, this time exceeds 6-9 months causing an impact on equpment maintenance due to lack of adequate procedures. The Military Services are investigating the use of centralized electronic demand printing equipment to improve printing schedule productivity, reduce printing cost, and eliminate printing for stock. Centralized electronic demand printing is also viewed as an interim step to electronic distribution (paperless environment).

The Army's 600S initiative includes electronic demand printing capability and will be utilized to demand print paper copy of publications prepared on the 600S system.

The Navy is also pursuing an electronic demand printing system (Navy Automated Printing System, (NAPS)). This system will receive a digital database of technical manuals from the preparing contractor and demand print paper copy for required distribution.

The Air Force is not currently pursuing centralized electronic demand printing for paper copy technical orders. The Air Force ATOS system is rapidly progressing to electronic delivery of digital data to the user location, where local print on demand capability will be utilized for paper copy when required.

5. Cost Savings

Potential cost savings for manuals have been identified during the preparation, printing, and distribution stage through use of automated techniques.

5.1 PREPARATION COST: Contractors have reported and passed on cost savings of approximately 25-30% by use of automation in the preparation of technical manuals. The deliverable master copy is composed from a digital database by means of electronic page layout and phototypesetting equipment. The majority of contractors who prepare technical manuals are currently utilizing automated techniques. (Accordingly, the need to provide incentives for prime contractors to automate the technical manual composition process does not appear to be a major priority). Non automated contractors are rapidly acquiring automated equipment to improve their productivity and cost effectiveness and the cost of this technology is steadily decreasing. An area for additional increase in efficiency is further automation of the authoring interface with CAE/CAD, and automation of updating based on design changes. This technology is being continuously explored with the Industry producing our manuals.

5.2 Printing Cost: Although cost savings are projected through use of electronic demand printing, they have not been finalized as yet. Of more significance, is the improvement in the printing cycle, elimination of stock and large volume reprint actions that can be achieved through demand printing.

5.3 DISTRIBUTION COST:

Distribution of paper copy technical manuals entail the cost for mailing/shipping and the cost of labor involved in receipt and storage for use at the user location. Although cost comparisons have not been finalized, as yet, between current paper copy and electronic or other medium distribution, initial indications are that use of a medium other than paper will be initially more expensive due to the cost of retrieval and user reader equipment.

6. COMMON ELECTRONIC PUBLISHING STANDARDS AND SPECIFICATIONS FOR ALL SERVICES:

The Department of Defense has three on-going initiatives for development of common electronic publishing standards and specifications.

6.1 STANDARDIZATION OF THE TECHNICAL MANUAL:

Currently there are over 150 specifications and standards applicable to technical manual requirements. These specifications and standards specify a variety of different types, styles, format and content requirements. This non standard condition creates costly, redundant, and conflicting conditions during preparation. These problems will magnify in an electronic mode.

A tri-service working group is currently chartered to consolidate and standardize technical manual types, format and content requirements. The working group efforts will result in a single standard and an acquisition specification to be utilized for technical manual/technical order acquisitions. The new documents are scheduled for completion in December 1986.

6.2 INTERIM STANDARDS FOR TECHNICAL MANUAL DATABASE: An initial interim military standard defining data format and interface requirements has been developed under Air Force leadership for use in acquiring technical manuals/technical orders in digital form. It is scheduled for completion and promulgation for prototype use by the Services in September 1986.

Utilization of the Interim standard will permit the digital delivery of the text and graphics content of the manual for electronic demand printing, storage, retrieval and update of procedures as appropriate. This proposed military standard is based on use of standards developed by industry for structuring the content and illustrations of technical publications.

6.3 FULLY COORDINATED DATABASE STANDARDS: The DoD Computer Aided Logistic Support (CALS) Steering Group, in December 1985, chartered a Tri-service Working Group to develop and coordinate Military Standards for the digital definition of the logistics documentation needed for support of weapon systems. These standards will allow eventual definition of a integrated digital database that will include product design and fabrication information (engineering drawings, specifications, process standards, and CAD/CAM files) as well as the logistic support analysis data, and maintenance and repair documentation. This information will allow improvements in all aspects of weapon system support, including technical data management.

The National Bureau of Standards has been funded to support the accelerated development of industry accepted standards, that are presently being implemented by commercial data processing hardware and software vendors.

The suite of coordinated standards to be developed by the Working Group will be flexible, with planned revision to accommodate anticipated changes in technology, industry accepted standards, and automation of additional functional applications.

Future projects for the development of documents that contain data preparation and delivery requirements will be reviewed by the CALS Specification and Standardization Working Group, and guidance will be provided to the functional area developing the document on the structure and format of the data requirement. The intent is to reduce the cost of data preparation including hardware, software, data entry and manipulation by adoption of the appropriate standards and coding subsets that can be used for exchanges of logistics technical information between subcontractors and prime contractors, as well as Industry and the Military Services.

The initial steps in the development of this suite of standards have already been taken. The proposed interim standard will begin DoD-wide coordination as soon as it is issued as an Air Force limited coordinated standard. The coordination will include Industry as well as all elements within the DoD. The standard includes a section on digital delivery of manuals using the Standard Generalized Markup Language (SGML) and a referenced set of SGML codes selected to support the markup coding of technical manuals and technical orders. In addition, there are sections on the coding of graphics information in both CAD/CAM and raster formats using the Initial Graphics Exchange Standard (IGES) for CAD/CAM files and CCITT Group 4 facsimile coding for raster graphics data. As additional applications are implemented, sections will be added by amendment or revision.

7. COMPATIBLE, TOTALLY AUTOMATED, DIGITAL ELECTRONIC SYSTEMS FOR TECHNICAL MANUAL PUBLISHING

The technical manual/technical order is one of the many logistics support elements included in DoD's Computer Aided Logistics Support initiatives. On-going automated technical manual publishing initiatives have been included and identified as modules of the CALS initiative. CALS will insure compatibility and interoperability of the various technical manual automation initiatives in conjunction with other logistics support automation initiatives. The data exchange standards effort, reflected herein, is viewed as the paramount vehicle to assure compatibility and interoperability.

The CALS implementation plan, currently in preparation, will be completed in July 1986.

8. REDUCING USE OF PAPER AS A TECHNICAL DOCUMENTATION MEDIUM TO 50% BY THE SERVICES

The technical manual is a vital logistics support element utilized by the equipment operator and maintenance technician in assuring weapons system readiness.

Lack of timely and accurate instructions suitable for use in the user work environment can result in unsafe, or even catastrophic conditions affecting human life and weapons system mission effectiveness. The paper copy manual provides a medium currently acceptable to the user in the various work environments. Paper copy is viewed as expensive, requiring excessive storage space, and places limitations on rapid distribution of changes and revision to published instructions. Consequently, acceptable altnerative mediums have been investigated for a number of years and are urgently desired.

There are on-going initiatives in each of the Services to derive an acceptable medium other than paper copy for technical manual distribution. These efforts have not as yet progressed to the point of definitive decision-making concerning choice of a different distribution mediums for all the DoD users involved at all environments which must be considered. A goal of a 50% reduction in paper distribution appears achievable through distribution of digital data to selected user environments. However, printing capability must be established in these user environments to permit paper copy where necessary.

There are existing technical, social and economical constraints that must be overcome to permit total or near total conversion to a medium other than paper. Due to the large volume (thousands) of technical manual users, the economical contraint of providing reader/printer peripheral for conversion to another medium will be the major pacing factor.

9. THE DoD APPROACH

There is a commitment to apply the best in modern technology to improve the transfer of technical information to our maintenance personnel and others who use technical manuals. The DoD CALS program will facilitate these efforts by providing a strong management thrust to achieve and maintain compatible interfaces and interchange standards for the flow of digital information between contractors, DoD centers, and users. DoD will manage technical documentation efforts to demonstrate and achieve the transitions as quickly as technology, available funding, and user applications allow.

GLOSSARY

A	Army
ADP	Automated Data Processing
AF	Air Force
AIA	Aerospace Industries Association
AIPPS/600S	Army Integrated Publishing and Printing Service
Air CAD/CAM	Aviation Computer Aided Design/Computer Aided Manufacturing
ALC	Air Logistics Center
APADE	Automation of Procurement and Accounting Data Entry
APPS	Automated Publications Production System
ATA	Advanced Tactical Aircraft
ATE	Automated Test Equipment
ATI	Automated Technical Information program
ATOS	Automated Technical Order System
CAD	Computer Aided Design
CADBIT	Computer Aided Design for Built-in Test
CADESS	Computer Aided Data Exchange Standards/Specifications
CADOSS	Computer Aided Development of Standards/Specifications
CADQAD	Computer Aided Development of Quality Assurance Data

CAE	Computer Aided Engineering
CAE Testability	Computer Aided Engineering Testability Tools
CALS	Computer Aided Logistic Support
CALSA	Computer Aided Integrated Logistics Life Cycle Support Analysis
CALS MIO	CALS Management Integration Office
CALS/TIMS	Computer Aided Logistic Support/Technical Information Management System
CAM	Computer Aided Manufacturing
CAMS	Core Automated Maintenance System
CASS	Consolidated Automated Support System
CATIS	Computer Aided Technical Information System
CBAT	Computer Based Aid for Troubleshooting
CECOM	Communications-Electronics Command
CIM	Computer Integrated Manufacturing
CMAS	Computer Based Maintenance Aids System
CRC	Computer Resources Council
CCITT	Consultative Committee on International Telephone and Telegraphy
DA	Department of the Army
DARPA	Defense Advanced Research Projects Agency
DCA	Defense Communications Agency
DCSLOG	Deputy Chief of Staff for Logistics
DDN	Defense Data Network

DGIS	DoD Gateway Information System
DLA	Defense Logistics Agency
DoD	Department of Defense
DSREDS	Digital Storage and Retrieval Engineering Data System
DEMO	Demonstration
EDASRE	Engineering Drawing Automated Storage and Retrieval Equipment
EDCARS	Engineering Data Computer Assisted Retrieval System
EDMICS	Engineering Drawing Management Information and Control System
EMPS	Electronic Maintenance Publications System
FEEDS	Facilities Engineering Expert and Diagnostic System
FINDER	Functionally Integrated Designating and Referencing System
FMPMIS	Fleet Modernization Program Management Information System
FY	Fiscal Year
GEMS	Graphics Engineering and Mapping System
GIMADS	Generic Integrated Maintenance Diagnostic System
GMAP	Geometric Modeling Applications Project
IDA	Institute for Defense Analyses
IDS	Integrated Design Support System

IDSS	Integrated Diagnostic Support System
IGES	Initial Graphics Exchange Standard
IISS	Integrated Information Support System
IMIS	Integrated Maintenance Information System
IMP	Information Management Program
ILS	Integrated Logistics Support
JPAPS	Job Performance Aids Production System
LIMSS	Logistics Information Management Support System
LOR	Level of Repair
LTI	Logistic Technical Information
LSAR	Logistics Support Analysis Record
LSMP	Logistics Systems Modernization Program
MAISRC	Major Automated Information Systems Review Council
MAP	Manufacturing Automation Protocol
MEDALS	Military Engineering Data Asset Locator
MEIDS	Militarized/Miniaturized Electronic Information Delivery System
MIO	Management Integration Office
MLCAD	Maintenance and Logistics Factors in Computer Aided Design
MPCASS	Modernized Parts Control Automated Support System

N	Navy
NAPPS	Navy Automated Publishing and Printing System
NATO	North Atlantic Treaty Organization
NBS	National Bureau of Standards
NPODS	Navy Print on Demand System
NSIA	National Security Industrial Association
NSTIS	Navy Standard Technical Information System
NTIPS	Navy Technical Information Presentation System
O&M	Operation and Maintenance
OSD	Office of the Secretary of Defense
OSI	Open System Interconnection
PDDI	Product Definition Data Interface
PEAM	Personal Electronic Aid for Maintenance
PED	Procurement Early Development
PM CALS/ATI	Department of the Army Program Manager for CALS
PPBS	Planning, Programming, and Budgeting System
RADC Testability Tools	Rome Air Development Center Testability Laboratory
RAMP	Rapid Acquisition of Manufactured Parts
R&D	Research and Development
R&M	Reliability and Maintainability
RDT&E	Research, Development, Test, and Evaluation
REMIS	Reliability and Maintainability Information System

SGML	Standard Generalized Markup Language
SHARP	Standard Hardware Acquisition and Reliability Program
Ship CAD/CAM	Ship Computer Aided Design/Computer Aided Manufacturing
600/S	See AIPPS/600S
SMARTBIT	Smart Built-in Test
SNAME	Society of Naval Architects & Marine Engineers
SPLICE	Stock Point Logistics Integrated Communications Environment
TD/CMS	Redesign of Technical Data/Configuration Management System
TIMS	Technical Information Management System
TLRN	Technical Logistics Reference Network
UDB	Unified Data Base for Acquisition Logistics
VLSI	Very Large Scale Integration Socketing Capability