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The ISO STEP Pilot Product Logistic Support Application Protocol Suite Developmental Plan

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The ISO STEP Pilot Product Logistic Support Application Protocal Suite Developmental Plan

by

Ruey Chen

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Product maintenance is becoming more expensive due to the increasing complexity of both product design and associated maintenance requirements. In order to build the reliability, maintainability, and supportability characteristics into a product at minimum life-cycle costs, a structured methodology should be used to facilitate the early identification and integration of these characteristics in the product design, to develop the most effective product support concepts, and to define the product support resource requirements.

To achieve these objectives, an integrated data base is required to integrate logistic related engineering information. The ISO STEP Product Logistic Support (PLS) Application Protocol suite (APs) now under development is proposed to define the data requirements for ensuring reliable, maintainable, and supportable products at minimum cost by integrating logistic support considerations into the evolving design, manufacturing, and support efforts. (Continued on reverse side)

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To achieve these objectives, an integrated data base is required to integrate logistic related engineering information. The ISO STEP Product Logistic Support (PLS) Application Protocol suite (APs) now under development is proposed to define the data requirements for ensuring reliable, maintainable, and supportable products at minimum cost by integrating logistic support considerations into the evolving design, manufacturing, and support efforts. The development of the PLS APs will be based primarily on the integration of U.S. CALS LSAR and IETMDB standards and on the European AECMA 2000M and 1000D specifications.

ADMINISTRATIVE INFORMATION

The Advanced Information System Branch (Code 183) of the Communications and Information Systems Department at the Carderock Division , Naval Surface Warfare Center, proposed and completed this work. under sponsorship of the Navy CALS Coordination Office. This work was performed under NSWC project number 1830-440.

The opinions expressed in this report are those of the author. They do not necessary reflect the views of the Department of the Navy.

EXECUTIVE SUMMARY

Due to the lack of international standards for the logistic support of product data exchange, it is becoming increasingly difficult to attain optimal data management (transmitting, accessing, and updating) of the enormous amounts of data for modern product systems (such as weapon systems) throughout their life cycle.

Continuous Acquisition and Life-cycle Support (CALS) is a Department of Defense (DoD) initiative to facilitate enterprising integration and to promote an electronic commerce environment to enhance industrial competitiveness and economic growth through process improvement, information integration, and data exchange standards.

ISO STEP is an international standard designed to give a complete computer-interpretable representation of product data in a neutral format throughout the complete product life cycle. This representation makes it suitable not only for file exchange but also as a basis for implementing, sharing, and archiving product data bases.

The STEP standards are fundamental to the CALS effort. The STEP shared data environment will provide the kernel of the IPDB/IWSDB. As STEP evolves, it will provide a major portion of the functional framework for the IPDB/IWSDB. Due to the rapid international acceptance of the CALS initiative and the worldwide agreement of STEP as the future product data exchange, more resources should be invested in the development of STEP standards.

The pilot PLS APs are designed as a part of the STEP standards for the implementation of a shared integrated data base environment for LSAR, TM, parts provisioning , and order administration. The goals of this data base environment are to: (1) ensure reliable, maintainable, and supportable products at minimum life-cycle cost; (2) harmonize existing AECMA specifications, CALS standards, and other national and international standards in the logistic support area; and (3) meet both industrial and military requirements. The pilot PLS APs effort (which can be implemented in about three years) will focus only on air vehicles. After the completion of and lessons learned from this pilot development effort, the scope of the pilot PLS APs can be extended to land and sea vehicles and to other product areas.

In cooperation with the CALS/CE ISG SALSA committee and other European representatives who were attending the CALS Expo 93 convention, a draft of the pilot PLS APs requirements has been prepared, it is attached as Appendixes E and F. This report also suggests the implementation plan for PLS APs.

The chief benefit for the U.S. participation in the development of PLS APs would be that of ensuring full consideration of U.S. military and industry requirements to be included in this international PLS APs standards. This will favor U.S. industry in world market competition and enhance foreign military sales.

1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to describe the requirements, strategy, and plans for developing a pilot effort of an ISO (International Organization for Standardization) STEP (STandard for the Exchange of Product data model) standard - the Product Logistic Support (PLS) Application Protocol (AP) suite. This pilot PLS AP suite prototyping effort, limited in scope, can currently be implemented in a relatively short period of time (three years).

1.2 Objectives

The objective of the pilot PLS APs project is to develop ISO STEP standards for representing and exchanging information with regard to product logistic support in order to achieve the following goals: (1) to establish the information requirements for ensuring reliable, maintainable, and supportable products at minimum life-cycle cost by integrating data bases for Logistic Support Analysis Records (LSARs), technical manuals (TMs), provisioning, and order administration; (2) to harmonize existing European AECMA (Association European des Constructeurs de Materiel Aerospatial) specifications, U.S. CALS (Continuous Acquisition and Life-cycle Support) standards, and other national and international standards in the acquisition logistic area; and (3) to meet both industry and military requirements.

The pilot PLS APs are designed as part of the ISO STEP standards for the implementation of a common and shared integrated data base environment for LSARs, TMs, parts provisioning , and order administration.

1.3 Scope

The scope of the pilot PLS APs project is to define the information requirements for acquisition and logistic support in the functional areas of:

- o LSAR,
- o TM,
- o Provisioning, and
- o Order administration.

The development of the pilot PLS APs will primarily be based on the existing national and international standards in the acquisition and logistic support areas. This will be accomplished by drawing upon the efforts that are being performed by NATO (North Atlantic Treaty Organization), CALS (Continuous Acquisition and Life-cycle Support), AECMA, ANSI, and ISO standards. By integrating and harmonizing efforts into the STEP environment, this project will provide the ISO STEP community with operational product support capabilities.

Some of the standards upon which this work will be based , such as AECMA 1000D and 2000M, were developed specifically for the use of air vehicles acquisition and support. Therefore, this pilot PLS APs prototyping effort (which should be implemented in about three years) will also focus on air vehicles. After completing the work and assimilating the information gained from this pilot development effort, the scope of the pilot PLS APs can be expanded to include land and sea vehicles as well as other product areas at a later time.

2.0 GLOSSARY

A glossary is provided in Appendix A.

3.0 REFERENCED DOCUMENTS

A list of "Referenced Documents" is provided in Appendix B.

4.0 PILOT PLS APS DEVELOPMENT

This section describes the needs, requirements, strategies, and plans required to develop the prototype pilot PLS APs for aircraft acquisition and logistic support.

4.1 Global Industrial Needs

Due to the lack of both international product data exchange standards and supporting data transferring infrastructures, it is becoming increasingly difficult for geographically distant partners in a given project to attain optimal data management for transmitting, accessing, and updating the enormous amounts of data for modern product systems (such as weapon systems) throughout their life cycle. The exchange of product information needs to be enhanced, international data exchange standards must be developed, and a modern data transfer infrastructure must be built.

4.1.1 World Product

National borders mean less and less in world trade and industry. Industry is trying new ways to integrate global design, manufacturing, and marketing in order to provide leverage of resources, maximize investments, reduce product unit costs, sell more products, balance currencies, and better satisfy local markets. Building a "world product" - one that can be designed, manufactured, supported, and marketed around the globe - is an ambitious goal for industry, because it represents the ultimate goal in terms of economic benefit. The current global environment cannot effectively support such an ambitious endeavor as designing, manufacturing, marketing, and supporting a world product.

For example, the 28 June 1993 issue of "Fortune" reported that Ford will introduce a midsize car model "Mondeo" in 1994, a "world car." Ford spent $6 billion and eight years on its development - twice the usual cost and time required to bring a new car model to the market. This is due in part to the lack of international product exchange standards and a supporting information exchange infrastructure. Six billion dollars is twice what Ford spent on developing the successful Taurus and Sable models. In the case of the Mondeo model, Ford had to both reconcile divergent European and American engineering standards and spend tens of millions of dollars on late design changes. Ford had to develop its own uniform standards for the designing, engineering, procuring, manufacturing, supporting, and marketing of the product.

4.1.2 Product Data Exchange Standards

Product data exchange is one of the fundamental requirements for industry and commerce. It is also not adequately understood. Everyone knows how to send a letter or make a phone call; very few know how to send product data.

When more and more workstations and networks are installed, more and more data are produced. However, users often find out that they cannot exchange data with vendors, customers, suppliers, and even their own nearby co-workers. This is not merely a technological problem, because they do not have compatible data formats and data exchange protocols.

Those enterprises that can communicate rapidly and accurately will have a competitive edge. Those that can integrate and address their customers' and suppliers' needs in their engineering and manufacturing data will gain an enormous advantage. The ability of vendors, manufacturers, and suppliers to receive and supply product information will provide a competitive edge. This requires both international data standards and protocols as well as a telecommunication infrastructure to transmit the data.

As distances become less significant through new communication technologies, the need for creating compatible national and international standards for product support increases. More and more countries are opening their borders to international commerce. This necessitates the development of common product data exchange standards.

4.1.3 Acquisition and Logistic Support

Product maintenance is becoming more expensive due to the increasing complexity of both product design and associated maintenance requirements. In order to build the reliability, maintainability, and supportability characteristics into a product design, a structured methodology (see Section 4.2.4) should be used by systems engineering to facilitate the early identification and integration of these characteristics in the product design, to develop the most effective product support concepts, and to define the product support resource requirements.

International commerce and government activities do not have standardized procedures for exchanging Product Logistic Support information. There is a strong need to communicate supply support or provisioning information. Today's "Just in Time" support environments depend upon the rapid procurement of parts and supplies. This requires that the communication of procurement requirements be integrated with an enterprise's product definition data bases. Accordingly, an integrated data base is required to integrate logistics related engineering information. The pilot PLS APs are proposed to meet these needs.

4.2 Related Initiatives and Development

In the last decade or so, several relevant initiatives have been undertaken with regard to improving the acquisition and logistic processes and product data exchange.

Figure 1 (from Ref. 62; see Appendix B) shows how CALS relates to other initiatives, standards, processes, networks, and environments.

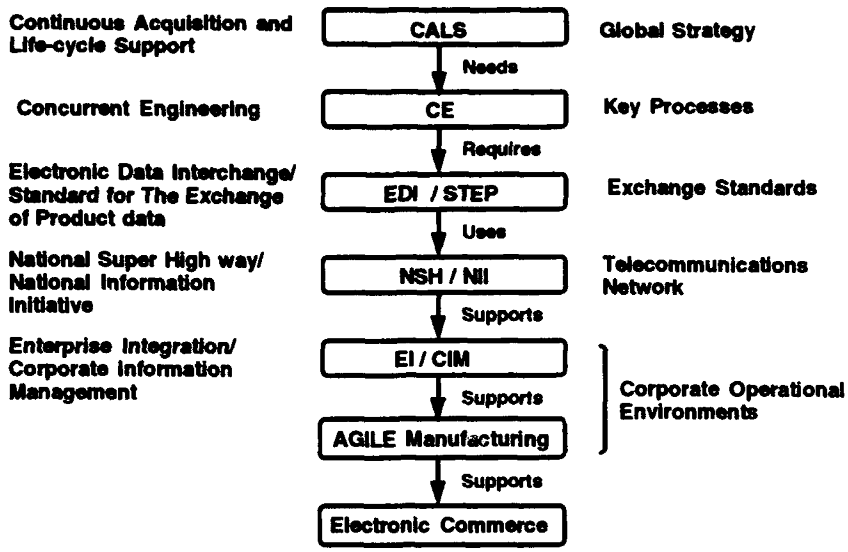

Fig. 1. CALS relationship with other activities.

4.2.1 Continuous Acquisition and Life-cycle Support (CALS)

The Continuous Acquisition and Life-cycle Support (CALS), formerly "Computer-aided Acquisition and Logistic Support," initiative was formalized by DoD in 1985 to facilitate the integration of digital technical information for weapon system acquisition, design, manufacture, and support functions. CALS addresses requirements for an orderly transition from a paper and labor-intensive environment to the use of integrated digital technical information for design, manufacturing, and support processes. CALS technical information is generated once, stored electronically for access, and transferred in neutral formats: thereby making the information easily available to any legitimate user of the data. The objectives of the CALS program are: (1) to REDUCE LEAD TIMES for creating, transferring, managing, and accessing technical information used to produce and maintain weapon systems; (2) to IMPROVE THE QUALITY of the technical information; and, ultimately, (3) to REDUCE THE COST associated with creating, transferring, managing, and accessing technical data. To achieve these CALS objectives, a phased strategy has been established.

The CALS strategy is to facilitate enterprising integration and promote an electronic commerce environment to enhance industrial competitiveness and economic growth through process improvement, information technology, and international product data exchange standards. To attain these goals, the following are required: (1) a common integrated product data base (IPDB) which is often referred to in DoD as an Integrated Weapon System Data Base (IWSDB); (2) process re-engineering, i.e., application of concurrent engineering (CE) principles; (3) an open systems environment of product data exchange using the evolving data exchange standards, STEP and EDI; and (4) an information infrastructure, i.e., electronic highway. These will result in a faster time to the market, improved acquisition, better quality products and product support, along with lower life-cycle product and support costs.

The CALS shared data environment, IPDB/IWSDB, will be created by applying the best technologies, processes, and standards for the development, management, exchange, and use of business and technical information among government activities and industrial enterprises.

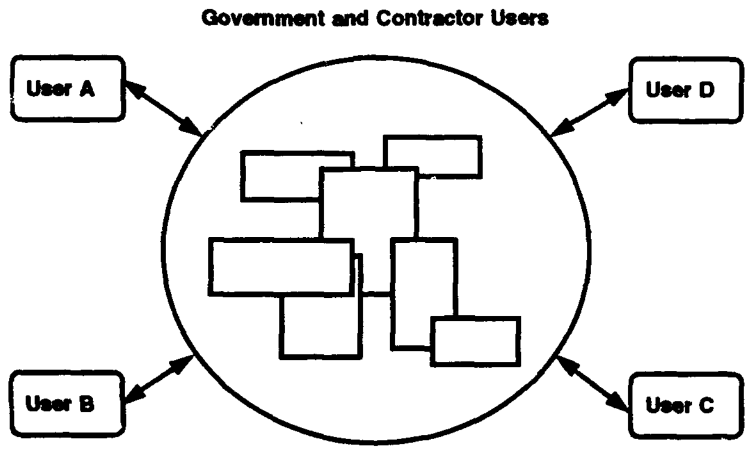

Fig. 2. IPDB/IWSDB environment.

Figure 2 shows the IPDB/IWSDB operations concept. Data sharing is at the heart of the operations concept. The IPDB/IWSDB will provide the user with the ability to obtain all needed technical and business information from a single workstation. The technical information will most likely be physically located in many different places. The development and implementation of the IPDB/IWSDB involves the following issues: (1) defining the types of information (functions) to be included; (2) specifying user operational environments; and (3) determining an effective implementation of the IPDB/IWSDB.

Figure 3 shows the implementation of IPDB/IWSDB which will be defined in terms of conceptual and external schemes. The conceptual scheme is produced by way of data modeling and identifies what kinds of data should be stored. The conceptual scheme defines the data in an integrated, consistent, and neutral format, which is not dependent on the characteristics of any proprietary data base management system. The conceptual scheme also defines referential integrity and supports the business rules of the organization which owns the data. The external scheme describes the user's view of the data. These views are typically represented by tabular and matrix arrangements of data items.

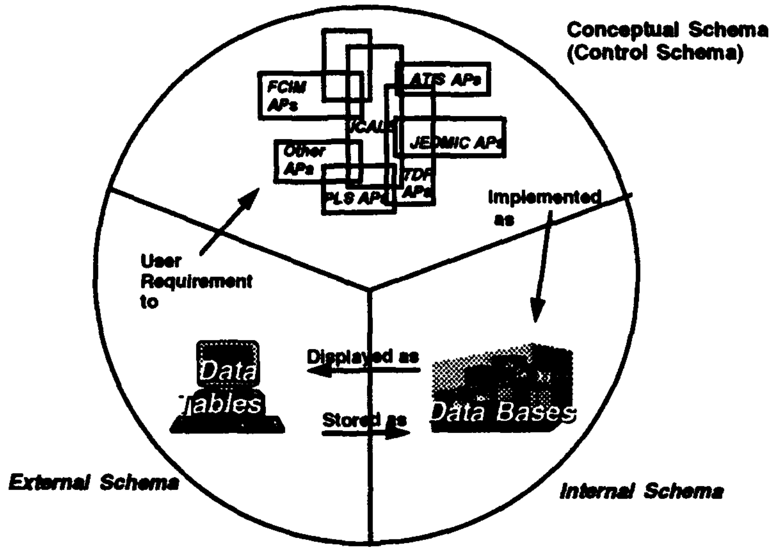

Fig. 3. IPDB/IWSDB Implementation.

For a successful implementation of CALS, the following three things are required: (1) industry must modernize its procedures for creating technical information in digital format, (2) DoD must modernize its procedures for receiving and using digital information, and (3) digital information must be easily exchanged between government and industry. EDI and STEP play an important role, since they promote an end-to-end transfer of all information, both business and technical data, for the acquisition and support of DoD weapon systems.

4.2.2 Concurrent Engineering

The traditional engineering life cycle has four major phases used in serial fashion. These four phases are: requirements analysis, design, manufacture, and maintenance support. This traditional engineering life cycle has many shortcomings which results in long times and high costs in introducing a new product.

Concurrent engineering is a systematic approach to the integrated design of products and processes, taking into account concurrently all phases including requirements analysis, design, manufacture, and maintenance support. A product is engineered by concurrently considering all phases of its life cycle and modifying the design to optimize its suitability for all of the phases. For example, a product's maintenance requirements are determined while the product is still being analyzed and designed; design modifications are made to eliminate maintenance problems. Concurrent engineering is seen as the key to reducing product development cost by reducing product reworks and modifications after a design is released. Concurrent engineering allows more design changes than traditional processes; it concentrates them into the design phase where design changes are least costly. Concurrent engineering also reduces both time to market and cost, while also improving product quality.

Figure 4 compares a sequential approach to product development (at the top of the figure) with a concurrent approach (in the lower half). In the sequential method, information flows from left to right only. In the concurrent approach, information flows are bi-directional and decisions are based on consideration of downstream as well as upstream inputs.

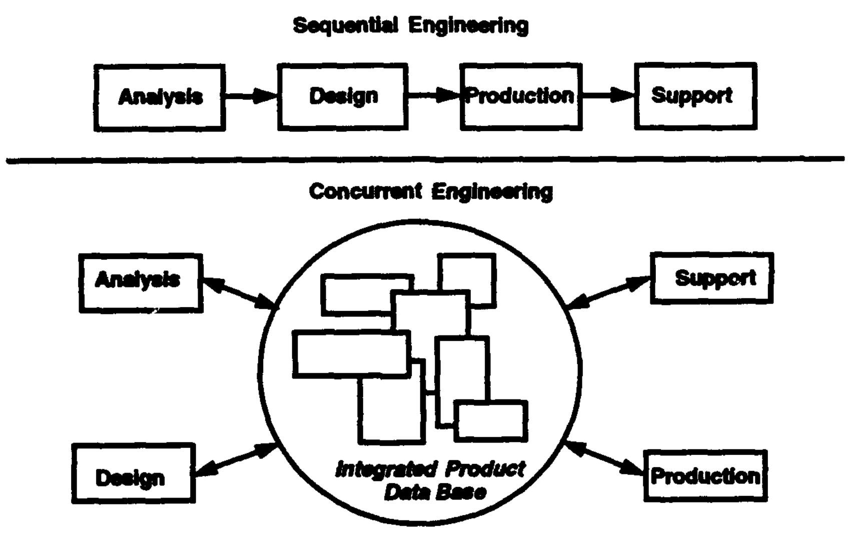

Fig. 4. Comparison of sequential and concurrent engineering.

The major obstacles to concurrent engineering are the challenges posed by effectively sharing product data across the development phases. The foundation of effective concurrent engineering is a single integrated product data base, such as IPDB/IWSDB, which stores all product information required by the different life-cycle phases and also is easily accessible at each phase. For convenience and efficiency, the information representation must also be neutral with respect to the different life-cycle applications. STEP is designed to support such an application of an integrated product data base for concurrent engineering.

4.2.3 Electronic Data Interchange

To facilitate the exchange of business information in the global marketplace, national and international organizations recognized the need to standardize Electronic Data Interchange (EDI) message formats. In the United States, the ANSI Accredited Standards Committee X12 has developed standard definitions for the components of an EDI message. However, the syntax standard adopted by the EDIFACT (Electronic Data Interchange for Administration, Commerce, and Transport) is not identical to X12. As a result, the EDI message developed by EDIFACT are not interchangeable with X12 messages. Global users will have to support both the ANSI X12 and EDIFACT standards until they can be reconciled.

EDI is the application-to-application electronic exchange of business data in a standardized, nonproprietary format. EDI replaces paper documents with an electronic transmission of the data contained in them. EDI transmissions are machine-readable and transaction-oriented. They are intended to be integrated into applications to automatically update inventory, trigger a tickler, invoice a customer, or pay a vendor. EDI is not the same as an exchange of forms. With EDI, only a document's contents are transmitted, not an image of the document itself. However, data can be transmitted via EDI to a user's data base and then selectively loaded into a form displayed on the user's screen.

EDI can be viewed as an extended enterprising model that transcends the boundaries of the organization, creating so-called "virtual organizations." EDI allows business partners to share structured information. In an extended enterprising model, workflow progresses across organizational boundaries. Government agencies and vendors not only share the same information base, but also can initiate transactions across that information base. EDI, together with STEP (for exchanging product data), plays a major role creating a set of operational standards that influence CALS operations.

CALS is gaining acceptance around the world. Both CALS and EDI/STEP (business/product data) are contributing to international competitiveness in a real way. An organization's technology investments can provide a gateway to the global marketplace if CALS and EDI/STEP standards are included.

4.2.4 Integrated Logistic Support

Integrated Logistic Support (ILS) is the process through which the composite of management and analysis actions necessary to assure effective and economical support of a materiel system, both before and after fielding, are accomplished. The basic management principle of the ILS process is that logistic support resources must be developed, acquired, tested, and deployed as an integral part of the materiel acquisition process.

The primary tool employed in ILS is the Logistic Support Analysis (LSA). For details of LSA, please refer to Ref. 1. LSA is used to obtain a reliable, maintainable, transportable, and supportable materiel system at the least cost of ownership by integrating logistic support considerations into both the system and detail design efforts.

The Logistic Support Analysis Record (LSAR) is a system of data records, computer programs, and output reports which has been developed to document portions of the LSA. The LSAR provides a single logistic data base to input, store, process, and retrieve selected LSA data. For details of LSAR, see Ref. 2.

4.2.5 Relationship Between CE and ILS

The CALS acceleration of information distribution and delivery will materially enhance the efficiency of CE processes. A prerequisite for CE and ILS is an efficient information flow by means of an electronic data interchange closely combined with IPDB/IWSDB for storage and retrieval of these product data. Therefore, a worldwide standardized EDI is required not only for development, design, and manufacturing data,but also for product support; program management; and operational business information. In this scenario, the CALS strategy can be regarded as an umbrella for all relevant standards required for the EDI of CE and ILS. Figure 5 (from Ref. 52) shows these relationships.

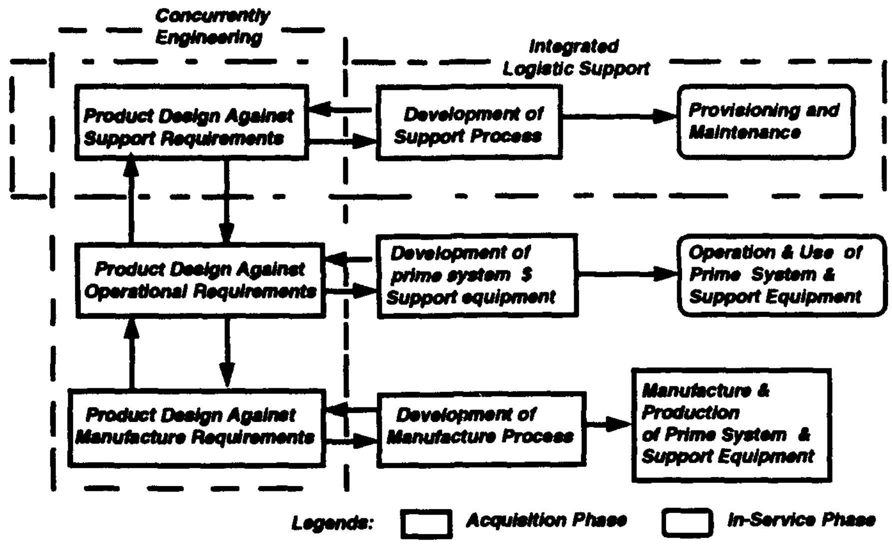

Fig. 5. Interrelationship of CE and ILS.

4.2.6 LSAR, Provisioning and TM Integration

Currently, there is data duplication and overlap in the LSAR, TM (including maintenance, training, etc.), and provisioning data bases. Shared information is not prepared once and then utilized throughout each area of a weapon system program. In many cases, the organizational structure determines how the LSAR, TM, and part provisioning data are procured and developed. As a result, work is performed along traditional organizational lines, with little consideration of the concurrent engineering principle. Therefore, costs for developing and updating the various data bases for LSAR, TM, and parts provisioning are high due to the duplication of effort. Duplication could also result in errors and inconsistencies in the same information in the different data bases. Development of the LSAR, TM, and parts provisioning data should be oriented to shared data element generation and should not be oriented to product development. Reference 59 estimates that development costs can be reduced 25 percent through a shared data base for LSAR, and TM.

4.3 STandard for the Exchange of Product Model Data

STandard for the Exchange of Product (STEP) model data is the unofficial name for the ISO 10303 standard being developed by the International Organization for Standardization (ISO). STEP is formally called the "Industrial Automation Systems and Integration - Product Data

Representation and Exchange Standard." In the United States, STEP is known as PDES (Product Data Exchange using STEP), the U.S. organizational activity which supports the development and implementation of STEP. Product data is defined as the data used to define the product over its life cycle; the data include geometry, tolerance, material composition, assembly information, and other attributes necessary to completely define a component for design, analysis, manufacture, test, inspection, support, maintenance, and disposal.

STEP is an international standard which is being designed to give a complete computer-interpretable representation of product data in a neutral format throughout the complete product life-cycle (design, engineering analysis, manufacture, support and maintenance, and disposal). As a result, STEP is suitable not only for file exchange but also for serving as the basis for implementation, sharing, and archiving product data bases.

The STEP standard is fundamental to the CALS. CALS encompasses an architecture for Contractor Integrated Technical Information Services (CITIS) which requires an IPDB/IWSDB. The STEP shared data environment will provide the kernel of the IPDB/IWSDB and will support information access for prime contractors, sub-contractors, and the DoD.

4.3.1 Application Protocols

Application Protocols (APs) provide the mechanism both for specifying implementation requirements and for ensuring reliable information communication within the context of a given application. An AP is a complete specification of the context and scope for the use of product data in a particular domain using standardized integrated resources and other application specific entities. The AP also describes the conformance requirements. Appendixes C and D list APs currently being developed within the ISO STEP community.

4.3.2 Components of Application Protocol

Figure 6 shows the steps and components in the development of an AP:

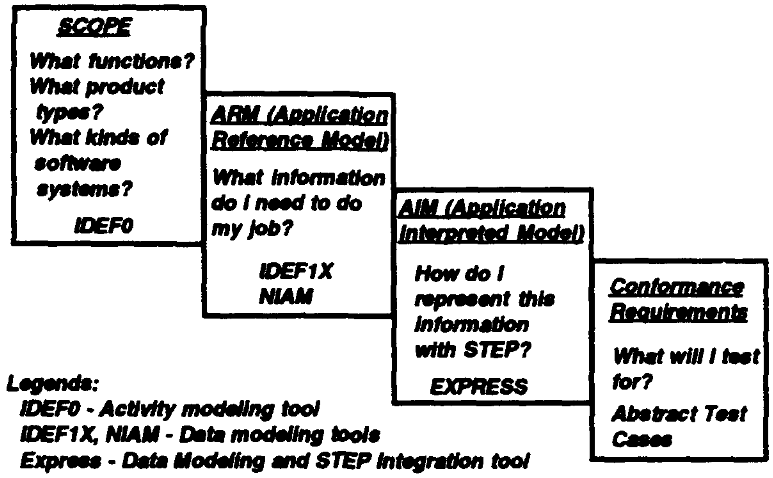

Fig. 6. Steps in the development of an application protocol.

a. Application Activity Model:

The scope statement is based on an Application Activity Model (AAM) developed by the Integrated Computer-aided Manufacturing Definition Method (IDEF0). The AAM is used to clarify the application activities, processes, and data flows involved in the application.

b. Application Reference Model:

The Application Reference Model (ARM), describes the information requirements, content, structure, and constraints with regard to the specific application domain. The ARM is developed in one of the following modeling languages: EXPRESS, the Integrated Computer-aided Manufacturing Definition Method (IDEF1X), or Nijssen's Information Analysis Methodology (NIAM).

c. Application Interpreted Model:

An Application Interpreted Model (AIM) is developed by interpreting the Integrated Resource Constructs (IRC) and Application Interpreted Constructs (AIC) based on the information requirements defined in the ARM. The AIM is defined using the EXPRESS language.

When two or more APs contain equivalent information requirements, these APs shall use the same interpretation of the IRCs. A group of constructs which comprise a common interpretation of common information requirements is called an AIC. A library of these AICs (Fig. 7) shall be maintained as a resource for defining AIMs.

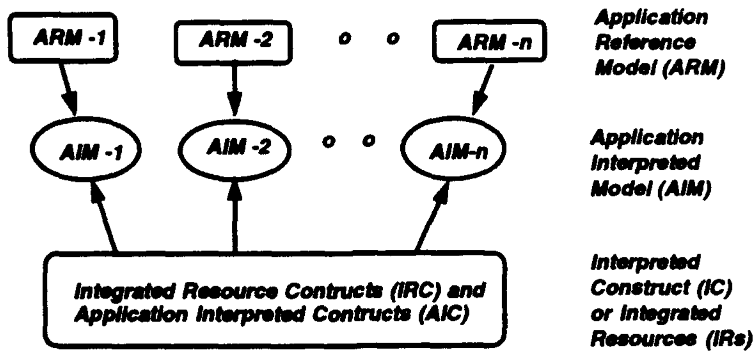

Fig. 7. Development of AIMs.

d. Conformance Requirements and Test Purposes:

The AP also includes a set of conformance requirements and test procedures from which an abstract test suite may be developed and used for conformance testing.

4.3.3 Application Protocol Implementation

STEP provides a wide variety of levels for system implementation. Implementation levels are particular ways of storing, exchanging,or accessing information which is distinguished by the degree of data sharing. Those levels may include the following:

a. Exchange File - Product data are exchanged between computer systems or applications using STEP exchange files which are defined in STEP Part 21 (see Appendix C). The structure of the exchange file is derived from the conceptual data model's EXPRESS definition (AIM). It is expected that the early use of STEP will involve using exchange files to move data between systems.

b. Data base - Product data are stored and accessed in data bases based on various data base architectures (such as relational or object-oriented). This data base level will allow application developers to create, manipulate, and share STEP data, based on standard data models and system interfaces. Applications use a standard query language such as SQL or standard interfaces such as the STEP Data Access Interface (SDAI) defined in Part 22 (see Appendix D).

c. Data Access - Product data can be accessed independent of the storage method used.

As STEP evolves, it will provide a major portion of the functional framework for the IPDB/IWSDB. Due to the rapid international acceptance of the CALS initiative and the worldwide agreement that STEP can be the future standard for product data exchange, a worldwide standard on product data can be built from the beginning - a true breakthrough in the CALS standards world. STEP and the development of the IPDB/IWSDB are the most technically challenging CALS responsibilities.

4.3.4 Application Protocol Interoperability

More than forty APs (Appendixes C and D) have been approved by ISO TC184/SC4 for formal development as part of the STEP standards. The implementation of these APs will provide the solution for product data exchange. AP interoperability implies that two APs will be able to share data which is defined in the overlapping area of the APs. The development of the Integrated Resources (IRs) (see Fig. 7) that support the information requirements of multiple applications ensures the interoperability of APs. Therefore, two or more APs can exchange data only if they share common IRs.

4.3.5 Impact of STEP

STEP is an extremely broad specification, including virtually every data item required to develop, analyze, manufacture, document, and support products ranging from mechanical products and electronic products, to large structures such as ships and buildings.

STEP is a conceptual specification for communicating product information at all stages in a product's life cycle, covering all aspects of product description and manufacturing specifications. The fundamental components of STEP are the product information models and specifications to exchange information corresponding to these product models.

STEP will provide tools to reduce time to market, lower costs, improve quality, and continuously improve processes. STEP will enable the effective integration of finance, marketing, engineering, manufacturing, and support data. STEP data are open, are independent of the applications or systems that create it, and are accessible to and usable by any other applications that need to use them. STEP will provide the ability to turn data into meaningful information to support decision making, and will provide a foundation for the next generation of open systems.

4.4 Pilot PLS APs Implementation Requirements

The first step in the implementation of the pilot PLS APs was to define the scope and requirements for both military and industrial use in the product logistic support area.

In cooperation with the CALS/CE ISG (Industry Steering Group) SALSA (Spares Acquisition and Logistics Support Analysis) Committee and other representatives from European countries, the draft of the pilot PLS APs implementation requirements has been completed; see Appendixes A through I. Two working group meetings were held on 2 September 1994 (third quarter SALSA committee meeting) and 2 November 1994 (fourth quarter SALSA committee meeting at CALS Expo 93) respectively. Assistance was also obtained from the Air Force's ManTech office which initiated and managed the STEP AP-209 and AP-211 contracts. The highlights of the implementation requirements are as follows:

a. The pilot PLS APs is designed as part of the ISO STEP standards for: (1) establishing the information requirements to ensure reliable, maintainable, and supportable products at minimum life-cycle cost, and (2) representing and exchanging product logistic support information by the implementation of a common and shared integrated information environment for LSAR, TM, parts provisioning, and order administration.

b. The development of the pilot PLS APs primarily will be based on the harmonization of existing European AECMA specifications, U.S. CALS standards, and other national and international standards in the acquisition logistic area. This will be accomplished by drawing upon the efforts that are being performed by CALS, AECMA, ANSI, ATA/AIA, and ISO standards. These standards and specifications include:

MIL-STD-1388-2B: LSAR (Logistic Support Analysis Record)
MIL-M-28001: SGML (Standard General Markup Language)
MIL-D-87269: IETMDB (Interactive Electronic Technical Manual)
MILSTRIP: Military Standard Requisitioning and Issue Procedures

MILSTRAP: Military Standard Transaction Reporting and Accounting Procedures

AECMA Spec 2000M: Material Provisioning and Management

AECMA Spec 1000D: Technical Publication

ATA Spec 100: Manufacturers Technical Data

ATA Spec 200: Data Base and Customer Support

ISO 8879: SGML (Standard Generalized Markup Language)

ISO 10744: HyTime (Hypermedia/Time-based Structuring Language)

c. Some of the standards on which this standard will be based such as AECMA 1000D and 2000M are developed specifically for air vehicles acquisition and support (e.g., the Standard Numbering System and Data Module Code of AECMA 1000D), this pilot PLS APs prototyping effort (which can be implemented in about three years) also will focus on air vehicles. After the completion of and the assimilation of lessons learned from this pilot development effort, the scope of the pilot PLS APs can be expanded to include land and sea vehicles as well as other product areas at a later time.

d. This pilot PLS APs will meet requirements and also will prove useful and effective for both military and industrial operations.

e. This pilot PLS APs will accept the NATO standards harmonization workshop recommendations (see Appendix G).

f. This pilot PLS APs will ensure compatibility with the planned TDP (Technical Data Package) and PSA (Product Support Analysis) APs (see Appendix H).

Figure 8 (see Appendix E) is the currently envisioned configuration implementation. The actual configuration implementation can vary, if detailed analysis warrants. It assumes that the pilot PLS APs (Box 2 of Fig. 8) includes three STEP APs (Boxes 3, 4, and 5). A more detailed description of Fig. 8 can be found in Appendix F of this report.

4.5 Resources Estimates

The resources required to complete the initial implementation of the pilot PLS APs for air vehicles are estimated to be about ten full-time equivalents per year for the first two years and about four full-time equivalents for the third year. All countries participating in the pilot PLS APs' development will be requested to share the development costs.

4.6 Implementation Strategy

The strategy for the implementation of pilot PLS APs is as follows.

a. Due to the excessive labor required to implement the pilot PLS APs, the implementation requirements will be developed as a SOW and then a cost plus type of contract will be awarded to a qualified company for the development of this pilot PLS APs. Because this pilot PLS APs will be an ISO international standard, the requirements will be defined by multi-national representatives and used by different countries for the exchange of product logistic support data. All participating countries will be requested to share developmental funding.

b. The Program Management Board (PMB) will consistof representatives from fund-contributing countries to manage this contract. The Industry Review Board (IRB) will be formed from the CALS ISG, NATO IAG (Industry Advisory Group), and other CALS advisory groups of the participating countries to provide advice to the pilot PLS APs development team. The IRB will provide a forum for international industry to review the progress of this effort and to offer advice and guidance to the pilot PLS APs development team. The IRB makeup shall be determined by both the PMB and the contractor. IRB comments and recommendations resulting from review meetings shall be considered, and acted upon when the PMB deems them appropriate.

c. The PMB will continue to work with IRB to completely define the SOW (see Appendix E), develop the RFP, and award the contract in 1995. The contractor shall complete the development of the pilot PLS APs in three years.

d. The development effort will be managed using a multi-phase approach to incrementally develop the pilot PLS APs. There will be three major phases which are described in more detail in Section 4.7. The rationale in developing the pilot PLS APs in a phased approach is to minimize the risks associated with attempting to develop the complete suite as a single effort. Each incremental phase addition to the suite builds upon the foundation provided by earlier efforts.

e. Methods will be developed to ensure that the APs development meets ISO STEP AP requirements.

f. The PMB will ensure that the contractor shall plan for the transfer of the technology established in this program to industry and to the government of all participating countries. The contractor shall identify the anticipated requirements for and the benefits of implementing this AP suite.

4.7 Implementation Phases

The development of the pilot PLS APs consists of two development phases and one demonstration phase.

Phase I - Technical Issues Assessment and Pilot PLS APs Development and Demonstration Planning

The technical issues crucial to the pilot PLS APs development effort should be thoroughly analyzed and studied first . All of the identified technical issues are described in Section 5 of this report. All of the proposed technical solutions should be presented to and agreed upon by the IRB and then approved by the PMB before proceeding to Phase II of this contract. The technical issues should include the following agenda:

a. Establish the functional view (IDEF0) of the pilot PLS APs. Develop integratable and harmonized data models (IDEF1X) for each of the APs (see Fig. 8) included in the pilot PLS APs.

b. Develop a data element dictionary for the data models. Assess the technical issues and determine any risks involved.

c. Prepare a plan to develop and demonstrate the pilot PLS APs with respect to a risk/benefits analysis and technical issues assessment.

d. Provide a plan for the development and demonstration of the AP suite to be used in Phases II and III respectively.

e. Analyze the issues and problems for the integration and harmonization of the standards involved.

f. Assess and evaluate current STEP content and scope to determine the STEP capability to support the development of this AP suite. This assessment should project the progress of the STEP planned activities and emerging technologies that appear to offer contribution and impact to this program and to identify the inadequacies where the pilot PLS APs needs are not supported by STEP.

g. Produce an APs development and demonstration strategy. Develop a set of criteria with which the potential costs and benefits can be measured in relation to the NATO requirements to utilize the pilot PLS APs. The program shall not proceed with Phase II without the successful completion of Phase I.

Phase II - Pilot PLS APs Development

Phase II shall provide the development and specification of required models, mappings, and test criteria needed to support the functionality resulting from Phase I.

The pilot PLS APs is developed using the Application Reference Model(s) (ARMs), Application Interpreted Model(s) (AIMs), and conformance and test criteria (CTC). The process is to identify enhancements and proposed improvements for the STEP Community; refine preliminary activities to provide a detailed and cost effective demonstration plan; coordinate the development of the AP suite with international industry and standards organizations to facilitate the harmonization of data standards; and submit the ARMs, AIMs, CTC, and other necessary documents to the ISO STEP organization in order to qualify the pilot PLS APs as ISO standard(s).

Phase III - Pilot PLS APs Demonstration

Phase III shall provide the demonstration and validation of the application protocol suite developed in Phase II

Phase III will demonstrate functionality of the pilot PLS APs. Tasks are to: (1) project the performance and analyze the potential benefits accruing from implementing the AP suite in working environments; and (2) debrief industry and government representatives on the results and potential impact of this program. The contractor shall plan for the transfer of the technology developed by this program to industry.

5.0 TECHNICAL ISSUES

In the development of the pilot PLS APs, there are many technical issues that need to be understood, analyzed, agreed upon, and resolved. Phase I of this pilot PLS APs development effort will be totally devoted to the analysis and resolution of the technical issues. The results from the execution of Phase I will have to be completely satisfactory before the starting of Phase II. The technical issues crucial to the pilot PLS APs development include the following, detailed description of the technical issues that can be found in Appendix F of this report.

a. Data Modeling and Data Model Integration

Conceptual data modeling is becoming one of the most powerful techniques for establishing and maintaining control over information resources. Data models are used to represent conceptual schemes and to help integrate the information resources. Integrating large data resources without using data models can be very difficult. The challenge in developing this pilot PLS APs is the development of integratable data models based on the existing data standards and specifications which, in most cases, are not compatible with each other.

b. Enhancement of MIL-STD-1388

The NATO Harmonization Assessment Workshop in Acquisition Logistics Standards (see Ref. 51) and the ATIS (Advanced Technical Information System) program recommended that the scope of MIL-STD-1388 be expanded to include the following functions. The introduction of these processes may require additional data elements.

c. Integration Key

The activities of engineering design, LSA, technical documentation, and initial provisioning need a mechanism to provide an integrated cross reference capability. A single integration key is needed to cross reference each technical subject area.

This approach does not require the development of any new data elements, but uses a management activity to align and normalize the data between functional activities. Other technical disciplines can be added to the table without changing the existing structure or any existing relationships.

d. Integration of the PSA and ETM APs

The benefits of integrating the LSAR with ETM data bases are well known (see Refs. 56 to 59). Some companies have experienced a cost reduction of more than 25 percent in ETM authoring by integrating the LSAR and ETM data bases to improve the LSAR and ETM authoring processes.

The PSA and ETM data models should become the major components of both the CALS IPDB/IWSDB and AECMA CSDB.

e. Integration of AECMA 1000D and MIL-D-87269 (IETMDB)

Each of these two specifications contains a DTD (Document Type Definition) based on the same ISO 8879 (SGML) specification for a neutral data base. However, these two DTDs are different as they are designed for different technical documentation structures. The AECMA 1000D has been designed with the guideline to use MIL-M-28001 as close as possible. For ETM and IETM within AECMA 1000D the MIL-D-87269 is used as a basic reference document. Incompatibilities will be reported.

f. DTDs for the Training Material

The costs of providing separate hardware and software systems for ETMs, computer-aided training (CAT) and automatic/electronic test (ATE) equipment are high. In many instances, space is not available for separate systems. A set of SGML generic data element structures and DTDs for training material should be developed.

g. Integration of AECMA 2000M and MIL-STD-1388-2B

MIL-STD-1388-2B (LSAR) and AECMA 2000M are mutually complementary in scope and focus. Since LSAR collects its data as part of the system engineering management process, the resultant LSAR data base could conceivably provide the separable item data required by AECMA 2000M for the Initial Provisioning Lists (IPL) and Illustrated Parts Catalogues (IPC) construction.

h. Integration of AECMA 2000M and MILSTRIP/MILSTRAP

The functionality of MIL-STRIP/STRAP (Refs. 7 and 8) overlaps that of AECMA 2000M to a great extent. Except for stock replenishment modeling, both standards control the material flow/demand between a contractor and a customer. By redefining the roles of and the related data for customer and contractor on an operative functional level, both standards can be harmonized.

i. Data Dictionary

After the various data models (Fig. 8, Boxes 3, 4, and 5) have been developed and integrated, a consistent data element dictionary which encompasses all the data models will be a natural output. DoD 8320.1-M-1 (Ref. 15) should be regarded as the guiding document for the development of this dictionary.

6.0 BENEFITS ASSESSMENT

The STEP pilot PLS APs is primarily based on the integration of two key CALS standards, MIL-STD-1388-2B and MIL-D-87269. A 25 percent savings in TM authoring has been realized (see Ref. 59) in the integration of LSAR (MIL-STD-1388-2A) and TM data bases. This pilot PLS APs effort will accelerate the integration of the TM and LSAR data bases.

The STEP pilot PLS APs will harmonize the U.S. CALS standards with the European NATO AECMA specifications. This will greatly facilitate the exchange of logistic and maintenance information among the NATO countries, and also will establish a common international basis for the data exchange of logistic and maintenance information.

Active U.S. participation would ensure that U.S. military and industry requirements be addressed in the pilot PLS APs. Lack of U.S. involvement could allow the adoption of non-U.S. requirements in the pilot PLS APs development. This would result in less-compatible requirements for the U.S. industry and consequently higher conversion costs for U.S. industries. The MIL-STD-1388-2B standard has large implementation bases in this country. This would favor U.S. industry in the world market competition. Adoption of U.S. military standards would enhance foreign military sales. The Navy has been active in STEP development since 1987 through NIDDESC (Navy Industry Digital Exchange Standards Committee) and RAMP (Rapid Acquisition Manufacturing Parts)/FCIM (Flexible Computer Integrated Manufacturing).

7.0 CONCLUSIONS AND RECOMMENDATIONS

This report documents work performed in FY-93 and 94 concerning the identification and definition of the requirements for the implementation of PLS APs. Due to the very limited funding (less than a man-year) available, a draft SOW for PLS APs was developed (Appendixes A through I) with the help of the CALS/CE ISG SALSA technical committee.

For future work, it is recommended that an international working committee in the area of product logistic support be formed to complete the development of this SOW and then to manage the implementation of these PLS APs.

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The author wishes to thank Rear Admiral Paul M. Robinson (CNO N43) for his enthusiastic support and the funding for completing this project. The author also wishes to thank the following people who partipated in the CALS/CE ISG SALSA working group meetings and helped review and enhance the Statement of Work (SOW; Appendix E) and the Technical Issues section (Appendixes F).

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APPENDIX A - GLOSSARY

AAM - Application Activity Model

AECMA - Association Europeene des Constructeurs de Materiel Aerospatial

AIA - Aerospace Industries Association

AIC - Application Interpreted Construct

AIM - Application Interpreted Model

ALC - Alternate Logistic Support Analysis Control Number Code

AP - Application Protocol

ARM - Application Reference Model

ATA - Air Transport Association

ATIS - Advanced Technical Information System (Air Force B-2 Program)

CAD - Computer Aided Design

CAE - Computer Aided Engineering

CALS - Continuous Acquisition and Life-cycle Support

CDRL - Contract Data Requirements List

CITIS - Contractor Integrated Technical Information Services

CLDM - Corporate Logistics Data Model (DoD JLSC)

CSDB - Common Source Data Base

CTC - Conformance and Test Criteria

DBMS - Data Base Management System

DED - Data Element Description

DLE - Defense Logistics Encyclopedia (DoD JLSC)

DoD - Department of Defense

DTD - Document Type Definition

EDI - Electronic Data Interchange

EDIFACT - Electronic Data Interchange for Administration, Commerce and Transport

GLOSSARY (CONTINUED)

EFA - European Fighter Aircraft

EDFP - Engineering Data For Provisioning (SPTD)

EPC - Electronic Publishing Committee

ETM - Electronic Technical Manual

FCIM - Flexible Computer Integrated Manufacturing

FMECA - Failure Modes, Effects and Criticality Analysis

FRACAS - Failure Reporting and Corrective Action System

FOSI - Formatting Output Specification

IAG - Industry Advisory Group

IDEF - ICAM (Integrated Computer-Aided Manufacturing) DEFinition Method

IETM - Interactive Electronic Technical Manual

IETMDB - Interactive Electronic Technical Manual Data Base

IGES - Initial Graphics Exchange Specification

ILS - Integrated Logistic Support

IPC - Illustrated Parts Catalogues

IPDB - Integrated Product Data Base

IPL - Initial Provisioning Lists

IRB - Industry Review Board

IRC - Integrated Resource Construct

IRM - Integrated Resources Model

ISG - Industry Steering Group

ISO - International Organization for Standardization

IWSDB - Integrated Weapon System Data Base

LCN - Logistic Control Number

LSAR - Logistic Support Analysis Record

NATO - North Atlantic Treaty Organization

NIAM - Nijssen Information Analysis Model

GLOSSARY (CONTINUED)

NIDDESC - Navy Industry Digital Data Exchange Standards Committee

OS - Output Specification

OSD - Office of Secretary of Defense

PDES - Product Data Exchange using STEP

PLS - Product Logistic Support

PMB - Program Manager Board

PSA - Product Support Analysis

PTD - Provisioning Technical Package

RAMP - Rapid Acquisition Manufactures Parts

RFP - Request for Proposal

SDAI - STEP Data Access Interface

SALSA - Spares Acquisition and Logistic Support Analysis

SGML - Standard Generalized Markup Language

STEP - STandard for the Exchange of Product data model

TCP - Target Capability

TDP - Technical Data Package

TM - Technical Manual

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APPENDIX B - REFERENCED DOCUMENTS

STANDARDS AND SPECIFICATIONS

1. MIL-STD-1388-1A "Logistic Support Analysis (LSA)"
2. MIL-STD-1388-2B "Logistic Support Analysis Record (LSAR)"
3. MIL-D-87269 "Data Base, Revisable: Interactive Electronic Technical Manuals, for the support of"
4. MIL-M-28001 (SGML) "Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text"
5. AECMA SPEC 2000M "International Specification for Material Management Integrated Data Processing for Military Equipment"
6. AECMA SPEC 1000D "International Specification for Technical Publications Utilizing A Common Source Data Base"
7. MILSTRIP "Military Standard Requisitioning and Issue Procedures"
8. MILSTRAP "Military Standard Transaction Reporting and Accounting Procedures
9. Proposed ISO STEP Technical Data Package (TDP) AP
10. Proposed ISO STEP Product Support Analysis (PSA) AP
11. MIL-D-87268 "Manual Technical: General Content, Style, Format, and User Requirements for Interactive Electronic Technical Manuals"
12. MIL-D-87270 "Quality Assurance Program: Interactive Electronic Technical Manuals and Associated Technical Information; Requirements for"
13. MIL-STD-1840B "Automated Interchange of Technical Information"
14. MIL-HDBK-59 "CALS Program Implementation Guide"
15. DoD 8320.1-M-1 "Data Element Standardization Procedures"
16. ISO 8879 "Standard Generalized Markup language"
17. MIL-STD-2155 "Failure Reporting and Corrective Action System"
18. ISO 10744 "Hypermedia/Time-based Structuring Language"
19. ISO DIS 10179 "Document Style Semantics and Specification language"
20. IMPAES "Initial Multimedia Presentation and Access Exchange Specification"

REFERENCED DOCUMENTS (CONTINUED)

PROGRAMS

21. DoD Integrated Computer Aided Provisioning (ICAP) Program
22. DoD JCALS program
23. U.S. Air Force F-22 Procurement program
24. European Fighter Aircraft (EFA) Program
25. ATA Spec 2100 "Digital Data Standards for Aircraft Support"
26. ATA Spec 100 "Manufacturers Technical Data"
27. ATA Spec 2000 "Data Base and customer Support"

PROJECTS

31. DoD JLSC Defense Logistic Encyclopedia (DLE)
32. DoD JLSC Corporate Logistics Data Model (CLDM)
33. DoD CALS Integrated Weapon System Data Base (IWSDB)
34. AECMA Common Source Data Base (CSDB)
35. CALS/CE ISG TCAP EPC 93-4 "Output Specification (OS) Enhancements"
36. CALS/CE ISG TCAP EPC 93-5 "Investigate and Recommend how to Incorporate IETM Concepts and Guidelines into MIL-M-28001"
37. CALS/CE ISG TCAP EPC 93-6 "Incorporation of Architectural Forms into MIL-M-28001 for "C" Data Type Applications and Possible Inclusion (or reference) to HyTime"
38. CALS/CE ISG TCAP EPC 93-8 "Alignment of MIL-M-28001 with STEP/PDES"

REPORTS AND PAPERS

51. "Acquisition Logistics Standards Harmonization Assessment Workshop Report," NATO AC/301 SG/D (7 Apr 1993).
52. "The Applicability of CALS to the NATO Countries," NATO Industry Advisory Group Report (Oct 1992).
53. Military and Industry AECMA MSWG SPEC 2000M/LSA Study Group "A Comparison of AECMA 2000M (Chapter 1) and MIL-STD-1388-2A/2B Data Elements," (19 Feb 1993).
54. UK Military Defence Standard 00-60 "Data Dictionary."
55. "A Comparison of SPEC 2000M and MIL-STD-1388-2A/2B Data Elements," CALS/CE ISG SALSA Committee Project (7 Dec 1992).

REFERENCED DOCUMENTS (CONTINUED)

56. "CALS-LSA Process for IETMs," NPPMSO/NAVAIR Report, by Computer Applications & Systems Corp. (Jan 20, 1992).

57. Chen, R., "The Integration of the Air Force Content Data Model and MIL-STD-1388-2B," Report DTRC-90/034 (OcT 1990).

58. Bean, J. "Application of Advanced and Emerging Technology to ATIS Processes," CALS/CE ISG Project, Northrop B-2 Division MEMO L595-93-150 (20 Aug 1993).

59. Tilton, J. "Why Wait for CALS/CE," presented at the 48th Annual Forum of the American Helicopter Society (3-5 Jun 1992).

60. CALS/LSAR IDEF1X Data Model

61. CALS/CE ISG SALSA Technical Committee working paper - "Covering an Opportunity to Further Integrate Reliability and Maintainability into the MIL-STD-1388-2B Data Base," (2 Nov 1993).

62. Stormfeltz, H. B., "An Industry Perspective of CALS or Putting CALS in Its Place," CALS Journal, Winter (1993).

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APPENDIX C - STEP DIS INITIAL RELEASE STANDARDS

Twelve STEP Parts were registered for Draft International Standard (DIS) status in May 1993. This initial STEP release will provide capabilities for the exchange of two-dimensional drafting product data and the configuration controlled exchange of three-dimensional product definition data with emphasis on mechanical parts and assemblies. The initial STEP release establishes a foundation for subsequent STEP releases. This initial STEP release includes the following Parts:

Part 1 - Overview and Fundamental Principles
Part 11 - EXPRESS Language Reference Manual
Part 21 - Clear Text Encoding of the Exchange Structure
Part 31 - Conformance Testing Methodology
Part 41 - Fundamentals Product Description and Support
Part 42 - Geometric and Topological Representation
Part 43 - Representation Structures
Part 44 - Product Structure Configuration
Part 46 - Visual Presentation
Part 101 - Drafting Part 201 - Explicit Drafting
Part 203 - Configuration Controlled Design

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APPENDIX D - LIST OF OTHER APS BEING DEVELOPED

Subsequent STEP releases will provide added functionality and extend the capabilities of the Initial Release. The schedule for these subsequent STEP releases has not been determined. The following Parts are currently being developed.

Part 22 - STEP Data Access Interface (SDAI)
Part 32 - Test Laboratory Requirements
Part 33 - Structure and Use of Abstract Test Suites
Part 34 - Abstract Test Methods
Part 45 - Materials Products
Part 47 - Shape Tolerances
Part 48 - Form Features
Part 104 - Finite Element Analysis
Part 105 - Kinematics
Part 202 - Associative Drafting
Part 204 - Mechanical Design Using Boundary Representation
Part 205 - Mechanical Design Using Surface Representation
Part 206 - Mechanical Design Using Wireframe Representation
Part 207 - Sheet Metal Die Planning and Design
Part 208 - Life Cycle Product Change Process
Part 209 - Design Through Analysis of Composite & Metallic Structures
Part 210 - Electronic Printed Circuit Assembly: Design and Manufacture
Part 211 - Electronic Printed Circuit Assembly: Test, Integrated Diagnostics and Remanufacture
Part 212 - Electrotechnical Plants
Part 213 - NC Process Plans for Machined Parts
Part 214 - Core Data for Automotive Mechanical Design
Part 215 - Ship Arrangements
Part 216 - Ship Molded Forms
Part 217 - Ship Piping Systems
Part 218 - Ship Structures
Part 219 - Dimensional Inspection Process Planning

LIST OF OTHER APS BEING DEVELOPED (CONTINUED)

Part 220 - Printed Circuit Assembly Manufacturing planning

Part 221 - Functional Data and Schematic Representation for Process Plants

Part 222 - Exchange of Product Definition Data from Design engineering to Manufacturing Engineering for Composite Structures

Part 223 - Exchange of design and Manufacturing Product Information for Cast

Part 224 - Mechanical products Definition for Process Planning using Form Features

Part 225 - Structural Building Elements using Explicit Shape Representation

APPENDIX E - THE STATEMENT OF WORK

ISO STEP PRODUCT LOGISTIC SUPPORT APPLICATION PROTOCOL SUITE

1.0 OBJECTIVE

The objective of the Product Logistic Support (PLS) initiative is to develop STEP (Standard for the Exchange of Product data model) standards to represent and exchange information for product logistic support to achieve the following goals: (1) to establish the information requirements to ensure reliable, maintainable, and supportable products at minimum life cycle cost by integrating data bases for Logistic Support Analysis Record (LSAR), Technical Manual (TM), Provisioning, and Order Administration; (2) to harmonize existing European AECMA (Association European des Constructeurs de Materiel Aerospatial) specifications, U.S. CALS (Continuous Acquisition and Life-cycle Support) standards, and other national and international standards in the acquisition logistic area, and (3) to meet both industrial and military requirements.

Currently, there is data duplication and overlap in the LSAR, TM (including maintenance, training, etc.), and provisioning data bases. Shared information is not prepared once and then utilized throughout each area of a weapon system program. In many cases, the organizational structure determines how the LSAR, TM, and part provisioning data are procured and developed. As a result, work is performed along traditional organizational lines, with little consideration of the processes involved. Therefore, costs for developing and updating the various data bases for LSAR, TM, and parts provisioning are high due to duplications of effort. Additionally, this could result in errors and inconsistencies between the same information in the different data bases. Development of the LSAR, TM, and parts provisioning data should be oriented to shared data elements generation and should not be oriented to product development. Ref. 59 estimates that 25% of development cost can be eliminated, if a common shared data base can be developed for LSAR, and TM.

The PLS AP Suite is designed as part of the ISO STEP standards for the implementation of a common and shared integrated information environment for LSAR, TM, parts provisioning and order administration.

2.0 SCOPE

The scope of this PLS AP suite is to define the information requirements for acquisition logistics which includes LSAR, TM, parts provisioning, and order administration.

The development of the STEP PLS AP suite shall be based on existing technical data standards and specifications. These referenced standards and specifications (see Appendix I) are:

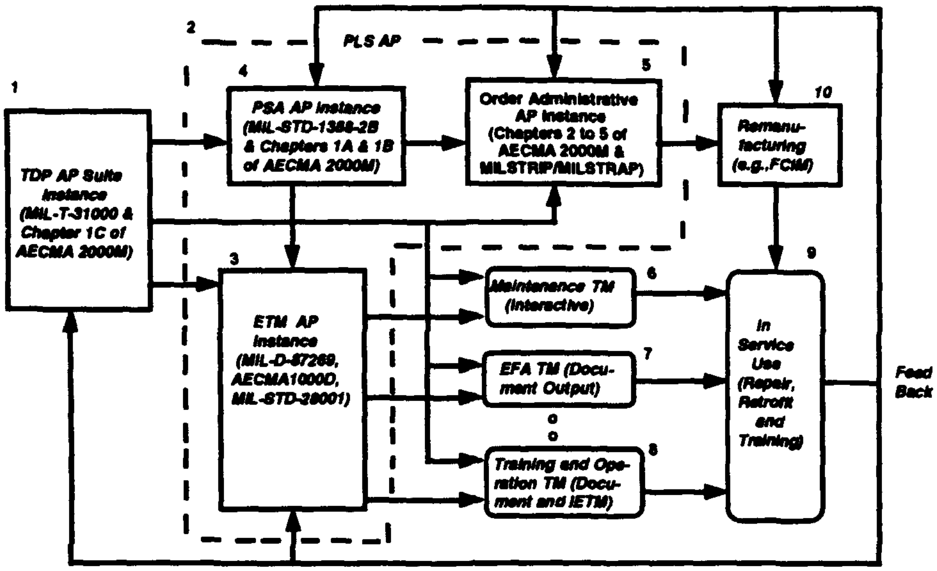
MIL-STD-1388-2B: LSAR (Logistic Support Analysis Record)
MIL-M-28001: SGML (Standard Generalized Markup Language)
MIL-D-87269: IETMDB (Interactive Electronic Technical Manual)
AECMA Spec 2000M: Material Provisioning and Management
AECMA Spec 1000D: Technical Publication
ATA Spec 100: Manufacturers Technical Data
ATA Spec 2000: Data Base and Customer Support
ISO 10744: HyTime (Hypermedia/Time-based Structuring Language)

Other standards listed below will also be referenced and studied:

MILSTRIP: Military Standard Requisitioning and Issue Procedures
MILSTRAP: Military Standard Transaction Reporting and Accounting Procedures
ATA Spec 2100: Digital Data Standards for Aircraft Support
ISO DIS 10179: DSSSL (Document Style Semantics and Specification Language)
IMPAES: Initial Multimedia Presentation and Access Exchange Specification

Because these standards were developed independently, most of them are not fully compatible with each other. An extensive effort will be needed to integrate and harmonize these standards and specifications.

Figure 8 is the currently envisioned configuration implementation. The actual configuration implementation can vary, if detailed analysis warrants. It assumes that the PLS AP suite (Box 2 of Fig. 8) includes three STEP APs (Boxes 3, 4, and 5). A more detailed description of Fig. 8 can be found in Appendix F of this report.



Legends: EFA - European Fighter Aircraft; ETM - Electronic Technical Manual; PLS - Product Logistic Support; PSA - Product Support Analysis; TDP - Technical Data Package

Fig. 8. Envisioned pilot PLS APs implementation environment.

The development of PLS AP suite consists of two development phases and one demonstration phase.

Phase I - Technical Issues Assessment and PLS AP Suite Development and Demonstration Planning

The first task is to assess each technical issue described in Appendix F of this report. Next, establish the functional view (IDEF0) of the PLS AP suite; develop key-only integratable and harmonized data models (IDEF1X) for each of the APs included in the PLS APs; develop a data element dictionary from the data models; assess the technical issues and determine any risks; then assess STEP standards (both existing and planned), as they relate to the development of the PLS APs; and determine relevant inadequacies. The final task is to prepare a plan to develop and demonstrate the PLS APs with respect to a risk/benefits analysis and technical issues assessment.

Phase II - PLS AP Suite Development

The Phase II tasks are to develop the PLS AP suite through the development of Application Reference Model(s) (ARMs), Application Interpreted Model(s) (AIMs), and conformance and test criteria (CTC); identify enhancements and proposed improvements for the STEP Community; refine preliminary activities to provide a detailed and cost effective demonstration plan; coordinate the development of the AP suite with international industry and the standards organizations to facilitate the harmonization of data standards; and submit the ARMs, AIMs, CTC, and other necessary documents to the ISO STEP organization in order to qualify the PLS APs as ISO standard(s).

Phase III - PLS AP Suite Demonstration

Phase III tasks are to demonstrate the functionality of the PLS AP suite; project the performance and analyze the potential benefits accruing from implementing the AP suite in working environments; and debrief industry and government representatives on the results and potential impact of this program. The contractor shall plan for the transfer of the technology developed by this program to industry.

3.0 TECHNICAL REQUIREMENTS

The contractor shall provide all necessary services, personnel, materials, facilities, and other items required to accomplish the following tasks and satisfy the overall program objectives.

3.0.1 Task 1 - Management Planning

The contractor shall develop and provide for program management, addressing: work plans (work breakdown structure and responsibility matrix), master schedule (critical path analysis and key milestones), subcontract management, data management, configuration management, and risk management. (CDRL Data Item)

3.0.2 Task 2 - Project Schedule and Control

The contractor shall monitor costs, work accomplishment and adherence to schedule on a monthly basis. (CDRL Data Item)

3.0.3 Task 3 - Project Coordination

Ongoing coordination is critical to PLS program success. The contractor shall establish and maintain coordination with applicable standards organizations and related programs which address similar areas of study. A list of related programs (Refs. 21 to 25), projects (Refs. 31 to 34) and reports (Refs. 51 to 59) is provided in Appendix B. The contractor shall ensure that there is maximum impact of the program and that no duplication of effort occurs. Inter-program coordination shall include the contractor's technical understanding of the program(s)' intent and the usability of the program(s)' results. (CDRL Data Item)

3.0.4 Task 4 - Technology Transfer

The contractor shall plan for the transfer of the technology developed in this program to industry and to the governments of all participating countries. The contractor shall identify the anticipated requirements for and the benefits of implementing this APs. This plan will be updated as required throughout the program and will be presented for discussion at all program reviews. (CDRL Data Item)

3.0.5 Task 5 - Industry Review Board

The contractor shall support the Industry Review Board (IRB). The IRB will provide a forum for international industry (in particular the NATO IAG, the CALS ISG, and the STEP community) to review the progress of this effort and to offer guidance. The IRB makeup shall consist of members from Project Management Board (PMB), contractors, the NATO IAG and CALS ISG, etc. The contractor shall provide all administrative support, such as preparing and providing the meeting sites, notifying the participants, moderating the meetings, and taking the meeting minutes, etc. The IRB shall meet at all review meetings specified by this program, unless otherwise noted by the PMB. IRB comments and recommendations resulting from review meetings shall be considered and acted upon when the PMB deems them appropriate. The initial composition of the IRB and changes to its composition during the course of the contract are subject to the approval of the PMB. (CDRL Data Item)

3.0.6 Task 6 - PLS AP Suite Kick-Off Meeting

The contractor shall conduct an initial meeting to discuss draft versions of the Project Master Plan and the Project Planning Chart. The contractor shall present for review the format for the Contract Fund Status Report, the Funds and Man-Hour Expenditure Report, the Contractor's Voucher, and the Scientific and Technical Reports. The contractor shall also be prepared to discuss the technical details of the contractor's proposal and the contractor team's work assignments, and coordinate efforts to accomplish the requirements of the statement of work. The initial meeting shall be held within 40 days after contract award. (CDRL Data Item)

The contractor shall not proceed with Phase I without written notice to proceed from the PMB. (CDRL Data Item)

3.1 Phase I - Technical Issues Assessment and PLS AP Suite Development Strategy

This phase shall assess and resolve all identified technical issues related to the PLS AP suite development, and also provide a plan for the development and demonstration of the AP suite to be used in Phases II, and III respectively.

3.1.1 Task 11 - Technical Issues Assessment

The technical issues crucial to the PLS AP suite development effort shall first be thoroughly analyzed and studied by the contractor. All proposed technical solutions shall be presented to and agreed upon by the IRB and then approved by the PMB before proceeding to Phase II of this contract. (CDRL Data Item)

3.1.1.1 Task 11.1 - Analyze the Scope and Configuration of the PLS AP Suite

The contractor shall develop and propose the PLS AP suite configuration implementation with respect to both Fig. 8 and Section 2 of Appendix F. The contractor shall propose the scope of the PLS APs and analyze the data flow among the APs. The contractor shall also analyze the AIA

Spec 2100 program with regard to the impact on the PLS AP suite development effort. The results of this analysis shall be presented to the IRB for comments and to PMB for acceptance. (CDRL Data Item)

3.1.1.2 Task 11.2 - Analyze the MIL-STD-1388 Enhancements

The contractor shall analyze the enhancements of MIL-STD-1388 and propose solutions. The enhancements to be investigated shall include but shall not be limited to their descriptions in Section 3 of Appendix F. The contractor shall propose technical solutions to the IRB for comments. The contractor shall implement any of the proposed solutions accepted by the IRB and approved by PMB. The contractor shall work closely with Joint Service LSA Technical Working Group. (CDRL Data Item)

3.1.1.3 Task 11.3 - Analyze the Integration Key Implementation

The contractor shall analyze the technical issues regarding the integration key and propose a solution. The investigation shall include but shall not be limited to the proposal in Section 4 in Appendix F. The contractor shall propose a technical solution to the IRB and shall implement any proposed solution accepted by the IRB and approved by the PMB. (CDRL Data Item)

3.1.1.4 Task 11.4 - Perform Functional Activity Analysis

The contractor shall develop a two-level functional analysis of the PLS APs using IDEF0 methodology. The contractor shall first collect and analyze all previous relevant material (Refs. 22, 31 to 34). The contractor shall present the IDEF0 to the IRB for comments and approval by the PMB. (CDRL Data Item)

3.1.1.5 Task 11.5 - Analyze the Integration of PSA and ETM APs

The contractor shall analyze the technical issues regarding the integration of PSA and ETM APs and propose solutions. The investigation shall include but shall not be limited to the descriptions in Section 5 of Appendix F. The contractor shall propose technical solutions to the

IRB and shall implement any proposed solution accepted by the IRB and approved by the PMB. (CDRL Data Item)

3.1.1.6 Task 11.6 - Analyze the Integration of AECMA 1000D and MIL-D-87269

The contractor shall analyze the technical issues regarding the integration of AECMA 1000D and MIL-D-87269 and propose solutions. The investigation shall include but shall not be limited to the descriptions in Section 6 of Appendix F. The contractor shall work closely with the SGML standards development organizations, i.e., the Tri-Service Working Group for IETM, the CALS ISG Electronic Publication Committee, and the ISO STEP Technical Publication Committee. The contractor shall propose technical solutions to the IRB and shall implement any proposed solutions accepted by the IRB and approved by the PMB. (CDRL Data Item)

3.1.1.7 Task 11.7 - Analyze the DTDs for the Training TM

The contractor shall analyze the technical issues regarding the development of DTDs for the training TM and propose solutions. The investigation shall include but shall not be limited to the descriptions in Section 7 of Appendix F. The contractor shall propose technical solutions to the IRB and shall implement any proposed solutions accepted by the IRB and approved by the PMB. (CDRL Data Item)

3.1.1.8 Task 11.8 - Analyze the Integration of AECMA 2000M and MIL-STD-1388-2B

The contractor shall analyze the technical issues regarding the integration of AECMA 2000M and MIL-STD-1388-2B and propose solutions. The investigation shall include but shall not be limited to the descriptions in Section 8 of Appendix F. The contractor shall propose technical solutions to the IRB and shall implement any proposed solution accepted by the IRB and approved by PMB. (CDRL Data Item)

3.1.1.9 Task 11.9 - Analyze the Integration of AECMA 2000M and MIL-STRIP/STRAP

The contractor shall analyze the technical issues regarding the integration of AECMA 2000M and MIL-STRIP/STRAP and propose solutions. The investigation shall include but shall not be limited to the descriptions in Section 9 of Appendix F. The contractor shall propose technical solutions to the IRB and shall implement any proposed solution accepted by the IRB and approved by the PMB. (CDRL Data Item)

3.1.1.10 Task 11.10 - Develop Data Models

The contractor shall develop data models for each of the proposed PLS APs using IDEF1X methodology. Each AP data model (key-only) shall be the result of the harmonization and integration of the respective data models of the standards and specifications.(Section 10 of Appendix I) All the AP data models developed shall share a common set of data elements. The contractor shall present the data models to the IRB which shall be accepted by the IRB and approved by PMB. (CDRL Data Item)

3.1.1.11 Task 11.11 - Develop Data Dictionary

The contractor shall compile a draft of a common data dictionary as a result of Task 11.11. The data dictionary shall use the format specified by DoD 8320. The data dictionary shall be presented to the IRB and approved by PMB. (CDRL Data Item)

3.1.1.12 Task 11.12 - Conduct Technical Issues Review Meetings

The contractor shall schedule and coordinate IRB meetings, at PMB approved sites, to review the results of preceding analyses. The contractor shall present the study results, proposed solutions, and implementations of the proposed solutions. The contractor's presentation shall include the minimum: any technical risk, schedule risk, implementation impact, benefit to NATO and industry, and performance factors. The contractor shall identify the factors that must be addressed and satisfactorily resolved during this program for the AP suite to be considered a success. The contractor shall respond to comments and action items that arise. (CDRL Data Item)

3.1.2.1 Task 12.1 - Assess STEP Inadequacies

The contractor shall assess and evaluate current STEP content and scope to determine the STEP capability for supporting the development of this AP suite. This process shall be a detailed continuation of the preliminary STEP assessment provided in the proposal. The contractor shall forecast the progress of STEP planned activities and emerging technologies that can contribute to and impact on this program. The contractor shall also identify the STEP inadequacies where the PLS APs needs are not supported by STEP. The contractor shall estimate the time and the cost of eliminating deficiencies from the ISO STEP standards. (CDRL Data Item)

3.1.3 Task 13 - Produce an AP Suite Development and Demonstration Strategy

3.1.3.1 Task 13.1 - Develop Criteria

The contractor shall develop a set of criteria against which the potential costs and benefits of filling each inadequacy identified in Tasks 11 and 12 can be measured in relation to NATO requirements to utilize the PLS APs. The contractor shall document the set of criteria which will include at the minimum: technical risk, schedule risk, implementation impact, benefit to NATO and industry, performance, and cost of each inadequacy elimination. The contractor shall also identify the tasks that must be completed and satisfactorily demonstrated during this program for the AP suite to be considered a success. (CDRL Data Item)

3.1.3.2 Task 13.2 - Develop the AP Suite Scope

Using the technical issues analyzed in Tasks 11 and 12, and the criteria set identified in Task 13.1 the contractor shall analyze and define the cost/benefits of eliminating each of the identified inadequacies. The contractor shall place the inadequacies in priority sequence and shall propose which inadequacies should be addressed during Phase II of this contract. The contractor shall also identify precisely the scope of this AP suite using IDEF0 methodology. (CDRL Data Item)

3.1.3.3 Task 13.3 - Plan AP Suite Development

Based upon the results of the scoping activities (Task 13.2), the contractor shall provide a plan for the definition of functional needs through the development of an AP suite. This approach shall be documented in terms of a planning model. The contractor shall highlight the incorporation of other STEP related models under development by other organizations and the methodology for harmonizing these efforts, if applicable. (CDRL Data Item)

3.1.3.4 Task 13.4 - Plan AP Suite Data Transferring Demonstration

The contractor shall propose a plan for the Phase III demonstration. The data necessary for population of the data base instantiated with the APs shall be provided by the contractor, after approval by the PMB through the contracting officer. The demonstration planning shall be designed but will maintain sufficient flexibility. At the minimum, the demonstration shall include exchange in a heterogeneous environment such as a prime contractor to subcontractor exchange and a prime contractor to NATO exchange. Potential AP suite implementation issues/impediments shall be documented with an assessment. (CDRL Data Item)

3.1.4 Task 14 - Critical Review of End of Phase I

The contractor shall conduct an end of Phase I review at a PMB approved site. The results of all technical analyses of Phase I shall be presented. Particular attention shall be focused on the following: analysis of technical issues, identification of all risks, risk mitigation plans, AP suite development planning, and demonstration planning. The contractor shall resolve comments and action items that arise. The contractor shall update the estimated time and costs for each task in Phases II and III. The results of this review will form the basis for the PMB to determine whether or not to recommend that the contractor proceed with Phase II. The contractor shall not proceed with Phase II without written notice from the PMB. (CDRL Data Item)

3.2 Phase II - PLS AP Suite Development

This phase shall provide for the development and specification of required models, as well as the mappings and test criteria needed to support the functionality resulting from Phase I.

3.2.1 Task 21 - Develop Application Reference Model (ARM)

The contractor shall develop a human interpretable user view of the application dependent information needs and specify them in the form of an ARM. (CDRL Data Item)

3.2.1.1 Task 21.1 - Develop AP Suite Scope and Content

Based on the results of Phase I, the contractor shall refine the scope and content of the AP suite. This shall include an IDEF0 activity model of the selected activities to be supported. (CDRL Data Item)

3.2.1.2 Task 21.2 - Develop ARMs

The contractor shall develop a set of human interpretable ARMs from an end user's viewpoint, which delineate the information needs of the AP suite scope from 3.2.1.1. The ARMs shall be documented using the IDEF1X structured modeling technique. (The contractor may make a written request to the PMB to consider using other graphical modeling techniques, such as NIAM or EXPRESS-G, in place of IDEF1X.) User context driven test and validation criteria for the ARMs shall be specified. (CDRL Data Item)

3.2.1.3 Task 21.3 - Review ARMs

The contractor shall conduct a meeting, at a PMB approved site, to review the results of work performed under Sections 3.2.1.1 and 3.2.1.2. The contractor shall resolve comments and action items that arise. (CDRL Data Item)

3.2.2 Task 22 - Develop AIM

For each ARM identified in Section 3.2.1.3 the contractor shall develop a complete, detailed computer interpretable AIM.

3.2.2.1 Task 22.1 - Information Model Development

The contractor shall develop a complete information model of the information needs identified by the ARM. Suitable STEP constructs already defined in the Integrated Resources Model (IRM) shall be used whenever possible. Additional constructs needed to fill the identified inadequacies shall be developed. (CDRL Data Item)

3.2.2.2 Task 22.2 - Review ISO/STEP

As an aid to technology transfer, the contractor shall conduct a meeting with the ISO/STEP organization to review potential IRM shortcomings (both entity and methodological) and any additional information constructs developed in Section 3.2.2.1. (CDRL Data Item)

3.2.2.3 Task 22.3 - Document AIM

The contractor shall document the AIM developed in Section 3.2.2.1 by means of the EXPRESS language. Two models shall be specified. The first is a Short Form model consisting of an EXPRESS mapping from the IRM and the additional constructs needed to support the APs. The second is an Expanded Model resulting from applying the mapping. The Expanded Model shall be completely interpretable and understandable without reference to the IRM documentation. (CDRL Data Item)

3.2.3 Task 23 - Develop Test and Conformance Criteria

The contractor shall develop and document conformance criteria, tests, and demonstration scenarios for each AIM and ARM. Demonstration scenarios for the purpose of evaluating the AP suite against the conformance criteria and the validation criteria identified in Section 3.2.1.2 shall be developed. The test criteria shall be developed first for the LSAR, AECMA SPEC 2000M (Chapter 1), and IETMDB views. (CDRL Data Item)

3.2.4 Task 24 - Review Application Protocol Suite

The contractor shall conduct a meeting, at a PMB approved site, to review the results of Phase II. The contractor shall resolve comments and action items that arise. Any resulting changes in the AP suite specifications shall be documented for PMB approval. The results of the review, coupled with detailed analyses of how the ARM, the AIM, and the Test Criteria synergistically combine to form the AP suite specifications will form the basis of the PMB recommendation on whether or not to proceed with Phase III. Cost, benefit, and risk analyses supporting demonstration decisions shall be performed as a function of the demonstration scenarios (Section 3.1.3.4). The contractor shall not proceed with Phase III without written notice to proceed from the PMB. (CDRL Data Item)

3.3 Phase III - PLS AP Suite Demonstration

This phase shall demonstrate and validate the application protocol suite developed in Phase II.

3.3.1 Task 31 - Refine Demonstration Planning

Based upon the information provided during the Application Protocol Suite review (Section 3.2.4), the contractor shall refine the demonstration plan (Section 3.1.3.4) as required to ensure that the latest version of the AP suite is demonstrated and validated in a cost effective manner. (CDRL Data Item)

3.3.2 Task 32 - Demonstrate the PLS AP Suite

The contractor shall demonstrate the APs developed in Phases I and II. The demonstration shall be executed according to the plan developed in Section 3.1.3.4 and refined in Section 3.3.1. Demonstration results and any necessary changes to the AP suite specifications shall be documented. (CDRL Data Item)

3.3.3 Task 33 - Final Analysis of Program Performance and Benefits Analysis

The contractor shall collect data about the PLS AP suite performance from the results of the demonstration. The contractor shall address the potential for AP suite related implementations for logistic support and shall analyze business case requirements for the implementation of this and other AP suite programs. (CDRL Data Item)

3.3.6 Task 36 - Capture the Product Data for the Demonstration

The product data for the demonstration shall be captured. (CDRL Data Item)

4.0 DELIVERABLE

4.1 Data requirements shall be strictly in accordance with DD Form 1423, Contract Data Requirements List.

5.0 SPECIAL CONSIDERATIONS

5.1 Industry/Government Debriefing. The contractor shall conduct a debriefing subsequent to completion of the technical effort. The purpose of the debriefing shall be the transmission of the salient results of this program in a timely manner to appropriate representatives from industry and government. Feedback from this debriefing shall be solicited and documented as appropriate. The contractor shall develop a professional quality display board and a professional quality video tape which illustrate the program's history, phases, findings, conclusions, and benefits. (CDRL Data Item)

5.2 Environmental Impact. The contractor shall assess the environmental consequences of the concepts being developed from the standpoint of the program. (CDRL Data Item)

This draft SOW was reviewed and enhanced at the CALS/CE ISG SALSA third quarterly technical working group meeting on 2 September 1993 with the following attendees:

Ellis Atkinson	LOGSA
Peter Bergmann	Deutsche Aerospace/AECMA, Germany
Ruey Chen	Naval Surface Warfare Center
Sandra Facon	Northrop Corporation
Dane Gayle	Airoliv, Inc., U.S.
Michael Hurn	Texas InstrumentsCorporation
Lisa Kove	Joint Logistic System Center

CALS/CE ISG SALSA COMMITTEE (CONTINUED)

Tom Kulik	McDonnell Douglas Corporation
John McLaughlin	Lockheed Company (Forth Worth)
Tom Parker	Defense Logistics Agency
Gary Smith	Joint Logistic System Center, U.S.
Nick Smith	Alliant TechSystems, U.S.
Garry Waters	AF Space System Division

Additional participants at the SALSA fourth quarterly working group meeting, held on 2 November 1993 (CALS Expo '93), include:

John Bean	Northrop Corporation
Hobest L. Bienvenu	Ministry of Defence, France
Bobby Chin	Battelle
Bernard Dumez	GAT Industries, France
James A. Hayes	Lockheed ASG
Jarl S Maguusson	Defence Department, Sweden
Alan Peltzman	OSD/DISA CFS
Rene J. Pistenon	Ministry of Defence, France
Michel Rodriavez	AEROSPATIALE, France
Yuri Rubinsky	Soft Quad Inc., Canada
Mick Smith	Ministry of Defence, Army, UK
Davis R. Watts	Ministry of Defence, Army, UK

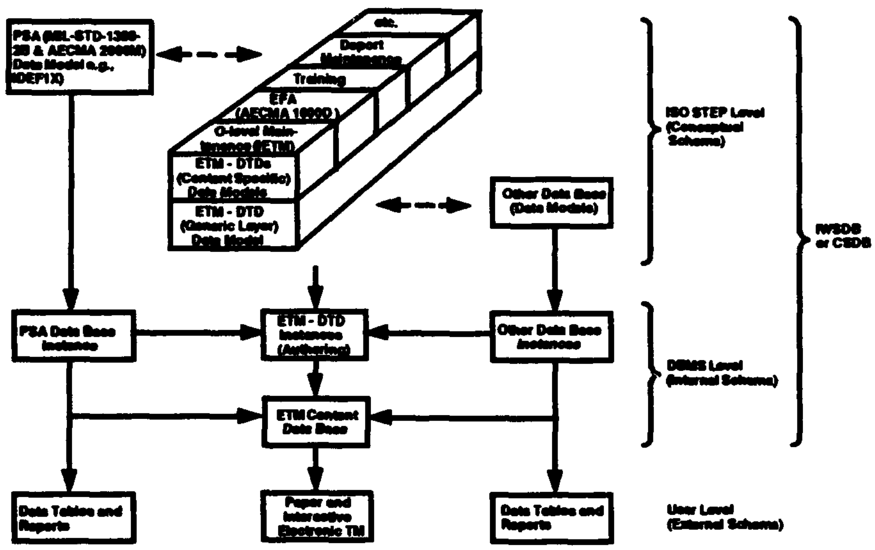
APPENDIX F - TECHNICAL ISSUES

In the development of the STEP PLS AP suite, there are many technical issues that need to be understood, analyzed, agreed upon, and resolved. The technical issues crucial to the PLS AP suite development include the following:

1.0 DATA MODELING AND DATA MODEL INTEGRATION

The most critical aspects of any modern information system's methodology are: specifying the user's information requirements, validating these requirement specifications, and converting them into data base designs. Conceptual data modeling has been used to fulfill these needs. Conceptual data modeling is becoming one of the most powerful techniques for establishing and maintaining control over information resources. Data models are used to represent conceptual schemes and to help integrate the information resources.

Figure 9 shows how the logical (conceptual scheme) view of data can be mapped to the various physical DBMS data base structures (internal schemes) as they are identified, implemented, and mapped to the user views (external schemes). Integrating large data resources without using data models can be very difficult.



Legends: CSDB - Common Source Data Base; DTD - Data Type Definition; EFA - European Fighter Aircraft; ETM - Electronic Technical Manual; IWSDB - Integrated Weapon System Data Base; PSA - Product Support Analysis

Fig. 9. Integration of PSA, ETM and other data models.

The CALS approach to integrating technical data information systems requires an integrated conceptual data model to control and coordinate all of the technical information systems supporting a weapon system. This concept of an integrated data model (which will include a logical collection of shared data models to support all technical information system users) is called the CALS IPDB (Integrated Product Data Base) / IWSDB (Integrated Weapon System Data Base) or Common Source Data Base (CSDB) which will provide the basis for the integrated shared data environment. The development of the ISO STEP/PDES standards will enable information systems to use a standardized digital representation (data models) for product data. It will provide a complete, unambiguous, digital definition of the physical and functional characteristics of each element/part of a product throughout its life cycle.

The challenge in developing this PLS AP suite is the development of integratable data models based on the existing data standards and specifications which, in most cases, are not compatible with each other.

2.0 PLS AP SUITE IMPLEMENTATION ENVIRONMENT

The following paragraph describes the contents of Fig. 8:

Box 1 - Technical Data Package (TDP) APs: This box represents the STEP TDP APs which will provide product definition input such as engineering drawing, graphics, bills of material, etc. The proposed TDP AP suite being developed is based on MIL-T-31000 to meet DoD and industry requirements on the transferring of technical data packages. Chapter 1C of AECMA 2000M (for preparing the IPC) should be harmonized with MIL-T-31000.

Box 2 - PLS AP Suite: The PLS AP suite will include at least three APs (Boxes 3, 4, and 5).

Box 3 - Electronic Technical Manual (ETM) AP: This is the harmonization of MIL-D-87269 and AECMA 1000D. See Section 6 of this appendix for a detailed description.

Box 4 - Product Support Analysis (PSA) AP: This is the harmonization of MIL-STD-1388-2B and Chapters 1A and 1B of AECMA SPEC 2000M. See Section 8 of this appendix for a detailed description of this AP.

The PSA AP is a proposed STEP AP which was submitted to ISO STEP in September 1993 for approval. This is the result of a year-long effort on the part of the Product Life Cycle Support technical committee of the IGES/PDES Organization to produce this proposed PSA AP. The development of this PSA AP is also the first attempt to introduce existing DoD military data standards into the ISO STEP/PDES community.

Box 5 - Order Administration AP: This is the harmonization of MILSTRIP/STRAP and the Procurement Planning, Order Administration, and Invoicing sections of AECMA 2000M (Chapters 2 to 5). See Section 9 of this appendix for a detailed description of this AP.

Boxes 6, 7 and 8 - These three boxes represent various forms of TM output from the ETM AP instance.

Box 9 - This box represents the in-service use of the maintenance and training TMs.

Box 10 - Manufacturing or remanufacturing

3.0 ENHANCEMENT OF MIL-STD-1388

The NATO Harmonization Assessment Workshop in Acquisition Logistics Standards (Ref. 51) recommended that the scope of MIL-STD-1388 be expanded to include the following functions. The introduction of these processes may require additional data elements.

a. Logistic Support Analysis for Software

The majority of product or weapon systems used in an integrated weapons platform require the use of software. However, there appears to be no process described in MIL-STD-1388-1A that requires an LSA type of process to be applied to software design to enable the inclusion of supportability features. The principles of the LSA process can be applied to software and it is therefore considered feasible that support analysis for software can be achieved.

b. Equipment Disposal and Recycle Analysis

The disposal, decommisioning (demilitarizing), and recycling aspects of equipment constitute an important life cycle phase with regard to the determination of support analysis. The present MIL-STD-1388-1A tasks do not directly address the identification of disposal tasks and leave much of the interpretation to the reader. In any event, recycle analysis is not considered. The various aspects of disposal, decommisioning, and recycle analysis would be better defined in terms of specific sub-tasks describing the requirements for identifying the associated logistic support requirements.

c. Surge Production

Certain equipment items can become critical because of increased need in times of crisis. The existing Tasks in the 303 and 401 series of MIL-STD-1388-1A can be interpreted as identifying those logistic support requirements resulting from a change in rate of utilization. This gives rise to the requirement for surge production of critical items in response to operational needs.

d. Candidate Item Selection Procedure

LSA is carried out on items that are considered to be maintenance significant. Customer and contractor generated lists of candidate items which have already been written in both the LSA Strategy and LSA Plans. The procedure of selection criteria for identifying candidate items should be described in greater detail.

e. Reliability and Maintainability

To ensure that the delivered weapon system is both reliable and logistically supportable in the field, a common means of tracking failures during and after the system is built is a primary requirement. Failure Reporting and Corrective Action System (FRACAS) requirements were originally defined in MIL-STD-2155. In today's digital environment, this standard is nearly obsolete.

Most Failure Modes, Effects and Criticality Analysis (FMECA) information is based on theory. By including Failure Reporting and Corrective Action System (FRACAS) data in the LSAR data base, theoretical part failures can be compared against actual part failures. Additionally, malfunctions can be identified for verification of initial LSAR data.

Reference 61 recommends that FRACA reporting become a part of the MIL-STD-1388-2B data base capabilities. MIL-STD-2155 should be enhanced to directly support data collection within the LSAR data bases.

4.0 INTEGRATION KEY

The activities of engineering design, LSA, technical documentation, and initial provisioning need a mechanism to provide an integrated cross reference capability. A single integration key is needed to cross reference each technical subject area.

The NATO Standard Harmonization Workshop (Ref. 51) recommends the development of a relational data table (data model) to define an integration key. The base control value for each record of the relational table is its LCN/ALC combination. This relational table can be used to cross reference the design engineering control number, the logistics LSA control number, the IP project number, and the technical documentation control number. For example, the LSA control number can be built on the structure of the LSA/ALC and LSAR's Task Code.

This approach does not require the development of any new data elements, but rather uses a management activity to align and normalize the data between functional activities. Other technical disciplines can be added to the table without changing the existing structure or any existing relationships.

5.0 INTEGRATION OF THE PSA AND ETM APS

Figure 9 shows the envisioned integration of the PSA, ETM, and other related data models in the ISO STEP environment.

The benefits of integrating the LSAR with ETM data bases are well known (Refs. 56 to 59). Some companies have experienced a cost reduction of more than 25 percent in ETM authoring by integrating the LSAR and ETM data bases to improve the LSAR and ETM authoring processes.

A common practice of ETM development is to first develop the related LSAR data base and then use it as source data in authoring a ETM. A preferred procedure for ETM development is to combine the two processes into one process which requires the integration or alignment of the LSAR and IETMDB data bases. This one step process can considerably diminish ETM development time and cost and also greatly enhance quality and productivity.

The main concern of this PLS program is the two levels of integration shown in Fig. 9. The oblong rectangular shape in Fig. 9 represents the first level of integration. It addresses the integration of various SGML ETM DTDs (data models). The second level addresses the integrated ETM DTDs with PSA (based on MIL-STD-1388-2B and AECMA 2000M) and other related data models.

For example, with regard to the first level of integration the O-level maintenance DTD (based on MIL-D-87269) and the EFA DTD of AECMA 1000D are not compatible with each other. Detailed discussions of the harmonization of these two DTDs can be found in Section 6.

With regard to the second level of integration, the PSA and the ETM DTD data models were developed independently. Adjustment and alignment of these two sets of data models will be required to make them compatible at the conceptual scheme level.

The PSA and ETM data models should become the major components of both the CALS IPDB/IWSDB and AECMA CSDB.

6.0 INTEGRATION OF AECMA 1000D AND MIL-D-87269 (IETMDB)

AECMA 1000D is designed for use within the European aerospace industry to acquire format-free technical information in the form of standardized data modules (DMs) for the creation and updating of technical documents on different media. The DM is loaded into a Common Source Data Base (CSDB) via SGML DTDs. AECMA 1000D allows an entire ETM or any required single DM (a part of the document) to be exacted from the CSDB. The AECMA 1000D is currently being expanded to allow production of ETMs and IETMs.

On the other hand the MIL-D-87269 (IETMDB) specification, as a U.S. DoD supported effort, specifies the requirements for an interactive electronic technical manual data base (IETMDB) for the purpose of creating an interactive electronic technical manual. The MIL-D-87269 specification contains a comprehensive set of SGML generic data element structures such as text, graphics, audio, video, and links to external processes. This external link provides capability for users to access and interact with the data base content through the electronic display screen. MIL-D-87269 was not developed for paper publications.

Each of these two specifications contains a DTD based on the same ISO 8879 (SGML) specification for a neutral data base. However, these two DTDs are different because they were designed for different Technical Documentation structures. The AECMA 1000D DTD was designed to follow MIL-M-28001 as close as possible. For ETM and IETM within the AECMA 1000D environment, MIL-D-87269 is used as a basic reference document. Incompatibilities will be reported.

MIL-D-87269 does not require the Format Output Specification Instances (FOSIs) of MIL-M-28001 to provide machine-interpretable output processing information for printing or interactive electronic delivery. On the other hand, MIL-M-28001 does not enforce the development of a content-tagged and nonduplicative data base as does MIL-D-87269. MIL-M-28001 instead relies on the DTD to address these requirements.

Th AECMA 1000D and MIL-D-87269 specifications should be made compatible so that any presentation/delivery systems can use either data base. The obvious approach appears to be combining these two specifications into a single one. It would specify the development of flexible, neutral, content-oriented, and nonduplicative SGML data bases. It could use HyTime

(Ref. 18) and DSSSL (Ref. 19) to enable the output systems to provide both interactive electronic and printed media.

The CALS/ISG Electronic Publication Committee (EPC) is investigating the incorporation of IETM concepts and guidelines into MIL-M-28001. (Refs. 35 to 38, and 51)

7.0 DTDS FOR THE TRAINING MATERIAL

The costs of providing separate hardware and software systems for ETMs, computer-aided training (CAT) and automatic/electronic test (ATE) equipment are high. In many instances, space is not available for separate systems. There are currently no CALS specification which enables the electronic integration of ETMs, CAT, and ATE. Ref.erence 59 suggests that a list of data elements be provided for training material development. A set of SGML generic data element structures and DTDs for the training material should be developed as shown in Fig. 9.

8.0 INTEGRATION OF AECMA 2000M AND MIL-STD-1388-2B

AECMA 2000M was prepared for military aircraft systems. Its scope is limited to the material management process, because it addresses processes and data related to parts provisioning, i.e., initial provisioning, initial provisioning list (IPL), illustrated parts catalogues (IPC), procurement planning, order administration, and invoicing.

MIL-STD-1388-2B (LSAR) and AECMA 2000M are mutually complementary in scope and focus. Because LSAR collects its data as part of the system engineering management process, the resultant LSAR data base could conceivably provide the spareable item data required by 2000M for the Initial Provisioning Lists (IPL) and Illustrated Parts Catalogues (IPC) construction.

In recent years, several studies concerning the the harmonization and alignment of data elements corresponding to these two standards have been conducted.

A detailed study has been conducted by the Military and Industry AECMA MSWG 2000M and LSA study group to analyze the overlap between AECMA 2000M (Chapter 1) and MIL-STD-1388-2B. (Ref. 53)

The UK Ministry of Defence Standard 00-60 has also compared the data elements of AECMA 2000M (Chapter 1) and MIL-STD-1388-2B, and has created a UK LSA data dictionary (Ref. 54). This dictionary contains harmonized MIL-1388-2B and AECMA 2000M DEDs and additional 2000M DEDs where harmonization could not be achieved.

The CALS ISG/SALSA committee has also analyzed and compared the data elements of AECMA 2000M and MIL-STD-1388-2A/2B. (Ref. 55)

9.0 INTEGRATION OF AECMA 2000M AND MILSTRIP/MILSTRAP

The data requirements for the preparation of the procurement package for the Order Administration AP will include the Provisioning Technical Package (PTD) which will be provided by the PSA AP (Box 4 in Figure 8) and Engineering Data for Provisioning (EDFP) which will be provided by the TDP AP (Box 1 in Fig. 8).

This Order Administration AP is the result of the integration of the Provisioning Planning, Order Administration, and Invoicing of AECMA 2000M with MIL-STRIP/STRAP.

The functionality of MIL-STRIP/STRAP overlaps that of AECMA 2000M to a great extent. Except for stock replenishment modeling, both standards control the material flow/demand between a contractor and a customer. By redefining the roles of and the related data for both customer and contractor on an operative functional level, both standards can be harmonized.

10.0 DATA DICTIONARY

After the various data models (Boxes 3, 4, and 5) have been developed and integrated, a consistent data element dictionary which encompasses all the data models will be a natural output. DoD 8320.1-M-1 (Ref. 15) should be regarded as the guiding document for the development of this data element dictionary.

APPENDIX G - RELATED ACTIVITIES

1.0 HARMONIZATION WORKSHOP:

The internationalization of CALS took a major step forward with the completion of the Acquisition Logistics Standards Harmonization Assessment Workshop sponsored by the NATO Armaments Committee 301 Subgroup D on CALS. The workshop was chaired by the UK delegate to AC 301 and was hosted by France in March and April 1993. The workshop addressed the following elements of Acquisition Logistics: (a) Logistic Support Analysis (LSAR); (b) Provisioning; (c) Order Administration; (d) Technical Documentation ; and (e) EDI. Some fifty members participated, drawn from France, Germany, Italy, Spain, the United States, and the United kingdom.

The major standards considered were the U.S. military standards MIL-STD-1388/1A and 2B, MIL-M-87268, MIL-D-87269, and MIL-Q87270 as well as AECMA Spec 2000M, and AECMA 1000D. The workshop also considered the business process in the context of EDI and examined ANSI X.12, EDIFACT, and the EDI elements of Spec 2000M. The core CALS standards of MIL-STD-1840B and the MIL-X-28000 series of specifications completed the scope of this study.

The workshop found out that it is technically feasible to harmonize and integrate these existing standards and specifications to enable NATO to exchange data for CALS. The process and data requirements examined were also seen to have applications for dual civilian and military use. It is recommended that the standards and specifications discussed evolve into a consistent set of international standards, such as the ISO STEP standards. For more detailed information, see Ref. 51.

2.0 NIAG CALS STUDY

Following a DoD CALS presentation to NATO in early 1989, the NATO Industry Advisory Group (NIAG) decided to undertake a formal study to determine a policy fostering the development and implementation of CALS standards and methods for all NATO countries.

More than forty technical experts from Europe and Canada were invited to participate in this study. The study began in late 1990 and ended in October 1991. The report produced by this study is "A NATO Industry Advisory Group Report on the Applicability of CALS to the NATO countries" (Ref. 52). The study was performed by four teams: (1) CALS technical standards, (2) CALS functional aspects, (3) network infrastructure, and cost benefit analysis. Some of the recommendations of this report are:

a. NATO should respond positively to the U.S. DoD CALS initiative, and should also develop a strategy which promotes a CALS-style concept within the defense agencies of all NATO countries.

b. NATO should actively seek an agreement between Europe and the U.S. to publish, maintain, and promote a single comprehensive set of standards to support the CALS-type philosophy.

c. Because the implications of CALS are t[illegible]obal, NATO standards should be regarded as forerunners to comprehensive ISO standards which will support both defense and commercial applications.

d. European collaborative projects should be selected as lead demonstrations.

e. The procurement policies of various NATO countries should be reviewed.

f. A NATO recommendation for a standard generic concurrent engineering model should be developed.

g. A standard set of ILS requirements should be developed.

h. A standardized breakdown of project phases into standard tasks and data sets should be developed.

i. CALS-type education should be actively supported.

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APPENDIX H - RELATED STEP AP DEVELOPMENTS

1.0 PRODUCT SUPPORT ANALYSIS AP

An ISO STEP Product Support Analysis (PSA) AP is being proposed to define the data requirements for ensuring reliable, maintainable, and supportable products at minimum cost by integrating logistic support considerations into the evolving design, manufacturing, and support efforts. The development of the PSA AP suite is based on the harmonization of the U.S. military standard MIL-STD-1388-2B (LSAR) and European specification AECMA 2000M. MIL-STD-1388 has been required for DoD equipment procurement since 1983.

Due to the increasing complexity of product design and the associated maintenance requirements, it is essential that the product's supportability characteristics be incorporated into the product's design and also that the associated maintenance support be developed on an integrated basis. Operational and maintenance support requirements should be planned as early as possible and be integrated into the total engineering design effort. This approach ensures the optimum balance between the product's performance and its associated maintenance support services. To achieve these objectives, a n integrated data base is required to integrate logistics related engineering information. The PSA AP is proposed to meet these needs. The PSA AP process is a structured methodology used by systems engineering to identify the supportability characteristics. The PSA AP facilitates the early identification of the supportability characteristics in the design and subsequent integration.

International commerce and government industries do not at present have a standardized mechanism to exchange product logistic support information. These industries have a strong need to communicate supply support or provisioning information. Today's "Just in Time" support environments depend upon the rapid procurement of parts and supplies. This need requires that the communication of procurement requirements be integrated with an organization's product definition data base. Such communications are currently performed in a manual and paper fashion that is very time consuming, error prone, and labor intensive. A more cost effective means is needed to address the following:

- The maintainability and supportability analysis of the product.
- The maintenance tasks required to support the operation of the product.
- The skills and training required to support the maintenance of the product.
- The parts, material, special tools, and equipment required to support the maintenance of the product.
- The technical publications required to support the maintenance of the product.
- The transportation, facility, packaging, and preservation to support the product.
- The recyclability and/or disposal of the maintained product and its by-products.

2.0 TECHNICAL DATA PACKAGE AP

The purpose of the Technical Data Package (TDP) AP is to define the common set of requirements for the operation and life-cycle support functions for DoD weapon systems. These functions include: (1) re-procurement, (2) re-manufacturing, (3) retrofit/modification, and (4) repair as representative functions from which a set of common needs could be derived. This initial TDP AP scope will exclude requirements for technical manuals, and engineering analysis.

Based on these DoD weapon system requirements, the initial focus will fall primarily into three major categories: (1) structural (e.g., mechanical parts, assemblies, etc.); (2) electronics; and (3) electrical components. The MIL-T-31000, MIL-STD-881A, MIL-STD-1840, and MIL-D-28000 are major standards of defining the content, delivery, and representation for technical data on DoD weapon system procurement. The TDP AP will support the structure and basis requirements of these military standards.

This TDP AP is sponsored by the DoD CALS/CE office, AF F-22 program office, and AF ManTech program office. This program is managed by NIST.

APPENDIX I - REFERENCED STANDARDS AND SPECIFICATIONS

1.0 MIL-STD-1388-2B: LSAR (LOGISTIC SUPPORT ANALYSIS RECORD)

The intent of MIL-STD-1388-1 is to ensure reliable, maintainable, and supportable weapon systems at minimum cost by integrating logistic support considerations into the evolving design effort. It is a dynamic, real-time interactive process requiring concurrence of the design, engineering analysis, and product support planning functions. As a result, addressing logistics requirements becomes part of the design process, rather than occuring after design decisions that excluded support requirements have been made.

MIL-STD-1388-2B defines the format and content of the LSAR and the structure of various standard reports that deliver data in digital form. It consolidates logistics oriented technical information with data from the various engineering disciplines and integrated logistic support elements to reduce redundancy, facilitate timely usage, and promote consistency of data elements from the various disciplines.

The MIL-STD-1388-2B data are organized in a relational data base format. The use of relational DBMS and tables offers many benefits, among which are ad hoc report generation and a more practical method of on-line access. Because the MIL-STD-1388-2B data base is already logically integrated, the use of other software tools as well as linkage with other related engineering data bases is encouraged. For detail information, see Ref. 2.

2.0 MIL-M-28001: SGML (STANDARD GENERAL MARKUP LANGUAGE)

The MIL-M-28001 military specification is the DoD implementation of the ISO 8879 SGML and establishes requirements for the digital interchange of technical publication text. Data prepared in conformance to MIL-M-28001 will facilitate the automated storage, retrieval, interchange, and processing of technical documents from heterogeneous data sources.

MIL-M-28001 defines both a methodology and a high level computer language for document representation. It provides coherent and unambiguous grammar and syntax for describing what a user chooses to identify within a document. Regardless of the type of document or the nature of the document's text, it provides a formal markup procedure, that is also independent of the system and output environments used for this purpose. The definition of the document's structure or content in terms of elements, their attributes, entities, and other components is called a "Document Type Definition" (DTD). A DTD defines the structure or content of a specific class of document. For detail information, see Ref. 4.

3.0 MIL-D-87269: IETMDB (INTERACTIVE ELECTRONIC TECHNICAL MANUL DATA BASE)

The MIL-D-87269 military specification defines requirements for the weapon system related data base from which IETMs or view packages are to be constructed. The data base elements are defined using SGML.

IETMs are the paperless functional equivalent of conventional paper based TMs and will ultimately replace some of those paper TMs in the field. This specification provides guidance for the acquisition of IETMs and associated support data bases by a DoD program manager. The extent to which automated access and presentation techniques are utilized in IETMs is such that this CALS specification will not be a simple extension of the paper-based TM specifications, but will be a new category of specification in the CALS program. For detail information, see Ref. 3.

4.0 AECMA SPEC 2000M: MATERIAL PROVISIONING AND MANAGEMENT

By using uniform formats in providing weapon system related logistics data, the AECMA Specification 2000M defines the materiel management processes and procedures to be used in support of aircraft and other aerospace airborne, and ground equipment supplied to military customers. Specification 2000M is the equivalent of ATA 2000 and parts of ATA 100 which are used to support airline aircraft. Although the ATA Spec 2000 was used as a basis for the AECMA 2000M development, different military policies and requirements prevented the European military adoption of the civil specification. Nevertheless, the development of a single common specification for both military and civilian use remains the ultimate goal of AECMA and ATA.

Spec 2000M covers the procedures related to:

a. Provisioning - defines the process and specifies the data, formats and transmission procedures to be used in providing provisioning information to the customer. It provides the data base from which Illustrated Parts Catalogues are produced.

b. NATO codification - defines the processes and information flow for all activities related to Codification.

c. Procurement Planning, Order Administration, and Invoicing - defines methods for industry to provide part information for sale and quotation processes, as well as order placement and deliveries. It also provides a standard process of transmitting invoice data.

d. Information Exchange - covers the exchange of spares consumption data between customers and industry as well as the transmission of repair arising forecast information.

For detail information, see Ref. 5.

5.0 AECMA SPEC 1000D: TECHNICAL PUBLICATION

The AECMA Specification 1000D has been produced to establish standards for technical documentation of air vehicle or associated equipment and to provide a definition of an information data base. The data base is intended to provide source information for compilation of the data required for technical documentation. It is referred to as the Common Source Data Base (CSDB).

Specification 1000D covers technical publications for air vehicle projects with the exception of Illustrated Parts Catalogues which are addressed by AECMA 2000M specification.

It is intended that this specification will be a common specification used by manufacturers and customers for both civilian and military air vehicles. In addition to this primary purpose, the Spec 1000D is planned to expand to land and sea systems.

Specification 1000D has already been stipulated in European procurement specifications, such as the European Fighter Aircraft. Data modules for the aircraft have been coded in SGML and illustrations to CALS base standards. DTDs use the tag set defined in MIL-M-28001, with necessary extensions and modifications. See Ref. 6.

6.0 ATA SPEC 100: MANUFACTURERS TECHNICAL DATA

The ATA Spec 100 establishes standards for the presentation of certain aircraft, engine, and component manufacturing data required for support of such products. While these standards are not mandatory per se, they become mandatory to the extent that they are incorporated into the purchase agreements between the individual suppliers and between individual suppliers and operators. These standards are intended to minimize the cost to and effort expended by operators to make the manufacturer's data compatible with the needs of their mechanics and other support personnel. See Ref. 26.

7.0 ATA SPEC 2000: DATA BASE AND CUSTOMER SUPPORT

The ATA Spec 2000 is an international specification covering procurement transactions for aircraft material acquisition, as well as support and repair activities which enable airlines and their suppliers to exchange information, using a common language. Its purpose is to provide cost-effective, state-of-the-art methods usable by the widest possible population of companies. More specifically, Spec 2000 covers initial provisioning, spares procurement, order administration, invoicing, inventory forecasting, performance reporting, repair administration, and bar coding. See Ref. 27.

8.0 ISO 10744: HYTIME (HYPERMEDIA/TIME-BASED STRUCTURING LANGUAGE)

HyTime is a structured language for representing the logical structure of documents with requirements for space and time based coordinates and addressing. HyTime is based on SGML (ISO 8879), and uses the grammatical and syntactical conventions of SGML. HyTime provides the capability to package information objects using a standardized markup language whose structure will enable nonsequential access, querying, version control, and long-time maintenance despite system evolution or migration.

The HyTime language can be directly applied to hypertext and multimedia applications. These include the design and encoding of information for IETMs, online review of existing documents both in and not in neutral formats, and the creation of large interoperable hyperdocument libraries or design data bases. See Ref. 18.

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