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Volume I

Architecture Survey Analysis by CSA Initiative

Final Report

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1. Introduction

1.1. Corporate Systems Architecture (CSA) Initiative

Many organizations, in industry and government, face challenges in information management similar to the Federal Aviation Administration (FAA). The objective of the Architecture Survey is to enable the FAA to build upon the experience and technical contributions of organizations that have already invested heavily in enterprise-wide Information Technology (IT) strategies.

CSA Objectives

The FAA CSA Initiative is intended to serve as a framework and vehicle for improved information systems within the FAA. Among the goals of the CSA are:

- Enterprise-wide IT Management - Achieving consistent implementation of enterprise-wide policy for information and information systems.
- Interoperability - Enabling individuals and organizations (and the systems they depend on) to share information without unnecessary impediments.
- Enhanced data quality and access - Improving data accuracy, timelines, availability, and consistency through implementation of data policies, standards and tools.
- Improved and modernized Mission/Business Processes - Enhancing the effectiveness of core business processes to meet mission goals at reduced cost.

Corporate Information Environment (CIE) Initiatives

The aim of the CSA Initiative is to create a CIE that will enable the FAA to realize these goals and enhance its value to the public and its industry partners. The requirements of the CIE have been defined in relation to six CIE Initiatives:

- **Core Architecture** - This initiative provides a framework for FAA standards, a migration path toward the Open Systems Environment (OSE), and support services for meeting those objectives.
- **Business Process Improvement (BPI)** - This initiative supports improvement of business processes through re-engineering and more effective use of IT to achieve FAA mission objectives.
- **Data Management** - This initiative will establish standards, procedures and tools, including an information repository, to improve accessibility and quality of FAA data.
- **Corporate Software Engineering** - This initiative will support improved processes for software applications development and the use of related tools such as Computer Aided Software Engineering (CASE) technology, software metrics, and software reuse repositories.
- **Electronic Data Interchange (EDI)** - This initiative supports FAA implementation of EDI standards and technologies that are required to enable exchange of information in support of FAA business and mission requirements.

- **IT Security** - This initiative supports the implementation of requirements for controlled access and physical security of data and information systems.

The "Architecture Survey: What Others are Doing" Task is one of several tasks to support FAA's development of the CIE Initiatives and satisfy the requirements of the Key Decision Point (KDP) process. The others include:

- **CSA Framework** - Development of architecture models for current- and future-state environments.
- **Baseline of Current Environment** - Assessment of existing FAA programs and systems.
- **Cost/Benefit Analysis** - Identification costs and benefits associated with the architecture alternatives.
- **Program/Budget Plan** - Definition of activities tasks, products, and required budgets for CSA initiatives.

The Architecture Survey Task is structured to support the other CSA tasks such as the Architecture Framework and the Cost Benefit Analysis as well as provide the FAA with information on what programs in government and industry can be built upon and learned from to realize the requirements of the CIE. In this way, the FAA CSA Initiative can benefit from the technologies and experience of other organizations. The effect will be to reduce both the costs and risks of CIE development and implementation.

1.2. ARCHITECTURE SURVEY METHODOLOGY

The approach followed by the Architecture Survey was to "develop criteria to identify, screen, and prioritize the systems architecture and systems development initiatives that may be applicable to the FAA CSA Initiative." The process of gathering and analyzing information on external government and industry programs was specifically structured to address the requirements of the proposed CIE Initiatives.

Architecture Survey Organizations

The organizations involved in the Architecture Survey were selected for their relevance to the FAA environment and ability to provide technologies and experience that could promote the development of the Initiatives. The FAA also requested that the Architecture Survey include companies involved in aviation as well as agencies from the Department of Transportation and the Department of Defense (DoD). An additional requirement was to address EDI in the DoD and industry because of the significant opportunities EDI can offer for the FAA and its industry partners. The criteria involved in the selection process are shown in Figure 1.

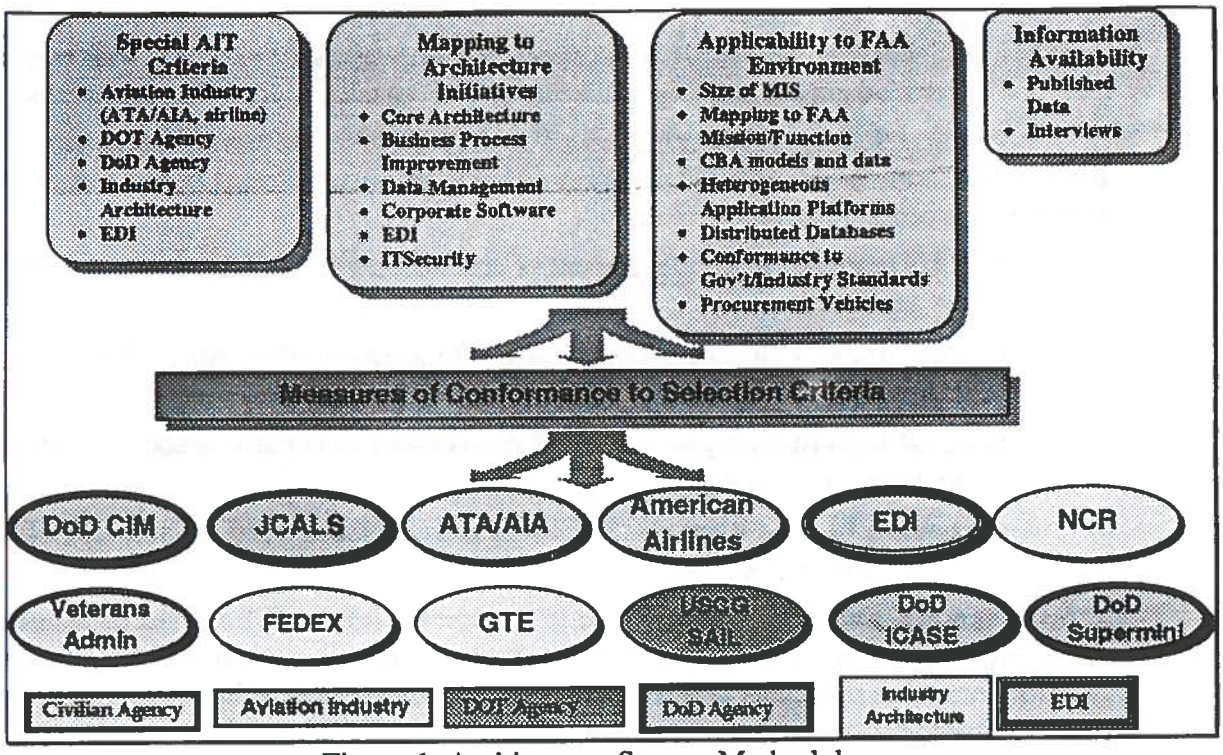

Figure 1. Architecture Survey Methodology

The application of the program selection criteria resulted in list of programs shown in Table 1, which formed the basis for the Architecture Survey.

• Architecture Survey Programs	Areas of Experience
DoD Corporate Information Management (CIM)	Experience with OSE, BPI, Data Management and Repositories, Software Process Improvement, CASE tools, Software Reuse, EDI, and Security
Joint Computer-aided Acquisition and Logistic Support (JCALS)	Implementation of CALS standards, technology to support electronic document and logistics data management
Electronic Data Interchange (EDI)	Government/industry experience and technology for EDI
GTE Data Systems (GTEDS)	Software metrics, software reuse and information repositories, CASE tools, client-server architecture
Veterans Administration (VA)	Experience with OSE, client-server architecture, EDI
Air Transport Association/Aerospace Industries Association of America (ATA/AIA)	Government and industry standards for mission EDI and other applications
American Airlines (AA)	Experience with FAA/airline data exchange applications, architecture development
Federal Express (FEDEX)	Experience with client-server architecture, object-oriented technology
DoD Integrated Computer Aided Software Environment (I-CASE)	DoD procurement for I-CASE tools
National Cash Register Corp. (NCR)	Enterprise wide data architecture and client-server implementation
U.S. Coast Guard Syste.. .. to Automate and Integrate Logistics (SAIL)	DOT agency with experience in logistics systems and supporting infrastructure
Air Force Supermini Acquisition - AF Computer Acquisition Contract (AFCAC 300)*	Procurement vehicle to support client-server infrastructure

* Program control has been transferred to the Navy.

Table 1. Architecture Survey Programs

Architecture Survey Analysis and Reporting

After gathering background information on the initiatives and the organizations in the Architecture Survey, interviews were carried out with key Information Resources Management (IRM) personnel in the surveyed organizations. To support the definition and assessment of the CIE initiatives, the Architecture Survey investigation pursued the following categories of information:

- **Cost/Benefit Analysis Data** - information that identifies costs and quantitative benefits associated government and private initiatives similar to requirements of CIE initiatives

- **Technology Transfer/Procurement Vehicles** - opportunities for the FAA to make use of commercial technologies and government contracts for government procurements
- **Lessons-learned** - guidelines for implementing CIE initiatives derived from similar experience in government and industry.

This volume of the Architecture Survey Report provides a detailed analysis of the Architecture Survey results in relation to the CIE Initiatives. Volume II provides a complete report of the results in relation to the surveyed organizations and programs (see Figure 2).

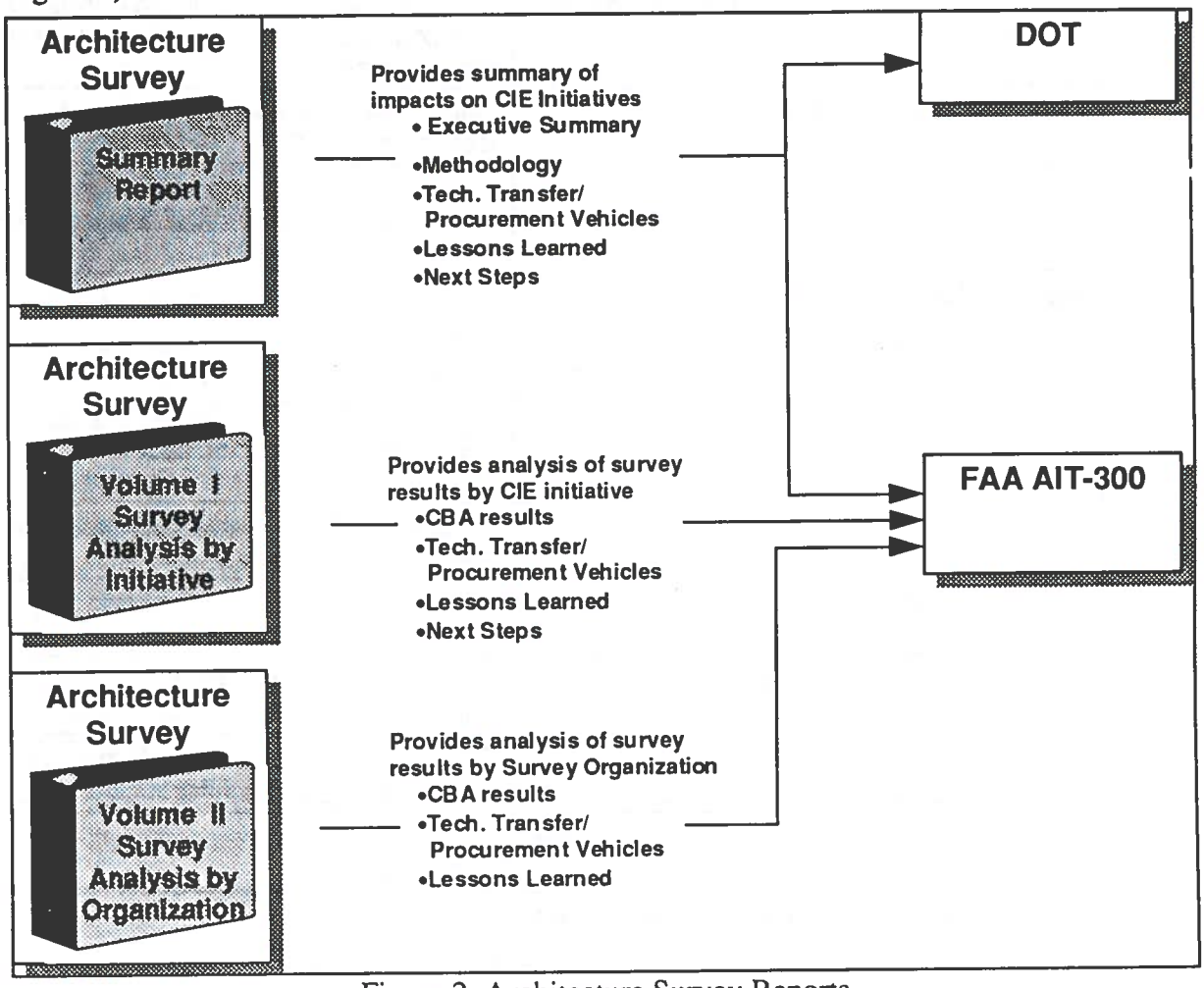

Figure 2. Architecture Survey Reports

2. Architecture Survey Results in relation to CIE Initiatives

2.1. CORE ARCHITECTURE

2.1.1 Description of Initiative

The Core Architecture Initiative establishes the overall framework for defining and implementing the OSE for the FAA. The initiative has the following objectives:

- To define the end-state for FAA information management and a migration path to achieve it.
- To define an architectural framework for evaluating and implementing standards for data, systems, applications, and methodologies.
- To provide policies and procedures for life cycle systems management.
- To provide methodology/metrics for technology assessment/selection.
- To provide support to national FAA programs for technology implementation.

The Architecture Survey has identified a number of technologies that can facilitate data exchange in an open systems environment, and otherwise support the objectives of the Core Architecture Initiative. These are discussed below.

2.1.2 Technology Transfer Opportunities

Source: DoD Corporate Information Management (CIM) Initiative

Portable Operating System Interface for Computer Environments (POSIX) 1000.3 Standard / Application Profiling Process

The POSIX Standard for a Unix OSE has been adopted as an American National Standard (ANSI). It provides the basis for the CIM Technical Reference Model (TRM). A key component of the National Institute for Standards and Technology (NIST) POSIX 1003.0 standard approach (see Federal Information Processing Standards Publication [FIPS PUB] 151-1) is to define Application Program Profiles (APP) that permit vendors to build applications consistent with the physical architecture requirements.

DoD CIM Architecture Framework

The Director of Defense Information (DDI) is publishing products of their architecture effort that are likely to be useful to the FAA. The **Technical Architecture Framework for Information Management (TAFIM)** consists of five volumes:

1. **Implementation Concept**
2. **Architecture Guidance and Design Concepts**
3. **Reference Model and Standards Profile**
4. **Support Plan**
5. **Implementation Manual**

The CIM TRM can be a foundation for a TRM for the FAA. It conforms to the framework defined by NIST that for a federal Open Systems Environment.

Resources Supporting the Defense Information Systems Agency (DISA)/CIM Architectural Approach

The documents produced by DMR, Inc. that define the CIM architecture process have been licensed for DoD use. Negotiations are underway to make the methodology available for government-wide use. The documents are available through Defense Technical Information Center (DTIC).

Title	DTIC Accession Number
• Stage One - Open Systems Status Report	B163950L
• Stage Two - The Experience with Open Systems	B163976L
• Stage Three - The Marketplace	B163909L
• **Stage Four - Standards-Based Architecture's (SBA)**	**B163891L**

The "Stage Four" document was used in DISA/CIM architecture (SBA) planning and is highly recommended by CIM.

Graphical User Interface (GUI)

An improved user interface to automated systems has been recognized as a key source of increased productivity. CIM has defined an initial set of requirements for a common GUI in the DISA/CIM ***Human Interface Style Guide*, Version 2.0. Sept. 30, 1992.** It addresses operational requirements for "windows"; object-oriented metaphors and requirements for interactions with systems users, help support, and the role of function keys. Some organizations within DoD, such as the Navy have developed more specific requirements that mandate, for example, where particular classes of information should be placed on the user's screen.

Consulting Services

The DISA/CIM Office of Technical Integration, Mr. Michael Mestrovich, director, is working with civilian agencies, such as the Department of Veterans Affairs (VA), to assist with development of technical architecture's. The office has special expertise in the areas of integrated support for personnel, finance, logistics, medical and acquisition systems.

- **Defense Technical Integrated Services (DTIS) acquisition** - The DTIS procurement, estimated at $830 Million over seven years, will provide for technical integration consulting services. *It is possible that services can be provided to other federal agencies like the FAA on a fee-for-service basis.* A formal Request For proposal (RFP) is expected to be released in summer, 1993.

Support for Acquisition of Commercial Products (DoD Information Tecnology Reuse Service [ITRUS] Program)

The DoD ITRUS Program provides a model for the Core Architecture Initiative support similar to the CIE Functional Technology Services. ITRUS supports the assessment of Commercial Off-The Shelf (COTS) products for the DoD infrastructure and coordinates COTS acquisitions with the requirements of the DoD Software Reuse Program.

Use of DISA/CIM Systems Engineering and Technical Assistance (SETA) Support Statement of Work (SOW) for Contract Requirements

The DoD has issued a SOW for a SETA contract for the DISA/CIM Center for Information Management. The SOW contains requirements, test problems, and contract language that may be useful for a corresponding FAA Core Contractual Vehicle. Such language would be relevant to other initiatives as well, including BPI, Data Management, and Corporate Software Engineering.

Source: Joint Computer-aided Acquisition and Logistics Support (JCALS)

The JCALS Workbench - Core Functions and Applications

One of the major features of JCALS is a suite of applications that support DoD requirements for managing and using electronic technical information.

The **core functions** of JCALS, *which could potentially support the FAA infrastructure for technical information,* are the following:

- Global Data Management System (GDMS) - directory for distributed data access
- Reference Library - management and retrieval of stored technical information
- Data Communications Network Management
- User Interface - graphics based interactions with users
- Workflow Manager - management of task planning, execution and related data
- Security - provision of multilevel security

Future Plans for Data Integration - Documentation and Drawings

The JCALS Program has begun to work with the DoD lead program for managing engineering drawings, Joint Engineering Data Management Information and Control System (JEDMICS). The objective is to achieve integrated access to both documents and drawing information. Responsibility for data management, including configuration management will be retained by JCALS for document data and by JEDMICS for drawings. *This capability may be applicable to the FAA for the management of National Air Space (NAS) technical documentation and engineering drawings.*

Source DoD Computer-aided Acquisition and Logistics Support (CALS):

Data Standards

JCALS has demonstrated the application of existing and proposed DoD CALS standards to the management of electronic documents and other types of technical information. *Many of the DoD CALS standards may be applicable to the FAA environment for electronic technical information.* The key standards that support data exchange in the POSIX-based open systems environment are listed in Table 2.

Standard Domain	Standard	
Data Interchange		
Vector Graphics	IGES	MIL-D-28000
Text	SGML	MIL-M-28001
Raster Graphics	CCITT GR4	MIL-D-28002
Technical Illustrations	CGM	MIL-M-28003
Logistics Data	LSAR	MIL-STD-1388
Electronic Forms and Transactions	EDI	ANSI X.12, Trans. set specs. (840, 841, 843...)
Engineering Product Data	PDES/STEP	
Communications	TCP/IP GOSIP (OSI)	
Database Query	SQL - FIPS 127-1	
Display	X-Windows MOTIF MS Windows	
Compound Documents	MIL-D-IETM DB, MIL-STD-1840A	
Operating System	POSIX	
Language	ADA for JCALS, C for ECALS	

Table 2. - JCALS Data Standards

Interactive Electronic Technical Manual (IETM)

For future production of integrated documents, the CALS IETM specifications will provide standards for database management of document content. *For the FAA, IETMs could support technical documentation for new NAS systems.* The standards include:

- MIL-M-87268 (GCSFUI) - provides for general content, style format and user-interaction requirements.
- MIL-M-87269 (DB) - provides for database for the support of Interactive Electronic Technical Manuals.
- MIL-M-87270 (QA) - provides for quality assurance program for IETMs and associated technical information.

Contractor Integrated Technical Information Support (CITIS)

The standard for interchange of technical information with and among contractors is known as CITIS. The proposed standard MIL-STD-974, draft dated November 16, 1992 was released for review and comment. The revised standard will be published this summer. *CITIS could enable FAA Program Offices to access NAS equipment CDRL information including documentation, plans, and proposed changes.*

Documents on CALS Policy

- DoD Instruction 5000.2 - "Defense Acquisition Management Policies and Procedures"
- MIL-HDBK 59B

CALS Shared Resource Centers (CSRCs)

The DoD has established a mechanism to provide education and outreach in CALS approaches to government agencies and small business. These CSRCs are managed by the Air Force. Each focuses on CSRC Specialized Technology Areas. Locations of the CSRCs and areas of specialization are given in the Table 3.

Location	Area of Specialization
Johnstown, PA	Metalworking
Palestine, TX	Scanning and Conversion
Fairfax, VA	Information Technology
Cleveland, OH	Automated Manufacturing
Dayton, OH	Automated Design
San Antonio, TX	Automated Business Practices
Orange, TX	Commercial Technology

Table 3. - CALS Shared Resource Centers

Source: Electronic data Interchange (EDI)

Federal agencies that choose to implement EDI systems must adopt recognized X12 (national) and EDIFACT (International-EDI for Finance, Administration, Commerce, and Trade) standards that meet their requirements. **The X12 Committee has approved for use over 100 EDI transaction sets.**

The DoD is in the process of creating a totally electronic business relationship with industry called Electronic Commerce (EC). EC, initiated at the Defense Logistics Agency (DLA) in 1990, is the integration of EDI, electronic mail, electronic bulletin boards, electronic funds transfer, and similar techniques into a comprehensive, electronic-based system - encompassing all DoD business functions, including procurement, contract administration, payment, supply management, transportation, and maintenance. **(Procurement, contract administration, and payments appears to offer the most significant opportunities to the FAA for EDI applications.)**

DLA works with some 300,000 vendors and approximately 38% of DLA business is now conducted electronically. **The goal is to reach 85% by 1995.**

Documents produced by Logistics Management Institute (LMI) in support of DoD's accelerated use of EDI are:

- A Business Case for Electronic Commerce, Report DL001-06R1, September 1990
- A Guide to EDI Translation Software, Report PL205RD1, Edition 1992
- EDI Planning and Implementation Guide, Report DL203RD1, August 1992

Source: Air Force Computer Acquisition Center (AFCAC 300) Super-Minicomputer

Industry analysts believe this contract could become the basic integration vehicle for the reorganization and modernization of the DoD based on their CIM Initiatives.

Over the nine-year life of the Supermini contract it is estimated that 130,000 computers, file servers, terminals, and workstations as well as distributed-processing equipment, including 1.4 million local-area network cables and 50,000 network cards, will be delivered. *Purchasing limitations for civilian agencies (Coast Guard is not included in civilian limitation) are 10% of the delegated procurement authority (DPA - $250 million), 2% of DPA for any one agency ($50 million).* Purchasing limitations are imposed by General Services Administration (GSA) and requests for an increase in purchasing authorization would be submitted through GSA. All products and services can be ordered up to September 1997 and services and maintenance is available to September 2001.

Equipment available on the contract includes: Hewlett-Packard high-powered Model 800 workstations to serve as file servers for groups of 64 to 256 users; Human Design Systems Inc. RISC X terminals; and Everex Federal System Inc 386DX/33 and 486 PCs. Inside the government, X terminals have traditionally been used for engineering applications, now they will be used for office automation and database applications. Supermini is supported by approximately 85 subcontractors, 50% of the products support communications, and over 1200 products are available.

Because civilian agencies can buy equipment and technical services (training, LAN/WAN communications, security, etc.) off Supermini, this contract has the potential of becoming the cornerstone of government efficiency. The systems offered clearly support distributed multi-user systems, therefore there is the potential that they will reduce or eliminate some of the older systems in place. Additionally, it appears this contract would meet the mid-range 'void' that exists between the FAA's Office Automation Technology ans Services (OATS) and Computer Resources Nucleus (CORN) contracts.

One of the alternative solutions identified in the NAS Program Initiative (NPI) for the FAA Advanced Information Management Systems (AIMS) to close the computing capability gap between OATS and CORN is to seek out and use another agencies procurement vehicle, e.g., AFCAC 300. This may still be a viable alternative because it will support AIMS "multiple source acquisition" strategy. The AFCAC 300 Supermini contract provides the FAA the opportunity to either:

- Purchase state of the art equipment to support the FAA infrastructure (mid-level equipment range to fill gaps in OATS and CORN) to support the FAA AIMS.
- Use AFCAC 300 contract (Request For Proposal [RFP], evaluation criteria, etc.) as a model for the acquisition documents for AIT-500 AIMS initiative.

As technology matures and evolves new products can be added to this contract. In fact the first technology refresher to the contract took one month to complete.

Source: American Airlines (AA)

Document Management

SABRE Computer Services (SCS) considers electronic documentation to be a major opportunity for reducing costs and improving core functions. American already has a great deal of documentation in electronic form. *FAA requirements to deliver notices and other data in manual (paper) form has inhibited the use of electronic documentation.*

AA is in the process of defining their own documentation standards. The company plans to develop expert system applications (similar to IETM) that will deliver information (e.g. specific tasks) from technical manuals that is required by maintenance mechanics.

Source: Federal Express (FEDEX)

FEDEX monitoring process in relation to customer satisfaction is based on integrated technology. Specifically, the integration of three classes of systems, physical systems that scan or monitor physical events, transition-oriented systems that use database technology to manage financial information, and end-user systems that directly support users.

Source: Air Transport Association/Aerospace Industries Association (ATA/AIA)

The FAA may be able to leverage the ATA standards(SPEC 2100, Digital Data Standards for Aircraft Support which defines authoring technical content/structure, interchange formats, and delivery/use in the digital data process) for FAA technical documentation and/or flight standards certification applications.

Source: Integrated Computer Aided Software Engineering (I-CASE)

The DoD I-CASE Program, a seven-year contract worth between $250 million and $1 billion, is intended to provide an integrated environment that supports the development and maintenance of DoD information systems applications. Reuse of domain knowledge and objects is a fundamental premise which I-CASE will adhere in order to further reduce manual development.

2.1.3 Key Lessons Learned

Source: DoD CIM Initiative

Consensus Building Process

- Use the TRM as a means to build consensus among the functional managers on architectural requirements.
- Involve the functional decision makers early in the process of architecture definition.
- Top-management commitment is required for gaining consensus on enterprise-wide requirements.

The existence of many stovepiped systems that impede the ability for systems to share data and organizations to interoperate has been widely recognized within the DoD. The DDI, Mr. Paul Strassman, understood the need to change a DoD culture that gave too much weight to autonomy over interoperability. A starting assumption for CIM was that a single architecture was better than many. The definition of a DoD-wide architecture could be used as a vehicle for building consensus around an improved view of the relationships between information systems and the organizations and business processes supported.

> ***Key Lesson Learned: An essential product of the process of Architecture Definition is a written statement of principles that define goals, roles and responsibilities and the criteria that govern decisions required to implement the architecture and other IRM objectives.***

For the DoD, the purpose of the statement of principles is counter the inevitable resistance from program managers when resources are reallocated to meet CIM objectives. *The FAA may this technique of value in the process of aligning FAA functional organizations with CIE objectives and implementation plans.*

Source: GTE Data Systems (GTEDS)

- Establishment of a high-performance reliable network is the first and most critical step.
- Security implementation must by synchronized with network building.
- Reusable components are a key to the implementation of a client-server architecture. In the GTEDS strategy, the server infrastructure is based on the use of reusable components. The components support user interfaces, interfaces between the three tiers in the architecture, and interfaces to the communications networks.

Source: VA Initiative

Key Lesson Learned: Develop a migration strategy for reaching an OSE.

Key Lesson Learned: Implementation of an Architecture is an evolutionary process. Moving to an OSE extends beyond the architecture and associated technology and represents a paradigm shift in the mindset of the organization.

OSE emphasizes data consolidation through the use of common data definitions and formats, transparent access to data through a common GUI, systems interoperability through the use of a common network protocol and interfaces, and protection of software investment through an emphasis on software portability and reuse. The use of the following standards will facilitate the interoperability of information systems, software portability, data interchange, access to information, and vendor independence:

- Open System Architecture will provide users with a broad range of applications across a wide variety of commercially available computer systems.
- GOSIP is designed to connect the Government's many multi-vendor networks and systems.
- Structured Query Language (SQL) is a language used to manipulate data in a relational database management file.
- POSIX facilitates the transfer of applications between hardware architecture.

Source: AFCAC 300

Key Lesson Learned: TRM configuration (Data Interchange Services component) supports CALS standards, scanning, electronic publishing, etc.

The Supermini Acquisition (AFCAC 300) appears to be the most encompassing and comprehensive procurement vehicle to-date. A key point is how this acquisition contract is mapped to the DISA/CIM TRM, Figure 3.

Specifically, the Supermini Acquisition could potentially support the Core Architecture activity titled "Functional Technology Services." This CSA product will generate a paper-based assessment of the different platforms and sizes for OATS, CORN, and the AIT-500 AIMS initiative. This CSA product will generate a paper-based product which assesses the different platforms and sizes for OATS, CORN, and AIMS. It will also include a hardware and software technology assessment to test and validate the software and hardware design. (In a more robust alternative, this effort will consist of actually performing demonstrations for proof of concept).

Technical Reference Model

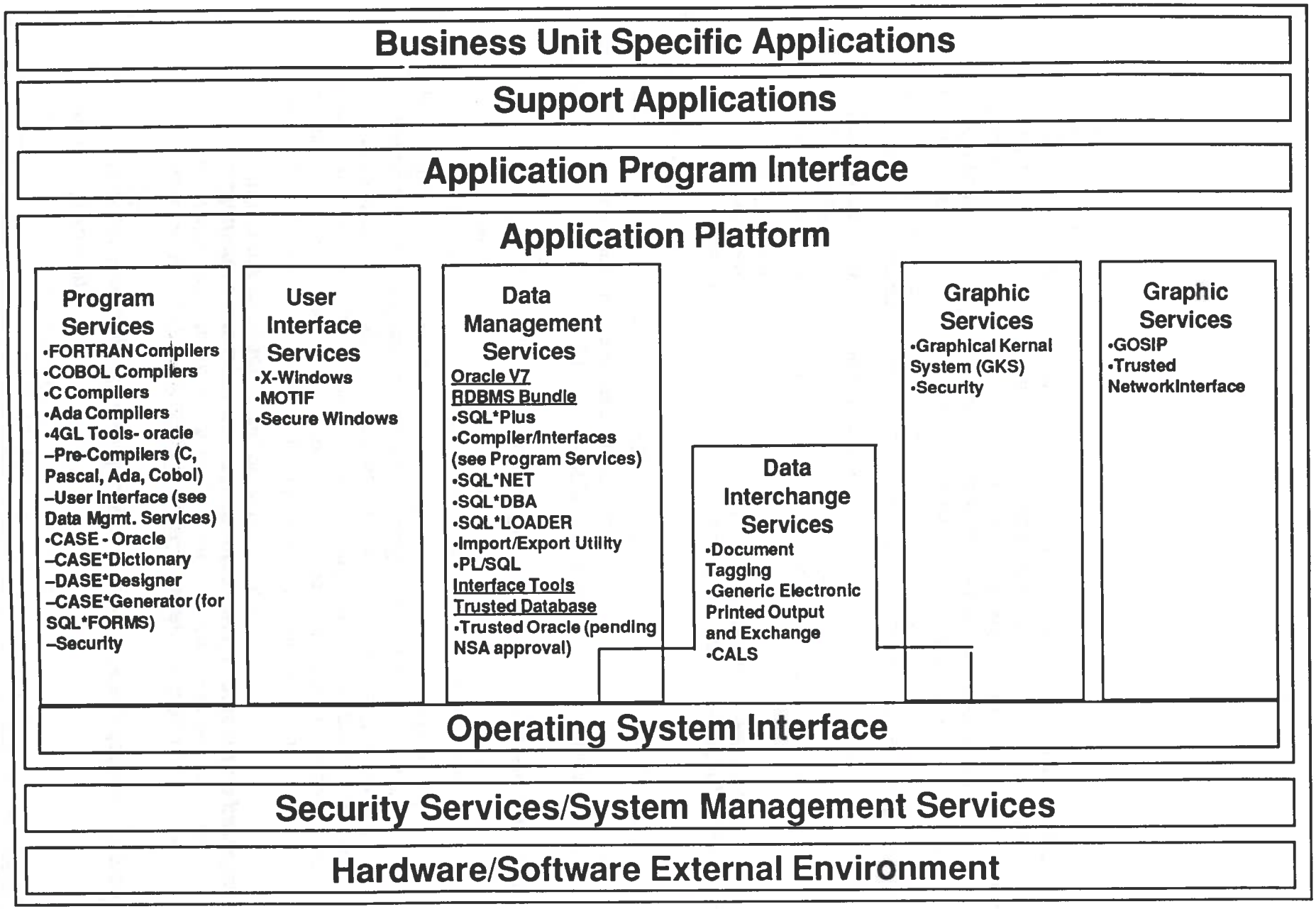

Figure 3

Source: AA

AA is a centrally run organization (14 - 15 people report directly to Robert Crandall, Chief Executive Officer) in which the core planning committee meets each week to discuss Corporate Strategy.

Client/Server Plans

AA has initiated a process for establishing a client-server architecture. The mainframe computers will provide major data management services, while applications, where appropriate, will be moved to smaller platforms such as workstations.

AA is using Powerbuilder from Powersoft to construct the client-server applications.

Architecture Framework

American is following a process of defining business and technology requirements that produces the following "generic architecture's:"

- Business Architecture - How the company organizes the business.
- Applications Architecture - How the company identifies, prioritizes, plans for integration of systems.
- Technology Architecture - How the company builds and integrates applications and technology products. Where systems cannot be designed to meet open system standards they will be designed to facilitate migration to open systems. Technology Architecture is comprised of three elements:
    1. *Principles* are fundamental beliefs regarding the planning, implementation and support of IT. *Principles are values made explicit and tangible.* They are intended to direct behavior and set the context for technology discussions.
    2. *Standards* identify both specific systems components and operating procedures that are supported by the organization.
    3. *Frameworks* provide a composite guideline for matching customer requirements to solution templates. The solution templates are comprised of compatible standards that provide full working solutions.
- Vendor Product Architecture - Whose technology products the company applies to meet the Technology Architecture standards.

Source: FEDEX

FEDEX is overhauling their IT infrastructure. The plan is to move from the current mainframe environment to a client-server architecture, based on open systems standards.

A great amount of resources is being invested in IT for improving the operation of the business. FEDEX regards itself as "an information processing company which moves packages."

Common Features between FEDEX and FAA Environment

- Need for integration of real-time systems and administrative databases.
- Need to provide systems that can be rapidly modified to meet changing customer needs.

Source: ATA/AIA

ATA SPEC 2100, Digital Data Standards for Aircraft Support, defines authoring technical content/structure, interchange formats, and delivery/use in the digital data process from increased use of automation. More definitive specifications are needed to design systems that will allow operators to implement information systems. The specifications will address the following areas:

- Authoring - content/structure includes the technical information requirements for processing print files, retrieval, and database information to assure entity consistency and semantic context. ATA 88-3 Maintenance Engineering is an example of a standard needed to design a database authoring/access system.
- Interchange formats - includes the text and graphic expressions from which ideas for aircraft support are created. Multimedia forms such as audio and video are requirements for Training activities. ATA 89-9A development of Standard Generalized Markup Language (SGML) Document Type Descriptions (DTD's) for text and ATA 89-9B Computer Graphics Metafile (CGM) vector and CCITT Group 4, raster formats are examples of standards used for neutral file exchange.
- Delivery/presentation - includes information user standards to accept digital media in magnetic, optical or electronic form for re-authoring, access, presentation and/or printing. ATA 89-9C Retrieval for optical media is an example of standards for the user, 89-9C also contains Structured Full Text Query Language (SFQL).

IETM

The commercial airlines through the ATA and AIA have developed an architecture for advanced retrieval technology which meets the needs of interactive document databases.

An IETM operates more interactively and its user interface is more like an ATM machine, a kiosk or a video game - that is, it's "interactive." An IETM works with unformatted information, selecting only that which is needed for the tasks at hand, formats the response in compliance with the standard client/server interface, and then sends the information to the users display device.

There are many parallels in the ATA and CALS standards development efforts. In both efforts, digital data standards for maintenance documents are being developed to address requirements for electronic document *interchange* and for *interactive retrieval*. Standards for document interchange provide a common mechanism to re-use information, to reauthor, or to load portions into data repositories, for example. Standards for interactive retrieval permit the publication of information in an electronic book form employing full search capabilities and sophisticated browsing techniques such as *hypertext* links, which let the

user view relevant material in another part of the document simply by pointing to its reference.

Further, both CALS and ATA incorporate many of the same industry standards in their implementation profiles. For example, both utilize SGML for interchange of text, and CGM for vector graphics. And both use CCITT Group Compression for raster images (although with different header formats).

Although there are many similarities between the ATA and CALS approaches, the focus of the interactive retrieval efforts is different. Whereas the IETM effort within CALS has emphasized data content and presentation issues, the *ATA has focused on interoperability requiring that an application used to access a particular vendors engine or airframe maintenance manual can access all other vendors maintenance manuals.*

John Anderson, co-chair of the CALS IETM Study, stated that in the very near future (within the next three years) IETMs will be a common application for the airline industry.

Technical Mail (T-Mail)

T-Mail is the term which includes E-Mail, EDI, notifications such as service bulletins, regulatory advisories, and other forms of text and graphics under the umbrella of a single set of standards and protocols. ATA's objective is to identify an interim standard that would allow T-Mail to function in 1993.

Source: National Cash Register (NCR)

The Enterprise Information Architecture (EIA) is a comprehensive set of Information Systems (IS) business and technology strategies needed to provide consistency in designing, constructing, and deploying business information systems within (NCR). The EIA identifies many opportunities NCR faces in doing business today. The architecture itself is divided into four sections:

- Business Principles -- are the criteria for establishing and maintaining the business infrastructure.
- Business Model -- is the framework for defining the relationships between business process and information.
- Technology Model -- defines the parameters for building the information processing environment and new business applications.
- Organization Model -- establishes the interrelationships of organizations with respect to the information needed to run NCR's business.

Together, these components provide a cohesive enterprise IS solution that is linked to NCR's business needs. NCR recognizes that many business processes are cross-functional in nature and their underlying information infrastructure is equally cross-functional. The EIA provides the framework for meeting their IS needs with a consistent approach to worldwide IS. *The FAA my be able to benefit from NCRs experience in implementing their EIA.*

2.2. BUSINESS PROCESS IMPROVEMENT (BPI)

2.2.1 Description of Initiative

The CIE BPI supports improvement of business processes through re-engineering and more effective use of IT to achieve FAA mission objectives. Principle objectives of the BPI Initiative include:

- To select and disseminate standard methods and tools to support BPI analysis and re-engineering of business processes.
- To develop a knowledge base of business process models that can support BPI.
- To provide for training, consulting, and other support required for BPI analysis and implementation within the FAA.

The DoD CIM Initiative and other programs have developed tools, methodologies, and documents that can be applied to the FAA BPI Initiative. These are identified below.

2.2.2 Technology Transfer Opportunities

Source: DoD CIM Initiative

Enterprise Model

The CIM Enterprise Model (EM) is viewed as a foundation for BPI as well as establishing a framework for enterprise-wide data management. For BPI the EM defines the core processes that are required to meet the mission of the enterprise. The model will also support more detailed process and data models for BPI. In addition, the EM can be applied to the Data Management Initiative in relation to the selection of enterprise-wide class names and prime words required for data naming conventions.

Repository for Data Process Modeling

The CIM Initiative is building an IDEF repository to support reuse of process definitions. The IDEF models will support a 3-schema approach. *General Motors is also sponsoring the development of a model for a repository under a 3-schema concept.* A key requirement for the government is to define data needs and structures and build a repository for the models. The program has explored the use of Index Technology's Excelerator and Oracle for the repository datatbase management system (DBMS). The repository data will be available on Compact Disk-Read Only Memory (CD-ROM).

Use of IDEF Modeling to Link Software Objects to BPI

One of the goals of the DoD BPI program is to incorporate identification of objects that are critical to the business into the BPI modeling process. Future versions of IDEF modeling will address some of these requirements. The CIM Initiative intends to prototype the use of extended IDEF tools to model objects in relation to business processes.

IDEF Standards

NIST is publishing a standard for IDEF modeling as a FIPS PUB. The CIM Initiative is planning to establish standards for process and data modeling (founded on IDEF) and for the associated repository. One of the obvious applications is to create standard processes and standard data structures for commonly performed processes. This resource will support the consolidation of multiple information systems that perform similar functions (e.g.

payroll, human resource management). *The FAA should examine the use of such a repository for its own process modeling.*

Use of DoD Methodologies for Functional Economic Analysis (FEA) and other Techniques to Support BPI

The CIM Initiative is publishing guidebooks that discuss techniques and technologies that can be used to support an FAA implementation of a BPI process. Subjects areas that have been or will soon be addressed in the guidebooks include:

- BPI Methodology
- FEA
- Integration
- Repository
- Functional Process Simulation (published 1 January 1993)
- Groupware

DoD Documents on BPI include:

- *Corporate Information Management: Process Improvement Methodology for DoD Functional Managers,* D. Appleton Company, Inc., 1992.
- DoD Corporate Information Management, *Functional Economic Analysis Guidebook,* version 1.0, 15 January 1993.
- DoD OASD, C^3I, DoD 8020.1-M (Draft) *Functional Process Improvement,* August 1992.
- DoD Director of Defense Information, *CIM Business Process Improvement Workshop: ABC Foundation, Final Report, Defense Investigative Service,* 26 May to 3 July 1992.

BPI Tools

DISA/CIM is also supporting the acquisition and/or development of a number of automated tools to support BPI analysis. The tools will provide FEA support and assess the anticipated impacts of business process changes. They include support for:

- Group decision-making (e.g. groupware)
- IDEF process and data modeling
- Activity-based costing
- Process simulation
- Performance analysis
- Prototyping

Navy Groupware Implementation

In February 1993, the Navy inaugurated the first DoD center to support BPI. The Groupware Center for Functional Process Improvement, at the Washington Navy Yard, combines technologies for group decision making and automated support for process modeling and simulation. The electronic meeting software (EMS) used is Group Systems

V from Ventana Corp. (Tucson, AZ). The use of the EMS is supported by a Center facilitator, who edits inputs to the system to avoid duplication of ideas. The results of the group sessions are entered into an IDEF modeling tool. The IDEF tools available include:

- Design/IDEF - Meta Software (Cambridge, Ma.)
- IDEFine - Wizdom Systems, Inc. (Napierville, Il.)
- IDEF Solutions - Structured Solutions (Vienna, Va.)

Contact: Rear Adm. Robert Moore, Cmdr. Naval Information Systems Management Command

Source: JCALS

Workflow Management Technology

JCALS is implementing a tool for linking task definitions to information requirements. The **JCALS Workflow Manager** is a project management tool that permits managers to define tasks and resources required to carryout a defined business task. The information flows and tasks are tracked by a Sybase database. While the Workflow Manager is currently based on a text file, graphical interface will be provided in future versions of the tool.

Source: EDI

Most organizations do not implement EDI exclusively to save resources. While they recognize that EDI is an excellent method to contain escalating costs for the future and even reduce costs in the near term, it is now widely accepted that technology represents only a small part of the total business solution.

The thrust of DoD's EC program is not just to automate manual processes but to put in place the necessary systems, capabilities, and procedures (BPI) that will enable DoD Components to fundamentally alter and improve the way they carry out their day-to-day business operations.

2.2.3 Key Lessons Learned

Source: DoD CIM

Key Lesson Learned: The major impact of CIM will be on productivity improvements that result from changes in DoD business, not from savings on IT expenditures.

The Defense Management Review Directives (DMRDs) define mandated targets for savings. Of the $71B that the DMRDs target for productivity improvements, the CIM Initiative estimates that $36B can be facilitated by IT. Of this only $6.9B will be saved due to direct savings in IT.

Key Lesson Learned: Market the vision defined by the CIE principles to the functional managers as early in the program as possible.

One of the requirements of the Core Architecture Initiative is to generate a commonly accepted vision for IT within the FAA. To establish the vision as an active process, a primary role of the Office of the DDI (ODDI) and the deputy director for BPI is to market

the vision for BPI to the functional managers within DoD. Involving the functional managers in BPI is the purpose of the various workshops on the FEA process being carried out by the CIM Initiative. **The FAA should initiate this type of marketing and education process, as soon as possible.**

Key Lesson Learned: Definition of IS requirements should not take place before process changes are defined and carried out.

The approach followed by DoD CIM for BPI assumes that information systems requirements will be defined following analysis of the business processes they support. It should be noted, however, that CIM has also recognized that certain categories of infrastructure (technology) support should be carried out in parallel to with BPI. For example, CIM has supported development of data management, software, telecommunications, and other technologies in advance of BPI results. The CIE Initiatives are following a similar strategy.

Key Lesson Learned: Success in BPI depends on a satisfactory incentive system for functional managers. CIM has not defined a set of rewards for functional managers that will motivate radical changes in business processes.

The BPI program recognizes the importance of establishing incentives for BPI. Those identified include implementing changes that will able the organization to

- Remain competitive
- Optimize scarce resources
- Consolidate wisely
- Improve quality
- Empower the workforce
- Leverage technology to improve business
- Create conditions for individual creativity

It is not clear that such goals, worthy as they are, will be sufficient to motivate functional managers who may be required to substantially reduce personnel and other resources in the course of implementing business process changes.

Key Lesson Learned: CIM has not addressed obstacles to implementing BPI recommendations for process change.

The cost reductions anticipated from BPI are typically derived from elimination of formerly required activities and associated reductions of personnel. Potential resistance from existing organizations presents a significant risk to realizing CIM benefits. The CIM Initiative has not explicitly addressed requirements for organizational change. Addressing human resource requirements and "change management" was noted by the Government Accounting Office (GAO) (in interviews) as one of the key requirements for IRM success.

Source: VA

Key Lesson Learned: BPI initiatives should be client-focused. The initial projects should be the ones your customer(s) will benefit the most from.

VA CIM project is to apply business process analysis and re-engineering principles across VA and establish information partnerships with DoD and other agencies, FY 1992 to 1997, $5.4 million. The project concentrates on re-engineering business processes followed by an analysis of the extent to which technology can play a role.

Source: AA

According to Max Hopper, Senior VP of Information Systems at American, systems that are useful are becoming too big and expensive for any one company to build. More and more, it makes sense to share network, share customer data, and share the costs of developing a commonly needed application. **More and more, companies need to work closely with various other aviation partners to solve commonly held problems and exploit mutual opportunities (e.g. technology transfer). And more and more, technology makes such relationships feasible.**

Improved access by Pilots to Critical Data

AA would like to provide visual displays of all information the pilot needs to assess current status and options.

Source: FEDEX

Key Lesson Learned: Build systems to support the major business processes and IT staff works for the functional managers.

The entire company is oriented to improving the processes that support the main business of reliable delivery of packages. IT is designed to support the business mission. While the Systems Development has its own organizational identity, the IT staff also works for the functional managers in Air Operations and Ground Operations.

Key Lesson Learned: Understand the business and the data needed by the business.

FEDEX has a well-defined mission and set of business processes that support the mission. They believe that they have a very good understanding of the data required for the business operations.

Source: NCR

Changes Driving the Business Environment

Key Lesson Learned: The success of business and information systems will be in how an organization can accept and adapt quickly to changes.

- The need for flexible and easy access to global data, applications, and services.
- Immediate access to business information is critical to building and maintaining a competitive advantage, providing "the right information to the right people at the right time."

- The one constant of the information technology industry is change -- rapid change.

IS Role

IS and user management are jointly responsible for the identification and successful implementation of information systems.

- IS is responsible for identifying and managing the uses of information system technology that enables business users to achieve their mission in a cost-effective and timely manner.

A well-defined "blueprint" or "roadmap" needs to be established that will factor the items listed below, and provide a framework for future systems:

Key Lesson Learned: There is a delicate balance in cost-effectively supporting enterprise-level requirements while providing a platform for user-driven innovation in the application of technology across an organization.

- Use information as a strategic resource.
- Empower people at all levels of the organization by giving them access to information scattered through the enterprise.
- Re-engineer processes that have become hindrances on productivity, service, and customer satisfaction.
- Define the enterprise architecture vision to support the business objectives.

The IS function at NCR is managed on an company-wide basis:

- There is central responsibility for establishing strategic direction, policies, and guidelines for the IS functions.
- Technical resources are pooled where common technologies and economies of scale permit.

2.3. DATA MANAGEMENT

2.3.1 Description of Initiative

The Data Management Initiative aims to establish standards, procedures and tools, including an information repository, to improve accessibility and quality of FAA data. Data Management objectives include:

- Establishment of an Information Repository to maintain consistent rules, names, locations, and other critical information on data elements employed in FAA databases.
- Implementation of an Information Warehouse to maintain data required for performance analysis and other assessments needed to meet FAA mission goals.
- Development of appropriate guidelines, standards, and procedures for FAA data management.
- Provision of policies training and other support required for an FAA Data Quality Improvement Program.

2.3.2 Technology Transfer Opportunities

Source: DoD CIM

Information Repository

The Defense Data Repository System (DDRS) is currently using a DoD developed automated data dictionary system to support the repository. It has been operational since August 1992. The DoD product is available free-of-charge to other government agencies. Recognizing that it will be more cost effective to use a commercial product than to enhance the existing DoD repository database, the DoD plans to move to a commercial system within about a year. Commercial products that are being evaluated include the Rochade dictionary system from R&O, Inc., Infospan, and Wisdom, an Oracle based CASE tool and dictionary. (The FAA is also investigating the R&O product.)

Information Warehouse

The DoD has identified a goal and tentative project that would establish a "DoD Enterprise Database." If the project is approved, DISA will create a multi-agency task force to define a vision for the Enterprise Database, develop a concept of operations, perform a FEA, and define a process to migrate data. It is not likely that this effort will be of benefit to the FAA in the short-term.

Data Administration Policies and Procedures

The DoD Data Administration program has created a number of policies and procedures that can provide a basis for "tailoring" corresponding policy development in the FAA. These include:

- DoD 8320.1 - DoD Data Administration - 26 Sept. 1991
  This document defines general policies and responsibilities for data administration . The policies authorized development of a DoD-wide data dictionary system and the procedures manual.
- DoD 8320.1-M - DoD Data Administration Procedures Manual - 21 Sept. 1992 (draft); cor ction scheduled for 31 Aug. 1993.
- DoD 8320.1-M-1- DoD Data Element Standardization Procedures - completed Jan. 1993
- DoD 8320.1-M-2 - DoD Data Security Procedures - Interim Draft Nov. 1993
- DoD 8320.1-M-3 - DoD Data Quality Assurance Procedures - coordination copy Nov. 1993
- DoD 8320.1-M-4 - DoD Database Administration Procedures - completion anticipated Dec. 1993.

Data Standards

The FAA can benefit from the standards development activities in which the DoD is participating. These include:

- CASE Data Interchange Format (CDIF)
- Information Resources Dictionary System (IRDS) 1 & 2
- EDI (ANSI STD X.12.)
- Semantics Unification Data Model
- CALS standards, e.g. SGML, ODA/ODIF, CGM)
- Portable Common Tool Environment (PCTE)
- CASE Interchange Standard (CIS)
- IEEE Computer Society Task Group on Professional Computing Tools (Γ1175)
- Model Harmonization Efforts (X3H4)

Data Quality

DISA/CIM has produced a draft concept paper on Data Quality. They have also initiated a pilot project with the Marine Corps to test a metrics tool. It is not yet a production system available for outside use.

Education, Training and Consulting

The FAA can build upon plans, course materials, and consulting techniques that the CIM program has developed for Data Administration.

Source: JCALS

Global Data Management System (GDMS) - Potential Support for FAA Repository

One of the major non-COTS systems developed for JCALS is the GDMS. The GDMS permits the operation of what JCALS calls the "Reference Library." This capability provides for integrated management of data (e.g. technical documentation and drawings) that may reside on multiple distributed databases. The reference library retrieves information on the basis of user selected categories and delivers the objects form distributed sources to a folder on the user's desktop system. The Reference Library also provides viewers for displaying objects that conform to differing data storage standards. This provides for interim capabilities of the DoD concept of an Integrated Weapon System Database (IWSDB). *The GDMS could provide capabilities for integrated access to distributed data that is required for the FAA repository and the Automated Documentation, Development and Maintenance (ADDM) Program.* The JCALS program has a working prototype of the GDMS that can be demonstrated at the CSC facility in Moorestown, NJ.

Interface between Repositories for Document Data and Repository for Engineering Drawings

The GDMS for JCALS will be linked to the index for engineering drawings developed by PRC under the Navy-led JEDMICS program. *This corresponds to the FAA (ADDM) requirement to link repository management of document data and engineering graphics*

(CAEG). The naming conventions used for the GDMS will be consistent with the definitions in the DISA/CIM repository, the DDRS.

JCALS Data Model

JCALS is building on the original data model developed by CACI for ACALS. The FAA may want to examine the process and results of JCALS data modeling for application to its own environment.

Electronic Document Management Capabilities

While JCALS intends to manage a broad scope of technical information, the first applications will be to the management of technical documentation (technical manuals). *The DoD requirements for integrated management of Technical Documentation corresponds in many ways to FAA requirements for ADDM*. Capabilities provided by JCALS that address requirements for document management include:

- Global locator for documents in distributed repositories.
- Implementation of standards for document content identification, format specification, and data interchange.
- Integration of document management with project management tools (Workflow Manager and Task manager).
- Support for the document production process, including authoring, editing, review, production, distribution, and user query and access.

Tools supporting document publishing capabilities include the following:

- **ArborText SGML Editor** - The ArborText product supports editing and review of the SGML document.
- **Datalogics JCALS Composer** - The composer takes the SGML document file and provides output in correct order and format to a standard PostScript printer.

JCALS Use of CALS Standards for Electronic Documents

- **SGML Document Standards** - JCALS representation of electronic d[illegible].ts conforms to the standard for SGML, MIL-M-28001A. Content tagging enables managing the content of documents using a relational database. The program will also conform to the new documentation standard, MIL-M-28001B and the DTD standard for technical manuals, MIL-M-38784B (*this DTD has a similar structure to FAA-D-2494B for FAA Technical Instruction Books*).
- So far DTDs have been defined for technical manuals and depot maintenance work records using the MIL-M-38784B standard. Additional DTDs have been created for statements of work and other manuals not already defined by CALS standards. *Many of the DTDs developed by the DoD could be tailored for adoption by the FAA.*
- **Multimedia Standards** - In addition to traditional document applications, SGML is used for a wide variety of documents including procurement forms, parts lists, and specifications. JCALS is also using SGML to provide hypertext links among document elements. InfoDesign is the contractor that is supporting

DTDs for documents. The definitions also provide for links to the Task Manager.

- **Content Data Model** - One of the requirements for JCALS is the implementation of a content data model (CDM) that provides for hypertext links among documents. The model must also address requirements of legacy paper documents, currently produced electronic documents and future documents. The standard that InfoDesign is using for this purpose is HyTime, the Hypermedia/Time-Based Structuring Language (ISO 10744).

JCALS and the IETMs Standard for Electronic Documents

IETMs is the standard, based on a content data model, that has been developed to newly produced DoD technical information. The IETMs standard provides a database model of technical manual content addresses a finer level of detail than the current JCALS models. The IETM database also includes information such as software and diagnostics which are associated with technical manual content. The JCALS data model will include identifiers that permit documents to be included in databases that conform to the IETMs standard.

CALS SGML Library

As part of the DoD CALS program, a SGML resources are being collected and made available to the DoD and industry. The CALS SGML Library will include:

- Baseline tags and attributes
- CALS DTDs and FOSIs
- DTD and FOSI fragments to be applied to new DTDs and FOSIs
- Boilerplate text and other reusable fragments for DTDs.

The CALS SGML Registry will maintain a standard set of approved SGML tags and attributes.

Tools to Support Data Access - Navigational Aids

- **Controlled Access Folder Executive** - Built on the X-Windows desktop is a layer of code that facilitates access of users to commonly used applications. Based on characteristics of the user, the Controlled Access Folder Executive (CAFE) associates objects in a user's folder with applications normally used to operate on the data or deliver data to the user. One desirable and innovative feature of the CAFE is its capability to create a virtual representation of the information the user requires. A user can see pictures of parts in a parts catalogue instead of lists of files. It should be noted that the MacIntosh operating system, Microsoft Windows, and other Windows products provide a number of capabilities similar to those offered by the CAFE.
- **Graphical Query Tool** - General Research Corporation (GRC) provided the data modeling tools for developing data models for the SGML, graphics, and LSAR data that is stored in the JCALS relational databases. GRC also developed an application that permits users to define queries graphically for accessing any type of data in the JCALS databases.

Source: EDI

The processing and distribution of paper forms within the FAA share some common processing operations. Since EDI would eliminate and/or streamline most of these operations, the associated savings would be direct benefits. These include:

- Distribution (making copies of documents and distributing them among users);
- mailing sorting, reconciling and auditing;
- data entry, which occurs several times if the same information is entered into more than one computer system;
- error resolution (checking for and correcting mistakes);
- storage and retrieval; and, for some documents;
- placement of procurement orders by telephone.

Source: AA

The Data Management function has been removed from the organization responsible for applications development and put under the VP for Development Resources. This area is functioning as a "Center of Excellence."

Source: FEDEX

FEDEX recognizes the need for a data administration program. The decentralization of computer systems poses a challenge for the company to implement standard procedures throughout the organization.

Source: I-CASE

Integration of CASE, Reuse and Data Repositories

> ***Key Lesson Learned: Effective implementation of software process improvement will require integration of processes and supporting technologies of CASE, Reuse and Data Management.***

DISA/CIM plans to develop a strategy for integrating CASE, Reuse, Data Administration, and a Concept of Operations. It is recognized that the I-CASE tools must be connected to the data repositories, e.g. DDRS and the DSRS. The I-CASE tools must support the full-suite of process and system engineering tools, including process simulation, functional decomposition, and data-oriented information engineering approaches.

Source: NCR

Data is viewed by NCR as strategic resource and is managed as such on an enterprise-wide basis.

- Data that is used by more than one group (e.g. FAA Division) is classified as Enterprise Data.
- There is an organization-wide function responsible for establishing strategic direction, policies, and standards for the management of data.

Enterprise Data has common, consistent definitions throughout the organization.

- Physical databases are based upon the standard data definitions.
- Data is captured and validated once, at its source.
- A common information infrastructure is used for data access.

Data is owned by the organization and is assigned to designated Data Trustees for developing standard definitions.

- An enterprise-wide classification of data by subject area is used.
- The Data Trustee is responsible for determining the standard definitions for "Enterprise Data" for each subject area.
- Business experts will establish the standard names, definitions, formats, structures, domains, and business rules for Enterprise Data.

Information processing conforms to a set of established infrastructure standards, which includes hardware, software, and network products.

- The enterprise infrastructure consists of open, industry-standard products and interfaces.
- Computing is distributed to the most practical location.
- The enterprise architecture provides a robust set of applications and services. to support the business requirements.

Data application and infrastructure services are designed so that each component can be implemented independently of the underlying infrastructure.

- Client-server applications will provide the optimum solutions in processing, design, portability, and interoperability as a result of independence of the components.
- Empower the end-user to develop application solutions.

2.4. CORPORATE SOFTWARE ENGINEERING

2.4.1 Description of Initiative

The Corporate Software Engineering aims to improve the quality and reduce the cost of FAA software development and maintenance through process improvement and the use of appropriate automated tools. Specific objectives include:

- Development of software engineering standards, policies, procedures and metrics.
- Providing guidelines for corporate applications and databases.
- Development of requirements for CASE tools, support and training.
- Development of a repository and related policies for software reuse.

2.4.2 Technology Transfer Opportunities

Source: DoD CIM Initiative

The DoD has ambitious objectives for improving software productivity through the implementation of a standard methodology, I-CASE tools and promotion of software reuse. While CIM and other DoD programs are likely to make significant contributions to software process improvement, thus far actual DoD implementations of the techniques and tools have been modest.

Standards - MIL-STD-SDD (Software Development and Documentation)

The I-CASE program requires that industry standards are employed where they exist. PCTE, for example, will be used as the interface to the repository for software product data.

The new standard for software, MIL-STD-SDD (Software Development and Documentation), will combine development and documentation standards to address both business and weapons systems requirements. The result will supercede MIL-STD 2167A and DOD-STD 7935A.

Software Process Assessment Methodology

The Software Engineering Institute Capability Maturity Model (CMM) is being used as basis for the assessment methodology that DISA/CIM is applying to DoD software development sites. This approach should be evaluated for establishing a software process baseline for FAA organizations.

Metrics for Process and Reuse

The DoD has placed a high priority on the development of a metrics program to support software process improvement and software reuse. The FAA may be able to benefit from the experience of the DoD in adapting existing metrics programs developed by the SEI, GTE and other organizations.

Software Re-engineering

CIM is supporting the acquisition and development of automated tools to support software re-engineering. The FAA should evaluate these tools in relation to FAA re-engineering requirements.

Object-Oriented Methods and Technology

CIM is evaluating Object Oriented Technology (OOT) for potential DoD applications. It is uncertain at this time how broadly the DoD will implement OOT for requirements analysis and/or software development.

DDRS

The DDRS is founded upon the products of the RAPID (Reusable Ada Packages for Information Systems Development). There are 2575 objects in the repository (as of March 1993). According to the ODDI, this program offers the best prospects for implementation within the DoD.

Central Archive for Reusable Defense Software (CARDS) Program

CARDS - Use of Reusability Library Framework (RLF), a knowledge representation framework to support use of domain specific reuse libraries. This is publicly available software.

The CARDS Program has also produced a set of handbooks that address potential obstacles to reuse. These include:

- Direction Level Handbook (for top level-managers)
- Acquisition Level Handbook (for program managers)
- Engineer's Handbook
- Component Developer's and Tool Builder's Handbook.

Other areas that the FAA should look for transfer opportunities include:

- the classification schema developed for categorization of reusable components
- legal and accounting procedures for authorizing and tracking reuse

Source: JCALS

Reusable JCALS Components

JCALS methods are w..... for inclusion in the DISA reuse library, the DSRS. The JCALS program plans to address requirements for linking the GDMS to the locator in the DSRS.

Source: *GTEDS*

Process of CASE Tool Selection - GTEDS Use of PACBASE

GTEDS established a weighted evaluation of the tools in relation to business requirements. After the top three tools were selected, GTEDS evaluated the tools in relation to their ability to mature with the architecture. Requirements considered for evaluation of the CASE tools included:

- Tool integration
- Compatibility with client-server environment
- Capability to manage centralized repository
- Support for asset reusability

The CASE tool GTEDS selected was PACBASE. The CGI product provided for a repository, integrated upper and lower CASE, (future) reverse engineering capabilities, and for client-server support. It also met GTEDS architectural requirements through its support of applications development for IBM mainframes, DEC and RISC 6000 workstations in a UNIX environment, PC DOS, and Tandem platforms. IDE and Knowledgeware had not demonstrated adequate capabilities for lower case functionality.

Software Reuse

PACBASE is being used to manage the GTEDS repository for software reuse. GTE Federal Systems is a participant in the DARPA funded Domain Specific Software Architecture Program. (*Crosstalk*, Software Technology Support Center, Oct. 1992)

Software Process Metrics

GTEDS has implemented a system of measures that are tied to the hierarchy of enterprise and project management (see Figure 4). So far the process of tracking the hierarchy of metrics has not been automated. Such a product would be the equivalent of an Executive Information System for software production. Some of the sources of data, such as project tracking and scheduling are derived from existing systems for project control and time-reporting. *The FAA may be able to use this type of metrics hierarchy for to support its own program of software process improvement.*

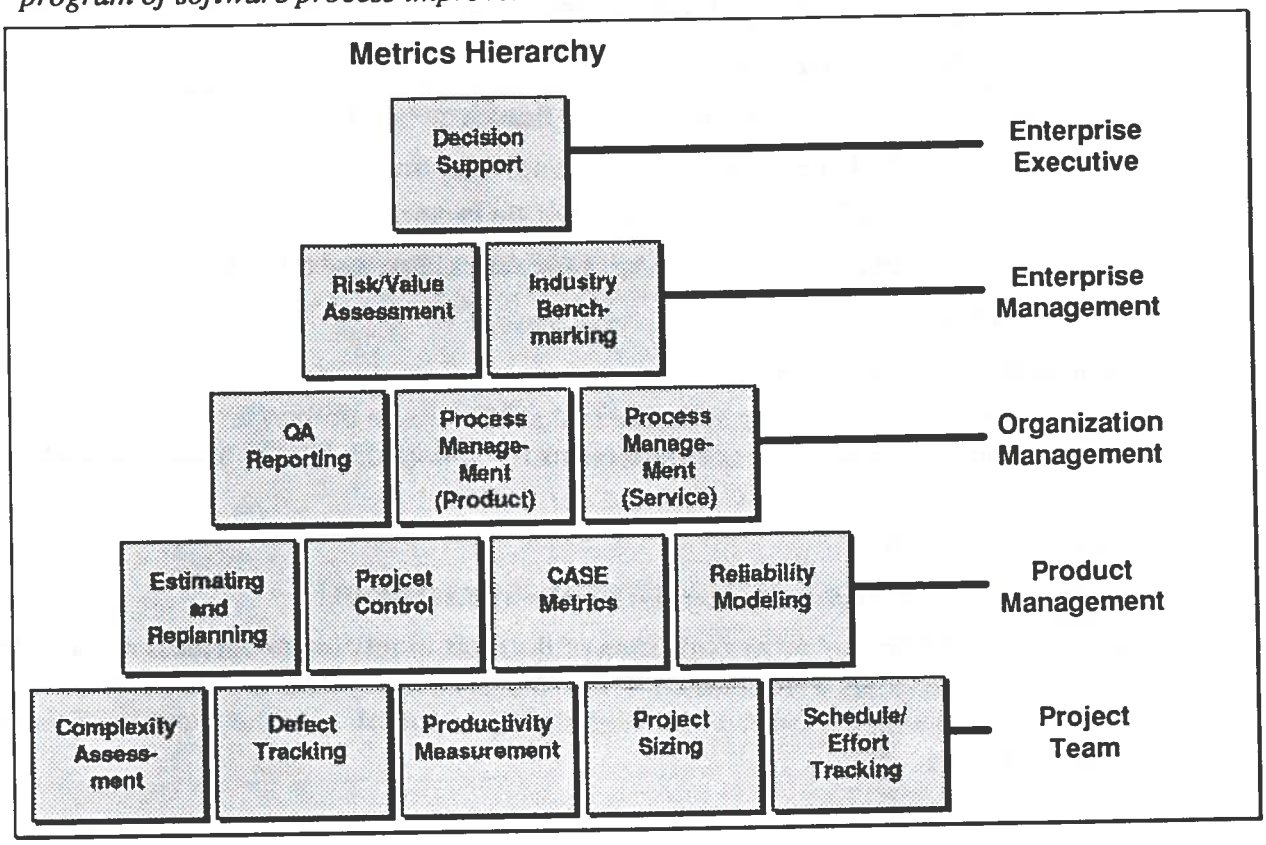

Figure 4. - GTEDS Metrics Hierarchy for Software Process

Specific measures that feed into the metrics hierarchy include the following:

- Development Metrics
  - Productivity Index
  - Estimate Error
  - Defect Containment Ratio
  - Mean Time to Defect
  - Lines of Code
  - Number of Inspection/Test Defects
  - Productive Staff Hours
  - Actual versus Estimated Schedule
- Production Metrics
  - Mean Time to Defect
  - Lines of Code
  - Equivalent Lines of COBOL Code
  - Basic Support Hours
  - Basic Support Hours per Defect
  - Defects per KLOC / (external) KLOC
  - % External Defects Completed on Time
  - % Defects Re-opened
- Other CASE Metrics (number of)
  - Graphical Entities
  - Graphical Components
  - Text Entities
  - Lines of Documentation
  - Parametrized Input Aids Defined / Reused
  - Data Elements Defined / Reused / Referenced
  - Reports and Screens Defined
  - Programs Generated
  - Lines of Code Manually Written

Complexity Matrix for Targeting Re-engineering Efforts

GTEDS has used the measured metrics for software process tracking to assess maintenance requirements for existing systems. The GTEDS Complexity Matrix displays different systems in relation to *Product Defects per KLOC* and *Project Support Hours per KLOC*. Systems that require a high number of hours to fix a defect and which have large numbers of defects that require maintenance are candidates for re-engineering. The Complexity Matrix provides a means for re-engineering opportunities that will have the greatest effect on reduce maintenance costs. The matrix is also used to track the effects of the re-engineering efforts.

Source: VA

The Veterans Benefits Administration (VBA) is using the information methodology and CASE tools from KnowledgeWare in its business process improvement effort. The VBA

used the models to help identify the information required to perform various business activities and chart the utilization of current information resources.

Source: AA

AA is exploring the use of:

- Artificial Intelligence (AI) Technologies: knowledge engineering, neural nets and other AI applications to be run on RISC-based platforms.
- Massively parallel processor technology.

AA eventually wants to transition to a gate link system. Digitized sensor data (e.g. engine performance, "black box" maintenance data, etc.) recorded during flight operations could be downloaded at the gate when the aircraft arrives (estimated data sets are 60-80 MBs). This would provide nearer real-time access to vital data to whomever needs it. *This concept is similar to FAA's new CIE Program called Intelligent Flight Quality Assurance (IFQA).*

Source: I-CASE

The DoD and the NIST joined forces to institute open systems architecture for I-CASE tools, the core enabler for heterogeneous software environments. The standard for the PCTE is one effort to achieve this objective.

The effort to develop open standards for software tools has unfolded in the midst of increasing frustration by both vendors and users with continuing delays in the DoD's I-CASE procurement. Kurt Fischer, DoD Deputy Director for Information Technology, said the proposed North American PCTE "is a key core technology for the...I-CASE Program as well as for other DoD software engineering projects."

PCTE will allow tools developed by different vendors to access the data contained in a CASE repository easily. This standard will allow tools to work across different CASE environments. Right now all vendors have a different way of handling this, the standard will allow for the interchange of tools.

The DoD estimates it will cost $10 million to establish the PCTE standard. DoD and NIST will work with the Object Management Group, a non-profit company that provides standard object-oriented technology, in developing the North American PCTE initiative. The standard will be based on an existing European Computer Manufacturers Association (ECMA) standard, known as ECMA-149, that is also accepted in draft form as an International Standards Organization standard.

This standard provides a set of basic services for software tools, and each of these sets of services supply capabilities referred to as "framework."

I-CASE Acquisition

The GSA has made I-CASE a Federal acquisition contract open to all government agencies (limited to 10% of the delegated procurement authority). Specifically, the FAA has the opportunity to:

- Purchase DoD I-CASE tools to support the FAA IT systems development and maintenance, or

- Use the I-CASE contract (RFP, evaluation criteria, etc.) as a model for a future acquisition of I-CASE tools by AIT.

The I-CASE acquisition is a major vehicle for DoD to implement standard software development production environment for all DoD developed information systems. Current CASE technology is not mature enough to establish the kind of open environment DoD wants.

The I-CASE contract award is slated in September 1993 with 19 pilot implementations to begin shortly after contract award. The I-CASE contract award was slated for May, but program officials said they needed more time because the bids are complex resulting in a longer evaluation than anticipated. The contract is being managed by the Air Force Standard Systems Center for all services and DoD agencies. The I-CASE requirements provide for a Software Engineering Environment (SEE) that will provide a migration path toward an open systems environment.

The procurement is structured so that the vendor will need to meet minimum requirements in the first year and define a migration path to meet a broader set of requirements. For example, the I-CASE procurement will allow for a proprietary environment at the time of contract award. Within three years of the award, however, the contractor will be required to migrate to an open systems environment. The migration strategy path towards integration of the requirements tool and the development tool (upper and lower CASE). Initial implementations are not likely to support such integration.

Internal Revenue Service (IRS)

Industry experts believe that the IRS will have to employ a minimum of six tools for each software "problem set." Multivendor integration, therefore, will be crucial to the IRS. *This same issue exists for the FAA environment which has many different application environments used in the agency (e.g. Tandems, IBM, NAS/ATC, etc.).*

The IRS is preparing an I-CASE procurement that will provide the agency with a standard toolkit for its $23 million Tax Systems Modernization (TSM) program. The agency hopes to field a comprehensive suite of tools--from reverse engineering to software maint e.

The IRS's pending procurement parallels the Air Force's I-CASE project. But the IRS has decided to award its own contract because of special requirements for CASE tool integration.

2.4.3 Key Lessons Learned

Source: DoD CIM Initiative

Key Lesson Learned: A standard assessment methodology must be applied to establish a baseline for software process improvement.

One of the main functions of DISA/CIM Software Process Improvement is to develop a capability to perform formal Software Process Assessments. This is in accord with DoD policy to require that "All DoD Central Design Agencies will perform self-assessments of their software development processes to establish a baseline of software practice." The product of the assessment is a baseline that leads to the formulation of an action plan for software process improvement. The goal is to perform 50 SPAs/year. As of March 1993, DISA/CIM has completed six SPAs.

Key Lesson Learned: Use of CASE must be mandated for the entire enterprise.

Key Lesson Learned: Address the training requirements for I-CASE implementations.

CIM recognizes the importance of introducing training in process change to support the implementation of CASE tools. For the 19 pilots that will implement tools derived from the I-CASE procurement, an I-CASE Readiness Program will be implemented to prepare the sites. CIM will carry out an assessment to identify site requirements for training and to identify other obstacles that may inhibit the movement toward a CASE environment.

Key Lesson Learned: Build on pilot projects and gain consensus on metric definition and implementation. Establish a management structure to implement metrics and integrate the metrics into all levels of project management and decision-making.

The DoD Metrics Program is beginning with the existing SEI Core Metrics and evaluating their utility in pilot projects. CIM is also working the GTE in relation development of a metrics hierarchy to address requirements of multiple managerial levels in software development. A consensus on metrics will be developed with the support of the DoD Information Management Software Metrics Council.

Key Lesson Learned: Effective implementation of software process improvement will require integration of processes and supporting technologies for CASE, Reuse, and Data Management.

DISA/CIM plans to develop a strategy and Concept of Operations for integrating Reuse, CASE, and Data Administration. It is recognized that the I-CASE tools must be interfaced to the data repositories, i.e. the DDRS and the DSRS. The I-CASE tools must support the full-suite of process and system engineering tools, including process simulation, functional decomposition, and data-oriented information engineering approaches.

Source: *GTEDS*

CASE Implementation

Key Lesson Learned: Avoid storing source code in the software repository.

What is reusable in a "software factory" is not the computer code, but the sets of requirements that define the component that is replicated in the system design. CASE tools should be viewed as a means to make the develop processes independent of specific language requirements.

The GTEDS software repository contains the requirements and specifications needed to generate the source code and executables incorporated into implemented systems. Combined with the GTEDS policy requiring production and use of reusable components, the policy of only storing requirements in standard CASE format encourages both the use of CASE tools and reusable components. The policy has the additional benefit of encourage software maintenance to focus on extending functionality with the CASE tool as opposed to improving source code in small increments.

Re-engineering

Key Lesson Learned: Re-engineering reduces the risk of missing essential functionality in a new application.

GTEDS has emphasized the value of re-engineering as opposed to new development. One of the major advantages of re-engineering is the reduced risk of missing functionality that was present in the original application. Properly structured the re-engineering process will generate repository resources, including data models and reusable components. Such products would be similar in utility to those produced by new development.

Reuse Policy

The establishment of a reuse repository is no guarantee of success for the application of that capability. GTEDS established a policy to promote reuse based on the following priorities:

- The corporation invests in the maintenance of reusable components.
- Reusable components are a required product of new applications development.
- Reusable assets will be integrated into legacy systems.

Source: VA

Once the process and data models were established (using CASE), the VBA used a statistical analysis software package to determine the "degree of association" between the models. This identified problems with the data and processes.

Key Lesson Learned: Using the re-engineering tools and methods, the VBA was able to eliminate redundant or unnecessary processes and data.

The agency reduced processes from more than 300 to 165 and data entities from 219 to 86.

Source: AA

Software Process Improvement

The Methods and Standards Group has responsibility for the establishing and support of the company's Standards Development Process. The group oversees CASE tools and training requirements.

Changes in the Process of Applications Development

AA is attempting to introduce fundamental changes in the way in which applications development personnel support the business operations. The rapid growth of personnel from 30K to 100K employees has produced an applications development organization in which 2000 developers support the operations of 50 corporate officers. The (stovepiped) nature of the operations has resulted in inefficient use of development resources and applications that fail to take advantage of opportunities for data and process integration.

Improvement in the process focuses on two areas:

- Prioritization of applications in relation to strategic business goals. The company's resources hadn't been allocated in relation to corporate objectives. SCS found, for example, that some projects situated in the top twenty in terms of strategic priority had as few as six staff members assigned.
- Breaking the organizational bonds that inhibit access to developers with required skills. In the past developers had been "owned" by the functional organizations and the corporate VPs responsible for the functional area. In the new environment AA is following the model of a consulting organization, developers are assigned on the basis of matching required skills and availability (e.g. a matrix organization).

Source: FEDEX

Limitations of Object-Oriented (O-O) CASE Tools

FEDEX's experience is that O-O CASE tools have not matured sufficiently to support their development process. The current state of CASE has not addressed the requirements of OOT in a distributed environment.

FEDEX has experimented with the use of CASE tools, but they did not realize the productivity gains they expected and discontinued the tests. OOT was considered an alternative to the use of CASE as a means to speed development and reduce future maintenance costs. The use of O-O techniques will require intense retraining of personnel to new methods of analysis and application development.

Objects as Enterprise Assets

FEDEX is building an enterprise wide set of objects to define the business and support development of required applications. The company considers the object models as a corporate asset just like the aircraft. In keeping with that view, FEDEX is using an accounting approach for tracking and maintaining the object-assets.

The recognized importance of the definition of the class hierarchy has led to intense debate on the characteristics of the object classes.

Objects and Reuse

FEDEX is developing a faceted classification scheme to support access to objects and their reuse in software development.

Use of OOT in Mission Critical Applications

The pilot project for the use of OOT is in the area of load-balancing of aircraft. Maintaining proper weight distribution is a mission critical area for FEDEX because of the sensitivity of the Airbus (the major transport medium) to weight imbalances.

Achieving Rapid Development Cycles

FEDEX has achieved quick cycle times for software development. Factors that contribute to the rapid development cycle include:

- Focus on business requirements
- Constant attention to process improvement

FEDEX Strategy for Implementing OOT

- **Training** - The use of O-O techniques will require intense retraining of personnel to new methods of analysis and application development. FEDEX found it was easier to retrain COBOL programmers than analysts trained in the C language. FEDEX allows for about one-year for training and integration of personnel into the software production process.
- **Use of Contractors to Maintain Legacy Systems** - In order to maximize internal capabilities, FEDEX personnel are trained to develop the mission critical systems. Outside contractors are hired to maintain existing applications.
- **Development of Detailed Plan for Evolving toward OOT** - FEDEX has developed a detailed migration strategy for introducing OOT. Applications development is planned in relation to the availability of FEDEX personnel who are trained in the required techniques.

Issues related to OOT

The environment in FEDEX was particularly conducive to the use of OOT because if its well-defined business mission and disciplined approach to software development.

Source: I-CASE

I-CASE Strategy

I-CASE becomes economically feasible when a single language monopolizes (e.g. C++, COBOL, or ADA) almost all application development. The variety inherent in the client/server world complicates this level of integration, but vendors have found at least two strategies to deliver I-CASE for client/server systems:

- One strategy links up with the most popular front ends, while the other requires vendors to deliver application generators of their own. PowerBuilder (a front end tool) from Powersoft has attracted integration support from a number of CASE vendors.
- The second approach to providing client/server I-CASE involves application generators provided by CASE vendors. Two vendors pursuing this strategy are Intersolv and Intellicorp.

I-CASE and Software Repositories

> ***Key Lesson Learned: Current repositories and CASE tools do not meet user's expectations. Since data is redundantly maintained across multiple workstations, the synchronization of updates can be a major effort.***

Most I-CASE tools and repositories were originally designed to support new applications development or forward engineering (e.g. Yourdon Structured Method and Information Engineering). The repository is populated as a by-product of analyzing business areas and developing applications.

Single-vendor I-CASE products exist that are based on repository concepts, but their conceptual repository model is usually proprietary and not extensible. Few I-CASE tools provide an application programming interface (API) language for establishing on-line

interaction between their CASE encyclopedia and third-party tools; therefore, batch 'bridge' technology must be used to upload and download repository data. More alliances and additional techniques will likely emerge over the next few years. In the long-term, future vendors will be producing integrated tools that automate the complete life cycle. This trend promises developers a broader and stronger suite of tools to build applications

DoD I-CASE Environment

The implementation of I-CASE is viewed as a key component of the DoD's DISA/CIM strategy to enhance productivity for software development and maintenance and improve the quality and reusability of the software products.

DoD Implementation Policy -- I-CASE will be required for "each military department and defense agency for all in-house, government development automated information systems." (DoD I-CASE Policy Letter, 27 Feb. 1992)

The I-CASE procurement, an I-CASE Readiness Program will be implemented to prepare the sites. CIM will carry out an assessment to identify site requirements for training and to identify other obstacles that may inhibit the movement toward a CASE environment.

Source: NCR

Key Lesson Learned: The FAA should review the NCR Architecture material for applicability to Architecture guidance being developed by AIT.

The enterprise infrastructure consists of open, industry-standard products and interfaces that provide easy, transparent access to strategic business information. Product life-cycle management is an integral part of the product evaluation process. The use of industry-wide standards maximizes the number and quality of products.

2.5. EDI

2.5.1 Description of Initiative

The EDI Initiative supports FAA implementation of EDI standards and technologies that are required to enable exchange of information in support of FAA business and mission requirements. Major objectives of the initiatives are:

- To establish standards, procedures and changes in business processes required for EDI applications within the FAA.
- To acquire and implement required EDI technologies, such as translation software, network interconnects, and database support.
- To develop an appropriate migration strategy for EDI implementation.
- To provide training and other required support for effective use of EDI.

Specific technologies and guidelines that may support EDI development in the FAA are identified below.

2.5.2 Technology Transfer Opportunities

Government Acquisition Through Electronic Commerce (GATEC)

A DoD pilot project called GATEC, will allow vendors to conduct business electronically using one of the Value Added Networks (VANs) participating in the project. GATEC was developed as a standard system (participation is open to Federal Agencies). It is an end to end connection tool, capable of communication with any/all standard procurement systems providing data to it. The development of the standard gateway will depend on a uniform DoD VAN agreement and the use of X.12 standards for transaction sets, X.400 telecommunications messaging standards, and the X.500 standard for directory access.

Via these VANs, vendors will have access to Request for Quotation (RFQ) issued (under $25,000) by any participating federal agency. RFQs will be issued as "public RFQs" accessible to any interested vendor. Similarly, public award summaries will be accessible via the VANs to inform interested vendors of awards made in response to RFQs.

Pilot project buyers may send an electronic RFQ to a specific vendor; as a public RFQ; or as both. Also, as is now the case, buyers may occasionally issue a purchase order of delivery order without competition.

The project is conducted using ANSI EDI X.12 standards and the acquisition network in which requests for quotation, bids, and awards flow back and forth through a prototype gateway was developed by (and is maintained by) the Lawrence Livermore National Laboratory (LLNL). LLNL is also responsible for testing each VAN for compliance with standards and conventions being used. Six firms have been qualified to participate in the project; Bell Atlantic, Datamix, AT&T EasyLink, EDI Able, Harbinger EDI, and Simplix.

EDI Guidelines and Procedures

The DoD is developing guidelines for the use of EDI and applications in which EDI can have a substantial impact on reducing transaction costs. The FAA should monitor DoD developments in this area.

Source: JCALS

Integration of Mission and Business EDI capabilities using the CALS Transaction Set 841

The JCALS Program uses multiple standards and technologies to support the exchange of data between distributed data sources and between different applications. JCALS will use EDI standards, in addition to other CALS standards, to support exchange of data with DoD contractors. The CALS EDI Transaction Set 841 is specifically designed to support transfer of documents and engineering data required for business functions such as contracting and supply.

The detail area can include graphic, text, parametric, tabular, image, spectral, or audio data. A transmission includes information to assist the receiver in interpreting and utilizing the information included in the transaction.

The detail area of the Specification/Technical Information transaction set provides a structure which allows for the exchange of a variety of specification information. For example, if the transaction contains information describing a complete assembly, it would

be necessary to include the assembly model, the models for each of the individual parts, and the associated specifications. This transaction set can also be linked to other transaction sets.

EDI transaction sets (e.g. 836, 840, 841, 843, 850, 856) can be used to combine business transactions with transfers of electronic documents and engineering data. *The EDI CALS Transaction Set 841 supports the exchange of technical documents, engineering drawings, and specifications, which can be used to support data interchange required for key logistics functions such as such as spares reprocurement, bidsets, provisioning, and supply by transferring CALS data between the Logistics Center and aviation industry partners such as NAS contractors and vendors. The use of these transaction sets integrates both business and mission EDI capabilities*

Interface to EDI VANs

JCALS Program provides an interface to commercial VANs that support EDI. The FAA should evaluate the use of this interface to support the implementation of EDI with NAS contractors, vendors, and aviation industry partners.

Source: ATA/AIA

> ***Key Lesson Learned: The FAA may be able to leverage some of the ATA 200/2000 EDI guidelines and infrastructures for their EDI applications.***

SPEC 2000 is an international specification covering procurement transactions for aircraft material acquisition, support, and repair which enables airlines and their suppliers to exchange information using a common language. SPEC 2000 is an advanced system designed in part to succeed SPEC 200 for administering and processing procurement data. The Program enables suppliers to list for sale, and purchasers to obtain access to information about those components and parts of aircraft, engine and supporting equipment parts and materiel that suppliers offer for sale. Both International and Domestic Airlines and Suppliers participate in the program by being a member of the ATA and paying nominal fees for the services and systems managed by the ATA.

Two of the functions of the Specification are widely used today to increase efficiency in the exchange of business information. These are:

- central procurement database -is a centralized electronic catalog composed of parts data from airframe, engine, avionics and component manufacturers, suppliers and distributors.
- order administration and invoice processing (EDI)

2.5.3 Key Lessons Learned

EDI Guidelines

The EDI enabling technology is automated information systems (AIS) independent, therefore, EDI can be implemented in support of all legacy systems. The keys to a typical EDI application include:

- The availability of universally accepted data formats, frequently referred to as EDI standards or *transaction sets*, to exchange business information.
- The accessibility of trading partners (i.e., vendors, carriers, and banks) to commercial VANs that receive store, and transmit EDI transmissions.
- The capability of all *trading partners* to automatically send, receive, and process purchase-order, shipment, and payment information.

The wide availability of EDI transaction sets stems primarily from the efforts of two standard groups: the Electronic Data Interchange Association (EDIA) and ANSI. In 1979, ANSI formed the Accredited Standards Committee (ASC X12) to develop uniform standards for electronic interchange of business transactions. Those standards are now widely used by U.S. and international industries.

A successful EDI system does not depend on technology; it relies on a strong business relationship with the trading partner. It has to be truly a partnership agreement because it involves a commitment to a long-term investment, to refine the system over time. An organization should not initiate EDI Projects by sending transactions back and forth; it should review and rethink about the whole process, end-to-end. The implementation of **EDI will require a fundamental change to business processes (i.e. BPI).** Plan for resistance and develop contingencies.

Training and education on how EDI concepts enhance business operations and promote electronic commerce are important elements for the successful implementation of EDI throughout the FAA. Training is an investment which usually requires a change in an organization's paradigm.

Key Lesson Learned: Every prospective EDI project needs to be supported by a business plan.

That plan consists of the following three parts:

- An **opportunity assessment process** that identifies the paper documents dominating an organization's workload; evaluates the organization's and all trading partners' computers' capabilities for sending, receiving, and processing EDI transactions; presents an understanding of the business effects of replacing specific paper documents with electronic transmissions; and, based on these results, formulates a list of promising EDI applications.
- An **economic analysis**, building upon an operating concept for each EDI application, that includes the calculation of direct and indirect cost savings, investment costs, and rates of return for each EDI application under consideration. These calculations yield a list of potential EDI applications in order of priority.

- An **implementation plan** that identifies, sequences, and schedules all of the events necessary to implement the organization's most promising EDI applications (EDI can be used for *all* business functions).

Merger of EDI and CALS

Key Lesson Learned: EDI and CALS approaches should be merged to address the information required to carry out business transactions.

"No doubt whatsoever, EDI promises high levels of savings in business transactions. Beyond that I see a need to progressively merge CALS and EDI initiatives." -- MGEN. Baldwin, Defense CALS Executive.[1]

While CALS and EDI have different origins, one in the DoD and the other in the commercial environment, the objectives of both are to improve business processes by facilitating exchange of data among individuals and organizations involved in business transactions. The strategies for CALS and EDI should, therefore, be coordinated to achieve the business objective as opposed to implementing existing or proposed standards.

EDI Methodology

The description of the five-step methodology that is used to identify an organization's most promising opportunities and the conditions that must exist for the implementation of EDI to be both practicable and beneficial is described below.

Step One: Select Key Documents

Much of the savings from EDI occur because electronic processing of documents is less costly than manual processing. As a consequence, the number of times that an activity sends or receives a particular document **(i.e., its transaction volume) is the primary criterion in selecting documents for potential transmission by EDI**. However, volume is not the only consideration. Other criteria require that the document be used extensively throughout the FAA, be handled by several departments within the organization, and be supported by an existing EDI transaction set.

Step Two: Assess the Capabilities of Internal Systems

Following the identification of the best candidates for EDI, the activity assesses its system capability to electronically send, receive, and process business documents. Without this capability, EDI is little more than a telecommunications method - which could lead to higher rather than lower processing costs. For each document or category of documents, a variety of information must be obtained: the automated system currently supporting processing of the document; the hardware, software, and operating system configuration of the current systems; and any planned enhancements to that system (with EDI initiatives singled-out for additional detail.)

Step Three: Assess the Capabilities of Trading Partners

Each organization needs to estimate the investment required by its external trading partners to implement EDI, following the same methodology described here:

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[1] *CALS/CE Report*, vol. 6, no.1, January 1993, Knowledge Base International, p.4.

For each candidate document, specific information must be listed: the external activity with which the document is exchanged; the capability of those systems to send, receive, and process EDI transactions; and the number of documents exchanged each year. The organization also **lists the number of trading partners required to reach a 70 to 80 percent implementation level (in terms of the number of transactions) for the documents. (Many private-sector firms use this range as the "critical mass" level for achieving the economies of scale associated with EDI.)**

Step Four: Review Business Practices and Workflows

In determining whether a document is a good candidate for EDI automation, each organization needs to consider its specific business practices. For example, before making a payment on an invoice, many activities require a record of acceptance showing that delivery has occurred and that the material received is not defective. If invoices are received electronically and, say, acceptance notices are received manually, the number of late payments could actually increase rather than decrease using EDI. Many private-sector companies have found that they cannot make effective use of EDI without changing their internal business practices and workflows (i.e., BPI).

Step Five: Summarize EDI Opportunities

Based on the information collected in the four steps described above, the organization summarizes its findings about EDI opportunities. For each document, the organization lists the corresponding EDI transaction set, the volume rating, the EDI capability of the internal automation systems, the ratings for external trading partners, and the business practices rating. Using this information, the organization then assigns an overall opportunity rating to each document.

VANs

Key Lesson Learned: VANs provide those services needed to facilitate EDI procurement between the federal government and the vendor community.

Businesses can exchange data either by connecting to each other directly or by hooking into a VAN. A VAN is a communications network that typically exchanges EDI messages among trading partners and provides other services that include holding messages in "electronic mailboxes," interfacing with other VANs, and supporting many telecommunications modes and transfer protocols.

VANs provide many services. Since cost is always a big factor, it is advisable to closely scrutinize what the startup and continuing costs of VAN service really are. VAN services are offered by the GSA and DoD is developing a means of interchanging data internally, with private industry, and with other Federal Agencies - with minimum impact on its installed systems.

The DoD EDI architecture is based on the principles of open systems. The common approach requirement is being satisfied through the use of distribution points that provide connectivity between the DoD EDI Gateway and EDI VANs that have entered into a license agreement to communicate DoD (government agency) EDI data to and from their subscribers.

Source: VA Initiative

Key Lesson Learned: One of the most significant impacts EDI will have is its ability to improve the work flow through an organization. It is not uncommon for a document to be the genesis for two or more unrelated processes which could be performed "simultaneously" by different functional groups.

Key Lesson Learned: Functional users must be actively involved in EDI planning, testing, and implementation projects.

The VA has worked closely with the Office of Management and Budget (OMB) in the pre-review/approval for funding process for their EDI projects. The VA IRM does not control funding, which makes their task more difficult as they must convince the applicable program office(s) that would benefit from the proposed EDI project to submit the appropriate paperwork.

VA, using EDI transactions, has taken supply out of the acquisition process and they have their prime vendors 'drop ship' goods (e.g. medical supplies) directly to the VA field office. VA has eliminated the need for the vendor to deliver the goods to their depot for inchecking and for the depot to reship the item(s) to the field office(s).

Regarding mission EDI, Mr. Bob Woods (formerly worked in AT and AMS for 6 years before moving to his present position of Deputy Assistant Secretary for Information Resources Management at VA) thought that 'weather data' would be an excellent opportunity for the FAA.

Using EDI to streamline invoice processing offers improved efficiency in work processes, improved data accuracy, and significant savings through increased capture of vendor-offered discounts and improved compliance with the Prompt Payment Act (PPA).

In addition to workflow improvements, significant benefits should be realized in:

- Avoiding mispayments;
- Eliminating Bills of Collection; and
- Eliminating invoice processing backlogs.

Benefits associated with using EDI to process Government Bills of Ladings (GBLs) include reduced postage and paper-processing costs, improved payment audits, and improved ability to meet PPA time frames.

The Federal Government faces many of the same processing problems as does private industry and can learn from private industry's experience. Analysis of root causes, or performance drivers, for customer dissatisfaction and waste in existing processes contributes to an assessment of current effectiveness.

EDI Opportunity Descriptions:

VA EDI initiatives identified that could be relevant to the FAA are electronic invoicing and payment information for goods and services and the exchange of GBLs.

Source: FEDEX

FEDEX has an active program for invoicing customers through EDI. The Commerce Department's National Technical Information Service (NTIS) is among the federal agencies and private companies participating in the program.

The EDI setup at NTIS bar codes the shipments and once a package is sent (approximately 500 to 600 packages per week) FEDEX generates an X12 transaction set for air freight details and invoicing. NTIS later responds by transmitting an X12 transaction set that specifies payment.

Participation in Data Exchange with FAA

FEDEX is very interested in developing programs that support electronic exchange of information that is now supplied in paper format to the FAA. The company understands the advantages in terms of cost savings, e.g. automating the coding and tracking of air bills and manifests eliminates mounds of paperwork and improves bill reconciliation(i.e., bills get paid on time, and improved quality of the information).

Business EDI

Source: ATA/AIA

ATA SPEC 2000/ANSI X12:

ATA administers and maintains an automated information system known as the S: ication 2000 Pro: m SPEC 2000 is an international system covering procurem... transactions for aircraft material acquisition, support and repair which enables airlines and their suppliers to exchange information using EDI. More specifically, SPEC 2000 covers:

- initial provisioning
- spares procurement
- order administration
- invoicing
- inventory forecasting
- performance reporting
- repair administration
- bar coding

SPEC 2000 is an advanced EDI system designed in part to succeed SPEC 200 for administering and processing procurement data. The Program enables suppliers to list for sale, and purchasers to obtain access to information about those components and parts of

aircraft, engine and supporting equipment parts and materiel that suppliers offer for sale. Both International and Domestic Airlines and Suppliers participate in the program by being a member of the ATA and paying nominal fees for the services and systems managed by the ATA. The software used for the SPEC 2000 program was created by Multilink EDI, Ltd. (a British software company).

Two of the functions of the Specification are widely used today to increase efficiency in the exchange of business information. These are:

- central procurement database -is a centralized electronic catalog composed of parts data from airframe, engine, avionics and component manufacturers, suppliers and distributors.
- order administration and invoice processing (EDI)

Implementation Guide

The *ATA SPEC 2000/ASC X12 Implementation Guide for Electronic Data Interchange* was developed by a joint EDI Task Force of the ATA and AIA. The Task Force consisted of representatives from the North American and international airlines and aerospace manufacturers, including users of both ATA SPEC 2000 and ANSI ASC X12 standards.

The Implementation Guide, which was developed as a companion to SPEC 2000, deals specifically with the format for electronically exchanging order administration, invoicing, and payment order/remittance advice information between trading partners. In order to comply with the Implementation Guide, it must be used in conjunction with the ATA SPEC 2000 Main Document and Data Dictionary, which defines the business practices and data definitions used in the procurement of aircraft spare parts.

The SPEC 2000/ASC X12 EDI Task Force effort worked to maintain comparability of information contained in the two standard formats; the Implementation Guide applies to the communications between trading partners regardless of their internal application systems. The aim of the Implementation Guide is to make execution of EDI in either or both standards straightforward and nearly transparent to the user.

Mission EDI

Master Minimum Equipment List (MMEL)

> ***Key Lesson Learned: The MMEL program would benefit from CSA guidelines on SGML and other related standards.***

The MMEL describes the equipment that needs to be functional before an aircraft is dispatched. The FAA generates a MMEL for each type of aircraft. This is updated frequently based on input from the airlines, manufacturers, and flight inspectors. Notification of updates is made by computer-generated post cards. The actual MMEL is posted to an electronic bulletin board and to COMPUSERVE where it can be retrieved by the airlines. The bulletin board pages are not in the multi-column tabular form that can be used by the airlines and reformatting by each recipient is necessary.

The MEL (Minimum Equipment List) is the tailoring of the MMEL by the aircraft operators.

There are two different types of updates to the MMEL. Unrestricted updates do not require a change to the operator's MEL. Restrictive updates require changes to the MEL. Ancillary documents that could be converted to SGML -- Flight Standards Board, Maintenance Review Board, and Configuration Maintenance documents. *MMEL's provide the FAA an opportunity as a Mission EDI application.*

Service Difficulty Reports (SDRs)

> ***Key Lesson Learned: If the FAA could transmit SDRs electronically -- it is likely that the other carriers would be willing to submit their SDR electronically. SDRs provide the FAA an opportunity as a "mission" EDI application.***

Aircraft operators and repair stations submit SDRs and Malfunction Defect Reports to the FAA. The SDR program objective is to help airline and FAA personnel to promptly correct conditions that could adversely affect air safety. Most of these are submitted in hard copy. The consolidated SDR's are published on a weekly basis in hard copy. Some key problems identified with the current procedures are:

- Information that one airline considers reportable may go unreported by another airline;
- Useful information does not reach subscribers for over 6 weeks because of delays in manual data processing through a paper-based system; and
- FAA does not analyze the data, as required by FAA policy, to detect malfunctions trends in specific aircraft models or focus the efforts of FAA's inspection workforce because of insufficient staff and unreliable data.

Currently 8 carriers submit SDRs electronically, using a template developed at The Aeronautical Center. The FAA does not have the capability to transmit SDR's back to the airlines. Every week, 2 versions of the SDR are sent out to the 1,500 subscribers.

Source: DoD CIM Initiative

Some key lessons learned from the DoD experience include the following requirements for successful implementation:

- Fundamentally changing business processes and organizations that depend on manual transactions;
- Establishing DoD-wide standards for EDI that conform to industry implementations;
- Implementing standards for the content of EDI messages that are integrated with the standard data definitions, structures, models, contained in the DoD repository (DDRS).

The overall implication is that *realizing potential EDI benefits requires the support of the other CIE initiatives* to establish standards (Core Architecture), change business processes (BPI), integrate EDI content with other data (Data Management), modify applications to build in standard EDI components (Corporate Software Engineering); establishing security for EDI messages (IT Security).

2.6. IT SECURITY

IT Security - This initiative supports the implementation of requirements for controlled access and physical security of data and information systems.

2.6.1 Description of Initiative

The IT Security Initiative supports the implementation of requirements for controlled access and physical security of data and information systems. Specific objectives are:

- To develop a Security Architecture Framework including appropriate requirements and standards;
- To define an implementation strategy to test potential solutions;
- To support acquisition of technologies needed to implement security requirements.

2.6.2 Technology Transfer Opportunities

Source: DoD CIM Initiative

The DoD is examining products that support secure access to servers in a TCP/IP environment.

- DoD 8320.1-M-2 - DoD Data Security Procedures

Source: JCALS

Multilevel Security

JCALS provides support for MLS Plus security levels. CSC has been collaborating with DEC to provide for a distributed security capability for JCALS sites. Because of DoD requirements, JCALS is likely to make significant progress in the implementation of secure relational databases in a POSIX environment. *The FAA may want to evaluate this implementation for its own security applications.*

Source: EDI Initiative

As with paper documents, care must be taken to ensure that EDI messages are authentic, properly authorized, and traceable; the messages also need to be protected from loss, modification, or unauthorized disclosure both during transmission and storage. **Major EDI software vendor packages include access security measures (passwords, electronic signatures, and so on) for disguising EDI data for secure electronic data transfer between organizations; Encryption - ensures data confidentiality; and Authentication - ensures data integrity.**

2.6.3 Key Lessons Learned

Source: EDI Initiative

Use of EDI will have a profound effect on auditing activities, as shown in Table 4. With these issues in mind, the information systems can be designed to account for the changes available by EDI.

Source: AA

Electronic Signatures

AA regards the implementation of electronic signatures as a major opportunity to support business transactions with the FAA and other organizations. The definition of an appropriate standard will have to be an industry-wide effort.

Source: FEDEX

FEDEX has taken steps to provide better customer service by allowing their large accounts direct inquiry access to their parcel tracing system.

> ***Key Lesson Learned: Security is the most difficult problem for the FEDEX open systems program.***

FEDEX is working with the Object Management Group (Framingham, Ma.) on security issues.

Auditor concerns	Effect of EDI	Changes
Payment validation		
• Reconciliation of invoice, purchase order, and receiving documents to assure correct payment amount.	• All of these documents are now computerized. Lack of paper changes the validation process.	• Automate the validation process - in fact, this time savings is a key benefit of EDI.
Audit trail of activity		
• Tracking data flow within the organization. • Recording authorizations	• Computerized data changes information security procedures. • Lack of paper includes paper backup files. • EDI data flow can be documented internally, between organization and EDI VAN, and between organization and trading partner.	• Replace signatures with codes and IDs; electronic signatures are also an option. • Date/time stamp all activity and attempts to access the information system. • Maintain a specific audit trail database. • Require identification of terminal/PC to track point of access.
Order/payment control		
• Insuring only authorized sources can place orders and initiate payments.	• No authorization "sign-off."	• Create safeguards parallel to those of paper systems. • Require password access to the system. • Incorporate "reasonable checks" into the system ("Is it reasonable th[illegible] were ordered for home delivery to John Smith?") • Emphasize user training to reduce system errors.
Correspondence of accounting records with actual transaction		
• Insuring that internal organization data reflects actual inventory and dollar figures.	• All files are computerized; no paper backup to verify records.	• Spot check actual transactions versus system files. • Verify assets with different (that is, non-EDI) data.

Table 4 - EDI Impact on Auditing

2.7. SUMMARY

One of the objectives of the Architecture Survey was to gain an understanding of the current view of "best practice" in the management of information systems. The results of this task is quite consistent with the results of a study of the GAO on best practice for IRM. A major finding is that there is an emerging consensus on the criteria for success in IRM for an enterprise. These criteria include:

- Constant attention to BPI to enable the use of information as a strategic resource;
- Use of decision tools to prioritize IRM investments in relation to business objectives;
- Involvement of functional managers in the process of strategic planning for the business and for IRM;
- Visible top-down commitment to change in business practices and the use of IRM.

The FAA should build on this experience and on the other guidelines and other success factors that pertain to specific initiatives, which have been identified in the previous sections.

Interdependence of the CIE Initiatives

The effort to define the requirements of the six CSA initiatives can sometimes obscure essential interrelationships. The Architecture Survey has confirmed the need to view the initiatives as mutually dependent sets of requirements for achieving the objectives of the FAA CIE.

For example, the experience of the VA, DoD, and industry organizations indicates that EDI offers the FAA an opportunity to realize enormous benefits in relation to the required investment. The success of EDI applications, however, depend on parallel capabilities produced by the other CIE Initiatives. EDI depends on changes in business processes to provide and make effective use of rapid delivery of electronic data. The content of EDI transactions needs to be integrated into other FAA IT applications via the Data Management Initiative and the use of the FAA Information Repository. Corporate Software Engineering must support efficient generation of EDI-based applications, and IT Security has to provide access controls, electronic signature functions, and protection of sensitive EDI applications. *The potential benefits of EDI can, therefore, be considered one of the major justifications for integrated implementation of the CIE Initiatives.*

Another example of interdependency is the relationship between Data Management and Corporate Software Initiatives. Standardization of data elements via the information repository has an important impact on complexity, reliability, and speed of software development. Reciprocally, the use of CASE tools and reusable software components can assist the enforcement of data standards. Data Management strategies for the FAA and the repository becomes a key mechanism for integrating the data and applications development. There should, therefore, be close coordination of the Data Management and Corporate Software Engineering Initiatives.

Integrating Role for Information Repository

Because of these interrelationships, the FAA Information Repository along with the Core Architecture standards, takes on particular significance as an integrating mechanism for the CIE. The Information Repository will provide a mechanism for integrated data associated with the other Initiatives. Process models, data models, software metrics, software component attributes, data standards and rules, formats and forms, application requirements, security requirements are all interrelated. The Information Repository provides a means to maintain consistency among the related classes of information that support the FAA mission.

Need for Detailed Evaluation of Technologies Identified in Architecture Survey

The Architecture Survey identified a number of technologies and products, such as data and software repositories and policy documents, that the FAA can apply to the CIE Initiatives. It must be emphasized, however, that further evaluation will be required to establish value-added to FAA and to identify requirements for adapting the outside capabilities to the FAA environment. These opportunities for technology transfer are discussed in individual CIE Initiative Sections. A summary of key technologies and recommendations for FAA actions are given in Section 3, "Next Steps".

The following chart (Table 5) provides a summary of major technology transfer opportunities and lessons-learned that have been identified in the Architecture Survey.

Table 5. Summary of Survey Results for CIE Initiatives

	Technology Transfer Opportunities	Lessons Learned
Core Architecture	• ***DoD use of POSIX 1000.3 standard/Application Profiling process.*** • ***CIM TRM as basis for FAA TRM and definition of OSE reqs.*** • ***CIM Architecture Docs. - "Technical Architecture Framework for Information. Mgt."*** • ***DMR Standards Based Arch. (SBA) Methodology*** • DISA/CIM SETA SOW for contract requirements for all CIE Initiatives • DoD DTIS and ITRUS programs for acquisition of commercial products and consulting services • ***Use of CALS standards for exchange of technical information and other logistics data*** • ***Use of ANSI 841 Spec. and other EDI Transaction Sets for data exch. stds.*** • Use of AFCAC 300 Supermini Acquisition for contract reqs. and/or mid-range systems acquisition	• Use the TRM as a means to build consensus on OSE requirements. • Establish a visible commitment from top management. • Process of architecture definition must involve and benefit non-technical managers who will implement enterprise-wide requirements. • Avoid massive inventory effort because the baseline changes more rapidly than a detailed assessment would warrant.
Business Process Improvement	• ***DoD Repository for process modeling*** • IDEF standards • IDEF repository for process models • ***DoD CIM BPI methodology and tools***	• Establish metrics and rewards for BPI process implementation. • Address organizational requirements for implementing BPI recommendations. • Establish metrics and rewards for BPI implementation

Data Management	• ***JCALS GDMS capabilities to link diverse types of data in a distributed environment to support requirements of FAA Information Repository and ADDM*** • ***JCALS DTDs can be tailored for use by FAA ADDM program and implementation of CALS document standards*** • ***DoD Data Administration policies and procedures*** • ***Use of DoD data standards*** • DoD DDRS for FAA Information Repository ◆ Repository mgt. SW ◆ Data models and definitions	• There needs to be close coordination of strategies for the DM and Corp. Software Eng. Initiatives ◆ Data element stds. improve s/w development. ◆ CASE tools help implement data stds. • Derive class names and naming conventions from Enterprise Model • Developed integrated repository for metadata, software reuse, and process models • Information Repository is key integration mechanism for products of all Initiatives
Corporate Software Engineering	• ***Use of I-CASE contract to support FAA acquisition of CASE tools and/or as a model for AIT CASE contract documents. (9/93 contract award)*** • IRS I-CASE acquisition • ***GTEDS Hierarchical Metrics for s/w process improvement and reuse*** • GTEDS use of PACBASE for integrated data and s/w reuse repository • GTEDS use of LEVERAGE and PACBASE for upper- and lower-CASE tools	• Define enterprise-wide standard methodology and metrics for s/w development. , re-engineering, and reuse. • Apply metrics to all levels of mgt. • Define model for reuse decisions and integrate into s/w dev. process improvement • Store requirements not code in the reuse repository. • Investment in training is critical to success of CASE. • Use of OOT requires large investment in training and carefully designed migration strategy.
Electronic Data Interchange	• ***The ANSI EDI 841 Specification can enable the FAA to support mission EDI functions , e.g. spares re procurement, requiring exchange of technical information such as engineering drawings.*** • ***FAA can apply ANSI X.12 transactions sets to support current business operations, e.g. procurement and contract administration.*** • ***Use DoD pilot, GATEC to provide access to commercial EDI Value-Added Networks*** • ***Use of ATA/AIA SPEC 2000 to support EDI between FAA and aviation industry partners***	• EDI success depends on support from the other initiatives. • EDI savings will be realized through changes in business process.
IT Security	• GTEDS implementation of multi-level security	• Effective use of EDI requires implementation of method for electronic signatures.

***Documentation, software and other resources that the FAA may be able to leverage are highlighted.**

3. Next Steps

The results of the Architecture Survey indicate that the FAA is approaching problems and opportunities in IRM that are similar to those of many government agencies and private companies. The task of implementing the CIE Initiatives will be greatly facilitated by making use of the experience of these organizations, as well as the methods and techniques they have used to enhance the value of information to their business processes.

Some of these technical capabilities, including various standards, databases, and policies have been developed with government support and can be made available to the FAA at little or no cost. What must be emphasized, however, is that the Architecture Survey has only identified potential candidates for use by the FAA. It will be necessary for the FAA to assess these technologies more thoroughly in relation to the FAA strategy for IRM and the strategies of the individual CIE Initiatives. Key technology transfer opportunities, systems, and procurement vehicles that should be investigated further are described below:

DoD CIM Products

The CIM Initiative has produced methods and tools that are relevant to all the CSA initiatives. Of particular significance to the FAA are the following:

- TAFIM - The documents supporting the DoD OSE include the DoD TRM that can be a basis for the definition of standards and other requirements for the FAA OSE.
- Standards-Based Architecture - The process for defining architecture requirements, developed by DMR, Inc. has been use by the DoD and is available to other government agencies.
- Data Administration Procedures (DoD 8320.1-M) - The DoD policy for Data Administration can be a basis for a similar policy for the FAA in support of the Data Management Initiative. The FAA may also want to examine related policies for Data Standardization and the use of the DDRS that supports implementation of the data management strategy.

JCALS Technologies for Management of Electronic Documents (ADDM) and other Logistics Information

The products of the DoD JCALS Program may provide key technologies for the FAA ADDM Program as well as support for the CIE Core Architecture and Data Management Initiatives.

- JCALS GDMS - The GDMS provides a means to locate and link data in the JCALS distributed database environment (approximately 250 sites). The FAA should evaluate the GDMS for applications to the Data Management Initiative Information Repository. The GDMS can also provide integrated access to electronic documents and related data such as engineering graphics, a capability required for the FAA ADDM Program.
- Implementation of CALS Standards and JCALS tools- JCALS is the first large-scale implementation of CALS standards. The development of tools that support CALS standards can apply to both the CIE Core Architecture Initiative and the ADDM Program.

EDI

EDI standards and technologies provide an excellent opportunity for large savings in business processes now dependent on paper-based data exchange.

- Transaction Sets for procurement and contract administration - The FAA can make use of existing standard Transaction Sets for current business requirements, e.g.
  - ANSI 850, Purchase Order
  - ANSI 840, Request for Quotation
  - ANSI 810, Invoice
  - ANSI 859, Freight Invoice.

The FAA has an opportunity to implement these standards and achieve substantial benefits that have been demonstrated by such organizations as the VA and DLA.

- Transaction Set 841 - Along with other EDI specifications, the ANSI 841 transaction set provides for exchange of engineering drawings, documents and other logistics data that can support FAA applications including spares re procurement bidsets, provisioning, and supply. This transaction set would allow transferring CALS data between the Logistics Center and aviation industry partners (e.g. NAS contractors, DoD contractors, etc.) The FAA should evaluate use of ANSI 841 to support these and other "mission" EDI applications.
- GATEC - The DoD pilot permits access to commercial VANs in support of EDI data transmission.
- ATA/AIA Specification 2000 - The ATA/AIA system provides a means for using EDI specifications to exchange data between the FAA and aviation industry partners, such as the airlines, aircraft manufacturers, and state aviation agencies.

GTEDS Technologies for Repositories and Software Process Improvement

GTEDS has implemented a number of methodologies and industry products that the FAA should evaluate for application to the Data Management and Corporate Software Engineering Initiatives.

- Integration of Software and Data Repositories - GTEDS has implemented a repository for both reusable software components and standard data elements based on PACBASE (CGI, Inc.). The technologies and approach to supporting applications consolidation and software process improvement, in a client-server environment, should be evaluated for corresponding use within the FAA.
- Software Process Metrics - GTEDS has developed a hierarchical set of metrics for monitoring software development and integrating software development processes with management of IRM. The DoD is evaluating the GTE approach for use in software process improvement.

DoD Supermini Acquisition (AFCAC 300)

The DoD Supermini Acquisition provides a potential procurement vehicle to support the implementation of a client-server architecture within the FAA. The Supermini Acquisition can be used to:

- Purchase equipment to support the Core Architecture, "Functional Technology Services," and the objectives of the FAA AIMS. The FAA should evaluate this vehicle with respect to client-server mid-range requirements that are not satisfied by OATS and CORN, and/or
- Assist with the development of acquisition documents (RFP, evaluation criteria, etc.) required for the AIT-500 AIMS initiative.

DoD I-CASE Procurement

The DoD I-CASE Program offers potential support for the FAA Corporate Software Initiative in the following areas:

- Definition of CASE requirements - The I-CASE procurement provides a model for future acquisition of CASE tools by AIT.
- Integrated CASE tools - The FAA may be able to use the procurement as a vehicle for acquisition of required technologies for software process improvement. The DoD experience may also provide insights and lessons/learned on what to avoid in relation CASE implementation.
- I-CASE Readiness Program - The DoD has established a program to prepare sites for CASE implementation. The FAA may be able to build on this experience for its effort to meet training and other requirements for the introduction of CASE tools.

Recommended FAA Actions

In order to make use of these technologies, systems and procurement vehicles, the FAA should take the following steps:

- Establish FAA CIE strategy that will define the migration path and priorities for achieving CIE objectives. Because of the interdependence of the CIE Initiatives,
- Analyze Initiative interrelationships and use the analysis as a basis for CSA program planning
- Evaluate identified Architecture Survey technologies and guidance in relation to the CIE strategy
- Use the ADDM program as a vehicle for demonstrating the feasibility and value of key CSA technologies such as CALS standards and integrated access to distributed information via an information repository.

ACRONYM

AA	American Airlines
ADDM	Automated Documentation, Development and Maintenance
AFCAC	Air Force Computer Acquisition Contract
AI	Artificial Intelligence
AIMS	Advanced Information Management System
ANSI	American National Standards Institute
API	Application Programming Language
APP	Application Program Profiles
ATA/AIA	Air Transport Association/Aerospace Industries Association of America
BPI	Business Process Improvement
CAFE	Controlled Access Folder Executive
CALS	Computer-aided Acquisition and Logistics Support
CARDS	Central Archive for Reusable Defense Software
CASE	Computer Aided Software Engineering
CD-ROM	Compact Disk-Read Only Memory
CGM	Computer Graphics Metafile
CIE	Corporate Information Environment
CIM	Corporate Information Management
CIS	CASE Interchange Standard
CITIS	Contractor Integrated Technical Information Support
CMM	Capability Maturity Model
CORN	Computer Resources Nucleus
COTS	Commercial Off-The Shelf
CSA	Corporate Systems Architecture
CSRCs	CALS Shared Resource Centers
DBMS	Database Management System
DDI	Director of Defense Information
DDRS	Defense Data Repository System
DISA	Defense Information Systems Agency
DLA	Defense Logistics Agency
DMRDs	Defense Management Review Directives
DoD	Department of Defense
DPA	Delegated Proceurement Authority

DSRS	Defense Software Repository System
DTD	Document Type Description
DTIC	Defense Technical Information Center4
DTIS	Defense Technical Integrated Services
EC	Electronic Commerce
EDI	Electronic Data Interchange
EDIA	Electronic Data Interchange Association
EDIFACT	Electronic Data Interchange for Finance, Administration, Commerce, and Trade
EIA	Enterprise Information Architecture
EM	Entripise Model
EMS	Electronic Meeting Software
FAA	Federal Aviation Administration
FEA	Functional Economic Analysis
FEDEX	Federal Express
FIPS PUB	Federal Information Processing Standards Publication
GAO	Government Accounting Office
GATEC	Government Acquisition Through Electronic Commerce
GDMS	Global Data Management System
GSA	General Services Administration
GTEDS	GTE Data Services
GUI	Graphical User Interface
I-CASE	Integrated Computer Aided Software Environment
IETM	Interactive Electronic Technical Manual
IRM	Information Resources Management10
IRS	Internal Revenue Service
IS	Information Systems
IT	Information Technology
ITRUS	Information Technology Reuse Service
JCALS	Joint Computer-aided Acquisition Logistics Support
JEDMICS	Joint Engineering Data Management Information and Control System
KDP	Key Decision Point
LMI	Logistics Management Institute
MEL	Minimum Equipment List

MMEL	Master Minimum Equipment List
NAS	National Air Space
NCR	National Cash Register
NIST	National Institute for Standards and Technology
NPI	NAS Program Initiative8
NTIS	National Technical Information Service
O-O	Object Oriented
OATS	Office Automation Technology and Services
OOT	Object Oriented Technology
OSE	Open Systems Environment
PCTE	Portable Common Tool Environment
POSIX	Portable Operating Interface for Computer Environemnts
PPA	Prompt Payment Act
RFP	Request For Proposal
RFQ	Request For Quotation
SBA	Standards Based Architecture
SCS	SABRE Computer Services
SDR	Service Difficulty Report
SETA	Systems Engineering and Technical Assistance Support
SFQL	Structured Full Query Language
SGML	Standard Generalized Markup Language
SOW	Statement of Work
SQL	Structured Query Language
T-Mail	Technical Mail
TAFIM	Technical Architecture (4)
TRM	Technical Reference Model
VA	Department of Veterans Affairs
VAN	Value Added Network
VBA	Veterans Benefits Administration