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Architecture Survey Summary Report

Final Report

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Executive Summary

FAA Corporate Systems Architecture Initiative

The FAA Corporate Systems Architecture (CSA) Initiative is intended to enable the FAA to enhance the efficiency and effectiveness of the use of Information Technology (IT) throughout the FAA as well as meet specific federal mandates such as the implementation of open systems environment requirements. The CSA will implement a "Corporate Information Environment" (CIE) with enhanced data quality and access and improve the ability of the FAA to use IT to meet mission goals at reduced cost. The CSA supports the implementation of six initiatives: Core Architecture, Business Process Improvement (BPI), Data Management, Corporate Software Engineering, Electronic Data Interchange (EDI) and IT Security.

CSA Architecture Survey Task

The Architecture Survey Task was initiated by the AIT-300 division of the FAA to enable the CSA to reduce the risks and costs associated with implementing the CSA initiatives by building on the experience and technical contributions of organizations that have already invested heavily in enterprise-wide IT strategies. The Survey Task selected eleven programs in government and industry primarily on the basis of there similarity to the FAA environment and their ability to provide support for cost/benefit analysis, lessons-learned, and opportunities to specific transfers of technology or procurement vehicles that would support the CSA Initiatives. The participants in the Survey Task included:

- DoD Corporate Information Management (CIM)
- Joint Computer-aided Acquisition and Logistic Support (JCALS) Program
- Electronic Data Interchange (EDI) Program
- GTE Data Systems (GTEDS)
- Veterans Administration (VA)
- Air Transport Association/Aerospace Industries Association of America (ATA/AIA)
- American Airlines (AA)
- Federal Express (FEDEX)
- DoD Integrated Computer Aided Software Environment (I-CASE) Program
- NCR Corp. (National Cash Register)
- U.S. Coast Guard Systems to Automate and Integrate Logistics (SAIL)
- Air Force Supermini Acquisition - AF Computer Acquisition Contract (AFCAC-300) Program

MITRE Corp. has surveyed several additional government defense and civilian agencies that will contribute to the Architecture Survey results.

Major Findings

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 Corporate Information Environment (CIE).

For example, there are interdependencies and relationships 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 information 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.

Another example of interdependency is the relationship of the VA, DoD, and industry organizations such as Wal-Mart, Texas Instruments, Sears, etc. 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 information repository has to encompass the content of EDI transactions. 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.*

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. The consistent control of data through the Information Repository increases the likelihood that all of the initiatives will realize expected benefits.

Key Opportunities for Technology Transfer and Use of Procurement Vehicles

The Architecture Survey identified a number of technologies and products, such as information 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 external capabilities to the FAA environment.*

DoD CIM Products

- Technical Architecture for Information Management (TAFIM) - The documents supporting the DoD Open Systems Environment (OSE) include the DoD Technical Reference Model (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 Defense Data Repository System (DDRS) that supports implementation of the data management strategy.
- DISA/CIM Systems Engineering and Technical Assistance Support (SETA) Statement of Work (SOW) - The SETA SOW can be applied to the development requirements for contractor support vehicles for the Core Architecture, BPI, Data Management, and Corporate Software Engineering Initiatives.

JCALS Technologies

- JCALS Global Data Management System (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 and Automated Documentation Development and Maintenance (ADDM) Program requirements for integrated access to electronic documents and related data such as engineering graphics.
- Implementation of Computer-aided Acquisition and Logistic Support (CALS) Standards and Joint Computer-aided Acquisition Logistic Support (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 Transaction Sets for procurement and contract administration - The FAA can make use of existing standard Transaction Sets for current business requirements, for example:
  - 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 Veterans Administration and the Defense Logistics Agency (DLA).
- EDI 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 reprocurement 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.

- Government Acquisition Through Electronic Commerce (GATEC) - The DoD pilot permits access to commercial Value Added Networks (VANs) in support of EDI data transmissions.
- 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.

GTE Data Systems (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.).
- Software Process Metrics - GTEDS has developed a hierarchical set of metrics for monitoring software development and integrating software development processes with management of IRM.

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 Advanced Information Management Systems (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 the Corporate Software Engineering Initiative.

- I-CASE Readiness Program - The FAA may be able to build on this program for CASE training and preparation for its own effort to meet training and other requirements for the introduction of CASE tools.

Key Lessons Learned

- Market vision for CIE to functional managers and involve them in the process of architecture definition as early as possible. - The DoD CIM experience has demonstrated the need to involve functional managers early in the process of defining global BPIs, architecture requirements, and implementation plans.
- Invest in training - Implementing I-CASE, BPI, and Data Management techniques depends on adequate investment in training.
- Productivity improvement from BPI is the major source of benefit. The CIM Initiative is premised on the assumption that the major savings are in major reductions in expenditures will be derived from productivity improvements that result from changes in DoD business, *not from savings on IT expenditures*. Of the $71B that the CIM Initiative targets for productivity improvements, CIM estimates that $36B can be facilitated by IT. Of this only $6.9B is estimated to be saved from direct impacts of IT.
- Establish metrics and rewards for Business Process Improvement Implementation
- Avoid a massive inventory effort because of rapid changes in the baseline.

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.
- 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.

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Architecture Survey
Summary Report

1. Introduction

Many organizations, in industry and government, face challenges in information management similar to the 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 IT strategies.

Corporate Systems Architecture (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 Information Technology (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 for 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 aims to improve the quality and reduce the cost of FAA software development and maintenance through process improvement and the use of appropriate tools such as 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:

- **Corporate Systems Architecture 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.

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 Corporate Systems Architecture 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 to 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 Electronic Data Interchange (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.

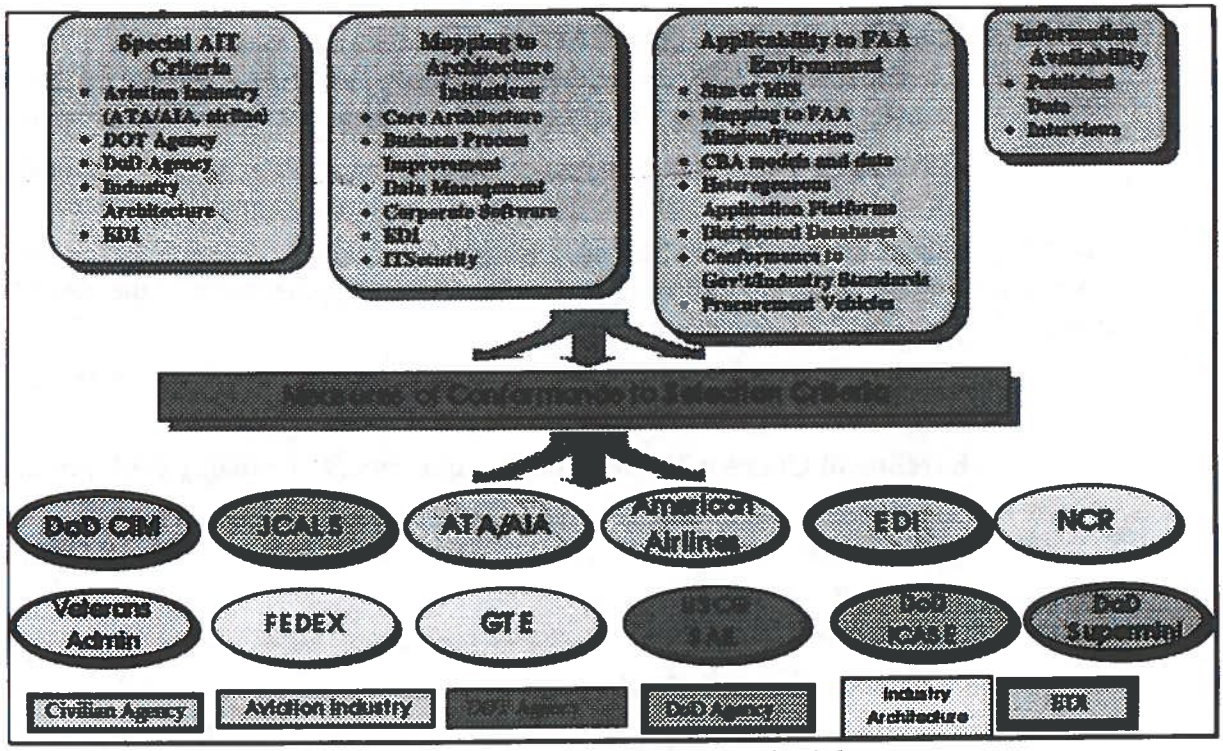

Figure 1. Architecture Survey Methodology

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

Table 1. Architecture Survey Programs

Architecture Survey Programs	Areas of Experience
DoD Corporate Information Management (CIM)	Experience with Open Systems Environment (OSE), Business Process Improvement, Data Management and Repositories, Software Process Improvement, Computer Aided Software Engineering (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
NCR Corp. (National Cash Register)	Enterprise wide data architecture and client-server implementation
U.S. Coast Guard Systems 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

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 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 information has been synthesized into three reports (see Figure 2). This "Overview of Findings" provides a summary of the Architecture Survey approach, key findings in relation to the CIE Initiatives, and a set of recommendations for subsequent FAA actions that will be required to apply the Architecture Survey results to implementing the CIE Initiatives. Attached to the Overview are two additional volumes. Volume I provides a more 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.

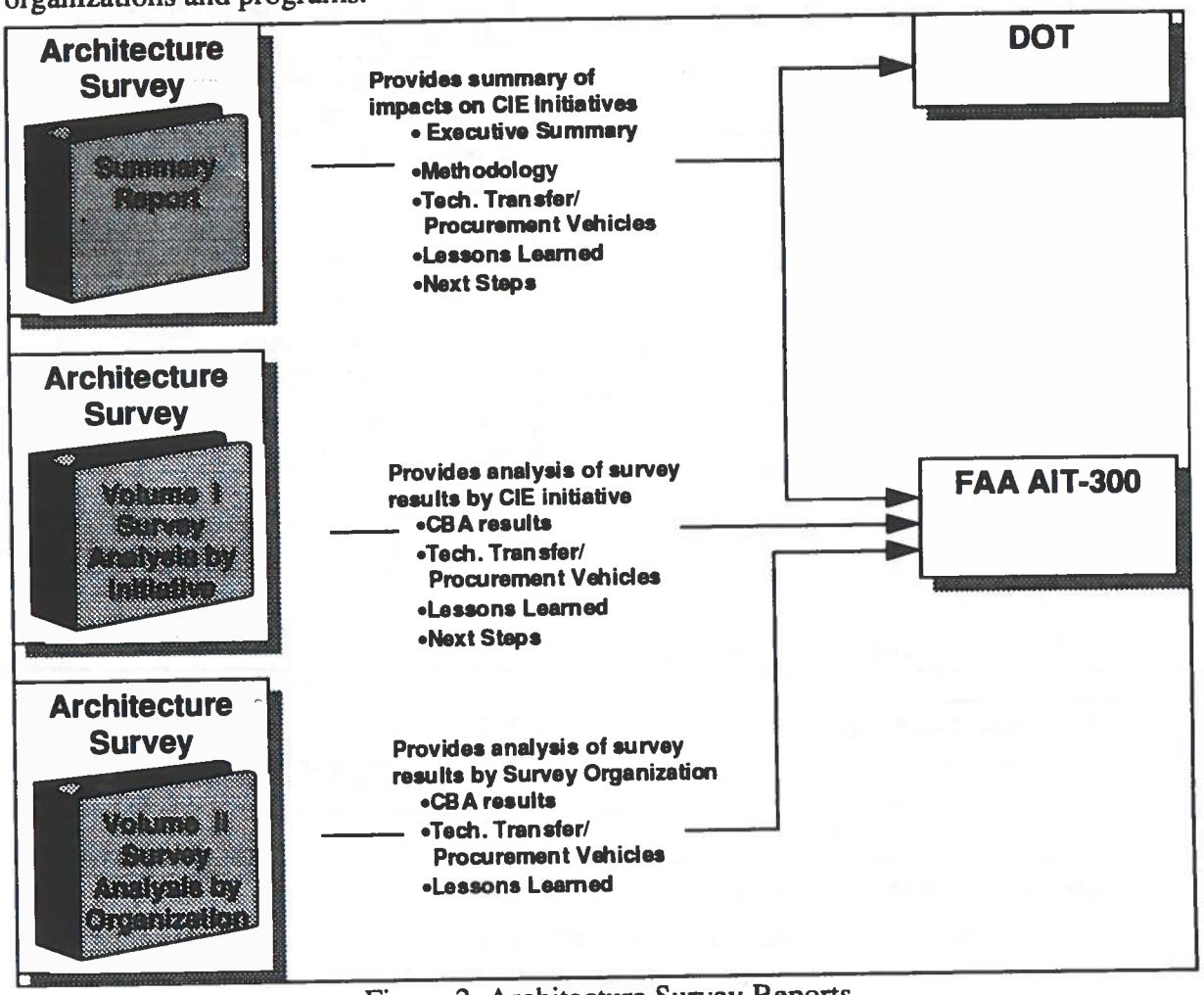

Figure 2. Architecture Survey Reports

3. Summary of Findings

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 Government Accounting Office (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 Business Process Improvement (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 success factors that pertain to specific initiatives, which are discussed in the sections below:

Interdependence of the CIE Initiatives

Another major finding that the FAA should consider in development of detailed strategies for the CIE is the *high-degree of interdependence among the initiatives*. The success of EDI for example will depend on the support from the all of the other initiatives. For example, EDI benefits cannot be realized without significant changes in business processes that depend on data exchange. EDI depends on the Core Architecture to implement required standards among FAA organizations and industry partners. The content of EDI transactions needs to be integrated into other FAA IT applications via the Data Management Initiative. Finally, the IT Security Initiative is required to ensure that sensitive data transmitted via EDI is properly controlled and protected.

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 the "Next Steps" section at the end of the Overview.

3.1 CORE ARCHITECTURE

Technical Reference Model (TRM) and DoD Architecture Documents

One of the key elements of the Core Architecture Initiative is the definition of standards and other requirements for an OSE for the FAA. The CIM Initiative has addressed many of the issues concerning the implementation of an OSE in a diverse, distributed government IT environment. One product of the CIM Initiative to implement an OSE is the definition of a TRM, architecture and implementation plan. The TRM was used by the CIM Initiative as a mechanism to build consensus among functional managers on the requirements for an OSE. *The FAA may find it advantageous to develop a similar consensus building process for its own set of architectural requirements.*

The DoD TRM can be considered a starting point for development of a FAA Core Architectural Guidance that provides a framework for FAA Technical Architecture and Standards. The DoD plan for the OSE is being published as the ***Technical Architecture Framework for Information Management (TAFIM).*** It consists of five volumes; the first three have been completed.

- **Implementation Concept**
- **Architecture Guidance and Design Concepts**
- **Reference Model and Standards Profile**
- **Support Plan**
- **Implementation Manual**

Complementing these documents the is the architectural development process developed by DMR, Inc. The documents produced by DMR that define the CIM architecture process have been mandated for DoD use. Negotiations are underway to make the methodology available for government-wide use. The documents are available through DTIC (Accession Number B163891L). The process defined in the DMR publication, "Standards-Based Architectures," was used in CIM architecture planning and is highly recommended by those responsible for DoD architecture development. *The FAA may want to evaluate and tailor the Standards-Based Architecture process for its own needs.*

Procurement Vehicles

CIM Systems Engineering and Technical Assistance Support (SETA) Statement of Work (SOW)

In addition to the TAFIM, the SOW for the act for the Defense Information Systems Agency/Center for Information Management (DISA/CIM) is a document that can be applied to the development of Core Architecture requirements for contractor support in such areas as standards development. 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. The SOW can be developed in a manner that can be reused by multiple CIE initiatives.

DoD Information Technology 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 Computer-Off-the-Shelf (COTS) software for the DoD infrastructure and coordinates COTS acquisitions with the requirements of the DoD Software Reuse Program.

Defense Technical Integrated Services (DTIS)

The DTIS acquisition provides another vehicle for obtaining technical integration consulting services. The DTIS procurement, estimated at $830 Million over seven years, is also likely to provide *services to other federal agencies (like the FAA) on a fee-for-service basis*. A formal RFP is expected to be released in summer, 1993.

Supermini Acquisition (AFCAC-300)

Finally, the DoD Supermini Acquisition (AFCAC 300) initiative will provide the DoD with substantial purchasing capability for computers, file servers, workstations, and network equipment. 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 Advanced Information Management Systems (AIMS) initiative. It will also include a hardware and software technology assessment to test and validate the software and hardware design.

Purchasing limitations under the Supermini Acquisition 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). The FAA may be able to use the Supermini Acquisition as a vehicle for purchases designed to fill gaps in OATS and CORN and as a model for meeting other acquisition requirements, such as the higher-end workstations needed for the AIMS initiative.

Standards

CALS Standards

The FAA is currently evaluating the standards developed for the DoD Computer-aided Acquisition and Logistic Support (CALS) Program and the EDI/Electronic Commerce (EC) Program. In addition to the standards referenced in the TAFIM, the CALS standards and related technologies meets some of the FAA requirements for management and interchange of technical information, including technical documentation, drawings and other logistics data. Key CALS standards are listed in Table 2.

Table 2. - CALS Data Standards

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 Data	PDES/STEP ISO STD 10303 (STEP)
Compound Documents	MIL-D-IETM DB, MIL-STD-1840A

The FAA should also assess the utility of using the DoD standard for Interactive Electronic Technical Manual (IETM) (MIL-M-87268, MIL-M-87269, MIL-M-872670), which provide for database management of document content. *For the FAA, IETMs would be apply to technical documentation for new NAS systems.*

The Core Architecture Initiative will also have to integrate EDI standards into the standards framework for data exchange. Particular EDI requirements are discussed under the EDI Initiative. Finally, the FAA may need to integrate the ATA standards (SPEC 2100) for applications to support exchange of FAA technical documentation and/or flight standards certification information. There are, in fact, many parallels between the ATA and CALS standards development efforts. In both ATA and CALS standards, digital data standards for maintenance documents are being developed to address requirements for electronic document *interchange* and for *interactive retrieval*. Nevertheless, 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 vendor's engine or airframe maintenance manual can access all other vendors' maintenance manuals.

Related CALS Initiatives

The CALS Shared Resource Centers (CSRCs) provide education and outreach in CALS approaches to government agencies and small business. These efforts can support applications such as spares acquisition involving small suppliers. The FAA should also evaluate the Contractor Integrated Technical Information Support (CITIS) standard to *access NAS equipment CDRL information including documentation, plans, and proposed changes.*

Lessons-Learned

Client-Server Architecture Transition

The objective of moving towards an OSE is one that is shared by many of the organizations examined in the Architecture Survey. GTEDS, American Airlines, Coast Guard SAIL, Veterans Administration, Federal Express, NCR, and JCALS are all developing client-server architectures for an Unix (POSIX)-based OSE. If the FAA is to follow the consensus, it should develop a migration strategy based on a transition for network from TCP/IP to OSI. The FAA should apply the experience of these implementation of these

client-server architectures to its own client-server strategies. The objective of client-server architectures, however, should not be limited to direct cost savings. The client-server strategies should focus on enhancing functionality and responsiveness to the business requirements of information system users.

3.2 BUSINESS PROCESS IMPROVEMENT (BPI)

CIM Tools and Methodologies for BPI

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.

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 Functional Economic Analysis (FEA) support and assess the anticipated impacts of business process changes. The FAA should also evaluate the DoD Functional Process Improvement Methodology based on Activity-Based Costing (ABC) and other tools for FEA. In the area of electronic document management, relevant to the FAA ADDM Program, JCALS has developed a workflow manager to manage processes involved in authoring and publication of technical documents.

Lessons Learned

CIM Savings

One of the major guidelines that has governed the CIM Initiative is that the major savings will be derived from productivity improvements that result from changes in DoD business, *not from savings on IT expenditures*. Of the $71B that the CIM Initiative targets for productivity improvements, CIM estimates that $36B can be facilitated by IT. Of this only $6.9B is estimated to be saved due to direct impacts of IT.

BPI/EDI Relationships

An example of the central importance of BPI is the opportunity provided by EDI. The technology should be regarded as a tool to implement changes in business operations (e.g. procurement and contracting)that depend on carrying out transactions, and related exchanges of data, among organizations. The goal must be to eliminate unnecessary transactions, not just reduce their cost. The experience of the DoD, the Veterans Administration, and many private companies confirms the finding that EDI cannot be implemented effectively without changing internal business practices and workflows.

BPI Implementation Risks

While the potential benefits of BPI are large, the risk of implementation are also substation. The CIM Initiative, for example, has faced obstacles which it has not overcome in implementing changes in business processes and in the use of IT resources. CIM has faced severe resistance, and loss of administrative and budgetary support, from functional

managers in the services. For the FAA, the implication is that functional managers will have to be involved and motivated to support the changes required by the BPI (and the other CIE Initiatives). One step is to involve the functional managers in the definition of governing IT principles, to educate the managers in BPI techniques, and to market the vision for BPI as early as possible in the change process.

3.3 DATA MANAGEMENT

Data Management Policy Documents

The CIM Initiative has produced 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
- DoD 8320.1-M - DoD Data Administration Procedures Manual - 21 Sept. 1992 (draft); completion 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 Repositories

One of the critical integrating requirements for the FAA Data Management Initiative is the implementation of an information repository that can maintain consistent definitions and rules for data and provide access to data in a distributed database environment. A number of organizations in the Architecture Survey have developed repositories that meet some of the FAA requirements (as described below).

Defense Data Repository System (DDRS)

The DoD is developing a repository called the Defense Data Repository System (DDRS). It provides automated data dictionary capabilities and 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 Wizdom, an Oracle based CASE tool and dictionary. (The FAA is also investigating the R&O product.) *The FAA may want to monitor DoD evaluations of repository products in relation to applications to the FAA Information Repository.*

JCALS Global Data Management System (GDMS) - Relationship to the FAA Repository and Automated Documentation, Development and Maintenance (ADDM)

The DoD JCALS Program is designed to provide management and distribution of logistics data to approximately 250 DoD sites. To manage data at multiple locations, JCALS has

developed a distributed information repository. The JCALS GDMS provides for integrated management of data (e.g. technical documentation and drawings) that may reside on multiple distributed databases. 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 ADDM Program.*

JCALS also provides specific capabilities required for document management. In addition to global location provided by the GDMS, JCALS provides:

- 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.

The JCALS experience illustrates the potential of using document management for a low-risk, high-value demonstration of the benefits of integrated management of technical data. The JCALS document management technologies should be evaluated in relation to FAA requirements (e.g. ADDM). The FAA can build upon the testing and evaluation processes that have already been carried out by the JCALS Program.

JCALS implements CALS standards for data management and document management. JCALS representation of electronic documents conforms to the standard for Standard Generalized Markup Language (SGML), MIL-M-28001B and the Document Type Description (DTD) standard for technical manuals, MIL-M-38784B (this DTD has a similar structure to FAA-D-2494B for FAA Technical Instruction Books). *Many of the DTDs developed by the DoD could be tailored for adoption by the FAA.* The FAA (ASE-630) has a current effort to develop an FAA Order, *Electronic Technical Information Standards Guidance*. This FAA Order will provide FAA Program Managers guidelines to acquire technical information in standardized electronic formats to be made accessible by FAA programs (ADDM and CAEG).

GTE Data Systems (GTEDS) Data Repository

GTE Data Systems has also implemented a repository for data. The GTE approach integrates the repository with tools for data analysis and software development. The tools employed for this purpose are LEVERAGE (D. Appleton Company, Inc.) and PACBASE (CGI, Inc.) for maintaining the information repository. The corporate-wide repository contains 25,000 data elements.

Lessons Learned

A number of the organizations in the Architecture Survey, including CIM, GTE, NCR, and American Airlines, developed principles for both architecture and data management. Typical of the principles for data management are the following:

- A common information infrastructure is used for data access.
- An enterprise-wide classification of data by subject area is used.
- Business experts will establish the standard names, definitions, formats, structures, domains, and business rules for Enterprise Data.
- Data is captured and validated once, at its source.
- Physical databases are based upon the standard data definitions.
- The Data Trustee (e.g. Database Administrator) is responsible for determining the standard definitions for "Enterprise Data" for each subject area.

These guidelines for data management are supported by the OSE based on the following assumptions:

- 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.
- 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.

FAA/Industry Partnerships

One of the important conclusions from the Architecture Survey is that the FAA has substantial opportunities to develop data sharing strategies in common with aviation industry partners. American Airlines, for example, is very interested in developing ways to share networks, customer data, and the costs of developing a commonly needed applications. American anticipates a large potential benefit from an FAA/industry partnership. A major opportunity exists in the area of sharing of critical data for flight operations such as weather information as well as using electronic documents for meeting FAA requirements to deliver notices and other data, currently handled in manual (paper) form.

One issue that needs to be addressed in the DoD, as well as the FAA, is the integration between repositories for data structures/definitions and for software reuse. The DoD has initiated a long-range effort to develop requirements for a "DoD Enterprise Database." GTE has also implemented a more general strategy for data management. To support a corporate process of application consolidation, GTE defined the following requirements for data management:

- Establishment of a single, centralized source of information on data elements and rules employed in the business
- Ability to perform impact analysis for proposed changes in system functionality
- Ability to use metrics to track reuse versus definition of data elements (the goal is to radically reduce the need to define "new" data elements.)
- Ability to share data and reference tables across applications.

The FAA may be able to adopt a similar strategy for data management.

GTE has, in addition, integrated data management strategies with implementation of CASE tools and a repository for software reuse. 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 information repositories, i.e. the DDRS (Defense Data Repository System) and the DSRS (Defense Software Repository System).

Relationship between Data Management and Corporate Software Initiatives

Another key conclusion is that there should be close coordination of the Data Management and Corporate Software Engineering 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. With respect to EDI, the CIM Initiative has pointed to the importance of linking the content of EDI transactions with the information repository. *Data Management strategies for the FAA and the repository becomes a key mechanism for integrating the data and applications development.*

3.4 Corporate Software Engineering

CASE Tools and Procurement Vehicles

The number and variety of CASE tools available to support software process improvement has proliferated in recent years. Less certain are the are requirements for enabling an organization to succeed in using the tools to achieve software process improvement objectives. Several organizations in the Architecture Survey have experience with CASE tool implementation.

DoD I-CASE Acquisition

The DoD I-CASE Program is a planned seven-year contract worth between $250M and $1B, intended to provide an integrated environment that supports the development and maintenance of DoD information systems applications. The I-CASE contract is expected to be awarded in September 1993 with 19 pilot implementations to begin approximately 6 months after the award date. Reuse of domain knowledge and objects is a fundamental

premise which I-CASE will adhere in order to further reduce manual development. The DoD and the National Institute of Standards and Technology (NIST) joined forces to institute open systems architecture for I-CASE tools, the core enabler for heterogeneous software environments. The standard for the Portable Common Tools Environment (PCTE) is one effort to achieve this objective.

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. The General Services Administration (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.

Internal Revenue Service (IRS) I-CASE Acquisition

The IRS is also preparing an I-CASE procurement that will provide the agency with a standard toolkit for its $23M Tax Systems Modernization (TSM) Program. The agency hopes to field a comprehensive suite of tools--from reverse engineering to software maintenance. The IRS's pending procurement parallels the DoD I-CASE program, but the IRS has decided to award its own contract because of special requirements for CASE tool integration. The FAA may want to examine the IRS CASE procurement and compare it with the DoD's I-CASE migration strategy.

Reuse Repositories

DoD Software Repositories

Another key technology being developed by CIM is the repository for software reuse. The Defense Software Repository System (DSRS) 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). Other DoD sources for reuse include the Adaptable CALS Catalog for Embedded Systems Software (ASSET) and the Central Archive for Reusable Defense Software (CARDS), programs funded by the Advanced Research Projects Agency.

GTEDS Software Repository

GTEDS, as was mentioned in the Data Management section, has implemented a software repository using PACBASE. The repository supports enterprise-wide applications development and is viewed as critical to implementing the client-server architecture. PACBASE is also used as the tool for lower-CASE software development. The ability to support client-server applications and integration between the CASE tool and the software repository were critical factors in GTE's selection of PACBASE.

Metrics for Software Process Improvement and Reuse

One of the key components of the GTEDS effort to improve the software production process is the implementation of process metrics. DoD has also put a high priority on the development of a metrics program and is examining the GTE program for adaptation

within the DoD. 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. GTE has implemented a system of measures that are tied to the hierarchy of enterprise and project management (see Figure 3). The objectives of the GTE metrics program include:

- Identifying areas of excellence within the company
- Managing resources more efficiently in relation to project requirements and history
- Implementing function point analysis to control complexity
- Implementing continuous improvement program for software quality
- Identifying candidates for re-engineering

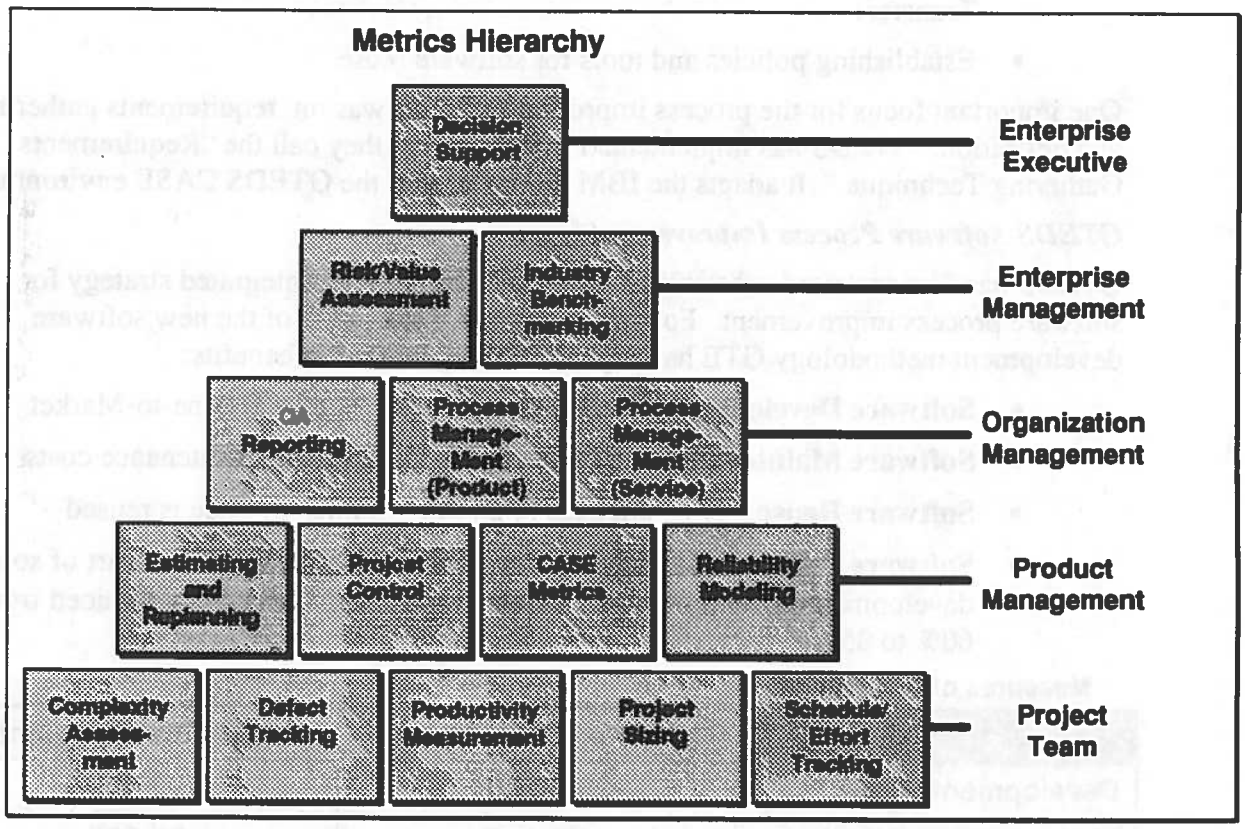

Figure 3. - GTEDS Metrics Hierarchy for Software Process

So far the process of tracking the hierarchy of metrics at GTEDS 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 want to attempt a similar integration of software metrics and tools used to monitor acquisition programs and internal software projects.

Lessons Learned

While the importance of improving the software development process is generally recognized among the Architecture Survey participants, there is not complete agreement in

the path that needs to be followed. In general, most of the organizations have made the use CASE tools a key component of the effort to improve the speed and quality of applications development. An exception is Federal Express, which has placed a high-priority on Object-Oriented technology (OOT) and considers the current state of CASE tool support for OOT inadequate.

GTEDS Software Process Improvement Initiative

The GTEDS effort to improve the process of software development and maintenance involves a number of coordinated efforts including:

- Definition of a standard methodology for both new development and re-engineering
- Introduction of software process metrics (see description under Technology Transfer)
- Establishing policies and tools for software reuse

One important focus for the process improvement effort was on requirements gathering and definition. GTEDS has implemented a new process they call the "Requirements Gathering Technique." It adapts the IBM JAD model to the GTEDS CASE environment.

GTEDS Software Process Improvement Impact

GTEDS has demonstrated substantial success as a result of its integrated strategy for software process improvement. For applications that make use of the new software development methodology GTE has experienced the following benefits:

- **Software Development Cycle Time** -30% reduction in Time-to-Market
- **Software Maintenance** - 50% reduction in life cycle maintenance costs
- **Software Reuse** - 17% of a base of 20 million lines-of-code is reused
- **Software Development Cycle** - Time spent on "Lower CASE" part of software development process (system production and testing) has been reduced from 60% to 35%.

Measures of CASE Impact

	Traditional Environment	CASE Environment
Development Hours	20,000	12,000
Lines of System Code	89,230	36,568
Avg. Hours to Fix Defect	11.4	5.6

Other critical success factors for implementation of a program for software process improvement and reuse include the following:

- Use of CASE must be mandated for the entire enterprise.
- Investment in training is a critical to the success of CASE implementation.
- Avoid storing sources 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*

The final key lesson learned regards the integration of strategies for software process improvement, reuse and data management. Because the interdependence of software development and data management, success in either area requires integration of processes and tools supporting a common set of objectives for data, applications and repositories. *For the FAA this requires close linkage between the Data Management and Corporate Software Engineering Initiatives.*

3.5 ELECTRONIC DATA INTERCHANGE (EDI)

EDI is the set of standards and other technologies that support exchange of data required for commonly performed business transactions. EDI has the potential to dramatically change the way many organizations conduct business.

EDI offers the FAA an opportunity to realize enormous benefits in relation to the required investment. It should be emphasized, however, that the success of EDI applications 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 information repository has to encompass the content of EDI transactions. Corporate Software Engineering must support EDI-based applications, and IT Security has to provide access controls 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.*

Business EDI Applications

Traditional EDI Applications

Organizations such as the Veterans Administration have demonstrated the utility of traditional uses of EDI in the government environment. These applications include electronic invoicing and payment information for goods and services and the exchange of Government Bills of Lading (GBLs).

EDI and ATA Specification 2000 Program

One of the major opportunities for EDI implementation within the FAA is the ATA's Specification 2000 Program. SPEC 2000 is an international specification and automated system to facilitate procurement transactions for aircraft material acquisition, support and repair which enables airlines and their suppliers to exchange information using a common language based on ANSI X.12 EDI standard. More specifically, SPEC 2000 covers:

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

The SPEC 2000 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 -a centralized electronic catalog composed of parts data from airframe, engine, avionics and component manufacturers, suppliers and distributors.
- order administration and invoice processing (EDI).

Mission EDI Applications - SDR/MMEL Opportunities

EDI also has the potential of substantially reducing costs incurred by the airlines and FAA in conjunction with processing of paper-based forms. In particular, "mission" EDI will enable electronic exchange of Service Difficulty Reports (SDRs). Currently 8 carriers submit SDRs electronically, using a template developed by the Aeronautical Center. The FAA does not have the capability to transmit SDRs back to the airlines. Every week, two versions of the SDR are sent out to the 1,500 subscribers.

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.

If the FAA could transmit and receive SDRs electronically, the carriers are likely to respond with implementation of EDI because of the substantial opportunities for cost reductions and faster processing of the required forms.

The use of EDI to support data exchange for Master Maintenance Equipment Lists (MMELs) provides another opportunity for a mission EDI application. There are two different types of updates to the MMEL. Unrestricted updates do not require a change to the operator's Maintenance Equipment List (MEL). Restrictive updates require changes to the MEL. Availability of the MEL data can support requirements of the Flight Standards, Maintenance Review, and Configuration Maintenance.

Government Acquisition Through Electronic Commerce (GATEC)

A DoD pilot project , GATEC, will allow vendors to EDI conduct business electronically using a Value-Added Network (VAN). GATEC was developed as a standard system (participation is open to Federal Agency's). It is an end to end connection tool, capable of

communication with any/all standard procurement systems. *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.

ANSI EDI 841 Specifications/Technical Information

The ANSI 841 Specification/Technical Information transaction set provides a structure which allows for the exchange of a variety of technical information and business data. The detail area can include graphic, text, parametric, tabular, image, spectral, or audio data. A transmission provides information to assist the receiver in interpreting and utilizing the information contained in the transaction. For example, if the transaction can contain engineering drawings describing a complete assembly and models for each of the individual parts and the associated specifications. This transaction set can also be linked to other transaction sets, such as 836, 840, 850, 843,856.

These transaction sets 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

Lessons Learned

Convergence of EDI and CALS

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. In the view of the DoD officer in charge of CALS, MGEN. E.R. (Russ) Baldwin, "No doubt whatsoever, EDI promises high levels of savings in business transactions. Beyond that I see a need to progressively [illegible] CALS and EDI initiatives." -- MGEN. Baldwin, Defense CALS Executive.[1]

EDI and Business Process Improvement

The experience of the DoD and other organizations such as the Veterans Administration supports the guideline that technology implementation is only a small part of what is required to achieve benefits through the use of EDI. Business process have to be transformed to take advantage of the ability to transmit business data electronically. As a consequence 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

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

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.

3.6 IT SECURITY

Multi-level Security (MLS)

JCALS provides support for MLS Plus security levels. Computer Sciences Corp., the JCALS prime contractor has been collaborating with Digital Equipment Corp. 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.*

3.7 SUMMARY

The following chart (Table 3) provides a summary of major technology transfer opportunities and lessons-learned that have been identified in the Architecture Survey.

Table 3. 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 Technical Reference Model (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 • ***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 Defense Data Repository System (DDRS) ♦ 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 • ***GTE Data Systems (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 dev., 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 Object-Oriented Tech. (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 reprocurement, 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, Government Acquisition Through Electronic Commerce (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.**

4. 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:

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:

- Technical Architecture for Information Management (TAFIM) - The documents supporting the DoD Open Systems Environment (OSE) include the DoD Technical Reference Model (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 Defense Data Repository System (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 Global Data Management System (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 Veterans Administration and the Defense Logistics Agency.
- 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 reprocurement 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.
- Government Acquisition Through Electronic Commerce (GATEC) - The DoD pilot permits access to commercial Value Added Networks (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.

GTE Data Systems (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 Advanced Information Management Systems (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.
- 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.