



TFM Strategic Approach

MITRE

March 2000

© 2000 The MITRE Corporation. All rights reserved.

Purpose

- **Identify an outline for the TFM strategic plan**
- **Provide examples for specific strategic plan elements to illustrate candidate concepts, approaches and processes for AUA-700's consideration in their strategic planning activity.**



This briefing has been prepared in conjunction with AUA-700's current strategic planning activity. CAASD was requested to develop a strawman outline for the strategic plan and a strategic approach providing candidate concepts, approaches and processes to be considered by AUA-700 as they develop their strategic plan.

3

Outline of Strategic Plan

- **Mission Statement**
- **Vision**
- ✓ • **Customers and their Major Requirements**
- ✓ • **Other Stakeholders**
- ✓ • **Major Products and Services**
- ✓ • **Enabling Techniques and Methodologies**
- ✓ • **Portfolio Management**
- **Organizational-level**
 - **Assumptions**
 - **Goals, Objectives and Critical Success Factors**

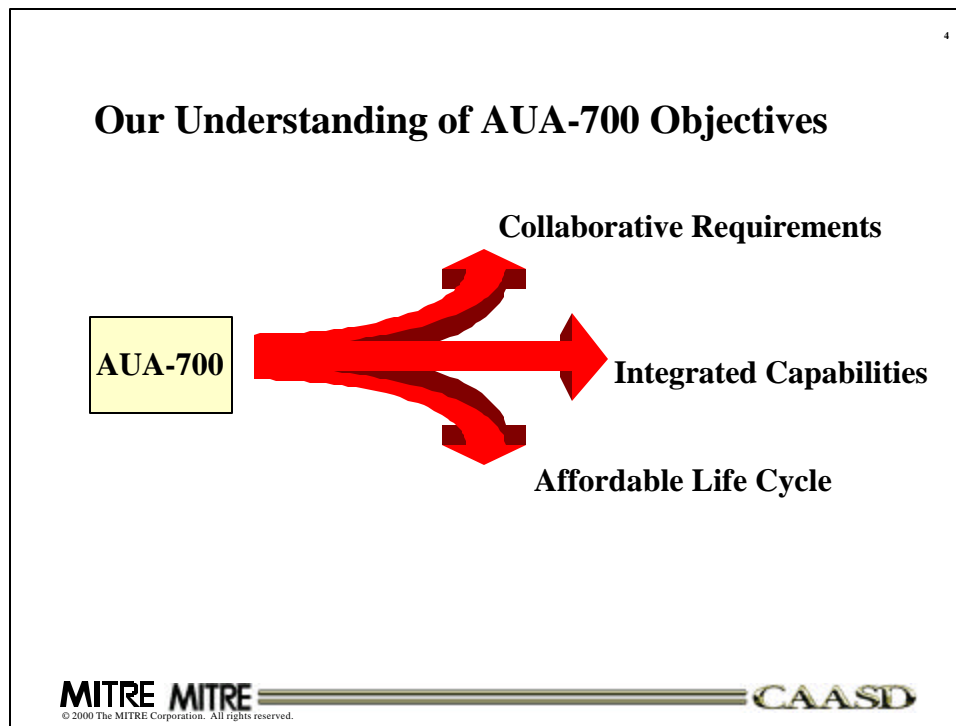
✓ Addressed in this Strategic Approach

MITRE MITRE  **CAASD**

© 2000 The MITRE Corporation. All rights reserved.

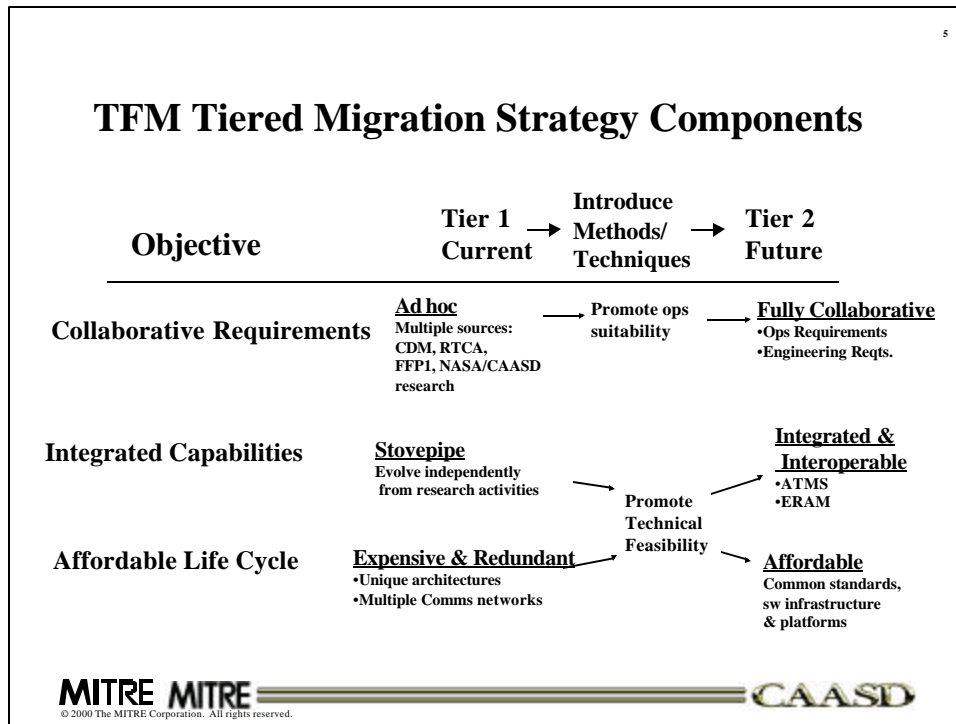
The elements in this strategic plan outline have been accumulated from among the sources noted in the reference list on the last page of this briefing. The full outline is provided as a second enclosure with this document.

The strategic approach concentrates on the strategic plan elements indicated with a check mark on the facing slide. During the development of the Strategic Approach, the focus was on identification of concepts and approaches which are effectively being used by other groups within the FAA/DOT, other agencies, the DOD and industry which offer the potential of being useful to the AUA-700 initiative.



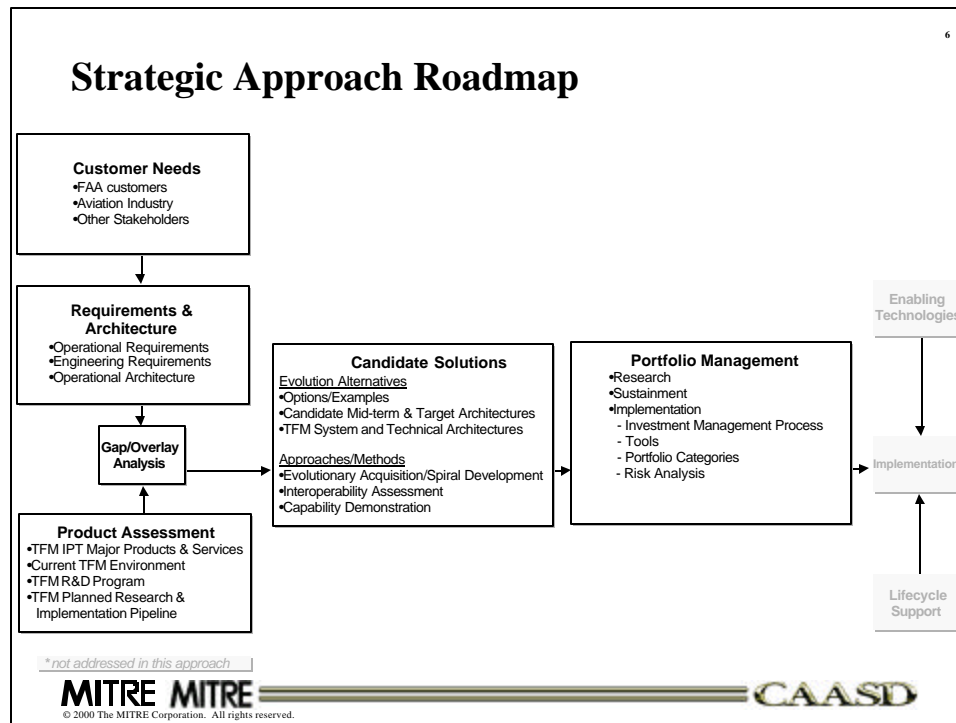
We understand AUA-700's objectives for the future to be focused in three primary areas:

- Collaborative Requirements development as an on-going, interactive process taking into account the operational needs of both internal FAA and aviation industry customers.
- Integrated Capabilities which effectively support TFM operational use and enable timely introduction of enhanced capabilities. The integrated capabilities have a high degree of interoperability, a consistent user interface and present timely and consistent information.
- Affordable Life Cycle considering one-time and recurring costs from concept exploration through technology refresh. Keeping Operations and Maintenance costs within reasonable limits will enable additional capability development.



This chart identifies a high-level two-tiered migration strategy in association with the three AUA-700 areas of interest discussed earlier. The migration strategy postulates moving from the current environment of each of the three objectives to a more integrated future through the introduction of new methods and techniques. In the area of Collaborative Requirements, the methods and techniques would focus on promoting operational suitability.

For Integrated Capabilities and Affordable Life Cycle, the thrust of the methods and techniques is on promoting technical feasibility.



High-level View of Roadmap

- Identify major customer groups and their needs
- Derive operational and functional requirements associated with those needs
- Align with existing and planned products and services
- Identify gaps and overlaps
- Develop candidate solutions
- Identify and tailor enabling technologies
- Utilize Portfolio Management to assess and identify priorities

As mentioned earlier, the identification of customer needs and the development of associated operational and engineering requirements support the AUA-700 objective of Collaborative Requirements.

Then, an analysis is made to identify gaps and potential overlaps. Candidate solutions and alternatives are developed and analyzed. The assessment of current and planned products and services and the development of candidate solutions are most closely related to the objective of Integrated Capabilities.

The objective of an Affordable Life Cycle is supported by the selection and tailoring of enabling technologies and the use of Portfolio Management. Portfolio Management is utilized to examine possible courses of action, assess and manage risk, and to identify priorities and courses of action. Portfolio Management leads to selections for implementation. Appropriate enabling technologies are examined and utilized as appropriate to the specific implementation.

Identify Customer Needs



8

Customers

- **FAA Customers**
 - Air Traffic - ATCSCC, TMUs (ARTCCs, TRACONs, major ATCTs)
 - Airway Facilities
- **External Customers - Aviation Industry**
 - Major Carriers
 - Other aviation industry groups (e.g. NBAA, AOPA, RAA)
 - Consensus Mechanisms
 - ATA/CDM Group
 - RTCA Free Flight Steering Committee

MITRE MITRE  **CAASD**
© 2000 The MITRE Corporation. All rights reserved.

TFM customers are in two major categories:

FAA Internal customers including the Air Traffic Control System Command Center (ATCSCC) and the Traffic Management Units (TMUs) in the ARTCCs, TRACONs and in major ATCTs.

External customers in the Aviation Community include the major carriers and aviation industry groups. Two active customer groups are the Air Transport Association's Collaborative Decision Making (CDM) group and the RTCA Select Committee on Free Flight.

FAA Customer Needs

- **Better understanding of ATCSCC and TMU needs / requirements is necessary**
 - **Enhanced capabilities**
 - **Integration of multiple displays**
 - **Consistent look and feel**
 - **Consistent information**
- **Plan and mechanism to collect, assess and prioritize**
- **Customer Evaluation: current / planned products / services**
 - **Analyze current level of service: determine level of satisfaction in quality of existing products/services**
 - **Identify new products/services of interest**
- **Cross-AUA Systems Engineering Team a key player in this**



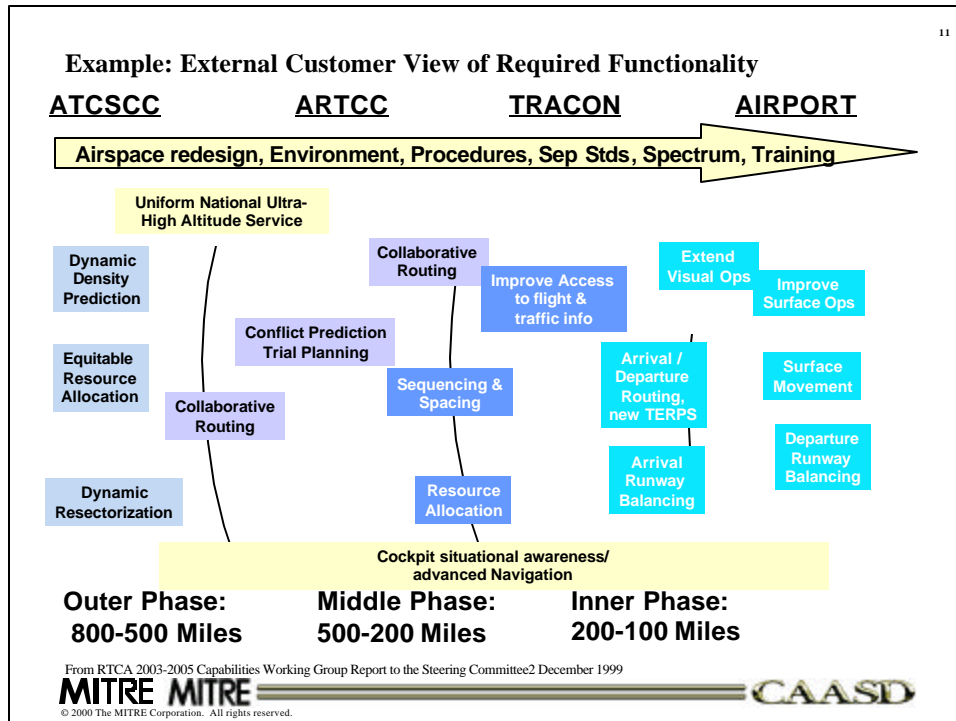
The needs of the FAA customer community are less well understood and documented than those of the external customers. A number of general needs have been expressed, but additional information is needed. In order to develop such an understanding, a plan must be developed defining how this information will be collected, assessed and prioritized. A starting point for such an evaluation would be a customer evaluation of current and planned products and services in order to assess the adequacy of the current level of service and what additional elements are needed.

External Customer Needs: Example

- **The RTCA Steering Committee on Free Flight and ATA/CDM group direction :**
 - **System-Wide Needs**
 - **Improved information availability and flow**
 - **Problem Prediction and equitable resource allocation**
 - **Efficient aircraft movement through En Route airspace**
 - **Flow efficiency through transition airspace**
 - **Improved airport acceptance and departure rates**
 - **Inefficient airport surface operations**



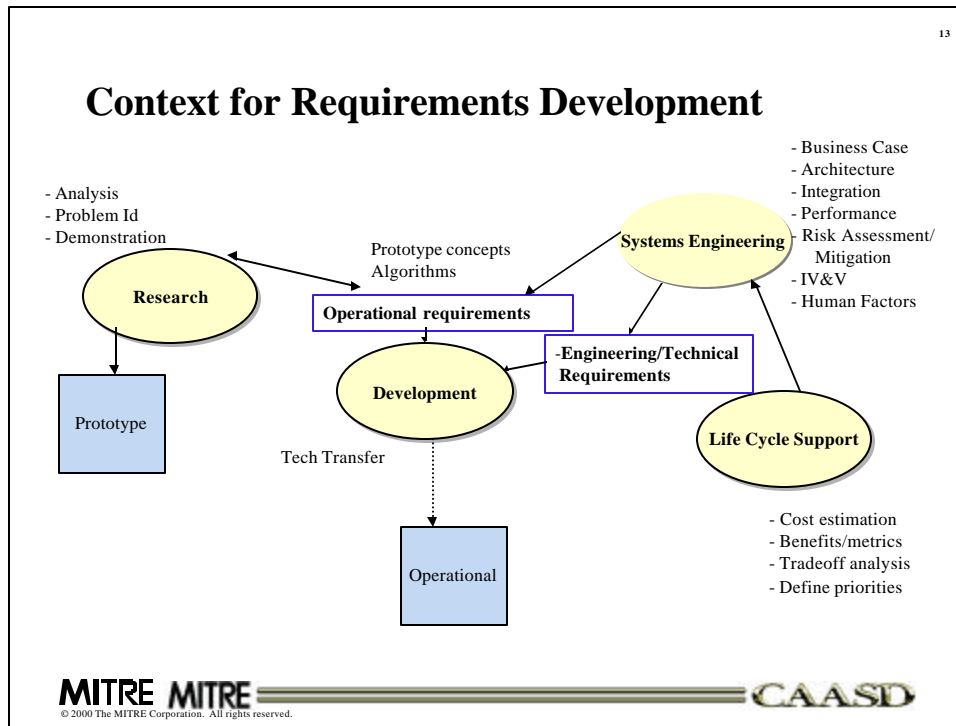
The high-level statement of needs and current problem areas seems consistent with both the ATA/CDM group's direction and that of the RTCA's Steering Committee on Free Flight. These groups provide focal points for collaborative dialogue on future needs and requirements.



This example of a TFM Customer’s view of required functionality is taken from the recent RTCA 2003-2005 Working Group Report to the Steering Committee, 2 December 1999. It illustrates needed functionality across the FAA operational facilities and associated phasing with respect to destination airport. It emphasizes the required synergy between operational automation capabilities and associated airspace redesign, environment, procedures, spectrum and training as necessary elements to achieve needed benefits.

Develop:

- **Requirements**
 - **Operational**
 - **Engineering**
- **Operational Architecture**



The purpose of this slide is to illustrate a context for the development of operational requirements and engineering/technical requirements within the overall life cycle of Research, Development, Systems Engineering and Life Cycle Support.

TFM Operational Architecture Development

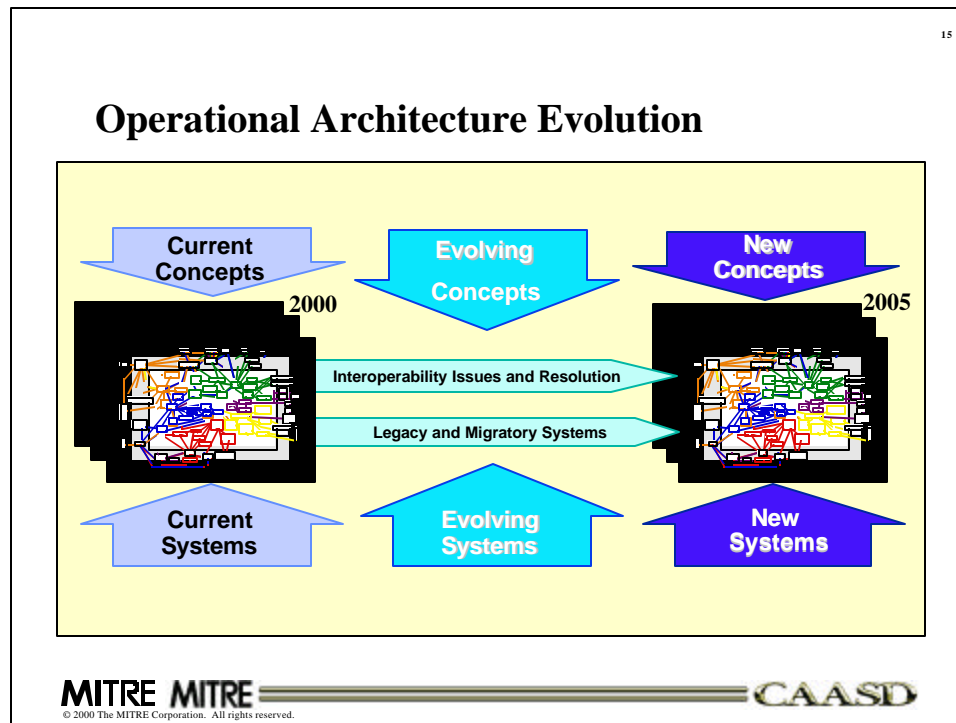
- **Purpose: define the current and future operational mission**
 - **Tasks and objectives**
 - **Internal and External customer needs**
 - **Maps to operational concept**
 - **Information flow requirements**
 - **Evolution concepts**
- **Characteristics**
 - **Establishes focus on future evolution strategy**
 - **Describes the operational capability needed**
 - **Basis for requirements development**
 - **Analysis of interoperability issues and inter-program dependencies**
 - **Considers information exchange activities that cross organizational boundaries**
 - **Not constrained by current systems or organizations**



© 2000 The MITRE Corporation. All rights reserved.

In the future, AUA-700 may wish to consider the advantages of developing a TFM Operational Architecture. The Operational Architecture is one of the three major architectural components of the DOD's C4ISR Architecture Framework. Since the purpose of the operational architecture is to define the current and future operational mission, it can be viewed as a key component of a strategic approach. The operational architecture provides a focal point to associate elements of the operational concept, customer needs and evolution concepts. It can provide a context for discussion of information exchange requirements, interoperability issues and inter-program dependencies across organizational boundaries. The operational architecture can provide the foundation for requirements development by describing the needed operational capabilities.

Note that this is adapted from DOD C4ISR Architecture Framework



The operational architecture addresses the mapping between the current concepts and systems and their evolution to future concepts and systems. The issues associated with migration of legacy systems are addressed. Current and emerging interoperability issues are examined and resolutions proposed.

Assess Current and Planned

- **Products**
- **Services**

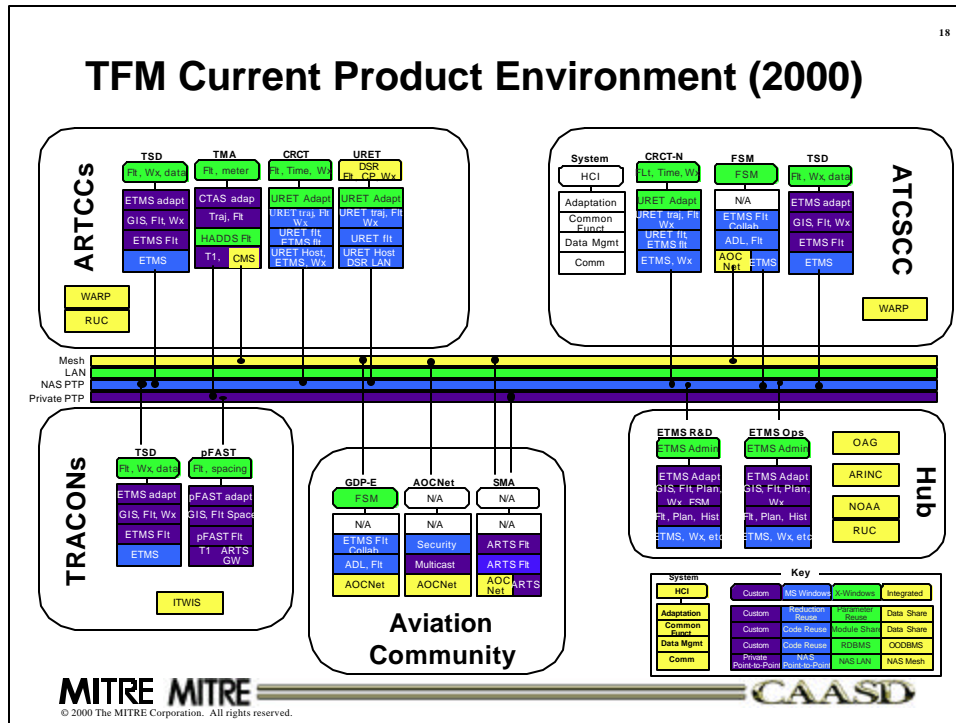
TFM IPT - Major Products and Services

- | | |
|--|---|
| <ul style="list-style-type: none">• Products• Infrastructure Management<ul style="list-style-type: none">- ETMS- TSD- Communications• New Technologies/Research<ul style="list-style-type: none">- CDM- GDPE/FSM- NASSI- DSP- CRCT- Others | <ul style="list-style-type: none">• Services• Systems Engineering• Acquisition• Integration/Interface Management• Implementation• Technology Refresh• Requirements Integration (broader IPT) |
|--|---|



© 2000 The MITRE Corporation. All rights reserved.

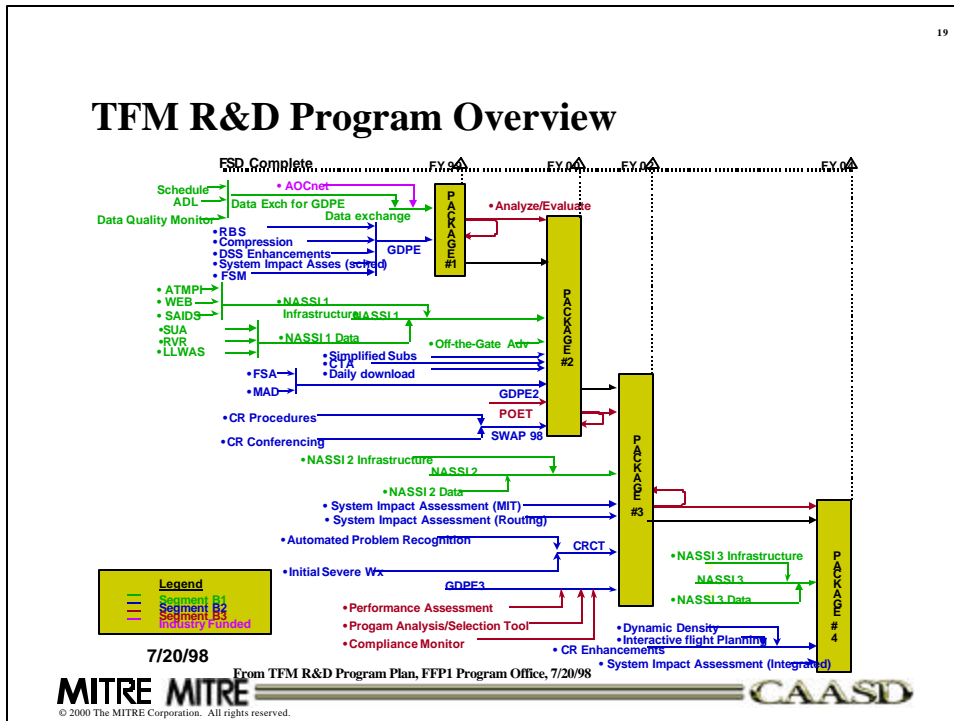
This chart is intended to provide a high-level view of the current products provided and services performed by the TFM IPT.



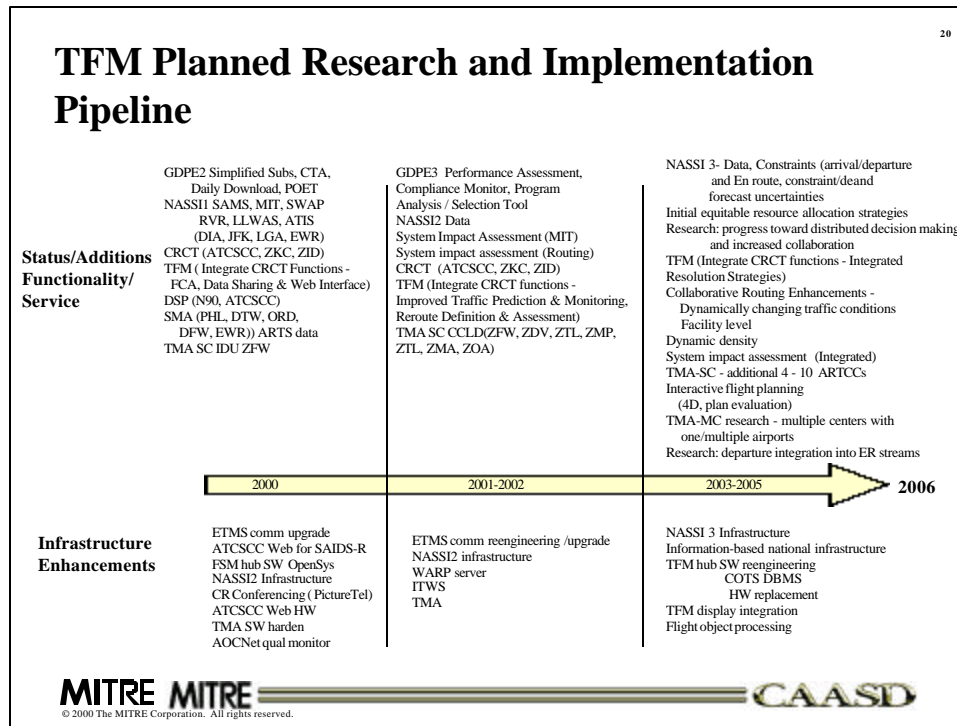
Automation components providing capabilities for Traffic Management operations in Traffic Management Units (TMUs) in ARTCCs, in many TRACONS, in some towers, in the FAA’s Air Traffic Control Command Center (ATCSCC), and in Aeronautical Operations Centers (AOCs) of the commercial, general, military, and international aviation communities have for the most part evolved without an overall plan or architecture. This figure illustrates some specific architectural considerations of this disparate collection of TFM automation.

In addition to the architectural elements identified above, other elements, such as platforms and operating systems, are also inconsistent. Such variations in architectural elements require that:

- Operations personnel be familiar with diverse and sometimes conflicting human-computer interfaces
- Additional operations workload to resolve sometimes conflicting results from different automation presented by system, function, and data redundancy.
- Systems administration, management, and maintenance personnel be employed to support all of these diverse components
- More automation than necessary is required to support system, software, and data redundancy.



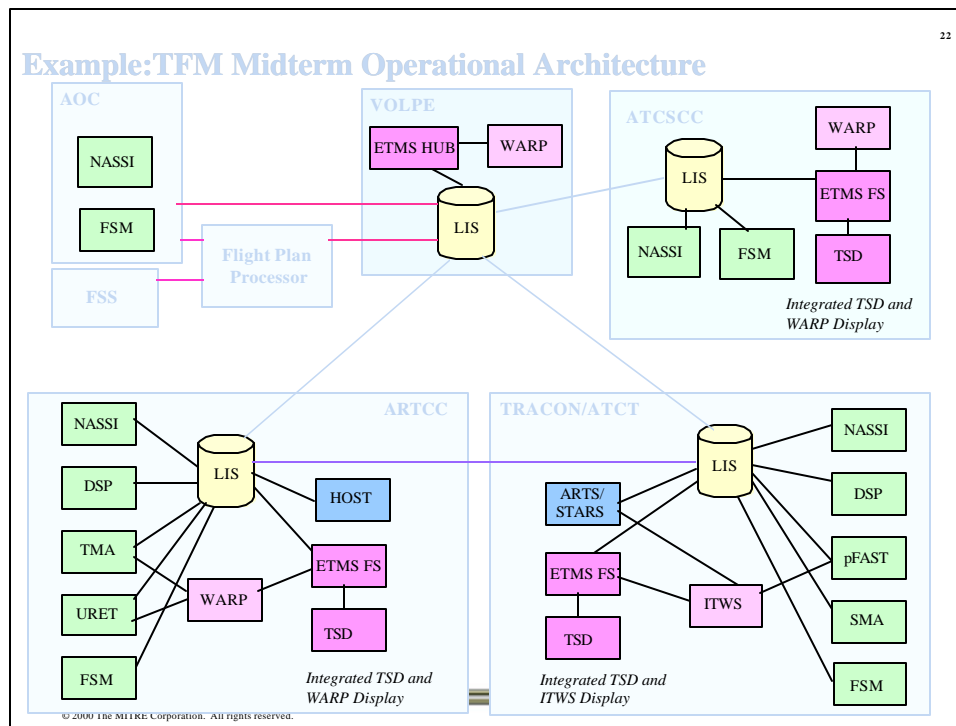
This chart is extracted from a 1998 TFM R&D Program Plan. It highlights the research timeline through 2004 and packaging of TFM capabilities in the research pipeline at that time.



The timeline illustrated in this chart highlights the planned evolution of functionality / services and enabling infrastructure enhancements. Sources consulted to assemble this information include the NAS Architecture Version 4.0, the TFM R&D Program Plan and the RTCA 03-05 Working Group briefing to the Free Flight Steering Committee.

Candidate Solutions:

- **Evolution Alternatives**

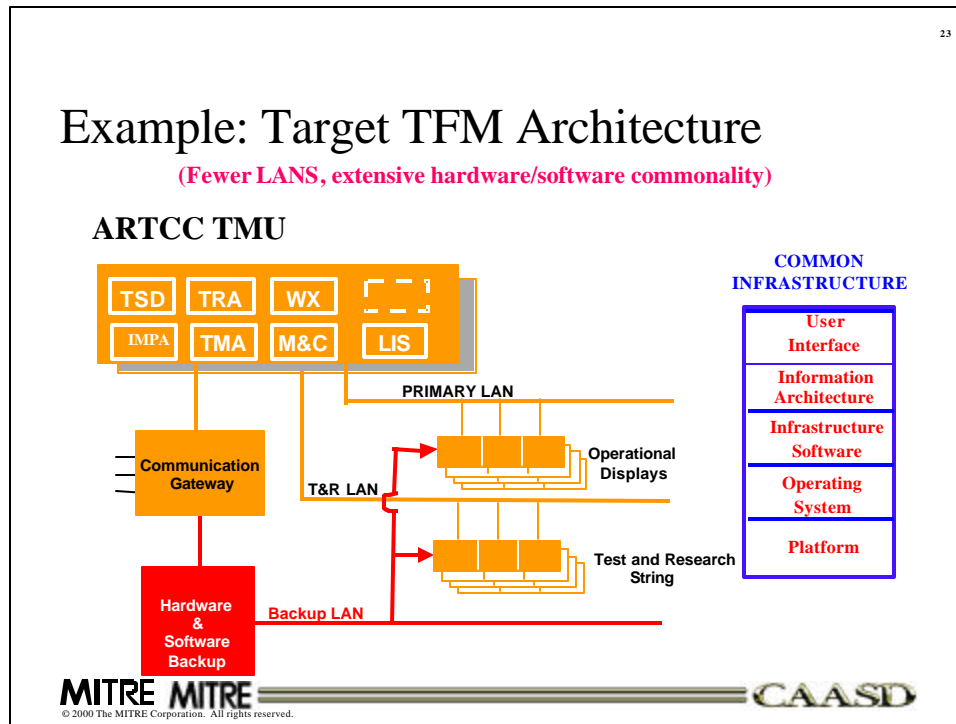


Example: Mid Term TFM Architecture

This chart is intended as an example of how an alternative architecture evolution could be illustrated. In this example:

The Flight Plan Processor (new) will receive filed flight plans from FSS and from AOCs and check the flight plans for logic and format errors.. The Flight Plan Processor will forward flight plans to the ETMS HUB to check for flight restrictions.

- The ETMS HUB will maintain a Local Information System (LIS) (new) for flight and track data and ADL messages.
- The AOCs will have a direct connection to the LIS at VOLPE. The AOCs can access the LIS for the most current flight restrictions. The LIS will make filtered flight and track data available to the AOC and thus will replace the ASDI. The LIS will also make ADL messages available to the AOC.
- The LIS at the ETMS HUB will use the ETMS network to transmit flight and track data to the LIS (new) at the ATCSCC, ARTCCs, and the TRACONs.
- For TRACONs and ATCTs that are not connected to the ETMS network, the LIS at the ARTCC will transmit flight and track data to the LIS at the TRACON.
- Note that data other than Flight and Track data will continue to be exchanged directly between the ETMS HUB and the ETMS Field Site(FS) as it is currently.
- The ETMS HUB and ETMS FS will be updated to include some of the CRCT functions.
- At each facility, applications can access flight and track data from LIS.
- At the TRACON/ATCT, NASSI will collect airport equipment status and make the data available to other facilities via the LIS.
- At ATCSCC and ARTCCs, each application will access weather data directly from WARP. In addition, there will be an integrated TSD/WARP display.
- At the TRACON/ATCT, each application will access weather data directly from ITWS. In addition, there will be an integrated TSD/ITWS display.

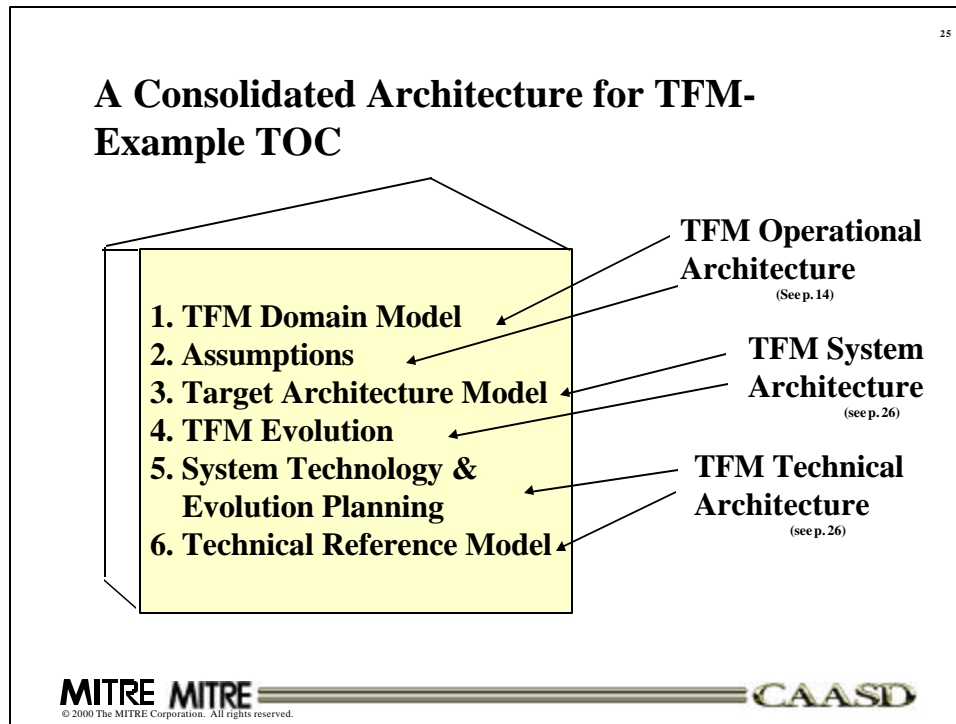


This chart provides a notional view of some elements to be considered in developing a target architecture for TFM. Some of the major thrusts are an emphasis on a simplified architecture with fewer LANs, extensive hardware and software commonality. The approach features both an operational string and a test and research string where mature research capabilities would be available for operational assessment for a specified period.

One of the key benefits of such a target architecture, once established, is that the degree of commonality will greatly contribute to the objective of an affordable life cycle.

System and Technical Architectures





This chart suggests a table of contents for a consolidated architecture for TFM. It borrows heavily from the approach taken in the draft En Route Architecture (Green Book) (see references page) currently being developed by AUA-200. It is also similar to AUA-400's Oceanic Blue book. The chart illustrates how the table of contents entries correspond to the operational, system, and technical architecture contents.

TFM System Architecture and TFM Technical Architecture

- **System Architecture**
 - **Inventory of current and planned hardware and software capabilities**
 - **Describe system evolution alternatives and plans**
- **TFM Technical Architecture**
 - **Technologies**
 - **Standards**
 - **Update TFM Domain Environment Definition Document (1996)**
- **Both adapted from DOD C4ISR Architecture Framework**



© 2000 The MITRE Corporation. All rights reserved.

This chart offers for future consideration the development of a TFM System Architecture and TFM Technical Architecture, the two additional three major architectural components of the DOD's C4ISR Architecture Framework. (The Operational Architecture is discussed on page 16.) The System Architecture would catalog the inventory of current and planned hardware and software capabilities suggested in this strategic approach. It would also describe the system evolution alternatives developed as candidate solutions and identify the plans resulting from the Portfolio management process. The TFM Technical Architecture would describe the selected technologies and methods as well as to detail the standards to be followed in the selection, development and acquisition of TFM capabilities and other components. Updating the TFM Domain Environment Definition Document would be a starting point for the Technical Architecture.

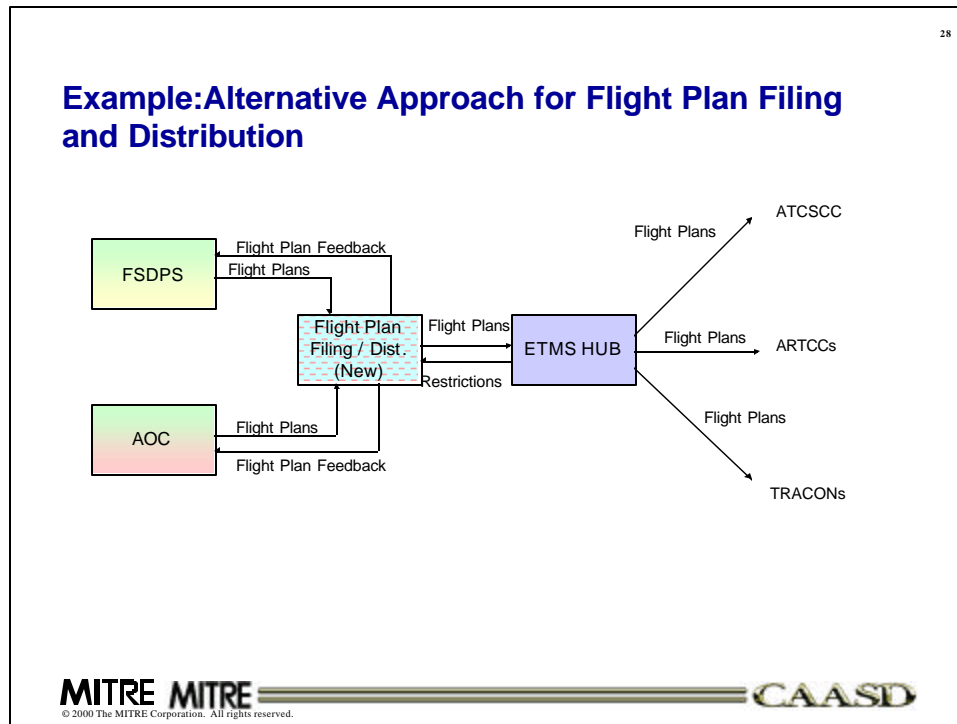
Example: Architecture Options

Functions	Centralized Architecture		Distributed Architecture		Combination Architecture	
	Hub Site	Field Site	Hub Site	Field Site	Hub Site	Field Site
Flight Plan Processing	X		X		X	
Trajectory Processing	X			X		X
Sector Counts	X			X	X	
FCA Impact	X			X		X
Time In Sector	X			X	X	

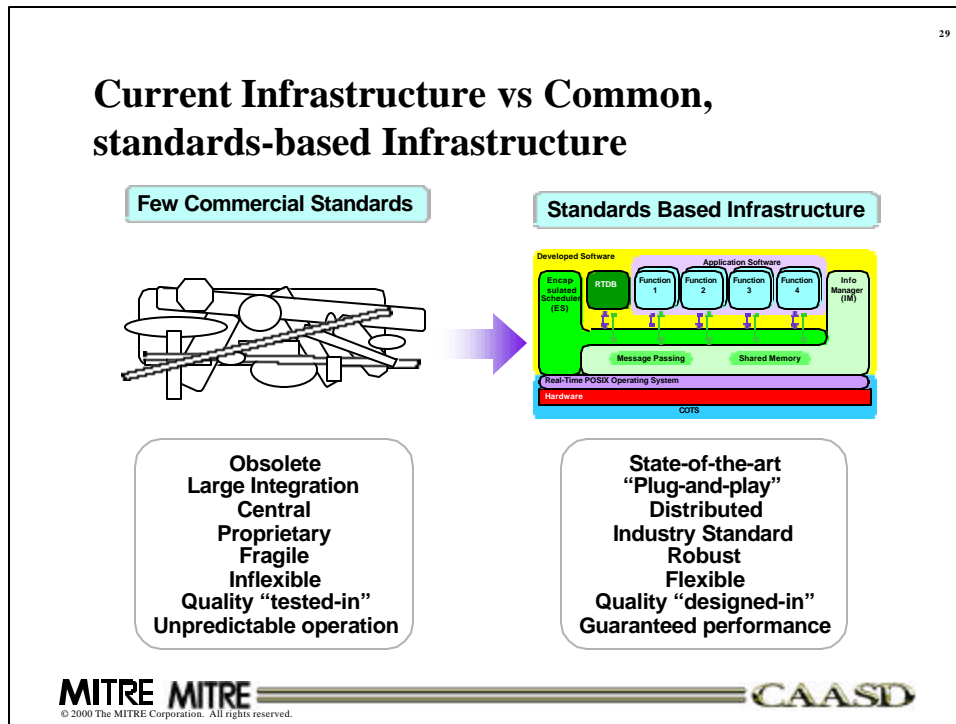


© 2000 The MITRE Corporation. All rights reserved.

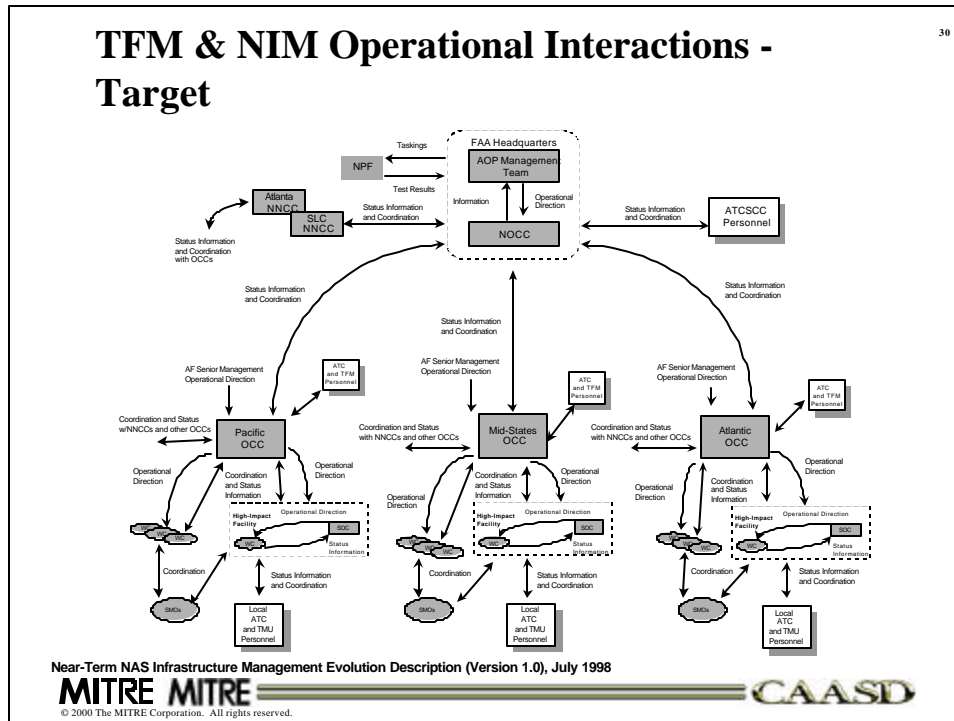
This illustration is intended as an example of some of the elements that could be considered in developing candidate solutions for TFM capability evolution. As noted, the requirements must be better understood before it would be feasible to develop candidate solutions.



This chart is intended as an example of how an alternative approach to a current or planned function could be illustrated.



This chart emphasizes the advantages of the standards-based common infrastructure and highlights the changes from the current environment.

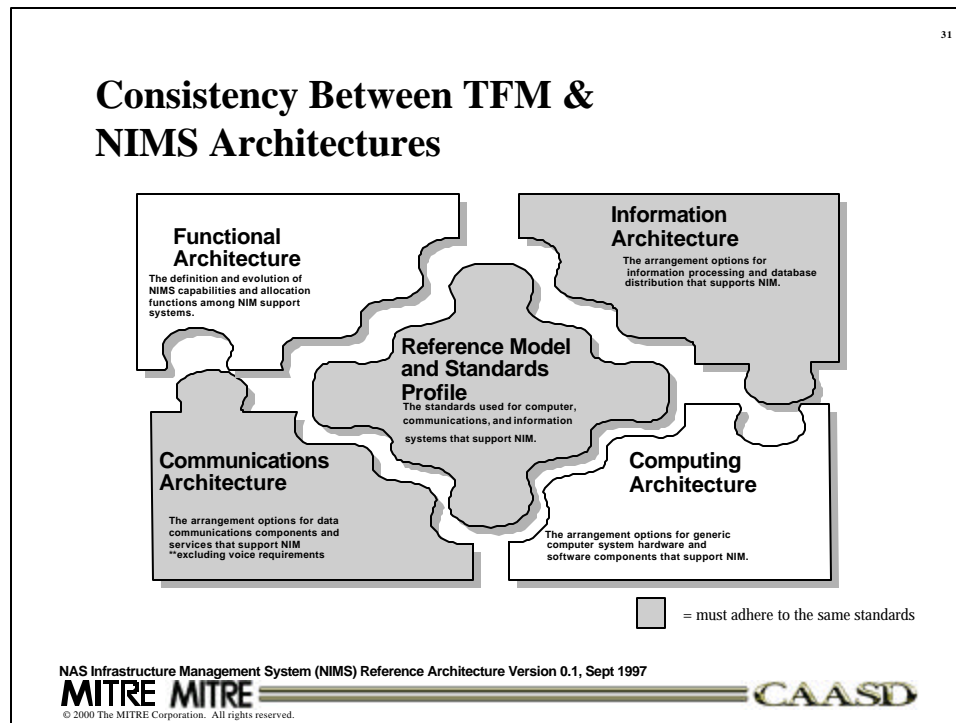


Knowledge of the state of NAS infrastructure is a critical component for operational use of the NAS. Outages of critical parts of the NAS infrastructure may have significant effects on the use of airport and airspace resources. However, the fundamental purpose of NIM activity and supporting systems is the detection and resolution of infrastructure problems and support and maintenance of these systems.

This figure illustrates a target of a complete NAS Infrastructure Management approach. The operational interactions between the NIM activities and the NAS operations, represented by Air Traffic Control and Traffic Flow Management at the local and national levels are integral to the successful operation of the NAS.

Not shown in this figure is the common situational awareness information shared with NAS users to facilitate better flight planning and collaboration among all parties for the most effective use of constrained NAS resources.

WC/SSC - Work Centers/System Support Centers



Consistency of architectures between TFM and NIM systems are required to achieve either of the objectives discussed above. To provide infrastructure status to the NIM automation, the TFM systems must provide interfaces and status data definitions consistent with those being used in the NIM architectures. In addition, for the TFM systems to provide NAS infrastructure status to the ATCSCC, TMUs, and NAS users, information exchange consistent with the NIM architecture must also occur.

The NIM architecture components are illustrated in the this figure. The shaded components are those that require a level of consistency between the TFM systems and NIM automation. The information architecture provides a common language between the TFM and NIM systems. The reference model and standards provide consistency at interfaces for that information to flow. And consistency in communications provides an available and compatible mechanism over which the information flows.

Candidate Solutions:

- Approaches and Methods**

Evolution of IPT Services: Examples

- **Development approaches:**
 - **Evolutionary Acquisition and Spiral development**
 - **Interoperability assessment**
- **Alternate approaches to:**
 - **Capability Demonstration**
 - **Technology Transfer**

For the purposes of this strategic approach, the examples shown on this chart are offered for consideration by AUA-700. The examples will be discussed in the following slides.

Evolutionary Acquisition (EA) and Spiral Development (SD)

- **EA and SD comprise an acquisition strategy and development approach used to take:**
 - **Undefined (or not well defined) problems and refine and evolve the requirements**
 - **Large and complex problems and break them into manageable development pieces**
- **Goals;**
 - **Rapid solutions to satisfy customer needs**
 - **Leverage commercial or reusable capabilities**

Adapted from "Understanding Evolutionary Acquisition and Spiral Development", A.M. Willhite, The MITRE Corp., 10/8/99



© 2000 The MITRE Corporation. All rights reserved.

Evolutionary Acquisition and Spiral Development offer the potential for developing more rapid solutions to satisfy customer needs as well as offering the possibility of effectively leveraging commercial or reusable capabilities. It takes an incremental approach to development by breaking down problems into manageable components and addressing the best understood elements first.

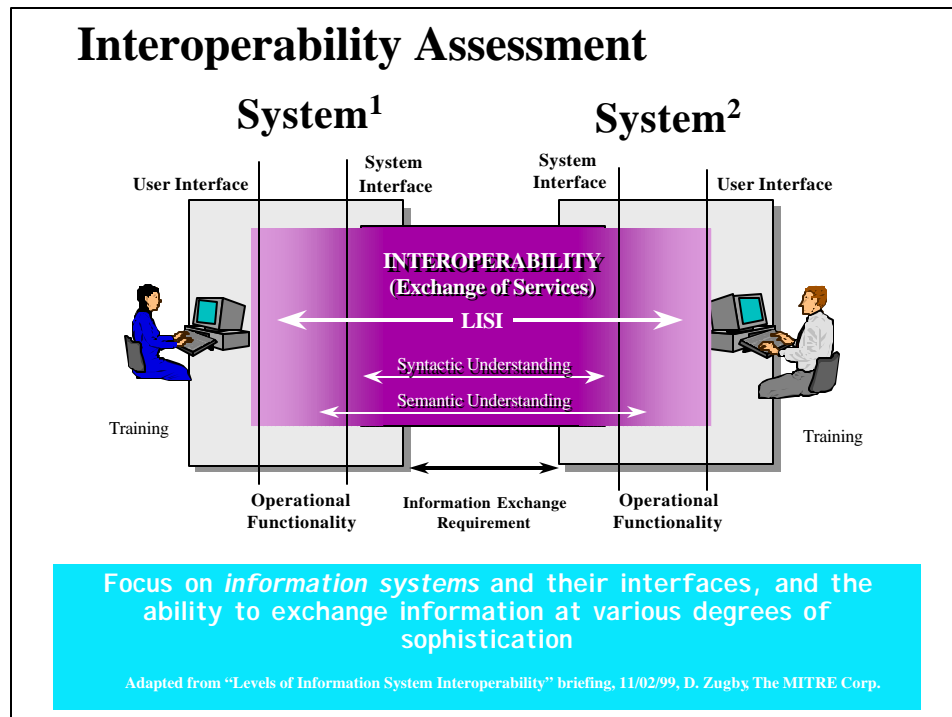
Evolutionary Acquisition (EA) and Spiral Development (SD) (Concluded)

- **A collaborative process involving users, acquirers, developers, testers and sustainers**
 - **Refine and prioritize the requirements**
 - **Establish flexible architecture**
 - **Provide the best possible capabilities within the priorities and budget constraints for an increment**
 - **Examine risk mitigation strategies and technology**
- **There are no silver bullets, there is no one size fits all approach -- Spiral development is one of a series of acquisition initiatives that must be balanced. Can work if adequately planned and managed**

Adapted from "Understanding Evolutionary Acquisition and Spiral Development", A.M. Willhite, The MITRE Corp., 10/8/99



One of the attractive features of the EA/SD approach is its collaborative nature. It appears well suited to support the AUA-700 objective of Collaborative Requirements. The joint emphasis on providing the best possible capabilities within the priorities and budget constraints and on risk mitigation strategies appear well suited to the Affordable Life Cycle objective. As expected, this approach is not a perfect solution, but is one that can work if it is adequately planned and managed.



In the evolution toward more integrated capabilities, there is increasing emphasis on improving the interoperability of current systems and capabilities. This assessment of level of interoperability focuses on the operational functionality of the information systems under consideration, their interfaces at the user and system level and the level of information exchange capability. This approach does not examine the operator role in interoperability, nor problems at that level rather the focus is on the engineering aspects of interoperability.


38

Interoperability Assessment: Contributing Initiatives

- **IT Interoperability Standards** -- *Criteria governing the implementation of information systems and capabilities*
- **Common Operating Environments** -- *Assurance of software portability and application-to-operating environment interactions*
- **Common Data Models** -- *Facilitation of uniform understanding of terms, definitions, and structure*
- **Interoperability & Integration Testing** -- *Verification of standards conformance, system certification, and field readiness*
- **Enterprise Architectures & Information Exchange Requirements** -- *Identification of information interactions needed to support the operational mission of the enterprise*

LISI capitalizes on these efforts to provide a composite view for assessing and measuring interoperability gaps and shortfalls

Adapted from "Levels of Information System Interoperability" briefing, 11/02/99, D. Zugby, The MITRE Corp.

MITRE MITRE  **CAASD**

© 2000 The MITRE Corporation. All rights reserved.

The Levels of System Interoperability approach is based on a number of contributing initiatives as shown here. Use of this approach offers the potential for providing a framework for the assessment and measurement of interoperability gaps and shortfalls.

Capability Demonstration: What is an Advanced Capability Technology Demonstration (ACTD)?

An approach currently in use in the DOD which permits early & relatively inexpensive evaluation of mature technologies to meet a critical operational need (Internal &/or External Customer).

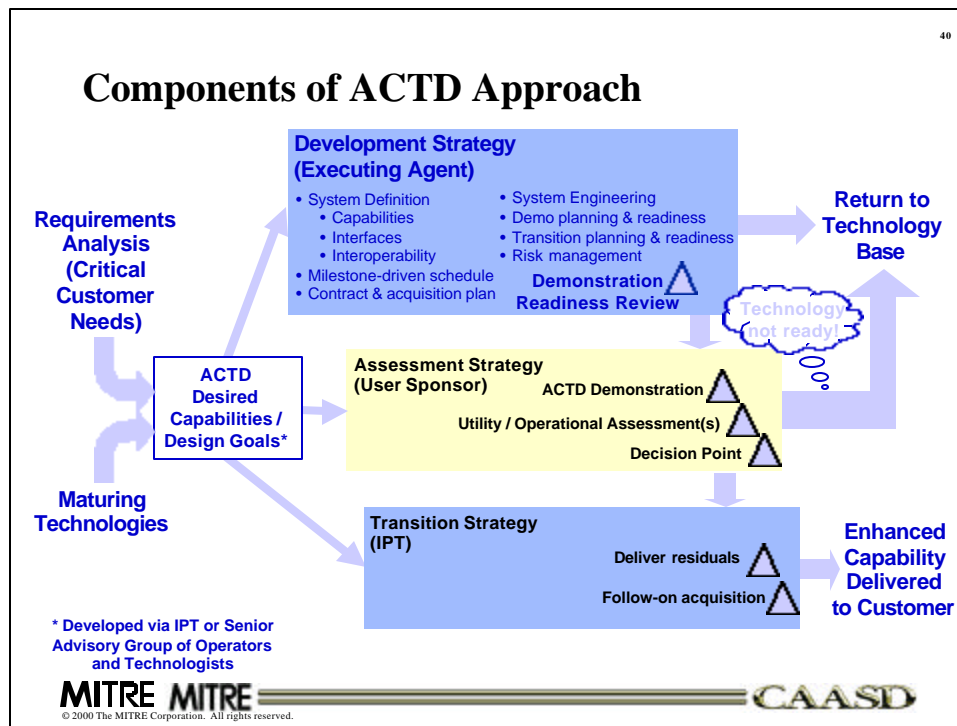
- **Customer(s) evaluation to determine operational utility before committing to formal acquisition.**
- **Includes CONOPS developed specifically to take advantage of new capability.**
- **If operational utility is demonstrated:**
 - **Field residual operational capability (until acquisition is completed)**
 - **Enter late stage formal acquisition**



© 2000 The MITRE Corporation. All rights reserved.

The current DOD Advanced Capability Technology Demonstration (ACTD) program evolved in 1994. This program exploits maturing technologies to address significant operational problems. It offers a means to rapidly transition new capabilities from the developer to the user/customer. These capability demonstrations emphasize assessment and integration rather than technology development. The objective is to enable the users to gain an understanding of proposed new capabilities as well as an opportunity to evaluate the capabilities in real operational mode sufficient to fully assess operational utility. The ACTDs enable the user/customer:

- to develop and refine the associated concept of operations in conjunction with the capability being evaluated
- to evolve his operational requirements as experience is gained with the capability
- to operate prototype systems in realistic operational demonstrations in order to make an assessment of the operational utility of the proposed capability.



A key goal of ACTDs is to move into the appropriate phase of acquisition without loss of momentum if the user/customer determines the capability under evaluation offers operational utility. Included in this preparation and planning are provisions for the development of operational requirements, plans addressing interoperability and other systems engineering issues, life cycle cost, staffing, training and preparation for supportability.



One of three outcomes is possible at the conclusion of the ACTD operational demonstration:

- The user/sponsor may recommend acquisition of the capability and fielding the residual capability to provide an interim and limited operational capability
- If the capability does not demonstrate operational utility, the project is either returned to the research environment for revision or it is terminated
- The users need is fully satisfied by fielding the residual capability and there is no need to acquire additional units.

41

Advanced Technology Demonstration (ATD) vs Advanced Capability Technology Demonstration (ACTD)

	<u>ATD</u>	<u>ACTD</u>
Primary Focus	Demonstrate maturity of emerging technology	Demonstrate operational utility of new capability using mature technology
Customer Participation	Yes	Yes
Explore new doctrine & operational concepts	Rarely	Often
Technical Maturity	Cutting Edge	Mature Technology
End product	Proven technology	Residual operational capability
Transition	Full Scale Development	Tech Transfer and Shortened Development Timeframe

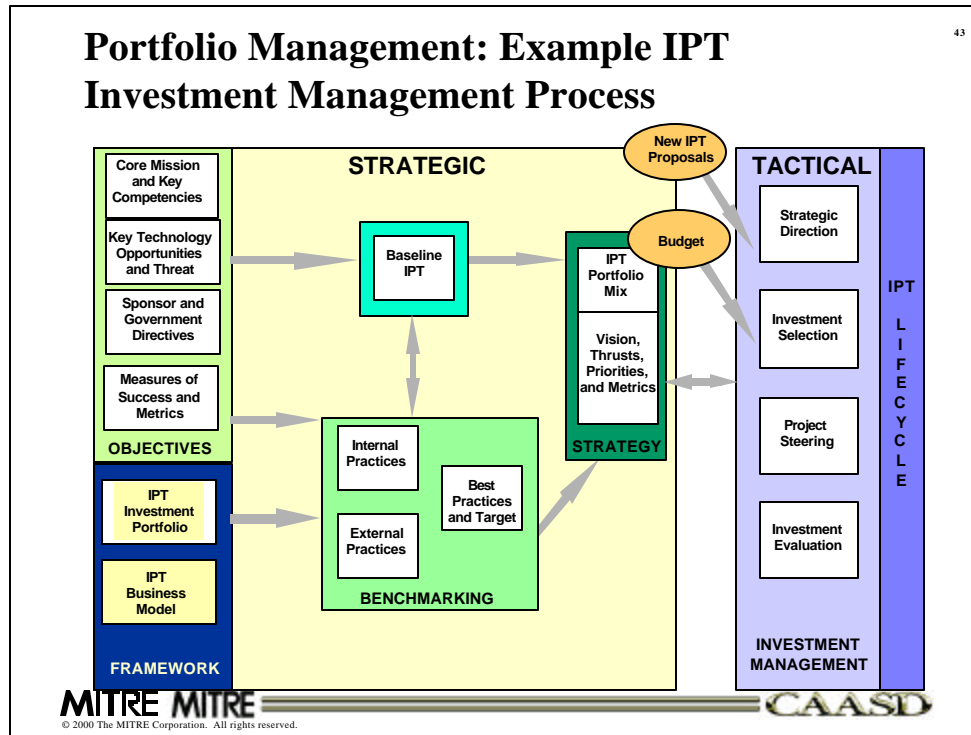



© 2000 The MITRE Corporation. All rights reserved.

This chart illustrates some of the similarities and differences between Advanced Technology Demonstration (ATD) and Advanced Capability Technology Demonstration (ACTD). As noted, the focus of the ATD is on technological maturity while with the ACTD the emphasis is on operational suitability and utility.

Portfolio Management





Annual strategic IPT management is tied to FAA, ARA, and AUA strategic planning. Corporate objectives set the requirements for IPT acquisition and implementation. An IPT business model and investment portfolio provide the structure for planning for TFM improvement. Benchmarking examines internal and external IPT practices together with industry best practices and sets targets for TFM capabilities. These targets are compared with baseline capabilities, and an IPT strategy is derived. This strategy sets the vision, targets, priorities, and metrics for individual and groups of investments as well as the targets for the distribution of investments according to the desired portfolio mix.

Tactical IPT management is the day-to-day management and operations of the IPT investments. Strategic direction drives the selection of investments. Projects are established to provide their management. Measures are put into place and monitored to ensure that projects are meeting strategic goals as well as being managed efficiently and effectively. Budget realities place a cap on the total annual spending. Budget realignment as well as new, promising TFM proposals may cause mid-year re-prioritization of investments or reallocation of investment funds.

Common Tools for Portfolio Management

- **Strategic Thrusts**
- **Business Model**
- **Portfolio Model**
- **Investment Plan**
- **Benchmarking**
- **Investment Scorecards**
- **Investment Selection Process**



Portfolio management is a combination of several methodologies to achieve the end results of consistent and justifiable investment and management. The tools listed above provide results that when looked at as a whole provide a managed overview of IPT investment and management. The strategic plan is the first component for portfolio management.

An example of an IPT Balanced Scorecard might include five categories: demonstrated production, financial soundness, technical excellence, business value, and human resources. Generally IPT investments will contribute to several of these objectives. Investment selection requires trade off decisions to achieve a balance among these objectives.

Managing by IPT Portfolio Category: Example

Category	Utility	Productivity	Frontier
Objective	Economize	Leverage	Discover
Expectations	Cost Effectiveness	Performance Enhancement	Paradigm Change
Target Portfolio Mix	65%	25%	10%
Investment Management	IPT provides day-to-day management and consults with ARA and Ops Team for significant cost or business impact	IPT prioritizes and identifies funding and consults with Ops Team for significant cost or business impact	IPT identifies and prioritizes topics and consults with Ops and Users for transition from Research to Develop

Portfolio mix is determined by the IPT with concurrence of AUA

* Derived from Gartner Group and Microsoft Models

MITRE MITRE

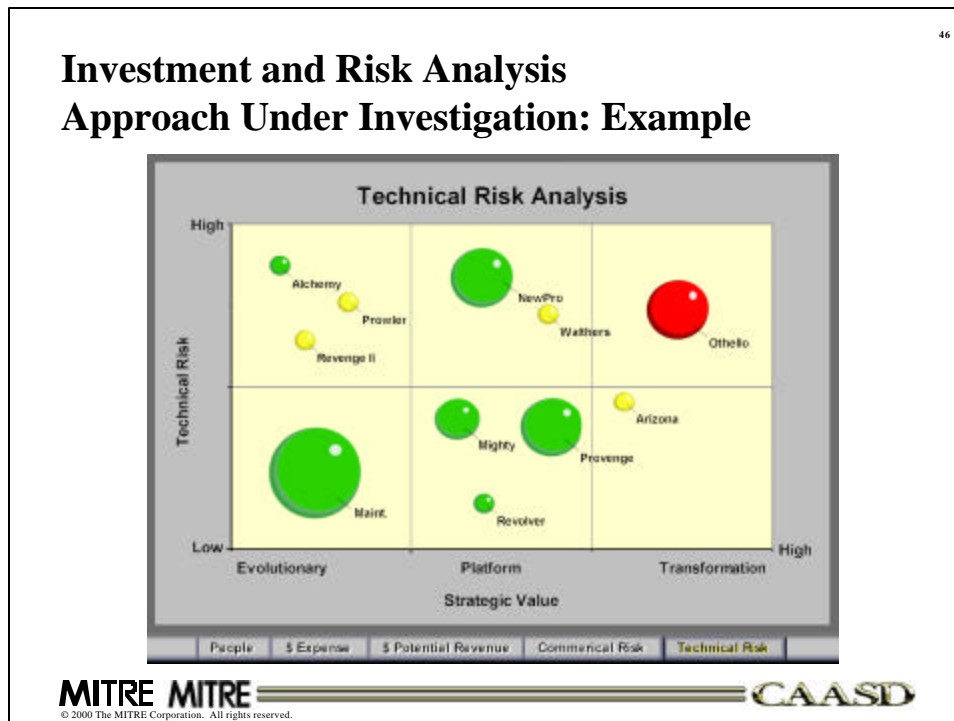
© 2000 The MITRE Corporation. All rights reserved.

CAASD

The IT investments illustrated above are organized according to a portfolio model developed by the Gartner Group. The model divides investments into three categories: Utility, Productivity, and Frontier. Investments are distinguished by the motivation of the investment. Utility investments are intended to reduce cost or increase operational efficiency; these are generally transparent to the end user. Productivity investments enhance end user performance, providing new services or improved service levels. Frontier investments are experimental, moving into new mission needs or into new technologies or applications.

The differing motivation and scope of these investment types lend them to differing management. Utility investments are, for the most part, managed by maintenance organizations, such as AOS. Productivity investments are proposed to and prioritized by the IPT prior to being funded and assigned for implementation. Frontier investments are identified, prioritized, and conducted under the auspices of research and development. In all cases, investments that will result in significant cost or business impact are reviewed and approved by the JRC.

Example goals for the expenditures in each of these investment categories are illustrated as: Utility 65%, Productivity 25%, and Frontier 10%. These goals are a shift from current spending to decrease Utility costs and to increase Frontier investments. The IPT may set a target of five years to effect this spending shift.



Some COTS tools are available to support decision making in portfolio management. The illustration above depicts a screen display for a tool that helps assess the relative merits of investment versus risk. The risk analysis is a standard technique supported by the tool and the strategic values are assigned based on standard criteria or supported by other techniques, such as balanced scorecard.

The results of tools like these can aid in the allocation of funding and resources to maintain a portfolio balanced according to the strategic plan. And providing a return on investment that achieves mission objectives.

Potential CAASD Role in Strategic Planning

- **CAASD participation in development of the Strategic Plan**
 - Provide assessment of gaps in current drafts
 - Provide details of accepted methodologies or assess alternative methodologies
- **CAASD participation in implementation of Strategic Plan**
 - Continue TFM research and tech transfer
 - Continue TFM architecture development
 - Provide technical contributions for System Engineering, priority setting, alternatives analysis, technology development

List of References

- *RTCA 2003-2005 Capabilities Working Group Report to the Steering Committee*, Roger Wall, 2 December 1999
- Home Page of the Deputy Undersecretary of Defense for Advanced Systems and Concepts (<http://www.acq.osd.mil/at>), Advanced Capability Technology Demonstration Guidelines
- *Introduction and ACTD Process Overview*, Michael J. O'Connor, O'Connor Consulting Services, 29 September 1999
- *Assessment Planning: ACTD Process for Planning Military Utility Assessments*, G.A. Koumbis, USACOM, 29 September 1999
- *Strategic IS/IT Planning*, Edwin E. Tozer, DATAMATION Professional Series, Butterworth Heinemann, 1996
- *En Route Architecture Update #01*, Review Draft, FAA/AUA-200, 17 December 1999
- *Strategic Planning for Information Systems* (2nd Edition), John Ward and Pat Griffiths, John Wiley & Sons, 1996
- *Systems Engineering Handbook*, Release 2.0 (Draft), International Council on Systems Engineering, January 2000
- *Department of Defense Joint Technical Architecture*, Version 3.0, 15 November 1999
- *Distributed Component Technology (DCT)*, STRICOM Technology Base Assessment, Diane Mularz, The MITRE Corp., January 1998
- *The Operational Architecture Role in Command and Control Effectiveness*, Stanley G. Becker and Raymond A. Beamer, MP98B000035, The MITRE Corp., July 1998
- *Structured System Evolution: Employing Dynamic, Executable Architectures*, Stanley G. Beckner, Raymond A. Beamer, MP99B000038, The MITRE Corp., July 1999
- *Levels of Information System Interoperability (LISI)*, Don Zugby, The MITRE Corp., 2 November 1999
- *Observations on Implementing Evolutionary Acquisition and Spiral Development*, Anne Marie Willhite, The MITRE Corp., 13 January 2000
- *Understanding Evolutionary Acquisition and Spiral Development*, Anne Marie Willhite, The MITRE Corp, 8 October 1999
- *Near-Term NAS Infrastructure Management Evolution Description* (Version 1.0), MTR 98W0000082
MITRE Technical Report, July 1998
- *NAS Infrastructure Management System (NIMS) Reference Architecture Version 0.1*, MTR97W0000065
MITRE Technical Report, September 1997
- *C4ISR Architecture Framework Version 2.0*, C4ISR Working Group, 18 December 1997
- *The Trouble with Spirals*, M. Hermes, The MITRE Corp., 23 November 1998
- *A Systems Engineering Capability Maturity Model Version 1.1*, SECMM-95-01, CMU/SEI-95-MM-003, November 1995 Federal Aviation Administration Information Technology Strategy FY2000-FY2002 Version 1.0, Office of Information Services and Chief Information Officer, 22 September 1999



List of References (concluded)

- *FAA Strategic Plan*, U.S. Department of Transportation, Federal Aviation Administration, Office of the Administrator
20 May 1998
- *Strategic Plan for Oceanic Airspace Enhancements and Separation Reductions*, Federal Aviation Administration,
January 1997
- *AUA Program Master Plan*, Federal Aviation Administration, Office of Air Traffic Systems Development, March 1997
- *NASA Strategic Management Handbook*, National Aeronautics and Space Administration, Washington DC, October 1996
- *Strategic Plan*, Office of System Safety, Federal Aviation Administration, 1996
- *Business Re-engineering with Information Technology*, John J. Donovan, PTR Prentice Hall, Englewood Cliffs, NJ, 1994
- *Practical Steps for Aligning Information Technology with Business Strategy*, Bernard H. Boar, John Wiley & Sons, Inc.,
New York, 1994
- *U.S. Department of Energy Strategic Plan*, September 1997
- *U.S. Department of Energy Research and Development Portfolio*, February 2000
- *Business Process Reengineering (BPR) Fundamentals*, DOD/OSD/C3I
- *Draft Information Technology Investment Portfolio (ITIP) Methodology White Paper*, prepared by: ITIP WIPT Office of
the DoD Deputy CIO, May 25, 1999
- *A Survey of IT Portfolio Selection Methodologies with Application to Logistics*, Lamar, B.W. and Lansdowne, Z.F.,
The MITRE Corporation, working paper (draft), 1998
- *Implementing Best Practices: Strategies at Work*, Federal CIO Council, Capital Planning and IT Investment Committee,
June 1998, p. 6
- *Translating Strategy into Action: The Balanced Scorecard*, Kaplan, R.S. and Norton, D.P., Harvard Business School Press,
Boston, (1996)
- *Portfolio Management (Investment Prioritization) Applied to the DoD Logistics Community*, Logistics Community Manager,
working paper, March 1999



© 2000 The MITRE Corporation. All rights reserved.

Backup Slides

Architecture Terms of Reference

- **Architecture:** Structures and components of a program/system, their interrelationships, and principles and guidelines governing their design and evolution over time. (modified from Garlan, 1995)
- Architectures:
 - **Operational Architecture:** A description of the roles and responsibilities, the operational elements, behavior, and information flows required to accomplish or support the delivery of local and enterprise services. (modified from C4ISR, 97)
 - **Functional Architecture:** A description of functions, data, and their interrelationships that provide capabilities to users, their evolution over time, and the principles and guidelines governing their design
 - **Software Architecture:** A description of the structures of a program or computing system which comprise the software components, the externally visible properties of those components, the relationships among them, and their evolution over time. (modified from Bass, 98)
 - **Information Architecture:** A description of the information structures providing for the managed collection, validation, standardization, storage, and access/dissemination of data, their evolution over time, and the principles and guidelines governing their design.
 - **Systems Architecture:** A description of systems and their interconnections and interoperability providing for, or supporting the delivery of system services. The system may be a single system or a system of systems. (modified from C4ISR, 97)
 - **Hardware Architecture:** A description of the physical components of systems and their interconnections.
 - **Communications Architecture:** A description of a system's communication devices, connectivity, interoperation, network protocols, and network mediums providing capabilities to users. (derived from Cisco, 94 and Newton, 66)
 - **Technical Architecture:** A description of the minimal set of rules governing the arrangement, interaction, and interdependence of system components to ensure that a conformant satisfies a specified set of requirements, as well as principles and guidelines governing their evolution over time. (modified from C4ISR, 97 and JTA, 96)

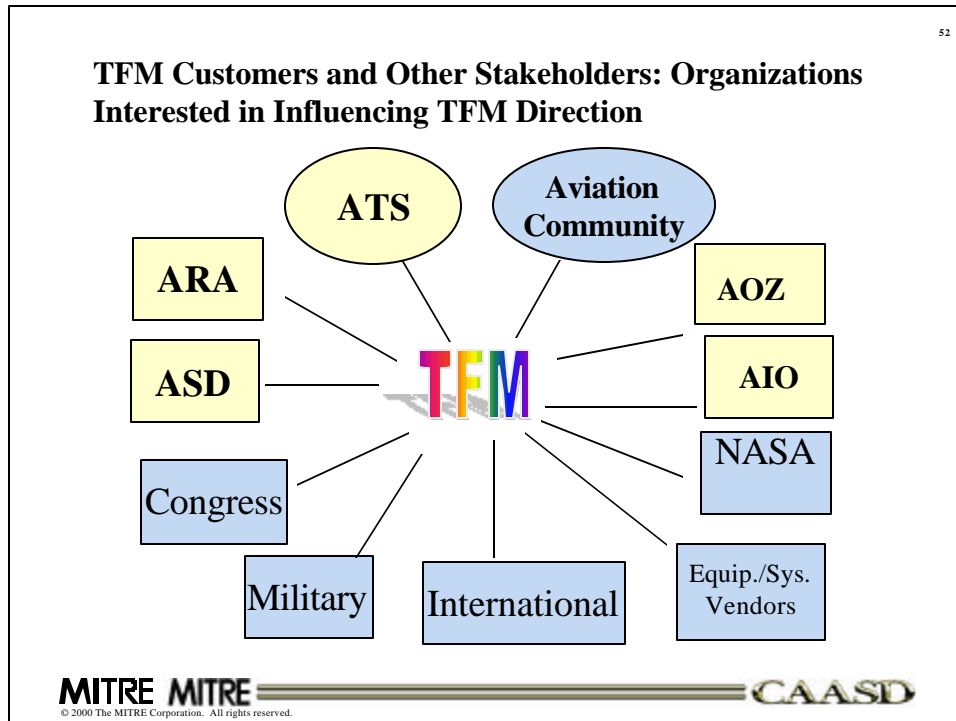


Architecture definitions are numerous and continually evolving.

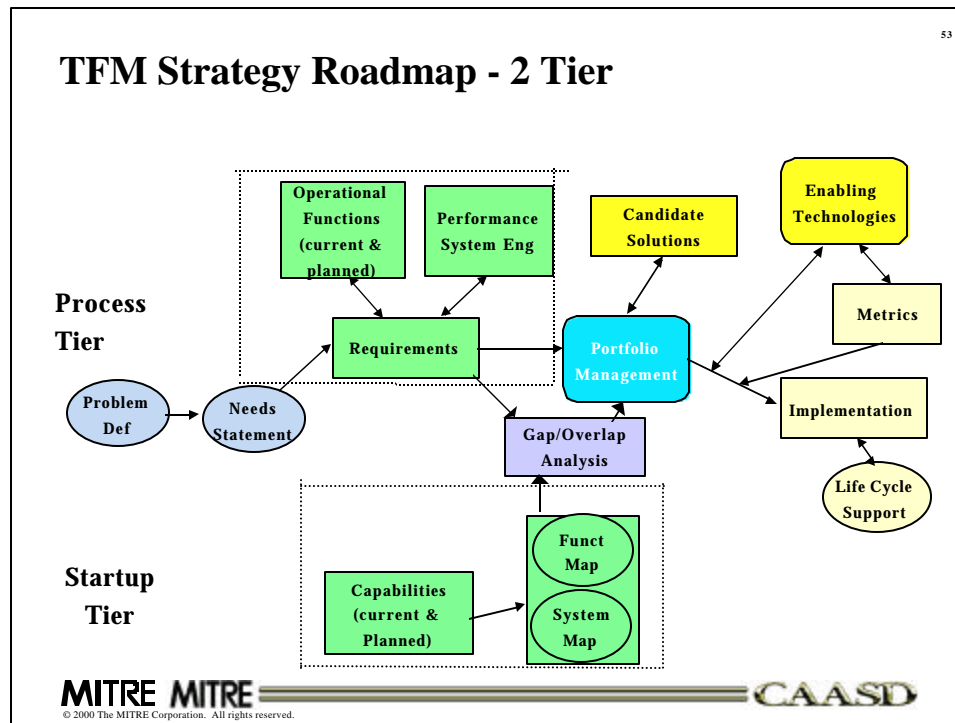
Definitions of terms must be tailored and consensus reached for common understanding.

An August 1998 GAO report, on *Defense Information Superiority* in the DOD, recognized the criticality of achieving cross-organizational consensus on common architecture.

The above set of *Systems Architecture Terms of Reference* was developed for the FAA environment. Common terms provide a common basis for defining architecture in the engineering of NAS systems.



The direction of the future evolution of TFM is of interest to multiple organizations both within the FAA and within the greater community. A deeper understanding of the interests of each of the stakeholders is important to the completion of the AUA-700 strategy.



This two tiered roadmap is offered as a candidate framework for considering the elements of this Strategic Approach.

The Startup Tier focuses on analysis of current and planned capabilities and a mapping of those capabilities to systems and functions. Once this process is completed the first time, it should be kept up to date on an ongoing basis.

The Process tier begins with a Problem Definition and articulation of associated needs. The Needs statement is considered in a Requirements development process which takes into account current and planned operational functions as well as performance and systems engineering requirements. The resulting requirements are analyzed against the Functional and System Maps prepared during the startup tier to identify gaps (requirements not covered by current and planned capabilities) and overlaps (requirements satisfied by more than one capability.)

Portfolio Management is used to determine priorities for strategic direction and investment selection. Portfolio management takes into account the requirements and gap/Overlap analysis to develop candidate solutions. The solutions are joined with appropriate enabling technologies. Based upon the decisions reached during portfolio management, an implementation sequence and strategy is developed along with performance metrics to monitor progress toward the selected goals.

Enabling Technologies / Methodologies

- **Strategic outlook on technology and where/how it can be most effectively applied**
- **Leverage promising technologies and methods currently in use**
 - **Highlight technologies to be aggressively pursued based on their potential payback to the organization**



Enabling technologies and methodologies are another major element of this strategic approach. The objective is to identify and leverage technologies and methods currently in use in other government agencies and in industry which appear to offer significant advantages and efficiencies for use by AUA-700 in accomplishing their mission. This technology outlook should be an ongoing activity to tailor and refine ongoing processes as well as to introduce new and promising approaches.

When is an ACTD Appropriate?

	<u>ATDs</u>	<u>ACTDs</u>	<u>Acquisition</u>
Requirements	Perf Rqmt	Need	ORD
Acq Commitment	No	No	Yes
Acq Funding	No	No	Yes
Tech Level	Evolving	Demonstrated	As Required
Dev Process	As Appropriate	As Appropriate	DoD 5000.2R
Prog Objective	Tech Maturity	Operational Utility	Acquisition
Timeframe ??	2-3 Years	2-4 Years	6-15 Years

Adapted from "Introduction and ACTD Process Overview", M.J. O'Connor, O'Connor Consulting Services, 9/29/99



© 2000 The MITRE Corporation. All rights reserved.