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DEFINING THE FUTURE

Integrating the Federal Enterprise Architecture with the Department of Defense Architecture Framework, the Information Technology Infrastructure Library and the Reference Architecture for Space Data Systems

2006 Ground Systems Architecture Workshop

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Favorite Quotes

- “It is not necessary to change. Survival is not mandatory.”
- “If you can’t describe what you are doing as a process, you don’t know what you are doing.”
- “If you do not know how to ask the right question, you discover nothing.”
- “Profit in business comes from repeat customers, customers that boast about your project or service, and that bring friends with them.”

W. Edward Deming

Introduction

- **TASC as a Systems Engineering and Integration (SE&I) contractor:**
 - Prepares and deploys large systems for customers world-wide
 - Systems routinely use Satellite, Terrestrial and Wireless components in End-to-End Communications Architectures
 - All architectures are laid out and Modeled prior to deployment to resolve:
 - Performance
 - Cost
 - Security
 - Requirements satisfaction
 - For efficiency it is essential to re-use data where possible - Data is shared between
 - Opnet Modeler®
 - Telelogic System Architect®
 - Satellite Tool Kit®
 - TRADES - TASC Internal Tool for Data Management
 - Others

What is Enterprise Architecture (EA)?

The Focus of EA is the entire Business, Not just the Technology

- “The analysis and documentation of an enterprise in its current and future states from a strategy, business, and technology perspective.”
An Introduction to Enterprise Architecture ©2005
- An integrated approach to organization-wide strategic, business, and technology planning
- A Framework that describes how an organization develops, manages, and uses information technology, data, systems, performance criteria and business processes to optimally support the enterprise business goals and strategy.
- An enterprise architecture provides a clear and comprehensive picture of an entity, whether it is an organization (e.g., a federal department) or a functional or mission area that cuts across more than one organization (e.g., financial management) US GAO July 2005

EA and Modeling Tool Observations

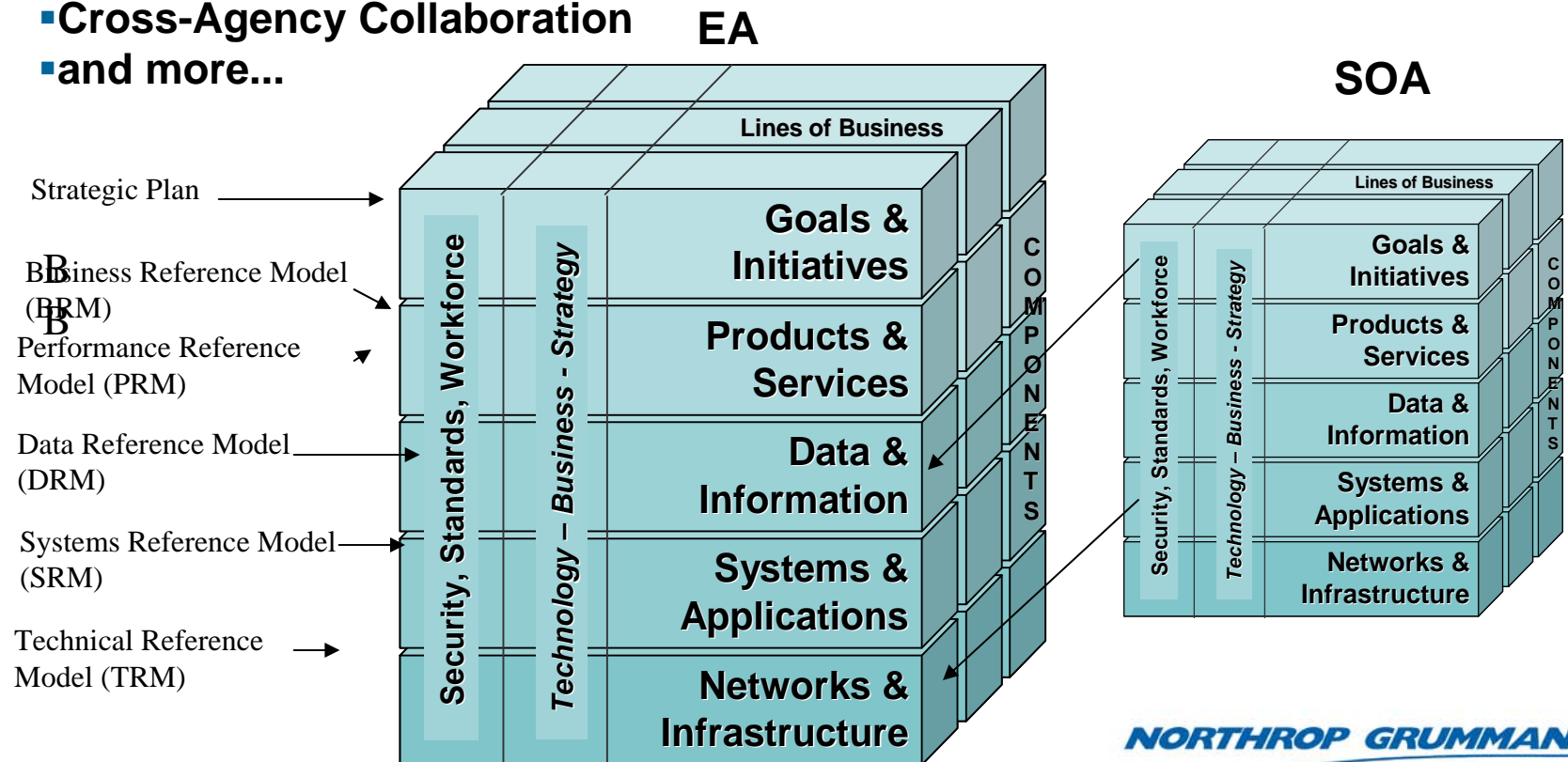
- An Enterprise Architecture by itself is worthless
 - Data needs to be shared and integrated to be useful
 - The Enterprise Architecture must be coupled to other business processes including modeling and analysis, budgeting, strategy, etc.
- Implementing an EA is very hard
 - Understanding the Enterprise and it's processes are Key
 - Unstructured data in many formats
 - Incomplete data
 - Lack of buy-in/cooperation -If you are not part of the planning and governance process, don't bother with an EA.
- Without maintenance and integration into business processes an EA is not worth doing.
 - Any EA must embrace, streamline and improve business processes.
- By integrating architectures (e.g. DoDAF and RASDS) and leveraging similarities communications can be improved.
- FEA as an EA Super Set can build on specialized EA's and extend and enhance them.
- Feedback is essential to maintain the EA and drive gains back into the business.

Enterprise Architecture is NOT...

- Service Oriented Architecture – but EA encompasses SOA and completes the business/technology relationships for the enterprise – SOA is a collection of IT services designed to integrate, separation of interfaces from implementations, standards-based
- Portfolio Management – but EA encompasses PM and provides the complete, integrated relationship for each item in the portfolio
- Records Management – but EA improves the clarity of RM activities
- A “Mapping” of hardware/communications linkages – but EA includes this mapping in the Technical Reference Model (TRM)

VISUALIZE EA & Service Oriented Architecture

- Intent is to provide a common framework for
 - Budget Allocation
 - Horizontal and Vertical Information Sharing
 - Performance Measurement
 - Budget / Performance Integration
 - Cross-Agency Collaboration
 - and more...



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Definitions

- **Knowledge Management**

- The systematic management and use of the knowledge in a system or framework in an organization by capturing, storing, organizing, analyzing, managing, and distributing all types of information, customized to meet the needs of a wide variety of users and maximize an organization's performance. Data mining is an adjunct process of KM whose overall goal is to ensure all in the organization know what they need to know, and are able to leverage what they know.

- **Data Mining**

- An information extraction activity whose goal is to discover hidden facts contained in databases, files and processes. Using a combination of machine learning statistical analysis, modeling techniques and database technology, data mining find patterns and subtle relationships in data and infers rules that allow the prediction of future results.

- **Enterprise Architecture**

- A set of descriptive representations (i.e. models) relevant to describing an Enterprise, including design of the components of an enterprise, their relationships and how they support enterprise objectives, that captures common architectural decisions that are common and enforced, that can be produced to management's requirements (quality) and maintained over the period of its useful life (changed). This includes standards, baselines, and commonality.

- **Taxonomy**

- The science of categorization or classification using a pre-determined system that generates a catalog used as framework for discussion, analysis, or information retrieval or simply a way to describe something in a pre-defined orderly process. For an enterprise architecture it is the organization of data using views and reference models.

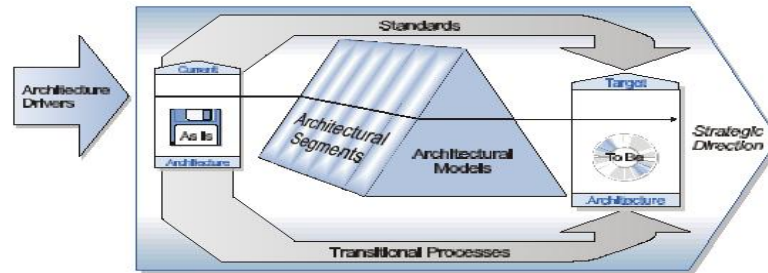
- **Ontology**

- Context of sharing information to refer to formal descriptions of particular domains; means to define classes, properties, individuals and relationships between them.

The Federal Enterprise Architecture (FEA) Framework

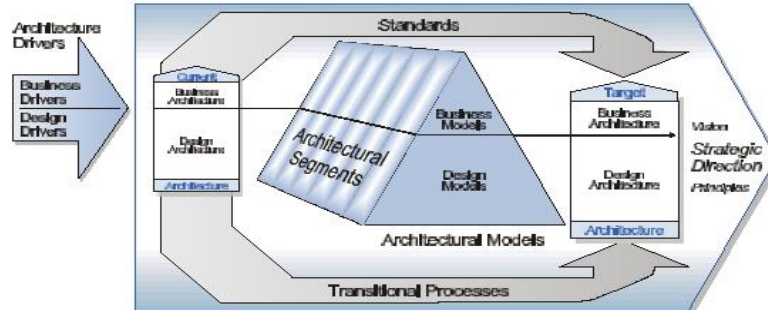
Level I (20,000 feet)

- Architecture Drivers
- Strategic Direction
- Current & Target Architectures
- Transition Processes
- Architectural Segments
- Architectural Models
- Standards



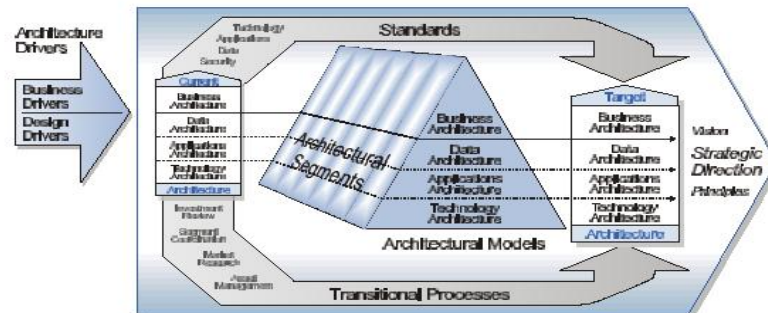
Level II (10,000 feet)

- Architecture Drivers
- Strategic Direction
- Current & Target Architectures
- Transition Processes
- Architectural Segments
- Architectural Models
- Standards



Level III (5,000 feet)

- Architecture Drivers
- Strategic Direction
- Current & Target Architectures
- Transition Processes
- Architectural Segments
- Architectural Models
- Standards



Higher
Level
of
Detail

**Framework Model of Choice
(e.g. Zachman, DoDAF, etc.)**

Level IV (500 feet)

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FEA Component Examples

- **Strategic Direction**
 - Example is President says to “Send men to Mars”
- **Architecture Drivers**
 - Derived from Strategic Direction and Constraints due to
 - Architecture, Technology, Time, etc.
 - Example: Current Architecture does not have reliable laser communications infrastructure so we are bandwidth limited.
- **Current Architecture**
 - Derived from Existing Infrastructure, People and Processes
- **Target Architecture**
 - Derived from Current Architecture – Can be organized by effectiveness, blocks, etc.
- **Transition Processes**
 - Derived from Current and Target Architectures
- **Architectural Segments**
 - Major Components in the OV and SV views
- **Architectural Models**
 - Currently a listing of DoDAF, Zachman, RASDS
- **Standards**
 - Applicable standards and their mappings to the architecture

FEA Reference Models

Enterprise Architecture

A set of descriptive representations (i.e. models) relevant to describing an Enterprise. This includes design of the components of an enterprise, their relationships and how they support enterprise objectives; this can stem from business processes or system functions within the Enterprise. This also includes architectural decisions that are common and enforced, can be produced to management's requirements (quality) and maintained over the period of its useful life (changed). These include standards, baselines, and commonality.

A well-documented architecture is a logical organization of information.

Information Architecture

Linking of an enterprise's strategic plan with its:

- Data Reference Model (DRM)
- Services Component Reference Model (SRM)
- Technical Reference Model (TRM)

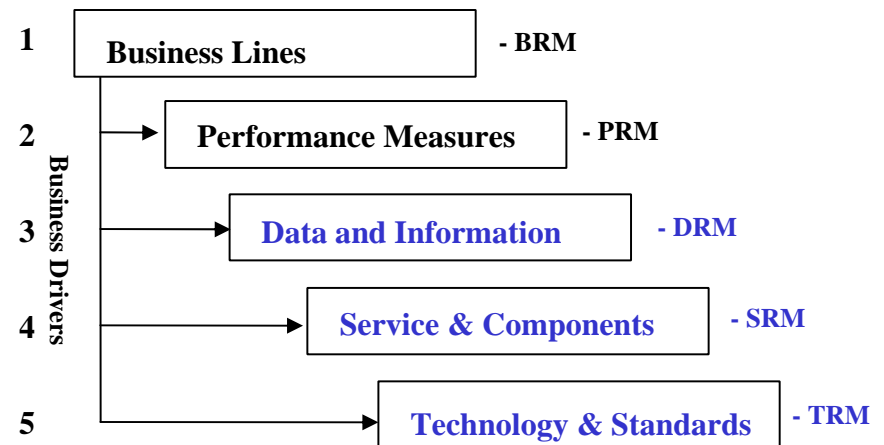
Communications Architecture

A set of rules for deploying and interconnecting objects facilitating communications that include:

- Web, Metadata, applications and data bases
- Information sharing & collaboration services
- Networks in a domain
- Trusted interfaces for transfer of information between domains

Federal Reference Models/EA

Process Creation Steps



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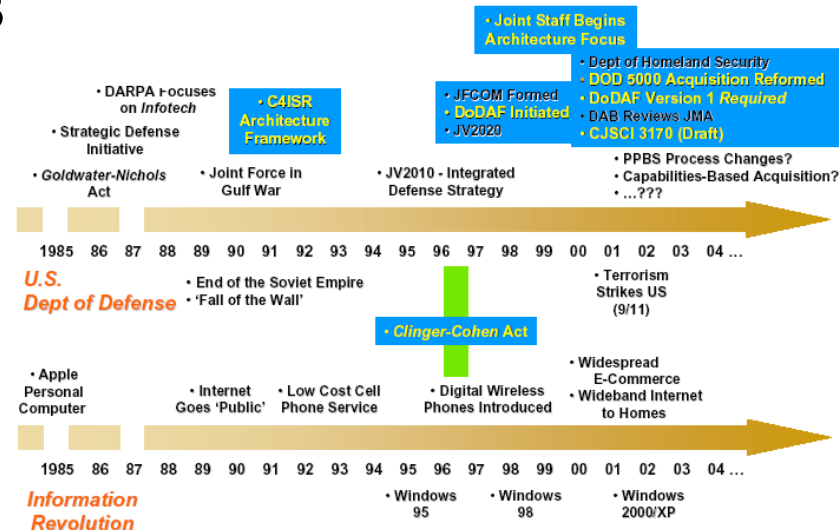
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DoDAF History

- Need for non-Disparate, Relatable, Architecture Products That Can be Integrated, Are Interoperable and Cost-Effective
- Effort to Enable Interrelation Between DoD Organization's Operational, Systems, and Technical Architecture Views
- C4ISR Architecture Framework Version 1.0 released in 1996
- DoDAF evolved from C4ISR
- DoDAF released October 2003

Parallel Revolutions



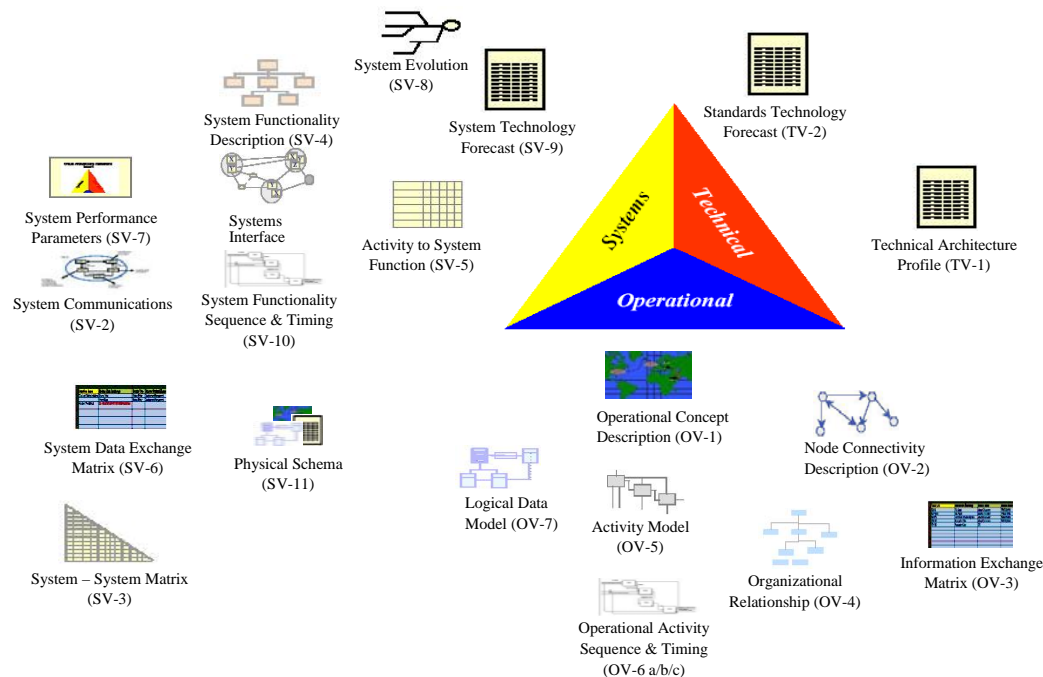
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DODAF Graphic, Textual and Tabular Products

- **System Views (SV)** describe systems and interconnections providing for, or supporting, war fighting functions

- **Technical Views (TV)** Set of rules and standards that govern system implementation and operation

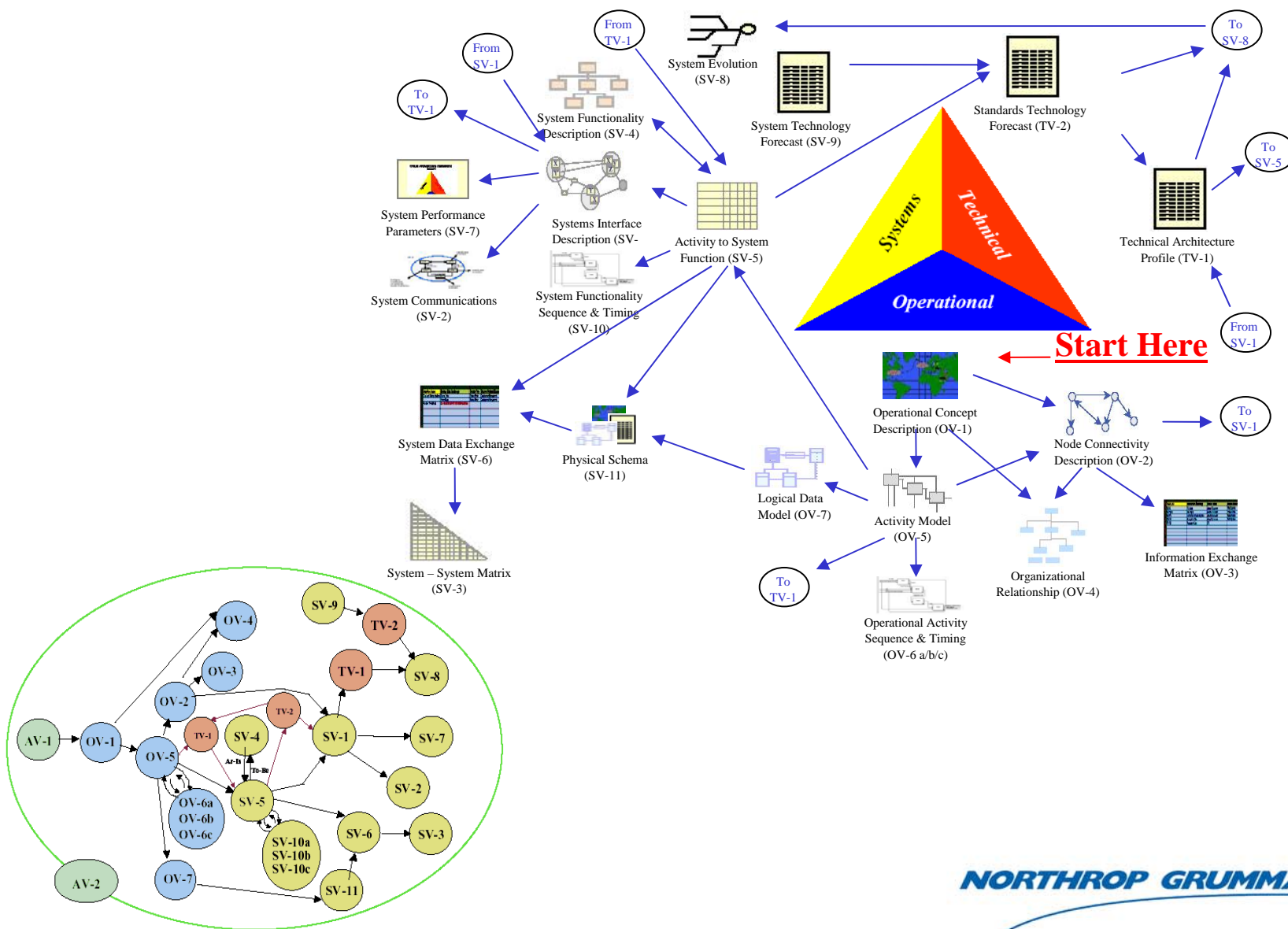


- **Operational Views (OV)** describe tasks and activities, operational elements, and information flows required to accomplish or support a military operation

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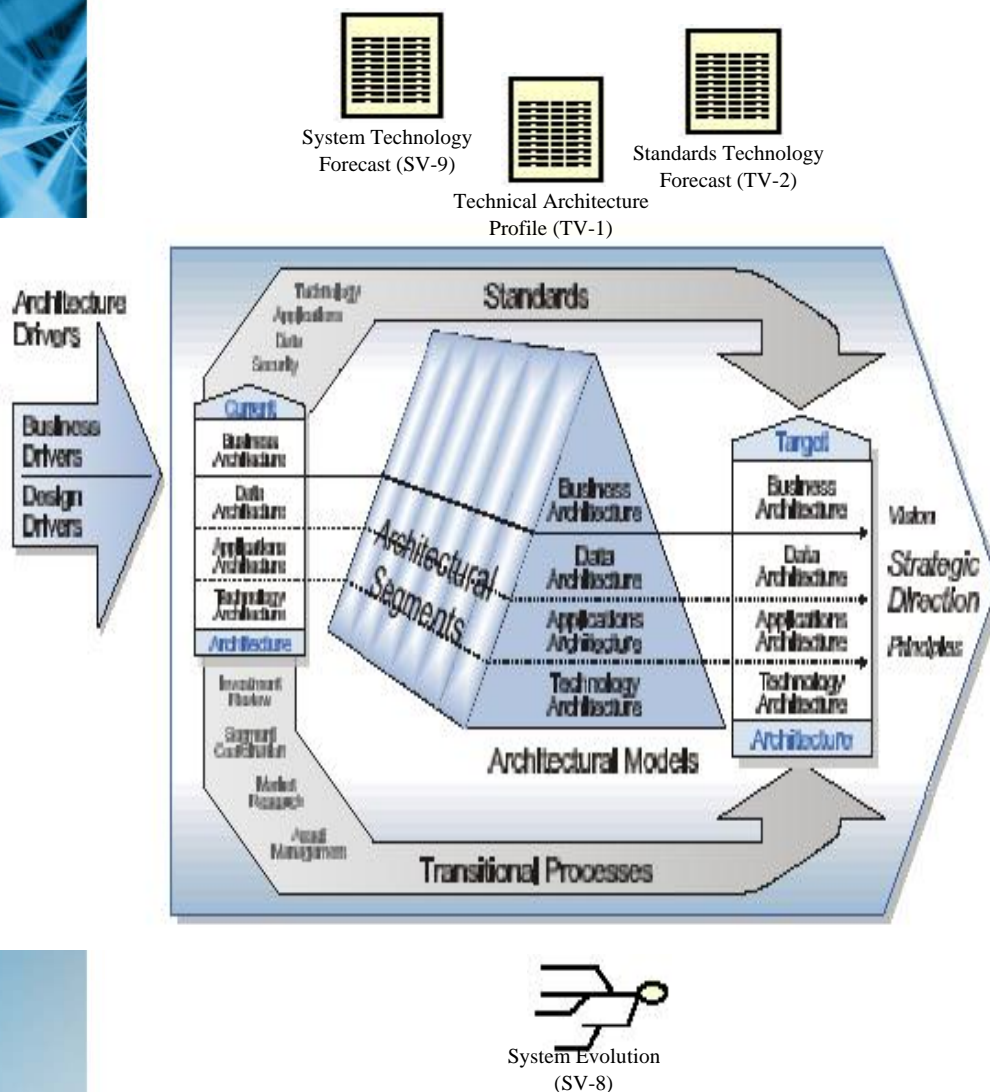
DoDAF Handbook Process



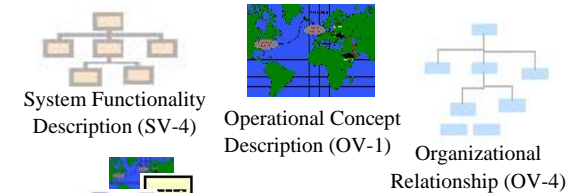
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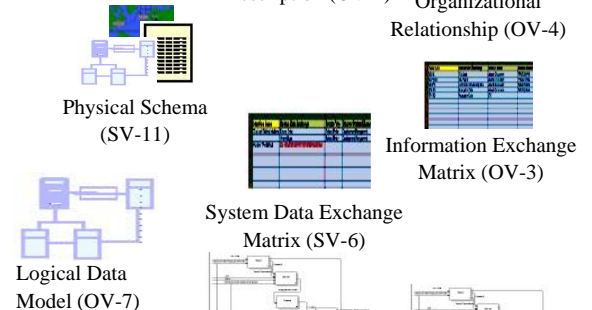
DODAT Components Mapped to FEA



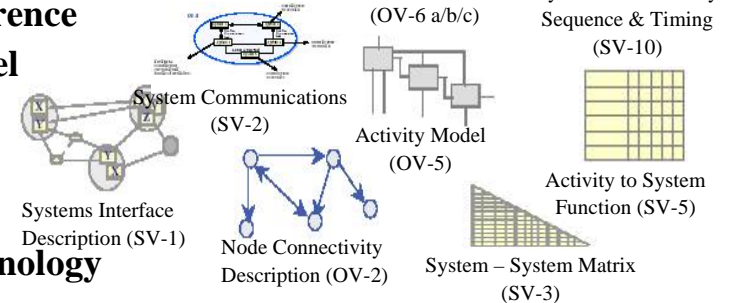
Business Reference Model



Data Reference Model



Application Reference Model



Technology Reference Model



Performance Reference Model



CCSDS RASDS Architecture

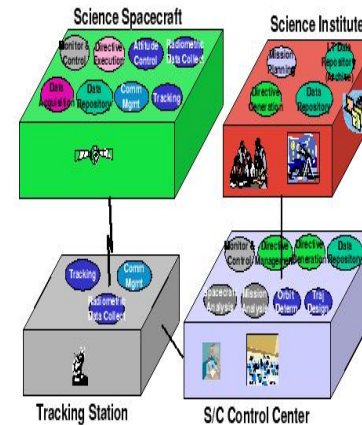
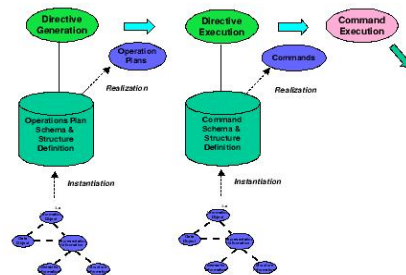
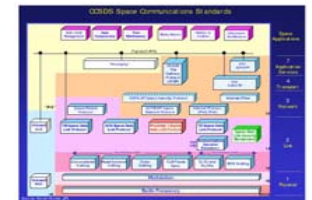
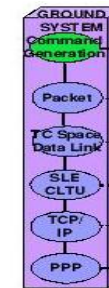
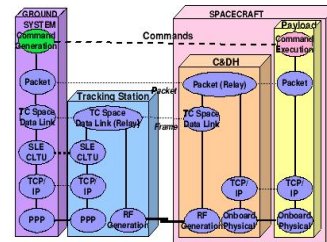
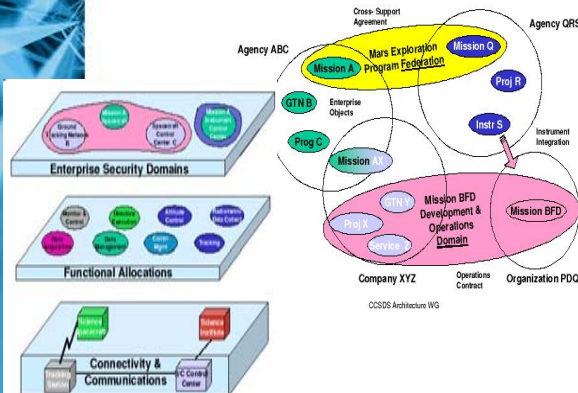
- **The Reference Architecture for Space Data Systems (RASDS) was defined by the Consultative Committee for Space Data Systems (CCSDS) as an international standard.**
- **5 Fundamental Viewpoints**
 - Enterprise - Organizational relationships involving
 - spacecraft
 - instruments
 - ground systems
 - scientists, staff and contractors
 - Physical/Connectivity View - physical structure and environment
 - Functional - structure of a space data system and its' interactions
 - Information - Information objects exchanged
 - Communications - Layered sets of communications protocols that support communications

Reference Architecture for Space Data System

Enterprise

Communications

Engineering



Information

Technology

RASDS has five basic areas: enterprise, communications, engineering, information and technology.

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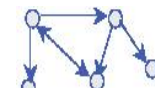
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RASDS to DoDAF Mapping

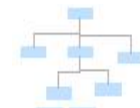
Enterprise =



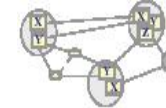
Operational Concept
Description (OV-1)



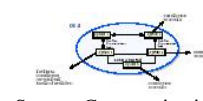
Node Connectivity
Description (OV-2)



Organizational
Relationship (OV-4)

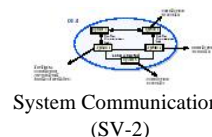


Systems Interface
Description (SV-1)



System Communications
(SV-2)

**Physical Viewpoint/
Connectivity View** =

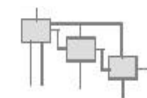
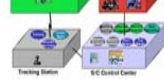


System Communications
(SV-2)



System - System Matrix
(SV-3)

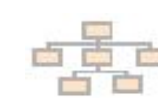
Functional =



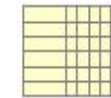
Activity Model
(OV-5)



Operational Activity
Sequence & Timing
(OV-6 a/b/c)

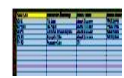


System Functionality
Description (SV-4)



Activity to System
Function (SV-5)

Information =



Information Exchange
Matrix (OV-3)



Logical Data
Model (OV-7)



System Data Exchange
Matrix (SV-6)

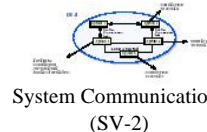
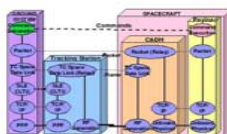


System Functionality
Sequence & Timing
(SV-10)

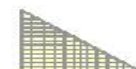


Physical Schema
(SV-11)

Communications =



System Communications
(SV-2)



System - System Matrix
(SV-3)

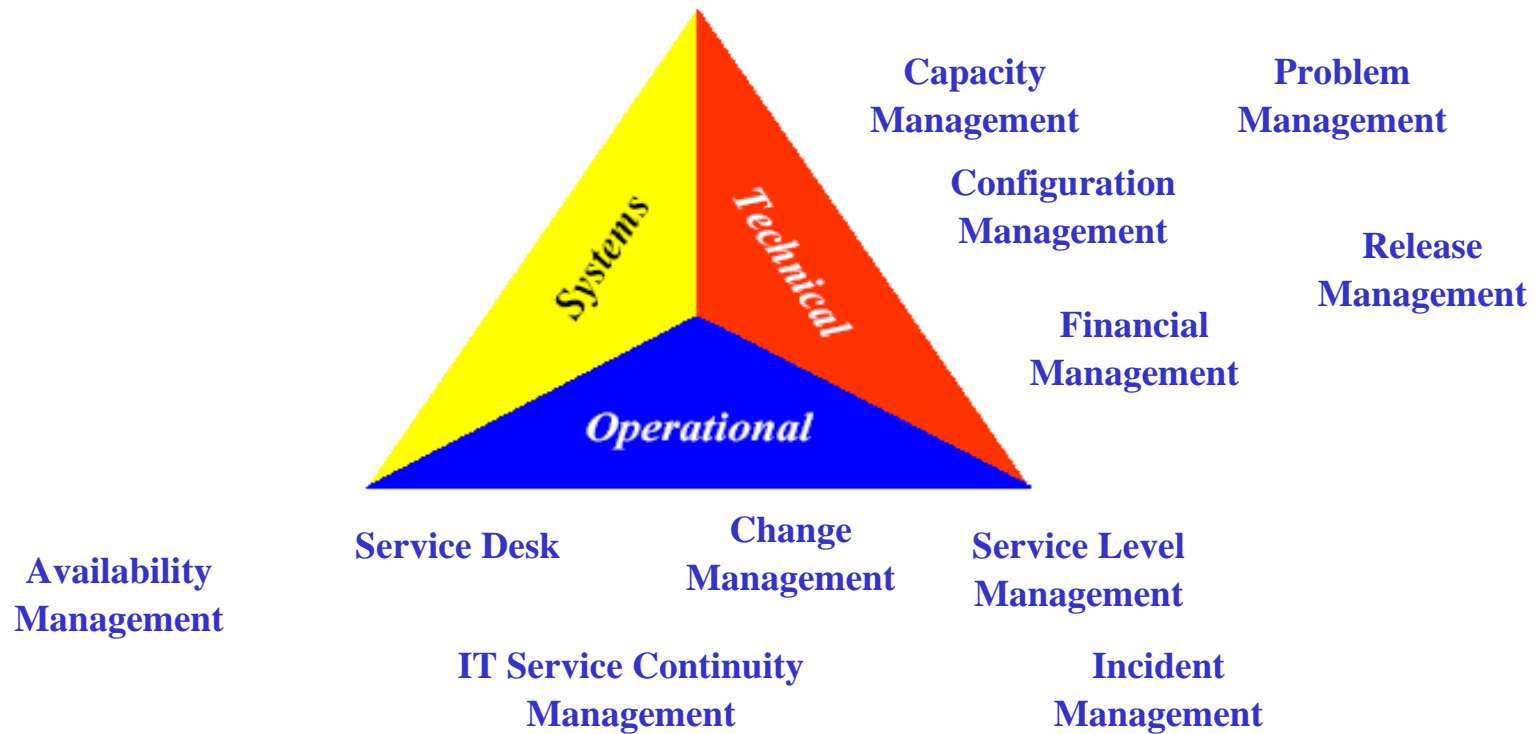
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ITIL Categorized by Service Management

- **The Information Technology Infrastructure Library (ITIL) is composed of 11 service areas with 84 sub-categories.**
- **With the advent of Service Oriented Architectures (SOA) we add the Service Delivery and Service Support categories to extend/refine ITIL.**
- **ITIL was developed by the British Government.**
- **ITIL can be compared to FEA Reference Models with qualifications.**
 - **Service Delivery**
 1. Availability Management
 2. Capacity Management
 3. Financial Management
 4. IT Service Continuity Management
 5. Service Level Management
 - **Service Support**
 6. Change Management
 7. Configuration Management
 8. Incident Management
 9. Problem Management
 10. Release Management
 11. Service Desk

ITIL Mapped to the DoDAF Framework



Comparing ITIL to DoDAF Shows a Focus on Operational and Technical Views with little to no focus on Systems Architectures - This Highlights ITIL as a Service Oriented Architecture

THE NASA XML ONTOLOGY

- The NASA Taxonomy Project has published an series of XML DTDs designed to be used as a way to share architecture data among organizations.
- <http://nasataxonomy.jpl.nasa.gov/xml.htm>
- Function can be compared to the FEA Reference Models.

Framework Observations

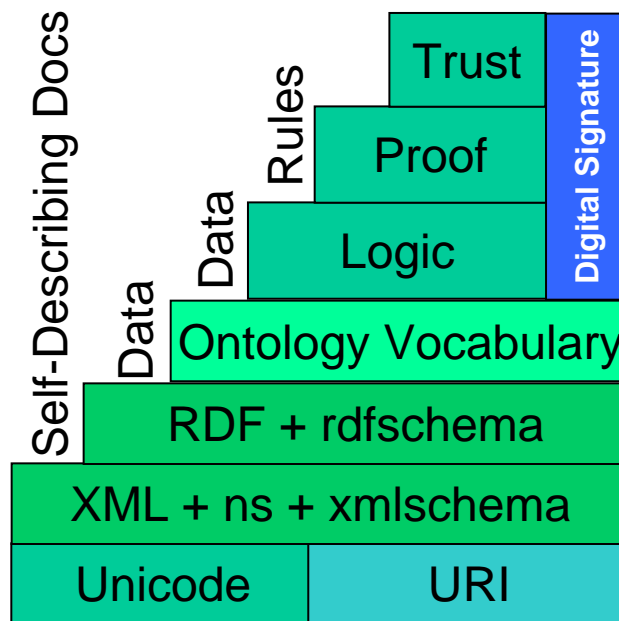
- **RASDS**
 - Very Software Centric
 - Compared to DoDAF, Somewhat Incomplete
- **DoDAF – DoD Architecture Framework**
 - Very Oriented to Military Operations
 - Still Very Applicable to NASA, and Other Customers
- **FEA - Federal Enterprise Architecture**
 - Superset of DoDAF, RASDS, Zachman, etc
 - Levels I, II and III are Concerned with Budget, Business Goals, External Drivers, Standards
 - Very Good General Framework
 - Mandated for USG Agencies

The Semantic Web and it's Impact

- **The FEA Reference Models and the FEA Management System are build around Semantic Web Technology**
- **The Semantic Web is supplanting Artificial Intelligence (AI)**
 - AI in and of itself was too general and too complex
 - Semantic Web constructs enable
 - Information to be self-descriptive and portable
 - Reduce the intelligence requirements in applications
 - We no longer need to account for every eventuality
- **The emerging Semantic Web has the potential to impact all aspects of our lives including our EA's**
- **The Semantic Web is based on the**
 - eXtensible Markup Language (XML)
 - Resource Description Framework (RDF)
 - Ontology Web Language (OWL)
 - And others
- **XML, RDF and OWL (e.g. the semantic web) introduce the ability to pass around information (e.g. EA's)**

Semantic Layering

XML, RDF, OWL and other methods build upon and depend on each other



TASC's TRADES

- **TASC Internal Software Toolkit - 100% Java**
- **Focused on Solving Specific SE&I Issues and Support to Modeling and EA tools**
- **Tools and Methods to Capture, Transform, and Manage Terrestrial, Wireless, and Satellite Communications Architectures**
 - End-to-End Communications Architectures including RF and Laser Communications
- **Leverage COTS tools for what they do well and share the data and results for efficiency.**
 - Discovery, Analysis, Visualization, and Simulation Tools
- **Accurately Depict “As-IS” Relationships and Performance**

TRADES is in Essence a Focused Data Warehouse that can Discover and/or Capture Raw Data, Merge that Data, Organically Analyze that Data or Export it to Selected External Tools

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The TRADES Object Tree – EA Hierarchy

FEA

FEAF (not in example tree)

Zachman (not in example tree)

RASDS

DoDAF

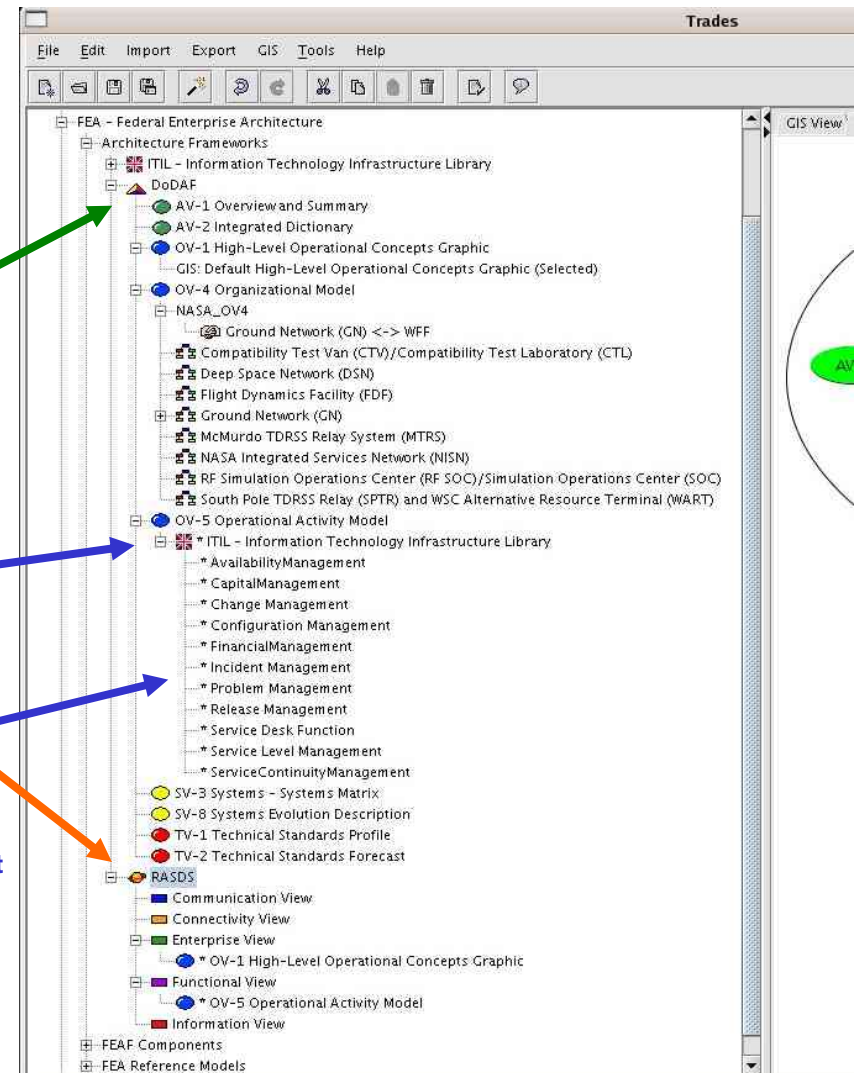
OV-5

ITIL

FEA Components

Architecture Drivers
Strategic Direction
Current Architecture
Target Architecture
Transitional Processes
Architectural Segments
Architectural Models
Standards

Service Delivery
Availability Management
Capacity Management
Financial Management
IT Service Continuity
Service Level Management
Service Support
Service Desk
Release Management
Change Management
Incident Management
Problem Management
Configuration Management

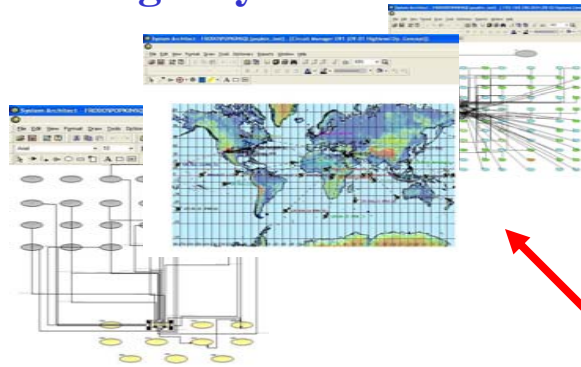


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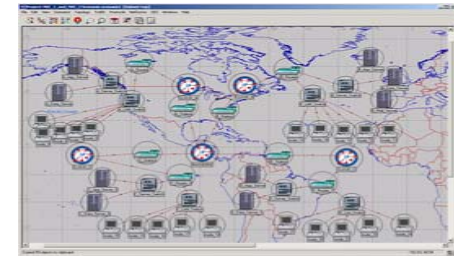
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Leverage Data by Sharing

Telelogic Systems Architect™

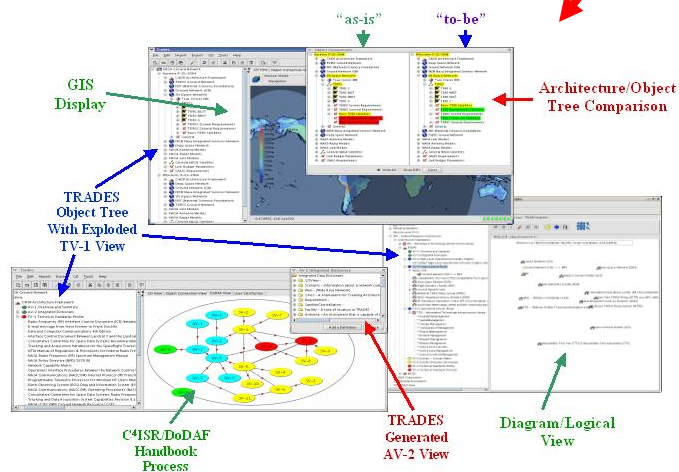


Opnet Modeler™

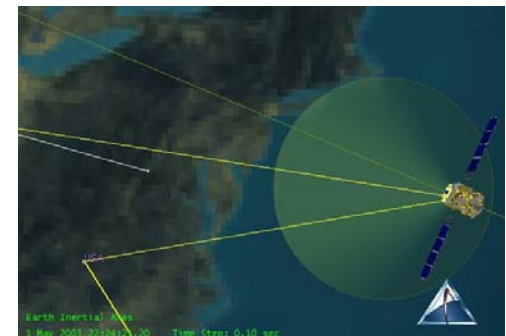


DATA

TRADES



Satellite Tool Kit™



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General Integration Scheme

1. Strategic Direction

- DoDAF Operational View (OV) Extracts

2. Architecture Drivers

- DoDAF Operational View (OV) and System View (SV) Extracts

3. Current Architecture

- DoDAF, RASDS, Zachman Exhibits

4. Target Architecture

- DoDAF, RASDS, Zachman Exhibits

5. Transition Processes

- DoDAF SV-8 Transition Diagrams or Appropriate

6. Architectural Segments

- Listing of Major Component Extracted from Current Architecture Level IV (DoDAF, RASDS, Zachman, ...) exhibits.

7. Architectural Models

- DoDAF, RASDS, Zachman Exhibits

8. Standards

- DoDAF TV-1,2 Technical Views

FEA and DoDAF Example

1.	Introduction to the Enterprise Architecture	2.7.2.10	As-Is TV-2 Technical Standards Forecast
1.1	Introduction	2.8	Future "To-Be" Architecture (FEA Component 8 of 8)
1.2	Background	2.8.1.1	"To-Be" Option 1 AV-1 Overview and Summary Information
1.3	Enterprise Architecture Methodology and Approach	2.8.1.2	"To-Be" Option 1 AV-2 Integrated Dictionary
2.	ESPC FEA Baseline Architecture	2.8.1.3	"To-Be" Option 1 OV-1 High-Level Operational Concept Graphic
2.1	Strategic Direction (FEA Component 1 of 8)	2.8.1.4	"To-Be" Option 1 OV-2 Operational Node Connectivity Description
2.2	Architecture Drivers (FEA Component 2 of 8)	2.8.1.5	"To-Be" Option 1 OV-3 Operational Information Exchange Matrix
2.3	Architectural Segments (FEA Component 3 of 8)	2.8.1.6	"To-Be" Option 1 OV-4 Organizational Relationships Chart
2.4	Architecture Models (FEA Component 4 of 8)	2.8.1.7	"To-Be" Option 1 OV-5 Operational Activity Model
2.5	Transition Processes (FEA Component 5 of 8)	2.8.1.8	"To-Be" Option 1 OV-6a Operational Rules Model
2.5.1	Data Growth	2.8.1.9	"To-Be" Option 1 OV-6b Operational State Transition Description
2.6	Standards (FEA Component 6 of 8)	2.8.1.10	"To-Be" Option 1 OV-6c Operational Event-Trace Description
2.7	Current "As-Is" Architectures (FEA Component 7 of 8)	2.8.1.11	"To-Be" Option 1 OV-7 Logical Data Model
2.7.1	As-Is	2.8.1.12	"To-Be" Option 1 SV-1 Systems Interface Description
2.7.1.1	As-Is AV-1 Overview and Summary Information	2.8.1.13	"To-Be" Option 1 SV-2 Systems Communications Description
2.7.1.2	As-Is AV-2 Integrated Dictionary	2.8.1.14	"To-Be" Option 1 SV-3 Systems-Systems Matrix
2.7.1.3	As-Is OV-1 High-Level Operational Concept Graphic	2.8.1.15	"To-Be" Option 1 SV-4 Systems Functionality Description
2.7.1.4	As-Is OV-2 Operational Node Connectivity Description	2.8.1.16	"To-Be" Option 1 SV-5 Operational Activity to Systems Function
2.7.1.5	As-Is OV-3 Operational Information Exchange Matrix	2.8.1.17	"To-Be" Option 1 SV-6 Systems Data Exchange Matrix
2.7.1.6	As-Is OV-4 Organizational Relationships Chart	2.8.1.18	"To-Be" Option 1 SV-7 System Performance Parameters Matrix
2.7.1.7	As-Is OV-5 Operational Activity Model	2.8.1.19	"To-Be" Option 1 SV-8 Systems Evolution Description
2.7.1.8	As-Is OV-6a Operational Rules Model	2.8.1.20	"To-Be" Option 1 SV-9 Systems Technology Forecast
2.7.1.9	As-Is OV-6b Operational State Transition Description	2.8.1.21	"To-Be" Option 1 SV-10b System State Transition Description
2.7.1.10	As-Is OV-6c Operational Event-Trace Description	2.8.1.22	"To-Be" Option 1 SV-10c Systems Event-Trace Description
2.7.1.11	As-Is OV-7 Logical Data Model	2.8.1.23	"To-Be" Option 1 TV-1 Technical Standards Profile
2.7.1.12	As-Is SV-1 Systems Interface Description	2.8.1.24	"To-Be" Option 1 TV-2 Technical Standards Forecast
2.7.1.13	As-Is SV-2 Systems Communications Description	3.	Summary of Major IT Investments
2.7.2	As-Is SV-3 Systems-Systems Matrix	4.	ESPC Consolidation Lines of Business/FEA Reference Models
2.7.2.1	As-Is SV-4 Systems Functionality Description	4.1	Mapping to FEA Business Reference Model
2.7.2.2	As-Is SV-5 Operational Activity to Systems Function	4.2	Mapping to FEA Data Reference Model
2.7.2.3	As-Is SV-6 Systems Data Exchange Matrix	4.3	Mapping to FEA Performance Reference Model
2.7.2.4	As-Is SV-7 System Performance Parameters Matrix	4.4	Mapping to FEA Service Component Reference Model
2.7.2.5	As-Is SV-8 Systems Evolution Description	4.5	Mapping to FEA Technical Reference Model
2.7.2.6	As-Is SV-9 Systems Technology Forecast		
2.7.2.7	As-Is SV-10b System State Transition Description		
2.7.2.8	As-Is SV-10c Systems Event-Trace Description		
2.7.2.9	As-Is TV-1 Technical Standards Profile		



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