Enabling Enterprise Transformation Using Enterprise Architecture Principles and Concepts

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Enterprise Transformation Considerations
Managing the Enterprise Portfolio to Maximize Mission Impact

If you don’t proactively manage your Portfolio, then your Portfolio will manage you!
Portfolio Management Examines Cost versus Effectiveness

What changes to **Capabilities** and **Operations** can lead to improved **Outcomes**?
Primary aim of the Enterprise is to maximize Positive Outcomes and minimize Negative Outcomes...
System Architecture is Like Blueprints for a Building

Outputs for a System tend to be the same over its lifetime. The requirements are established early on and tend not to change very much. Results for a system are more readily predicted.
Outcomes for an Enterprise are very complex and are shifting over time…

- Usually a “sequence” of outcomes is laid out in a Capability Roadmap
- The Enterprise can even change its own Objectives and Priorities!
Change the Focus from Control to Intervention…

**Traditional Systems Engineering**

**The Watchmaker:**
Everything has its place...

- Static: As Is – To Be Views
- Passive: One Design Choice
- Uniform: All Parts Are Equal

**Enterprise Systems Engineering**

**The Gardener:**
Plant, Fertilize, Weed → Repeat

- Dynamic: Constant Change
- Competitive: Crops compete
- Scale Free: 80-20 Rule

Source: Evolution Toward Engineering Complex Systems, Joseph DeRosa, MITRE, Complex Conference, Brisbane, Australia, 2007 (Used with permission)
Transforming the Enterprise to Achieve Desired Outcomes
Finding the Optimal States and the Right Processes

Drivers
- Demand
- Competition
- Laws
- Regulations
- People
- Technology
- Investment
- Revenues

Enterprise State

Outcomes
- Products
- Services
- Revenues
- Earnings
- Share Price
- Market Share
- Jobs
- Innovation

Work Processes

Architecture Models can help understand the landscape and how to change things for the better
Portfolio Management

DRIVERS → Enterprise → OUTCOMES

Portfolio (Current)
- Sub-portfolio
- Program
- Project
- Operation

Portfolio (Future)
- Sub-portfolio
- Program
- Project
- Operation
The Modeling Landscape

- **Modeling Language**
  - Syntax
  - Notation
  - Semantics

- **Modeling Patterns**
- **Modeling Templates**
- **Modeling Profile**
- **Modeling Methodology**
- **Architecture Models**
- **Architecture Views**
- **Architecture Description**
- **Modeling Workflow**
- **Architecture Framework**
  - Viewpoints
  - View Specifications
  - Domain Metamodel
OMG Modeling Standards

Modeling Languages

For modeling complex **Software Architectures** and applications

For modeling complex **System Architectures** that may include hardware, software, personnel, processes and facilities

For modeling complex **Business Processes**

For modeling complex **Enterprise Architectures** that includes strategy, capabilities, operations, programs/projects, services, resources, security, personnel, organizations and standards
Unified Architecture Framework (UAF)

Modeling Language
- Syntax
- Notation
- Semantics

Architecture Framework
- Viewpoints
- View Specifications
- Domain Metamodel

Modeling Profile

Modeling Workflow

Modeling Methodology

Modeling Patterns

Modeling Templates

Architecture Models

Architecture Views

Ontology

EA Guide

Language

Unified Architecture Framework (UAF)
Primary Use Cases for Architecture Models & Views

Modeling Methodology

✓ Generate views
✓ Basis for analysis
✓ Link Architecture to Design Engineering
✓ Check that architecture is complete & correct
✓ Capture ASOT data for a system or enterprise

Architecture Models

✓ Inform Decision Makers*
✓ Validate with Stakeholders*
✓ Justify budget request & plans*
✓ Basis for requirements definition & management
✓ Basis for V&V planning and execution (eg, test cases)

Architecture Views

✓ Basis for analysis
✓ Link Architecture to Design Engineering
✓ Check that architecture is complete & correct
✓ Capture ASOT data for a system or enterprise

Architecture Description

* Use cases most relevant to Portfolio Management
What Elements are in my Portfolio?
How much Value do they deliver?
How are these Elements related?
How much Cost is involved?
## The Four Layers of Enterprise Modeling

*Behaviors & Agents (ie, Doing and Being) at Different “Levels of Abstraction”*

<table>
<thead>
<tr>
<th>Behaviors</th>
<th>Agents</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capabilities</td>
<td>Effects &amp; Outcomes</td>
<td><strong>Why</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(High Level Needs)</td>
</tr>
<tr>
<td>Operational Activities</td>
<td>Operational Performers</td>
<td><strong>What</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Logical Analysis)</td>
</tr>
<tr>
<td>Resource Functions</td>
<td>Resource Performers</td>
<td><strong>How</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Resources Analysis)</td>
</tr>
<tr>
<td>Project Activities</td>
<td>Organizations &amp; Projects</td>
<td><strong>Who, When &amp; Where</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Realization)</td>
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The Four Layers of Enterprise Modeling

Key Relationships Between Behaviors & Agents

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<td></td>
</tr>
<tr>
<td>Implement</td>
<td>Resource Performers</td>
<td>How (Resources Analysis)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>Project Activities</td>
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<td>Who, When &amp; Where (Realization)</td>
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Drivers → Challenges → Opportunities → Capabilities → Effects → Outcomes

**Drivers**
- Demand
- Competition
- Laws
- Regulations
- People
- Technology
- Investment
- Revenues

**Enterprise State**

**Outcomes**
- Products
- Services
- Revenues
- Earnings
- Share Price
- Market Share
- Jobs
- Innovation

**Work Processes**
Challenges & Opportunities to be Identified for Achieving Enterprise Transformation

Drivers
- Demand
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Enterprise State

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Work Processes

Capabilities

Challenges

Opportunities

Risks

Effects
Identification of Capability Gaps and Shortfalls
Focus on Enterprise Capabilities & Desired Effects for Portfolio Management

Need to examine various factors that will help identify which Capabilities in the Enterprise have gaps and shortfalls with respect to causing desired Effects
System End of Life Before Next Delivery Causes a Capability Gap

Roadmap views provide key insights into Portfolio change impacts

Enterprise Models of the Portfolio can highlight issues and potential problems
Schedule Adjustment Closes Gap
Changing the Portfolio further to achieve proper balance

Without a good model of the Enterprise, it can be very difficult to discern impacts due to changes in a Portfolio
Portfolio Management

DRIVERS

Enterprise

OUTCOMES

Has

Desires

Portfolio (Current)

Sub-portfolio

Program

Program

Project

Project

Operation

Portfolio (Future)

Sub-portfolio

Program

Program

Project

Project

Operation
Identification of Capability Gaps and Shortfalls

Focus on Enterprise Capabilities & Desired Effects for Portfolio Management

Need to examine various factors that will help identify which Capabilities in the Enterprise have gaps and shortfalls with respect to causing desired Effects.

 ✓ **Drivers**
 ✓ **Challenges**
 ✓ **Opportunities**

These items provide the proper Justification for new & improved Capabilities.

Need to examine various factors that will help identify which Capabilities in the Enterprise have gaps and shortfalls with respect to causing desired Effects.
Unified Architecture Framework

- Modeling Language
  - Syntax
  - Notation
  - Semantics

- Architecture Framework
  - Viewpoints
  - View Specifications
  - Domain Metamodel

- Modeling Profile

- Modeling Methodology

- Architecture Models

- Architecture Views

- Architecture Description

- Ontology

- EA Guide

- Language

- Modeling Patterns

- Modeling Templates
Outcomes for an Enterprise are very complex and are shifting over time. However, you must be eternally mindful of the various Drivers in the environment, which are changing constantly…
**Systems Engineering** defines an Architecture of the System that addresses Stakeholder Concerns regarding the relevant Missions.
The **Enterprise Architecture** defines the various **Missions** along with associated **Mission Objectives** and **Strategic Capabilities**.
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Portfolio Management

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Project

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Enterprise Transformation Considerations
Managing the Enterprise Portfolio to Maximize Mission Impact

Keeping our focus on the most important dimensions of the Enterprise Total Solution
Higher Level for the Scope of Enterprise SE

Enterprise SE Scope

Mission Planning
Missions, Goals & Priorities

Strategic Planning
Objectives & Strategies

Business Process & Info Mgmt

Performance Management

Resource Allocation & Budgeting

Portfolio Management

Program Mgmt
People, Policies, Practices, Money, Platforms, Energy, Facilities & Infrastructure

Project Mgmt

Product SE Scope

Metrics & Figures of Merit

Systems of Systems
Individual Systems
Parts of Systems

Platforms & Facilities
Land & Rights of Way
Intellectual Property

Major Role of Enterprise SE

Different Groupings and Patterns Revealed at Different Scales

**Scales**
- Enterprise
  - Systems Engineering
- System of Systems
  - Engineering
- Systems
  - Engineering

**Groupings**
- Enterprise & Sub-enterprise
- Tens of System of Systems (Mission Strings)
- Hundreds of Independent Systems

**Patterns**
- Broad Descriptions
- Net-centric
- Capabilities-based Effects
- Evolutionary Development
- Emergent Behavior
- Mission Descriptions
- Mission-based Execution
- Composition and Structure of Systems and SOS’s
- Functional Descriptions
- Detailed Specifications
- Detailed Requirements

## How Can SE Enable Enterprise Transformation?

<table>
<thead>
<tr>
<th>Executive Concerns</th>
<th>SE Enablers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying <strong>ends</strong>, <strong>means</strong>, and <strong>scope</strong> and candidate changes</td>
<td>System complexity analysis to compare “as is” and “to be” enterprises</td>
</tr>
<tr>
<td>Evaluating changes in terms of process <strong>behaviors</strong> and performance</td>
<td>Organizational simulation of process flows and relationships</td>
</tr>
<tr>
<td>Assessing <strong>economics</strong> in terms of investments, operating costs, and returns</td>
<td>Economic modeling in terms of cash flows, volatility, and options</td>
</tr>
<tr>
<td>Defining the new enterprise in terms of <strong>processes</strong> and their integration</td>
<td>Enterprise architecting in terms of workflow, processes, and levels of maturity</td>
</tr>
<tr>
<td>Designing a strategy to change the <strong>culture</strong> for selected changes</td>
<td>Organizational and cultural change via leadership, vision, strategy, and incentives</td>
</tr>
<tr>
<td>Developing <strong>transformation action</strong> plans in terms of what, when, and who</td>
<td>Implementation planning in terms of tasks, schedule, people, and information</td>
</tr>
</tbody>
</table>

Components of the UAF Specification (v1.2)

1. View Specifications organized in Viewpoints and Aspects (Grid)
2. UAF Domain MetaModel (DMM)
3. UAF Modeling Language* (UAFML) based on SysML
4. EA Guide

* Formerly called the “UAF Profile (UAFP)” in version 1.1 of the UAF specification

https://www.omg.org/spec/UAF/
Standardized Enterprise Architecture Workflow in UAF
Establishes a Business Rhythm for Enterprise Transformation activities

Improves coordination and synchronization among the many players involved in Portfolio Management effort
Changing the Portfolio in Response to New Drivers & Challenges

The Enterprise Architecture serves as the foundation for understanding impact of changes.
What should motivate the Enterprise to change?
Drivers & Challenges as the basis for identification of Opportunities to pursue…
Conceptual Schema
Modeling of Enterprise Operations and their Implementing Resources
Systems Engineering defines an Architecture of the System that addresses Stakeholder Concerns regarding the relevant Missions.
Models are created to represent the System and its Architecture & Missions along with relevant Stakeholders and their Concerns.
The **Enterprise Architecture** defines the various **Missions** along with associated **Mission Objectives** and **Strategic Capabilities**.
The UAF Standard Provides Stakeholder-Based **Viewpoints** & Aspect-Oriented **Views** to Characterize an Architecture

**UAF Viewpoints**
- Strategic
- Operational
- Services
- Personnel
- Resources
- Security
- Projects
- Standards

**UAF Aspects**
- Motivation
- Taxonomy
- Structure
- Connectivity
- Processes
- States
- Sequences
- Information
- Parameters
- Constraints
- Roadmaps
- Traceability

**Stakeholders**
- have
- affect

**Missions**
- support

**Concerns**
- about

**System**
- characterized by

**Architecture**
- provides capabilities for

**Viewpoints**
- correspond to

**Views**
- specify

**UAF Viewpoints**
- Stakeholders
- Concerns
- System
- Architecture
The Two-Dimensional UAF Grid

Architecture Aspects

<table>
<thead>
<tr>
<th>Process</th>
<th>Resources</th>
<th>Strategic</th>
<th>Operational</th>
<th>Personnel</th>
<th>Security</th>
<th>Projects</th>
<th>Standards</th>
<th>Actual Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr</td>
<td>Rv</td>
<td>St</td>
<td>Op</td>
<td>Ps</td>
<td>Sc</td>
<td>PJ</td>
<td>Sd</td>
<td>Ar</td>
</tr>
<tr>
<td>Processes</td>
<td>Resources</td>
<td>Summary &amp; Overview</td>
<td>Operational Information Model Op-Rv</td>
<td>Resources Information Model Rv-Ps</td>
<td>Security Information Model Mv-Sc</td>
<td>Projects Information Model Rv-Pj</td>
<td>Standards Information Model Rv-Sd</td>
<td>Actual Resources Information Model Ar-Rv</td>
</tr>
<tr>
<td>Processes</td>
<td>Resources</td>
<td>Resources Viewpoint</td>
<td>Measures &amp; Risks Rv-Ps</td>
<td>Resources Constraints Rv-Ps</td>
<td>Security Constraints Mv-Sc</td>
<td>Projects Roadmap Rv-Pj</td>
<td>Standards Roadmap Rv-Sd</td>
<td>Actual Resources Structure, Ar-St</td>
</tr>
<tr>
<td>Processes</td>
<td>Resources</td>
<td>Stakeholder Viewpoints</td>
<td>Measures &amp; Risks Rv-Ps</td>
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<td>Actual Resources Structure, Ar-St</td>
</tr>
<tr>
<td>Processes</td>
<td>Resources</td>
<td>Processes Aspects of the Architecture Entity</td>
<td>Resources Viewpoint of Stakeholders</td>
<td>Resources Constraints Rv-Ps</td>
<td>Security Constraints Mv-Sc</td>
<td>Projects Roadmap Rv-Pj</td>
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View Specification for the Resources Viewpoint & the Processes Aspect (Rs-Pr)

Processes Aspects of the Architecture Entity

Resources Viewpoint of Stakeholders

Stakeholder Viewpoints
Capability Roadmap is Key for Identifying Gaps & Shortfalls

<table>
<thead>
<tr>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assistance</strong></td>
<td><strong>Rescue Ship</strong>&lt;br&gt;(SAR Project 1 Sustainment)</td>
</tr>
<tr>
<td>[no measurements]</td>
<td>[no measurements]</td>
</tr>
<tr>
<td><strong>Distress Signal Monitoring</strong></td>
<td><strong>Monitoring System</strong>&lt;br&gt;(SAR Project 1 Sustainment)</td>
</tr>
<tr>
<td>[no measurements]</td>
<td>[no measurements]</td>
</tr>
<tr>
<td><strong>Inform</strong></td>
<td><strong>C2 System</strong>&lt;br&gt;(SAR Project 1 Sustainment)</td>
</tr>
<tr>
<td>[no measurements]</td>
<td>[no measurements]</td>
</tr>
<tr>
<td><strong>Land SAR</strong></td>
<td><strong>Monitoring System</strong>&lt;br&gt;(SAR Project 1 Sustainment)</td>
</tr>
<tr>
<td><strong>Maritime SAR Phase 1</strong></td>
<td><strong>Maritime Rescue Architecture v1</strong>&lt;br&gt;(SAR Project 1 Sustainment)</td>
</tr>
<tr>
<td>[no measurements]</td>
<td>[no measurements]</td>
</tr>
<tr>
<td><strong>Maritime SAR Phase 2</strong></td>
<td><strong>Maritime SAR Phase 3</strong></td>
</tr>
<tr>
<td><strong>Maritime SAR Phase 4</strong></td>
<td><strong>SAR HQ</strong>&lt;br&gt;(SAR Project 1 Sustainment)</td>
</tr>
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Search & Rescue (SAR) Enterprise Architecture
(from the UAF Sample Model)
Operational Viewpoint Helps Identify Operational Impacts

Search & Rescue (SAR) Operational Process View

Operational Process Flow [ Distress signal valid and invalid handling ]
Progression from Architecture Drivers to Implementation and Deployment of Capabilities

The UAF modeling viewpoints facilitate a logical and systematic flow of architecting activities

I. Concerns drive a strategic plan

II. The strategic plan deploys capabilities in phases addressing gaps and shortfalls

III. Capabilities are implemented by conceptual operations

IV. Concepts are implemented through services, resources and personnel

V. Resources comply with standards

VI. Risk and threats are mitigated through security & protection controls (of resources and operations)

VII. Requirements are understood and communicated

VIII. Plans deliver the resources

IX. Resources are verified

UAF provides a complete set of modeling domains as basis for defining the necessary architecture views of an Enterprise that can support Portfolio Management
Summary & Overview

Iterative Analysis of Alternatives and Trades at each domain handoff

Implementation of Operational Elements

Verification, Validation and Assessment of Implementations

Stakeholders, needs, strategic opportunities, driving problems and issues

Strategy, objectives, desired capabilities, phasing structure, MOEs and roadmaps

Operational MOPs, taxonomy, activity flows, sequences, states, and information exchanges

Service agreements, partnerships, and external service dependencies

Physical resources, TPMs, function flows, sequences, states, and data exchanges

Standards profile and forecast

Human resources, knowledge and skills, positions, roles, and responsibilities

Risks, threats, operational and resource mitigations, security enclaves and policies

Integrated deployment schedule with delivery milestones

Validation, verification, deployment tracking, and use of employed resources

Actual Resources

Projects

Security

Personnel

Standards

Resources

Services

Operational

Strategic
Enterprise Architecture Guide for UAF
Standardizing the Modeling Workflow

Step 1 – Architecture Drivers
Step 2 – Strategy & Capabilities
Step 3 – Operational Architecture (Logical)
Step 4 – Service Architecture (Black Box)
Step 5 – Resource Architecture (Physical)
Step 6 – Personnel Resources (Organizational)
Step 7 – Security & Protection (Resilience)
Step 8 – Architecture Portfolios
Step 9 – Actual Resources
Step 0 – Plan and Prepare for Architecting & Assessments
Enterprise Modeling Ontology

Unified Architecture Framework (UAF) v1.2
A simplified partial view of the UAF Domain Metamodel (DMM) v1

UAF Element Legend
- Changed element for UAF v1.2
- Changed relationship for UAF v1.2
- (Name) - Implied name of relationship
- (Type) - Relationship type
- (Role) - Role
- (Subtype) - Is a kind of its "parent"

UAF Grid Legend
- Summary & Overview
- Strategic
- Operational
- Service
- Resource
- Personnel
- Security
- Project
- Standards
- Actual (Instance)
- Parametric
- Information
- Requirements

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