Enterprise Architecture Based Portfolio Management

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Distinguished Engineer
Enterprise Systems Engineering
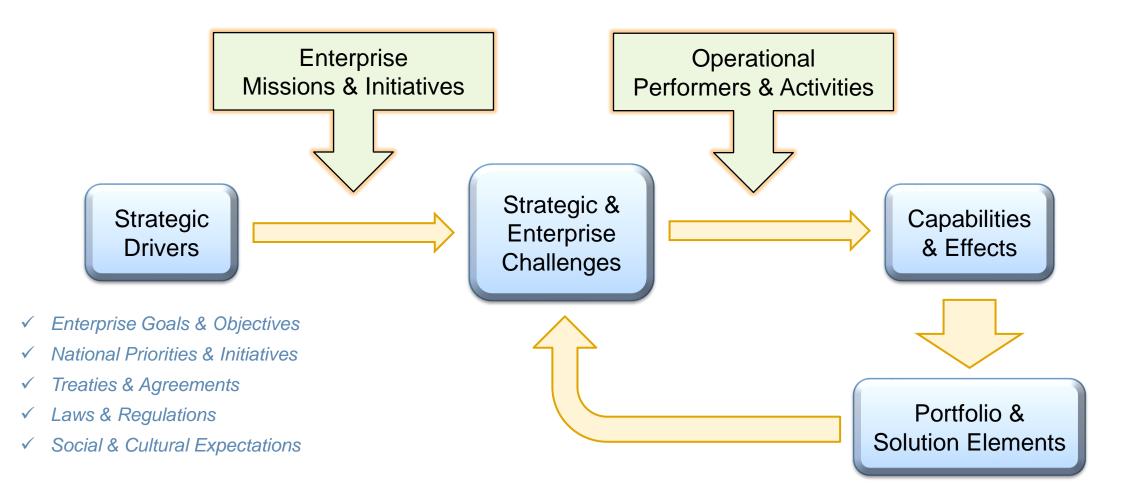
Systems Engineering Forum
15 February 2022

James.N.Martin@Aero.org
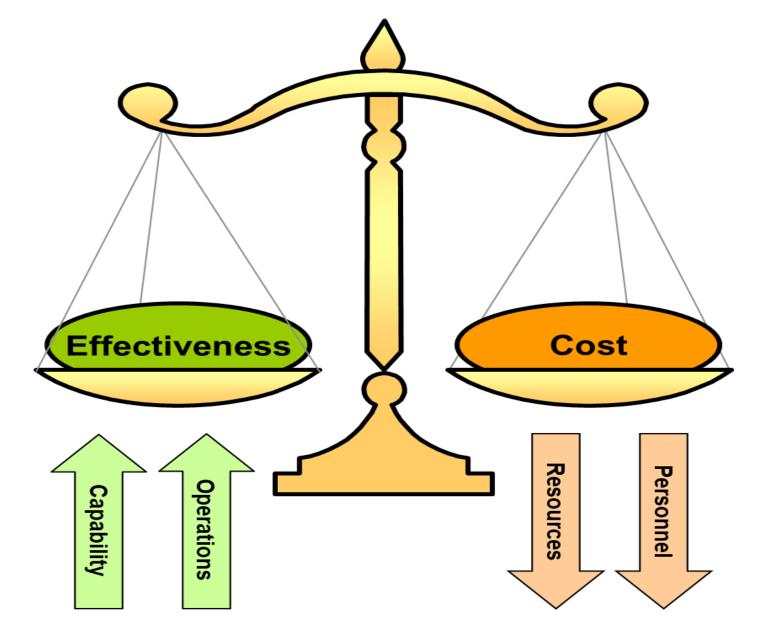
Key Enterprise Elements
Managing the Enterprise Portfolio to Maximize Mission Impact

Enterprise Missions & Initiatives

Operational Performers & Activities

Strategic Drivers

Strategic & Enterprise Challenges

Capabilities & Effects

Portfolio & Solution Elements

✓ Enterprise Goals & Objectives
✓ National Priorities & Initiatives
✓ Treaties & Agreements
✓ Laws & Regulations
✓ Social & Cultural Expectations

Keeping our focus on the most important dimensions of the Enterprise Total Solution Package

Portfolio Management Examines Cost versus Effectiveness

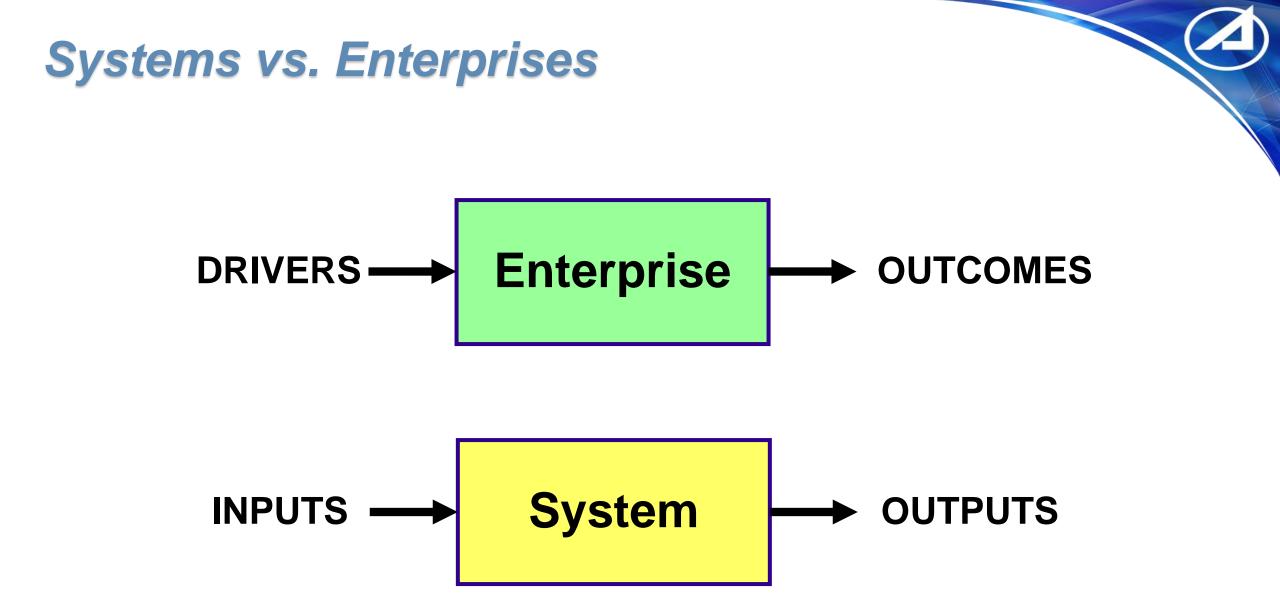*What Capabilities and Operations lead to improved Outcomes?*

Topics

- **Enterprise Concepts**
  - *Enterprise vs System*
  - *Enterprise Transformation*
  - *Drivers and Outcomes*
  - *Portfolio Management*

- **Architecture Modeling**
  - *Modeling Landscape*
  - *Modeling Languages*
  - *Enterprise Modeling Ontology*
  - *Architecture Views & Viewpoints*

- **Unified Architecture Framework (UAF)**
  - *UAF Specification*
  - *Architecture Modeling Workflow*
  - *Framework Grid*
    - Stakeholder Perspectives
    - Architectural Facets

- **Architecting Workflow**
  - *Workflow Steps*
  - *Architecture Views*

Systems vs. Enterprises

DRIVERS → **Enterprise** → OUTCOMES

INPUTS → **System** → OUTPUTS

Outputs for a System tend to be the same over its lifetime. But Outcomes for an Enterprise are very complex and are shifting over time. Usually a "sequence" of Outcomes will be laid out in a Roadmap.
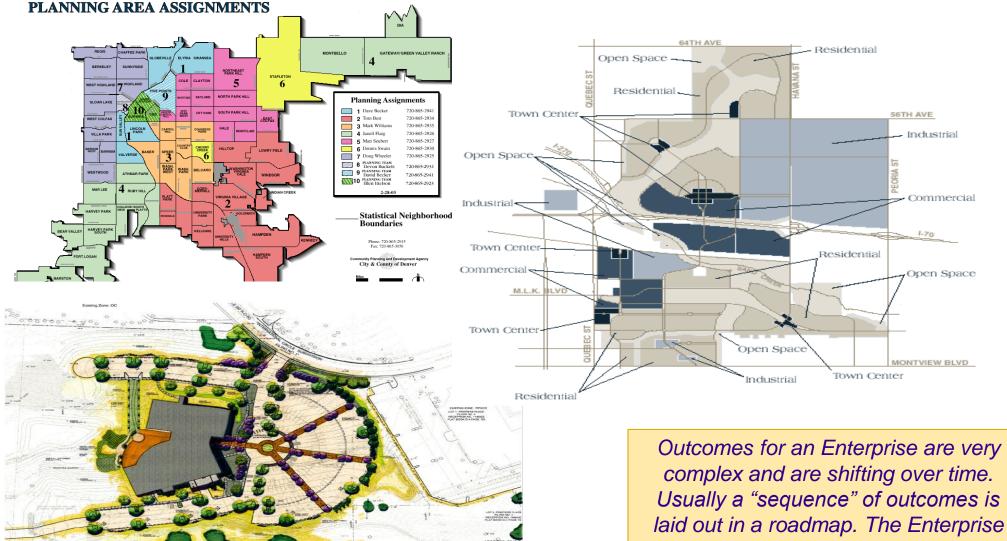
System Architecture is Like Blueprints for a Building

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.

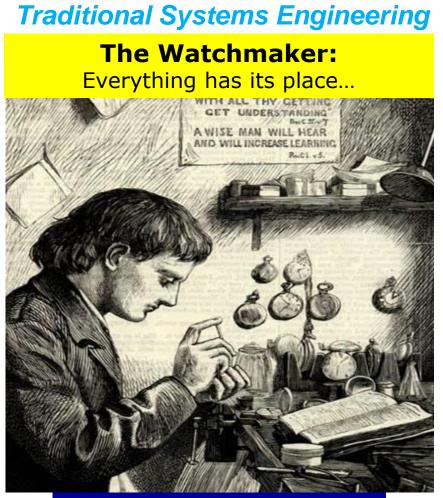# Enterprise Architecture is More Like Urban Planning

Outcomes for an Enterprise are very complex and are shifting over time. Usually a "sequence" of outcomes is laid out in a roadmap. The Enterprise can change its own objectives!

Change in 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
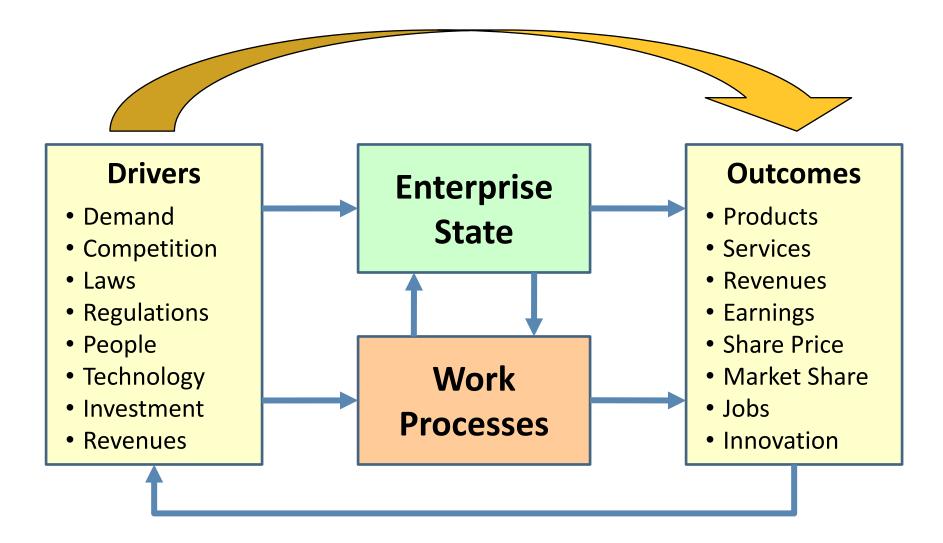
The Gardener:
Plant, Fertilize, Weed → Repeat

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)
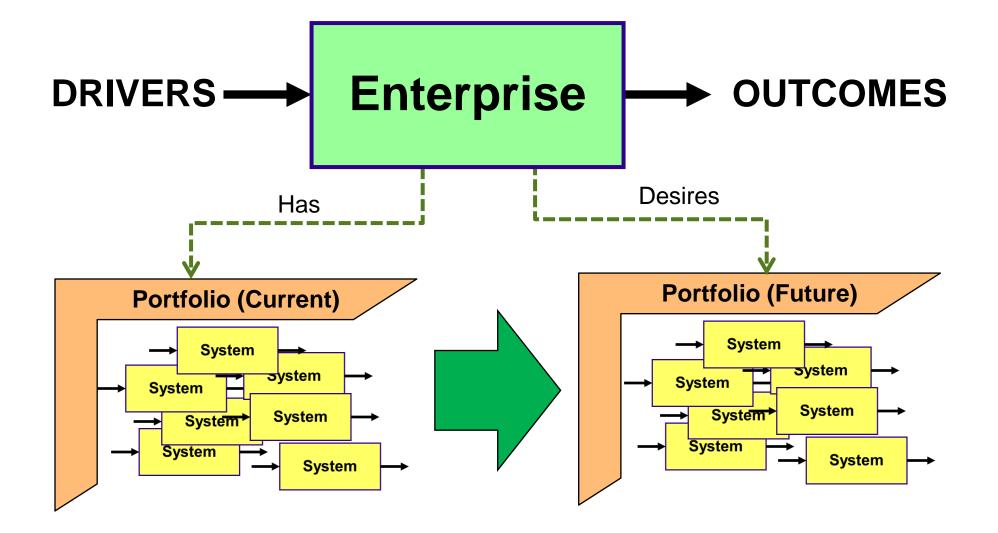
Transforming the Enterprise to Achieve Desired Outcomes

Finding the Optimal States and the Right Processes

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

Enterprise State

Work Processes

Outcomes
- Products
- Services
- Revenues
- Earnings
- Share Price
- Market Share
- Jobs
- Innovation
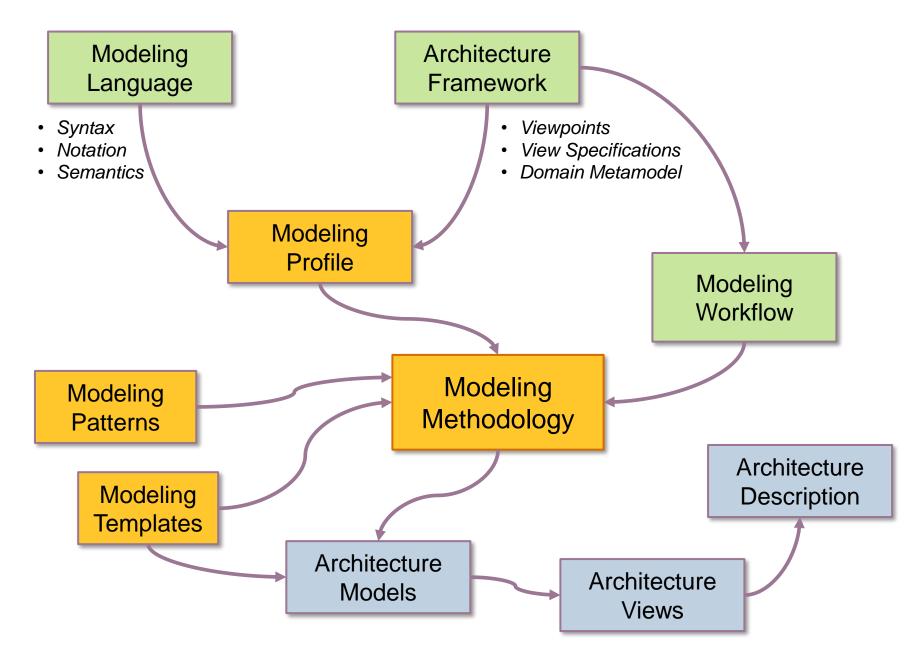
Architecture Models can help understand the landscape and how to change things for the better

Portfolio Management

DRIVERS → **Enterprise** → OUTCOMES

Has

Desires

Portfolio (Current)

Portfolio (Future)

System
System
System
System
System
System
System

System
System
System
System
System
System

The Modeling Landscape

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

Architecture Framework
- *Viewpoints*
- *View Specifications*
- *Domain Metamodel*

Modeling Profile

Modeling Workflow

Modeling Patterns

Modeling Methodology

Modeling Templates

Architecture Description

Architecture Models

Architecture Views

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 **enterprise architectures** that includes strategy, operations, programs/projects, services, resources, security, personnel, organizations and standards
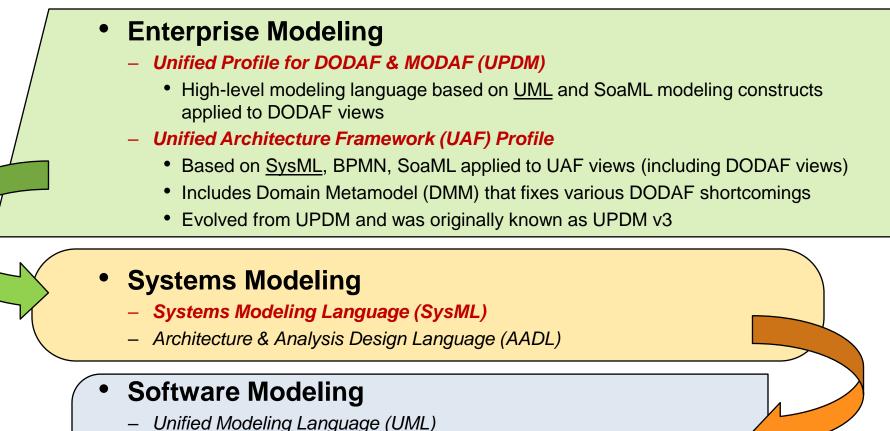
For modeling complex **business processes** for business process re-engineering initiatives, process maturity improvement, cycle time reduction, and business integration efforts
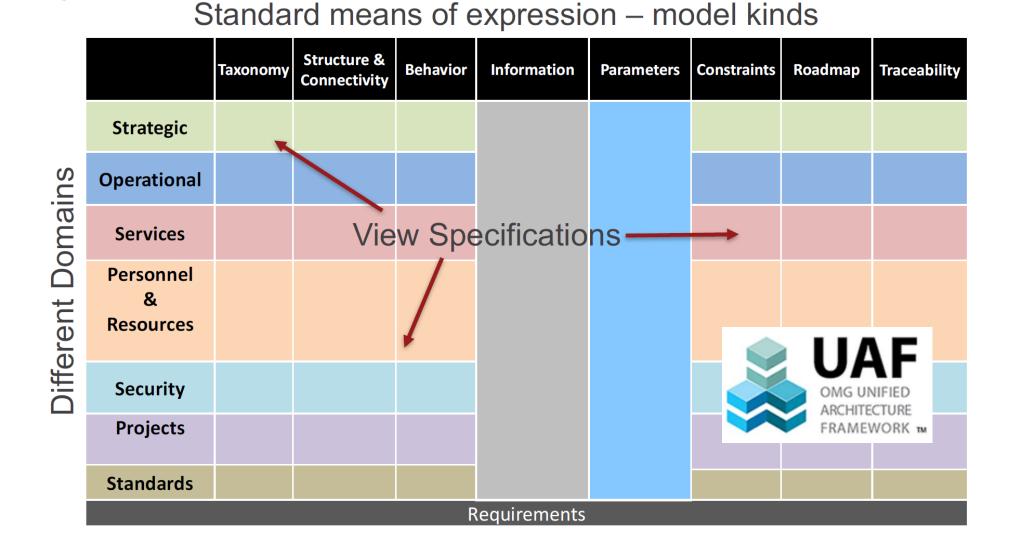
Modeling Languages for Different Levels

Using Modeling Languages to characterize the problem and solution spaces

- **Enterprise Modeling**
  - ***Unified Profile for DODAF & MODAF (UPDM)***
    - High-level modeling language based on <u>UML</u> and SoaML modeling constructs applied to DODAF views
  - ***Unified Architecture Framework (UAF) Profile***
    - Based on <u>SysML</u>, BPMN, SoaML applied to UAF views (including DODAF views)
    - Includes Domain Metamodel (DMM) that fixes various DODAF shortcomings
    - Evolved from UPDM and was originally known as UPDM v3

- **Systems Modeling**
  - ***Systems Modeling Language (SysML)***
  - *Architecture & Analysis Design Language (AADL)*

- **Software Modeling**
  - *Unified Modeling Language (UML)*
  - *Various extensions to UML*
    - MARTE profile for real-time and embedded systems
    - And other UML profiles for XSD schema definition, web modeling, business process modeling, open distributed processing, etc
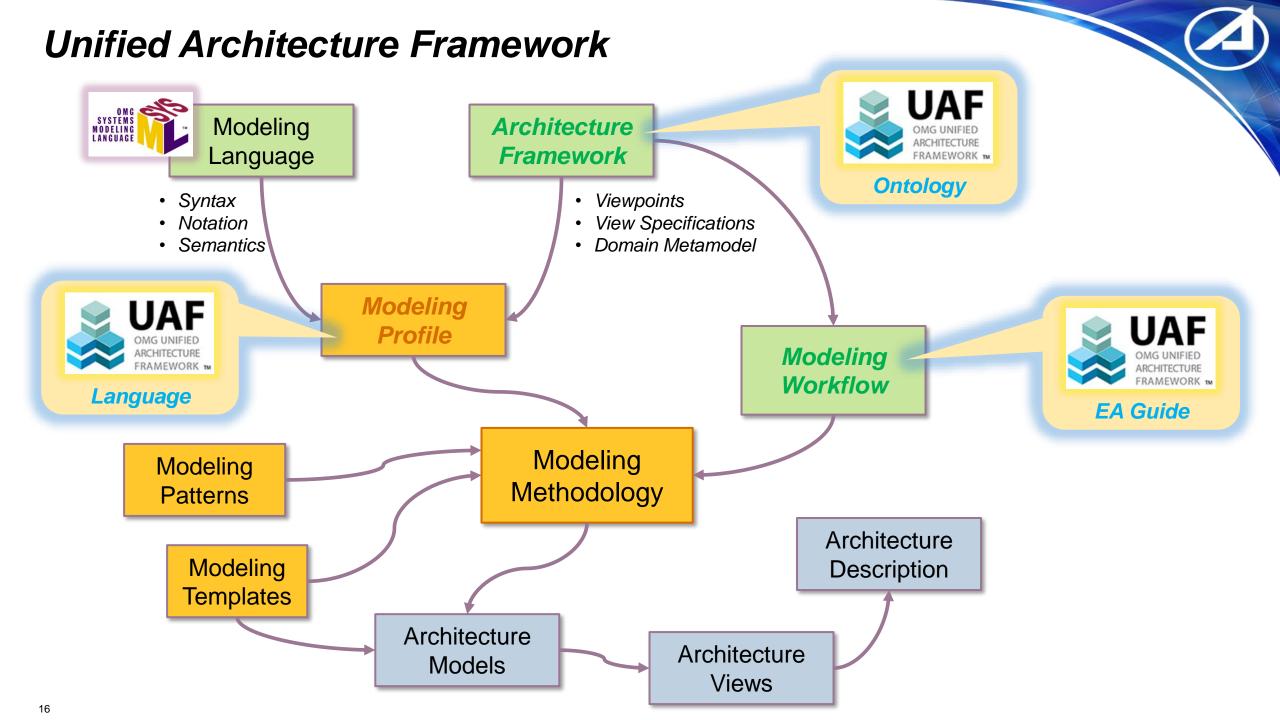
Modeling Languages are key enablers for Digital Engineering and for Architecture and other SE practices

Unified Architecture Framework (UAF) Views

Standard means of expression – model kinds

	Taxonomy	Structure & Connectivity	Behavior	Information	Parameters	Constraints	Roadmap	Traceability
Strategic								
Operational								
Services								
Personnel & Resources								
Security								
Projects								
Standards								

Different Domains

View Specifications

Requirements

UAF
OMG UNIFIED
ARCHITECTURE
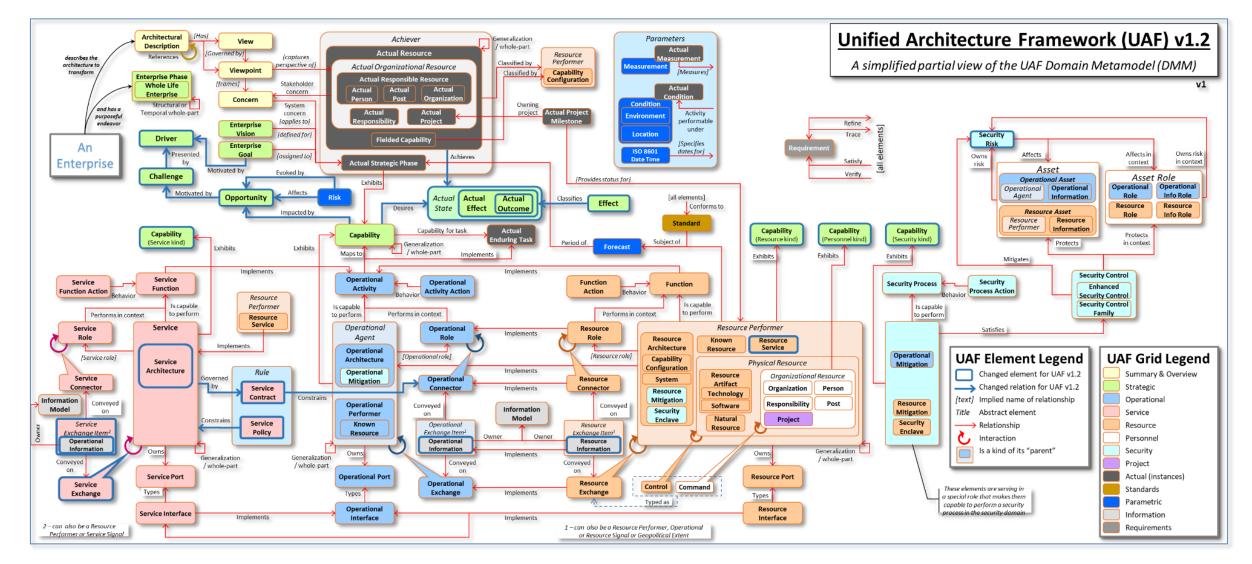FRAMEWORK ™

UAF Views & Models

UAF	Taxonomy Tx	Structure Sr	Connectivity Cn	Processes Pr	States St	Interaction Scenarios Is	Information If	Parameters Pm	Constraints Ct	Roadmap Rm	Traceability Tr
Metadata Md	Metadata Taxonomy Md-Tx	Architecture Viewpoints [a] Md-Sr	Metadata Connectivity Md-Cn	Metadata Processes [a] Md-Pr	-	-			Metadata Constraints [a] Md-Ct		Metadata Traceability Md-Tr
Strategic St	Strategic Taxonomy St-Tx	Strategic Structure St-Sr	Strategic Connectivity St-Cn	-	Strategic States St-St	-			Strategic Constraints St-Ct	Strategic Deployment, St-Rm / Strategic Phasing St-Rm	Strategic Traceability St-Tr
Operational Op	Operational Taxonomy Op-Tx	Operational Structure Op-Sr	Operational Connectivity Op-Cn	Operational Processes Op-Pr	Operational States Op-St	Operational Interaction Scenarios Op-Is			Operational Constraints Op-Ct	-	Operational Traceability Op-Tr
Services Sv	Service Taxonomy Sv-Tx	Service Structure Sv-Sr	Service Connectivity Sv-Cn	Service Processes Sv-Pr	Service States Sv-St	Service Interaction Scenarios Sv-Is	Conceptual Data Model,	Environment Pm-En	Service Constraints Sv-Ct	Service Roadmap Sv-Rm	Service Traceability Sv-Tr
Personnel Pr	Personnel Taxonomy Pr-Tx	Personnel Structure Pr-Sr	Personnel Connectivity Pr-Cn	Personnel Processes Pr-Pr	Personnel States Pr-St	Personnel Interaction Scenarios Pr-Is	Logical Data Model,		Competence, Drivers, Performance Pr-Ct	Personnel Availability, Personnel Evolution, Personnel Forecast Pr-Rm	Personnel Traceability Pr-Tr
Resources Rs	Resource Taxonomy Rs-Tx	Resource Structure Rs-Sr	Resource Connectivity Rs-Cn	Resource Processes Rs-Pr	Resource States Rs-St	Resource Interaction Scenarios Rs-Is	Physical Data Model	Measurements Pm-Me	Resource Constraints Rs-Ct	Resource evolution, Resource forecast Rs-Rm	Resource Traceability Rs-Tr
Security Sc	Security Taxonomy Sc-Tx	Security Structure Sc-Sr	Security Connectivity Sc-Cn	Security Processes Sc-Pr	-	-			Security Constraints Sc-Ct	-	Security Traceability Sc-Tr
Projects Pj	Project Taxonomy Pj-Tx	Project Structure Pj-Sr	Project Connectivity Pj-Cn	-	-	-			-	Project Roadmap Pj-Rm	Project Traceability Pj-Tr
Standards Sd	Standard Taxonomy Sd-Tx	Standards Structure Sd-Sr	-	-	-	-			-	Standards Roadmap Sd-Rm	Standards Traceability Sd-Tr
Actuals Resources Ar		Actual Resources Structure, Ar-Sr	Actual Resources Connectivity, Ar-Cn	Simulation [b]					Parametric Execution/ Evaluation [b]	-	-
Dictionary * Dc											
Summary & Overview Sm-Ov											
Requirements Req											

Unified Architecture Framework

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

Architecture Framework
- *Viewpoints*
- *View Specifications*
- *Domain Metamodel*

UAF — OMG UNIFIED ARCHITECTURE FRAMEWORK ™
Ontology

Modeling Profile

UAF — OMG UNIFIED ARCHITECTURE FRAMEWORK ™
Language

Modeling Workflow

UAF — OMG UNIFIED ARCHITECTURE FRAMEWORK ™
EA Guide

Modeling Patterns

Modeling Templates

Modeling Methodology

Architecture Models

Architecture Views

Architecture Description

UAF Conceptual Schema
(i.e. Ontology!)

Unified Architecture Framework (UAF) v1.2 — A simplified partial view of the UAF Domain Metamodel (DMM)
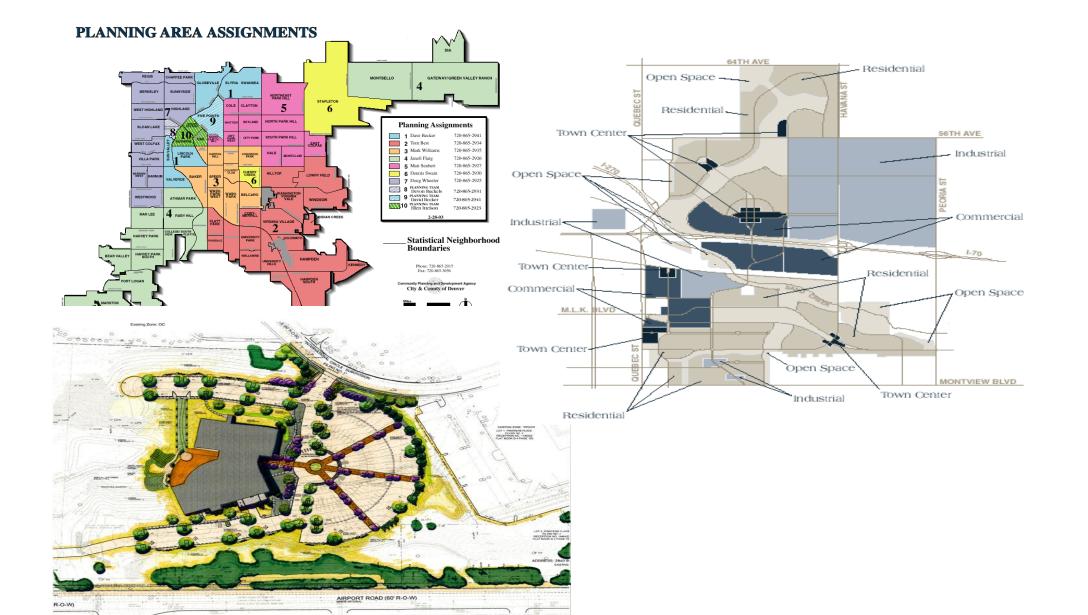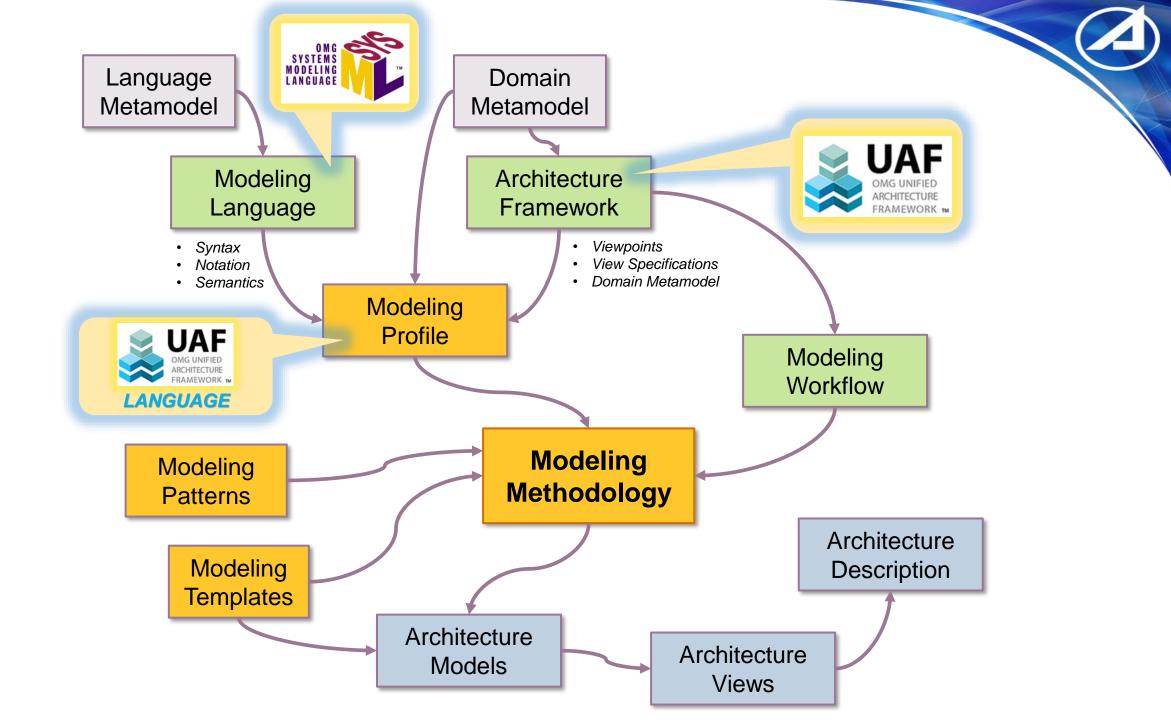
Primary Use Cases for Architecture Models & Views

Modeling Methodology

Architecture Description

Architecture Models

Architecture Views

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

- ✓ 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)

* Use cases most relevant to Portfolio Management

How to Model the Enterprise Architecture?

Language
Metamodel

OMG SYSTEMS MODELING LANGUAGE SYS ML™

Domain
Metamodel

UAF
OMG UNIFIED ARCHITECTURE FRAMEWORK ™

Modeling
Language

Architecture
Framework

- *Syntax*
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UAF
OMG UNIFIED ARCHITECTURE FRAMEWORK ™
LANGUAGE

Modeling
Profile

Modeling
Workflow

Modeling
Patterns

**Modeling
Methodology**

Modeling
Templates

Architecture
Description

Architecture
Models

Architecture
Views

Why not just use SysML?
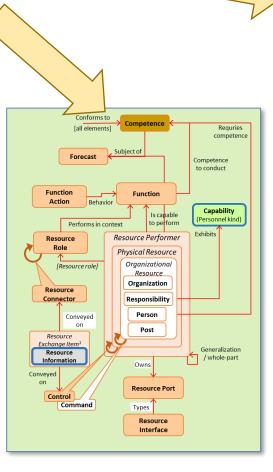
- **SysML is great for:**

  - *Modeling Systems and for doing Systems Engineering*

  - *Defining and tracing between levels of abstraction within a System*

  - *Defining the **RFLP** for a System – Requirements, Functions, Logic & Physical aspects*

- **The UAF Modeling Language (UAFML) provides all this, plus more:**

  - *Capability and Enterprise concepts: defines the "why" and "what" before the "how"*

  - *Services concepts: definition of Enterprise services (producing and consuming) and traceability to capabilities, operations, and implementing resources*

  - *Human Factors: How People and Systems interact, and knowledge & skills*

  - *Security: Identifying risk, mitigation, and integrating security in the Architecture*

  - *Standards: definition of and compliance with standards in the Architecture*

  - *Project Deliveries: phased milestone approach to Capability deployment*

  - *System Configuration over time: deployment and changes*

  - *Tie-in to Requirements Tools: Easy way to link Architecture to Requirements*

  - *Built-in Traceability between multiple views – Between Layers and Across Layers*
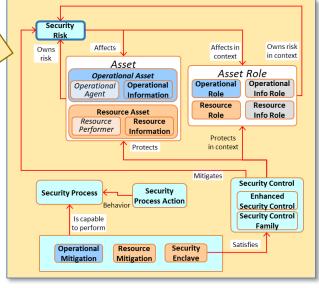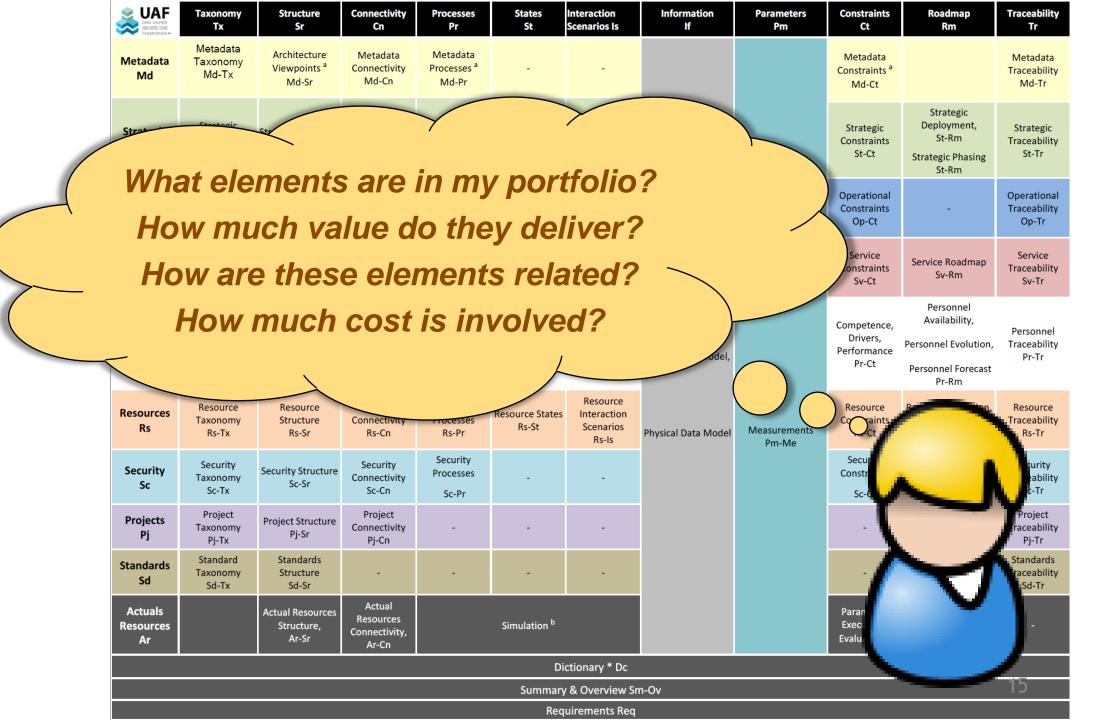
UAF Provides Additional Key Features...
New viewpoints to address other important stakeholders and their concerns

- **Security Views:** rules and constraints, enclaves and levels, threat analysis, security weaknesses and strongpoints

- **Personnel Views:** roles and responsibilities, knowledge and skills, organizational constructs, role dependencies

- **Resources Views:** kinds of resources (including Systems) that can implement functions and activities, interactions and dependencies, mapping to requirements
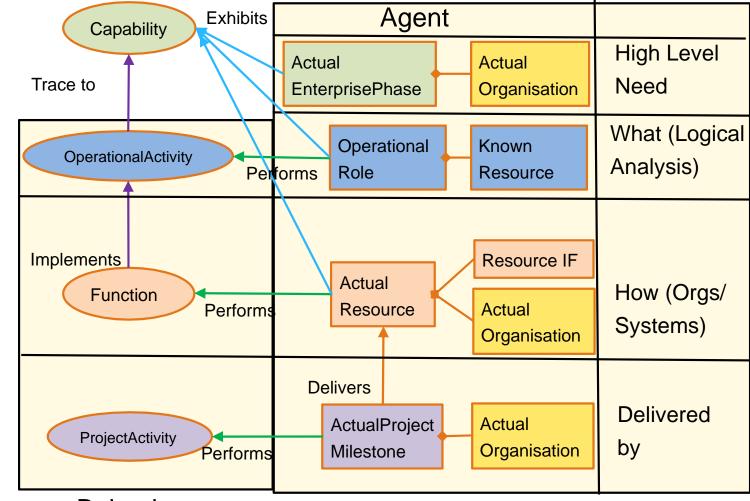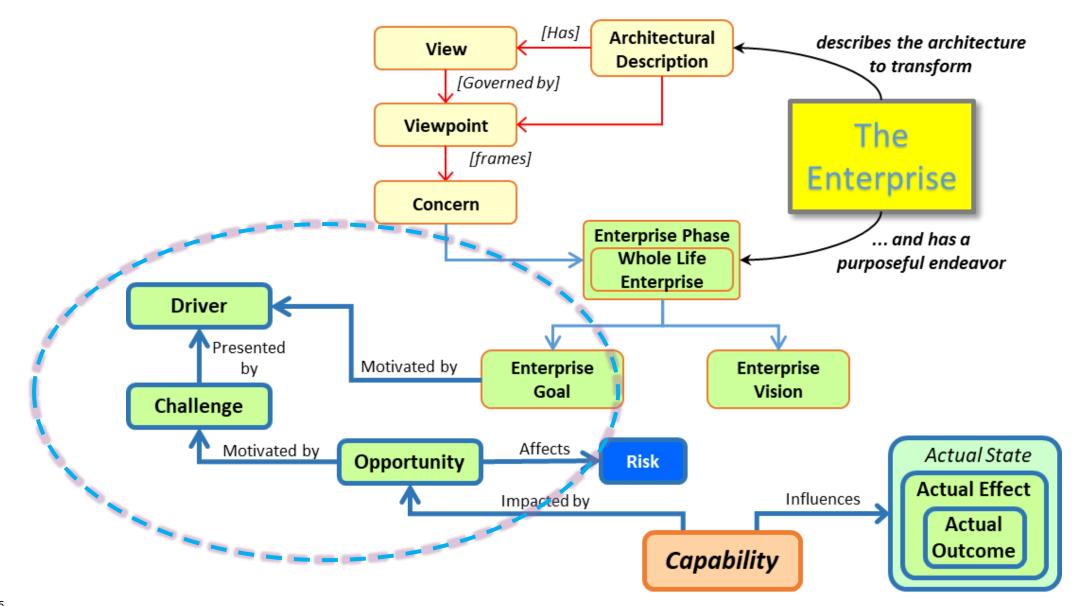
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Dictionary * Dc											
Summary & Overview Sm-Ov											
Requirements Req											

What elements are in my portfolio?

How much value do they deliver?

How are these elements related?

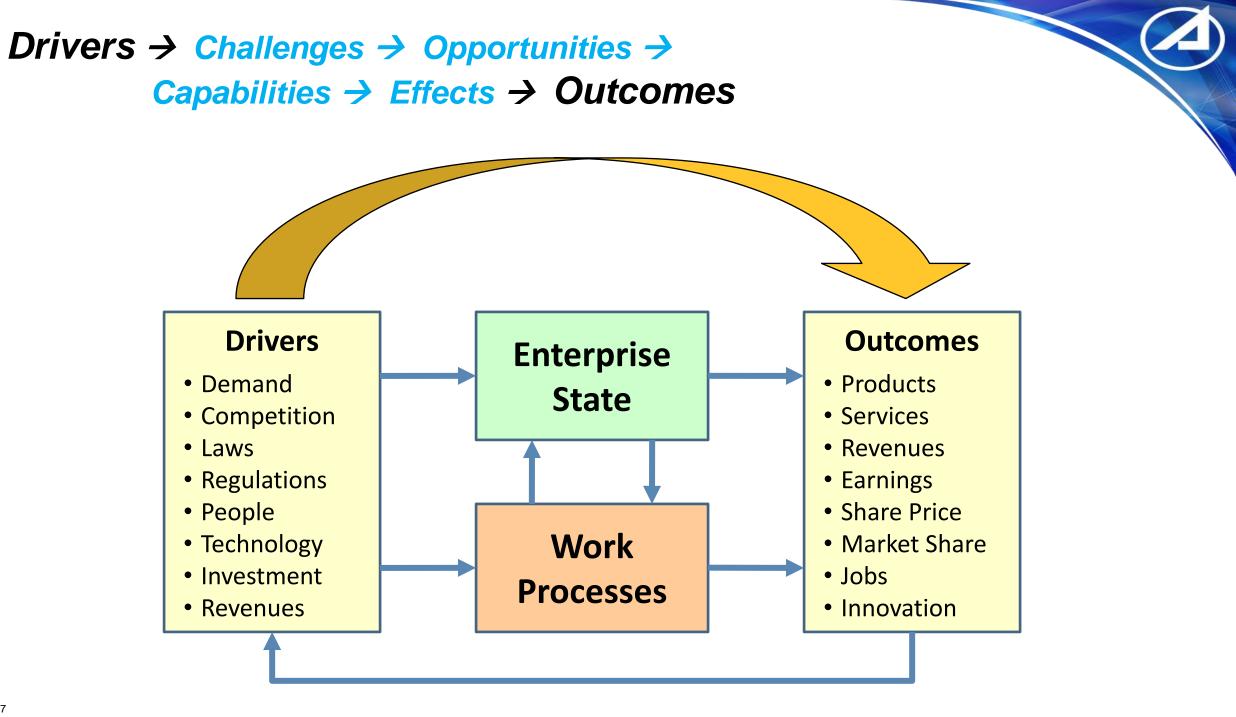**How much cost is involved?**

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What should motivate the Enterprise to change?

Drivers & Challenges as the basis for identification of Opportunities to pursue…

Conceptual Schema
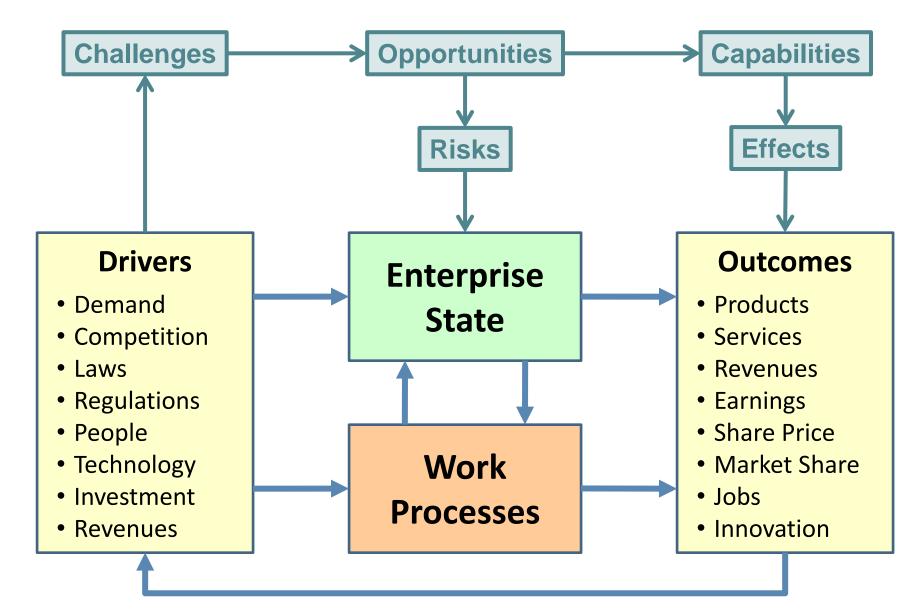
Modeling of Enterprise Operations and their Implementing Resources

* Can also be a Resource Performer, Signal or Geopolitical Extent
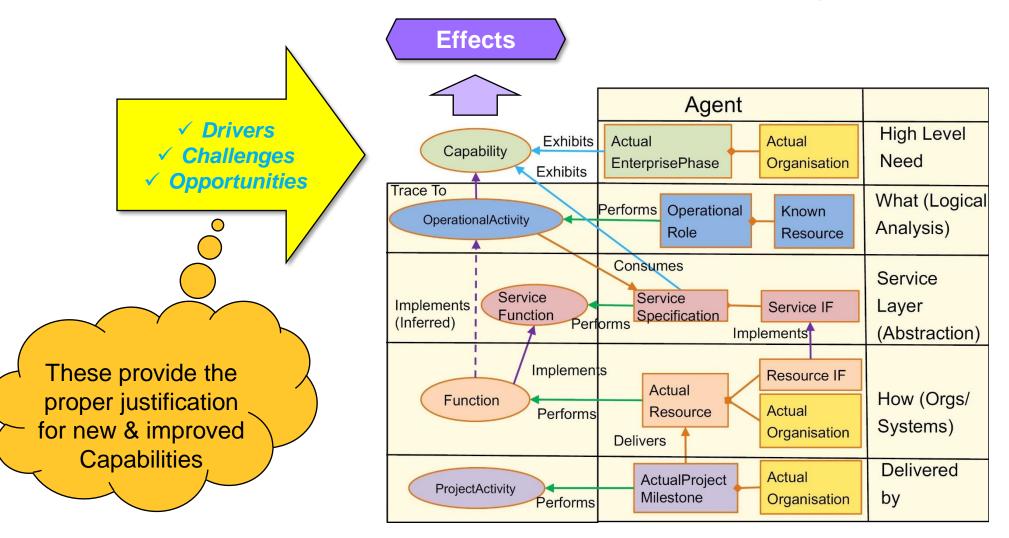
Challenges & Opportunities to be Identified for Achieving Enterprise Transformation

Identification of Capability Gaps and Shortfalls

Focus on Enterprise Capabilities & Desired Effects for Portfolio Management

Effects

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

These 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

Progression from Architecture Drivers to Implementation and Deployment of Capabilities
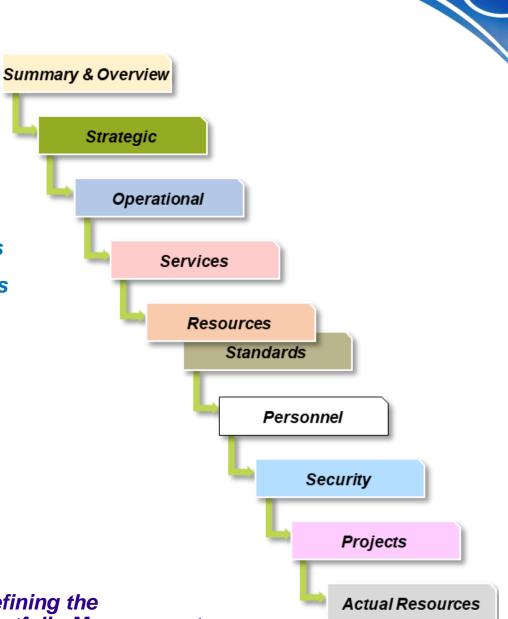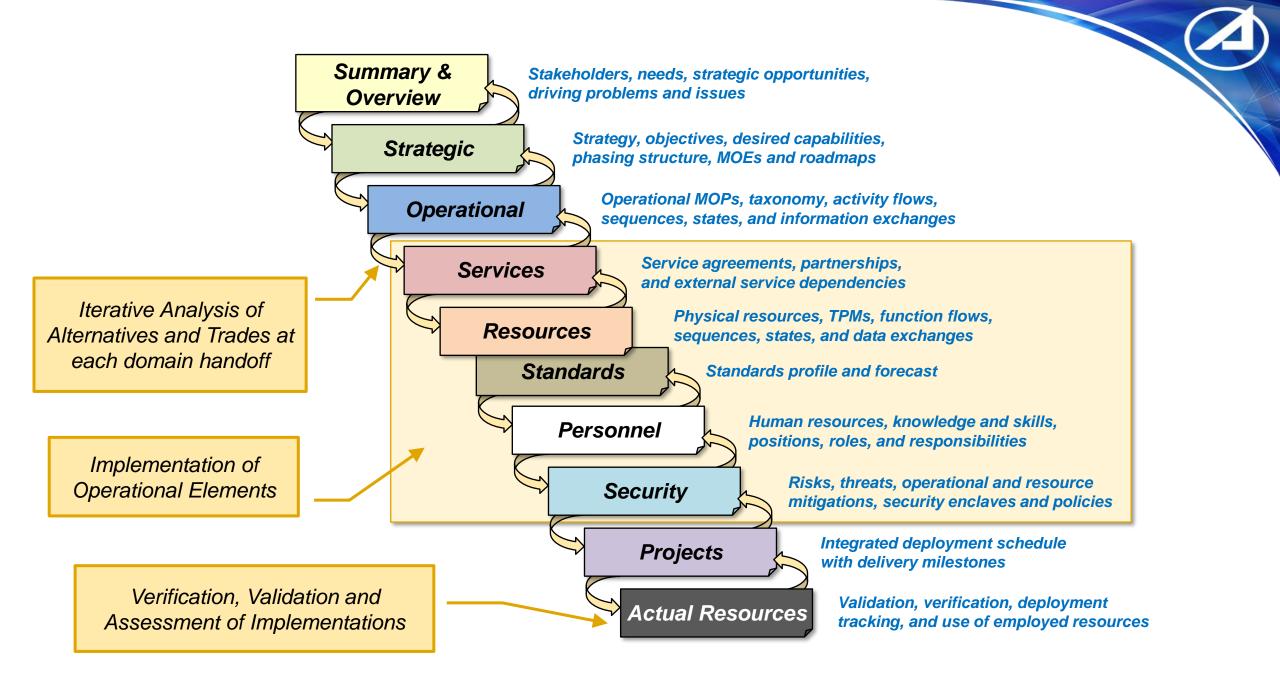
The UAF modeling viewpoints facilitate a logical and systematic flow of architecting activities

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**

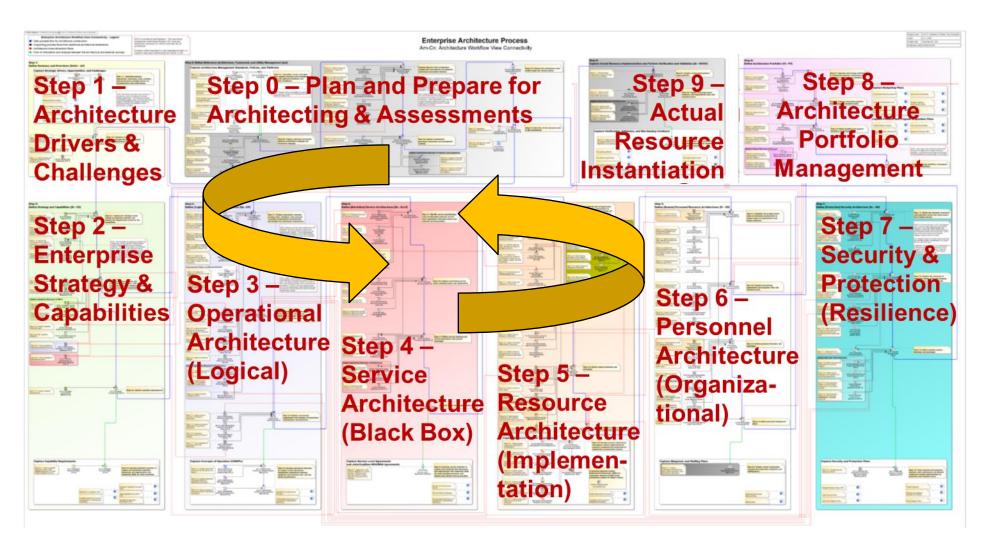VIII. **Plans deliver the resources**

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 — Stakeholders, needs, strategic opportunities, driving problems and issues

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

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

Services — Service agreements, partnerships, and external service dependencies

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

Standards — Standards profile and forecast

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

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

Projects — Integrated deployment schedule with delivery milestones

Actual Resources — Validation, verification, deployment tracking, and use of employed resources

Iterative Analysis of Alternatives and Trades at each domain handoff

Implementation of Operational Elements

Verification, Validation and Assessment of Implementations

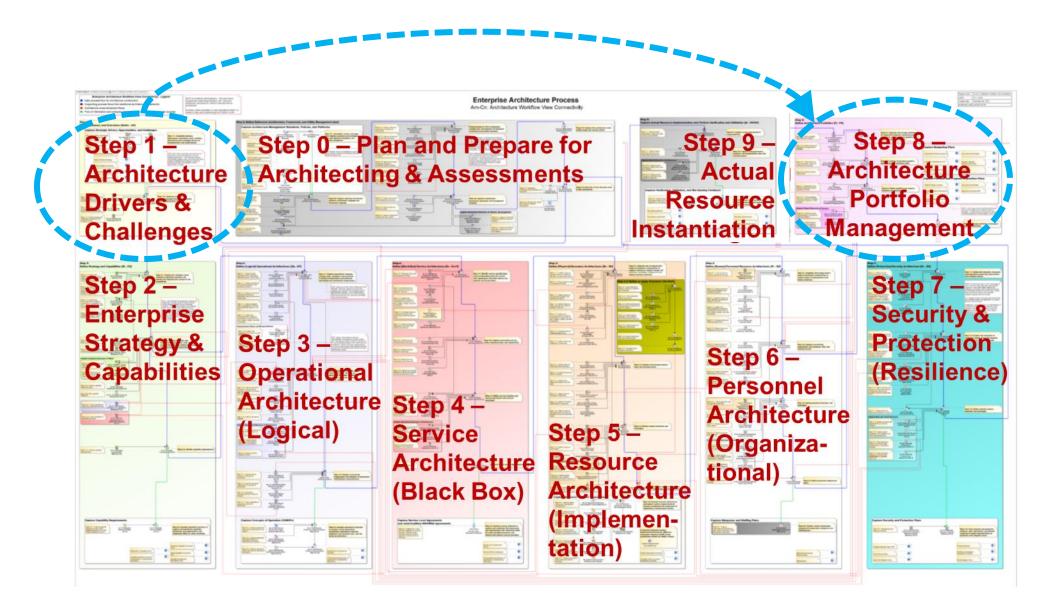# Standardized Enterprise Architecture Workflow in UAF

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

Uses and Challenges of Enterprise Architecture

- **Uses of an Enterprise Architecture**
  - *Enterprise Risk and Opportunity Assessment*
  - *Program Assessment and Evaluation*
  - *==Portfolio Management==*
  - *Budget Planning and Execution*
  - *Project Formulation and Planning*
  - *System Requirements Development*

- **Challenges Likely to be Encountered**
  - *Projects won't readily give up what they know (information is power)*
  - *Programs have their own spending authority (money is power)*
  - *Architecting an Enterprise demands a different mindset*
  - *Modeling an Enterprise requires different methods and tools*
  - *Easier to just incrementally change way things are done*
  - *The Future never arrives as we had planned…*

Capability Roadmap is Key for Identifying Gaps & Shortfalls

Table 7-1 Strategic Roadmap: Phasing

Capabilities Roadmap [St-Rm-Ph]

	2019												2020											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Assistance																								
[no measurements]	Rescue Ship (SAR Project 1 Sustainment)																							
Distress Signal Monitoring																								
[no measurements]	Monitoring System (SAR Project 1 Sustainment)																							
[no measurements]	SAR HQ (SAR Project 1 Sustainment)																							
Inform																								
[no measurements]	C2 System (SAR Project 1 Sustainment)																							
[no measurements]	Monitoring System (SAR Project 1 Sustainment)																							
[no measurements]	SAR HQ (SAR Project 1 Sustainment)																							
Land SAR																								
Maritime SAR Phase 1																								
[no measurements]	Maritime Rescue Architecture v1 (SAR Project 1 Sustainment)																							
Maritime SAR Phase 2																								
Maritime SAR Phase 3																								
Maritime SAR Phase 4																								

Search & Rescue (SAR) Enterprise Architecture *(from UAF Sample Model)*

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Operational Viewpoint Helps Identify Operational Impacts
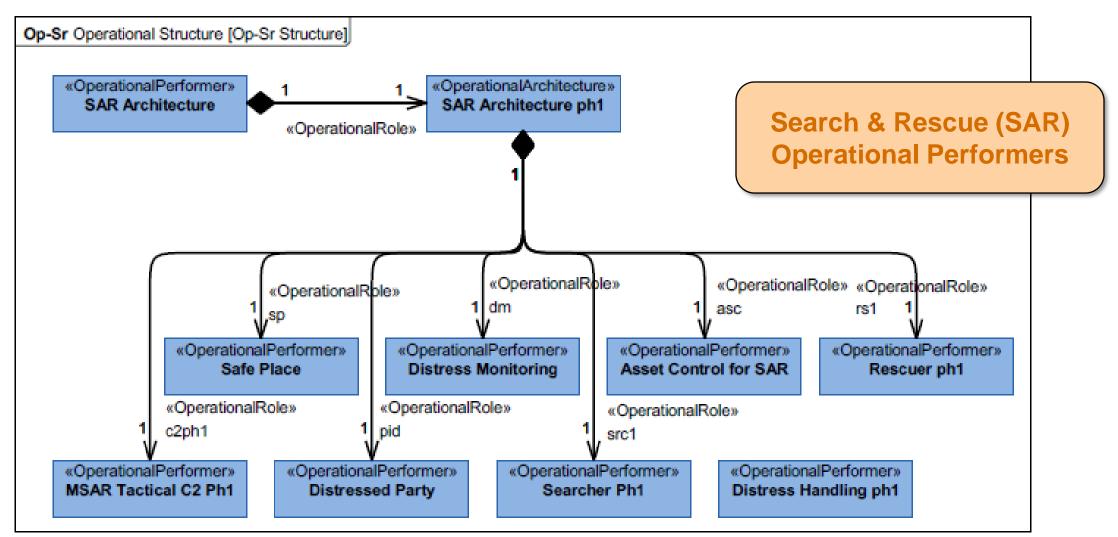
Figure 9:5 - Operational Structure SAR Structural Decomposition

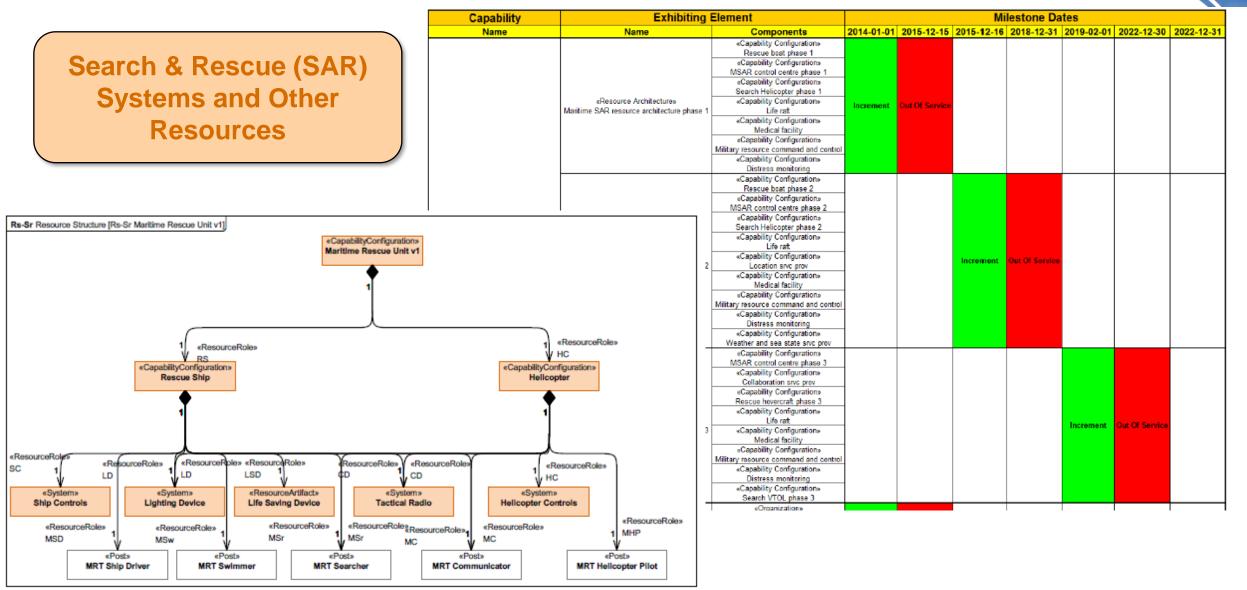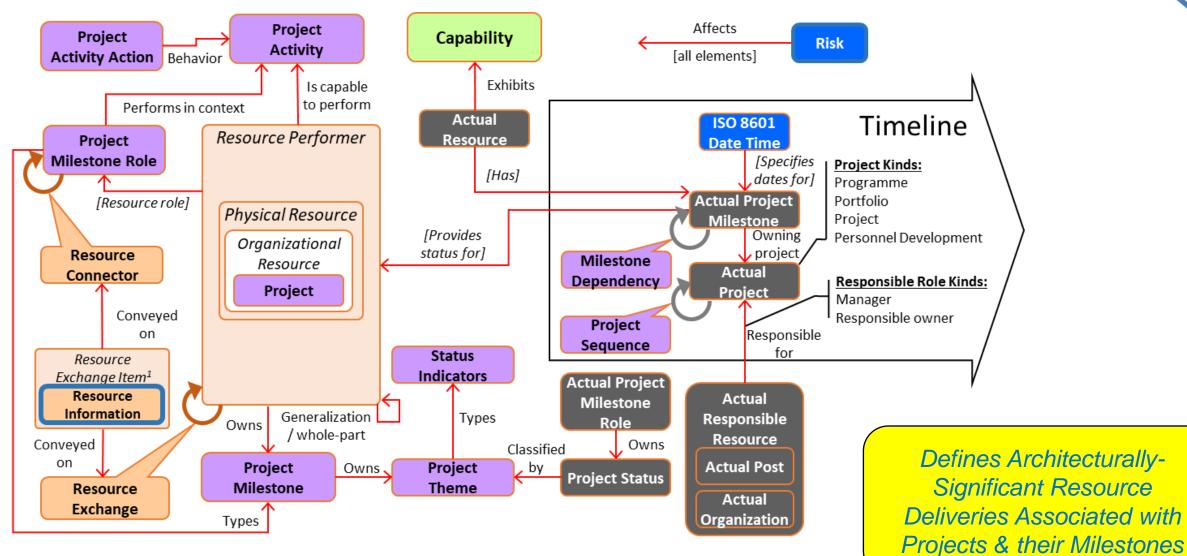**Search & Rescue (SAR) Systems and Other Resources**

Figure 10:3 - Resources Structure of the Maritime Rescue Unit v1
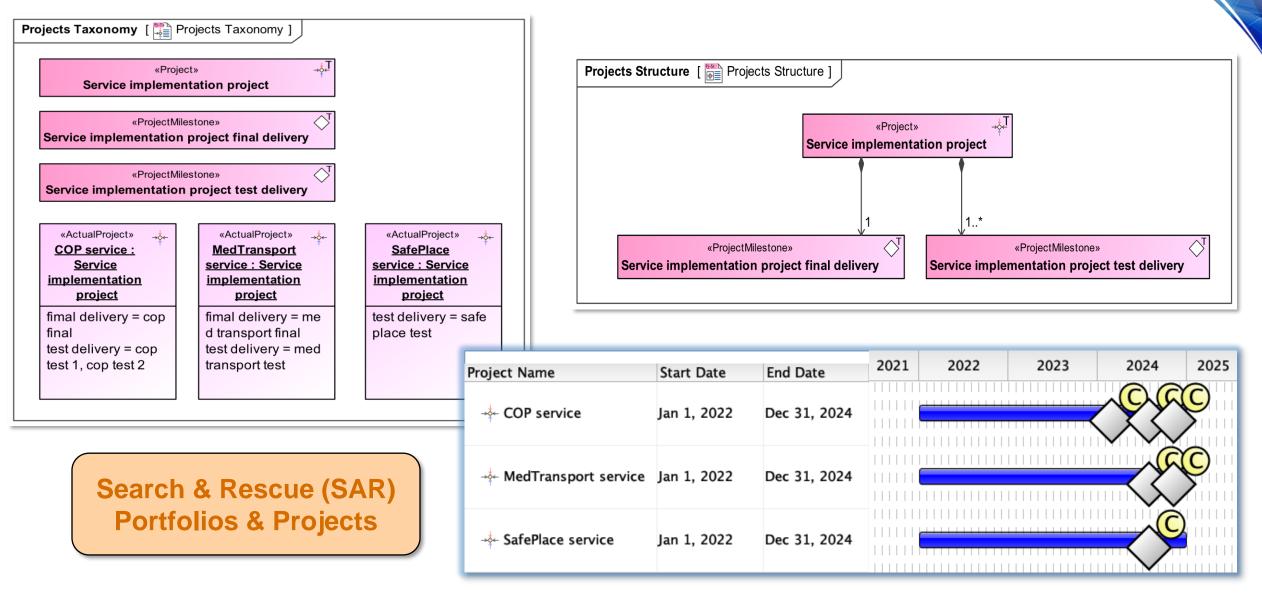
Projects Viewpoint Ontology

1 – can also be a Resource Performer, Resource Signal or Geopolitical Extent

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Projects Taxonomy, Structure & Roadmaps Views
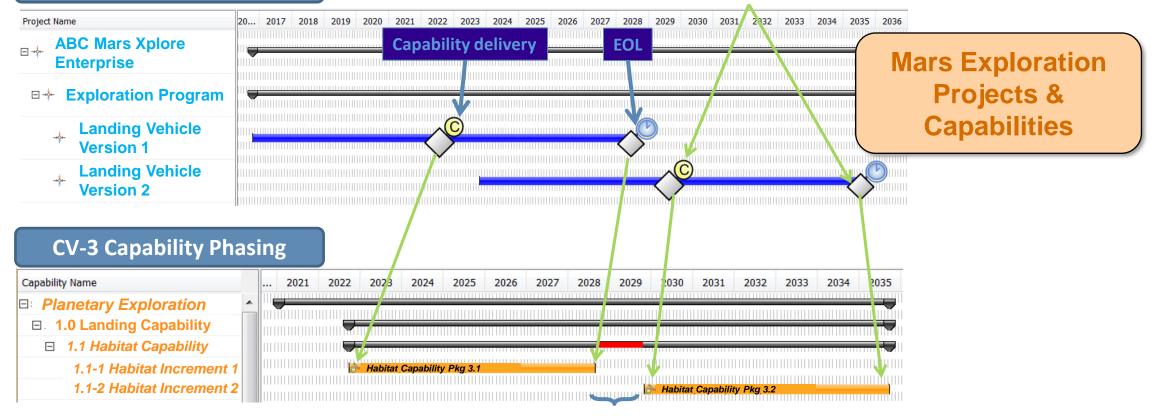
Project deliverables constitute the Capability Configurations on the Capability Roadmap

System End of Life Before Next Delivery Causes a Capability Gap

Roadmap views provide key insights into Portfolio change impacts

PV-2 Project Timelines

Adjusting milestones in PV-2 will affect CV-3

Mars Exploration Projects & Capabilities

Project Name — ABC Mars Xplore Enterprise, Exploration Program, Landing Vehicle Version 1, Landing Vehicle Version 2

Capability delivery | EOL

CV-3 Capability Phasing

Capability Name — Planetary Exploration, 1.0 Landing Capability, 1.1 Habitat Capability, 1.1-1 Habitat Increment 1, 1.1-2 Habitat Increment 2

Habitat Capability Pkg 3.1 | Habitat Capability Pkg 3.2

Open gap

Models can highlight issues and potential problems

Schedule Adjustment Closes Gap

Changing the Portfolio further to achieve proper balance
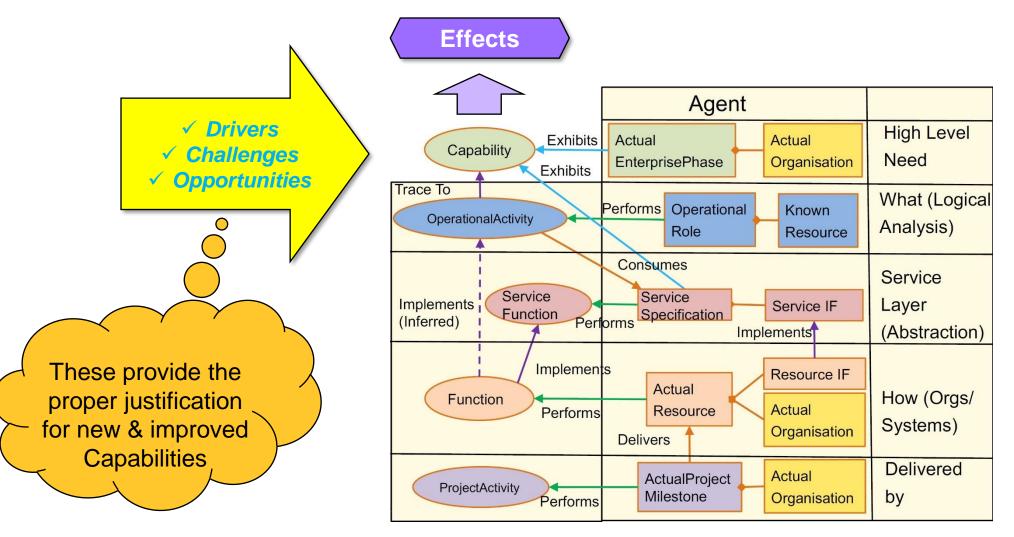
Adjusting milestone to the left closes the gap

PV-2 Project Timelines

| Project Name | 20... | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 |

- ABC Mars Xplore Enterprise
- Exploration Program
- Landing Vehicle Version 1
- Landing Vehicle Version 2

CV-3 Capability Phasing

| Capability Name | ... | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |

- Planetary Exploration
- 1.0 Landing Capability
- 1.1 Habitat Capability
- 1.1-1 Habitat Increment 1 — Habitat Capability Pkg 3.1
- 1.1-2 Habitat Increment 2 — Habitat Capability Pkg 3.2

Gap closed

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

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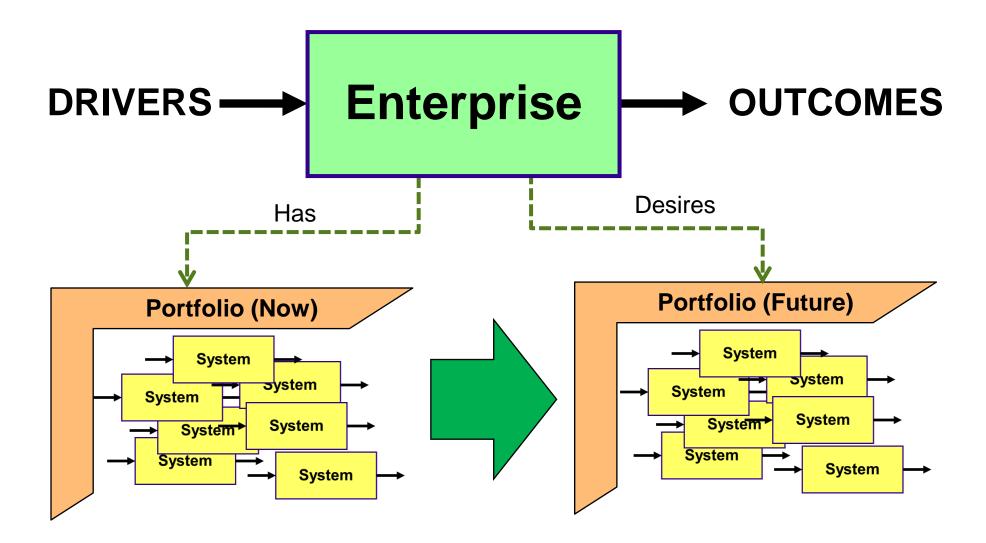
Strategic Views in UAF Provide Crucial Insights

Drivers, Challenges & Opportunities are Key to conducting Portfolio Management

Effects

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

These provide the proper justification for new & improved Capabilities
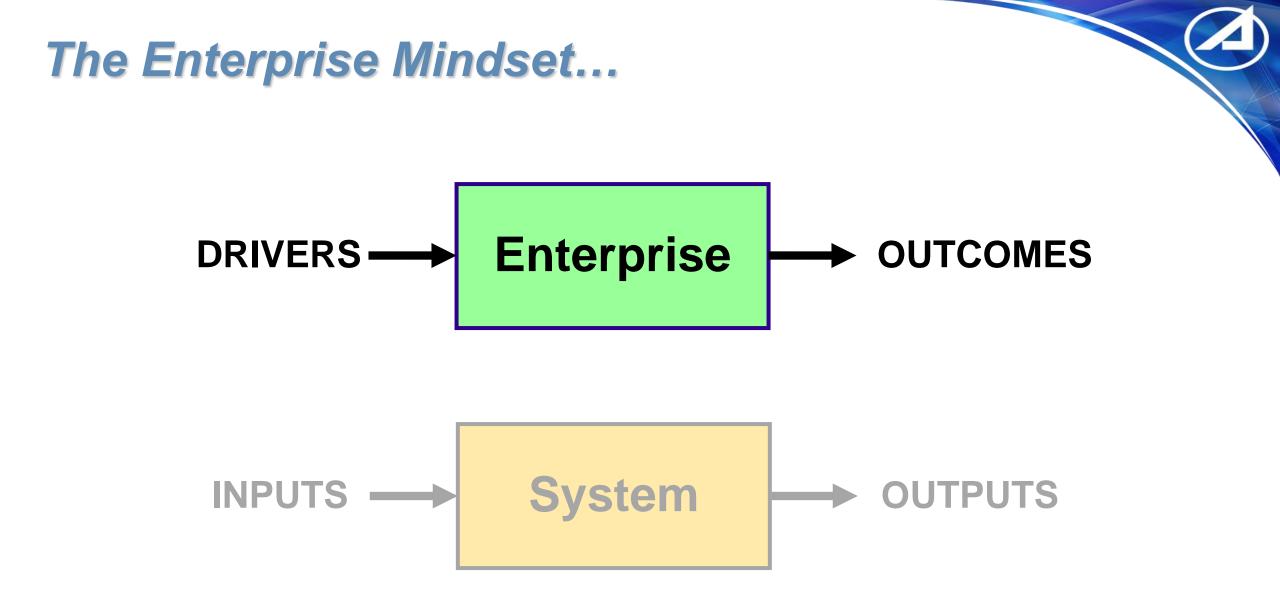
Enterprise Architecture models and views can serve to provide decision makers with the information about the rather complex situations to be encountered

An Enterprise Architecture Model can be a Key Enabler for Enterprise Transformation

DRIVERS → **Enterprise** → **OUTCOMES**

Has

Desires

Portfolio (Now)

Portfolio (Future)
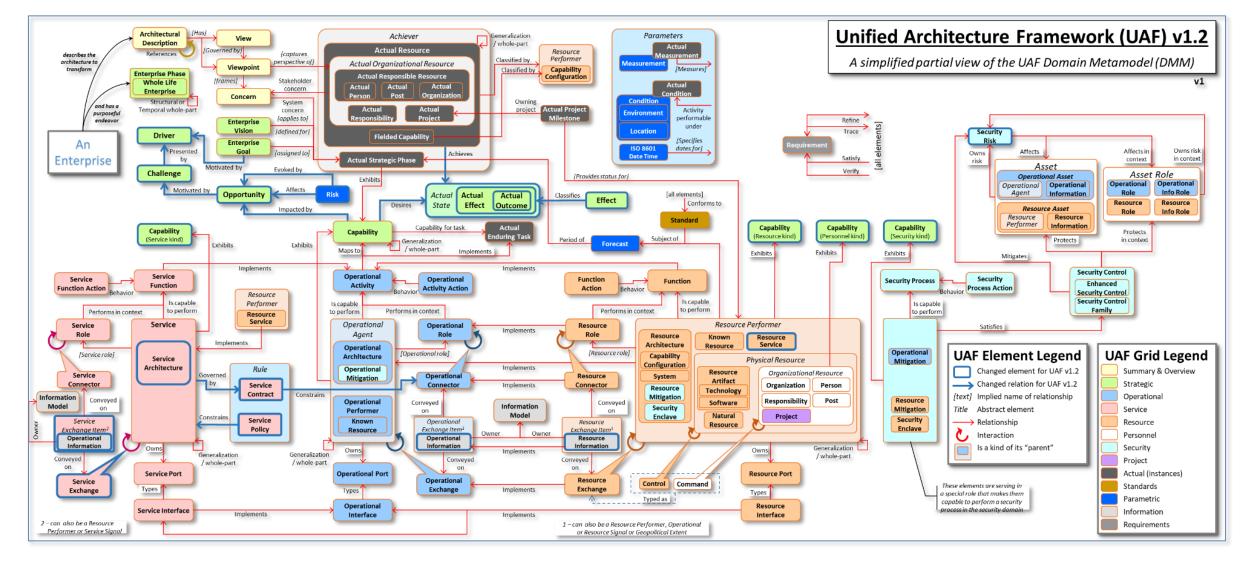
UAF can be a key enabler for helping do successful enterprise transformation

The Enterprise Mindset…

DRIVERS → **Enterprise** → **OUTCOMES**

INPUTS → **System** → **OUTPUTS**

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…

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

Summary & Overview — Stakeholders, needs, strategic opportunities, driving problems and issues

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

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

Services — Service agreements, partnerships, and external service dependencies

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

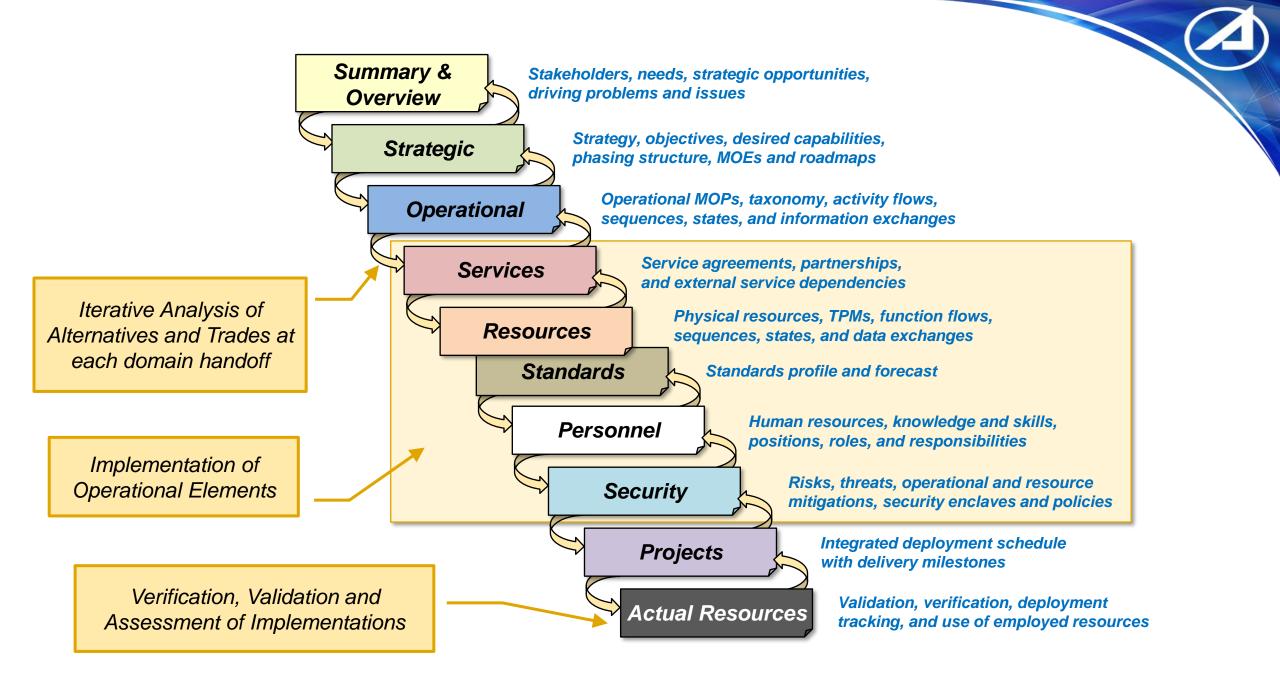**Standards** — Standards profile and forecast

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

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

Projects — Integrated deployment schedule with delivery milestones

Actual Resources — Validation, verification, deployment tracking, and use of employed resources

Iterative Analysis of Alternatives and Trades at each domain handoff

Implementation of Operational Elements

Verification, Validation and Assessment of Implementations

Changing the Portfolio in Response to New Drivers & Challenges

The Enterprise Architecture serves as the foundation for understanding impact of changes

Unified Architecture Framework

Modeling Language

- *Syntax*
- *Notation*
- *Semantics*

Architecture Framework

- *Viewpoints*
- *View Specifications*
- *Domain Metamodel*

UAF OMG UNIFIED ARCHITECTURE FRAMEWORK ™
Ontology

UAF OMG UNIFIED ARCHITECTURE FRAMEWORK ™
Language

Modeling Profile

Modeling Workflow

UAF OMG UNIFIED ARCHITECTURE FRAMEWORK ™
EA Guide

Modeling Patterns

Modeling Methodology

Modeling Templates

Architecture Models

Architecture Views
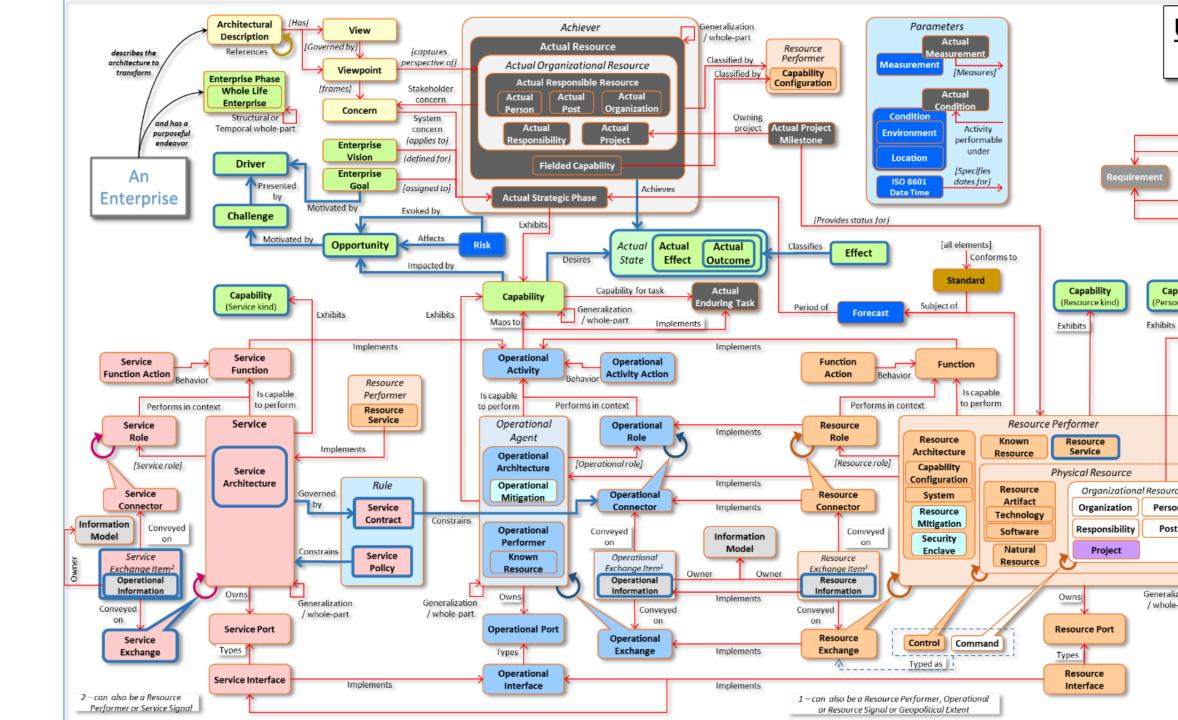
Architecture Description

Key Enterprise Elements

Managing the Enterprise Portfolio to Maximize Mission Impact

Keeping our focus on the most important dimensions of the Enterprise Total Solution

	Taxonomy Tx	Structure Sr	Connectivity Cn	Processes Pr	States St	Interaction Scenarios Is	Information If	Parameters Pm	Constraints Ct	Roadmap Rm	Traceability Tr
Metadata Md	Metadata Taxonomy Md-Tx	Architecture Viewpoints [a] Md-Sr	Metadata Connectivity Md-Cn	Metadata Processes [a] Md-Pr	-	-			Metadata Constraints [a] Md-Ct		Metadata Traceability Md-Tr
Strategic St	Strategic Taxonomy St-Tx	Strategic Structure St-Sr	Strategic Connectivity St-Cn	-	Strategic States St-St	-	Conceptual Data Model,	Environment Pm-En	Strategic Constraints St-Ct	Strategic Deployment, St-Rm Strategic Phasing St-Rm	Strategic Traceability St-Tr
Operational Op	Operational Taxonomy Op-Tx	Operational Structure Op-Sr	Operational Connectivity Op-Cn	Operational Processes Op-Pr	Operational States Op-St	Operational Interaction Scenarios Op-Is			Operational Constraints Op-Ct	-	Operational Traceability Op-Tr
Services Sv	Service Taxonomy Sv-Tx	Service Structure Sv-Sr	Service Connectivity Sv-Cn	Service Processes Sv-Pr	Service States Sv-St	Service Interaction Scenarios Sv-Is			Service Constraints Sv-Ct	Service Roadmap Sv-Rm	Service Traceability Sv-Tr
Personnel Pr	Personnel Taxonomy Pr-Tx	Personnel Structure Pr-Sr	Personnel Connectivity Pr-Cn	Personnel Processes Pr-Pr	Personnel States Pr-St	Personnel Interaction Scenarios Pr-Is	Logical Data Model,		Competence, Drivers, Performance Pr-Ct	Personnel Availability, Personnel Evolution, Personnel Forecast Pr-Rm	Personnel Traceability Pr-Tr
Resources Rs	Resource Taxonomy Rs-Tx	Resource Structure Rs-Sr	Resource Connectivity Rs-Cn	Resource Processes Rs-Pr	Resource States Rs-St	Resource Interaction Scenarios Rs-Is	Physical Data Model	Measurements Pm-Me	Resource Constraints Rs-Ct	Resource evolution, Resource forecast Rs-Rm	Resource Traceability Rs-Tr
Security Sc	Security Taxonomy Sc-Tx	Security Structure Sc-Sr	Security Connectivity Sc-Cn	Security Processes Sc-Pr	-	-			Security Constraints Sc-Ct	-	Security Traceability Sc-Tr
Projects Pj	Project Taxonomy Pj-Tx	Project Structure Pj-Sr	Project Connectivity Pj-Cn	-	-	-			-	Project Roadmap Pj-Rm	Project Traceability Pj-Tr
Standards Sd	Standard Taxonomy Sd-Tx	Standards Structure Sd-Sr	-	-	-	-			-	Standards Roadmap Sd-Rm	Standards Traceability Sd-Tr
Actuals Resources Ar		Actual Resources Structure, Ar-Sr	Actual Resources Connectivity, Ar-Cn	Simulation [b]					Parametric Execution/ Evaluation [b]	-	-

Dictionary * Dc
Summary & Overview Sm-Ov
Requirements Req

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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 relation for UAF v1.2
- *[text]* Implied name of relationship
- *Title* Abstract element
- → Relationship
- ↻ Interaction
- ☐ Is a kind of its "parent"

UAF Grid Legend

- Summary & Overview
- Strategic
- Operational
- Service
- Resource
- Personnel
- Security
- Project
- Actual (instances)
- Standards
- Parametric
- Information
- Requirements

These elements are serving in a special role that makes them capable to perform a security process in the security domain

1 – can also be a Resource Performer, Operational or Resource Signal or Geopolitical Extent

BACKUP

Enterprise Architecture Guide for UAF

Standardizing the Modeling Workflow

Step 1 – Architecture Drivers

Step 0 – Plan and Prepare for Architecting & Assessments

Step 8 – Architecture Portfolios

Step 9 – Actual Resources

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)
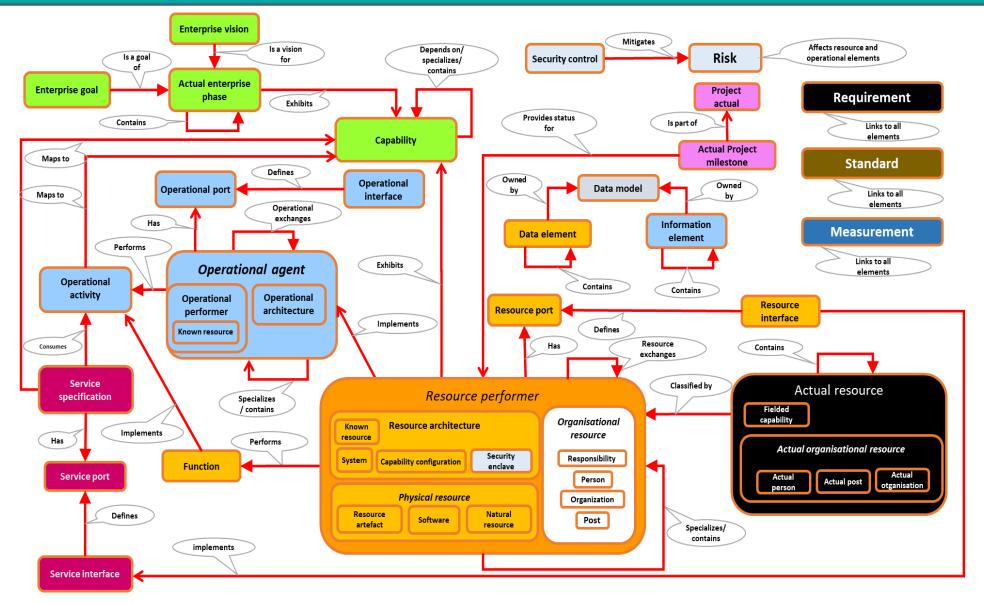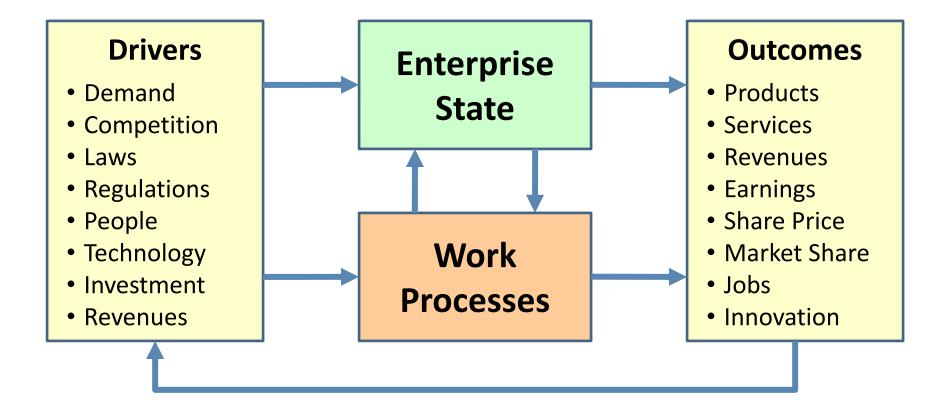
Enterprise Architecture Process
Am-Cn: Architecture Workflow View Connectivity

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UAF Conceptual Schema

Drivers and Outcomes for the Enterprise
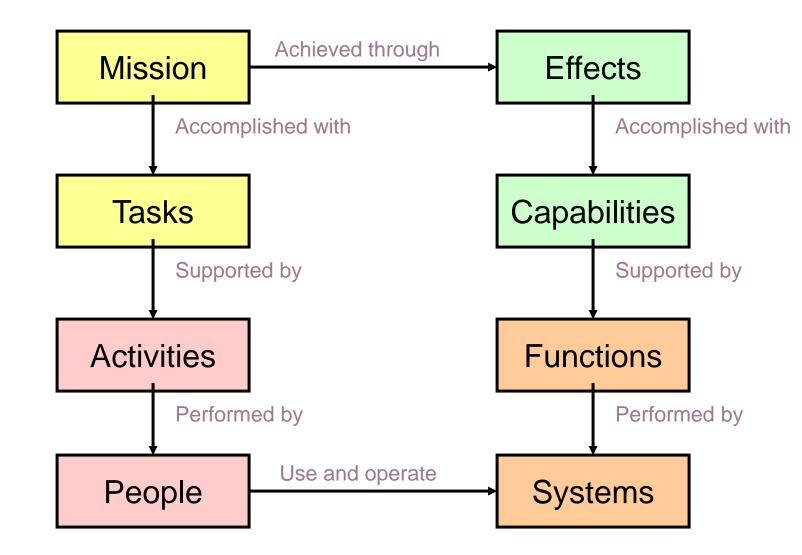
From the Theory of Enterprise Transformation (Rouse 2005)

Drivers

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

Enterprise State

Work Processes

Outcomes

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

Source: Rouse, W.B., 2009. "Engineering the enterprise as a system." (Chapter 10) In Sage, Andrew P. and William B. Rouse (Eds.), Handbook of Systems Engineering and Management, (Chapter 10), 2nd edition. John Wiley & Sons, 2009. FIGURE 10.3. Also in: Fig 2, "A Theory of Enterprise Transformation," William Rouse, Systems Engineering Journal, Vol 8, No 4, 2005
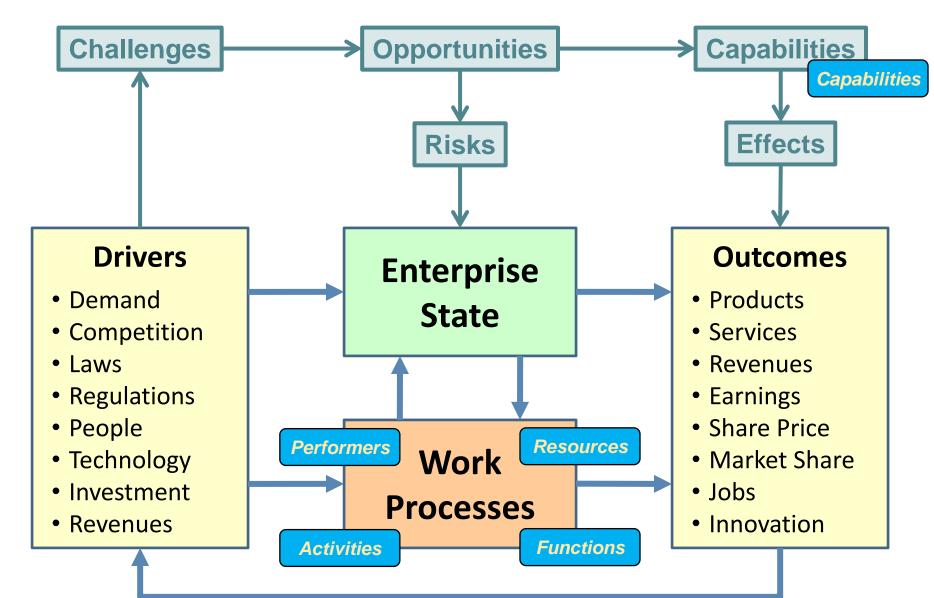
Effects Based Operations*

Mission Effects are what justify the Capabilities, Activities & Functions

```
  Mission  ── Achieved through ──>  Effects

     │ Accomplished with                │ Accomplished with

   Tasks                           Capabilities

     │ Supported by                     │ Supported by

  Activities                        Functions

     │ Performed by                     │ Performed by

  People  ── Use and operate ──>   Systems
```

* See https://en.wikipedia.org/wiki/Effects-based_operations

Challenges & Opportunities for Transformation

```
Challenges  →  Opportunities  →  Capabilities
```

[Capabilities]

Risks   Effects

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

Enterprise State

Work Processes

Performers   Resources
Activities   Functions

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

Architecture Tiers

UAF is most relevant at Tiers 4 and above…

Enterprises

Systems

Architecture Tier	Examples
1. Community / Domain	Defense, Intelligence, Space Exploration, Earth Observation, Transportation, Commerce
2. Department / Office / Administration	DOD, DOC, DOT, IRS, NASA, NOAA, FAA, FBI, National Security Council, White House
3. Command / Service / Agency (CSA)	Human Exploration, USSF, SMC, Air Force, Navy, National Weather Service, STRATCOM
4. Mission / Capability Area (MA/CA)	Lunar Mission, Launch, Missile Defense, Weather, Satcom, PNT, Air Traffic Control
5. Program / Node / Network	Artemis, International Space Station, GBSD, MilSatCom, GPS, AFSCN, DSN, AOC
6. Project / System / Segment	SLS, Orion, Lunar Lander, Lunar Habitat, Minuteman III, GPS Enterprise Ground

SysML and UAF are intended for modeling Systems and Enterprises, respectively, … so they can and should complement one another
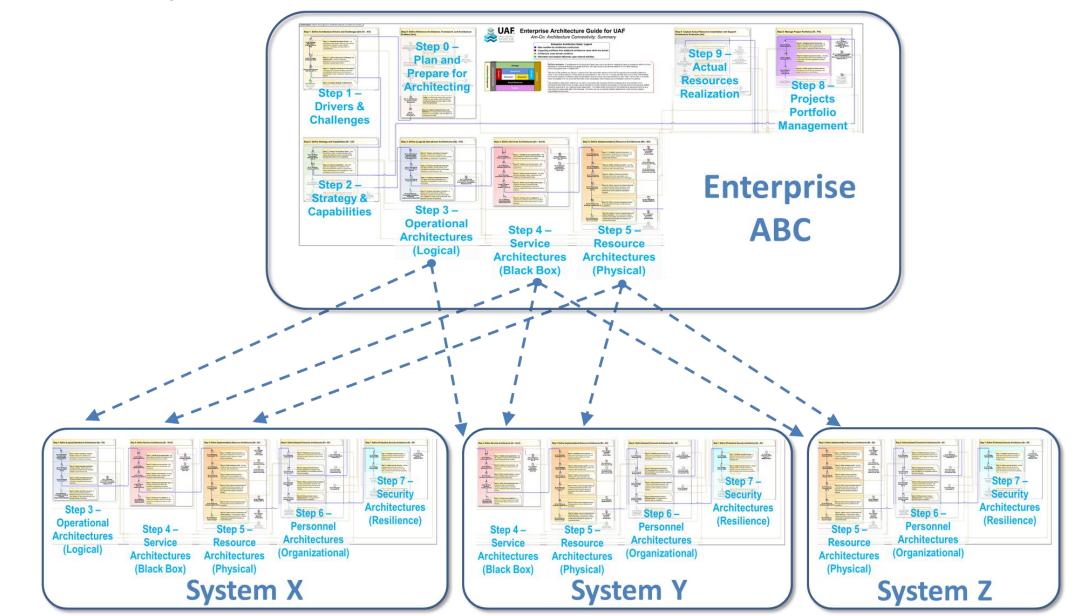
Architecture Tiers

For the Space Exploration Domain…

Enterprises

Systems

Architecture Tier	Examples
1. Community / Domain	Defense, Intelligence, ==Space Exploration==, Earth Observation, Transportation, Commerce
2. Department / Office / Administration	DOD, DOC, DOT, IRS, ==NASA==, NOAA, FAA, FBI, National Security Council, White House
3. Command / Service / Agency (CSA)	==Human Exploration==, USSF, SMC, Air Force, Navy, National Weather Service, STRATCOM
4. Mission / Capability Area (MA/CA)	==Lunar Mission, Launch==, Missile Defense, Weather, Satcom, PNT, Air Traffic Control
5. Program / Node / Network	==Artemis, International Space Station==, GBSD, MilSatCom, GPS, AFSCN, DSN, AOC
6. Project / System / Segment	==SLS, Orion, Lunar Lander, Lunar Habitat==, Minuteman III, GPS Enterprise Ground

SysML and UAF are intended for modeling Systems and Enterprises, respectively, … so they can and should complement one another
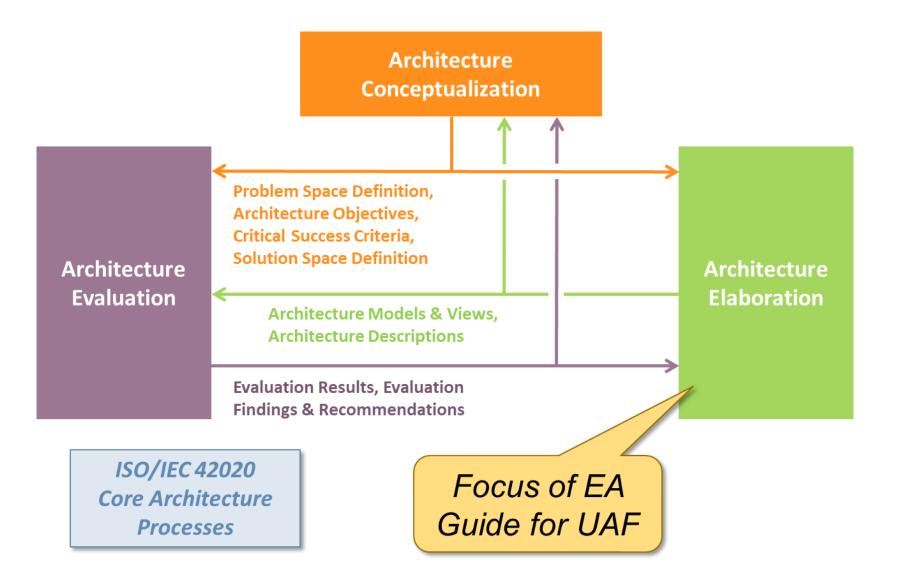
Multi-Tier Enterprise Modeling
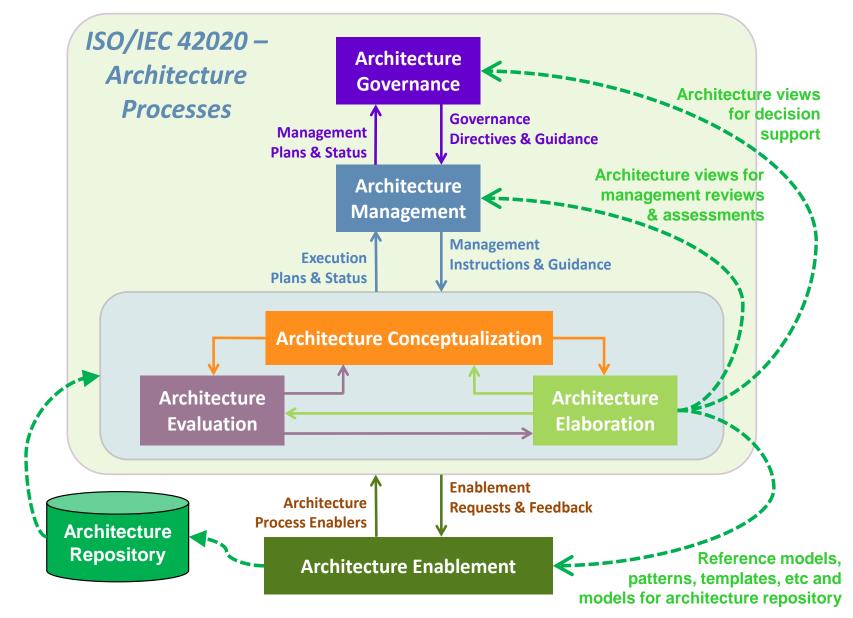## Only use the steps needed for each level and situation

ISO 42020 – Architecture Processes

EA Guide focus on "elaboration" of architecture with Models & Views
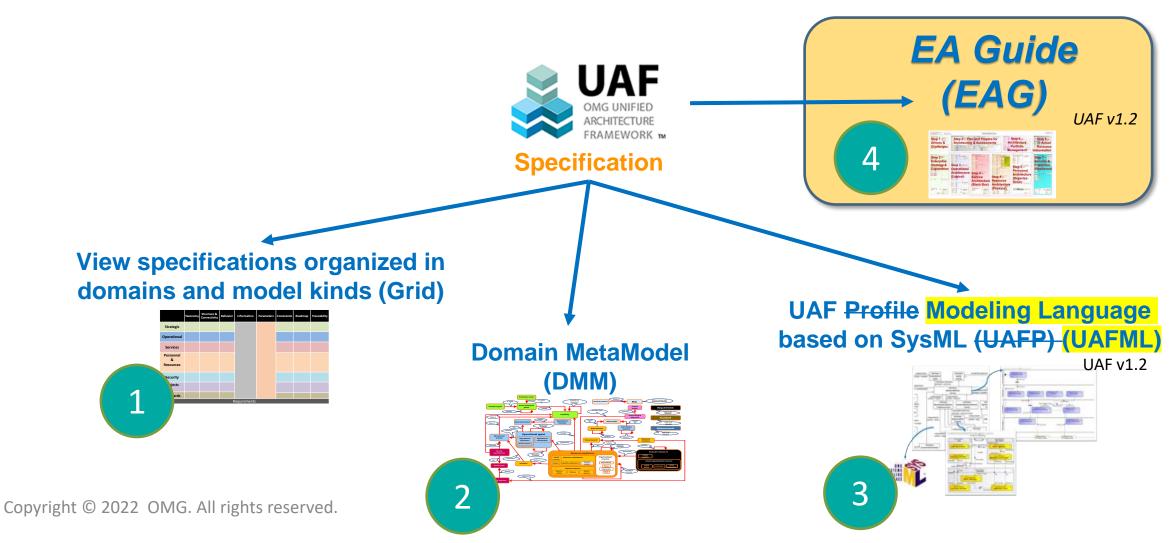
Architecture Used by Other Processes
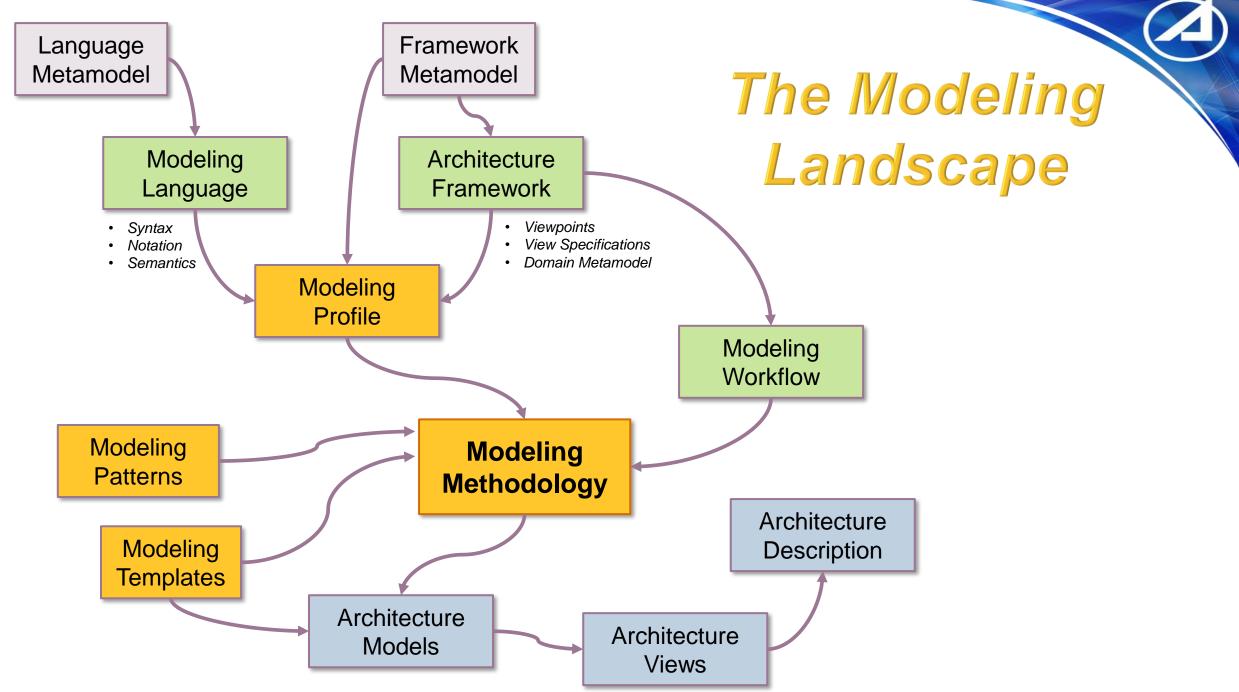
Governance & Management as a Basis for Enterprise Decisions

ISO/IEC 42020 – Architecture Processes

Architecture Governance

Management Plans & Status

Governance Directives & Guidance

Architecture Management

Execution Plans & Status

Management Instructions & Guidance

Architecture views for decision support

Architecture views for management reviews & assessments

Architecture Conceptualization

Architecture Evaluation

Architecture Elaboration

Architecture Repository

Architecture Process Enablers

Enablement Requests & Feedback

Architecture Enablement

Reference models, patterns, templates, etc and models for architecture repository

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UAF
OMG UNIFIED ARCHITECTURE FRAMEWORK ™

Specification

EA Guide (EAG)

UAF v1.2

4

View specifications organized in domains and model kinds (Grid)

1

Domain MetaModel (DMM)

2

UAF ~~Profile~~ Modeling Language based on SysML ~~(UAFP)~~ (UAFML)

UAF v1.2

3

The Modeling Landscape

- Language Metamodel
- Framework Metamodel
- Modeling Language
  - Syntax
  - Notation
  - Semantics
- Architecture Framework
  - Viewpoints
  - View Specifications
  - Domain Metamodel
- Modeling Profile
- Modeling Workflow
- Modeling Patterns
- Modeling Templates
- Modeling Methodology
- Architecture Description
- Architecture Models
- Architecture Views

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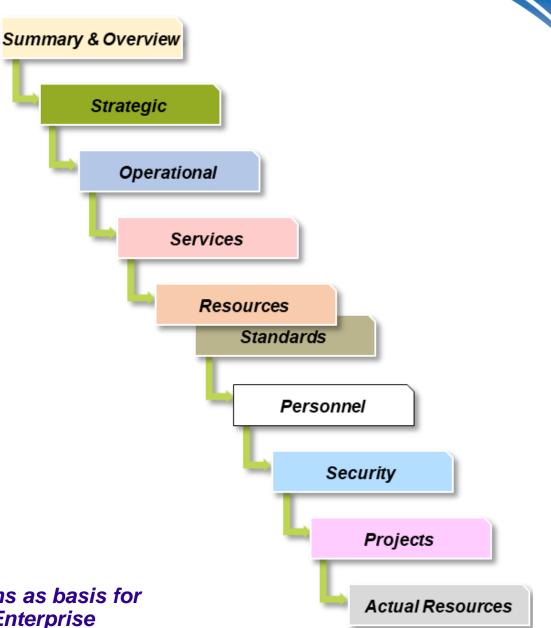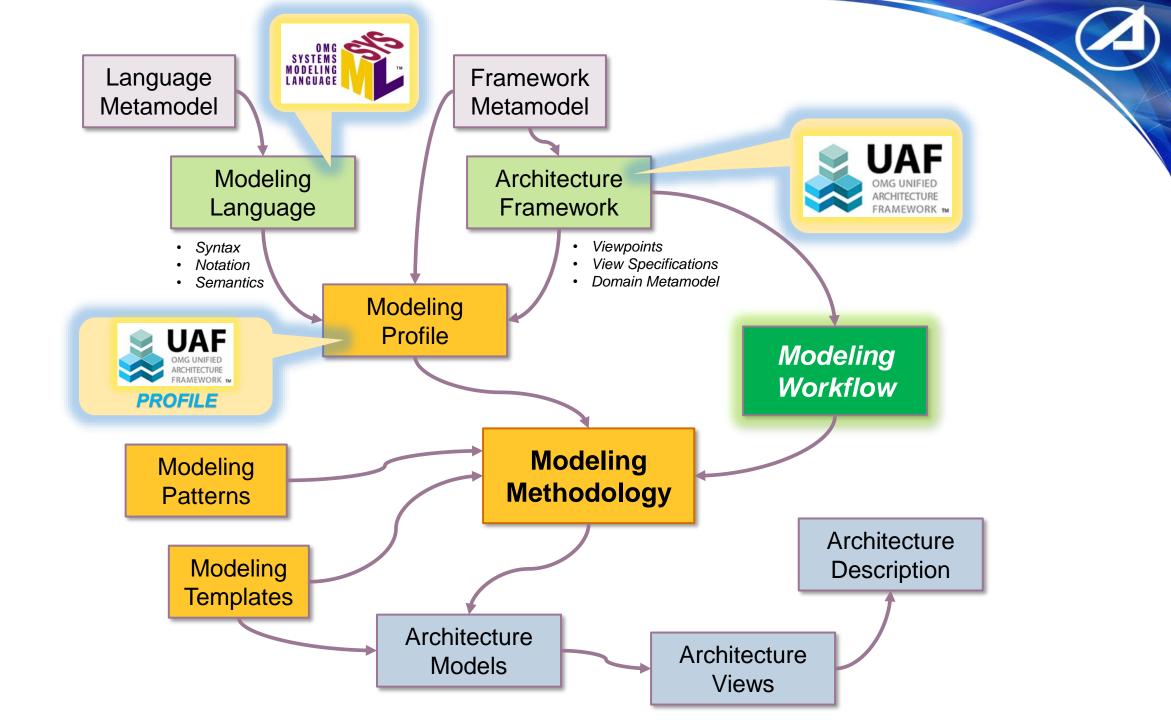
Progression from Architecture Drivers to Implementation and Deployment of Capabilities

- The domains present a logical and systematic flow of architecting precepts

  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

Summary & Overview
Strategic
Operational
Services
Resources
Standards
Personnel
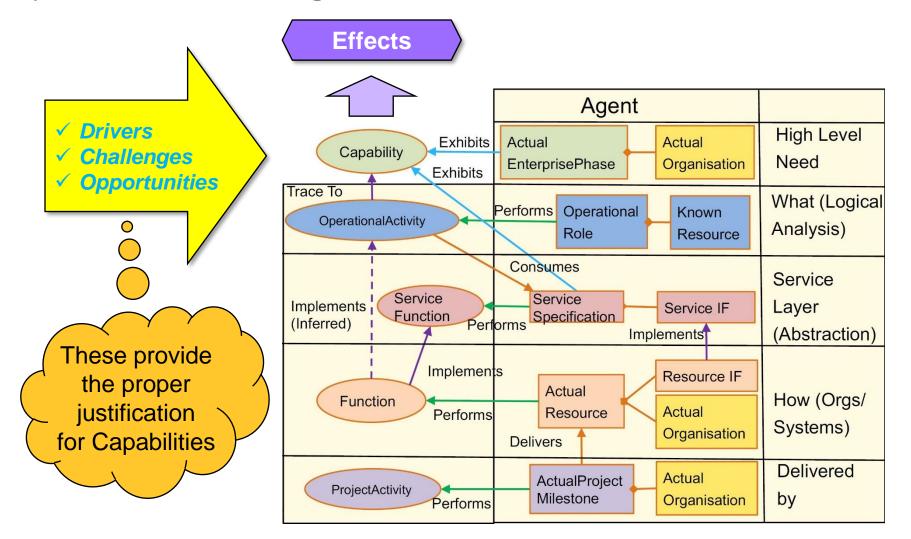Security
Projects
Actual Resources

Appendix A

Enterprise Architecture Based Portfolio Management:
Architectural Views of the Enterprise Portfolio Elements

James N Martin
Distinguished Engineer
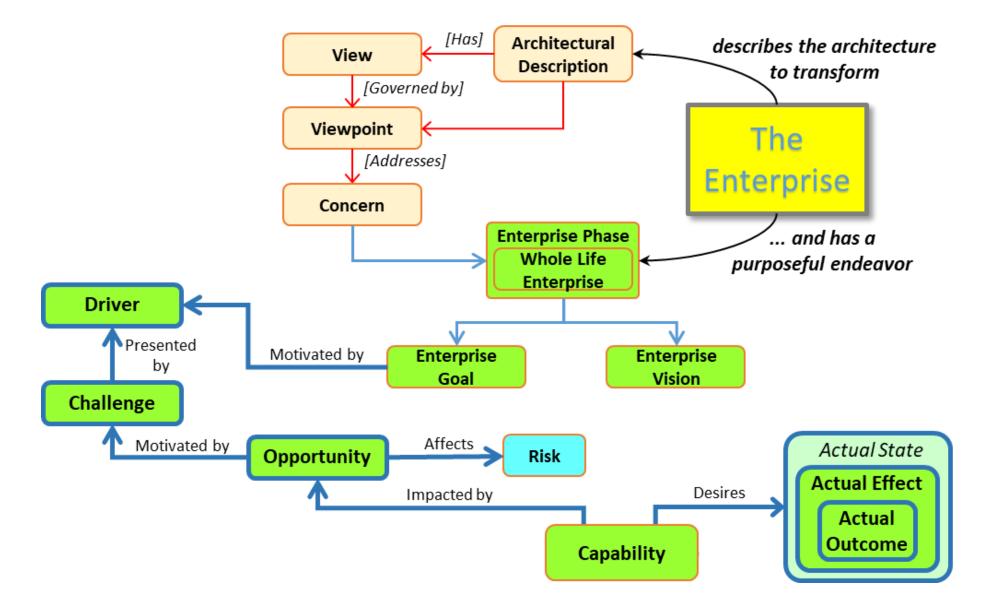*Aerospace Corporation*

Systems Engineering Forum
15 February 2022

UAF Key Elements
Focus on top tier for Portfolio Management

Effects

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

These provide the proper justification for Capabilities

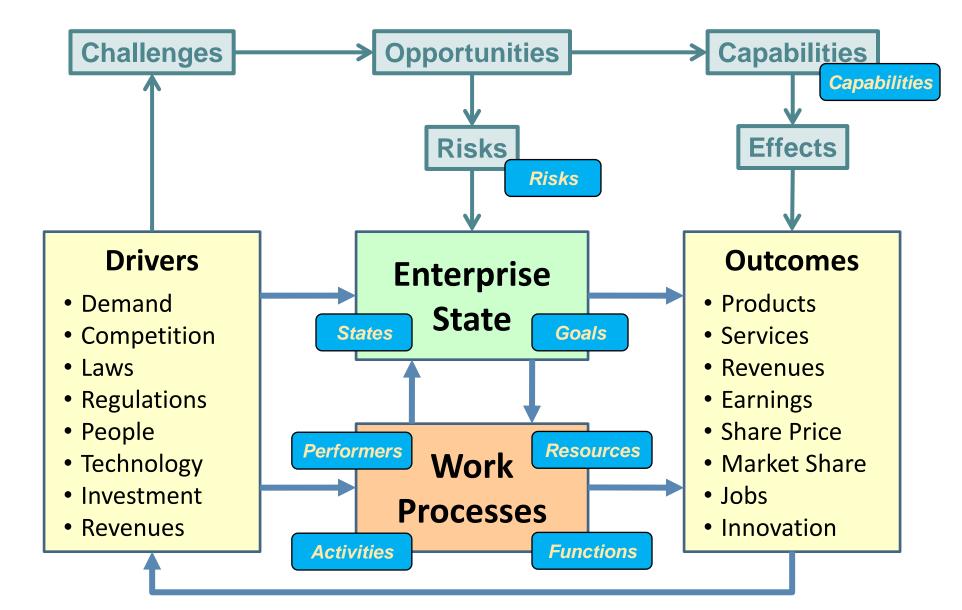|	Agent		
Capability — Exhibits	Actual EnterprisePhase — Actual Organisation		High Level Need
Trace To OperationalActivity — Exhibits	Performs — Operational Role — Known Resource		What (Logical Analysis)
Implements (Inferred) — Service Function	Consumes — Service Specification — Service IF — Implements		Service Layer (Abstraction)
Function — Implements / Performs	Actual Resource — Resource IF / Actual Organisation — Delivers		How (Orgs/ Systems)
ProjectActivity — Performs	ActualProject Milestone — Actual Organisation		Delivered by

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

Conceptual Schema for Architecture-Based Strategic Technical Planning

Challenges & Opportunities to be Identified for Achieving Enterprise Transformation

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Model Elements for Portfolio Management

Enhancements needed in the DMM

- **Driver (from _driving_ documents)**
  - *Thing that forces to work or act*
  - *That which urges you forward*
- **Enterprise State**
  - *Condition with respect to circumstances or attributes*
- **Outcome**
  - *Something that happens or is produced as the final consequence or product*

- **Capability**
  - *Ability to do something*
- **Effect**
  - *A phenomenon that follows and is caused by some previous phenomenon*

- **Challenge**
  - *A demanding or stimulating situation*
  - *A call to engage in a contest or fight*
- **Opportunity**
  - *A possibility due to a favorable combination of circumstances*
- **Risk**
  - *A source of danger*
  - *A possibility of incurring loss or misfortune*

- **Mission**
  - *special assignment or operation assigned to a person or group intended to carry out specific objectives*
  - *Note: Bring this back from UPDM*

Note: Only the Capabilities and Work Processes (ie, operational activities) are in DMM. Other elements need to be added.

Example Elements

These things provide the context in which Capabilities are assessed

Drivers
- Anticipate rapid emergence of competitor's capabilities and service offerings
- Preserve and protect supply chain by investing in modernization efforts
- Maintain continuity during degraded or disrupted environments

Challenges
- Access to and awareness of new and emerging markets and customers
- Availability of necessary industrial base capabilities and skills
- Explosion in data from large variety of sources and methods

Opportunities
- Social media products and services are proliferating
- Ubiquitous broadband connectivity from space
- Everything is Web-enabled – connections are low cost and easy to make

Effects
- Customer satisfaction with our products and services
- Increasing value for shareholders and owners
- Continuous peace and prosperity

Outcomes
- Security and well being of our customers and end users
- Affordable access to high-value products and services
- Value delivery in a timely and effective manner
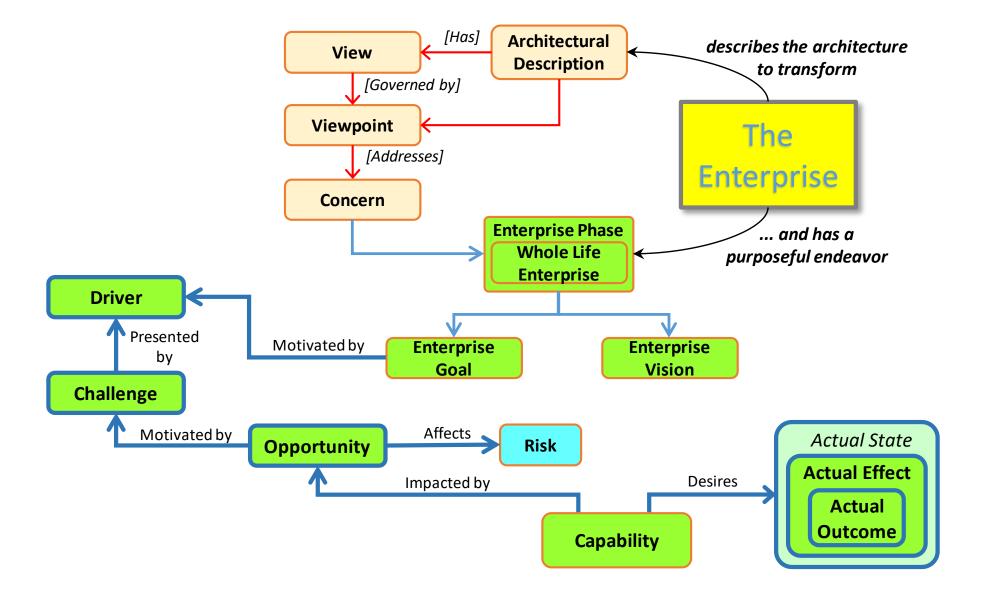
Example Measures

These things are measurable

Drivers
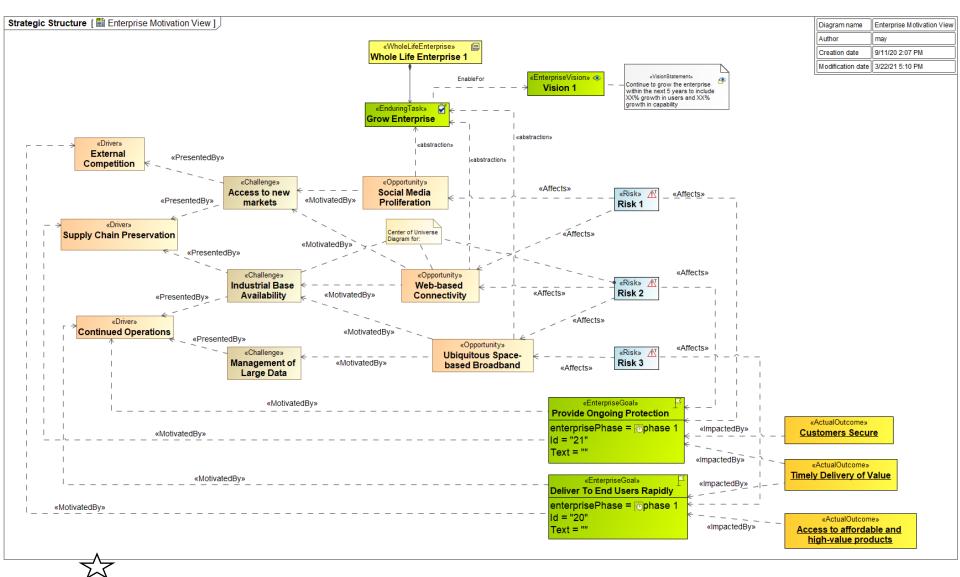- Extent of relevance to the enterprise
- Degree of urgency
- Extent of difficulty

Challenges
- Extent of difficulty
- Degree of criticality

Opportunities
- Probability of happening
- Magnitude of consequence if this comes about

Effects
- Measure of Effect (MOE)
- Measure of Success (MOS)

Outcomes
- Probability of happening
- Magnitude of impact on enterprise success or viability

What should motivate the Enterprise to change?

Drivers & Challenges for basis for identification of Opportunities

View — [Has] — Architectural Description

View — [Governed by] → Viewpoint

Architectural Description → Viewpoint

describes the architecture to transform

The Enterprise

... and has a purposeful endeavor

Viewpoint — [Addresses] → Concern

Concern → Enterprise Phase / Whole Life Enterprise

Driver — Motivated by — Enterprise Goal

Challenge — Presented by → Driver

Enterprise Phase / Whole Life Enterprise → Enterprise Goal / Enterprise Vision

Opportunity — Motivated by → Challenge

Opportunity — Affects → Risk

Capability — Impacted by → Opportunity

Capability — Desires → Actual State / Actual Effect / Actual Outcome

Strategic Motivation View: Drivers→ Challenges→ Opportunities→ Goals→ Outcomes

Strategic Structure [📖 Enterprise Motivation View]

Diagram name	Enterprise Motivation View
Author	may
Creation date	9/11/20 2:07 PM
Modification date	3/22/21 5:10 PM

«WholeLifeEnterprise»
Whole Life Enterprise 1

«EnterpriseVision»
Vision 1

«VisionStatement»
Continue to grow the enterprise within the next 5 years to include XX% growth in users and XX% growth in capability

EnableFor

«EnduringTask»
Grow Enterprise

«abstraction»

«Driver»
External Competition

«PresentedBy»

«Challenge»
Access to new markets

«Opportunity»
Social Media Proliferation

«Risk»
Risk 1

«Affects»

«Affects»

«MotivatedBy»

«PresentedBy»

«Driver»
Supply Chain Preservation

«MotivatedBy»

Center of Universe Diagram for:

«Affects»

«PresentedBy»

«Challenge»
Industrial Base Availability

«Opportunity»
Web-based Connectivity

«Risk»
Risk 2

«Affects»

«MotivatedBy»

«Affects»

«PresentedBy»

«Driver»
Continued Operations

«MotivatedBy»

«Affects»

«PresentedBy»

«Challenge»
Management of Large Data

«MotivatedBy»

«Opportunity»
Ubiquitous Space-based Broadband

«Risk»
Risk 3

«Affects»

«Affects»

«MotivatedBy»

«EnterpriseGoal»
Provide Ongoing Protection

enterprisePhase = phase 1
Id = "21"
Text = ""

«ImpactedBy»

«ActualOutcome»
Customers Secure

«MotivatedBy»

«ImpactedBy»

«ActualOutcome»
Timely Delivery of Value

«MotivatedBy»

«EnterpriseGoal»
Deliver To End Users Rapidly

enterprisePhase = phase 1
Id = "20"
Text = ""

«ImpactedBy»

«MotivatedBy»

«ImpactedBy»

«ActualOutcome»
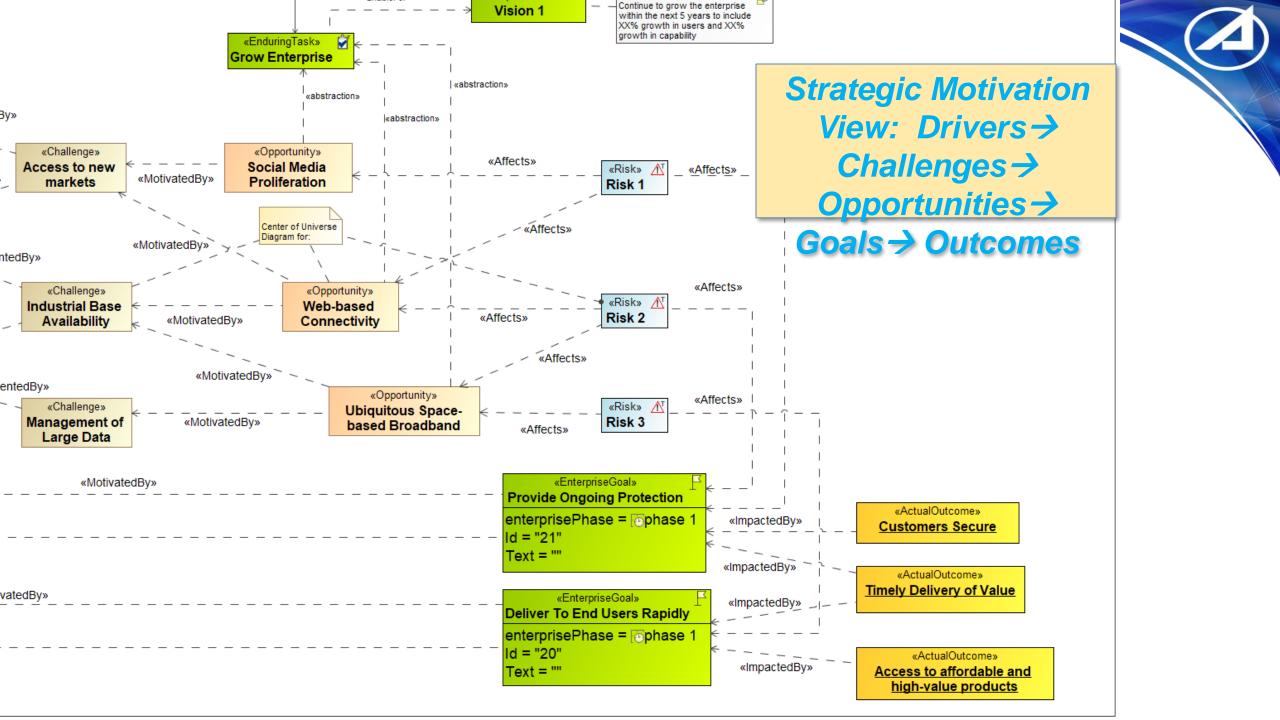**Access to affordable and high-value products**

Sample View

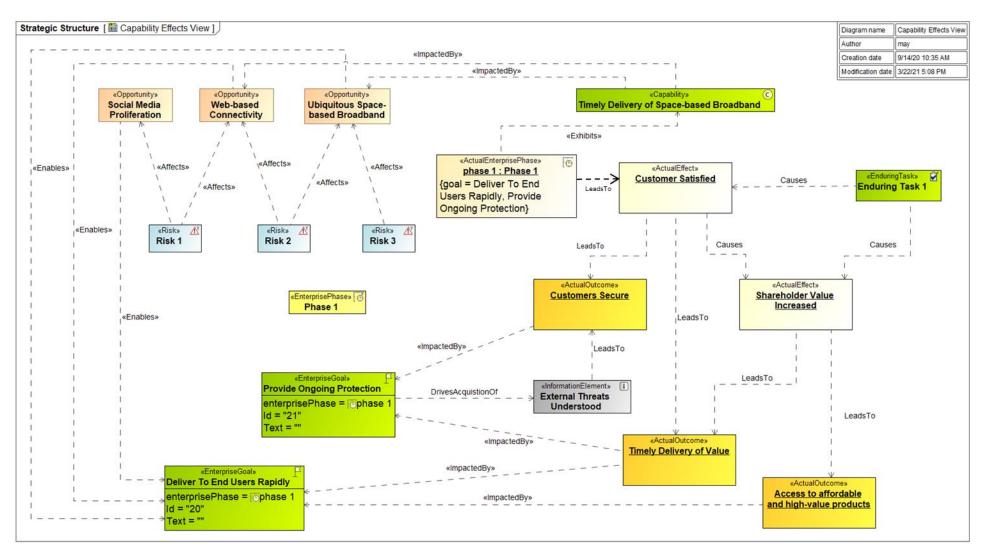**Strategic Motivation View:** *Drivers→ Challenges→ Opportunities→ Goals→ Outcomes*

Strategic Motivation View: Drivers→ Challenges→ Opportunities→ Goals→ Outcomes

Sample View

Strategic States: *Capability Effects View (Opportunities→ Capabilities→ Phases→ Effects→ Outcomes)*
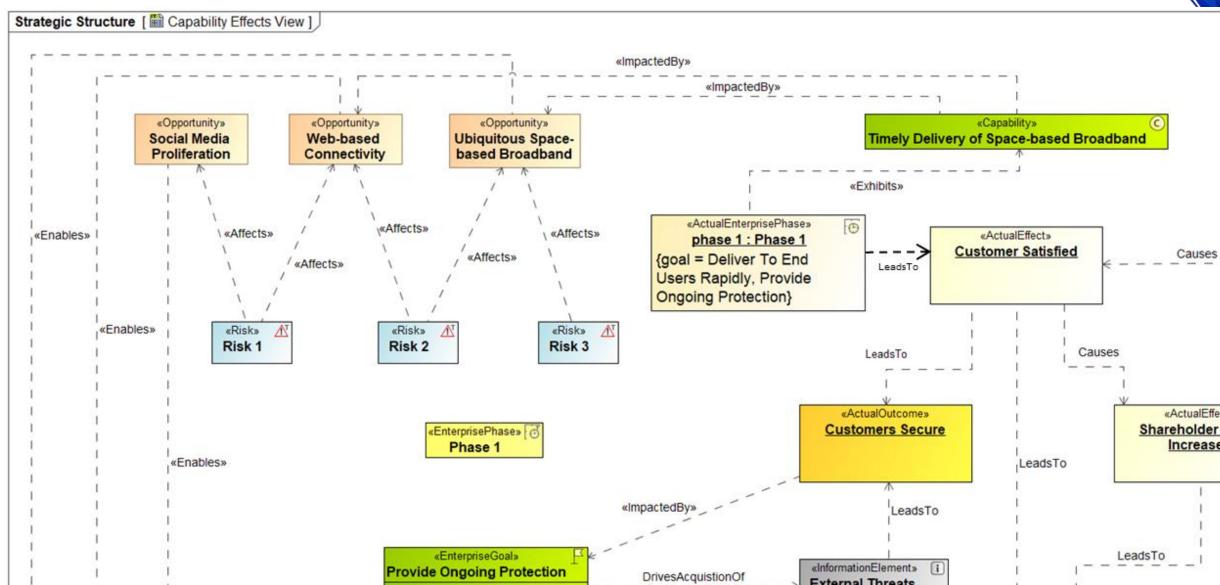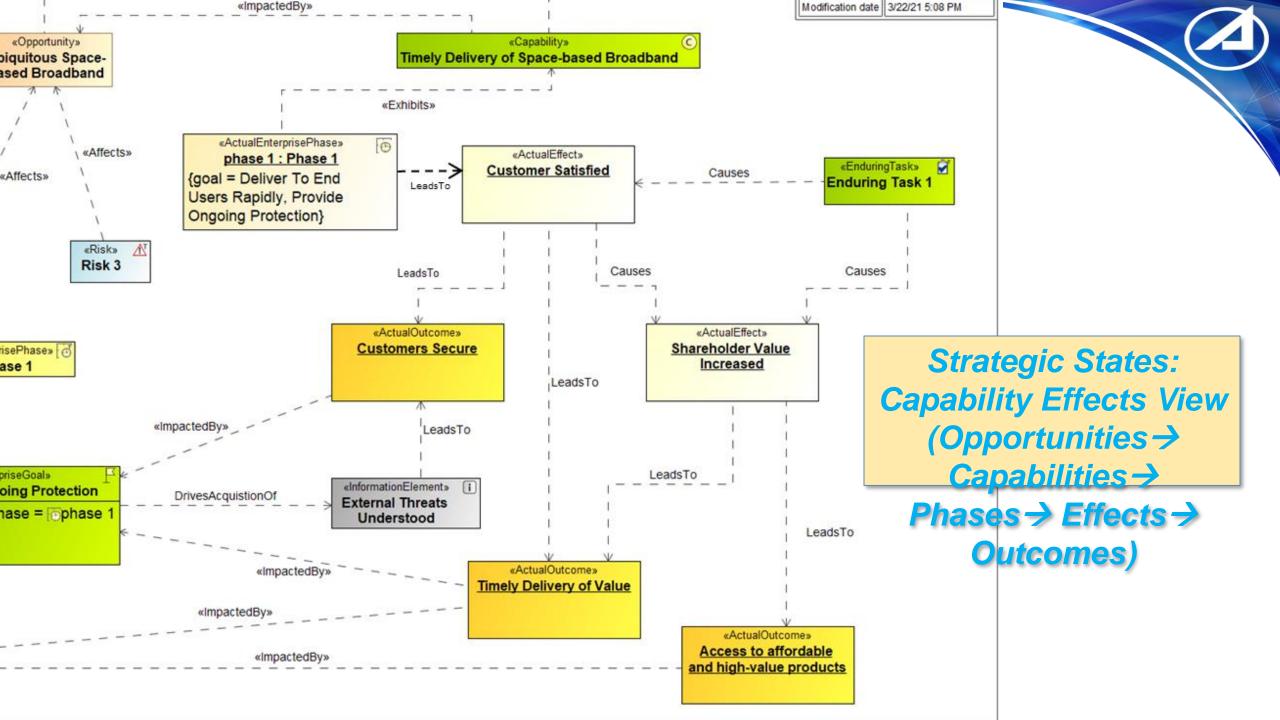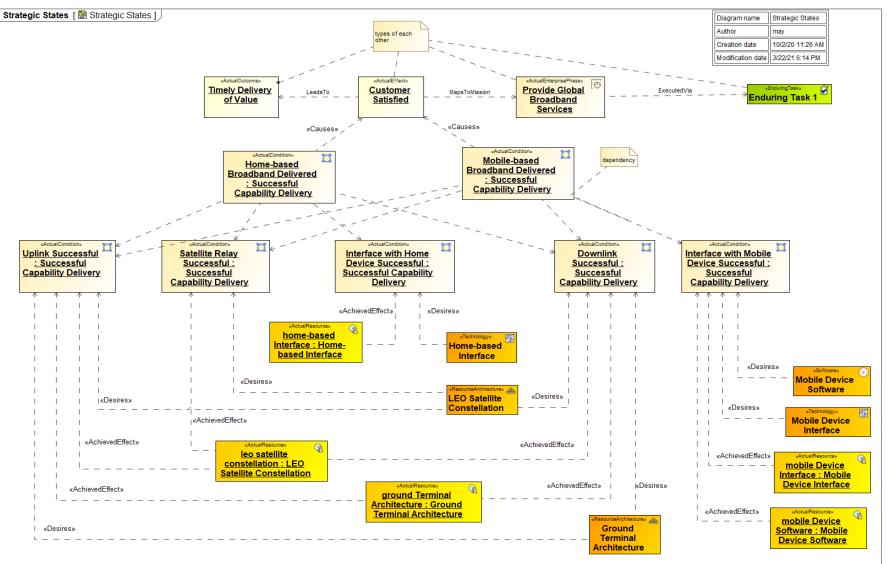
Sample View

Strategic States: *Capability Effects View (Opportunities→ Capabilities→ Phases→ Effects→ Outcomes)*

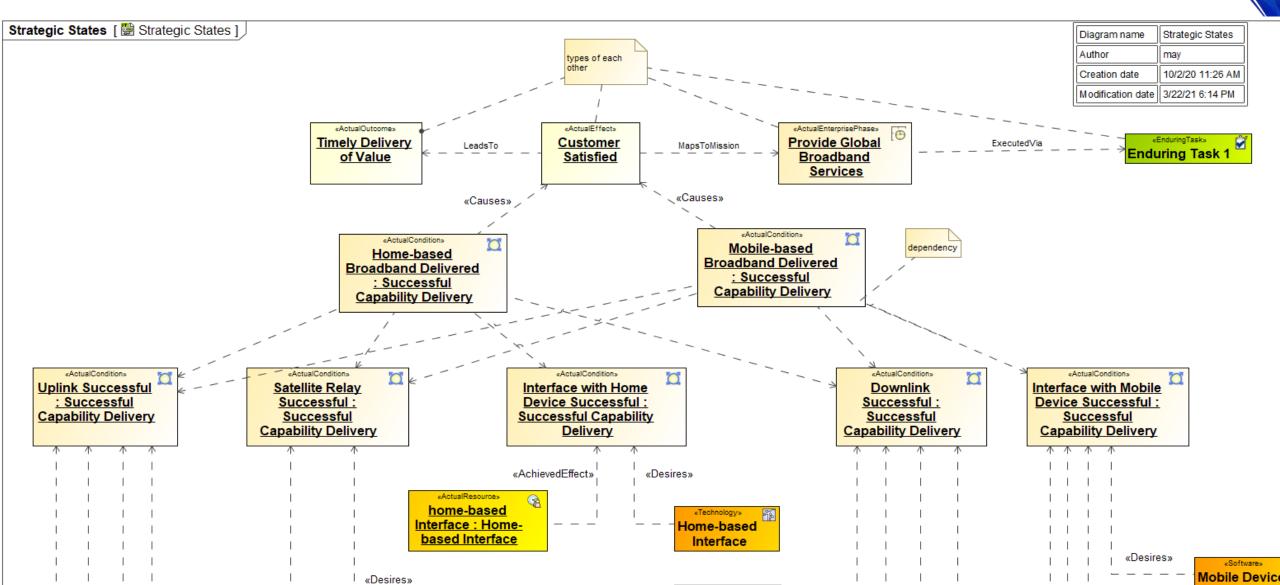Strategic States: Capability Effects View (Opportunities→ Capabilities→ Phases→ Effects→ Outcomes)
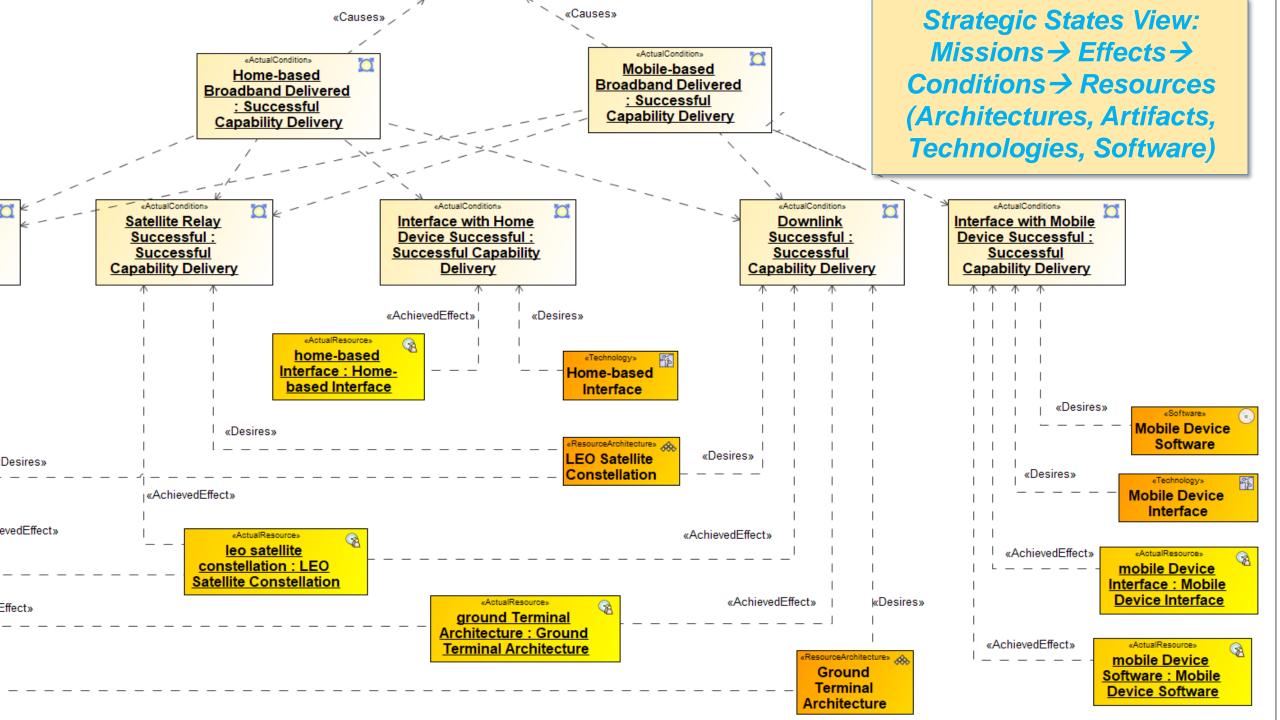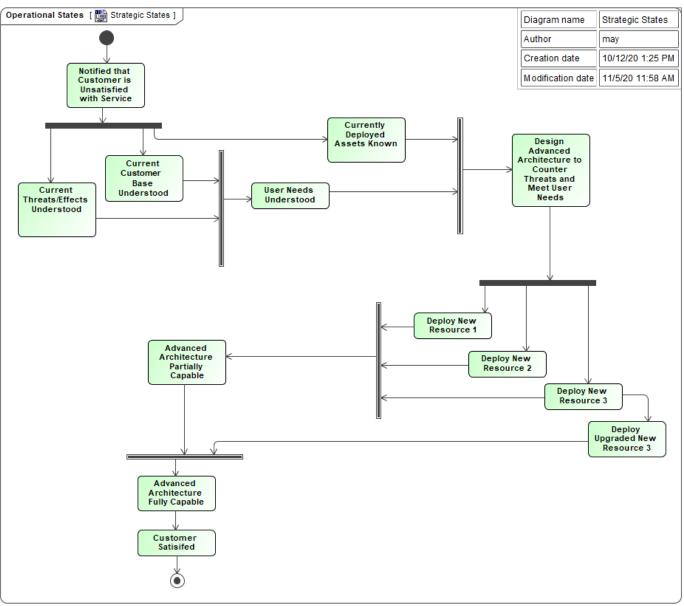
Sample View of Value Chain

Strategic States View: *Missions→ Effects→ Conditions→ Resources (Architectures, Artifacts, Technologies, Software)*

Sample View of Value Chain

Strategic States View: *Missions➔ Effects➔ Conditions➔ Resources (Architectures, Artifacts, Technologies, Software)*

Strategic States View: Missions→ Effects→ Conditions→ Resources (Architectures, Artifacts, Technologies, Software)

«Causes» «Causes»

«ActualCondition»
Home-based Broadband Delivered : Successful Capability Delivery

«ActualCondition»
Mobile-based Broadband Delivered : Successful Capability Delivery

«ActualCondition»
Satellite Relay Successful : Successful Capability Delivery

«ActualCondition»
Interface with Home Device Successful : Successful Capability Delivery

«ActualCondition»
Downlink Successful : Successful Capability Delivery

«ActualCondition»
Interface with Mobile Device Successful : Successful Capability Delivery

«AchievedEffect» «Desires»

«ActualResource»
home-based Interface : Home-based Interface

«Technology»
Home-based Interface

«Desires»

«Desires»

«ResourceArchitecture»
LEO Satellite Constellation

«Desires»

«Software»
Mobile Device Software

«AchievedEffect»

«Desires»

«ActualResource»
leo satellite constellation : LEO Satellite Constellation

«AchievedEffect»

«Technology»
Mobile Device Interface

«AchievedEffect»

«ActualResource»
mobile Device Interface : Mobile Device Interface

«ActualResource»
ground Terminal Architecture : Ground Terminal Architecture

«AchievedEffect» «Desires»

«ResourceArchitecture»
Ground Terminal Architecture

«AchievedEffect»

«ActualResource»
mobile Device Software : Mobile Device Software

Sample View of Value Chain
Strategic States Mock-Up (Desired Look & Feel)

Sample View
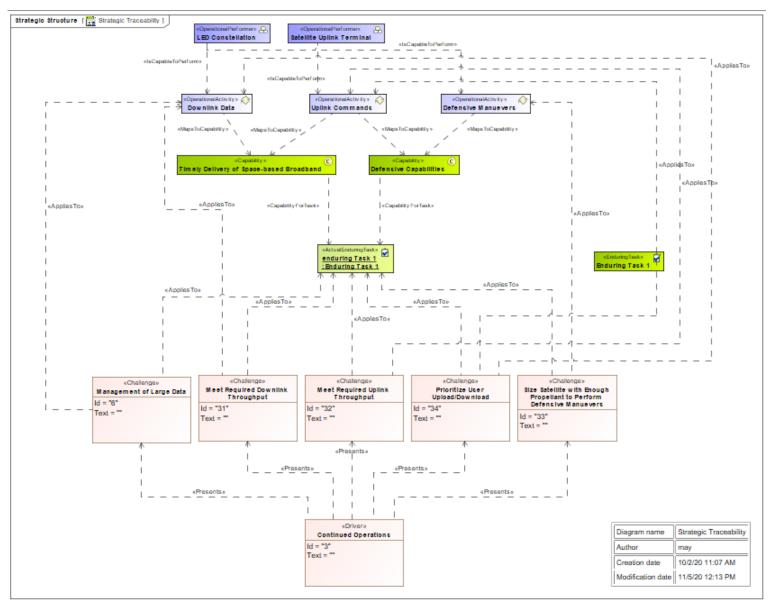
Strategic Traceability View

Mapping Challenges to Operational Activities
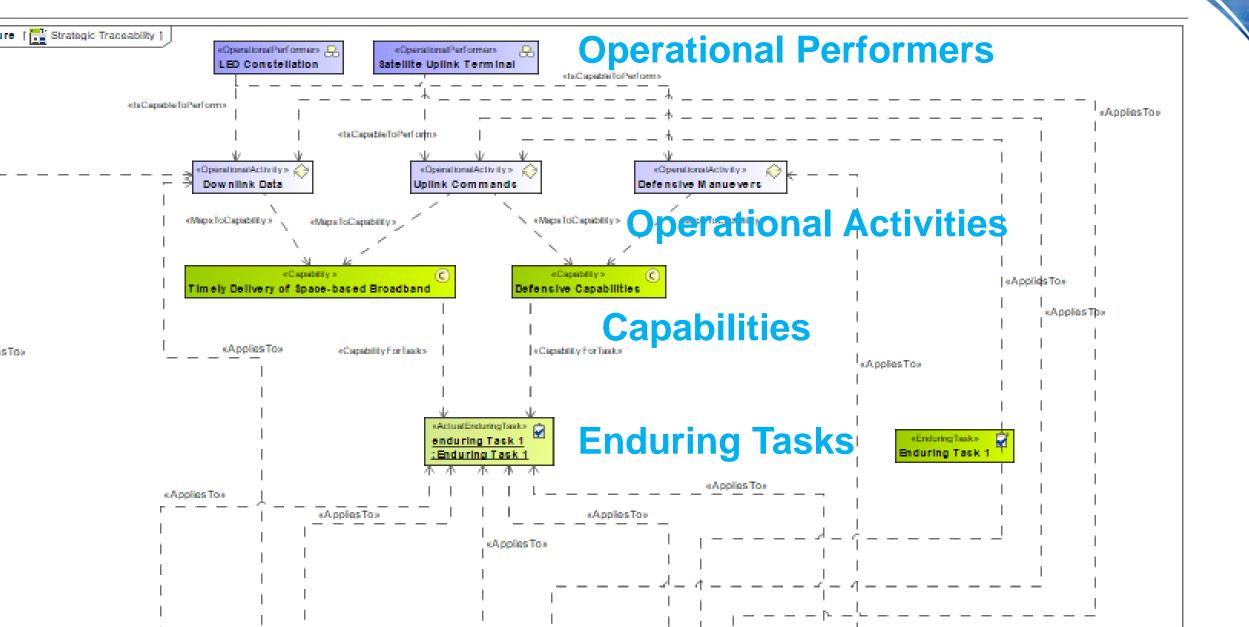
Mapping Drivers & Challenges to the Rest of the Architecture

Sample View

Strategic Traceability View

Sample View

Strategic Traceability View

Capabilities

«Capability»
Timely Delivery of Space-based Broadband

«Capability»
Defensive Capabilities

Enduring Tasks

«ActualEnduringTask»
enduring Task 1
: Enduring Task 1

«EnduringTasks»
Enduring Task 1

«AppliesTo»
«AppliesTo»
«AppliesTo»
«AppliesTo»
«AppliesTo»
«AppliesTo»
«AppliesTo»
«AppliesTo»
«Capability ForTasks»
«Capability ForTasks»

Challenges

«Challenge» Management of Large Data	«Challenge» Meet Required Downlink Throughput	«Challenge» Meet Required Uplink Throughput	«Challenge» Prioritize User Upload/Download	«Challenge» Size Satellite with Enough Propellant to Perform Defensive Manuevers
Id = "6" Text = ""	Id = "31" Text = ""	Id = "32" Text = ""	Id = "34" Text = ""	Id = "33" Text = ""

«Presents»
«Presents»
«Presents»
«Presents»
«Presents»

Drivers

«Driver»
Continued Operations
Id = "3"
Text = ""

Diagram name	Strategic Traceab
Author	may
Creation date	10/2/20 11:07 AM

Challenges & Opportunities Identified for Achieving Enterprise Transformation

Conceptual Schema for Architecture-Based Strategic Technical Planning

New UAF Model Elements in Support of Enterprise Portfolio Management

Appendix B
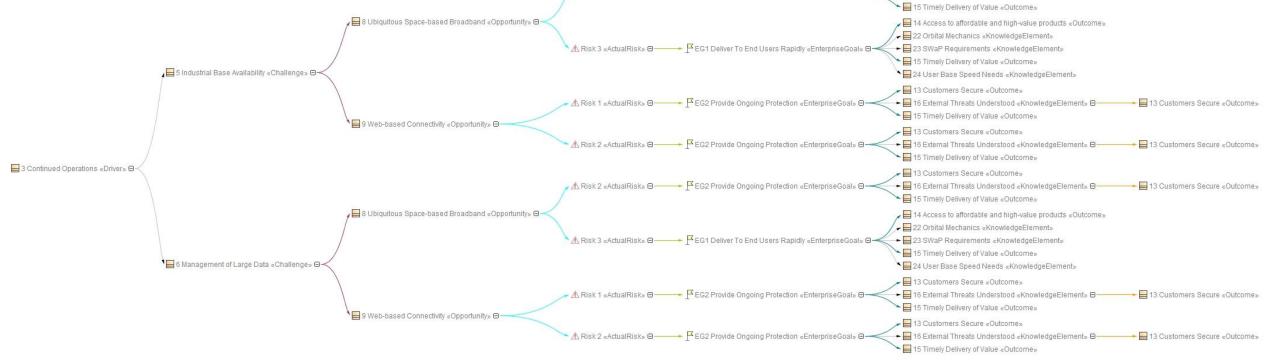
Enterprise Architecture Based Portfolio Management:
Architectural Queries of the EA Portfolio Model

James N Martin
Distinguished Engineer
Aerospace Corporation

Systems Engineering Forum
15 February 2022

Continued Operations (Driver) Impact Map

Driver→ Challenge→ Risk→ Goal→ Outcome
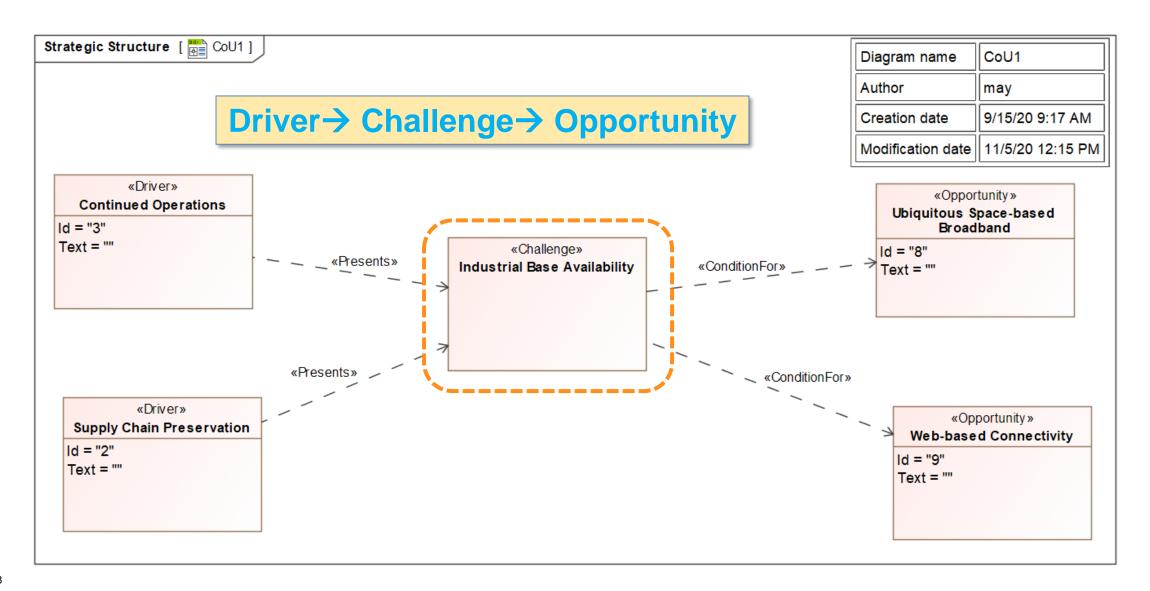
Sample Query of EA Model
Continued Operations (Driver) Impact Map

Driver→ Challenge→ Risk→ Goal→ Outcome

Legend
- Affects
- CircumstancesFor
- ConditionFor
- DrivesAcquisitionOf
- LeadsTo
- MapsToOutcome
- Presents

3 Continued Ope ... iver»

5 Industrial Ba ... enge»
- 8 Ubiquitous Sp ... nity»
  - Risk 2 «ActualRisk» → EG2 Provide Ong ... Goal»
    - 13 Customers Se ... come»
    - 16 External Thr ... ment» → 13 Customers Se ... come»
    - 15 Timely Deliv ... come»
  - Risk 3 «ActualRisk» → EG1 Deliver To ... Goal»
    - 14 Access to af ... come»
    - 22 Orbital Mech ... ment»
    - 23 SWaP Require ... ment»
    - 15 Timely Deliv ... come»
    - 24 User Base Sp ... ment»
- 9 Web-based Con ... nity»
  - Risk 1 «ActualRisk» → EG2 Provide Ong ... Goal»
    - 13 Customers Se ... come»
    - 16 External Thr ... ment» → 13 Customers Se ... come»
    - 15 Timely Deliv ... come»
  - Risk 2 «ActualRisk» → EG2 Provide Ong ... Goal»
    - 13 Customers Se ... come»
    - 16 External Thr ... ment» → 13 Customers Se ... come»
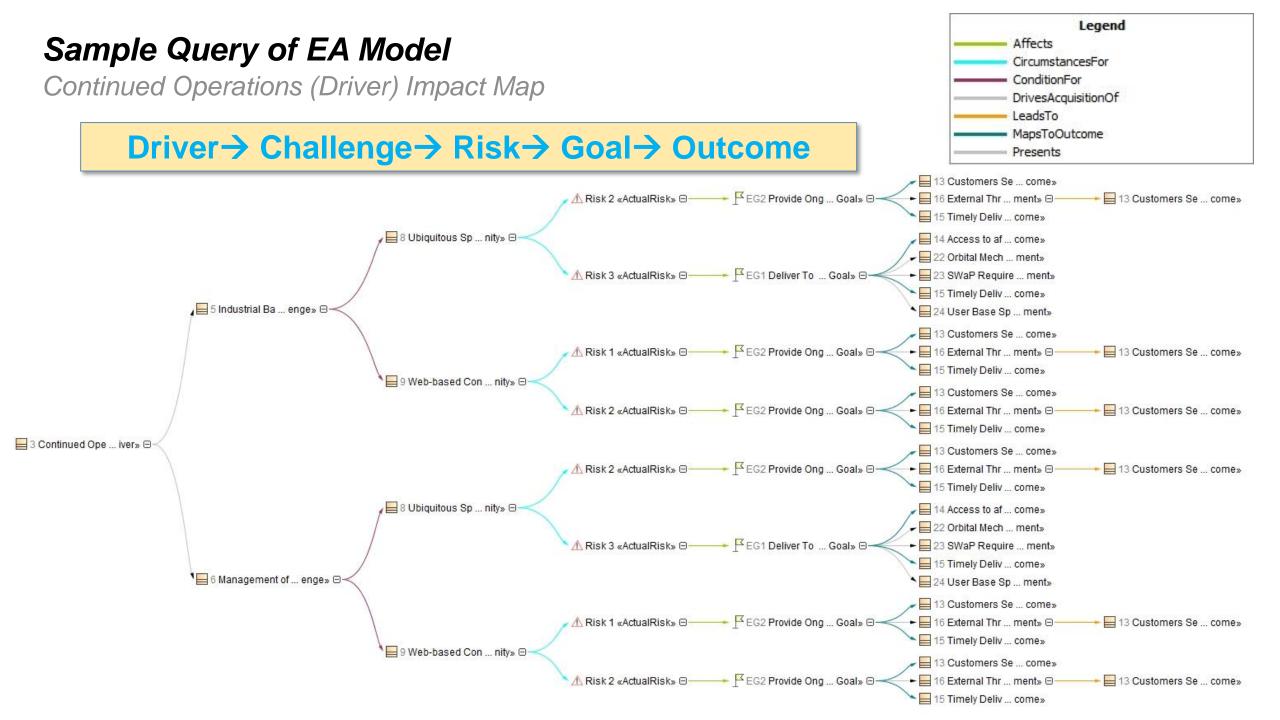   - 15 Timely Deliv ... come»

6 Management of ... enge»
- 8 Ubiquitous Sp ... nity»
  - Risk 2 «ActualRisk» → EG2 Provide Ong ... Goal»
    - 13 Customers Se ... come»
    - 16 External Thr ... ment» → 13 Customers Se ... come»
    - 15 Timely Deliv ... come»
  - Risk 3 «ActualRisk» → EG1 Deliver To ... Goal»
    - 14 Access to af ... come»
    - 22 Orbital Mech ... ment»
    - 23 SWaP Require ... ment»
    - 15 Timely Deliv ... come»
    - 24 User Base Sp ... ment»
- 9 Web-based Con ... nity»
  - Risk 1 «ActualRisk» → EG2 Provide Ong ... Goal»
    - 13 Customers Se ... come»
    - 16 External Thr ... ment» → 13 Customers Se ... come»
    - 15 Timely Deliv ... come»
  - Risk 2 «ActualRisk» → EG2 Provide Ong ... Goal»
    - 13 Customers Se ... come»
    - 16 External Thr ... ment» → 13 Customers Se ... come»
    - 15 Timely Deliv ... come»

Sample Query of EA Model

Industrial Base Availability (Challenge) Impact Analysis Diagram

Sample Query of EA Model

Web-based Connectivity (Opportunity) Impact Analysis Diagram

Driver→ Challenge→ Opportunity→ Capability→ Effect→ Outcome

Web-based Connectivity (Opportunity) Impact Analysis Diagram

Strategic Structure [CoU2]

- «Opportunity» **Ubiquitous Space-based Broadband** — Id = "8", Text = ""
- «Driver» **Continued Operations** — Id = "3", Text = ""
- «Challenge» **Management of Large Data** — Id = "6", Text = ""
- «ActualRisk» **Risk 2**
- «EnterpriseGoal» **Provide Ongoing Protection** — enterprisePhase = phase 1, Id = "21", Text = ""
- «Challenge» **Industrial Base Availability** — Id = "5", Text = ""
- «Opportunity» **Web-based Connectivity** — Id = "9", Text = ""
- «ActualRisk» **Risk 1**
- «Driver» **Supply Chain Preservation** — Id = "2", Text = ""
- Sha... — Id = "11", Text = ""
- «EnduringTask» **Grow Enterprise**
- «EnterpriseVision» **Vision 1**
- «Challenge» **Access to new markets** — Id = "4", Text = ""
- «WholeLifeEnterprise» **Whole Life Enterprise 1**
- «Capability» **Timely Delivery of Space-based**
- «Driver» **External Competition** — Id = "1", Text = ""
- «Opportunity» **Social Media Proliferation** — Id = "7", Text = ""
- «Effect» **Customer Satisfie...** — Id = "10", Text = ""
- «EnterprisePhase» **Phase 1**
- «EnterpriseGoal» **Deliver To End Users Rapidly** — enterprisePhase = phase...

Relationship labels: «OpportunityFor», «CircumstancesFor», «ConditionFor», «Presents», «DriverFor», «Affects», «EnablerFor», «MapsToOutcome», «LeadsTo»

Driver→ Challenge→ Opportunity→ Capability→ Effect→ Outcome

Driver→ Challenge→ Opportunity→ Capability→ Effect→ Outcome

Opportunity→ Risk→ Goal

Sample Query of EA Model
Risk 2 (Actual Risk) Impact Analysis Diagram

Driver→ Challenge→ Opportunity→ Risk→ Goal

Sample Query
Risk 2 (Actual Risk)
Impact Analysis
Diagram

Driver→
Challenge→
Opportunity→
Risk→ Goal

«EnablerFor»

«OpportunityFor»

«ActualEnterprisePhase»
phase 1 : Phase 1

«OpportunityFor»

«Opportunity»
Web-based Connectivity

Id = "9"
Text = ""

«PursuedBy»

«PursuedBy»

«Opportunity»
Ubiquitous Space-based Broadband

Id = "8"
Text = ""

«CircumstancesFor»

«ActualRisk»
Risk 2 ⚠

«CircumstancesFor»

«ConditionFor»

«ConditionFor»

«ConditionFor»

«ConditionFor»

«ConditionFor»

«Presents»

«ConditionFor»

«Presents»

«Challenge»
Access to new markets

Id = "4"
Text = ""

«Challenge»
Industrial Base Availability

Id = "5"
Text = ""

«Challenge»
Management of Large Data

Id = "6"
Text = ""

«EnduringTask»
Grow Enterprise

«Affects»

«Outcome»
Customers Secure

Id = "13"
Text = ""

«Outcome»
Timely Delivery of Value

Id = "15"
Text = ""

«KnowledgeElement»
Id = 16 **External Threats Understood**

Sample Query of EA Model
Challenges to Project Thread - Diagram View

Strategic Structure [Example Report Query- Diagram View]

Challenges→ Opportunities→ Capabilities→ Projects

Challenges

«Challenge»
Access to new markets

«Challenge»
Industrial Base Availability

«Challenge»
Management of Large Data

«Challenge»
Upload Speed Threshold

«Challenge»
Data Encryption

«Challenge»
Meet Required Downlink Throughput

«Challenge»
Meet Required Uplink

«Evokes»

«Opportunity»
Social Media Proliferation

«Opportunity»
Web-based Connectivity

«Opportunity»
Ubiquitous Space-based Broadband

«Opportunity»
Fiber Data Transmission update

«Opportunity»
High Capacity Terminal Develoment

«Opportunity»
Block Chain Implementation

«Opportunity»
Public/Private

«AppliesTo»

«Capability»
Timely Delivery of Space-based Broadband

«Capability»
Encrypted Data Transmision

«Capability»
Commercial Grade Encryption

«Capability»
Timely Delivery of Space-based Broadband

«Capability»
Mobile-based Broadband Delivery

«Capability»
Home-based Broadband Delivery

«Capability»
Mobile Customer Interface

«Capability»
Home Customer Interface

«Capability»
Timely Delivery of Ground-based

«Exhibits»

«Project»
Project 1

«Project»
Project 2

«Project»
Project 3

«Project»
Project 4

«Project»
Project 5

«Project»
Project 6

Sample Query of EA Model

Challenges to Project Thread - Relationship Map View

Challenges→ Opportunities→ Capabilities→ Projects

Sample Query of EA Model

Challenges to Project Thread - Relationship Map View

Challenges→ Opportunities→ Capabilities→ Projects

Legend
- AppliesTo
- Evokes
- Exhibits
- Owned Element

…→ **Capabilities**→ **Projects**

Sample Query of EA Model

Project to Challenges Thread – Table View (Meta-chains)

#	Name	Capability	Opportunity	Challenge Evokes Opportunity
1	Project 1			
2	Project 2	(C) Mobile Customer Interface (C) Space-based Data Relay	High Capacity Terminal Develoment Ubiquitous Space-based Broadband	Upload Speed Threshold Management of Large Data Meet Required Downlink Throughput
3	Project 3	(C) Commercial Grade Encryption	Public/Private Key Development Web-based Connectivity	Upload Speed Threshold Data Encryption Access to new markets Management of Large Data
4	Project 4	(C) Timely Delivery of Space-based Broadb (C) Encrypted Data Transmision	Social Media Proliferation Web-based Connectivity Public/Private Key Development	Access to new markets Management of Large Data Upload Speed Threshold Data Encryption
5	Project 5	(C) Home-based Broadband Delivery (C) Timely Delivery of Ground-based Broad (C) Timely Delivery of Space-based Broadb	Public/Private Key Development Social Media Proliferation Fiber Data Transmission update Web-based Connectivity	Upload Speed Threshold Data Encryption Access to new markets Management of Large Data Meet Required Downlink Throughput
6	Project 6	(C) Home-based Broadband Delivery (C) Encrypted Data Transmision (C) Commercial Grade Encryption	Public/Private Key Development Social Media Proliferation Web-based Connectivity	Upload Speed Threshold Data Encryption Access to new markets Management of Large Data
7	Project 7	(C) Home Customer Interface (C) Timely Delivery of Space-based Broadb (C) Encrypted Data Transmision	Public/Private Key Development Web-based Connectivity Social Media Proliferation	Upload Speed Threshold Data Encryption Access to new markets Management of Large Data

Sample Query of EA Model
Project to Challenges Thread – Table View (Meta-chains) – (Expanded View)

#	Name	Exhibits	Capability	Applies to / Association	Opportunity	Evokes / Abstraction	Challenge Evokes Opportunity
1	Project 1						
2	Project 2	Exhibits[Project 2 -> Mobile Customer Interface] Exhibits[Project 2 -> Space-based Data Relay]	Mobile Customer Interface Space-based Data Relay	Exhibits[Project 2 -> Mobile Customer Interface] AppliesTo[High Capacity Terminal Develoment -> Mobile Customer Interface] Exhibits[LEO Satellite Constellation -> Space-based Data Relay] AppliesTo[Ubiquitous Space-based Broadband -> Space-based Data Relay] Exhibits[Project 2 -> Space-based Data Relay]	High Capacity Terminal Develoment Ubiquitous Space-based Broadband	Evokes[Upload Speed Threshold -> High Capacity Terminal Develoment] Evokes[Management of Large Data -> High Capacity Terminal Develoment] Evokes[Meet Required Downlink Throughput -> High Capacity Terminal Develoment] Abstraction[Grow Enterprise -> Ubiquitous Space-based Broadband] Evokes[Management of Large Data -> Ubiquitous Space-based Broadband] Evokes[Meet Required Downlink Throughput -> Ubiquitous Space-based Broadband]	Upload Speed Threshold Management of Large Data Meet Required Downlink Throughput
3	Project 3	Exhibits[Project 3 -> Commercial Grade Encryption]	Commercial Grade Encryption	AppliesTo[Public/Private Key Development -> Commercial Grade Encryption] Exhibits[Project 3 -> Commercial Grade Encryption] Exhibits[Project 6 -> Commercial Grade Encryption] AppliesTo[Web-based Connectivity -> Commercial Grade Encryption]	Public/Private Key Development Web-based Connectivity	Evokes[Upload Speed Threshold -> Public/Private Key Development] Evokes[Data Encryption -> Public/Private Key Development] Abstraction[Grow Enterprise -> Web-based Connectivity] Evokes[Access to new markets -> Web-based Connectivity] Evokes[Management of Large Data -> Web-based Connectivity]	Upload Speed Threshold Data Encryption Access to new markets Management of Large Data
4	Project 4	Exhibits[Project 4 -> Timely Delivery of Space-based Broadband] Exhibits[Project 4 -> Encrypted Data Transmision]	Timely Delivery of Space-based Broadb... Encrypted Data Transmision	Exhibits[phase 1 -> Timely Delivery of Space-based Broadband] Exhibits[Home-based Broadband Delivery -> Timely Delivery of Space-based Broadband] Maps To Capability[Uplink Commands -> Timely Delivery of Space-based Broadband] Maps To Capability[Downlink Data -> Timely Delivery of Space-based Broadband] Abstraction[phase 2 -> Timely Delivery of Space-based Broadband] Abstraction[Orbital Mechanics -> Timely Delivery of Space-based Broadband] Abstraction[User Base Speed Needs -> Timely Delivery of Space-based Broadband] Abstraction[SWaP Requirements -> Timely Delivery of Space-based Broadband] Exhibits[Mobile-based Broadband Delivery -> Timely Delivery of Space-based Broadband] Exhibits[Capability Provider -> Timely Delivery of Space-based Broadband] Exhibits[phase 2 -> Timely Delivery of Space-based Broadband] Abstraction[Phase 1 -> Timely Delivery of Space-based Broadband] Abstraction[Phase 2 -> Timely Delivery of Space-based Broadband] AppliesTo[Social Media Proliferation -> Timely Delivery of Space-based Broadband] AppliesTo[Web-based Connectivity -> Timely Delivery of Space-based Broadband] Exhibits[Project 4 -> Timely Delivery of Space-based Broadband] Exhibits[Project 7 -> Timely Delivery of Space-based Broadband] Exhibits[Project 5 -> Timely Delivery of Space-based Broadband] AppliesTo[Public/Private Key Development -> Encrypted Data Transmision] Exhibits[Project 6 -> Encrypted Data Transmision] Exhibits[Project 4 -> Encrypted Data Transmision] Exhibits[Project 7 -> Encrypted Data Transmision]	Social Media Proliferation Web-based Connectivity Public/Private Key Development	Abstraction[Grow Enterprise -> Social Media Proliferation] Evokes[Access to new markets -> Social Media Proliferation] Abstraction[Grow Enterprise -> Web-based Connectivity] Evokes[Access to new markets -> Web-based Connectivity] Evokes[Management of Large Data -> Web-based Connectivity] Evokes[Upload Speed Threshold -> Public/Private Key Development] Evokes[Data Encryption -> Public/Private Key Development]	Access to new markets Management of Large Data Upload Speed Threshold Data Encryption
5	Project 5	Exhibits[Project 5 -> Home-based Broadband Delivery] Exhibits[Project 5 -> Timely Delivery of Ground-based Broadband] Exhibits[Project 5 -> Timely Delivery of Space-based Broadband]	Home-based Broadband Delivery Timely Delivery of Ground-based Broad... Timely Delivery of Space-based Broadb...	Exhibits[Project 6 -> Home-based Broadband Delivery] Exhibits[Project 5 -> Home-based Broadband Delivery] AppliesTo[Public/Private Key Development -> Home-based Broadband Delivery] AppliesTo[Social Media Proliferation -> Home-based Broadband Delivery] Exhibits[Ground Terminal Architecture -> Timely Delivery of Ground-based Broadband] AppliesTo[Fiber Data Transmission update -> Timely Delivery of Ground-based Broadband] Exhibits[Project 5 -> Timely Delivery of Ground-based Broadband] Exhibits[phase 1 -> Timely Delivery of Space-based Broadband] Exhibits[Home-based Broadband Delivery -> Timely Delivery of Space-based Broadband] Maps To Capability[Uplink Commands -> Timely Delivery of Space-based Broadband] Maps To Capability[Downlink Data -> Timely Delivery of Space-based Broadband] Abstraction[phase 2 -> Timely Delivery of Space-based Broadband] Abstraction[Orbital Mechanics -> Timely Delivery of Space-based Broadband] Abstraction[User Base Speed Needs -> Timely Delivery of Space-based Broadband] Abstraction[SWaP Requirements -> Timely Delivery of Space-based Broadband] Exhibits[Mobile-based Broadband Delivery -> Timely Delivery of Space-based Broadband] Exhibits[Capability Provider -> Timely Delivery of Space-based Broadband] Exhibits[phase 2 -> Timely Delivery of Space-based Broadband] Abstraction[Phase 1 -> Timely Delivery of Space-based Broadband] Abstraction[Phase 2 -> Timely Delivery of Space-based Broadband] AppliesTo[Social Media Proliferation -> Timely Delivery of Space-based Broadband] AppliesTo[Web-based Connectivity -> Timely Delivery of Space-based Broadband] Exhibits[Project 4 -> Timely Delivery of Space-based Broadband] Exhibits[Project 7 -> Timely Delivery of Space-based Broadband] Exhibits[Project 5 -> Timely Delivery of Space-based Broadband]	Public/Private Key Development Social Media Proliferation Fiber Data Transmission update Web-based Connectivity	Evokes[Upload Speed Threshold -> Public/Private Key Development] Evokes[Data Encryption -> Public/Private Key Development] Abstraction[Grow Enterprise -> Social Media Proliferation] Evokes[Access to new markets -> Social Media Proliferation] Evokes[Access to new markets -> Fiber Data Transmission update] Evokes[Management of Large Data -> Fiber Data Transmission update] Evokes[Upload Speed Threshold -> Fiber Data Transmission update] Evokes[Meet Required Downlink Throughput -> Fiber Data Transmission update] Abstraction[Grow Enterprise -> Web-based Connectivity] Evokes[Access to new markets -> Web-based Connectivity] Evokes[Management of Large Data -> Web-based Connectivity]	Upload Speed Threshold Data Encryption Access to new markets Management of Large Data Meet Required Downlink Throughput

Sample Query of EA Model
Challenges to Project Thread – Table View (Meta-chains)

#	Name	Opportunity	Capability	Project
1	Upload Speed Threshold	Fiber Data Transmission update / High Capacity Terminal Develoment / Public/Private Key Development	Timely Delivery of Ground-based Broadba / Mobile Customer Interface / Encrypted Data Transmision / Commercial Grade Encryption / Home Customer Interface / Home-based Broadband Delivery	Ground Terminal Architecture / Project 5 / Project 2 / Project 6 / Project 4 / Project 7 / Project 3 / Home-based Interface
2	Size Satellite with Enough Propellant to Perfor			
3	Prioritize User Upload/Download			
4	Meet Required Uplink Throughput			
5	Meet Required Downlink Throughput	High Capacity Terminal Develoment / Fiber Data Transmission update / Ubiquitous Space-based Broadband	Mobile Customer Interface / Timely Delivery of Ground-based Broadba / Mobile-based Broadband Delivery / Space-based Data Relay	Project 2 / Ground Terminal Architecture / Project 5 / LEO Satellite Constellation
6	Management of Large Data	Fiber Data Transmission update / High Capacity Terminal Develoment / Web-based Connectivity / Ubiquitous Space-based Broadband	Timely Delivery of Ground-based Broadba / Mobile Customer Interface / Timely Delivery of Space-based Broadban / Home Customer Interface / Commercial Grade Encryption / Mobile-based Broadband Delivery / Space-based Data Relay	Ground Terminal Architecture / Project 5 / Project 2 / phase 1 : Phase 1 / Home-based Broadband Delivery / Mobile-based Broadband Delivery / Capability Provider / phase 2 : Phase 2 / Project 4 / Project 7 / Home-based Interface / Project 3 / Project 6 / LEO Satellite Constellation
7	Industrial Base Availability			
8	Data Encryption	Public/Private Key Development / Block Chain Implementation	Encrypted Data Transmision / Commercial Grade Encryption / Home Customer Interface / Home-based Broadband Delivery / Secure Digital Networks	Project 6 / Project 4 / Project 7 / Project 3 / Home-based Interface / Project 5

Sample Query of EA Model
Challenges to Project Thread – Table View (Meta-chains) - Expanded

#	Name	Evokes / Abstraction	Opportunity	Applies To / Abstraction	Capability	Exhibits / Applies To / Abstraction	Challenge to Project
1	Access to new markets	Abstraction[Access to new markets -> enduring Task 1] Evokes[Access to new markets -> Social Media Proliferation] Evokes[Access to new markets -> Fiber Data Transmission up...] Evokes[Access to new markets -> Web-based Connectivity] Evokes[Access to new markets -> Block Chain Implementation]	Social Media Proliferation Fiber Data Transmission update Web-based Connectivity Block Chain Implementation	Abstraction[Social Media Proliferation -> Risk 1] Abstraction[Social Media Proliferation -> Deliver To End Users Rapidly] AppliesTo[Social Media Proliferation -> Timely Delivery of Space-based Broad... AppliesTo[Social Media Proliferation -> Home-based Broadband Delivery] AppliesTo[Fiber Data Transmission update -> Timely Delivery of Ground-base... Abstraction[Web-based Connectivity -> Risk 1] Abstraction[Web-based Connectivity -> Risk 2] Abstraction[Web-based Connectivity -> Deliver To End Users Rapidly] Abstraction[Web-based Connectivity -> phase 1] AppliesTo[Web-based Connectivity -> Timely Delivery of Space-based Broadb... AppliesTo[Web-based Connectivity -> Home Customer Interface] AppliesTo[Web-based Connectivity -> Commercial Grade Encryption] AppliesTo[Block Chain Implementation -> Secure Digital Networks]	Timely Delivery of Space-based Broadban... Home-based Broadband Delivery Timely Delivery of Ground-based Broadba... Home Customer Interface Commercial Grade Encryption Secure Digital Networks	Exhibits[phase 1 -> Timely Delivery of Space-based Broadband] Exhibits[Home-based Broadband Delivery -> Timely Delivery of Space-based Broadb... Maps To Capability[Uplink Commands -> Timely Delivery of Space-based Broadban... Maps To Capability[Downlink Data -> Timely Delivery of Space-based Broadband] Abstraction[phase 2 -> Timely Delivery of Space-based Broadband] Abstraction[Orbital Mechanics -> Timely Delivery of Space-based Broadband] Abstraction[User Base Speed Needs -> Timely Delivery of Space-based Broadband] Abstraction[SWaP Requirements -> Timely Delivery of Space-based Broadband] Exhibits[Mobile-based Broadband Delivery -> Timely Delivery of Space-based Broad... Exhibits[Capability Provider -> Timely Delivery of Space-based Broadband] Exhibits[phase 2 -> Timely Delivery of Space-based Broadband] Abstraction[Phase 1 -> Timely Delivery of Space-based Broadband] Abstraction[Phase 2 -> Timely Delivery of Space-based Broadband] AppliesTo[Social Media Proliferation -> Timely Delivery of Space-based Broadband... AppliesTo[Web-based Connectivity -> Timely Delivery of Space-based Broadband] Exhibits[Project 4 -> Timely Delivery of Space-based Broadband] Exhibits[Project 7 -> Timely Delivery of Space-based Broadband] Exhibits[Project 5 -> Timely Delivery of Space-based Broadband] Exhibits[Project 6 -> Home-based Broadband Delivery] Exhibits[Project 5 -> Home-based Broadband Delivery] AppliesTo[Public/Private Key Development -> Home-based Broadband Delivery] AppliesTo[Social Media Proliferation -> Home-based Broadband Delivery] Exhibits[Ground Terminal Architecture -> Timely Delivery of Ground-based Broadba... AppliesTo[Fiber Data Transmission update -> Timely Delivery of Ground-based Broa... Exhibits[Project 5 -> Timely Delivery of Ground-based Broadband] Exhibits[Home-based Interface -> Home Customer Interface] Exhibits[Project 7 -> Home Customer Interface] AppliesTo[Public/Private Key Development -> Home Customer Interface] AppliesTo[Web-based Connectivity -> Home Customer Interface] AppliesTo[Public/Private Key Development -> Commercial Grade Encryption] Exhibits[Project 3 -> Commercial Grade Encryption] Exhibits[Project 6 -> Commercial Grade Encryption] AppliesTo[Web-based Connectivity -> Commercial Grade Encryption] Exhibits[Mobile Device Software -> Secure Digital Networks] AppliesTo[Block Chain Implementation -> Secure Digital Networks]	phase 1 : Phase 1 Home-based Broadband Delivery Mobile-based Broadband Delivery Capability Provider phase 2 : Phase 2 Project 4 Project 7 Project 5 Project 6 Ground Terminal Architecture Home-based Interface Project 3 Mobile Device Software
2	Data Encryption	Evokes[Data Encryption -> Public/Private Key Development] Evokes[Data Encryption -> Block Chain Implementation]	Public/Private Key Development Block Chain Implementation	AppliesTo[Public/Private Key Development -> Encrypted Data Transmision] AppliesTo[Public/Private Key Development -> Commercial Grade Encryption] AppliesTo[Public/Private Key Development -> Home Customer Interface] AppliesTo[Public/Private Key Development -> Home-based Broadband Delivery] AppliesTo[Block Chain Implementation -> Secure Digital Networks]	Encrypted Data Transmision Commercial Grade Encryption Home Customer Interface Home-based Broadband Delivery Secure Digital Networks	AppliesTo[Public/Private Key Development -> Encrypted Data Transmision] Exhibits[Project 6 -> Encrypted Data Transmision] Exhibits[Project 4 -> Encrypted Data Transmision] Exhibits[Project 7 -> Encrypted Data Transmision] AppliesTo[Public/Private Key Development -> Commercial Grade Encryption] Exhibits[Project 3 -> Commercial Grade Encryption] Exhibits[Project 6 -> Commercial Grade Encryption] AppliesTo[Web-based Connectivity -> Commercial Grade Encryption] Exhibits[Home-based Interface -> Home Customer Interface] Exhibits[Project 7 -> Home Customer Interface] AppliesTo[Public/Private Key Development -> Home Customer Interface] AppliesTo[Web-based Connectivity -> Home Customer Interface] Exhibits[Project 6 -> Home-based Broadband Delivery] Exhibits[Project 5 -> Home-based Broadband Delivery] AppliesTo[Public/Private Key Development -> Home-based Broadband Delivery] AppliesTo[Social Media Proliferation -> Home-based Broadband Delivery] Exhibits[Mobile Device Software -> Secure Digital Networks] AppliesTo[Block Chain Implementation -> Secure Digital Networks]	Project 6 Project 4 Project 7 Project 3 Home-based Interface Project 5 Mobile Device Software