Unified Architecture Framework
An Introduction

ISACA / AEA / DRIE Professional Seminar
Ottawa, 28th of January 2019

Presented by:
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Unified Architecture Framework (UAF)
An Introduction - Abstract

The Unified Architecture Framework (UAF) is an extensive update of the NATO Architecture Framework (NAF), UK Ministry of Defence Architecture Framework (MODAF) and US Department of Defense Architecture Framework (DODAF) that provides the viewpoints necessary to enable complex architectures to be developed and implemented.

Some of the matters addressed include cyber-security, governance and enables continuous audit.

The presentation will provide an overview of the UAF, an open standard, that is expected to be used globally in defence as well as in many governments.

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Biography

Robert Weisman, MSc, PEng, PMP, CD

Robert Weisman MSc, PEng has been actively working in the field of Enterprise Architecture and Portfolio Management since the late 1980's in both public and private sector.

Robert is also heavily involved in governance and audit in consulting and is Vice President of the Information Systems Audit and Control Association (Ottawa Chapter). He has worked throughout the Government of Canada bringing business and technology stakeholders together.

Robert has worked in Enterprise Architecture since 1993 in Strategic Direction in the Defence Information Services Organization and after five years joined CGI as a management consultant where he started the global EA practice.

Robert is a civil / military engineer who also has completed Army staff college and undergraduate and graduate studies in Computer Science (artificial intelligence / decision support). Currently Bob is Engineer in Residence, part-time professor and Phd candidate at the University of Ottawa where he is studying in the multi-disciplinary domain of e-Business (e-Society, e-Management and e-Technology) specializing in the business of government. He created and has taught the graduate EA Course at UofO since 2016, as well as teaching TOGAF 9.2 in Build The Vision Inc.

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Agenda

1. Introduction and Context
2. EA Fundamentals
3. The Unified Architecture Framework
4. Concluding Material

Part 1
Introduction and Context

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What is the Unified Architecture Framework?

- The Unified Architecture Framework® (UAF®) is a generic and commercially orientated architecture framework based on work in defence domain by the Object Management Group (OMG)
- UAF defines ways of representing an enterprise architecture that enables stakeholders to focus on specific areas of interest in the enterprise while retaining sight of the big picture.
- UAF meets the specific business, operational and systems-of-systems integration needs of commercial and industrial enterprises as well as the U.S. Department of Defense (DoD), the UK Ministry of Defence (MOD), the North Atlantic Treaty Organization (NATO) and other defense organizations.
- Remember defence / defense has a huge supply chain of civilian providers

Model-Based Systems Engineering (MBSE)

- a systems engineering methodology that focuses on creating and exploiting domain models as the primary means of information exchange between engineers, rather than on document-based information exchange.
- More recently, the focus has also started to cover aspects related to the ***model execution in computer simulation experiment***, to further overcome the gap between the system model specification and the respective simulation software.
- As a consequence, the term **modeling and simulation-based systems engineering** (**M&SBSE**) has also been used along with MBSE

Model-Driven Architecture (MDA)

- a software design approach for the development of software systems.
- provides a set of guidelines for the structuring of specifications, which are expressed as models.
- launched by Object Management Group (OMG) in 2001.
- OMG focus for MDA is on forward engineering, i.e. producing code from abstract, human-elaborated modelling diagrams (e.g. class diagrams).
- Architecture-Driven Modernization's objective is to produce standards for model-based reverse engineering of legacy systems.

Part 2
EA Fundamentals

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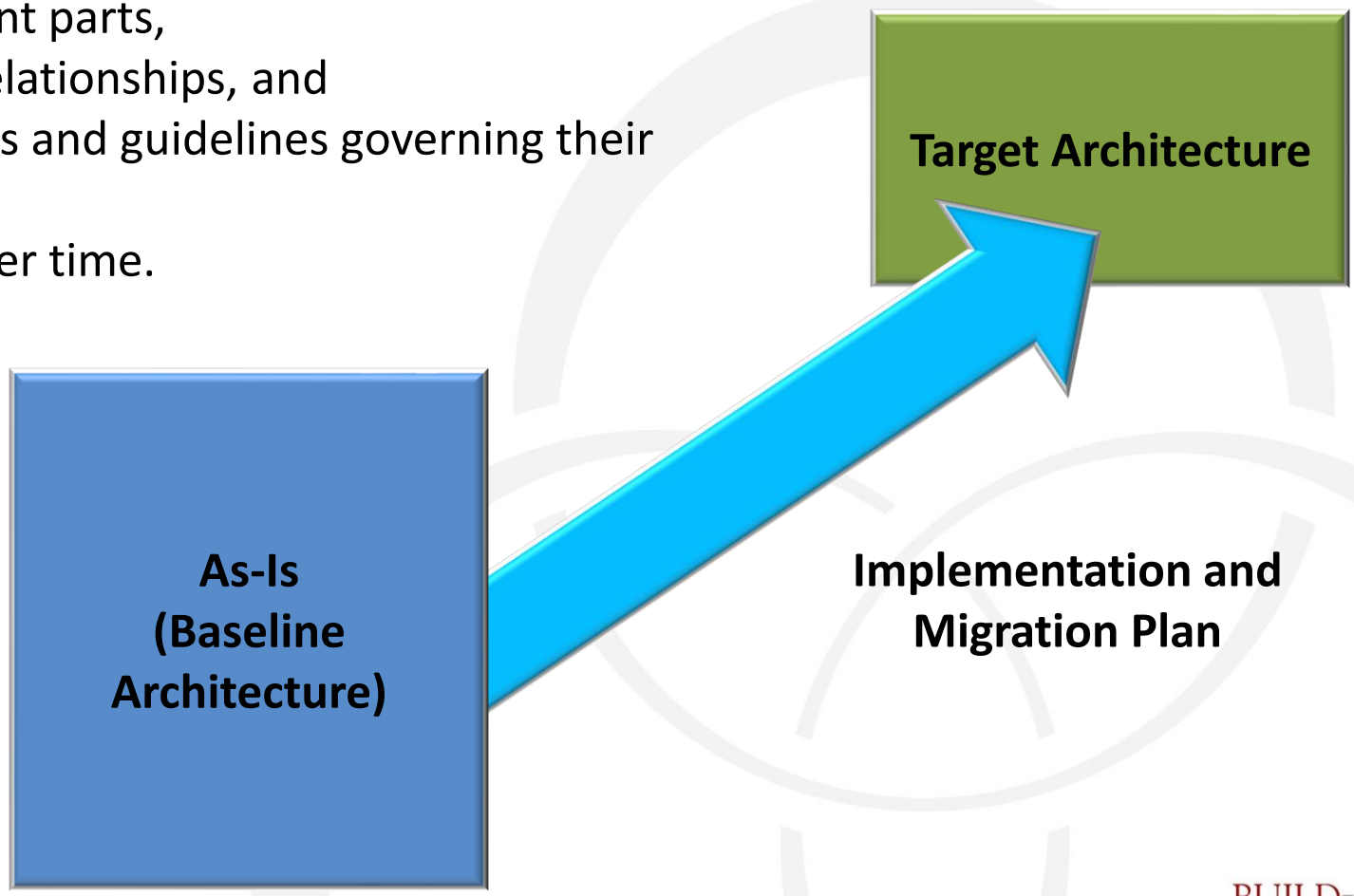
The Three Components of EA
(Also of Strategic Management EMBOK)

Architecture

A formal description of an enterprise,

a. its component parts,
b. their inter-relationships, and
c. the principles and guidelines governing their design and
d. evolution over time.



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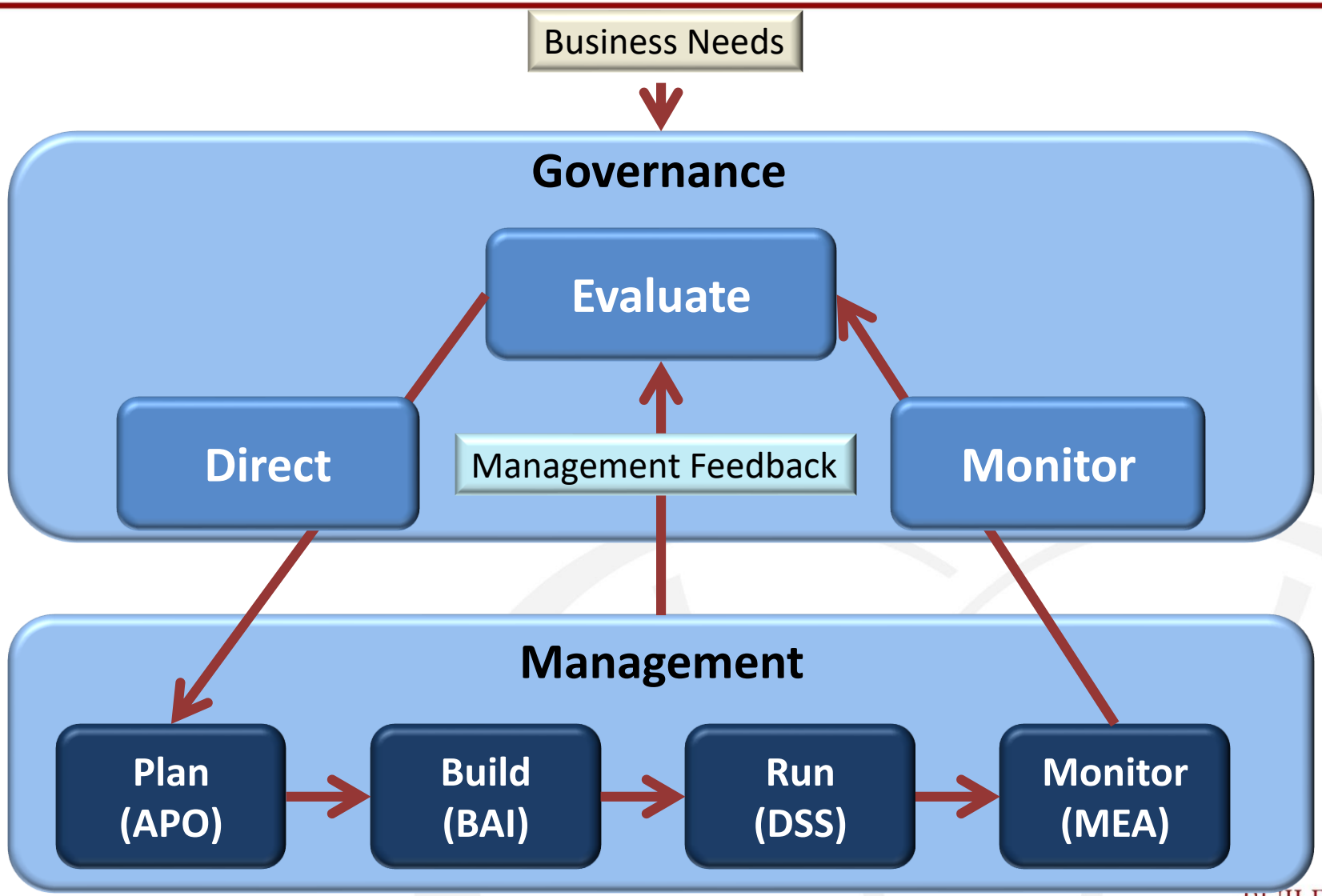
COBIT 5 – Governance and Management Key Areas



Why EA for Audit and Governence ?
COBIT 5 Process Reference Model

Processes for Governance of Enterprise IT
Evaluate, Direct and Monitor

- **EDM01** – Ensure Governance Framework Setting and Maintenance
- **EDM0**2– Ensure Benefits Delivery
- **EDM0**3– Ensure Risk Optimization
- **EDM0**4– Ensure Resource Optimization
- **EDM0**5– Ensure Stakeholder Transparency

Processes for Management of Enterprise IT

Align, Plan and Organize
- APO01 Manage IT Management Framework
- APO02 Manage Strategy
- APO03 Manage Enterprise Architecture
- APO04 Manage Innovation
- APO05 Manage Portfolio
- APO06 Manage Budget and Costs
- APO07 Manage Human Resources
- APO08 Manage Relationships
- APO09 Manage Service Agreements
- APO10 Manage Suppliers
- APO11 Manage Quality
- APO12 Manage Risk
- APO13 Manage Security

Build, Acquire and Implement
- BAI01 Manage Programmes and Projects
- BAI02 Manage Requirements Definition
- BAI03 Manage Solutions Identification and Build
- BAI04 Manage Availability and Capacity
- BAI05 Manage Organizational Change Enablement
- BAI06 Manage Changes
- BAI07 Manage Change Acceptance and Transitioning
- BAI08 Manage Knowledge
- BAI09 Manage Assets
- BAI10 Manage Configuration

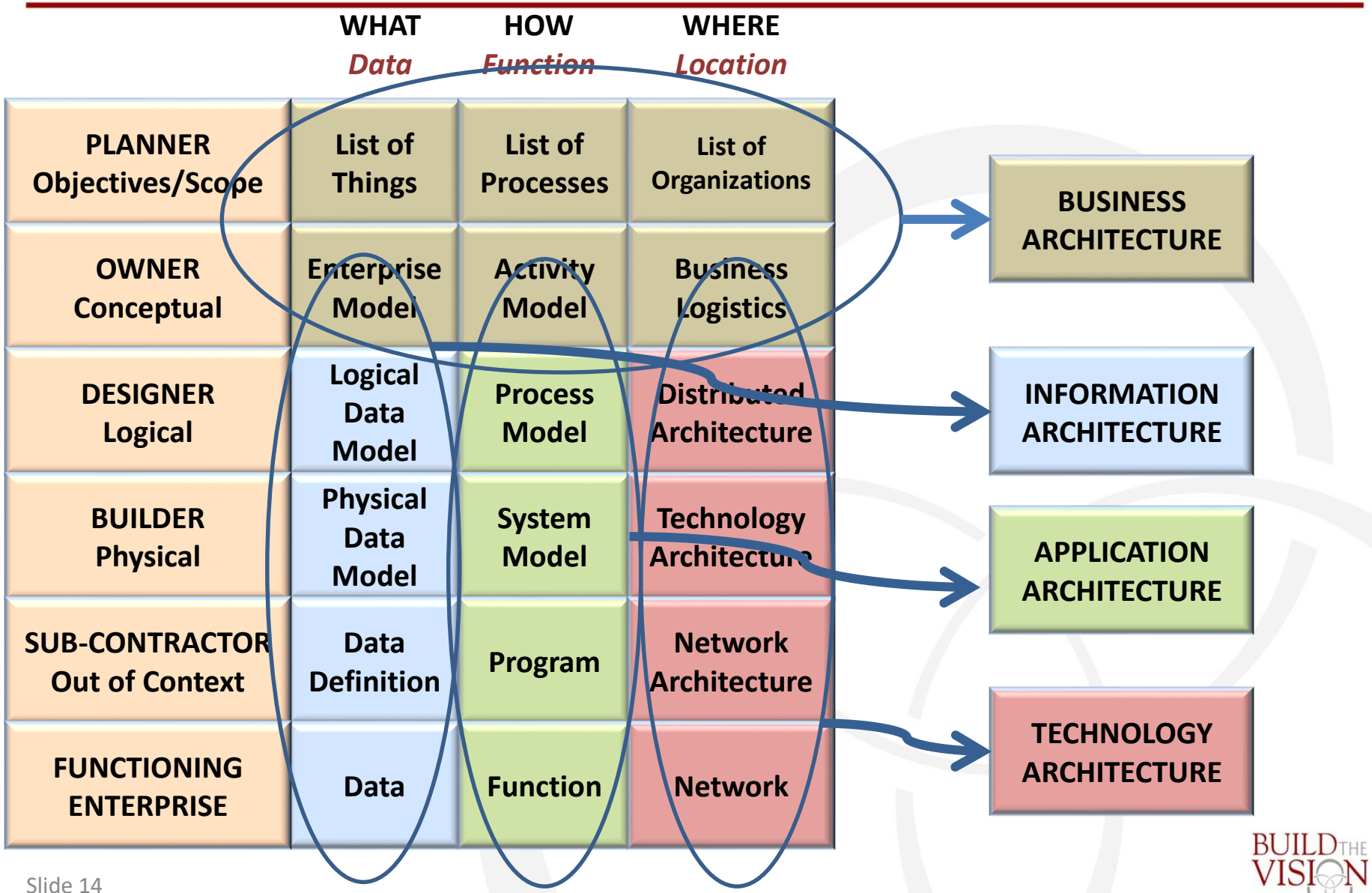
Deliver, Service and Support
- DSS01 Manage Operations
- DSS02 Manage Service Requests and Incidents
- DSS03 Manage Problems
- DSS04 Manage Continuity
- DSS05 Manage Security Services
- DSS06 Manage Business Process Controls

Monitor, Evaluate, and Assess
- MEA01 Monitor, Evaluate & Assess Performance and Conformance
- MEA02 Monitor, Evaluate & Assess the System of Internal Controls
- MEA03 Monitor, Evaluate & Assess Compliance with External Requirements

Different Dimensions to be Considered at Different Levels of Abstraction

	WHAT *Data*	HOW *Function*	WHERE *Location*
PLANNER Objectives/Scope	List of Things	List of Processes	List of Organizations
OWNER Conceptual	Enterprise Model	Activity Model	Business Logistics
DESIGNER Logical	Logical Data Model	Process Model	Distributed Architecture
BUILDER Physical	Physical Data Model	System Model	Technology Architecture
SUB-CONTRACTOR Out of Context	Data Definition	Program	Network Architecture
FUNCTIONING ENTERPRISE	Data	Function	Network

Where the Traditional Architecture Domains Come From



The Zachman EA Framework and Levels of Abstraction

	What Data	How Process	Where Network	Who People	When Time	Why Motivation
Scope/Objectives (Strategic View)	Contextual					
Model of Business (Owner's View)	Conceptual					
Description of IS (Designer's View)	Logical					
Technology Model (Builder's View)	Physical					
Detailed Description (Out-of-Context)	Physical (Out of Context)					
Actual System	Operating System					

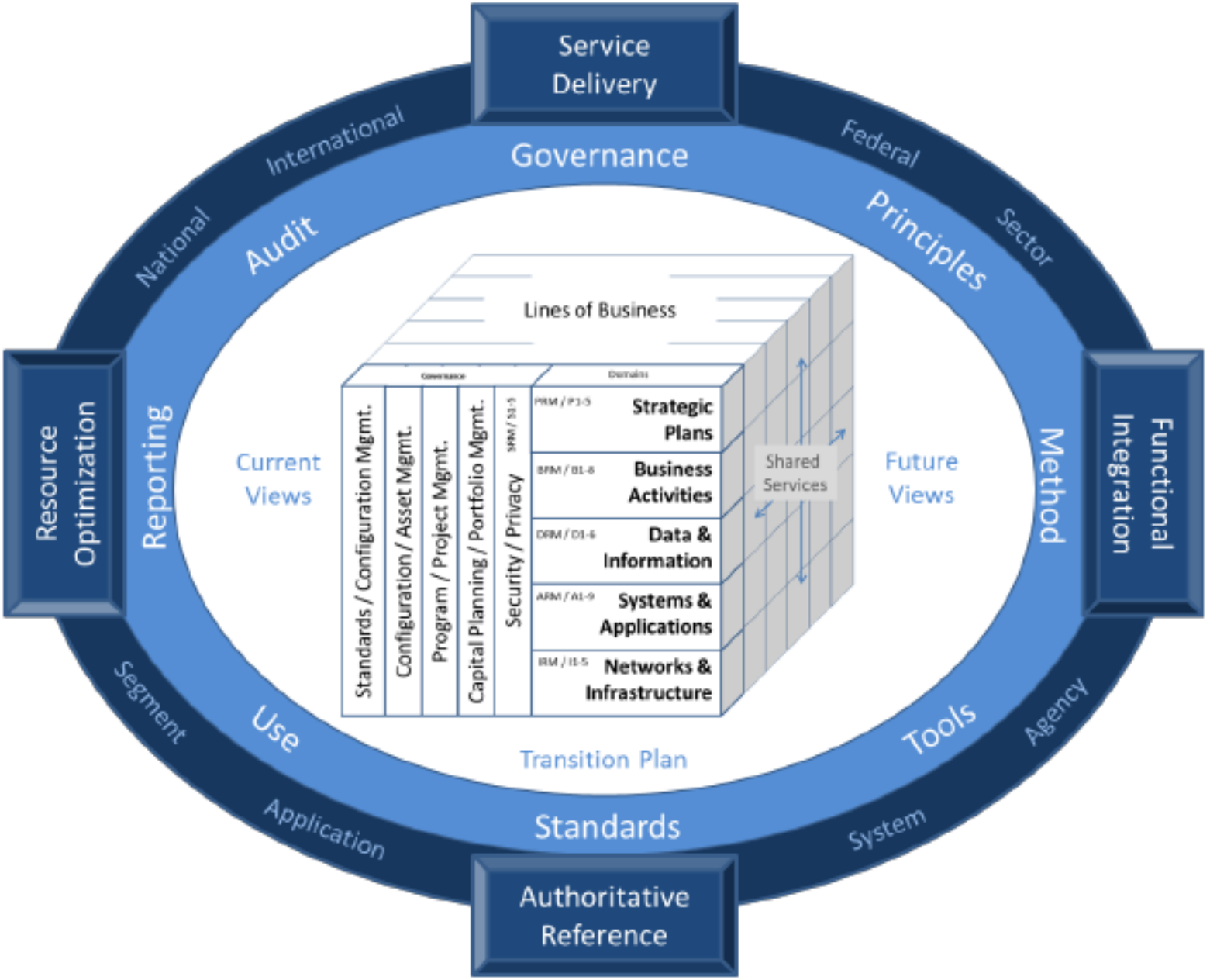
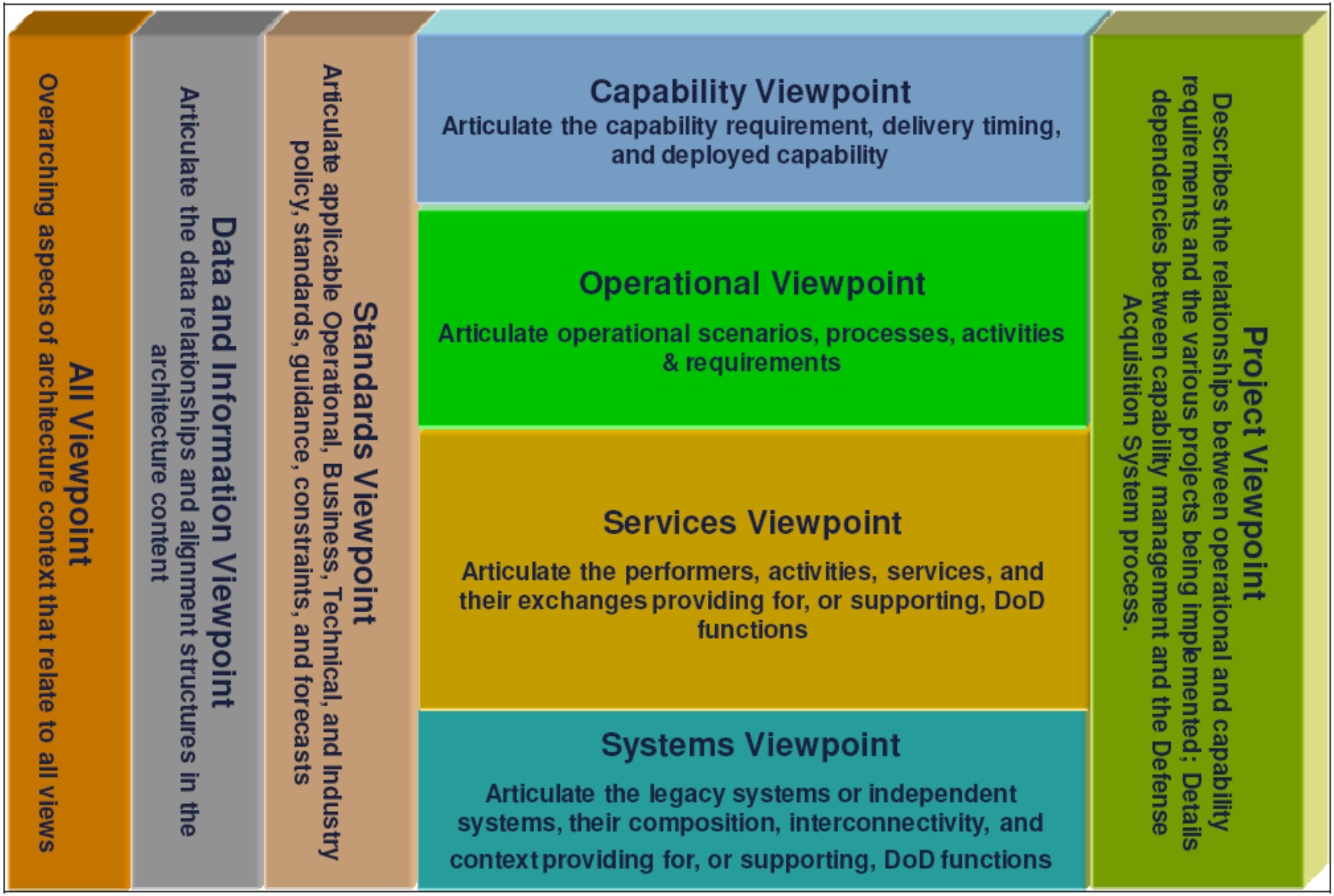


Figure 1. The Common Approach to Federal EA

DODAF 2 – Architecture Views



Basic Architecture Concepts

Architectural artefacts are created in order to describe a system, solution, or state of the enterprise. TOGAF 9.2 has adapted ISO/IEC 42010: 2011 definitions.

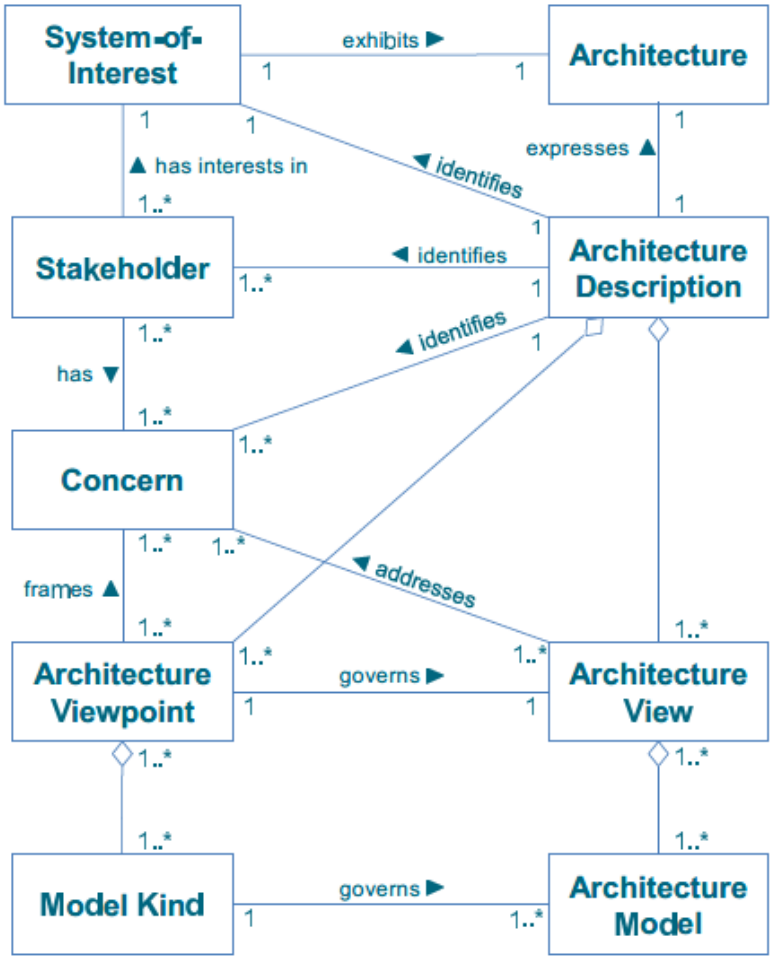


Figure 31-1 Basic Architectural Concepts

Crucial for Model and Tool Interoperability

Example View and Viewpoint

Architecture Viewpoint Element	Description
Stakeholders	Management Board, Chief Executive Officer
Concerns	Show the top-level relationships between US/UK geographical sites and business functions.
Modeling technique	Nested boxes diagram. Outer boxes = locations; inner boxes = business functions. Semantics of nesting = functions performed in the locations.

Architecture Viewpoint

Example Architecture View

The Open Group Business Domains

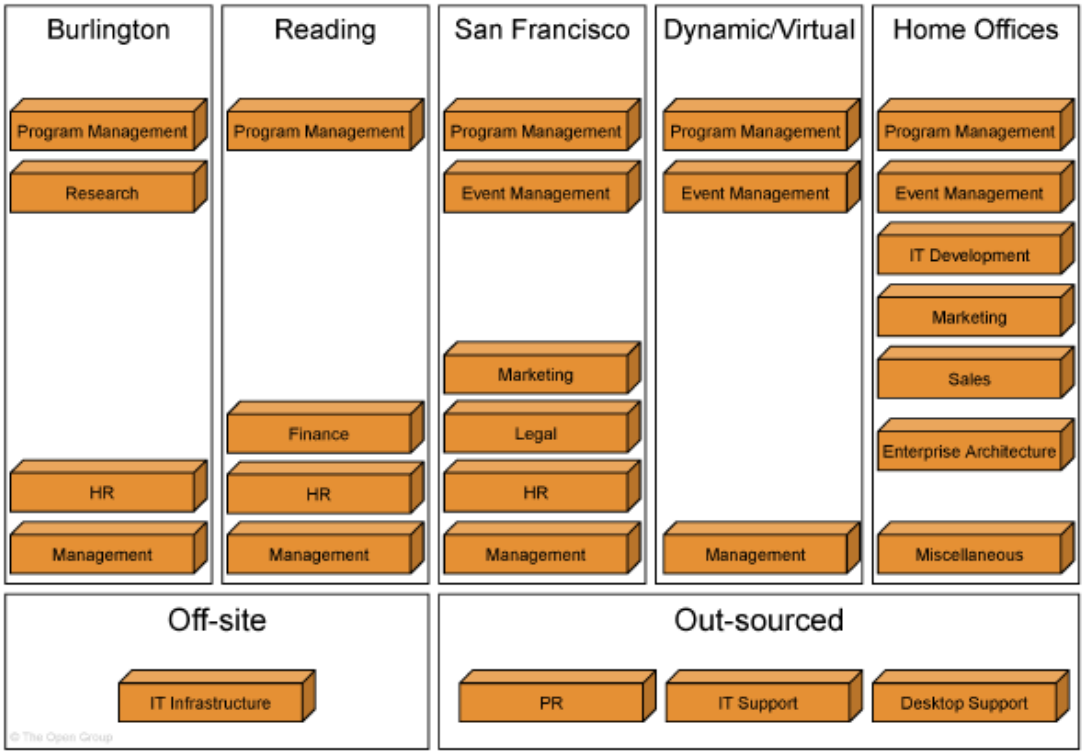
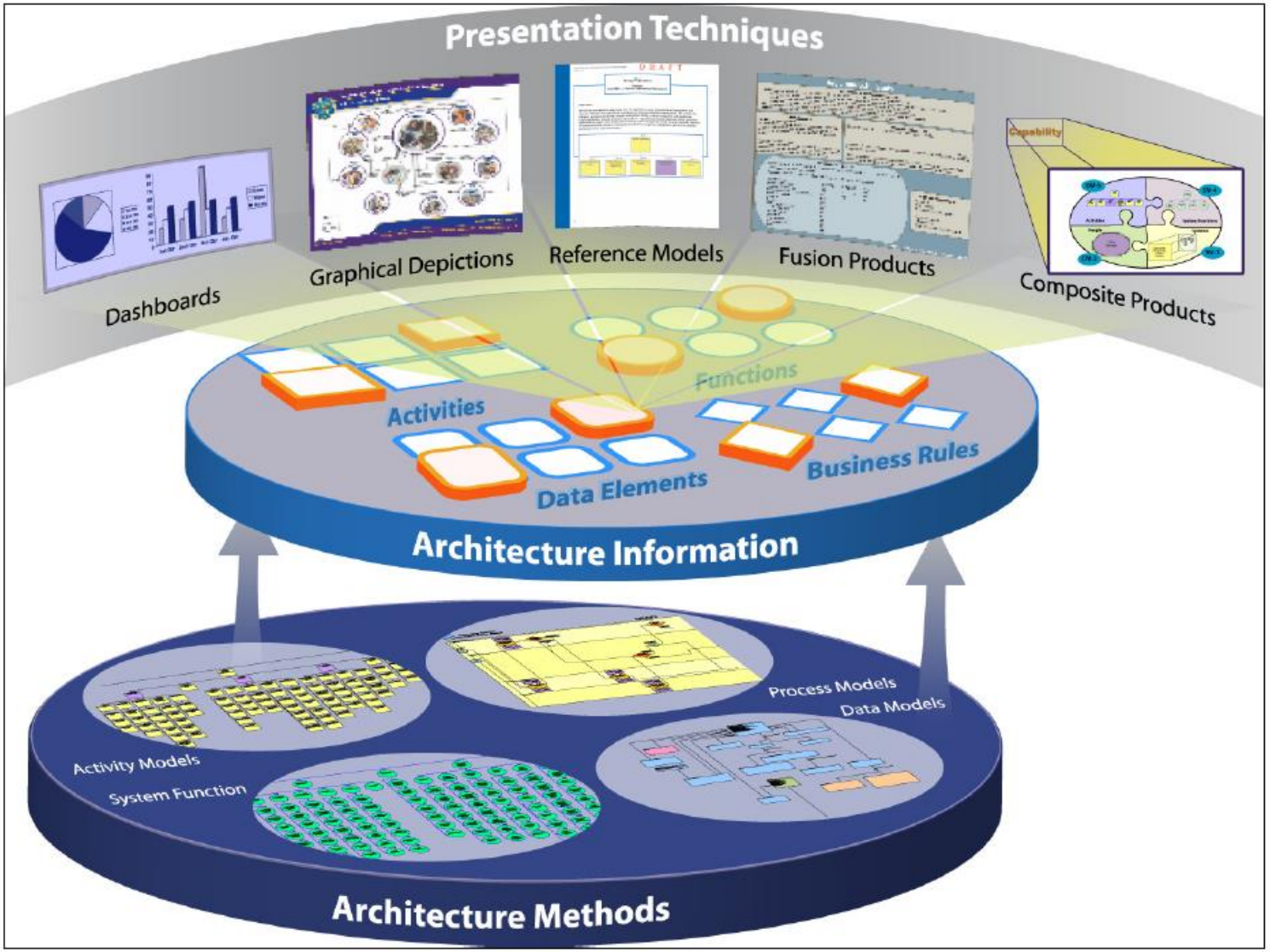


Figure 31-2 Example Architecture View — The Open Group Business Domains

DODAF 2 – Architecture Views / Presentation Techniques



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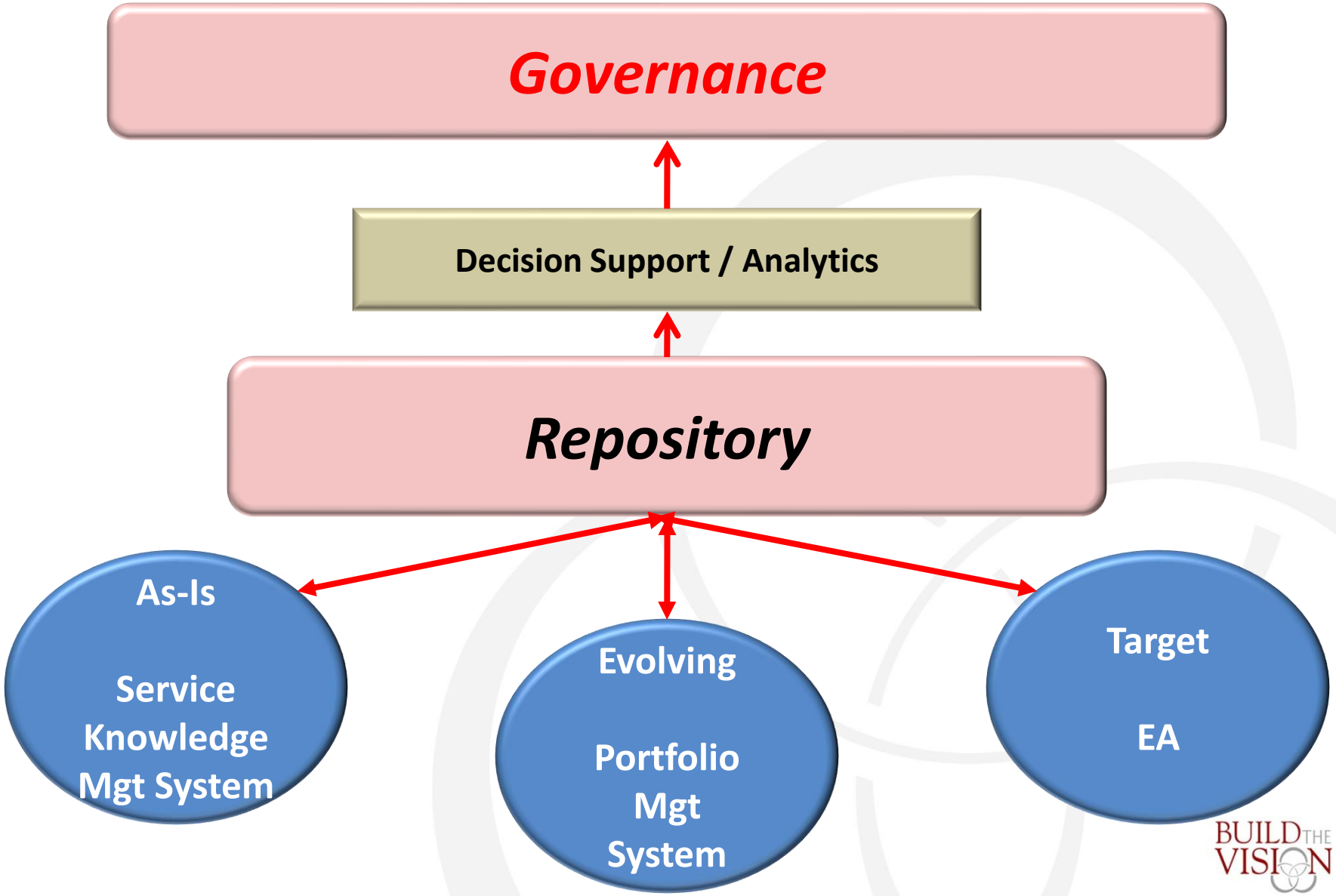
A Repository to Support All of Governance



Part 3
The Unified Architecture Framework

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Core Principles of the UAF Profile

- **Requirements-driven**:
  - UAFP is intended to satisfy the requirements.
- ***** Domain meta model (DMM) driven**: ***
  - The DMM was created first by domain experts and it served as a foundation for profile development.
- **Reuse of existing specifications**:
  - UAFP reuses UML/SysML wherever practical to satisfy the requirements and leverage features from both UML and SysML to provide a robust modeling capability.
- **Partitioning**:
  - The package is the basic unit of partitioning in this specification.
  - Packages partition the model elements into logical groupings that minimize circular dependencies among them.
- **Compliance levels**:
  - UAFP has a single compliance level based upon a combination of the reuse of UML and SysML elements, this simplifies the implementation of UAFP compared to UPDM 2.x for tool vendors.
  - Is expected that the views that are created as a result of this profile have frames that reflect the underlying SysML diagram type that is used as the basis for the view.
  - Also expected that the graphical notation used to display elements within those views correspond to the standard SysML graphical notation of the SysML/UML metaclass that the stereotype extends.
- **Interoperability**
  - UAFP inherits the XMI interchange capability from UML.
  - The UAFP specification reuses a subset of UML 2 and provides additional extensions needed to address mandatory requirements.

Unified Architecture Framework – Object Management Group - 2016

	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	-	-
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 schema, real world results	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	-	-
Projects Pj	Project Taxonomy Pj-Tx	Project Structure Pj-Sr	Project Connectivity Pj-Cn	Project Activity PJ-Pr	-	-			-	Project Roadmap Pj-Rm	Project Traceability Pj-Tr
Standards Sd	Standard Taxonomy Sd-Tx	Standards Structure Sd-Sr	-	-	-	-			-	Standards Roadmap Sr-Rm	Standards Traceability Sr-Tr
Actuals Resources Ar		Actual Resources Structure, Ar-Sr	Actual Resources Connectivity, Ar-Cn	Simulation [b]					Parametric Execution/ Evaluation [b]	-	-
Dictionary * Dc											
Summary & Overview SmOv											
Requirements Rq											

The UAF Grid Logic

based on UAF Annex A – OMG 2016

- View Types – Columns – Reflect generic perspective
- Domains – Rows – Reflect levels of abstraction and interests
- Viewpoints
  - Intersection set of View Types and Domains
  - Perspective on the problem space
  - For Stakeholders, Include WHAT is to presented and a MODEL on how it is to be presented; in UAF they use the System Modeling Language (SysML) which is an extension of the Unified Modeling Language (UML).
  - Reflects the layers of abstraction, interest, as per Zachman
  - Somewhat analogous to a “report” in old speak
  - For the Grid, the viewpoints represent a de-conflicted view of the underlying model
  - Practically, used to populate the repository database
  - Overall Viewpoints can be whatever is needed by the stakeholders reflecting data in the repository
- Domains
  - Reflects the areas of concern for architects that are described in varying levels of abstraction
  - Grid captures the information required by the frameworks using the Unified Architecture Framework

Notes on The UAF Grid

based on UAF Annex A – OMG 2016

- These viewpoints are architectural artifacts that contribute to the success in defining and developing an architecture.
- Viewpoints used to evaluate architecture behavior and constraints
- The information model is a column across the abstraction layers that can be defined in any of its forms, i.e., Conceptual, Logical, or as a schema at any level of abstraction.
- **Parameters column captures the measures and environments across the architecture in all the different layers of abstraction.**
- Expectation is that:
  - physical schema model not be developed in the framework
  - any tool implementing the framework provides a means to import or link-to representations of the physical model such as XML schemas.
- Metadata Taxonomy viewpoint provides a placeholder for a means to extend the profile to other domains,
  - consequently there is not a specific diagramming type for Metadata Taxonomy

View Types - Columns

- Taxonomy
  - Presents all the elements as a standalone structure.
  - Presents all the elements as a specialization hierarchy, provides a text definition for each one and references the source of the element.
- Structure
  - Describes the definitions of the dependencies, connections, and relationships between the different elements.

View Types – Columns - 2

- Connectivity
  - Describes connections, relationships, and interactions between the different elements.
- Processes
  - Captures activity based behavior and flows.
  - Describes activities, their Inputs/Outputs, activity actions and flows between them.
- States
  - Captures state-based behavior of an element.
  - Is a graphical representation of states of a structural element and how it responds to various events and actions.

View Types – Columns - 3

- Interaction Scenarios
  - Expresses a time ordered examination of the exchanges as a result of a particular scenario.
  - Is a time-ordered examination of the exchanges between participating elements as a result of a particular scenario.
- Information
  - Address the information perspective on operational, service, and resource architectures.
  - Allows analysis of an architecture's information and data definition aspect, without consideration of implementation specific issues
- Parameters
  - Captures the **measures** and **environments** across the architecture in all the different layers of abstraction

View Types – Columns - 4

- Constraints
  - Details the measurements that set performance requirements constraining capabilities.
  - Defines the rules governing behavior and structure.
- Roadmap
  - Addresses how elements in the architecture change over time.
  - Describes architecture elements at different points in time or different periods of time.
- Traceability
  - Describes the mapping between elements in the architecture.
  - Can be between different viewpoints within domains as well as between domains.
  - Can also be between structure and behaviors.

Domains – Rows - 1

- Metadata
  - Captures meta-data relevant to the entire architecture.
  - Provides information pertinent to the entire architecture.
  - Present supporting information rather than architectural models.
- Strategic
  - **Capability management** process.
  - Describes the capability taxonomy, composition, dependencies, and evolution
  - **“Conceptual”**
- Operational
  - Illustrates **Logical** Architecture of the enterprise.
  - Describes requirements, operational behavior, structure, and exchanges required to support (exhibit) capabilities.
  - Defines all operational elements in an **implementation/solution independent manner**

Domains – Rows - 2

- Services
  - Service-Orientated View (SOV) is a description of services needed to directly support the operational domain as described in the Operational View.
  - A service within UK Defence Architecture Framework (MODAF) is understood in its broadest sense, ***as a unit of work through which a provider provides a useful result to a consumer.***
  - DoDAF: The Service Views within the Services Viewpoint describe the design for service-based solutions to support operational development processes (JCIDS) and Defense Acquisition System or capability development within the Joint Capability Areas

Domains – Rows - 3

- Personnel
  - Defines and explores organizational resource types.
  - Shows taxonomy of types of organizational resources as well as connections, interaction, and growth over time.
- Resources
  - Captures a solution architecture consisting of resources, e.g., organizational, software, artifacts, capability configurations, and natural resources that implement the operational requirements.
- Security
  - Security assets and security enclaves.
  - Defines the hierarchy of security assets, asset owners, security constraints (policy, laws, and guidance) and details where they are located (security enclaves)

Domains – Rows - 4

- Projects
  - Describes projects and project milestones, how those projects deliver capabilities, the organizations contributing to the projects and dependencies between projects.
- Standards
  - MODAF: Technical Standards Views are extended from the core DoDAF views **to include non-technical standards** such as operational doctrine, industry process standards, etc.
  - DoDAF: The Standards Views within the Standards Viewpoint are the set of rules governing the arrangement, interaction, and interdependence of solution parts or elements.
- Actual Resources
  - The analysis, e.g., evaluation of different alternatives, what-if, trade-offs, V&V on the actual resource configurations. Illustrates the expected or achieved actual resource configurations

Be Careful Exposing SysML to Business

7.1.6.1 UAF::Services::Taxonomy

Contains the elements that contribute to the Services Taxonomy Viewpoint.

ServiceSpecification

Package: Taxonomy

isAbstract: No

Generalization: PropertySet, VersionedElement, CapableElement, Block

Extension: Class

Description

The specification of a set of functionality provided by one element for the use of others.

SysML Explanations – Good for Designers

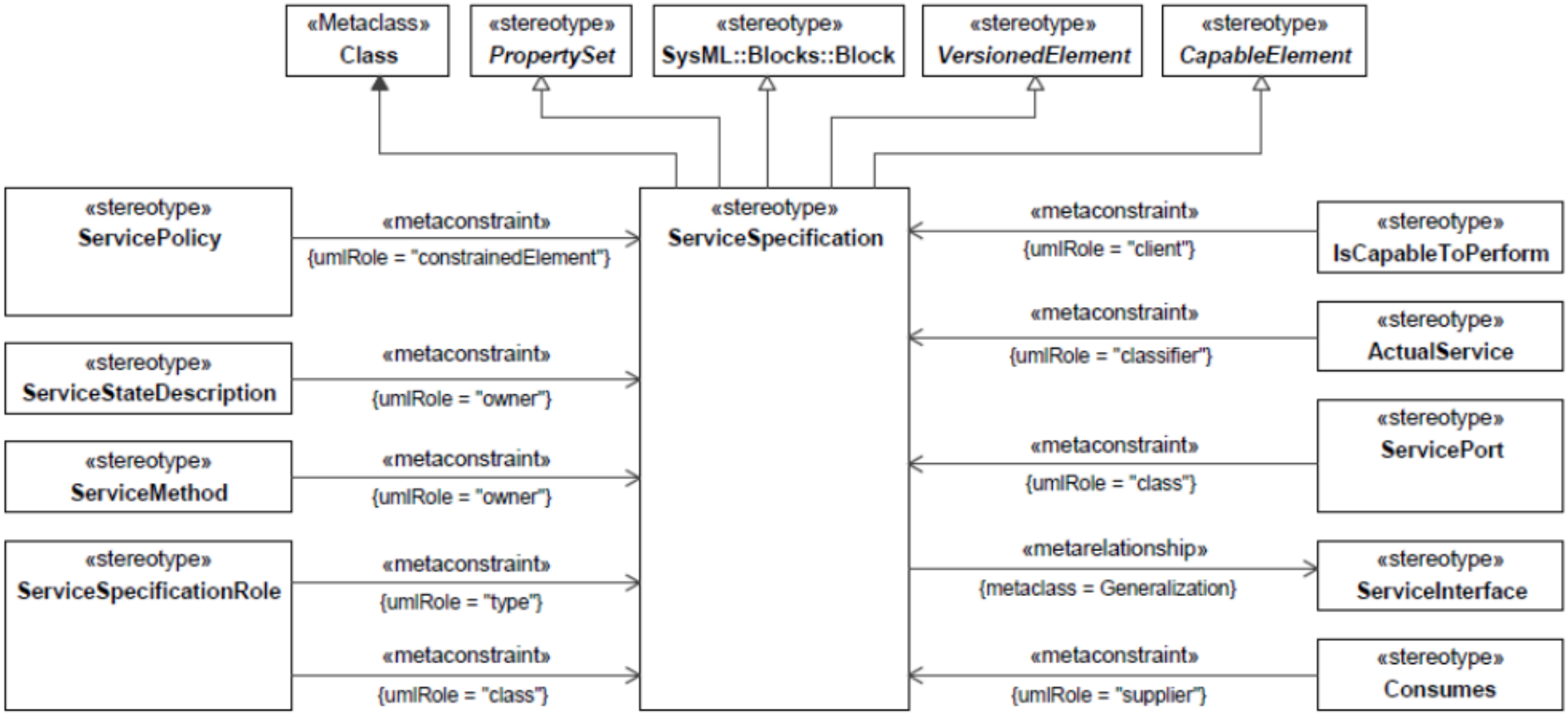

Figure 7.84 - ServiceSpecification

NATO Architecture Framework V4 - Viewpoints

Figure 1-1: NAFv4 Viewpoints

NAF V4 – Service Taxonomy Viewpoint

4.1 S1 – SERVICE TAXONOMY	NAFv3: NSOV-1/NAV-2

The S1 Viewpoint is concerned with the identification of service specifications, and their organization into specialization hierarchies (taxonomies).

Views implementing this Viewpoint:

- Shall include all service specifications relevant for the architecture.
- May organize all service specifications into a specialization hierarchy.
- May include measures for the service specifications.
- May include attributes for the service specifications.

A service taxonomy, in whole or parts, may be referenced by, or used in describing, multiple architectures (e.g. a S1 View at enterprise-level will be referenced by S1 Views at the capability-level).

CONCERNS ADDRESSED	USAGE
• Cataloguing Service Specifications. • Defining attributes used to measure Service Levels. • Specialization of Service Specifications.	• Service-oriented architecture governance. • Identification of services. • Service planning. • Service audit. • Service gap analysis. • Providing reference services for architectures. • Tailoring generic services for specific applications.

REPRESENTATION

- Tabulation.
- Hierarchical (connected shapes).
- UML class diagram.

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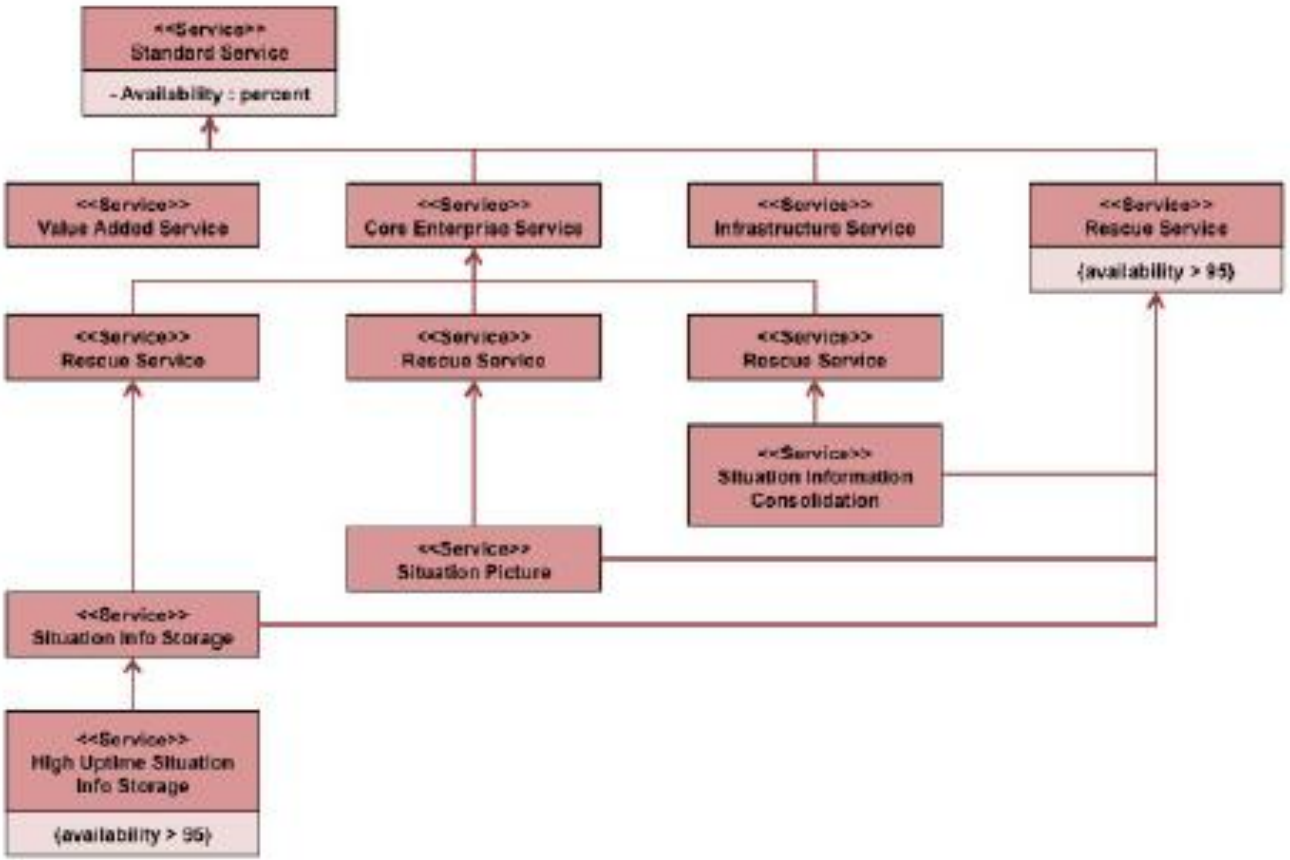
NAF V4 – Service Taxonomy Viewpoint

EXAMPLE

The example in Figure 3-10 shows a taxonomy of Standard Services. There is also an availability attribute defined against the top service specification. All other service specifications inherit that attribute, and the Warfighting Service sets a constraint (service policy) that the availability shall be greater than 95%.

Figure 3-10: Example S1 View



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NAF V4 – Capability Taxonomy Viewpoint

3.1 C1 – Capability Taxonomy	NAFv3: NCV-2
The C1 Viewpoint is concerned with the identification of capabilities, and their organization into specialization hierarchies (taxonomies) independent of their implementation and may be referenced in whole or part by, or used in, describing multiple architectures (e.g. a C1 View at Enterprise-level will be referenced by C1 Views at the Capability-level). Views implementing this Viewpoint • Shall include all capabilities relevant for the architecture. • Shall organize all capabilities into a specialization hierarchy. • May include Measures of Effectiveness (MoE).	
CONCERNS ADDRESSED	**USAGE**
• Capability Planning. • Capability Management.	• Identification of existing and required capabilities. • Source for the derivation of cohesive sets of Key User Requirements (KURs). • Providing reference capabilities for multiple architectures.
REPRESENTATION	
• Tabulation. • Hierarchical (Connected Shapes). Class Diagram (with generalization relationships and property definitions).	

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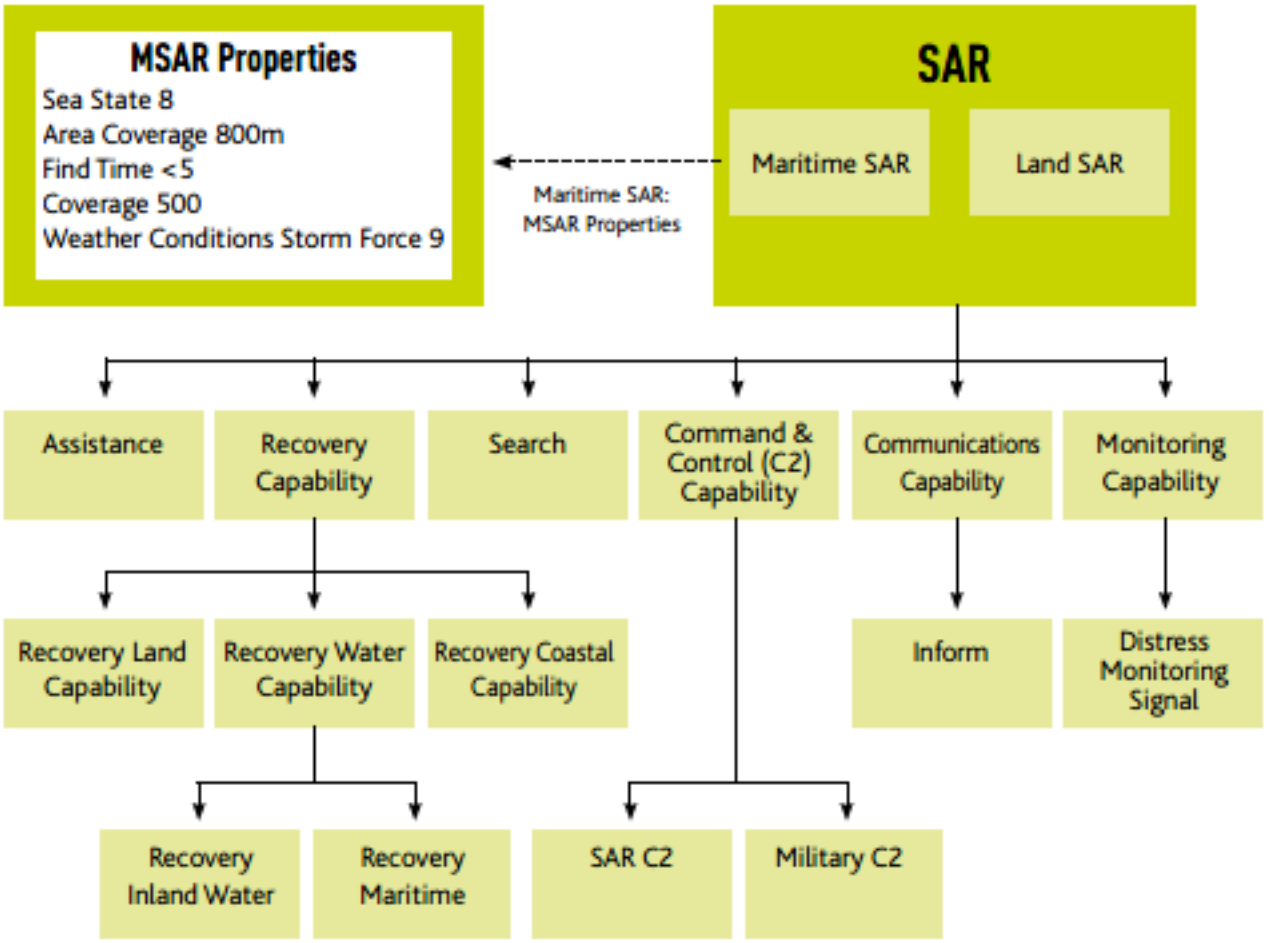
NAF V4 – Capability Taxonomy Viewpoint

EXAMPLE

The following example uses a hierarchical diagram to depict the individual capabilities and their place in the taxonomy.

Figure 3-2: Example C1 View



The capabilities in a C1 View are related by specialization relationships that assert one capability is a special case of another (e.g. Recovery Capability is specialized into Recovery Land Capability, Recovery Water Capability and Recovery Costal Capability in above example).

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Part 4
Concluding Material

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Conclusions

- UAF has a long pedigree in a very complex environment
- Linkage of concepts to execution
  - Constant direction of MDA and MBSE
- Language is technical but is business driven
  - SysML is not user friendly, redo diagrams
  - Look at the NATO Architecture Framework for business (and IM) friendly explanations
- This is future looking
  - Being extended for Internet of Things
  - Need for EAs to leverage
  - Great for auditors looking to place controls

QUESTIONS ?

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