Digital Modeling Training: Modeling and Framework Overview Session 1

May 2023

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DM23-0491

Digital Modeling Training Outline

Section 1: Modeling Overview

Section 2: DoDAF Overview

Section 3: Discussion

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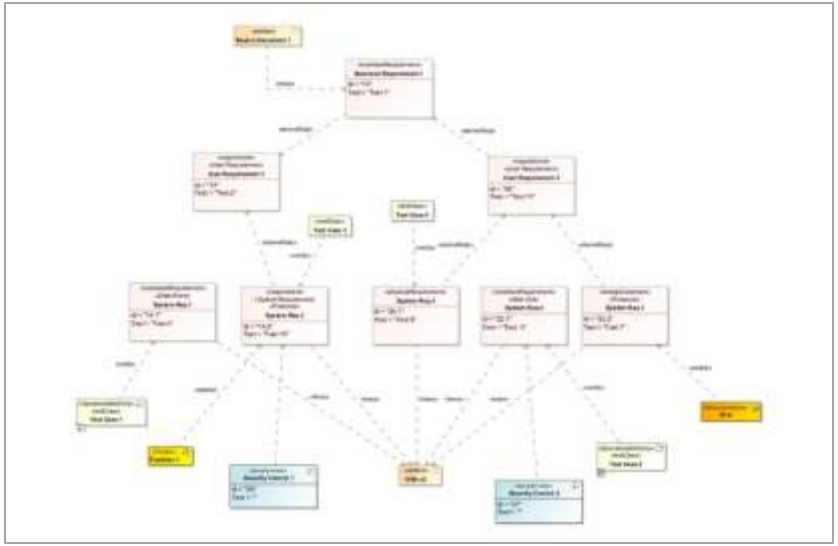
Section 1: Modeling Overview

Session 1: Agenda

1. Modeling Basics
2. MBSE Quadrants and Modeling Domains
3. Modeling Language
4. Applying Structure



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Modeling Basics

What is a model?

We have all seen, used, or created models throughout our lives.

These range from toys that represent cars or planes to mathematical formulas that describe and explain physical phenomena such as thermodynamics or gravity.

You may be familiar with engineering models that are form, fit, and functionally the same as a flight model but a flight model but may not be qualified to fly.

- ***A model is a simplified version of something--a graphical, mathematical, or physical representation that abstracts reality to eliminate some complexity.***

What is a “good” model?

To model a system, an architect must represent the system with less detail so that its structure and behavior are apparent, and its complexity is manageable.

- ***Models should sufficiently represent the system***
- ***And the system should confirm the model is accurate.***

Building a good model requires:

- Systems Thinking - looking at a system under consideration not as a self-sufficient entity, but as part of a larger system.
- Systems engineering – an approach to enable the successful realization, use and retirement of an engineered system

How to model?

Modeling instruments:

- ***Language*** - a common terminology for clearly communicating an abstract idea that the model model captures.
- ***Structure*** - A well-structured model can make the model understandable, usable, and maintainable.
- ***Argumentation*** - The model should demonstrate, in an easily comprehensible way, how the the system must be built to be successful.
- ***Presentation*** - Visualizing abstract ideas enables people to take the leap of imagination that is that is needed to "see" the system.

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MBSE Quadrants and Modeling Domains

MBSE Quadrants

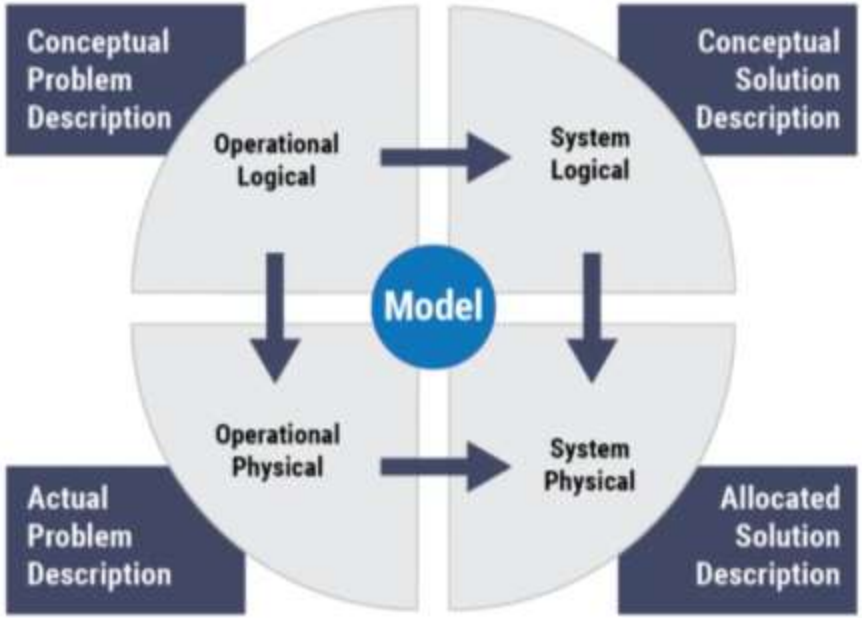

Figure 1: Components of A Model

Problem vs Solution

A model must describe the problem side and the solution side -the *operational* and *system* points of view.

The ***operational point of view*** is the perspective of users, operators, and business people.

The ***system point of view*** is the solution, the architecture of the system that solves the problem posed in the operational side of the model.

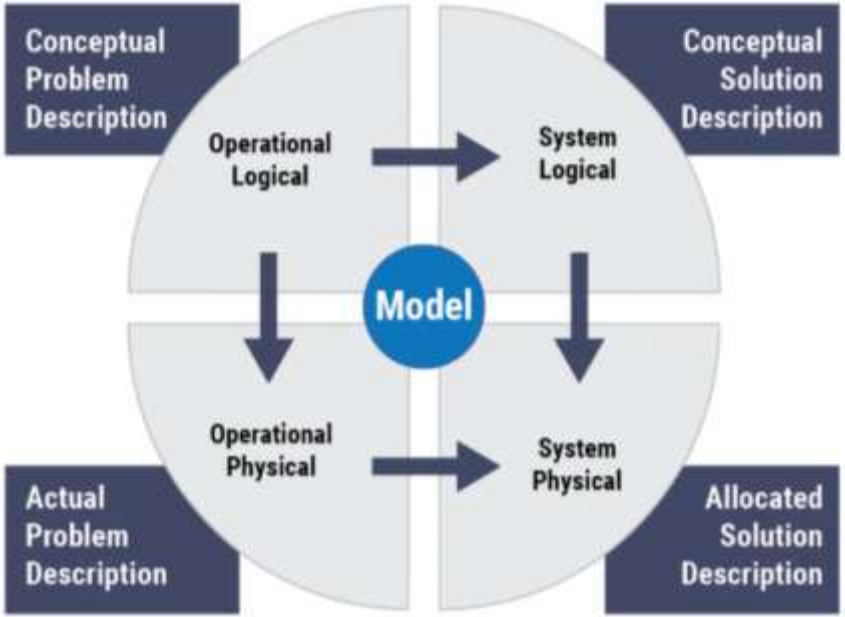

Figure 1: Components of A Model

Logical vs Physical

Each of those two points of view is further broken down into ***logical*** and ***physical parts***.

This breakdown is a method of managing complexity.

All four quadrants should be tightly connected**.**

Logical parts of the model usually change little over time. ***Physical*** changes are often initiated by technology advances.

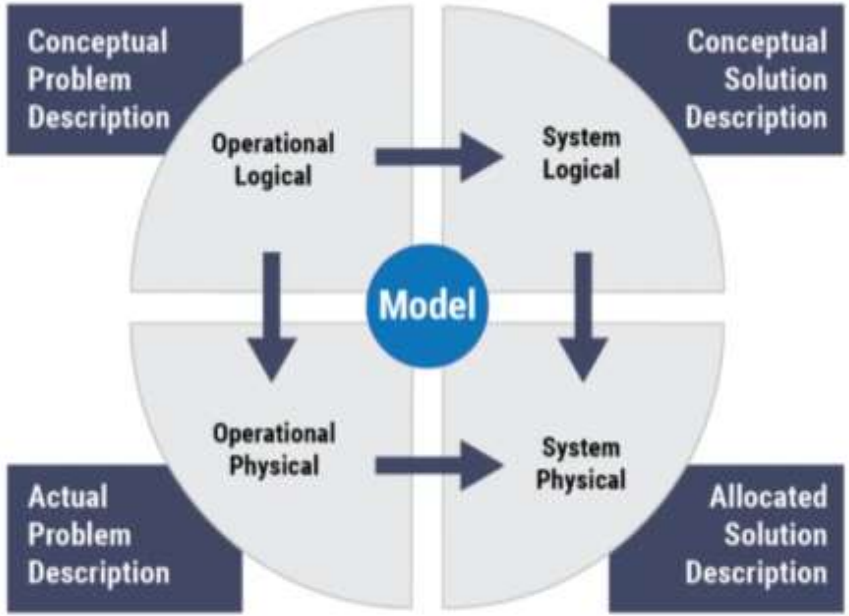

Figure 1: Components of A Model

Modeling Domains

Even though MBSE does not dictate any specific process, a model typically covers four systems-engineering domains.

These are:

1. requirements/capabilities
2. behavior/system dynamics
3. architecture/structure
4. verification and validation

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Modeling Language

Modeling Language - 1

A model manages complexity using language that is based on the human speech:

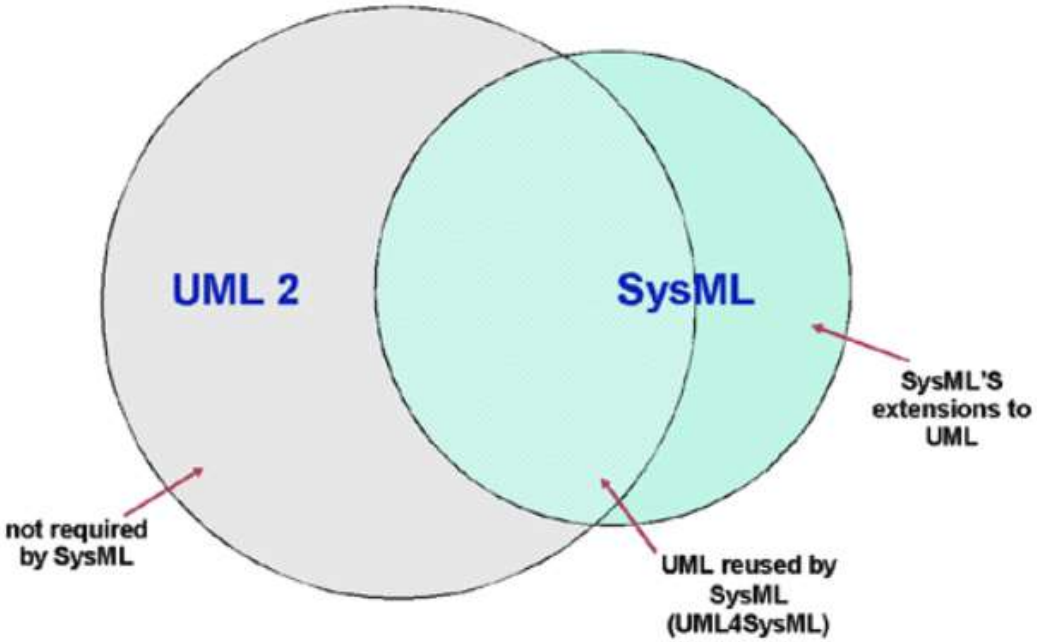
- ***Nouns*** describe actors, blocks, components, requirements
- ***Verbs*** describe operational activities, functions, use cases
- ***Adjectives*** describe attributes
- ***Adverbs*** represent relationships, needlines, exchanges, interfaces

A modeling language may be informal or formal.

Unified Modeling Language (UML) and Systems Modeling Language (SysML) are two examples of formal modeling languages.

From UML to SysML - 1

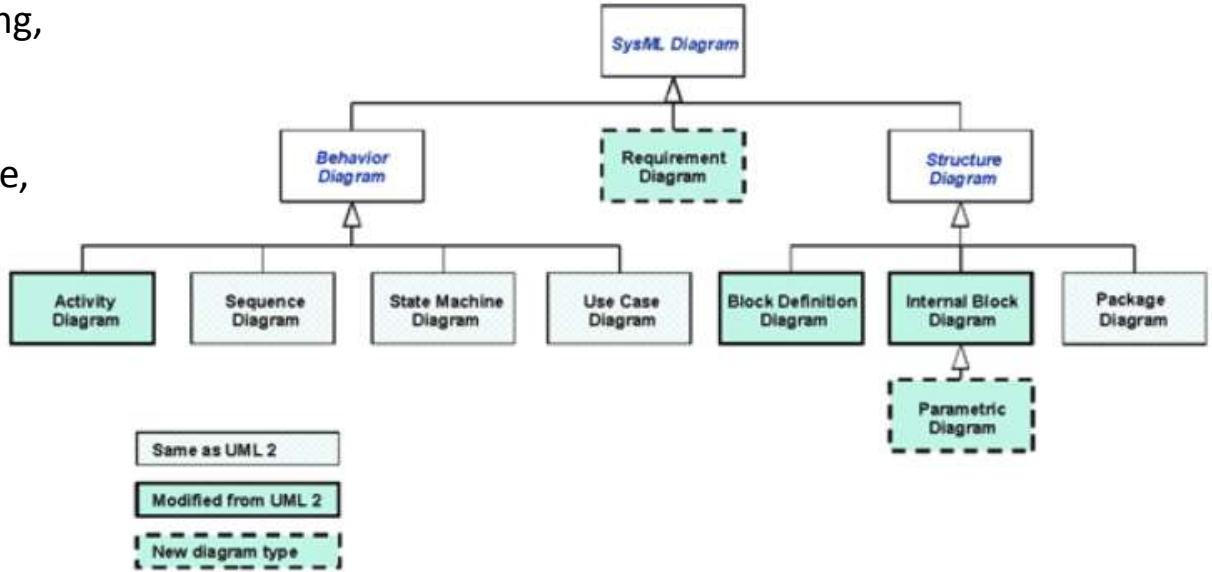
The Unified Modeling Language™ **(UML®)** is a specification defining a graphical language for visualizing, specifying, constructing, and documenting the artifacts of distributed object systems. [https://www.omg.org/spec/UML/]



Source: http://www.omgsysml.org/what-is-sysml.htm

From UML to SysML - 2

The OMG Systems Modeling Language™ **(OMG SysML®)** is a general-purpose graphical modeling language for specifying, analyzing, designing, and verifying complex systems that may include hardware, software, information, personnel, procedures, and facilities.



Source: http://www.omgsysml.org/what-is-sysml.htm

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Applying Structure

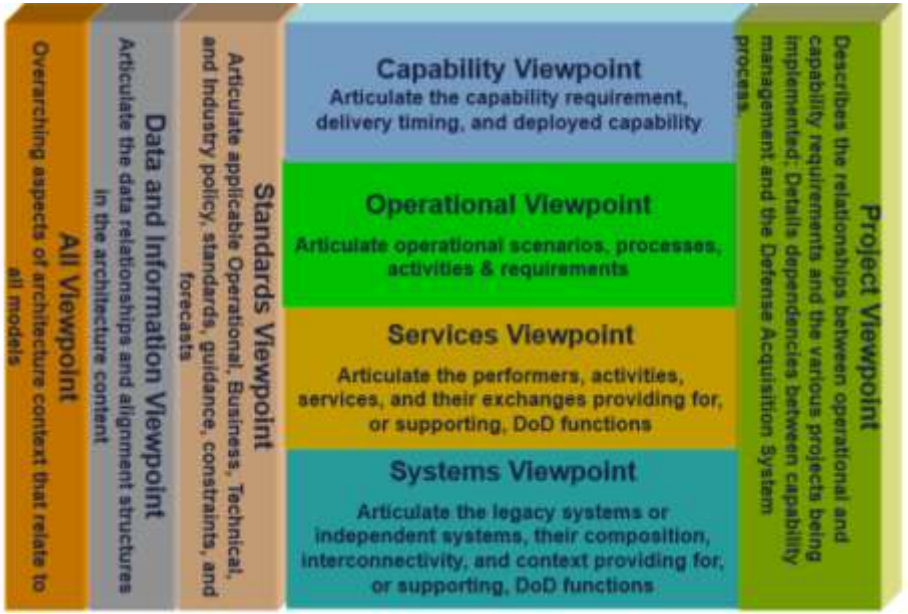
MagicGrid

	PILLAR						
DOMAIN			**Requirements**	**Behavior**	**Structure**	**Parameters**	
	Problem	**Black Box**	B1-W1 Stakeholder Needs	B2 Use Cases	B3 System Context	B4 Measurements of Effectiveness	**Specialty Engineering**
		White Box		W2 Functional Analysis	W3 Logical Subsystems Communication	W4 MoEs for Subsystems	
	Solution		S1 System Requirements	S2 System Behavior	S3 System Structure	S4 System Parameters	**Integrated Testing**
			SS1 Subsystem Requirements	SS2 Subsystem Behavior	SS3 Subsystem Structure	SS4 Subsystem Parameters	
			...	...	...	...	**Analysis**
			C1 Component Requirements	C2 Component Behavior	C3 Component Structure	C4 Component Parameters	
	Implementation		I1 Physical Requirements	Software, Electrical, Mechanical			

DoDAF

The DoDAF Architecture framework includes a further breakdown of viewpoints and uses a structure that encourages architecture conformance.

This helpful in the visualization of complex, large scale projects.



Perspectives: Viewpoints that Fit the Purpose, DoDAF V2.0 Community Update Overview

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Section 2: DoDAF Overview

Section 2: Agenda

1. What is DoDAF?
2. DoDAF Viewpoints

What is DoDAF?

DoD Architecture Framework (DoDAF)

DoDAF was developed as a means to compare architectures

A Framework is **NOT**:

- An Architecture
- A Methodology to develop Architectures

A Framework enables architecture comparison by defining a set of views of an architecture.

Views are simply ways to divide the architecture - providing different stakeholders with the view they find most useful and interesting.

Frameworks do not advocate any one methodology or notation.

DoDAF Viewpoints - 1

All Views Viewpoint (AV)

- Overview and Summary Information that provides executive - level information in a consistent form to allow quick reference and comparison among architectures.
- Integrated Dictionary which contains definitions of terms used in the architecture.

Capability Viewpoint (CV)

- Addresses the concerns of Capability Portfolio Managers and describes capability taxonomy and capability evolution.

Data and Information Viewpoint (DIV)

- Provides a means of portraying the operational and business information requirements and rules that are managed within and used as constraints on an organization's business activities.

Operational Viewpoint (OV)

- Describe the tasks and activities, operational elements, and resource flow exchanges required to conduct operations. Systems Viewpoint

DoDAF Viewpoints - 2

Services Viewpoint (SvcV)

- Describes services and their interconnections providing or supporting, DoD functions.

Systems Viewpoint (SV)

- Describes the systems and interconnections providing for, or supporting, DoD functions.

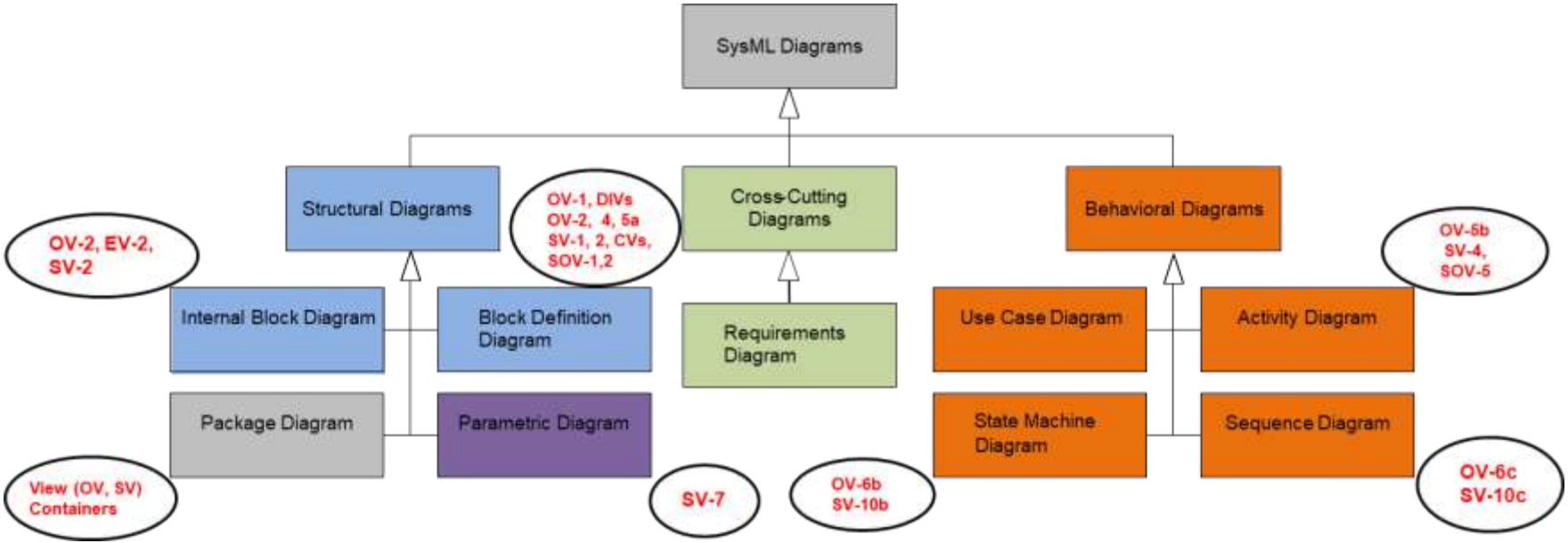
Standards Viewpoint (StdV)

- The set of rules governing the arrangement, interaction, and interdependence of parts or elements of the architectural description.

Project Viewpoint (PV)

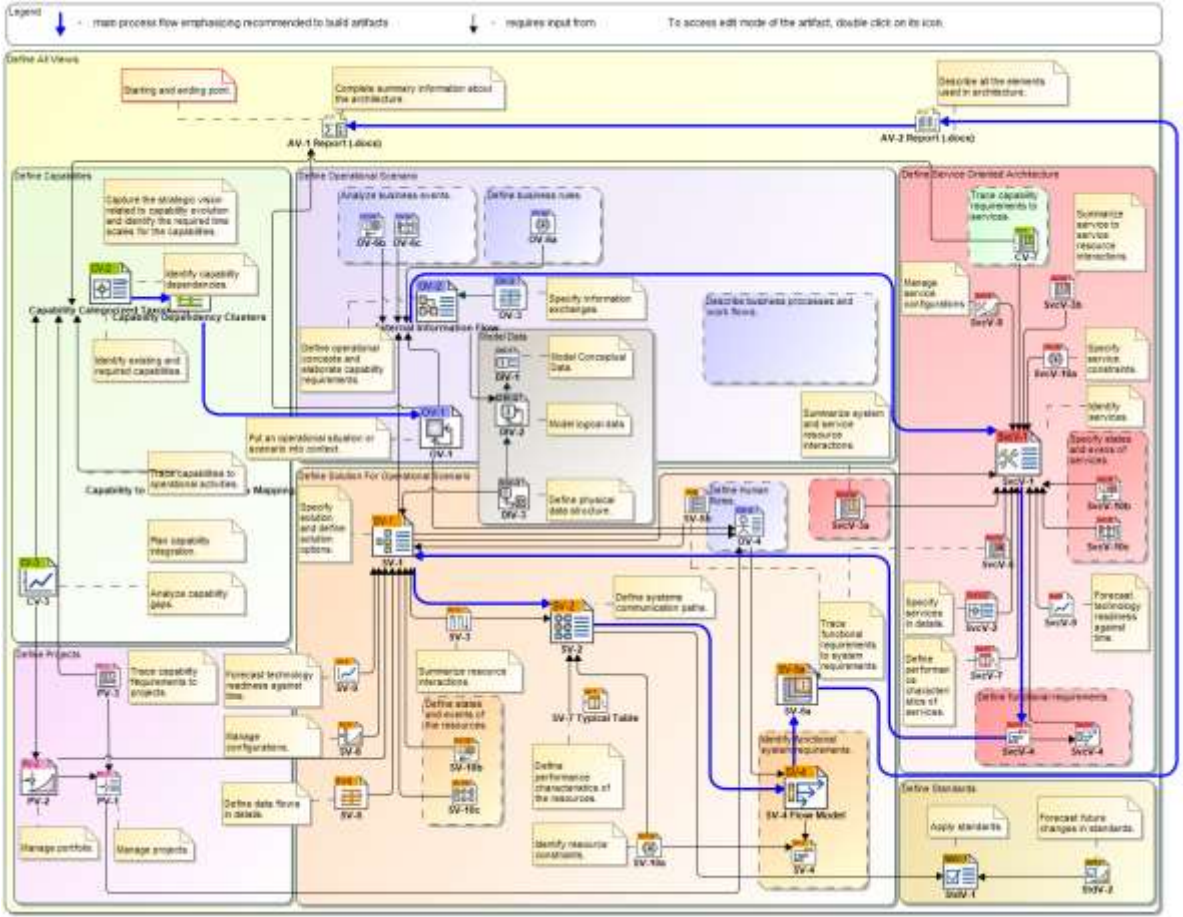
- Describes how programs, projects, portfolios, or initiatives deliver capabilities, the organizations contributing to them, and dependencies between them.

DoDAF with SysML



Source: "Model Based Systems Engineering and Systems Modeling Language", DoDAF Plenary, January 5,2012

Process Guide



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Section 3: Discussion

Discussion

1. What is the current process for reviewing MBSE models?
2. What kind of models do you review?
3. Do you have a requirements model? Do you review requirements traceability?
4. What are the current challenges of reviewing MBSE models?
5. Do you use any style guide for your models?
6. What custom profiles are used in the models you review?

Homework

1. Review DoDAF process guide.
2. Prepare questions (to inform learning objectives.) Email to Natasha Shevchenko ***san@sei.smu.edu***