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Enable Effective Digital Engineering Information Exchange Using Digital Viewpoint Model (DVM) Framework

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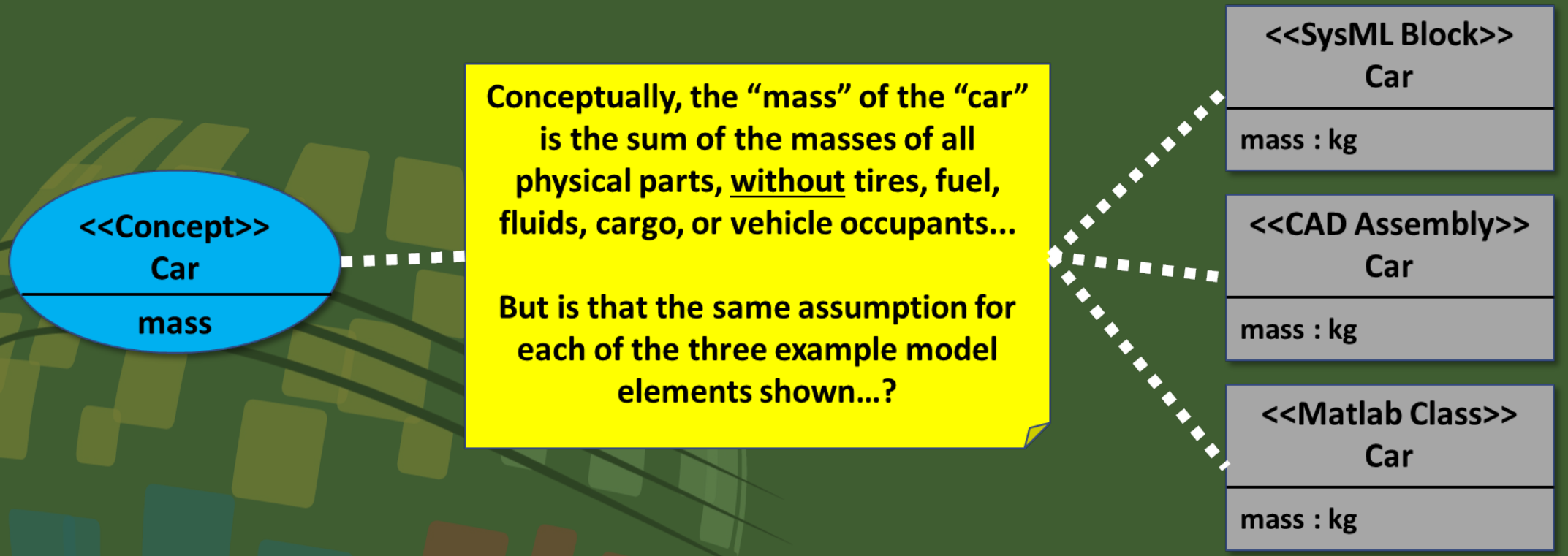
Digital Viewpoint Model (DVM) Framework Overview

Digital Viewpoint Model (DVM)

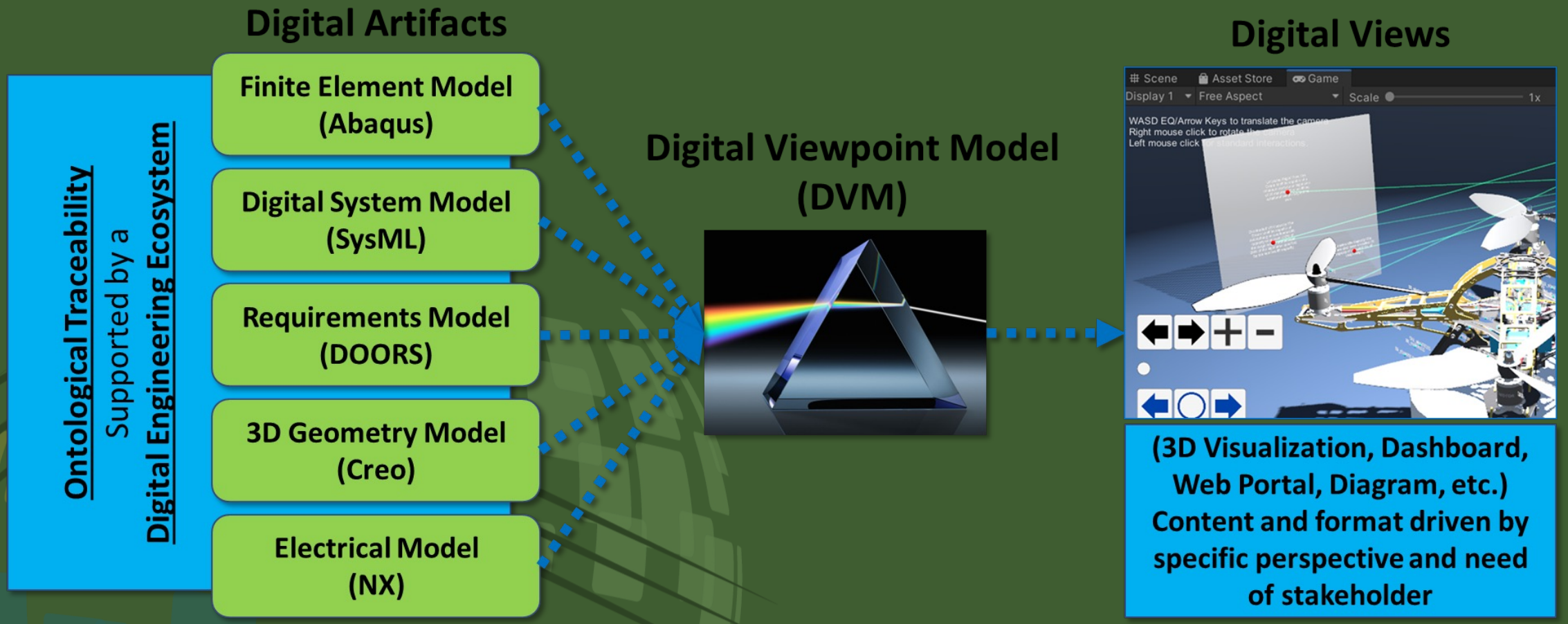
- Digital Engineering Information Exchange Working Group (DEIXWG)
  - Collaboration between the International Council of Systems Engineers (INCOSE), National Defense Industrial Association (NDIA), and the Office of the Under Secretary of Defense for Research and Engineering (DoD OUSD(R&E))
  - The DEIXWG supports the strategic objective of accelerating digital engineering transformation by characterizing the content and relationships involved in the exchange of digital artifacts between stakeholders of various disciplines throughout the engineering lifecycle
- The Digital Viewpoint Model (DVM) is an **implementation-agnostic (platform independent), referenced framework** developed from DEIXWG
- The DVM provides a high-level framework for describing sources of digital information in a digital engineering ecosystem (DEE)
- The DVM also conceptualizes how that information can be transferred, translated, transformed, and related for the purpose of exchanging digital information between stakeholders… who might not have the same DEE infrastructure or standards

Conceptually Relating Different Metamodels

- To address the inter-disciplinary data exchange challenge
  - Create a **mapping schema** to relate elements, but as with integrating multiple simulations, that can only be done if the elements are **conceptually relatable**

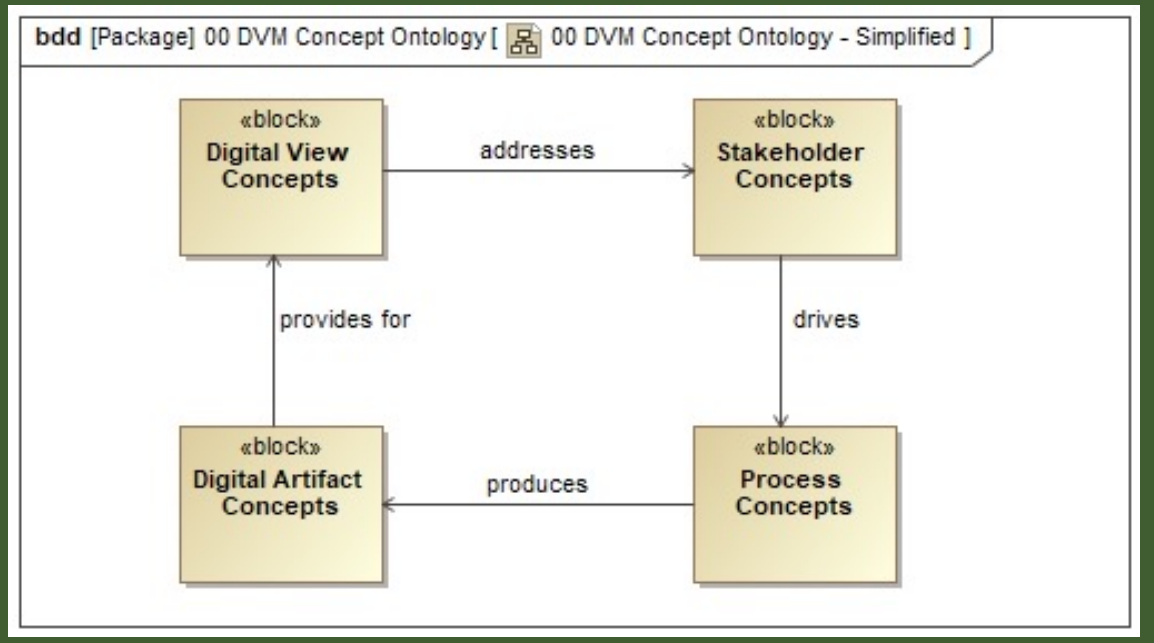


Digital Viewpoint Model (DVM)



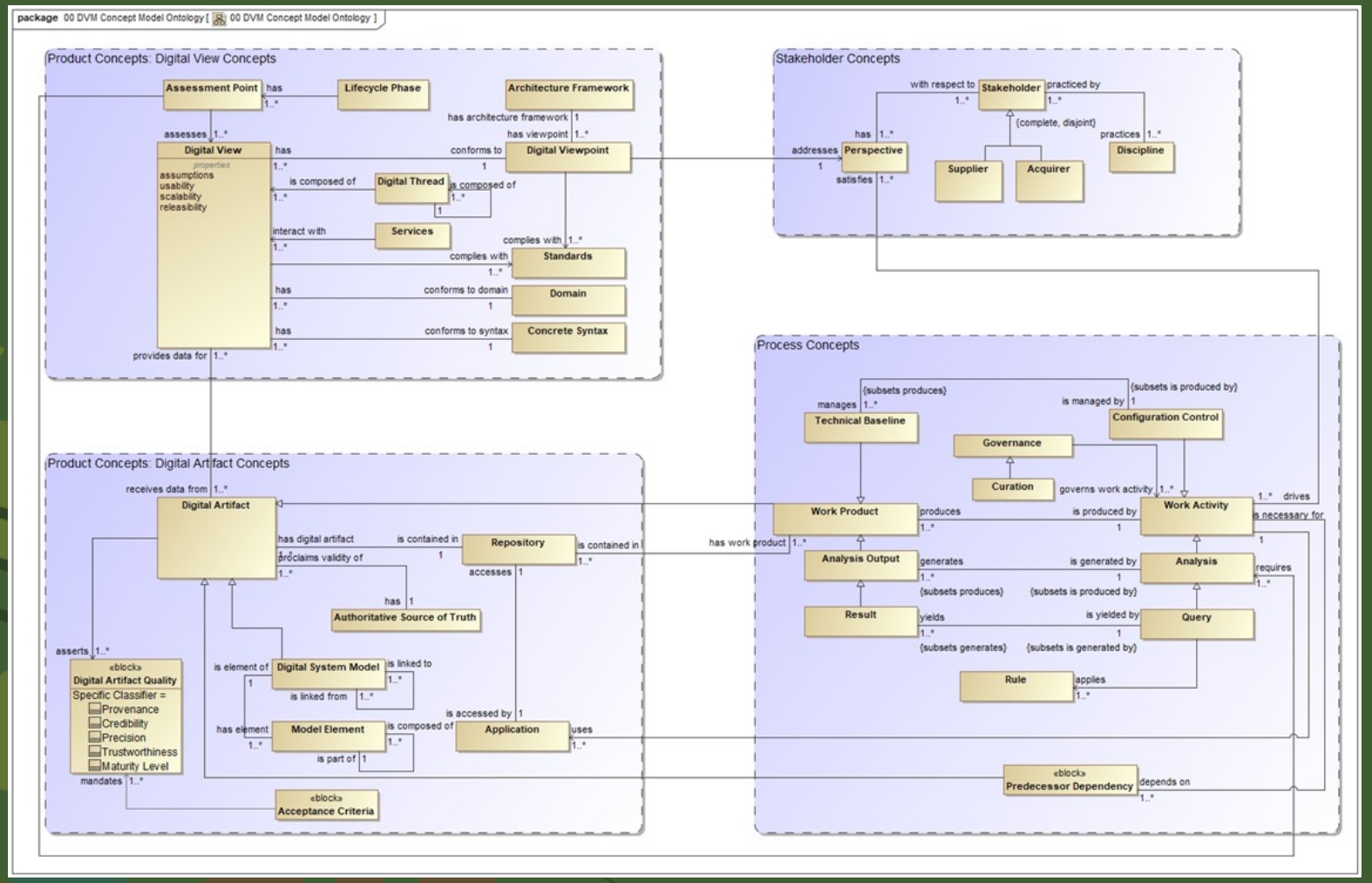
DVM Framework Overview

- Defined at the conceptual level
- Allow stakeholders to extend them with more specialized concepts
- Can be specialized to a given domain or need
- Instead of defining a set of all-purpose views, the framework simply provide guidance in defining views for specific exchanges
- DVM is about how to better define what needs to be exchanged, not the implementation of the exchange and associated artifacts
- The DVM is divided into four interconnected ontologies



While the DVM is modeled using SysML, the concepts are agnostic of any particular language, tool, or infrastructure

DVM: Exchanging Data Related Across Different Metamodels



Digital View Concepts

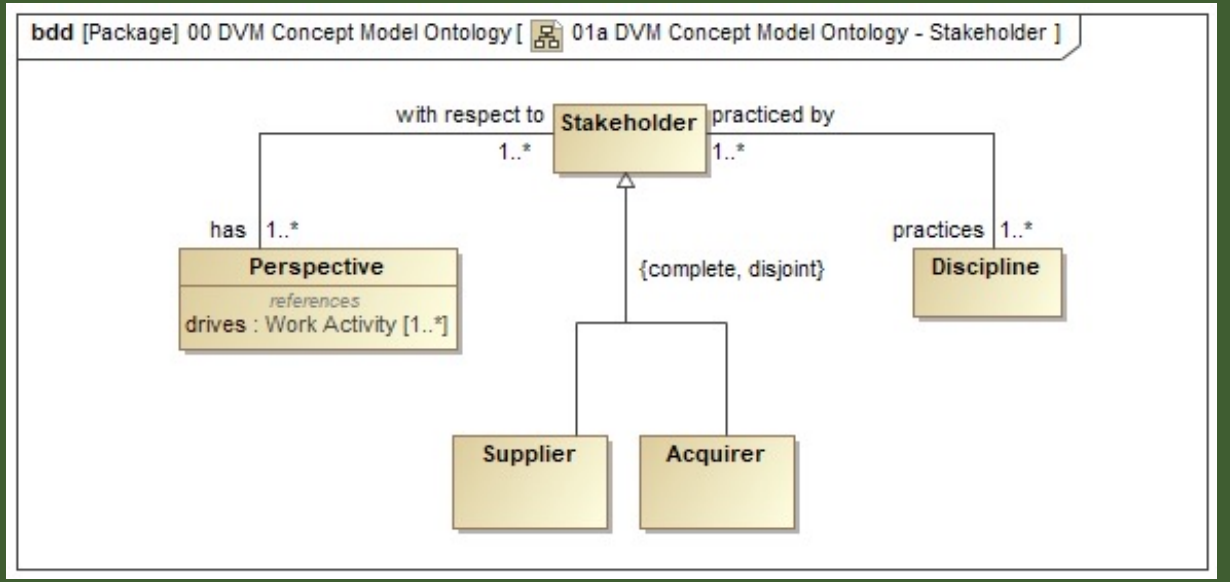
Digital Artifact Concepts

Stakeholder Concepts

Process Concepts

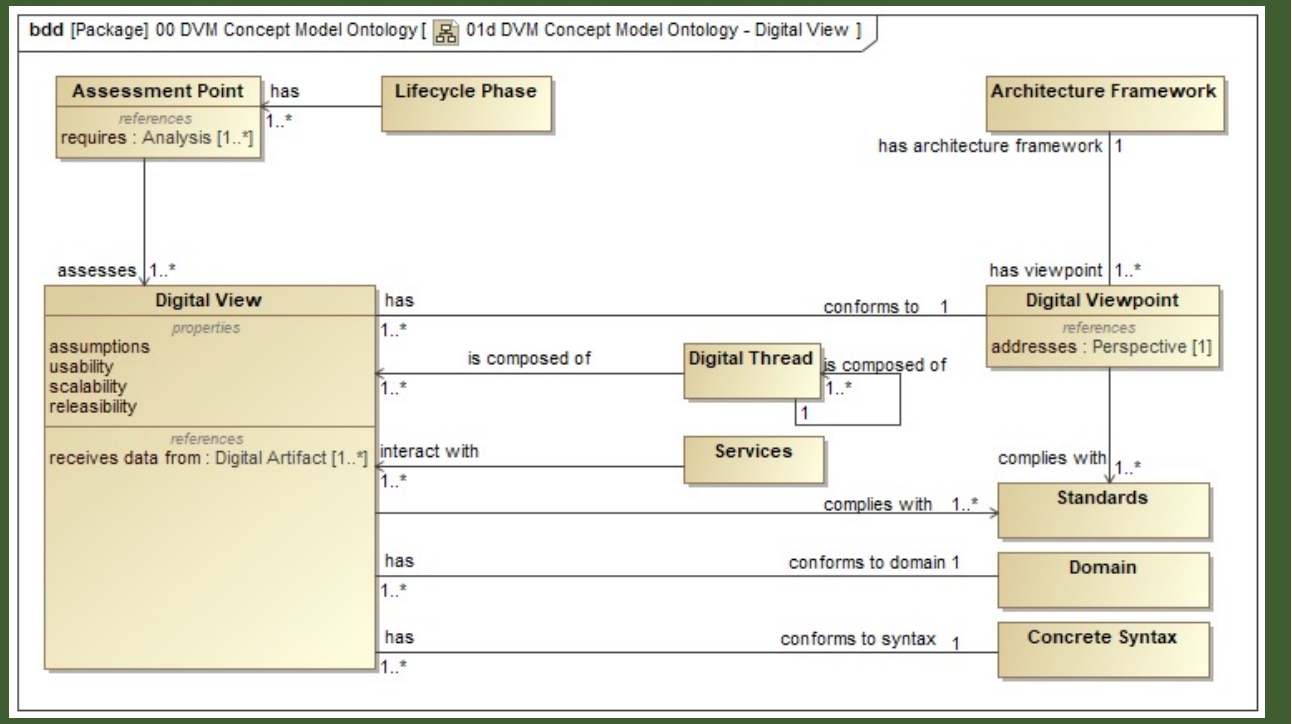
DVM: Stakeholder Concepts Framework

- Describe the stakeholders involved in a given exchange of digital information
- Can be applied to any stakeholders exchanging digital information, whether they are from the same or different organizations
- The perspective defines the specialized stakeholder needs that drive associated work activity and requirements for the digital view



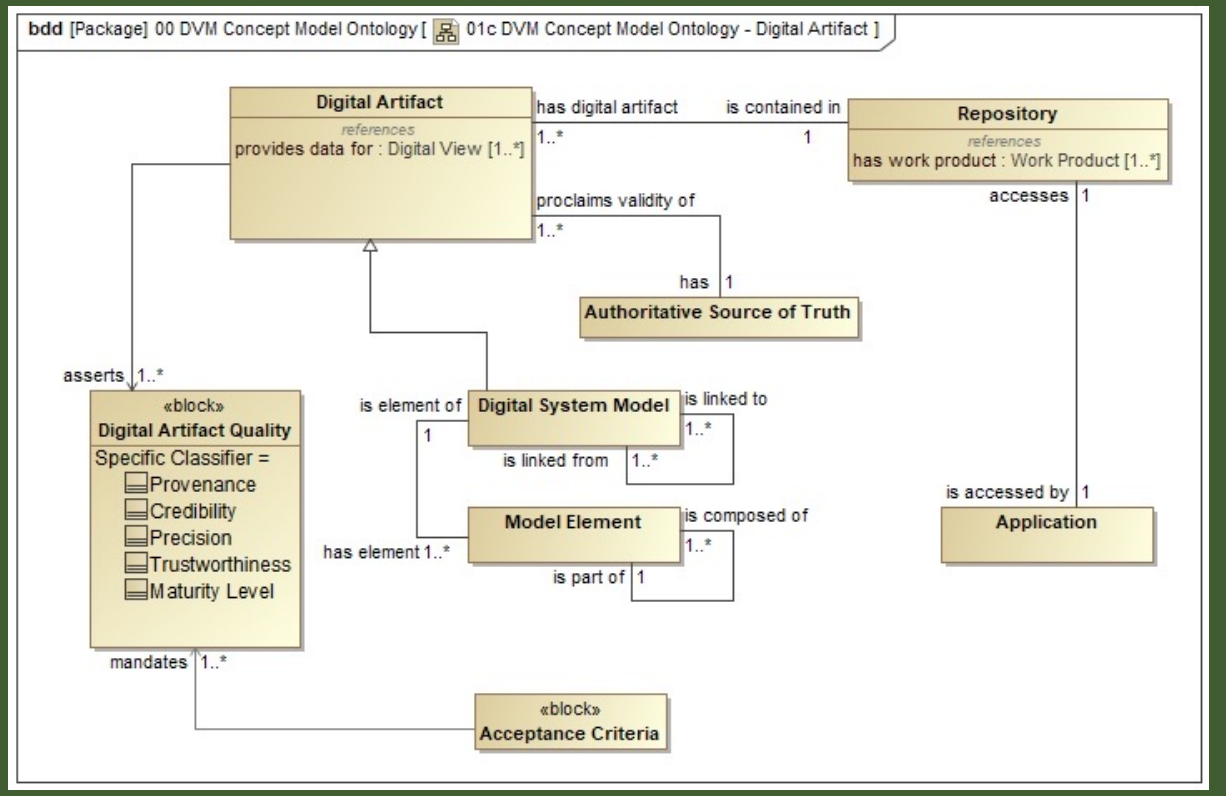
DVM: Digital View Concepts Framework

- This framework specifies concepts used to describe
  - Specify concepts describing digital views
  - Specify applicable standards and syntax
  - Influence of digital views in system life cycle
- The relationship between digital views and viewpoints is specified
- New digital views and viewpoints can be conceptualized as extensions of these base concepts



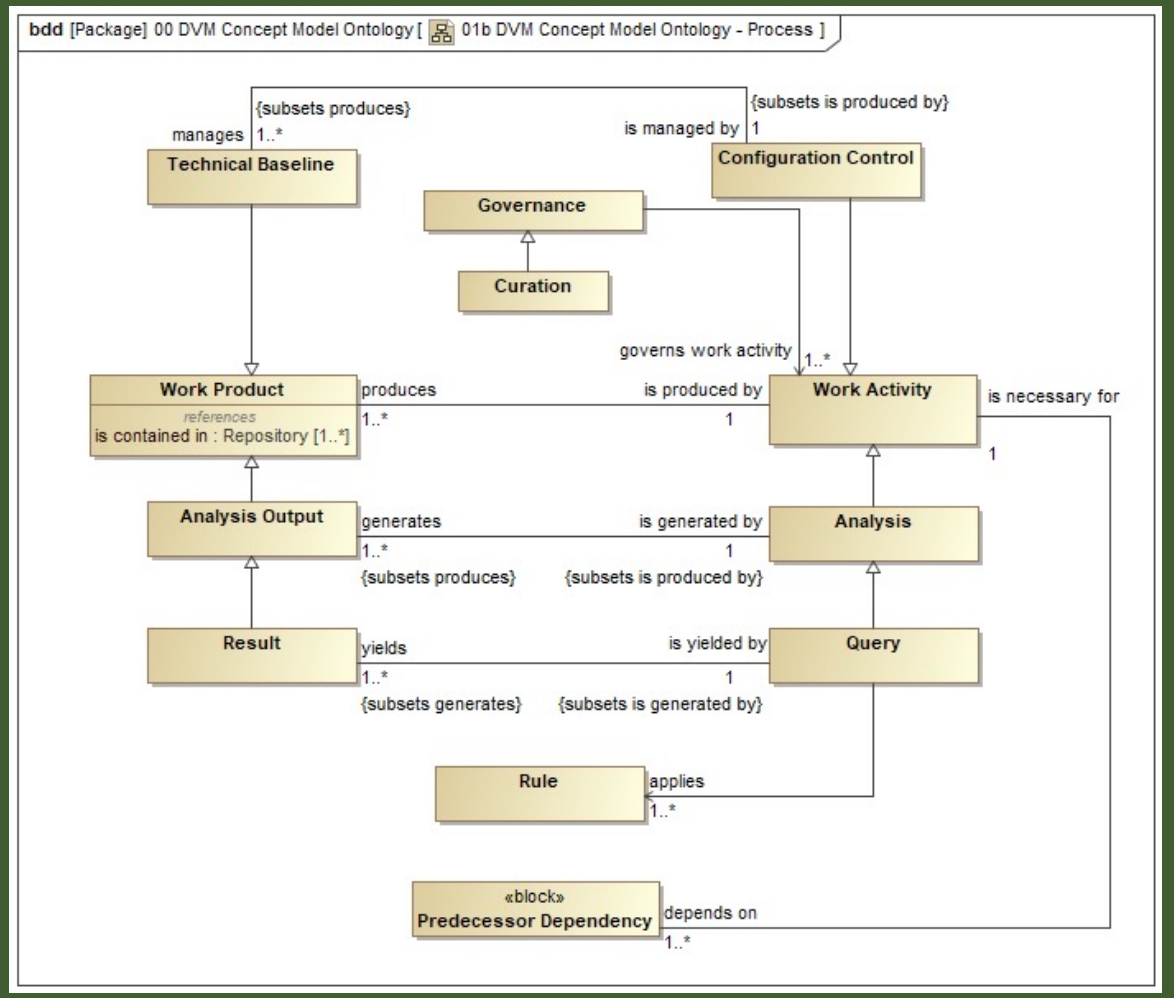
DVM: Digital Artifact Concepts Framework

- Describe the kinds of digital information (models, databases, etc.) that comprise a digital artifact to be exchanged
- Shows how repositories and authoritative sources of truth critical in specifying pedigree of digital artifacts
- Enables specification of digital artifact quality mandate by acceptance criteria



DVM: Process Concepts Framework

- This framework specifies concepts used to describe work products and the activities that produce them
- Some specialized kinds of work products and activities can be specified
- The concepts of governance can dictate how work activity should be performed



Example Usage of DVM Framework

Use Case

- DEIXWG has been working with INCOSE partners and communities to identify opportunities for DVM usage and the benefits
- A US Navy organization has reviewed the DVM and presented results of a study at the 2023 NDIA SME conference on their use of it

Capability/Maturity Gaps at the Engineering Organization Level

- Current guidance focuses on service-level objective and systems engineering process, leaving Digital Engineering definitions **up to local interpretation**
- Enterprise **lacks clarity** of end user **Engineering Lifecycle Management** requirements
- Working level organizations **lack a common framework** around which they can base ontologies, needs, and applications
- Leadership has no clear picture of who provides the **demand signal for evolution** at the working level
- Numerous silo'd DE initiatives **fail to align their challenges or successes** to be leveraged across organizations

Addressing the Capability/Maturity Gaps

- One of the US Navy organizations established a **Digital Engineering Framework (DEF)** that will align practices, products, and resources
  - Processes and methodologies in developing DE products/artifacts
  - Tool selection and mechanism associated with the tools
- Envisioned Benefit of DEF implementation:
  - **Collaboration**: Use as a tool for engineering organizations to collaborate on resources
  - **Advocacy**: Use as a method to communicate both individual capabilities and enterprise needs to Navy decision makers or those with authority and resources
  - **Transformation**: Move towards a desired end-state or vision by clearly defining current capabilities and needs
- Does not specify how an organization implements DE, but rather how to ensure a **common logical structure and terminology** can be used
  - Focus on alignment, not enforcement. Purpose is not to tell people how to do Digital Engineering; it is to provide a common organization of information that one should consider when one wants to apply DE practices

Digital Engineering Framework Basics

Digital Engineering Framework

- Reference and Standard
- Definition and Terminology

Implement View

Implementation of Digital Engineering takes an organizational perspective which best communicates to program leads, line management, and command.

How, Why

Artifact View

Artifacts are the products and enabling mechanisms through which data is exchanged and delivered to practitioners, stakeholders, and sponsors.

What, Who

Lifecycle View

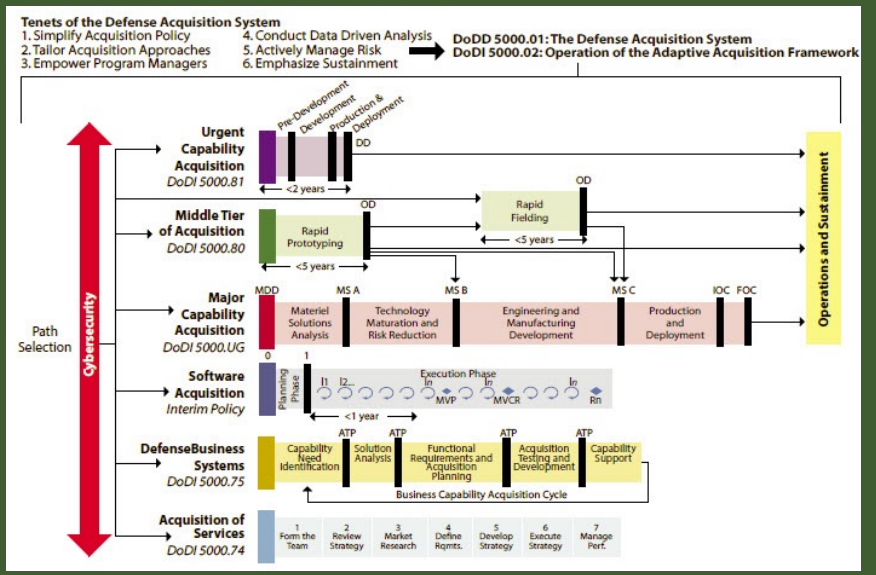
Lifecycles must be supported from system concept through sustainment; Digital Engineering facilitates knowledge integration across the lifecycle

When

[. . .] View

Digital Engineering provides benefits across the SYSCOM enterprise; other views may provide additional benefit in articulating use and benefits of digital evolution.

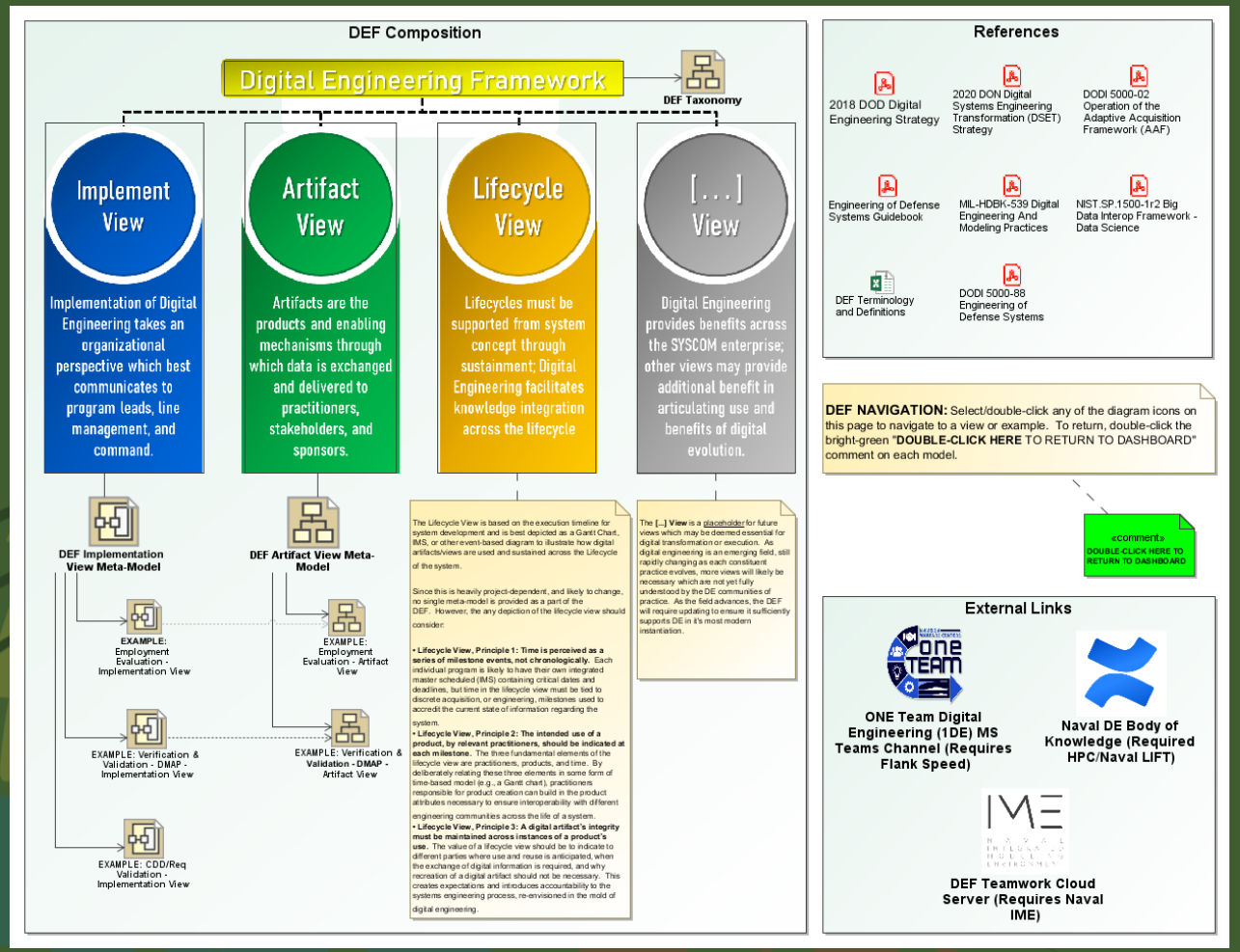
What if



DoDI 5000.02 Adaptive Acquisition Framework

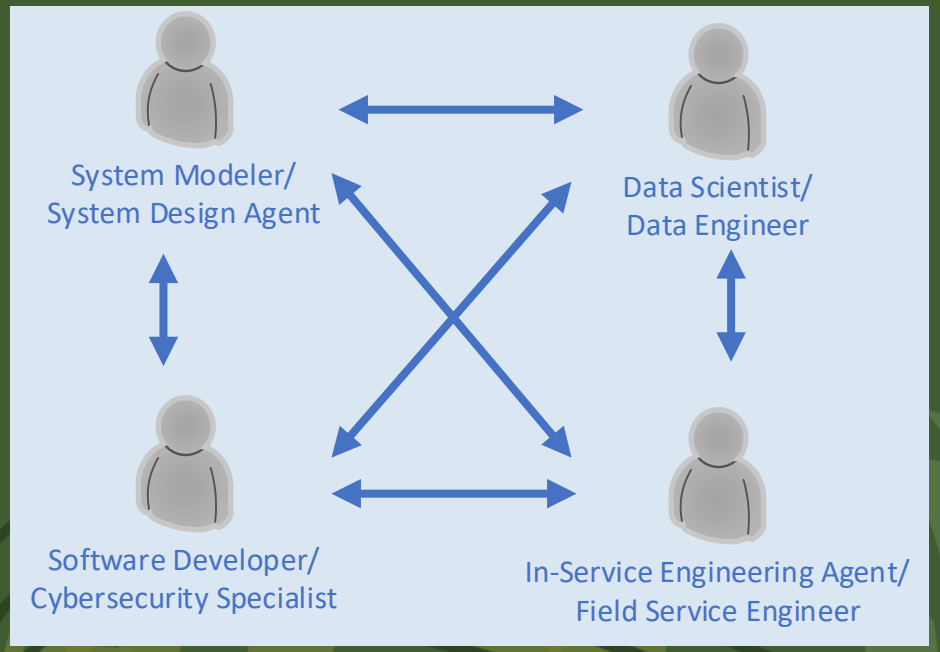
Digital Engineering Framework assists in defining the deliverables within the DoDI 5000.02 paths

Digital Engineering Framework Basics



- DEF is captured in a SysML model
- Create navigation to guide users between diagrams
- Offer forms to assist users in entering information used to generate diagrams
- Offer a taxonomy of components the community considers as part of DE

Example Challenges in Technical Exchanges



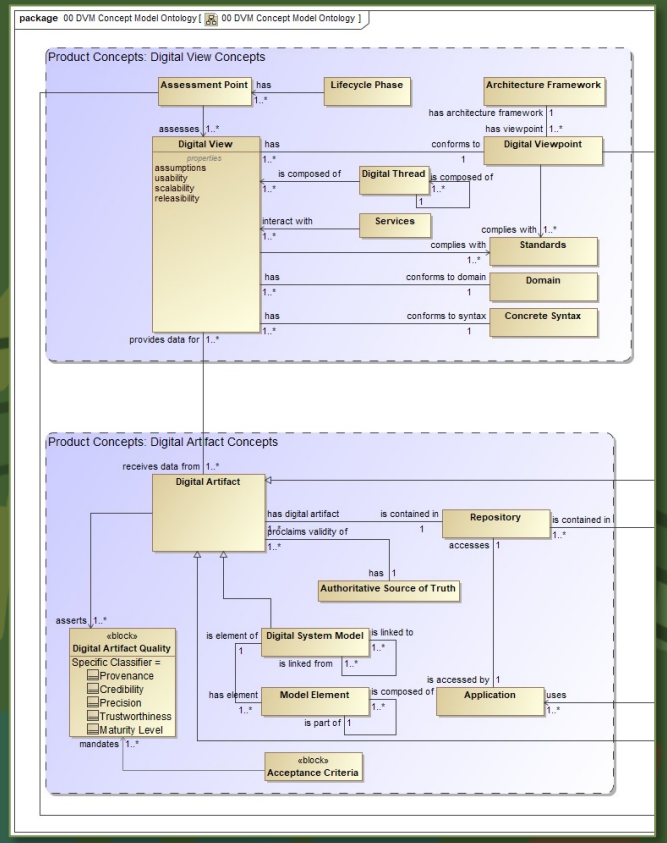
- **Inter-disciplinary data exchange is challenging**
  - Within a single discipline, data analysis is easier because the elements of the model are semantically related to each other via the rules established by the model's governing metamodel
  - When exchanging data across disciplines, it becomes a challenge to relate element between different meta models. The challenge grows exponentially as we add more types of models to the mix
- **Not everyone is a modeler**
  - Need a method for SMEs to view and provide their information without asking them to build block diagrams
- **Need to support any acquisition program as well as day-to-day deliverables**
  - Process/framework needs to be flexible to accommodate different exchange needs

DVM Application for Maturing a Digital Engineering Framework (DEF)

1. Use DVM to develop **Artifact View Metamodel**
2. Use DVM Digital View concept to **digitally transform** Data Management and Analysis Plan (DMAP) into a model
3. Use DVM to better **align product, authority, and mechanism** associated with DMAP

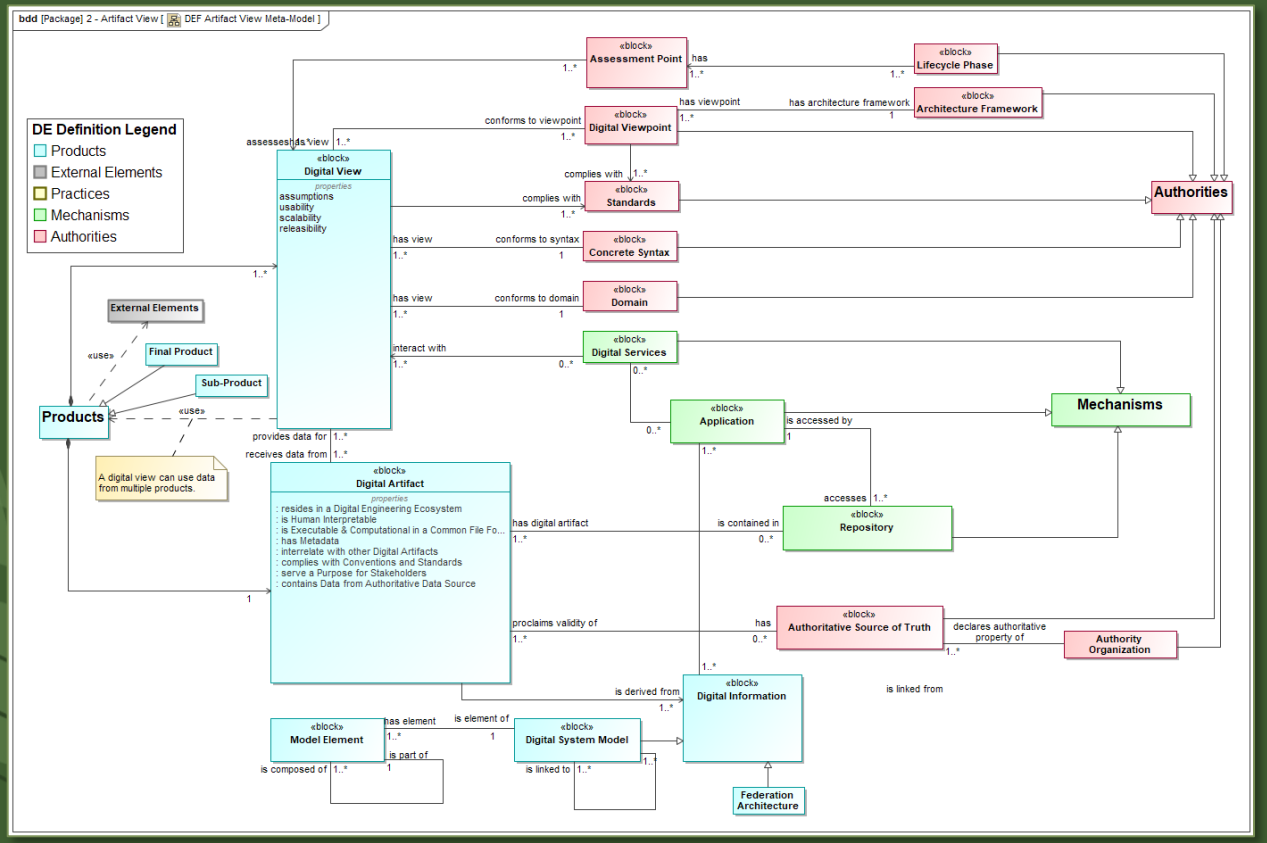
DVM/Artifact Metamodel Framework

- Digital View and Digital Artifact of DVM used as the basis for constructing the DEF Artifact View Model



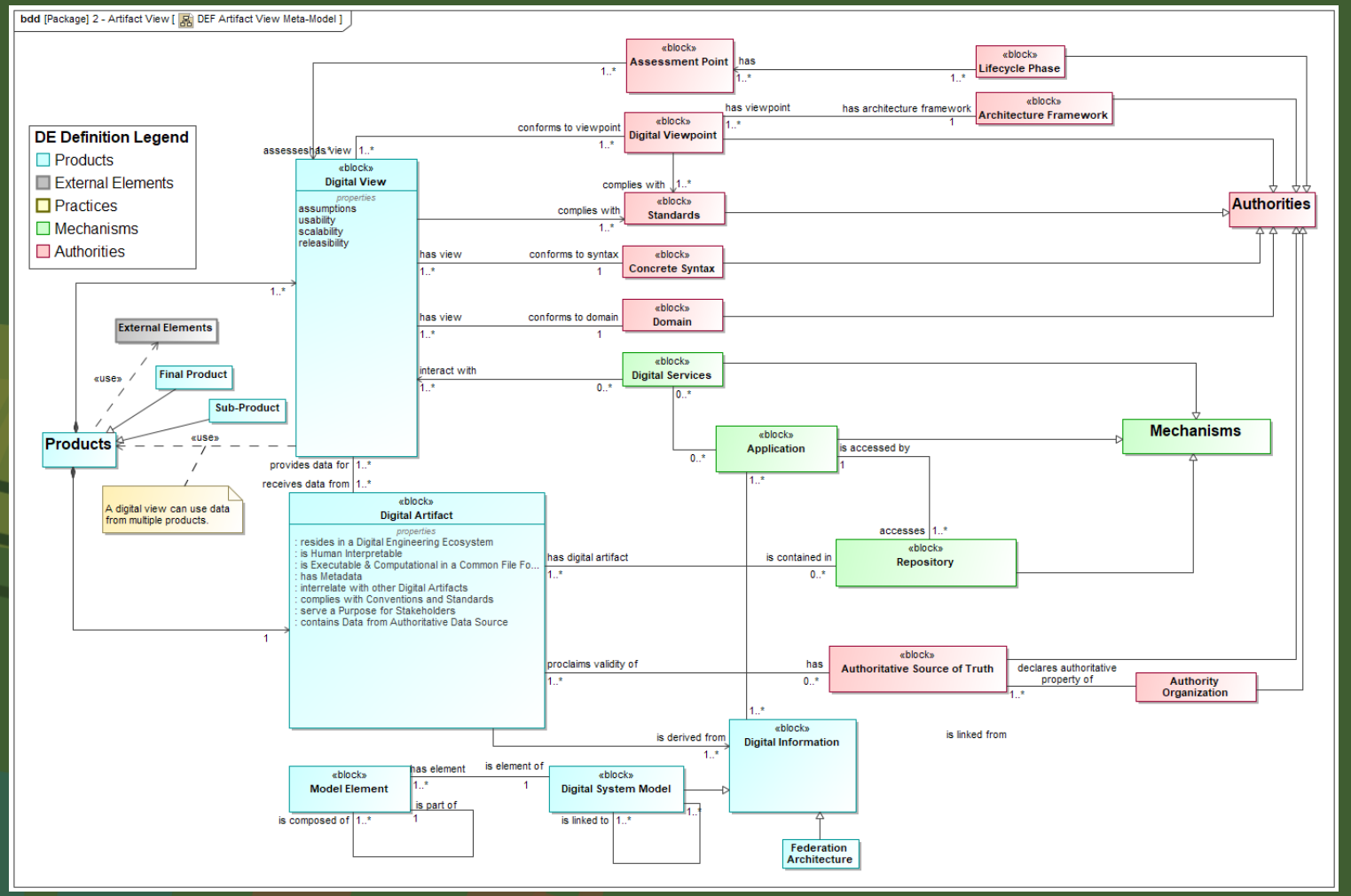
DVM

DEF Artifact View Model



DEF Artifact View Metamodel

Product
Addressing What product and information are created and consumed by the DE effort



Authority
Addressing What organizations, policies, procedures regulate the development of the Digital Artifact

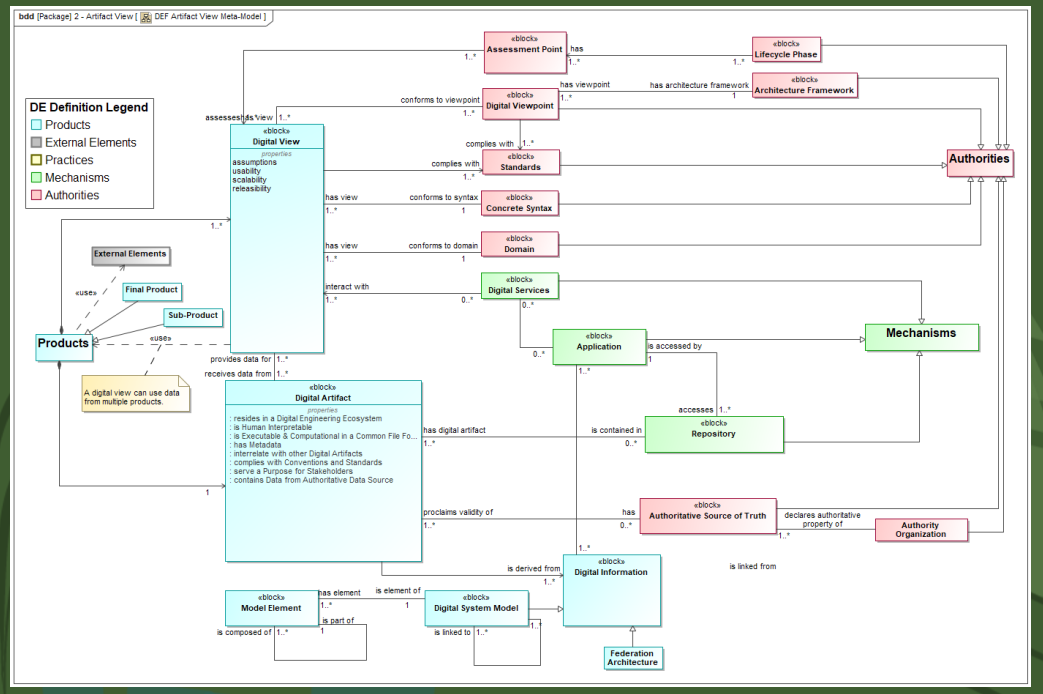
Mechanism
Addressing What resources (service and application) are needed to develop the Digital Artifact

Digitally Transforming the Data Management and Analysis Plan (DMAP)

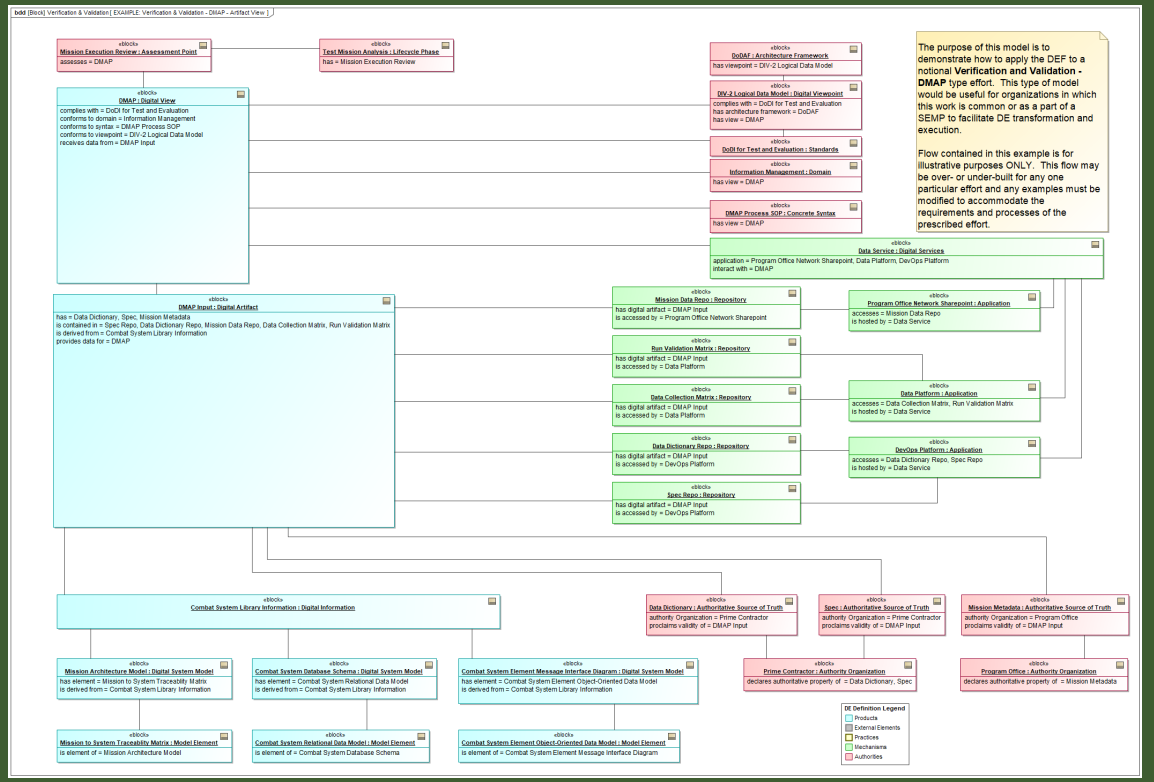
- DMAP is traditionally a document artifact driven by manual process
  - Format and process could vary among events, data managers and groups
  - Gathering information requires numerous exchange of emails between organizations
    - Some system information need to be retrieved from a contractor's data environment
  - Frequent update may cause confusion
  - New sponsor may not have clear picture on how and why DMAP is developed
    - How it ties to acquisition and higher governance
- DMAP provides detailed information on data collected during a test event
  - Test objective
  - Data collection and distribution methodology
  - Data distribution list and timeline
  - Analysis process
  - Analysis deliverable

Digitally Transforming the Data Management and Analysis Plan (DMAP)

- The DVM-based Artifact View Metamodel was used to transform DMAP data requirements into a digital artifact specification



DEF Artifact View Model

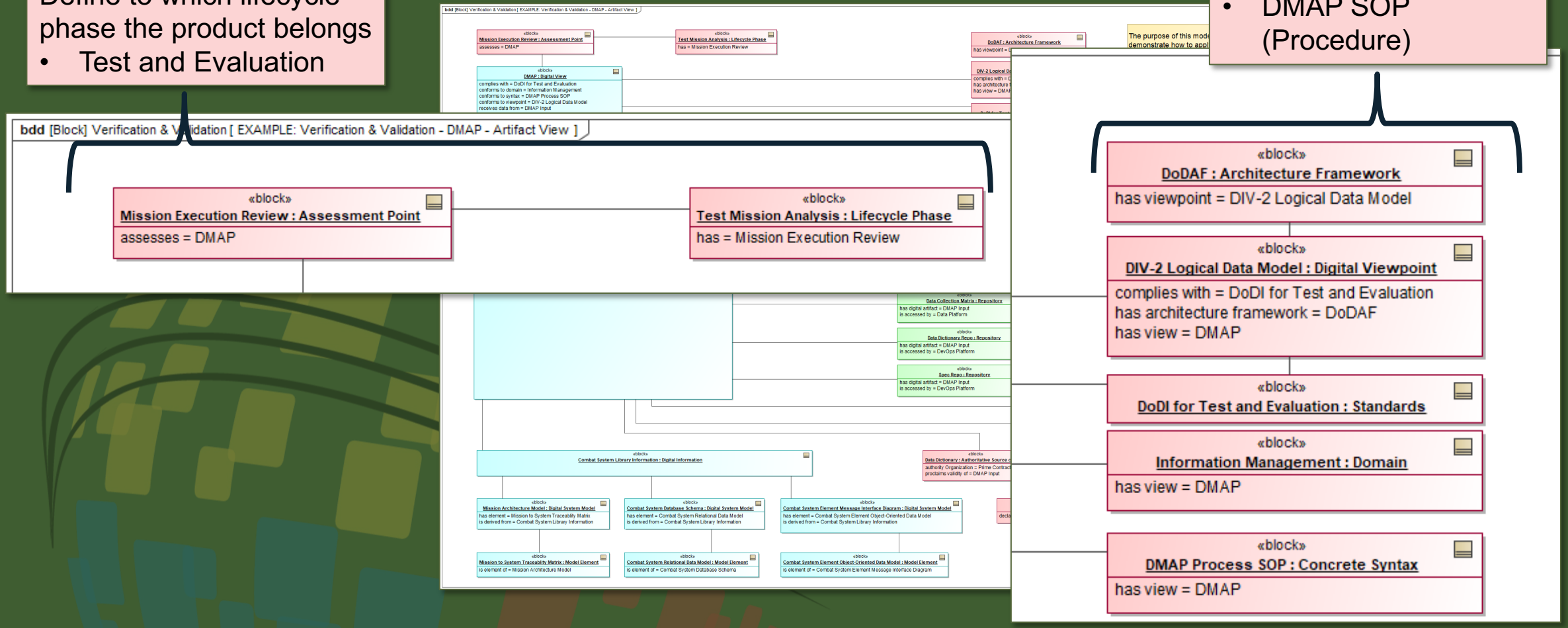


DMAP Artifact View

DEF Artifact View Example

Data Management and Analysis Plan (DMAP)

Define to which lifecycle phase the product belongs
- Test and Evaluation



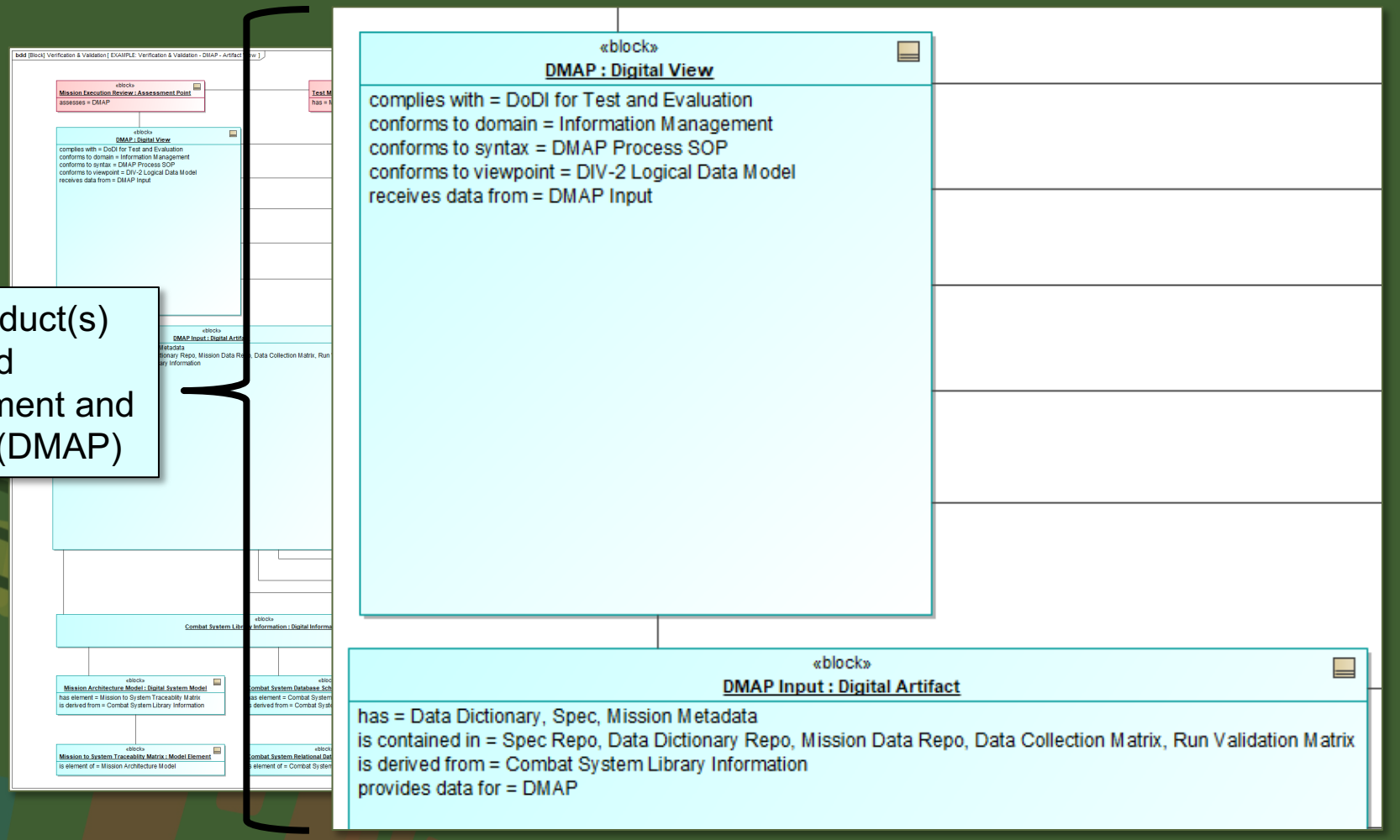
Identify the governance
- T&E Standard (Policy)
- DMAP SOP (Procedure)

DEF Artifact View Example

Data Management and Analysis Plan (DMAP)

Address what product(s) is being generated

- Data Management and Analysis Plan (DMAP)

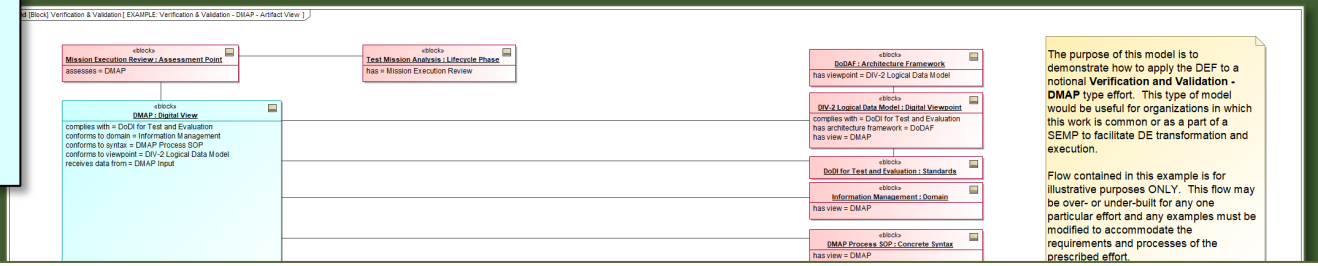


DEF Artifact View Example

Data Management and Analysis Plan (DMAP)

Address what information is needed

- System models
- Data models



«block»
Combat System Library Information : Digital Information

Data Dictionary : A
authority Organiza
proclaims validity

«block»
Mission Architecture Model : Digital System Model
has element = Mission to System Traceablity Matrix
is derived from = Combat System Library Information

«block»
Combat System Database Schema : Digital System Model
has element = Combat System Relational Data Model
is derived from = Combat System Library Information

«block»
Combat System Element Message Interface Diagram : Digital System Model
has element = Combat System Element Object-Oriented Data Model
is derived from = Combat System Library Information

«block»
Mission to System Traceablity Matrix : Model Element
is element of = Mission Architecture Model

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Combat System Relational Data Model : Model Element
is element of = Combat System Database Schema

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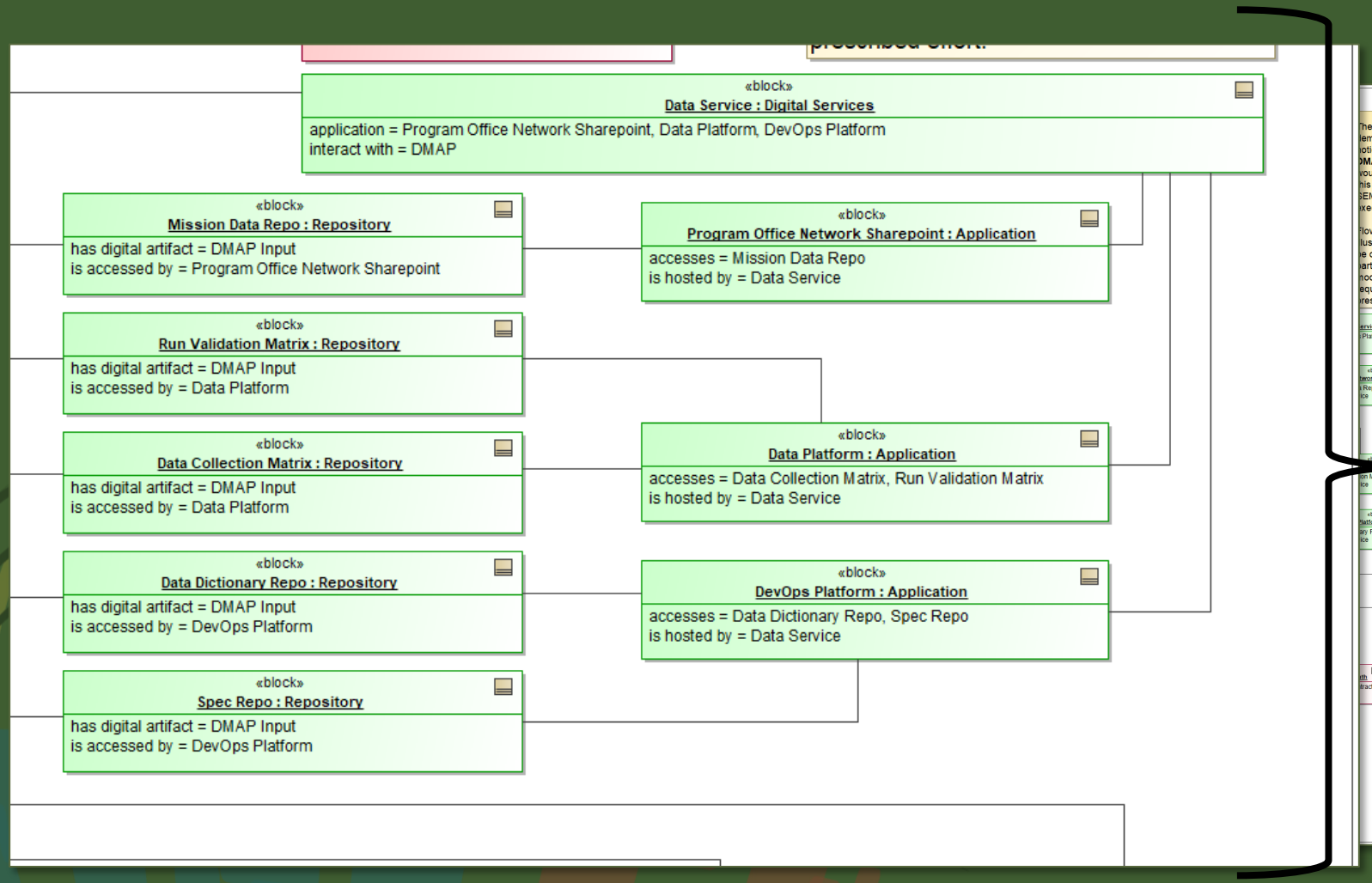
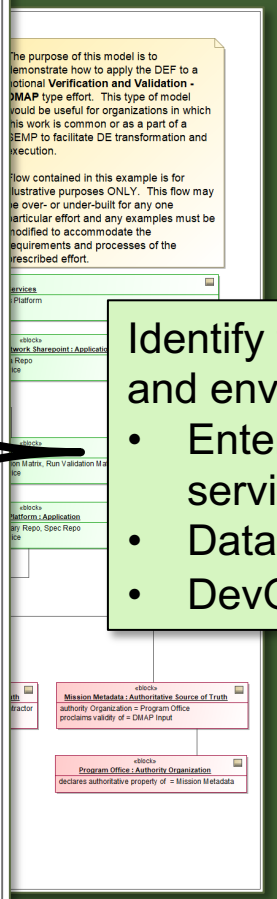
Combat System Element Object-Oriented Data Model : Model Element
is element of = Combat System Element Message Interface Diagram

DEF Artifact View Example

Data Management and Analysis Plan (DMAP)



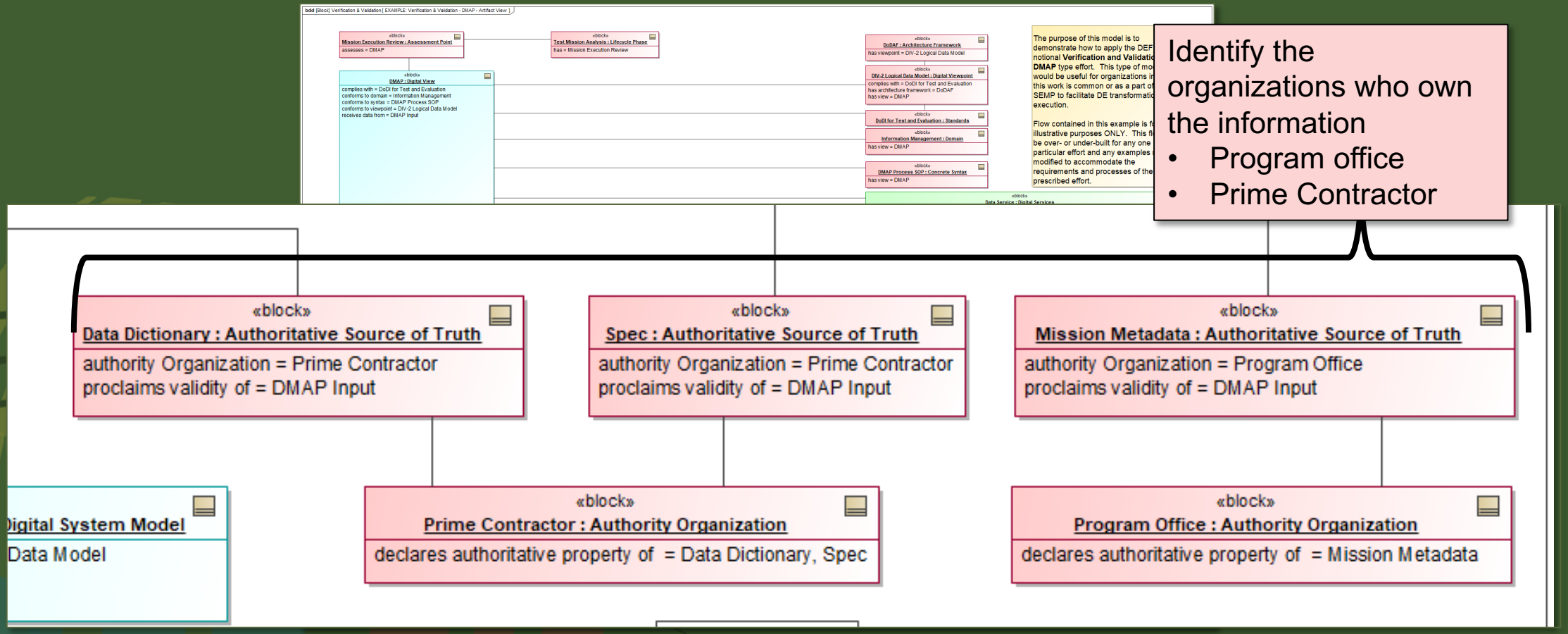


Identify the services and environments used

- Enterprise data service
- Data Environment
- DevOps Platform

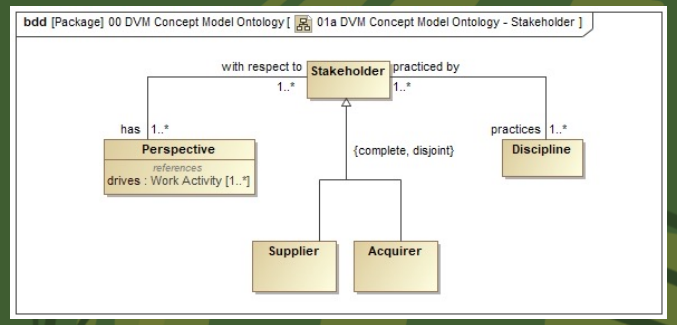
DEF Artifact View Example

Data Management and Analysis Plan (DMAP)

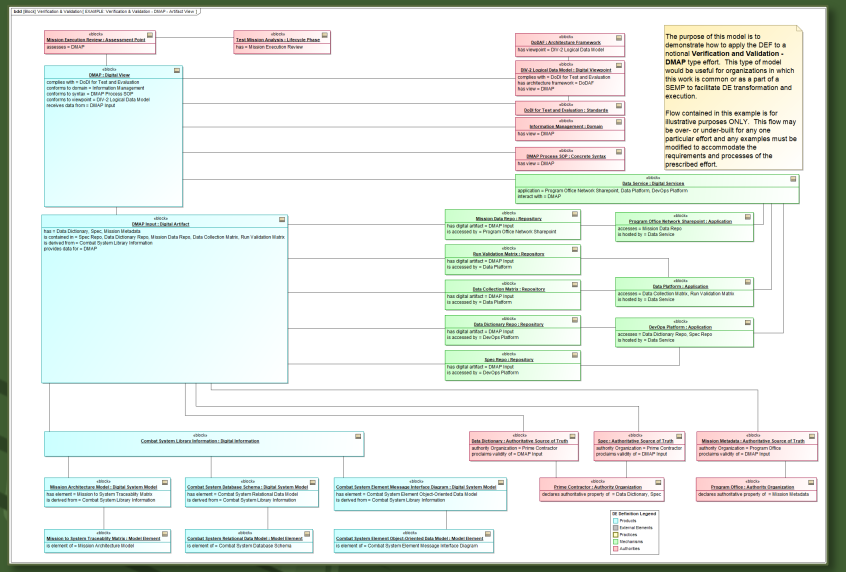


DMAP Stakeholder and Process

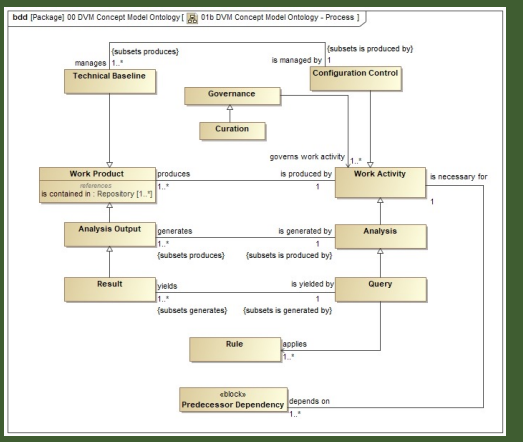
- Using the DMAP Artifact View, extend to leverage the DVM Stakeholder and Process framework to better define
  - Stakeholder needs
  - Process structure



DVM Stakeholder Framework



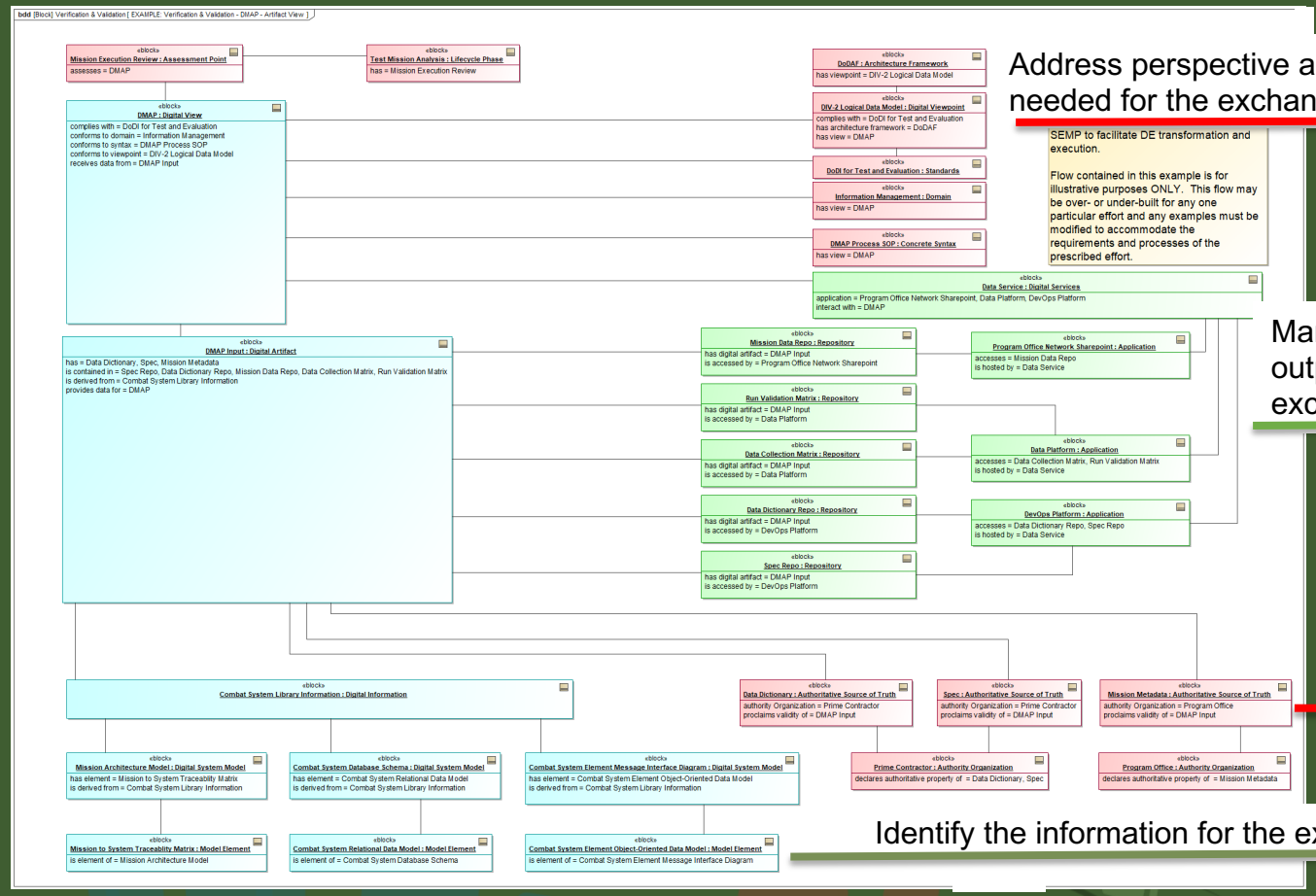
DMAP Artifact View



DVM Process Framework

DEF Artifact View Example

Extending to full DVM



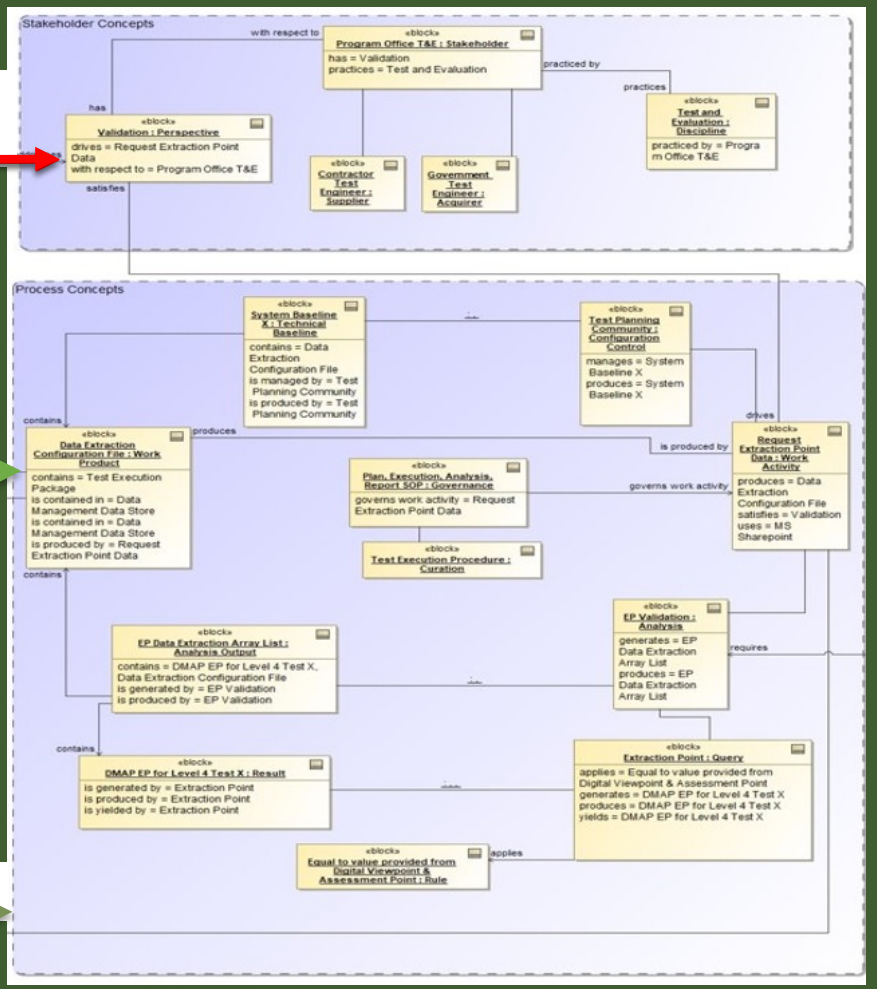
Address perspective and parties needed for the exchange

SEMP to facilitate DE transformation and execution.

Flow contained in this example is for illustrative purposes ONLY. This flow may be over- or under-built for any one particular effort and any examples must be modified to accommodate the requirements and processes of the prescribed effort.

Manage the output of the exchange

Identify the information for the exchange



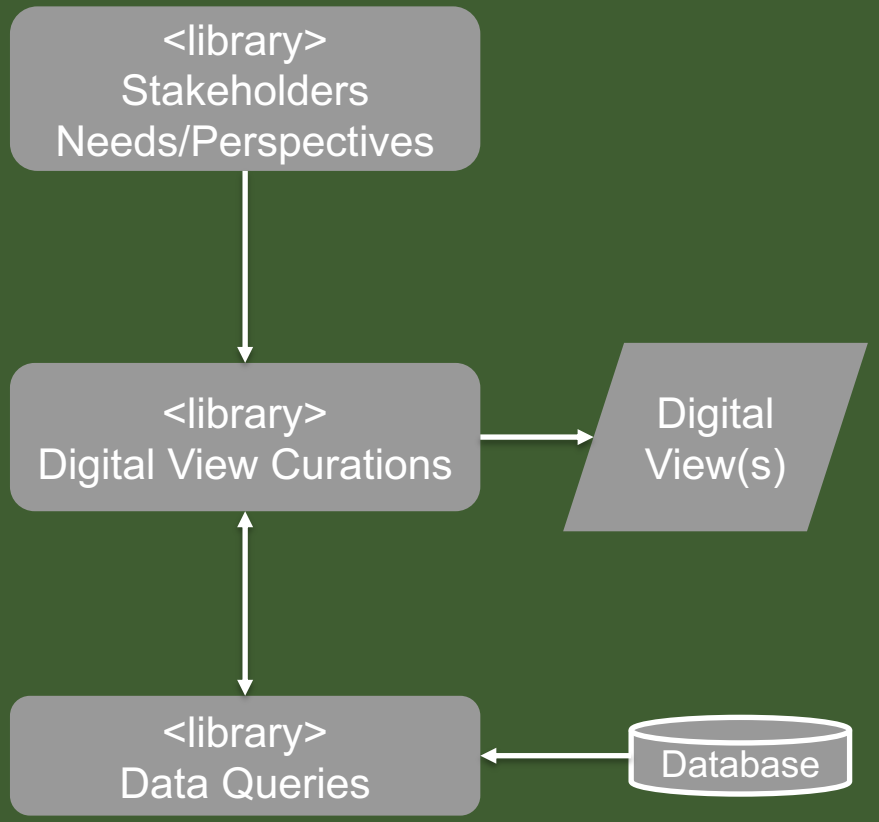
Having DMAP as a DVM allow clear representation on how information could be exchanged in a DE ecosystem

Future efforts

- Enhance utility of DVM for Digital View curation
  - Usage demonstration of DVM thus far has been “paper exercises,” it can be enhanced with inclusion of scripting/automation
- Concept of “Digital View Curator”
  - Use the DVM framework to define what constitutes a view for a particular perspective, then build reusable queries to retrieve data from a model to generate view(s) automatically
  - While the DVM is not meant to generate a set of all-purpose digital views, it can be used to generate a library of view curations for an organization

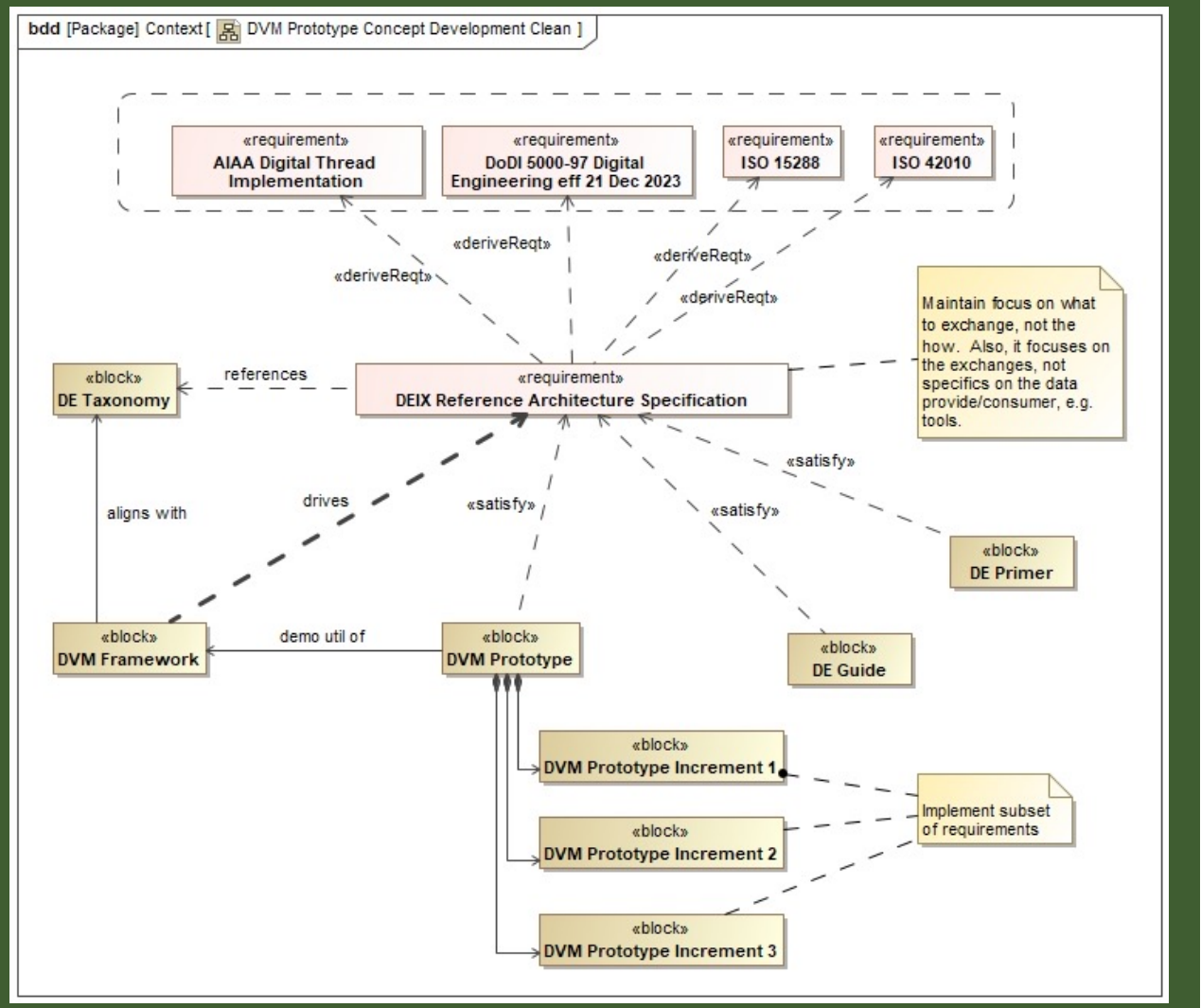
Future efforts

- Digital View Curator
  - Users: Stakeholder, Digital View Curator, Digital Data Owner
  - CONOPs
    - Stakeholders define stakeholder needs/perspective using a GUI form; based on standard Use Case definition form used at IW 2022 workshop
    - DV Curator reviews the stakeholder needs, uses a GUI to define the digital view(s) require to meet the needs. The tool allows for creation of new DV template or modification of existing ones. DV template is based on the DVM framework (primarily the Digital View quadrant)
    - DV Curator creates or selects data queries (GUI/scripts) to define and get data required to construct the digital views
    - Run curation scripts to generate the digital views, which can be a collection of diagrams, tables, graphics, raw data, etc.



Future efforts

- Digital View Curator
  - Development of the **DEIX Reference Architecture Specification** is in progress; 84 requirements written
  - Primarily to drive future development of Digital View Curator prototypes
  - Secondary as an artifact for organization to use to develop their own view curator capabilities



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