

## Systems Engineering Research Center (SERC)

# SysML-based, Collaborative Research Project Management

By:

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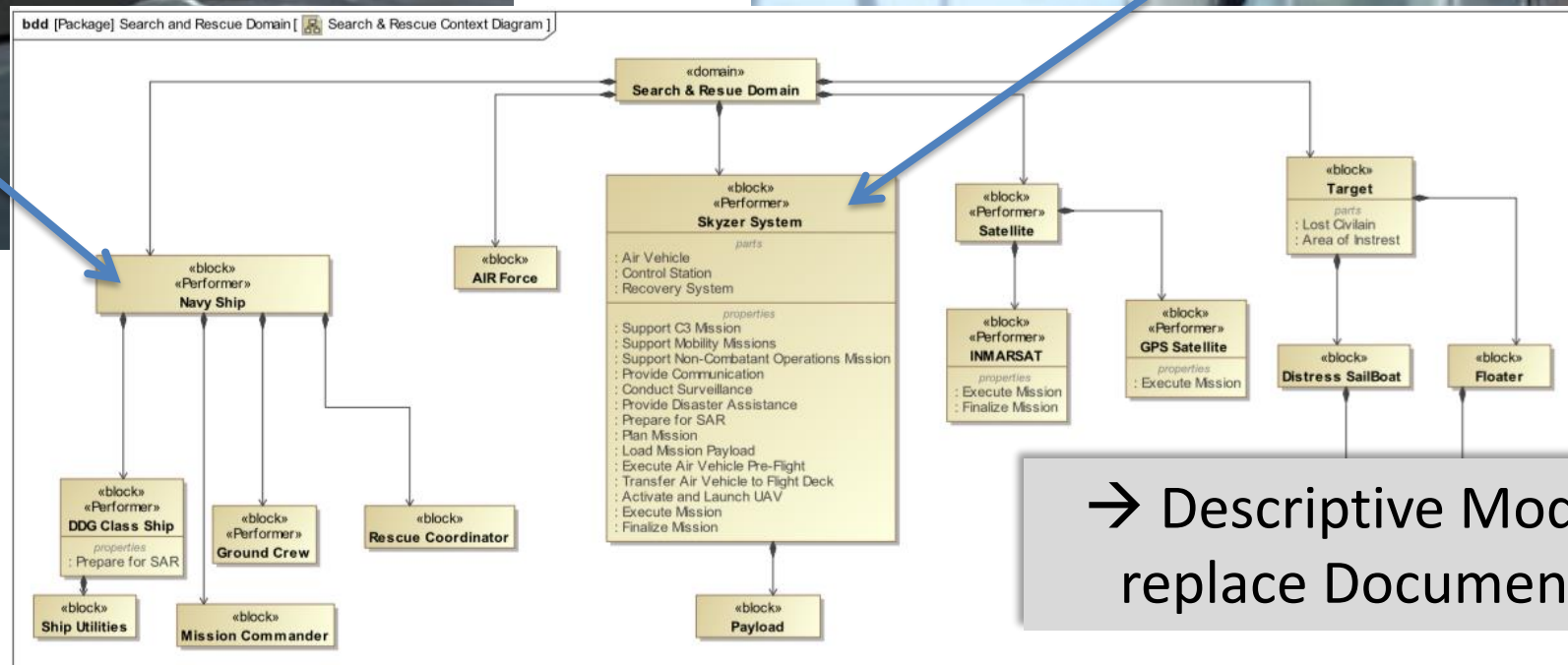
- Surrogate Pilot Research Project
  - What is OpenMBEE?
- Why having a Project Model in SysML?
- Project Ontology & Aligned SysML Profile
- Research Project Model in SysML
  - Assignments
  - Roles
  - Accomplishments
  - Model-based Report Generation
- Semantic Representation and Reasoning

- Execution of NAVAIR's Systems Engineering Transformation (SET) Framework
  - As part of the Systems Engineering Research Center (SERC) Research Task (WRT-1008)
- To simulate collaboration in an Authoritative Source of Truth
  - Implemented by **OpenMBEE** = Open Model Based Engineering Environment, developed by NASA/JPL
- To support new operational paradigm between government and industry
  - By elimination of paper artifacts and large-scale design reviews in favor of continuous insight/oversight via the digital collaborative environment
  - Online information available on Apan: <https://www.apan.org/>

Graphical CONOPS Scenario:  
Search & Rescue



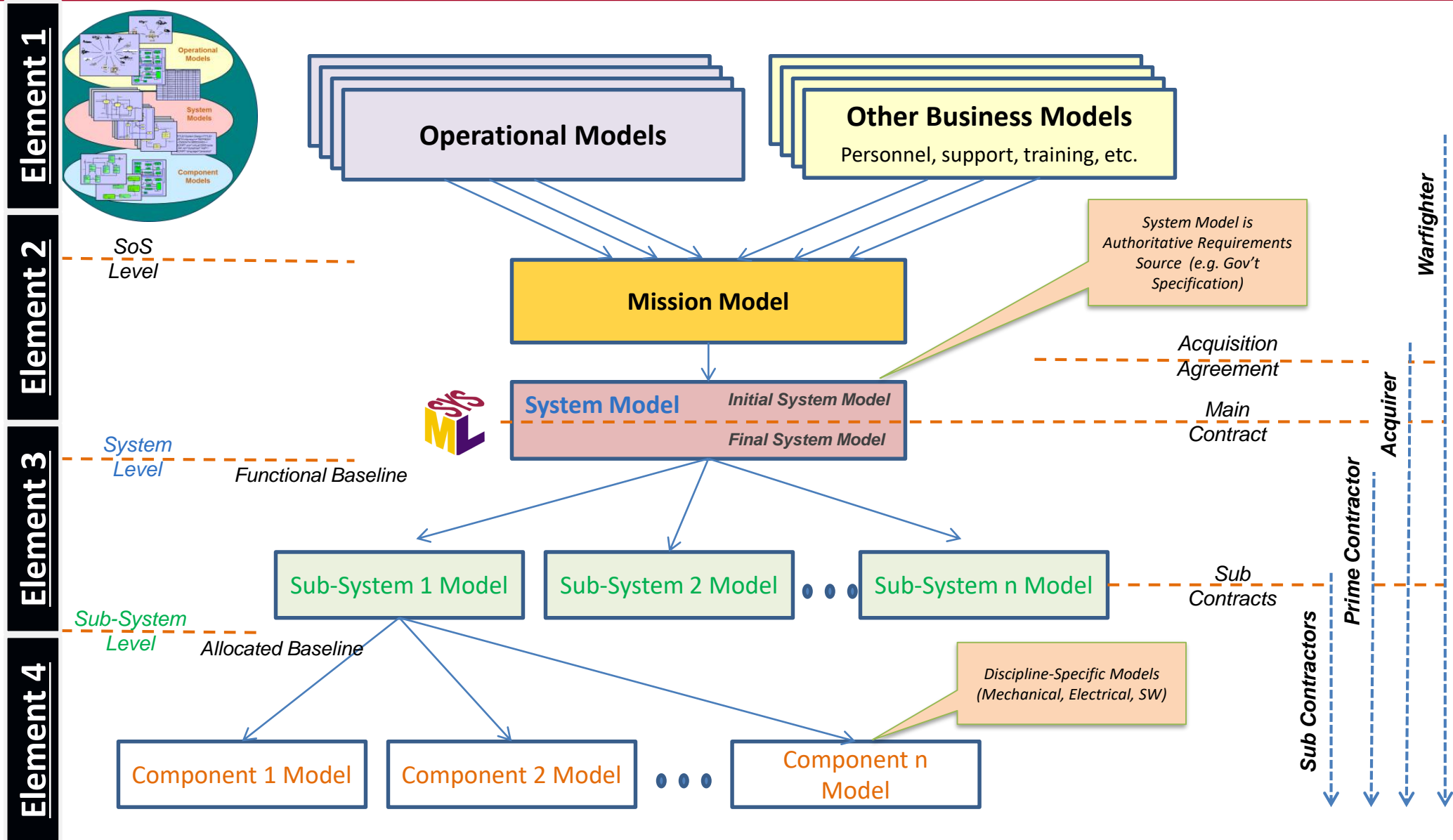
Airfoil designation for a similar Bell tilt-rotor  
(BA609)



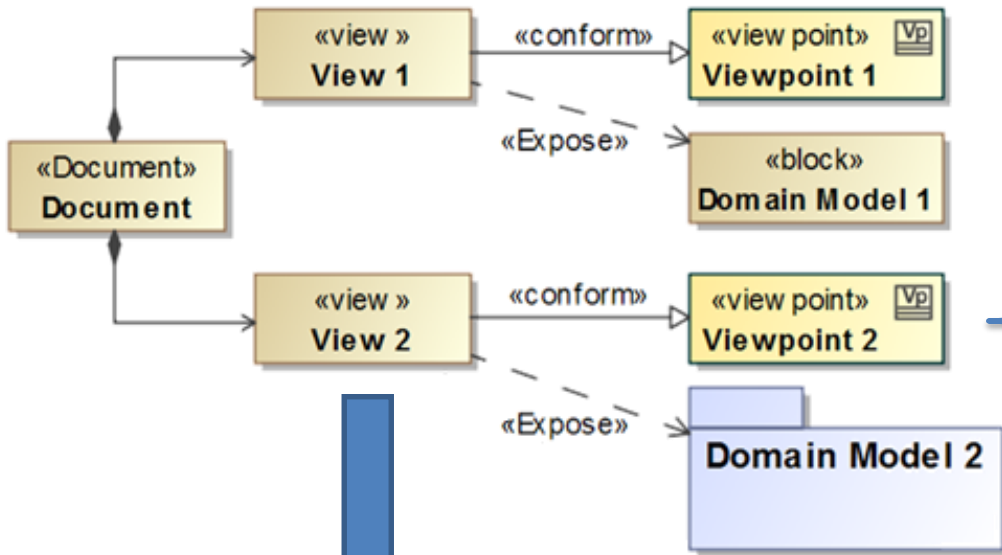
Skyzer System  
& Mission Models  
developed using SysML

→ Descriptive Models  
replace Documents

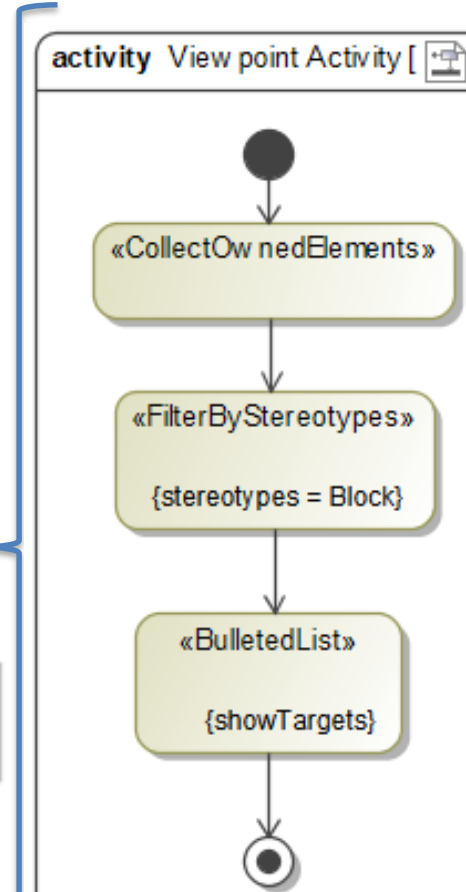
# Demonstrate Formalizing the Use of Models for SET Framework



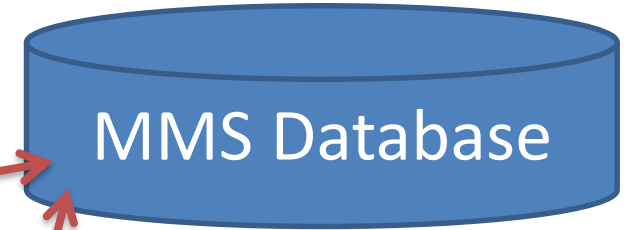
## Model Development Kit (MDK) in Magicdraw: DocGen with View and Viewpoint Hierarchy



Visualization in View Editor



## Model Management System (MMS)



## View Editor

Provides Rich Web Interface

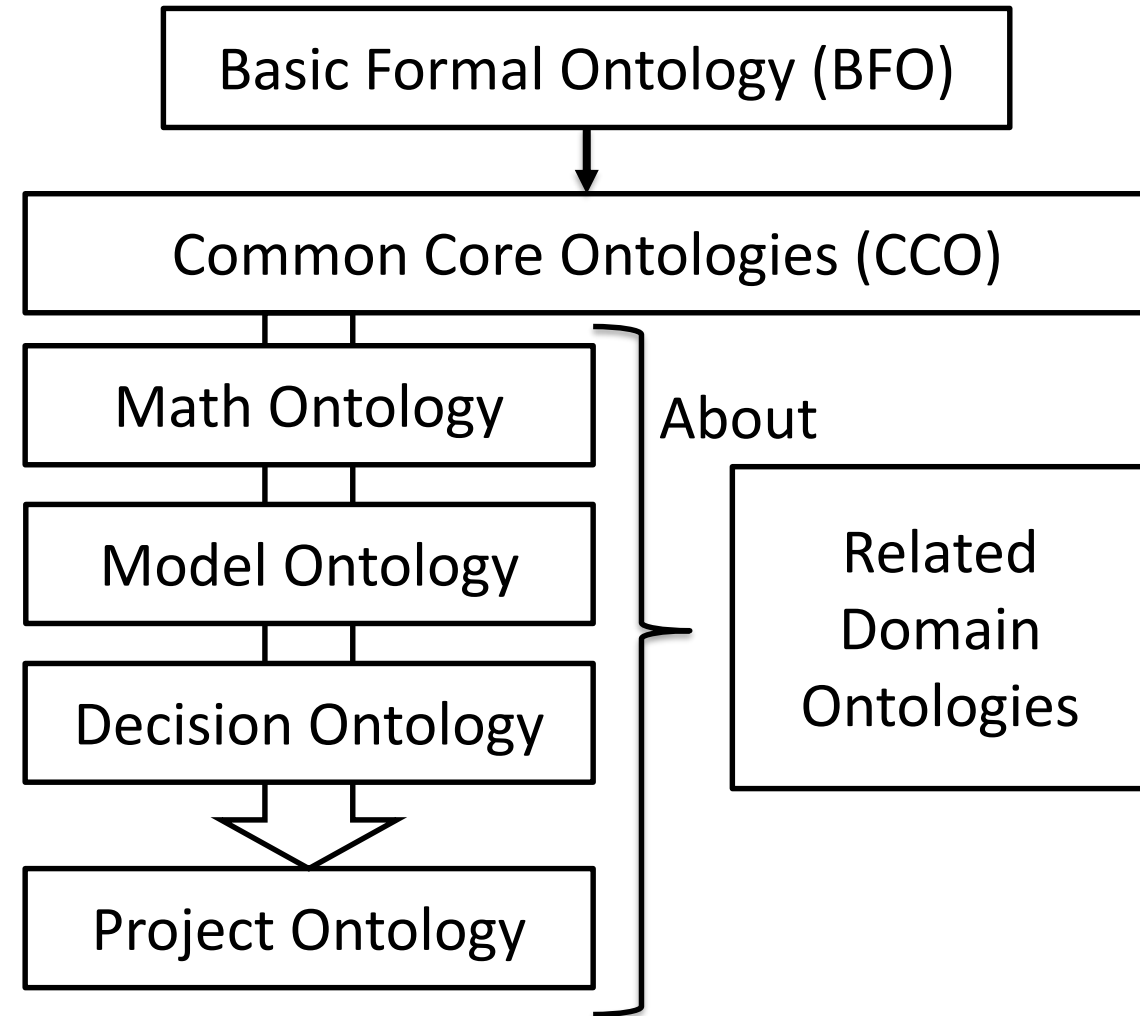
## Chapter 2: View 2

- Block 1
- Block 2
- Block 3

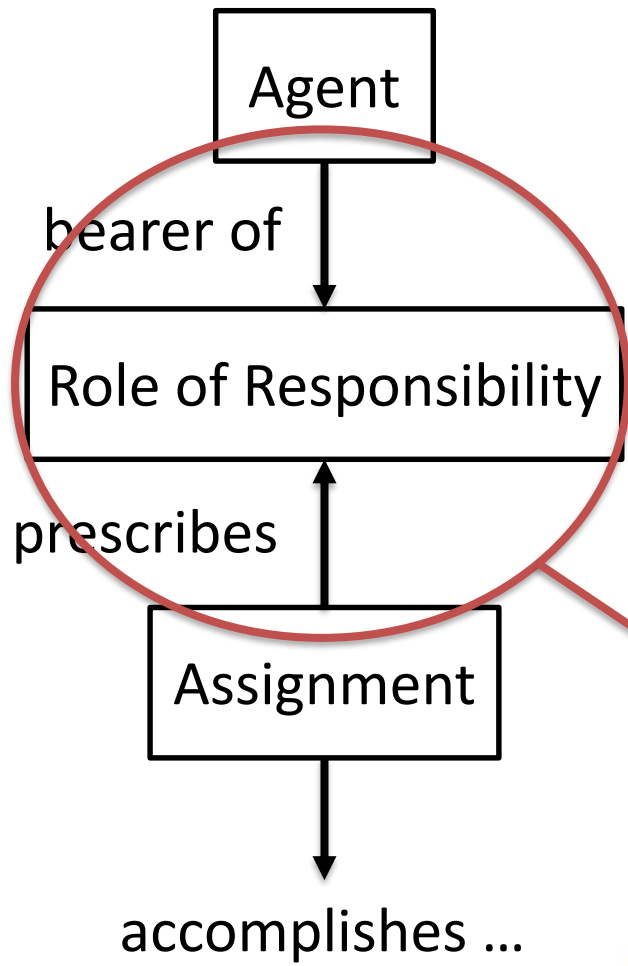
- Utilize View Editor for providing live and consistent data in model-derived views
  - To improve communication also with non-modelers
  - To derive/create requested project status reports
- Clarify and formally capture project details and their interrelations, e.g.:
  - Assignments/Tasks
  - Roles and Responsibilities
  - Accomplishments
- Unambiguous information representation and retrieval enabling semantic reasoning and inferencing about project data
- Practical application of research results within their own project: “eating our own dogfood”
- NOT: Replacement of MS Project or similar tools



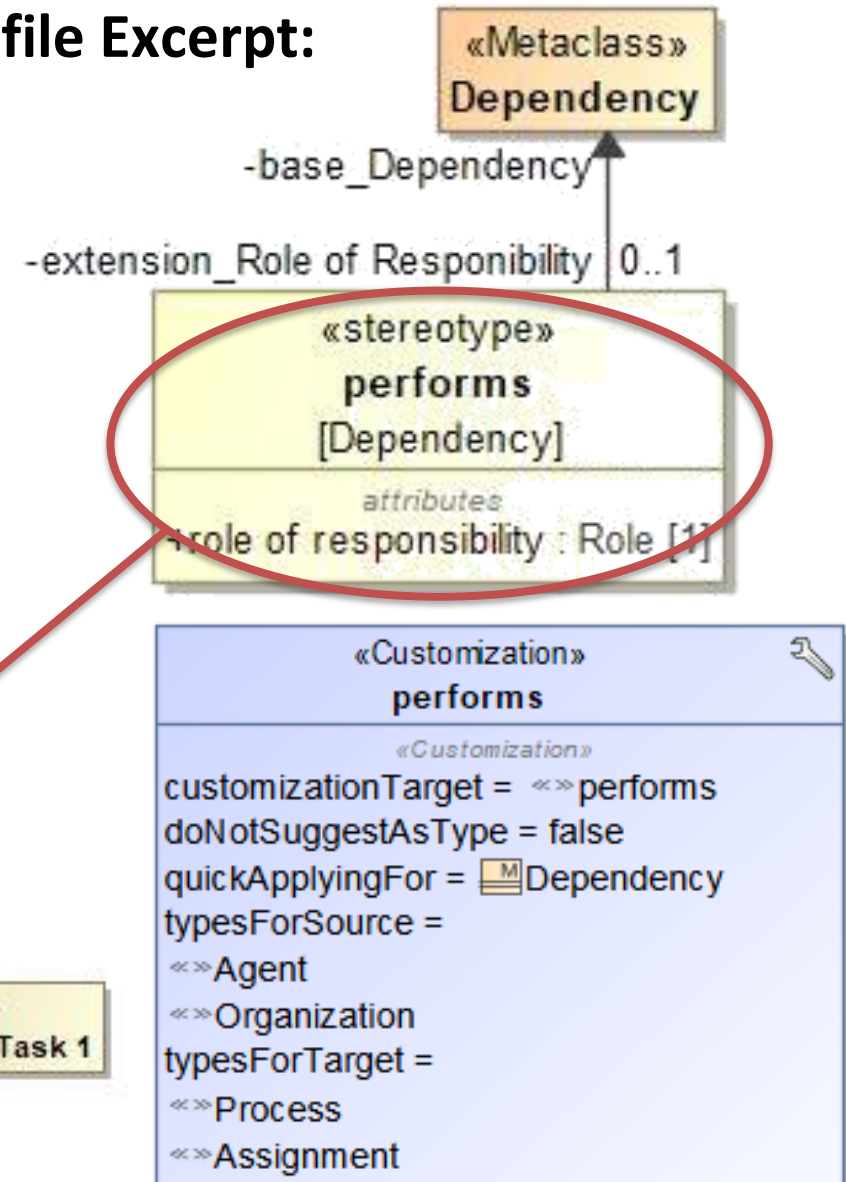
- Part of ontology ecosystem under the Basic Formal Ontology (BFO)
- Formalizes terms for responsibilities, assignments, deliverables, stakeholder roles, etc.
- Provides terminology to relate to project domain information



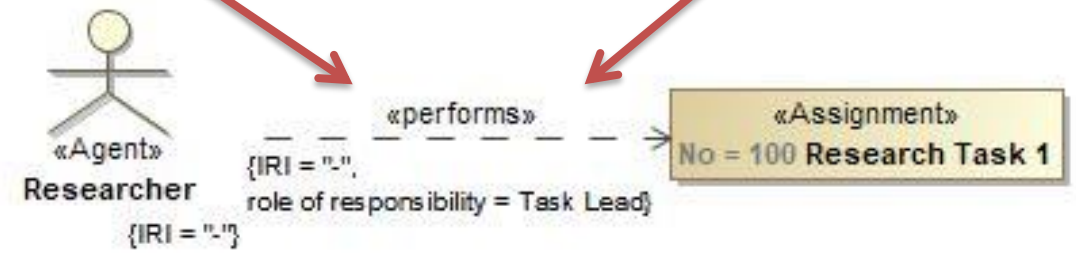
- Project Ontology Excerpt:



- Project Profile Excerpt:



- Seeking a compromise between modeling convenience and parsimonious ontology
- Ontology-based stereotypes provide an unambiguous context to the model required for mapping and reasoning



## Involved Personnel

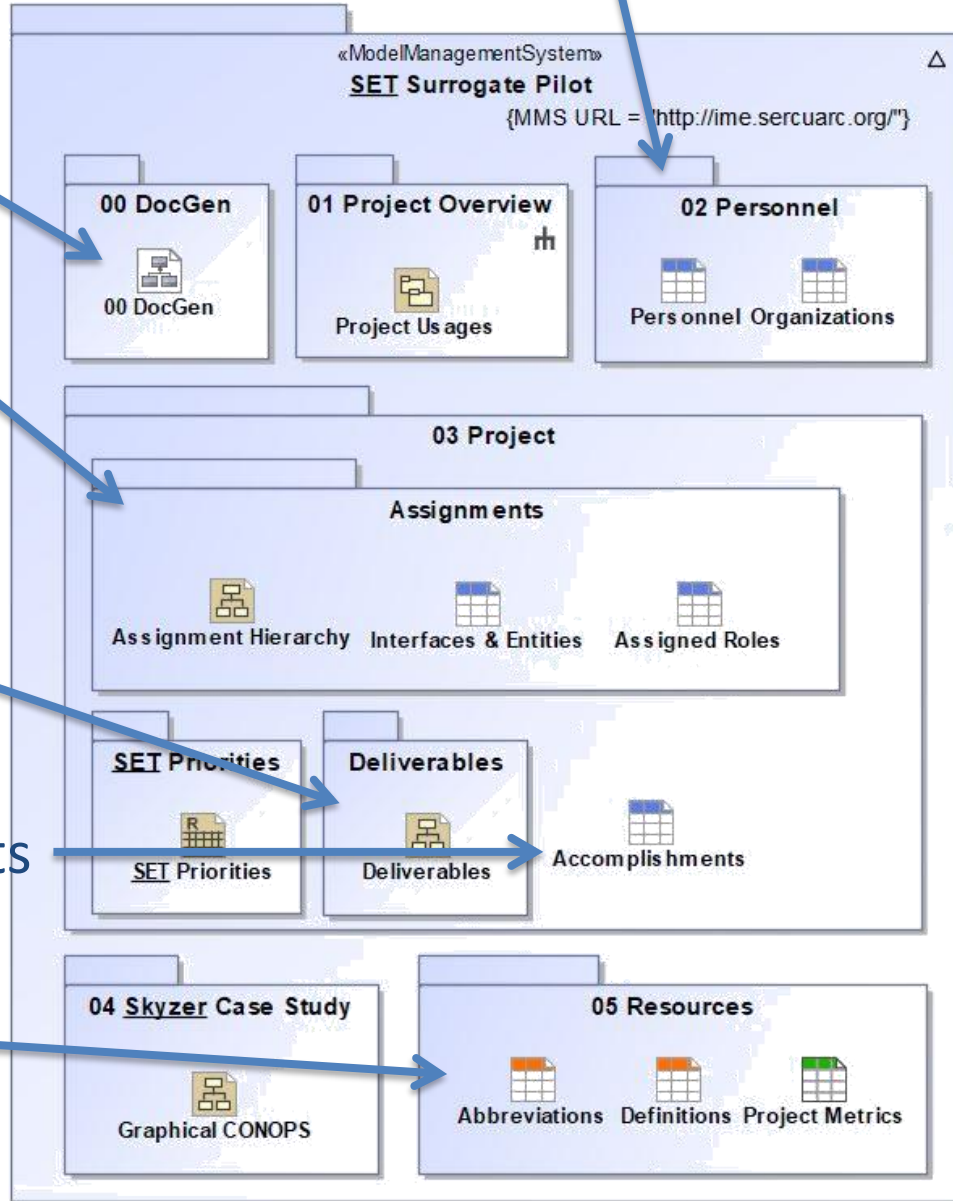
DocGen View Hierarchies

Assignments & Roles

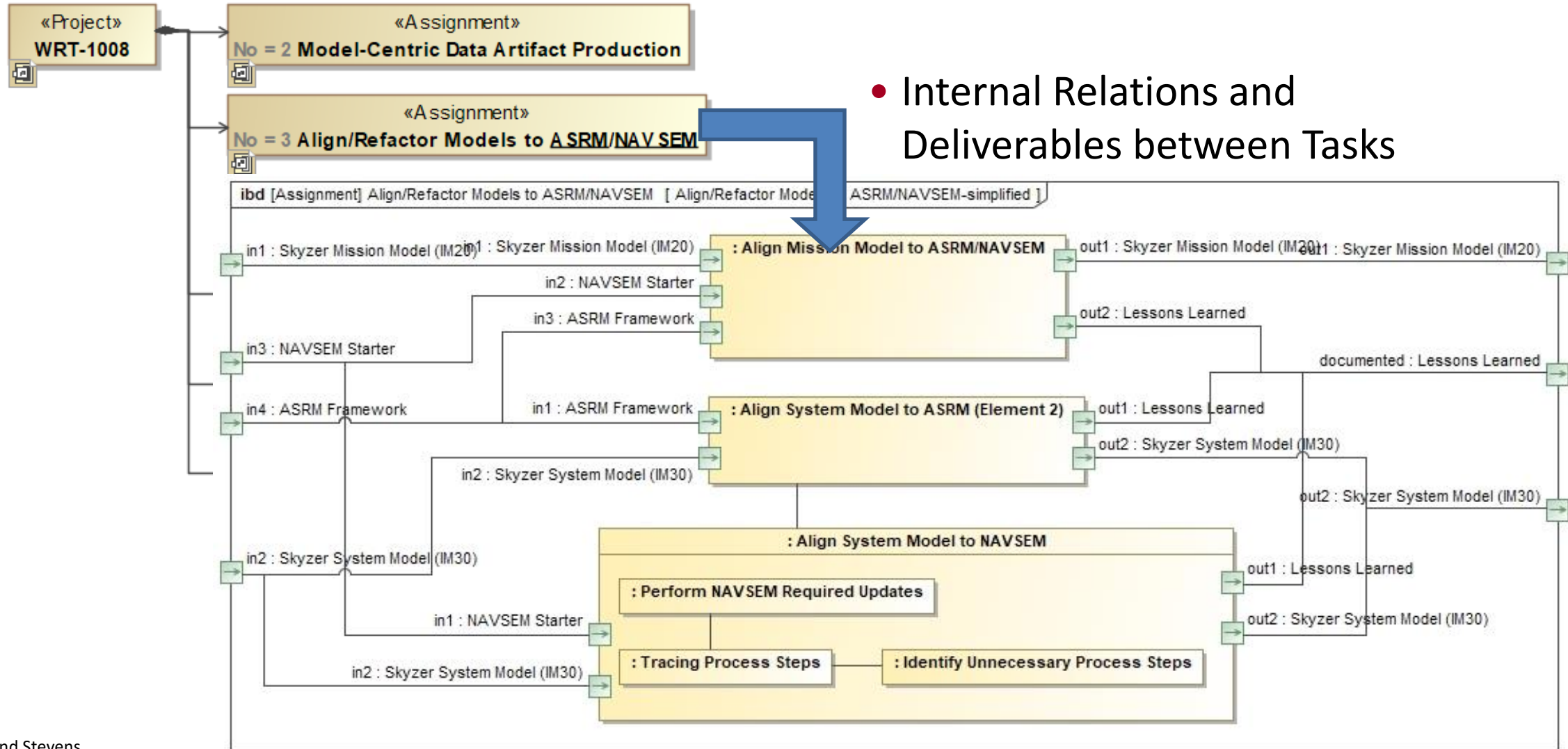
Involved Entities & Deliverables

Accomplishments

Resources & Metrics







- Excerpt of Assignment Hierarchy



- Internal Relations and Deliverables between Tasks



- Assignments with assigned Task Leads and Contributors

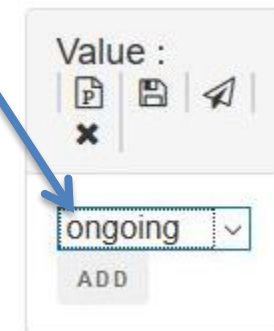
#	△ No	Name	Status	Documentation	Task Lead	Contributor
1	3	 Align/Refactor Models to ASRM/NAVSEM	ongoing	Applies for Skyzer Mission and System models.  System Model: We followed the OOSEM method, and the NAVSEM is not that far away. The only reason ...	♀ Mark Blackburn	♀ Mary Bone ♀ Benjamin Kruse
2	3.A	 Align Mission Model to ASRM/NAVSEM	ongoing		♀ Mary Bone	
3	3.B	 Align System Model to NAVSEM	ongoing		♀ Benjamin Kruse	
4	3.B.1	 Tracing Process Steps	ongoing	- Perform Startup Work (7 Steps - Need to decide how much of this we are going to do.) - Setup Model (6 Steps) - Develop Program Model: -- Develop Program Model (13 steps) ...		

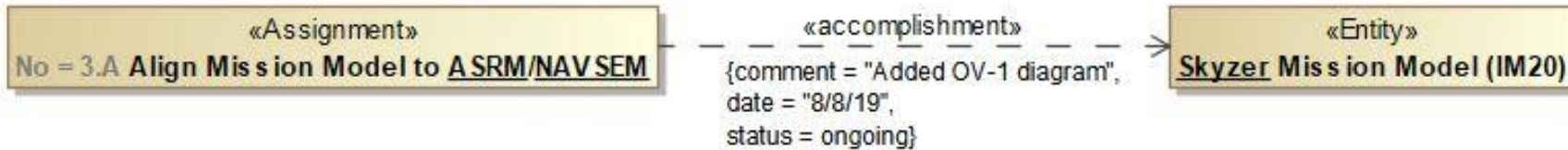
No.	Name	Documentation	Status
3	Align/Refactor Models to ASRM/NAVSEM	Applies for Skyzer Mission and System models. System Model: We followed the OOSEM method, and the NAVSEM is not that far away. The only reason this task has a duration of 20 days is because it probably cannot be complete until the ASRM alignment is done (and note that ASRM is not complete).	ongoing
3.A	Align Mission Model to ASRM/NAVSEM	(No Text)	undefined

Task Lead & Contributor Roles (of <<performs>> dependency)

- Exposed Elements can be edited in the View Editor



- Accomplishment Dependency with Date, Status and Comment, relating Assignment with accomplished Entity



- Representation in View Editor, including Placeholders to “create” new Accomplishments

Accomplishment	Part of Assignment	Date Accomplished	Status	Comment
Placeholder01 ↓	Align Mission Model to ASRM/NAVSEM	- ↓	unknown ↓	- ↓
Skyzer Mission Model (IM20)	Align Mission Model to ASRM/NAVSEM	8/8/19	ongoing	Added OV-1 diagram
Skyzer Mission Model Document (IM90-20)	Align Mission Model to ASRM/NAVSEM	8/1/19	complete	View hierarchy updated to reflect ASRM structure, while still exposing original Mission Model content

Editing of Placeholder Accomplishment

- Collaborative report creation in View Editor through direct input from non-modelers
  - Familiar text editing capability in View Editor, yet while working on SysML model elements
  - Adding new elements possible through used placeholders and their integration
  - Multiple documents based on the same consistent model data
  - History comparison and commenting features in View Editor, e.g., for issue tracking
- Direct access on other used SysML models
  - E.g. to document accomplishments of the Skyzer UAS models
- Use of baseline master branch and separate develop branches
  - Read-only Tags for bi-monthly reports
- Used Viewpoint Library saves modeling effort and supports more consistent documents
- Magicdraw Gantt Chart feature NOT compatible with MMS

- Unambiguous information representation and retrieval
  - Tool-agnostic data representation in graph pattern
  - Relating analysis data to project tasks
  - Semantic query of project data
- Automated and semi-automated inferencing about project data
  - Assess completeness of various data (e.g. Task Lead for each Assignment?)
  - Identify relations between assignments (e.g. Assignments with related Accomplishments?)
  - Verification and Validation of project data
- Interoperability and Integration Framework (IoIF) under development
  - Latest Demonstration: Weight breakdown calculations followed by reversal of the formal signoff/approval of impacted elements



- Application of SysML with OpenMBEE for managing research projects
  - Further supporting the Surrogate Pilot's proposition to develop everything as a model
  - View Editor offering consistent model data for improved communication, regardless SysML knowledge
  - Quick and consistent model-based report generation through DocGen & Viewpoint Library
  - Inputs must be made in the first place!
- Future Work
  - Keeping models up-to-date for ongoing projects!
  - Utilization of semantic representation for reasoning about project data (e.g. accomplishing integration of ANSYS simulation results with SysML)



**Thank you!**

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Systems Engineering Research Center  
Stevens Institute of Technology