

# Viewpoint Modeling and Model Based Media Generation for Systems Engineers

Document Generation and Scalable Model



Based Engineering



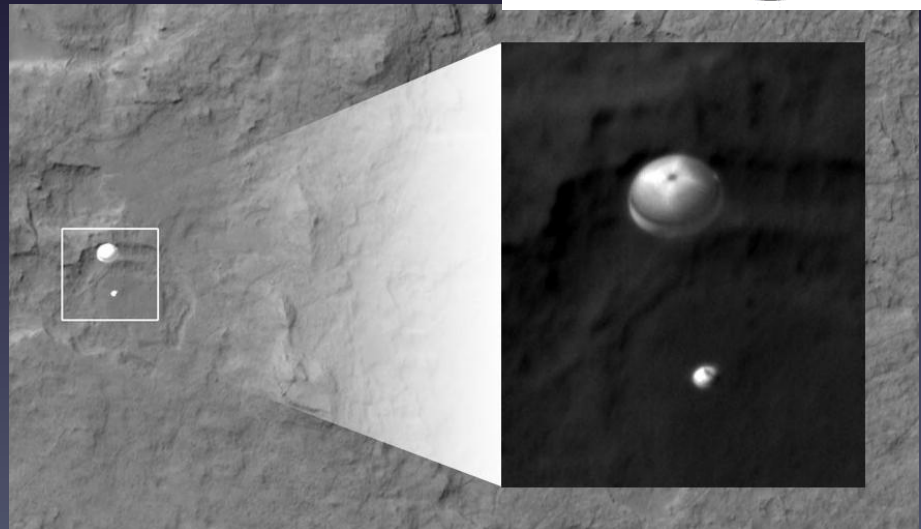
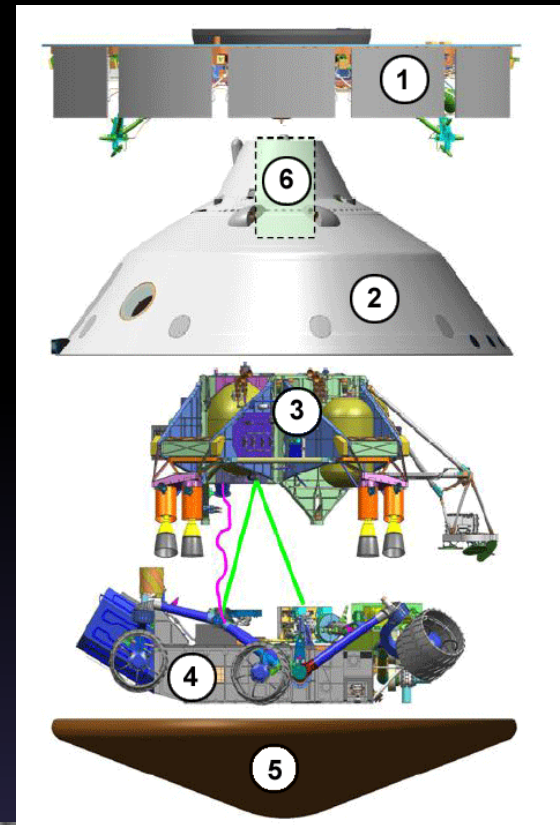
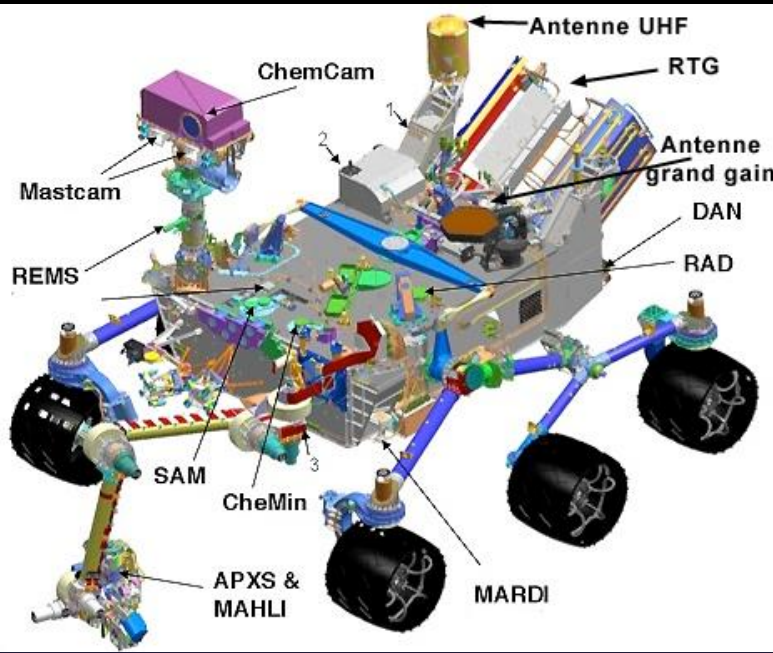
Christopher Delp

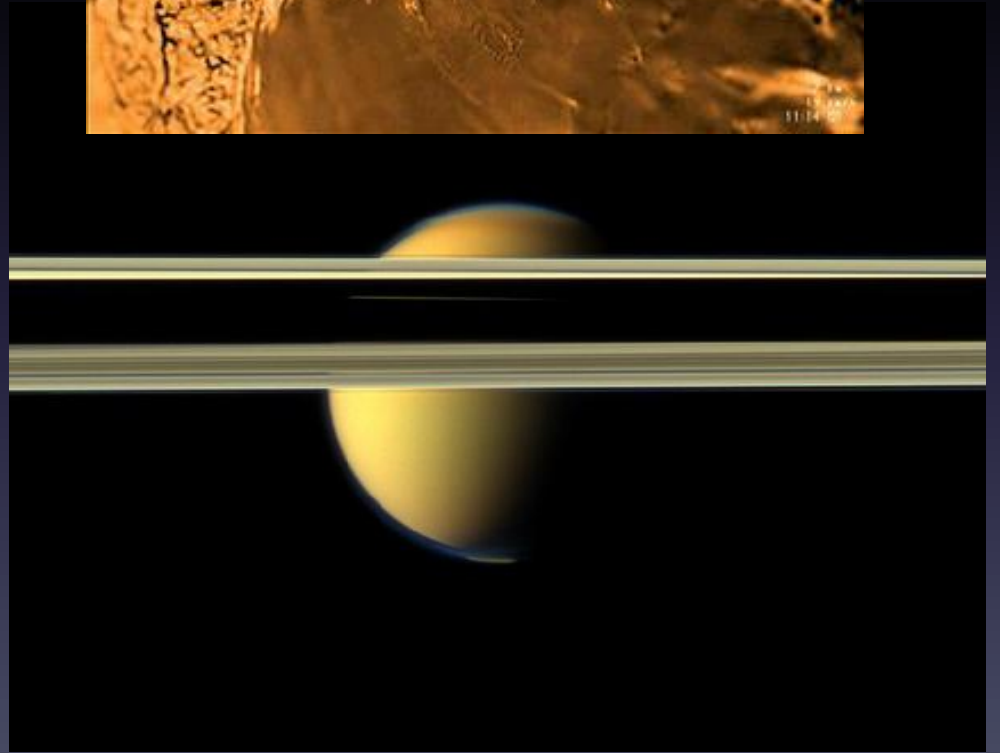
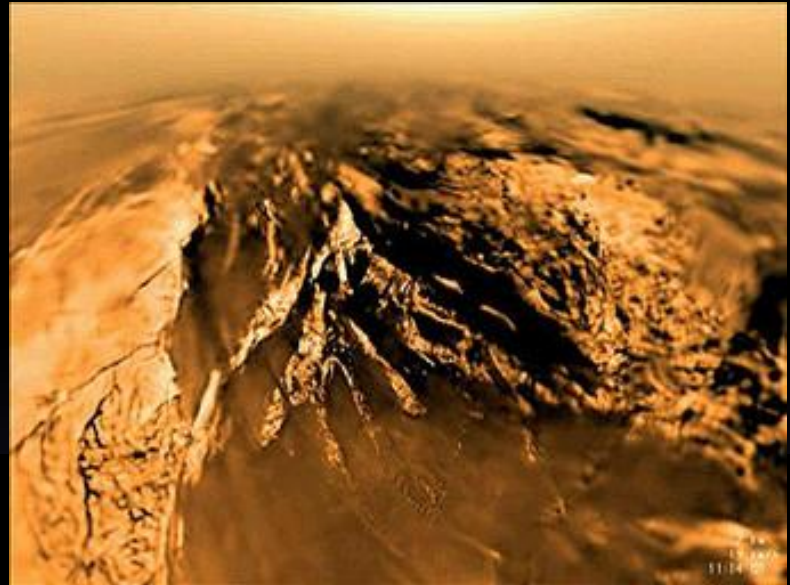
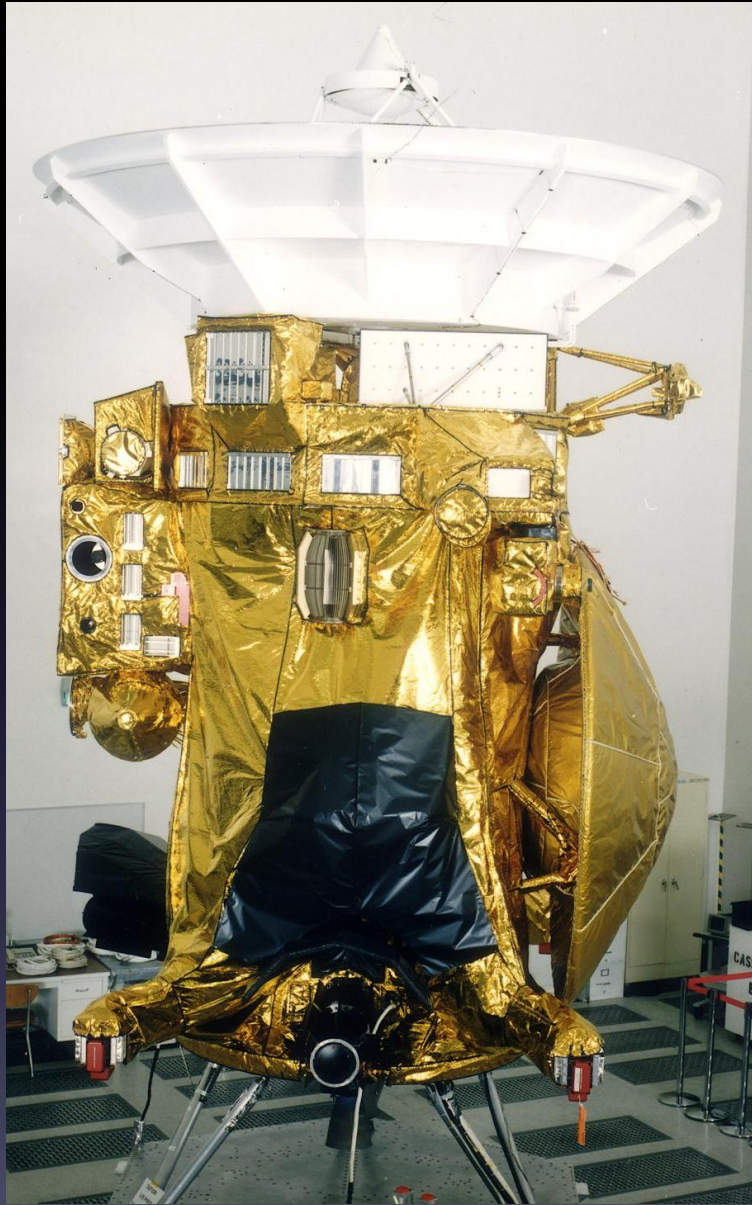
NASA/Caltech Jet Propulsion Laboratory

# Outline

- Docgen at JPL and Across Industry
- Communication
  - Models and Views
  - Methods and Analysis
  - View Models and Linearization of the Story
  - Libraries and Reusability
- Viewpoint as an Architecture for a Scalable Model Based Engineering Environment

# JPL Systems







# Modeling and Document Generation at JPL

- Developed on the Multimission Ground Systems and Services Ops Revitalization Task
  - Based on previous MBSE pilots at JPL
  - 200 users
  - ~20 projects and tasks
  - Removes barrier to using models in real engineering products

# Efforts Across Industry

- ESO Open Source Docgen
- JPL MBEE (Docgen, Docweb, View Editor, System Database)
- Lockheed Martin Document Generator
- Atos Gendoc

# Common Features Across Industry

- A need to communicate with stakeholders
  - According to terms of the stakeholders
- Variety of representations
- Edit the Model Information through multiple UI
  - Views at the stakeholder level
- Enterprise integration of multiple applications and modeling tools
  - Views that facilitate integration between applications

# Communication as a Principle

- Communicating through understanding point of view
  - Understanding the Point of View of Stakeholders
    - Concerns
  - Describing the model from that Point of View
    - Identifying parts of the model that address concerns
  - Telling the story of the Views
    - Linearization of the Views of the Model



# POINTS OF VIEW



## OPTIMIST

"The glass is half-full."



## PESSIMIST

"The glass is half-empty."



## REALIST

"Yep. That's a glass, alright."



## IDEALIST

"One day, cold-fusion from a glass of water will provide unlimited energy and end war."



## CAPITALIST

"If I bottled this and gave it a New Agey sounding name, I could make a fortune."



## COMMUNIST

"This drink belongs to every single one of us in equal measure."



## CONSPIRACIST

"The government is fluoridating the water for mind-control purposes."



## SEXIST

"This glass isn't gonna refill itself, honeybun..."



## NIHILIST

"The glass does not exist, and neither do I."



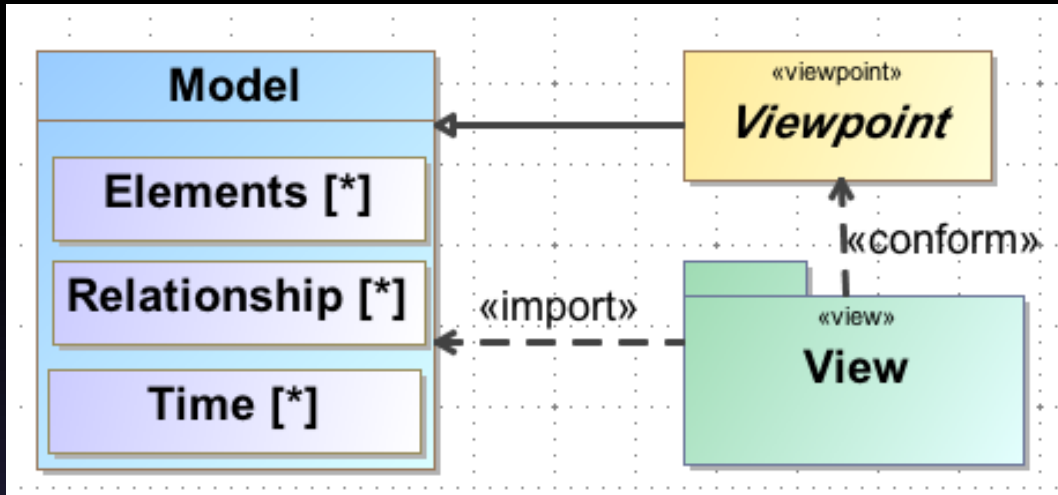
## OPPORTUNIST:

"There's a funny t-shirt in here somewhere."

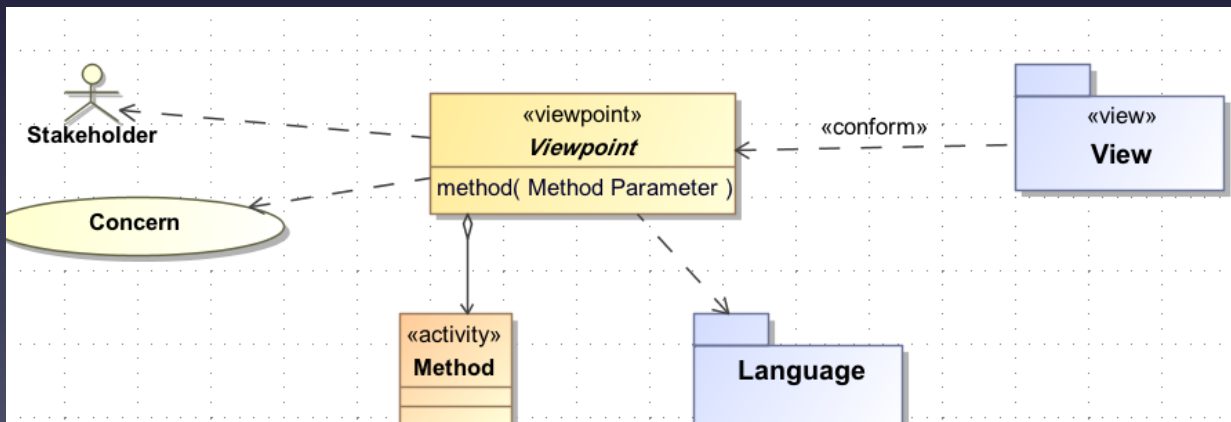
Engineer

"The glass is twice as big as it needs to be"

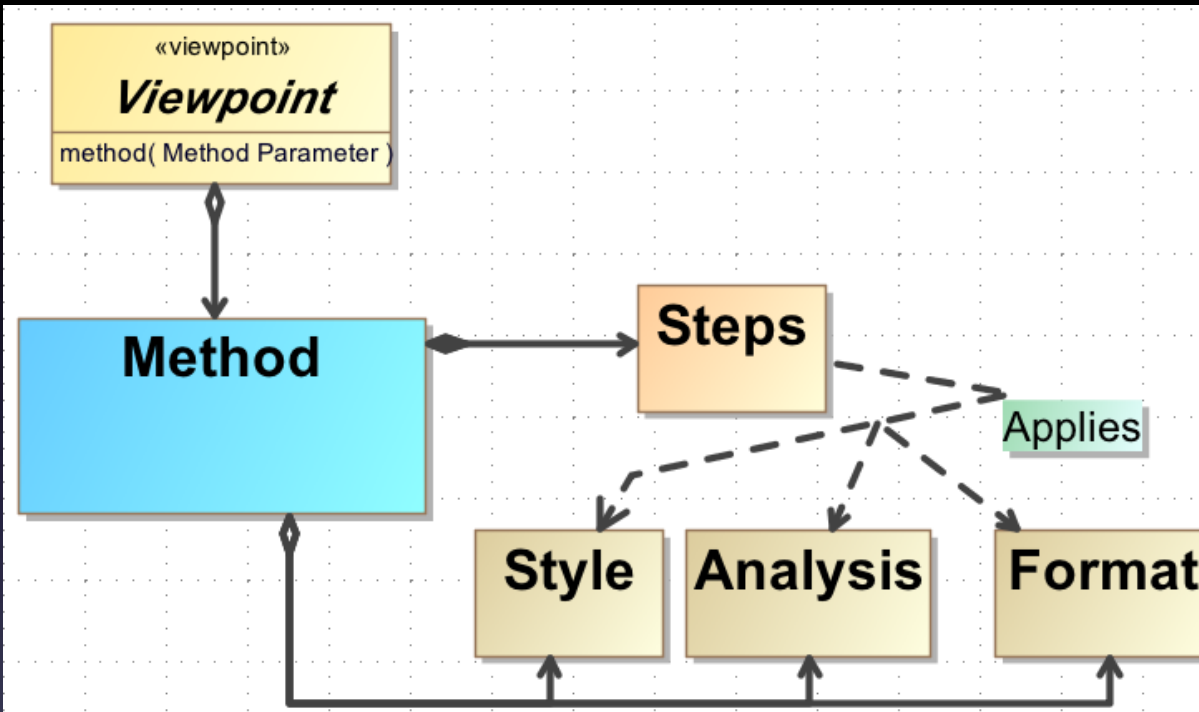
# Building the Viewpoint Model



- Viewpoint Model
  - Purpose informed by Stakeholder Concerns
  - Methods and Analysis for constructing the View from the Model
  - Presentation Rules

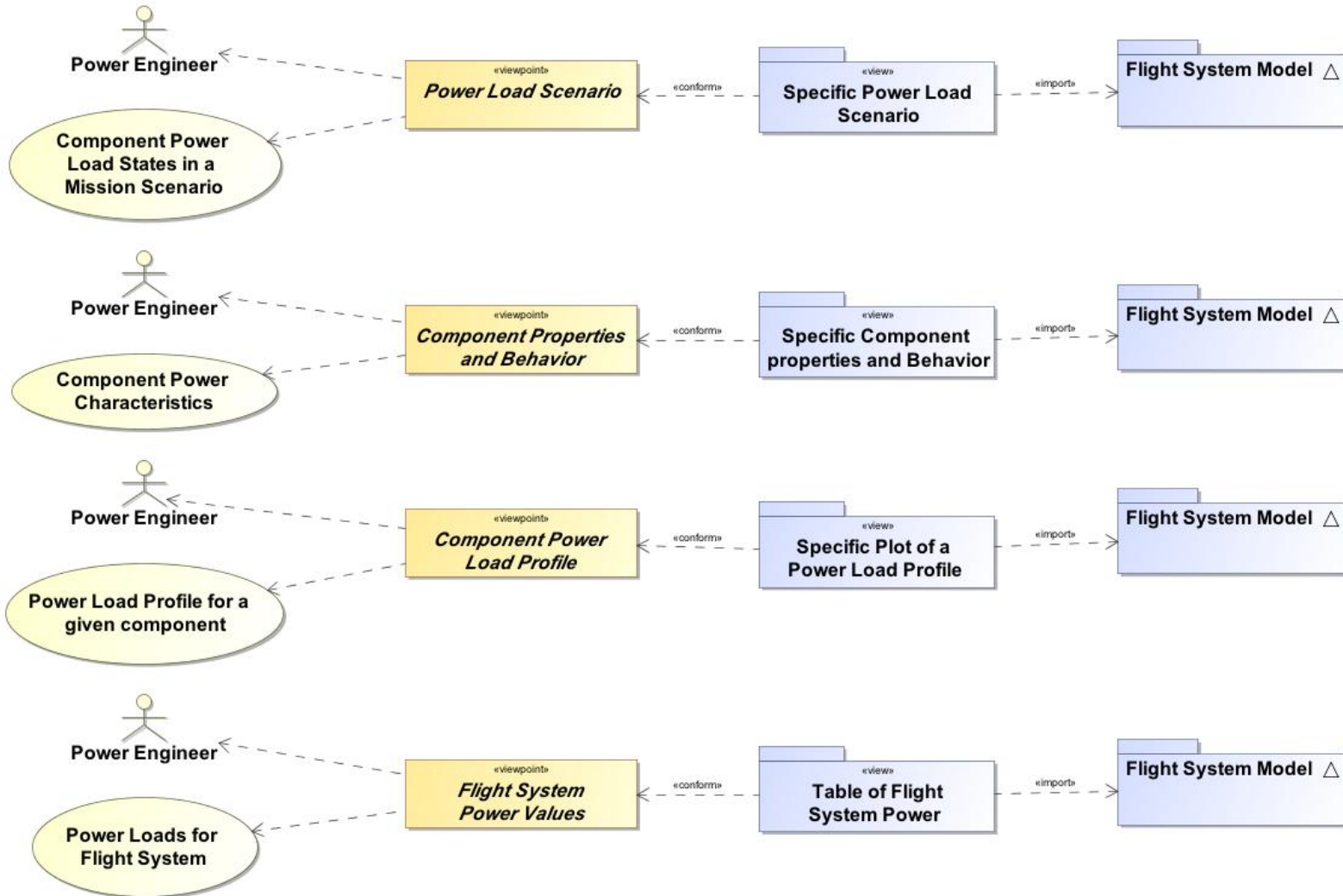


# Method and Analysis



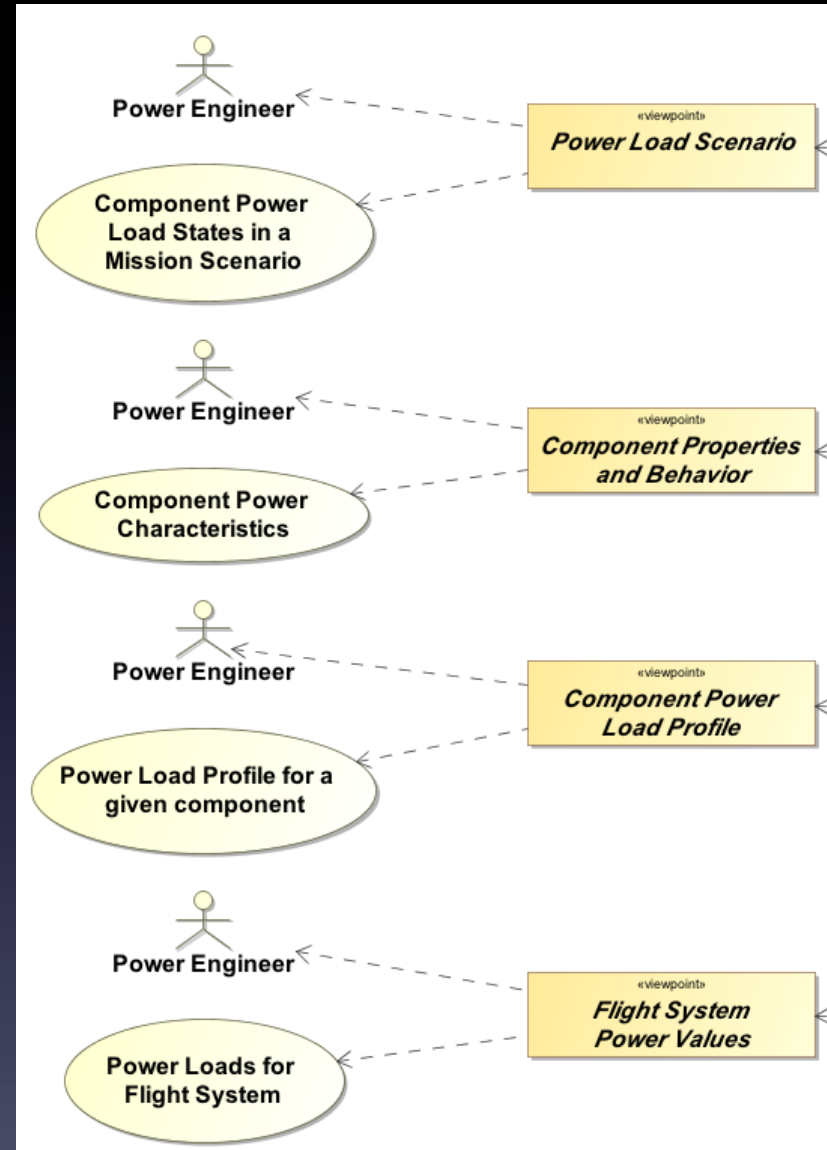
- **Methods**
  - Ordered steps for producing the View
- **Analysis**
  - describe the nature of queries of the model
  - Analytical assertions
  - Rules for completeness and consistency
- **Format and Presentation Style**
  - Describe the conventions styles and formats for how the information is presented in the View

# Viewpoint and View

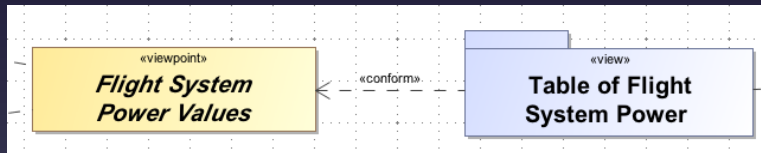
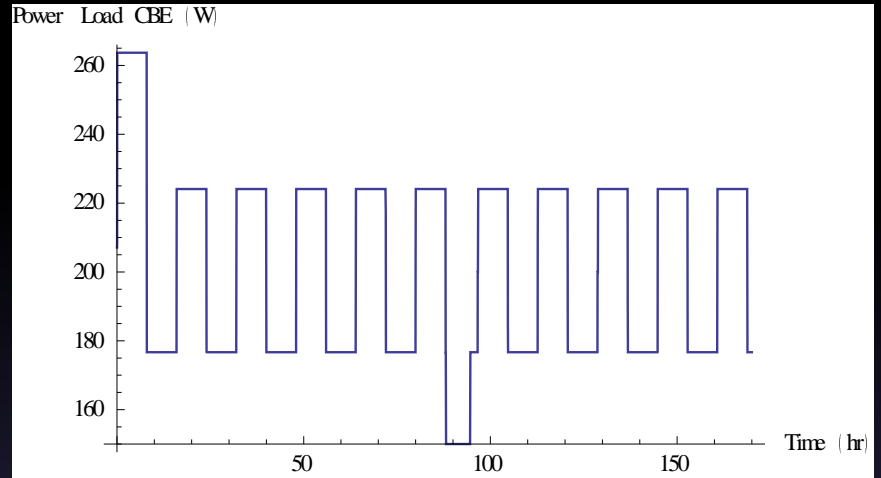
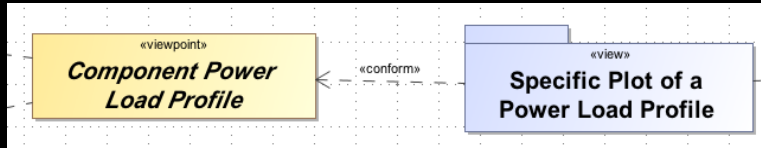


# Viewpoints

- Power from the point of view of:
  - Scenarios of component states
  - Components and properties and behavior
  - Power Load Profiles
  - Flight System Power

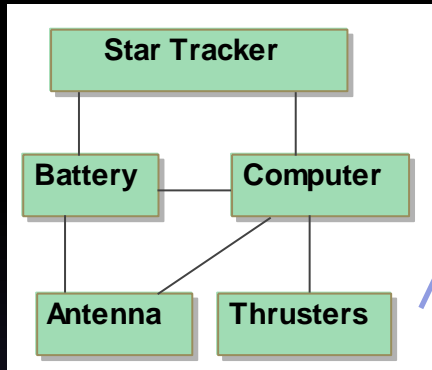


# Views of Models

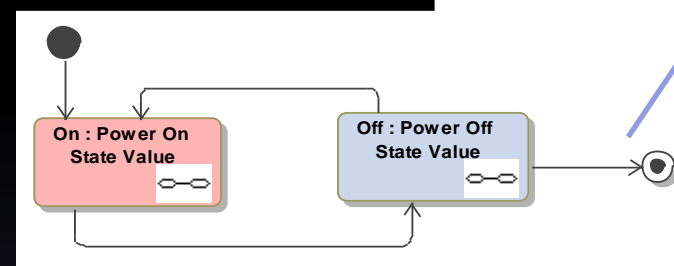
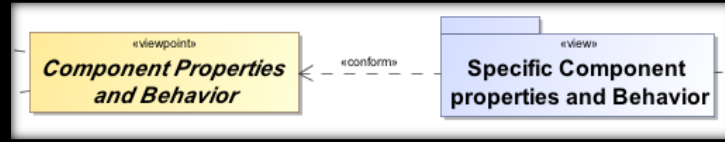


	Workpackage	Product	Number of Units	Cruise				
				State	Duration [%]	Steady-State Power CBE [W]	Contingency	Steady-State Power MEV [W]
1	00 Europa Habitability Mission Project					77	0.3	100.1
2	05 Payload System					0	0	0
3	06 Spacecraft System					77	0.3	100.1
4	06.06 Telecom SS					64	0.3	83.2
5				Off, On		64	0.3	83.2
6		TWTA (TWTA)	1	Off	20.0%	0	0.3	0
7				On	80.0%	80	0.3	104
8	06.07 Mechanical SS					8	0.3	10.4
9		SDST (SDST-A)	1	Standby		4	0.3	5.2
10		SDST (SDST-B)	1	Standby		4	0.3	5.2
11	06.10 GN & C SS					5	0.3	6.5
12		Reaction Wheel (RWA)	1	Low Speed		5	0.3	6.5

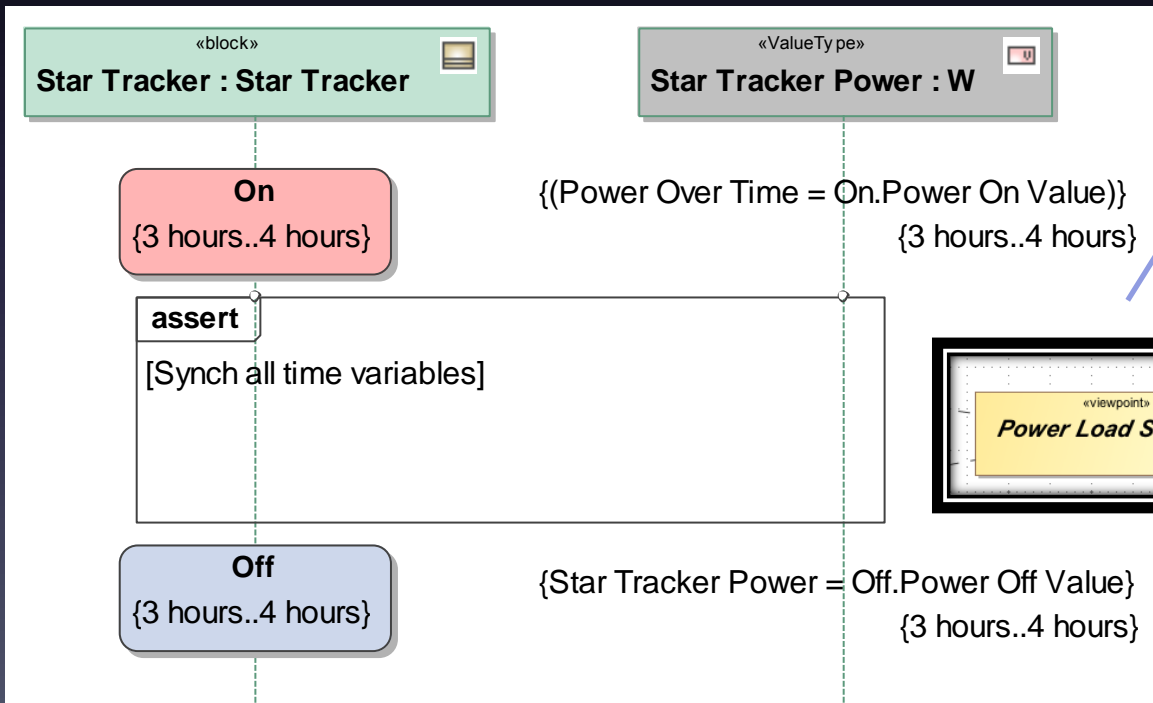
# Simple Spacecraft Diagram Views



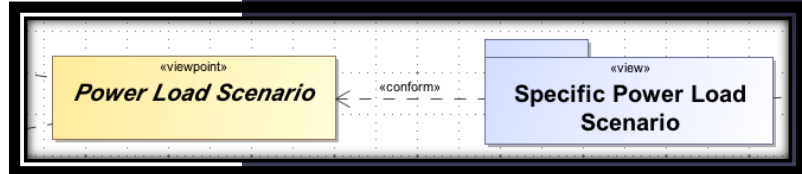
Spacecraft SysML IBD



Spacecraft Star tracker Behavior

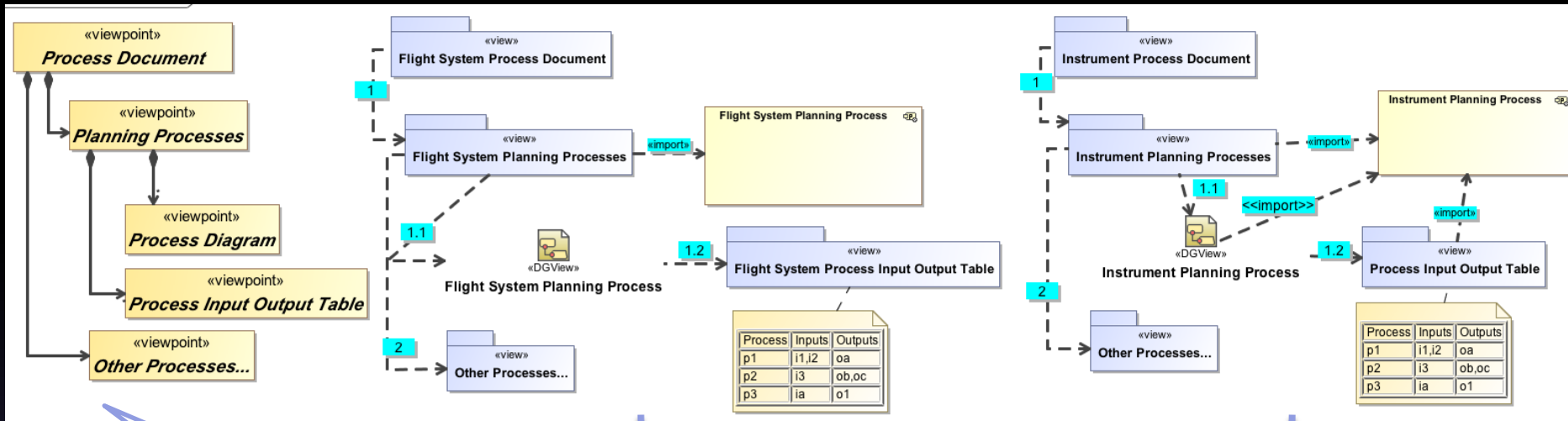


StarTracker Behavior Scenario





# Linearizing the Views



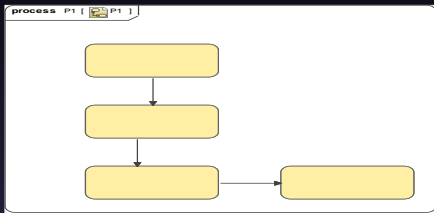
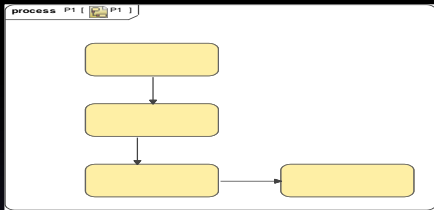
“Template”  
Outline of  
Viewpoints

2 Model Outlines of  
Views based on the  
same Viewpoint  
Template

- Model of Views
  - Story of Views
  - Outline of Views
  - Template Outline of Viewpoints

# Operations Processes and Checklists

## Training Document

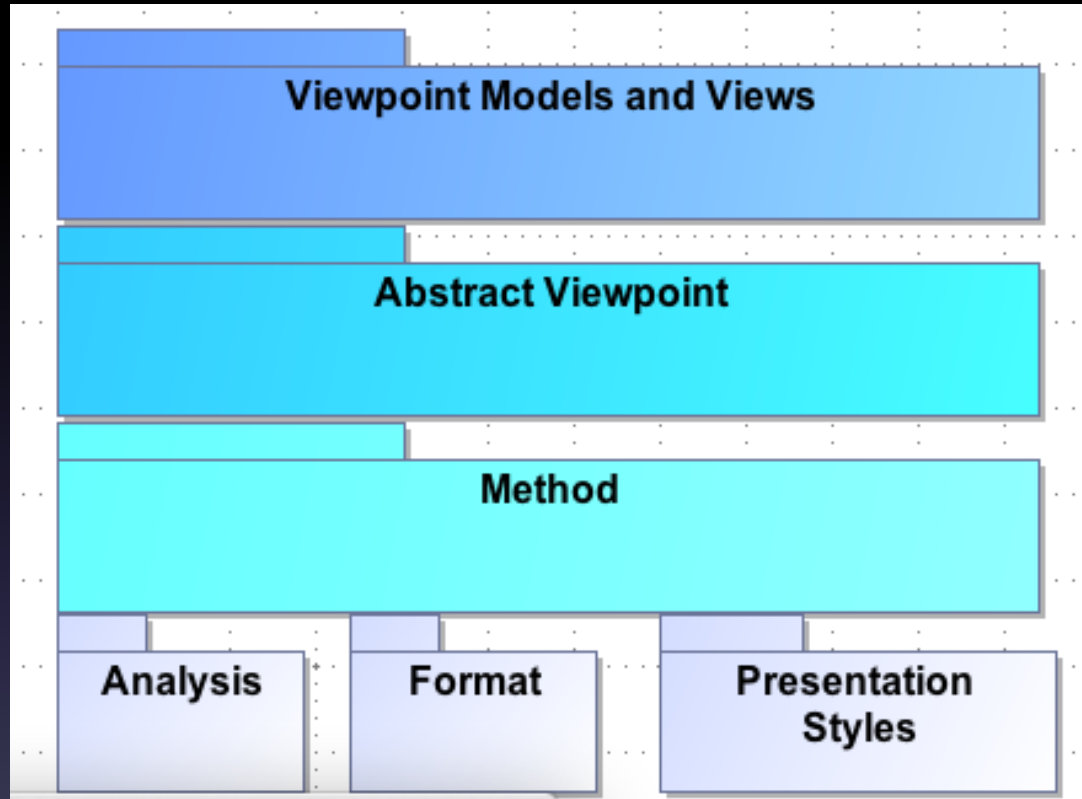


## Operational Checklist

1. Step 1
2. Step 2
  1. Sub Step 1
  2. Sub Step 2

- Training View Models
  - Layered Story through process
  - Understand bigger picture down to smallest detail
- Checklist Views
  - Single thread through entire process
  - Layout the clean step-by-step
  - Minimum amount of information to do the job

# Libraries

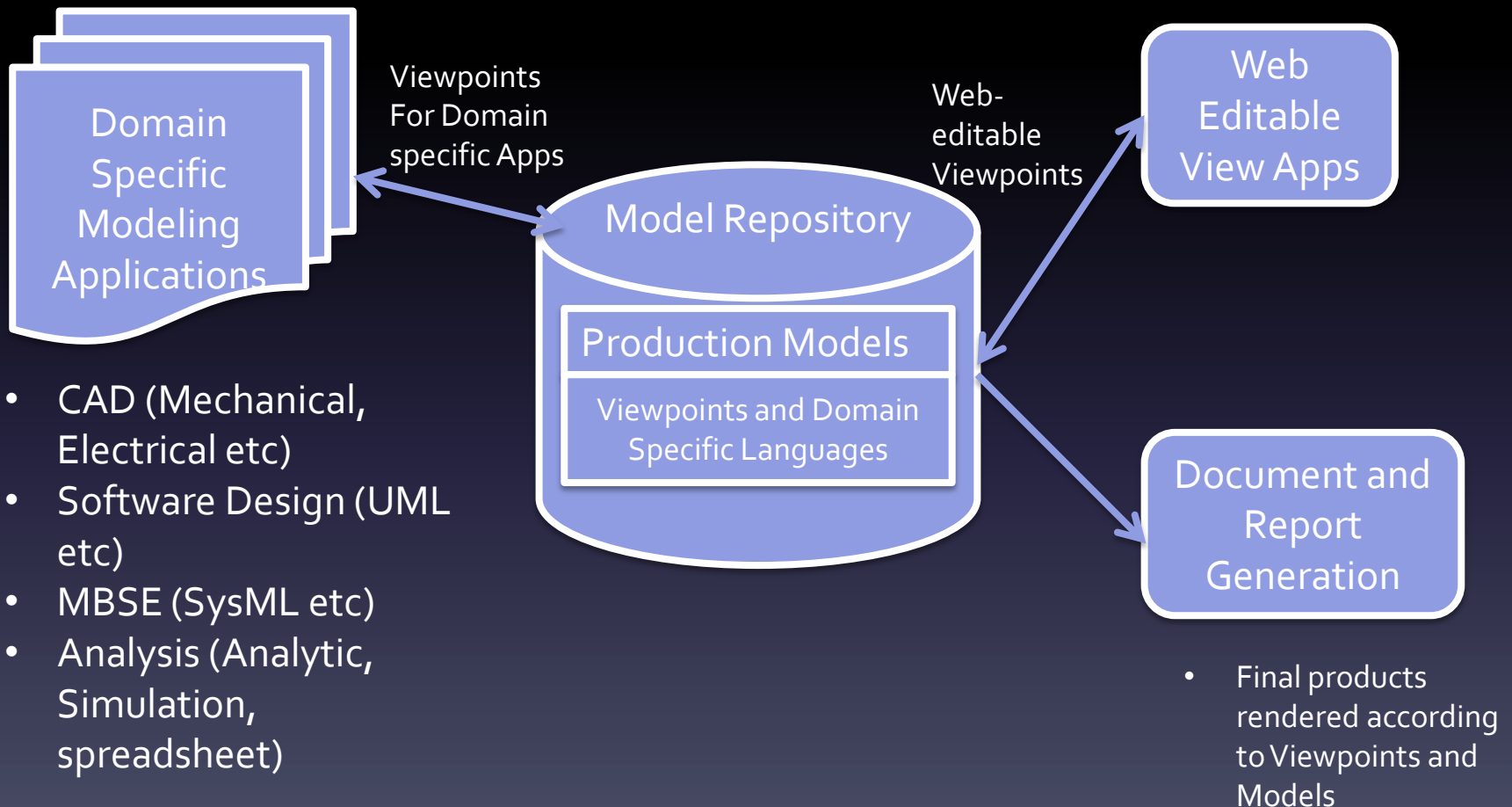


- Viewpoints
  - Collections of standard representations
- Methods
  - Reusable methods for producing different models and representations used in Views
- Analyses
  - Libraries of model analyses, queries and rules for checking models
- Presentation Styles
  - Styles for presenting models and data such as colors, layout schemes, and conventions
- Format
  - Models for formatting information such as Docbook, Office Schemas and modeling languages

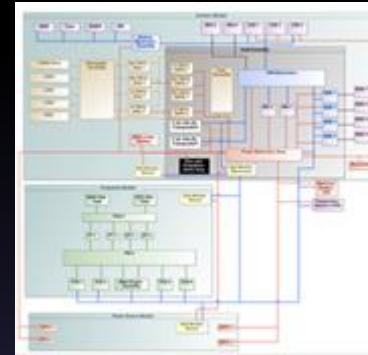
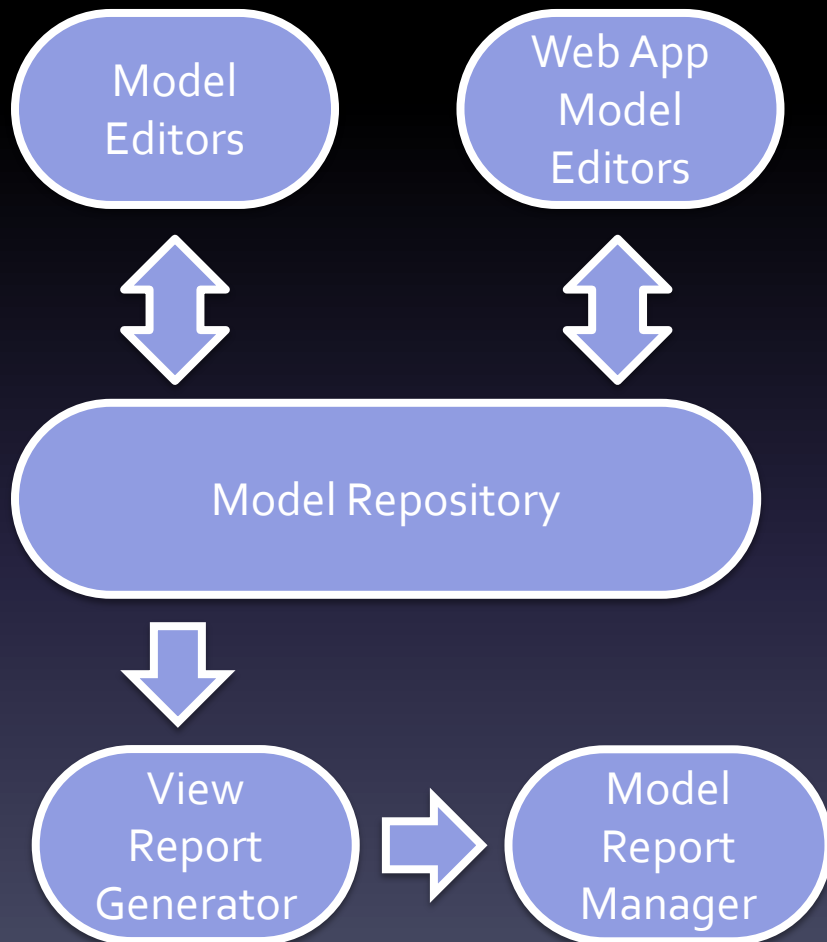
# Software Environment for MBSE

- Model Based Engineering Environment
  - An environment for developing mutually correspondent and consistent engineering models
- Engineering Modeling Information Systems
  - A class of Information Systems design to enable the development of engineering models

# Information Rendered According to Viewpoints



# Generating Reports from Models



- Model, Viewpoints and View Models



Model transformation from SysML to Documents (HTML, PDF etc)

A screenshot of a web-based report titled 'DocWeb' and 'PEL Example Document'. The report displays a table of contents and a table of data. The table has columns for 'Workpackage', 'Priority', 'Number of Units', 'Status', 'Priority', 'Start Date', 'End Date', 'Estimate', and 'Units'. The data is organized into sections like '1.1. PEL (Simplified)' and '1.2. PEL (Simplified)'. The table shows various workpackages with their respective priorities and dates.

Workpackage	Priority	Number of Units	Status	Priority	Start Date	End Date	Estimate	Units
1.1. PEL (Simplified)								
1.2. PEL (Simplified)								
1.1. PEL (Simplified)								
1.2. PEL (Simplified)								

- Reports output using styles and formats specified in the method

# Conclusions

- MBSE Success has a strong dependence on the capability to communicate with stakeholders and system implementers.
  - SysML provides the basic semantics to model and generate these artifacts
  - Use of web applications can provide an accessible mechanism for interacting and data collection from stakeholders
  - Model based document generation from View models puts the value of models into the work products systems engineers must deliver.
  - A scalable enterprise for modeling is feasible built around the concept of view point and view.



# Backup