The SPDM Enabled DRM

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Presenters Bio

Kyle Kochel
Application Engineer, Digital Engineering Lab
Ansys Government Initiatives (AGI)

- 3 months in Digital Engineering Lab
- 4 years working with USAF using Systems Tool Kit (STK) and Test and Evaluation Tool Kit (TETK)
- 2 years working general customer and sales support for STK

Hometown: Reading, PA

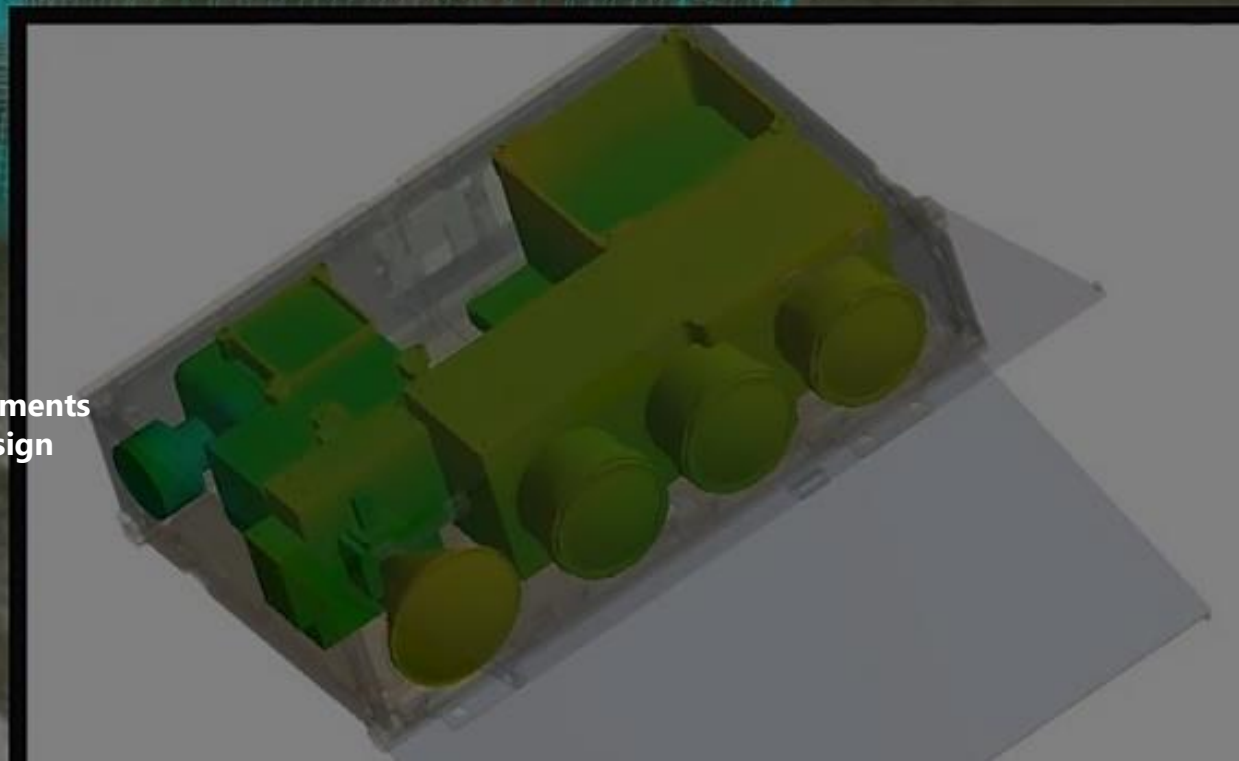
Undergraduate Schooling: Aerospace Engineering, The Pennsylvania State University

Graduate Schooling: Computer Science, The Georgia Institute of Technology [*In progress*]

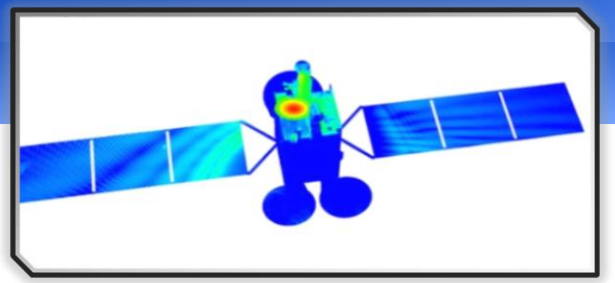
Favorite Hobby: Disc golf

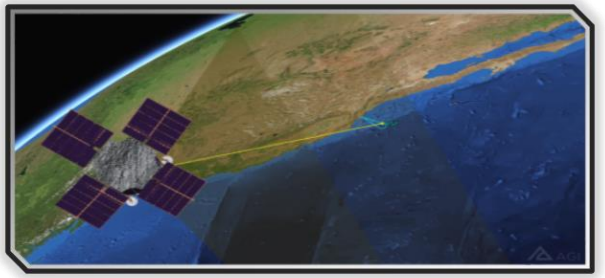
Digital Mission Engineering (DME)

Using digital **modeling, simulation, and analysis** to incorporate the **operational environment** and **evaluate mission outcomes** at every phase of the lifecycle.



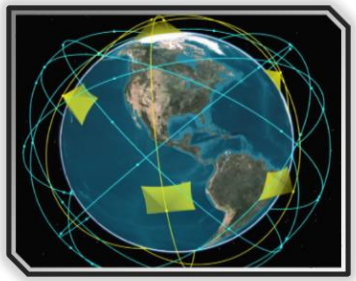
The Design Reference Mission (DRM)

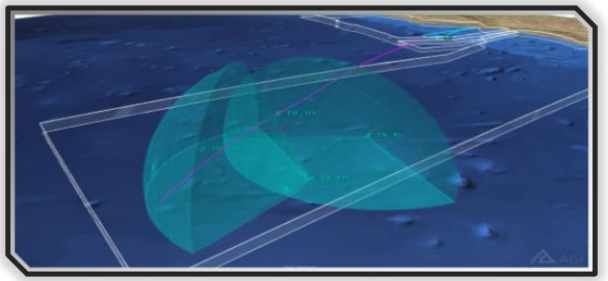


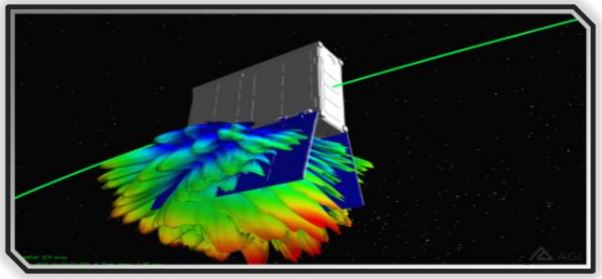


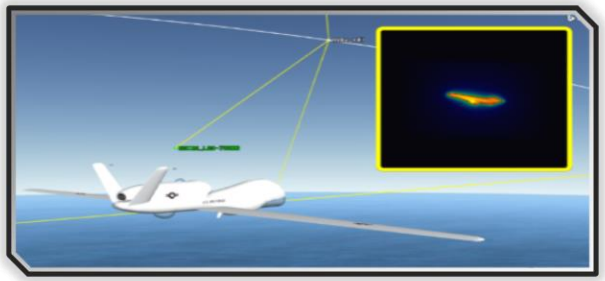
A series of **representative mission profiles** that sufficiently **describe the intended system use** across its nominal and most stressful operating conditions.

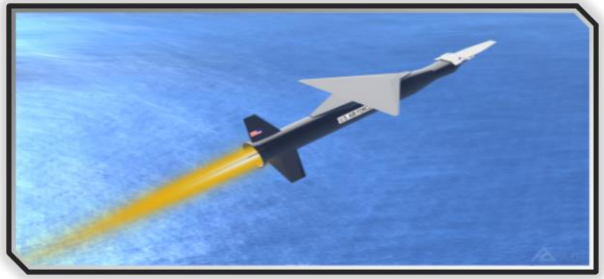
The DRM is the mechanism used to **evaluate system performance** and **guide development efforts**.

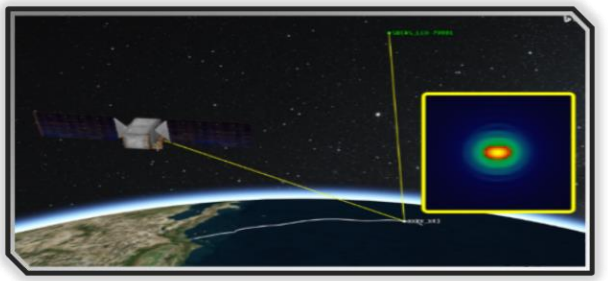




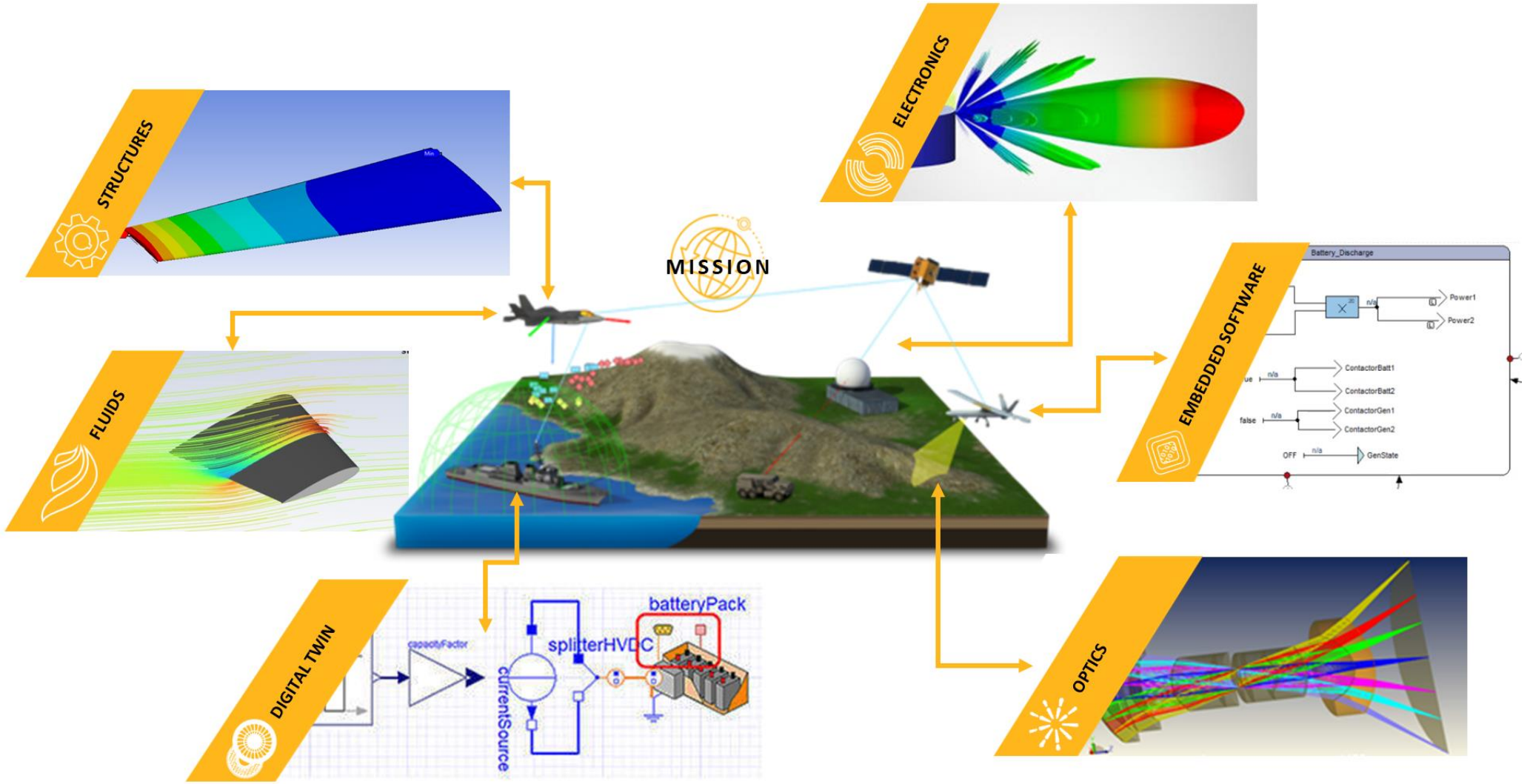








Integrating Models into the Mission



Mission Models and 5000.97 Requirements

DoD Instruction 5000.97

Digital Engineering

Originating Component:	Office of the Under Secretary of Defense for Research and Engineering
Effective:	December 21, 2023
Releasability:	Cleared for public release. Available on the Directives Division Website at https://www.esd.whs.mil/DD/.
Incorporates and Cancels:	Department of Defense Directive 5000.59, "DoD Modeling and Simulation (M&S) Management," August 8, 2007, as amended
Approved by:	Heidi Shyu, Under Secretary of Defense for Research and Engineering

Purpose: In accordance with the authority in DoD Directive 5137.02, this issuance establishes policy, assigns responsibilities, and provides procedures for implementing and using digital engineering in the development and sustainment of defense systems.

3.5. PROCEDURES FOR MAINTAINING DIGITAL MODELS AND AUTHORITATIVE DATA SOURCES.

a. Digital Models.

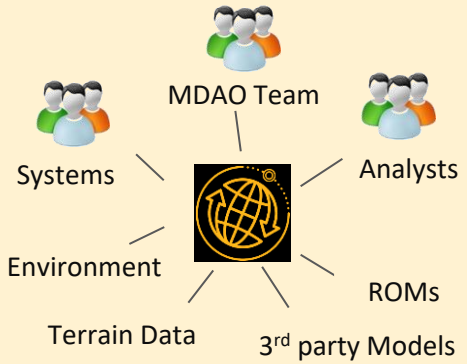
(1) Programs will identify and maintain model-centric baselines, approaches, and applications in a digital form that integrates the technical data and associated digital artifacts that stakeholders generate throughout the system life cycle. The program should develop digital model(s) using standard and best practice model representations, methods, and underlying data structures to maximize interoperability.

(2) Programs should establish a standard approach for developing each type of digital model. Programs should consider the use of existing modeling standards and approaches to improve integration of models across the DoD. Programs must evaluate all digital models to ensure they are accurate, complete, trusted, and reusable. Programs will develop digital models in accordance with applicable DoD policies, guidance, and standards. Programs should

Simulation Data and Process Management (SPDM) Challenges

Organizations recognize the critical value of Mission Simulation

Functional/Organizational/Geographically distributed collaboration



Leveraging a Variety of Unmanaged data sources

Explosion of data

Data from commercial + in-house sources

Ansys · Excel · MathWorks · python · DTED · fmu FUNCTIONAL MOCK-UP UNIT

… which result in new challenges …

Who?

- Where is data/model library located?
- Is this correct version of model & data objects?
- What were key assumptions used to create the mission?
- Can we be efficient with creating and using these models?
- Bob is on vacation – How did we get these results?

What?

Status

When? **Where?** **How?**

… requiring a simulation management solution

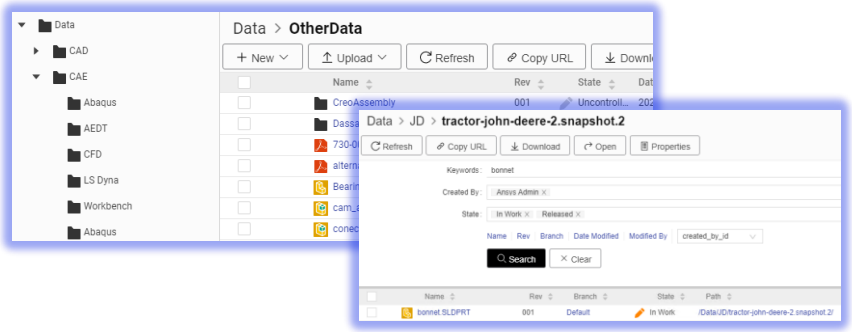
Data Governance	Data Archival	Traceability	Security
Standardization	Best Practices	Approval	Audit Trails
Collaboration	Visibility	Share	Reuse
Democratize	Non-Experts	Training	Accessibility

SPDM System – Key Capabilities

Global Product Data Interoperability Summit | **2024**

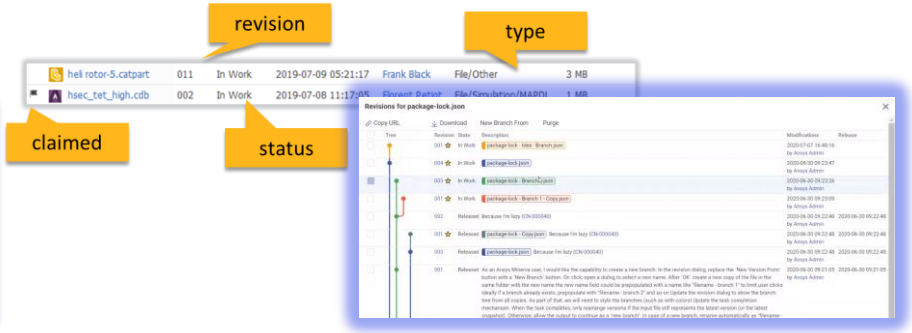
Model Data Management

Data Management



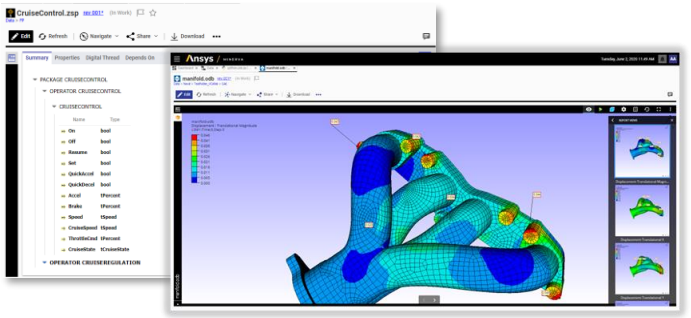
Data organization, libraries, how know, search

Configuration Management



Manage versions, references

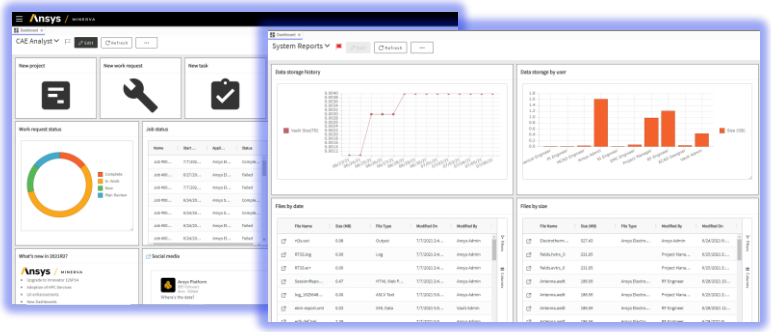
Reports and Visualization



CAE result (Abaqus)

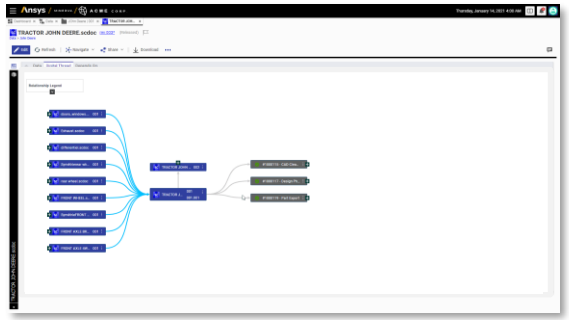
Automated extraction of relevant information

Simulation Decision Support



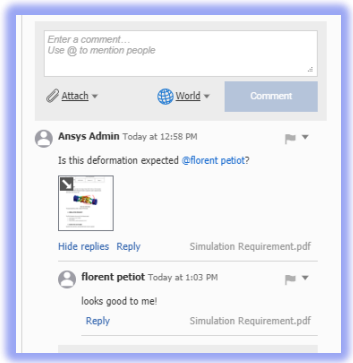
Role-based dashboards, reports

Traceability/Dependencies



Digital Thread automatically updated

Collaboration



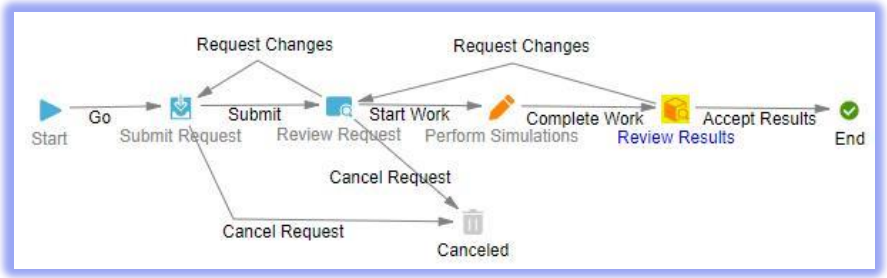
Discussions, tagging

SPDM System – Key Capabilities

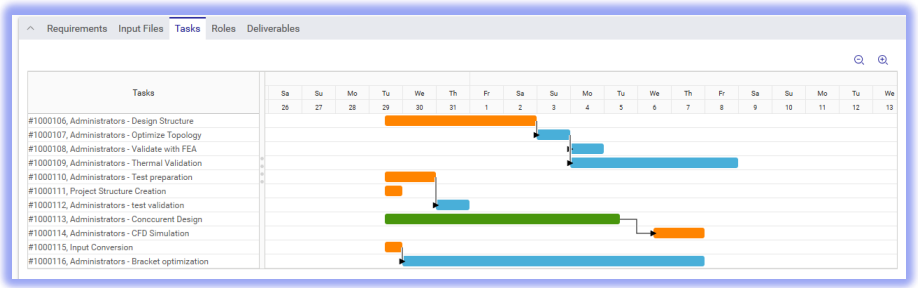
Simulation Process Management

Heterogeneous Commercial + in-house tools

Business Process/ Lifecycle Support



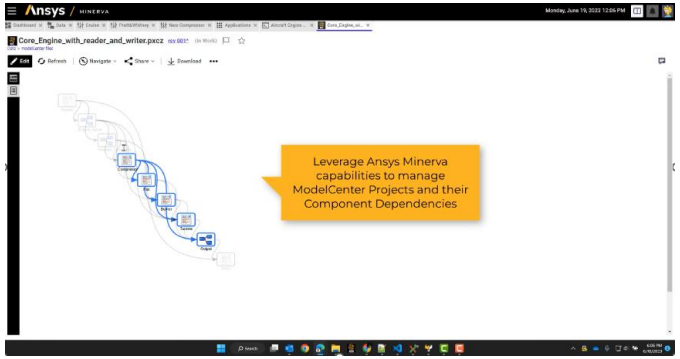
Configure Business Processes and lifecycle needs



Simulation Process Management for Teams

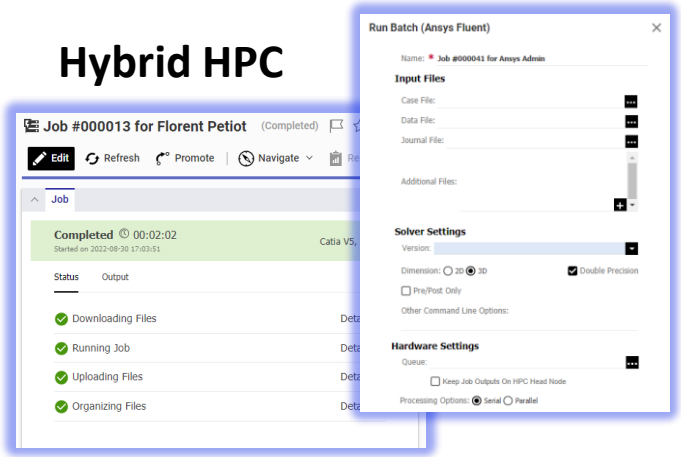
Templates, roles, deliverables, audit configurability

Tool chain and optimization integration

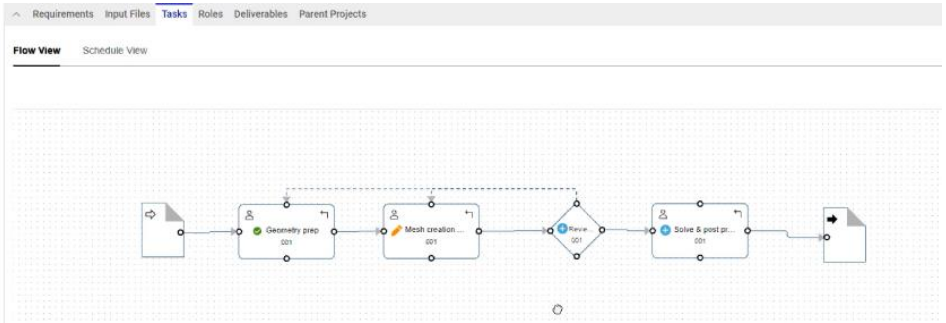


Ansys optiSLang/ModelCenter for Simulation Workflow Automation, optimization and robust design – publish web templates to Minerva

Hybrid HPC

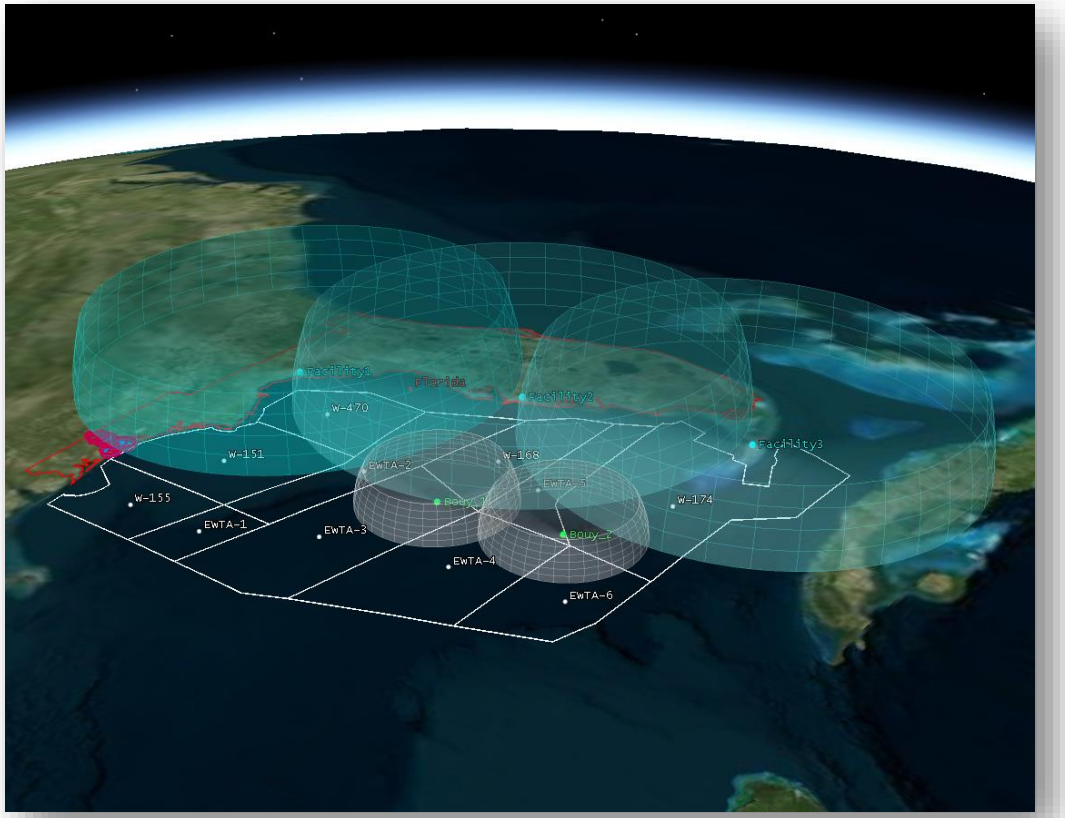


Execute and manage batch and interactive jobs



Example: Creating a Digital Test Range

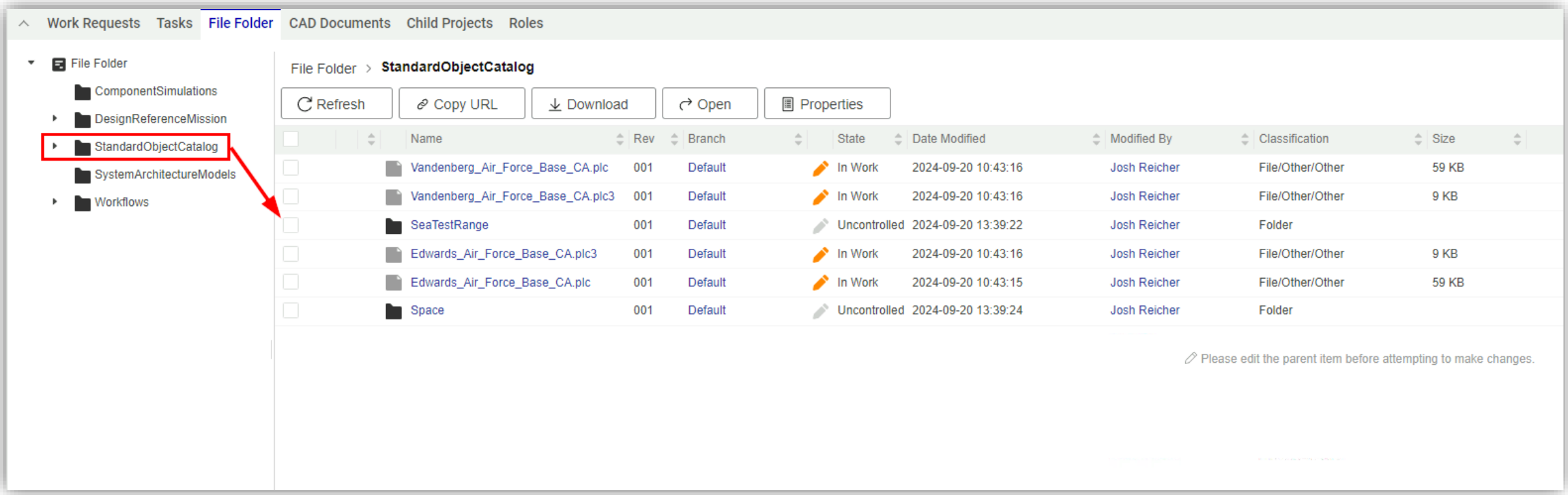
- **Modeling of all assets across a test range (digital twins)**
  - Ground sites
  - Antennas – low and high fidelity
  - Aircraft (flight performance models, attachments, etc)
  - Operating areas
  - Safety corridors
  - GIS data
- **SPDM solution (Minerva) to manage asset design iterations and ownership**
- **Enabling mission planning activities**
- **Pre-mission and/or post-mission evaluation of data to refine digital test models**



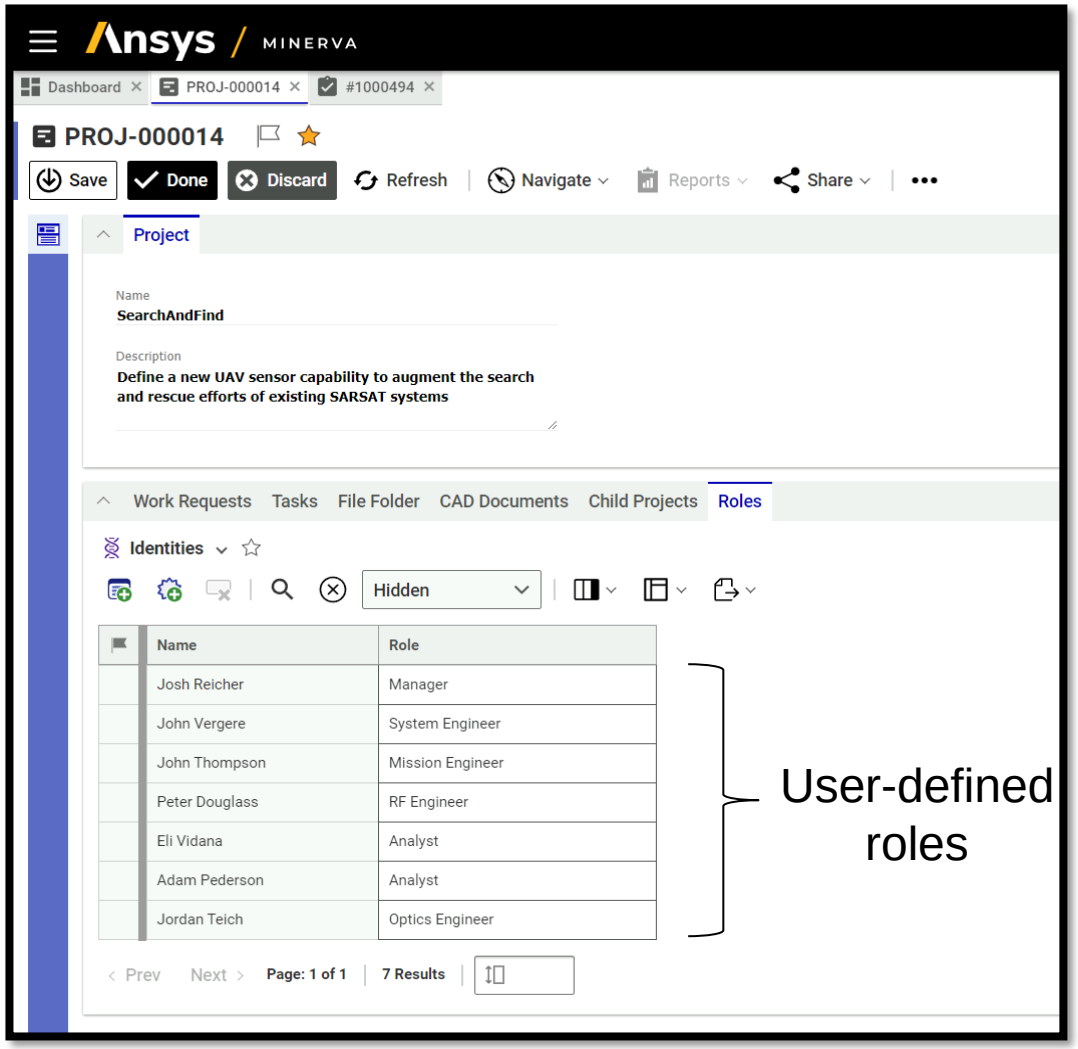
[NOTIONAL] *Example Eglin Digital Test Range using Systems Tool Kit (STK)*

Standard Object File Catalog

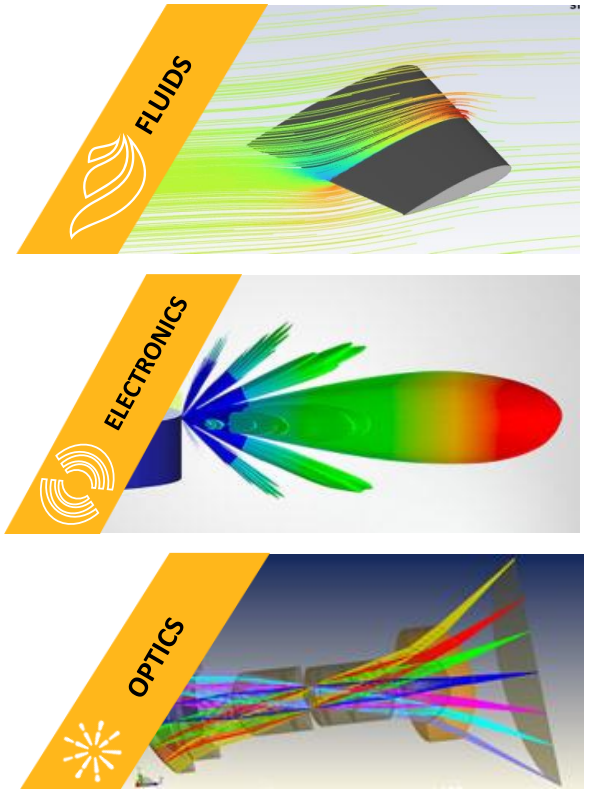
- **Gather or create object files that model range assets**
- **Store files in a shared version-controlled repository**



Multi-Domain Collaboration

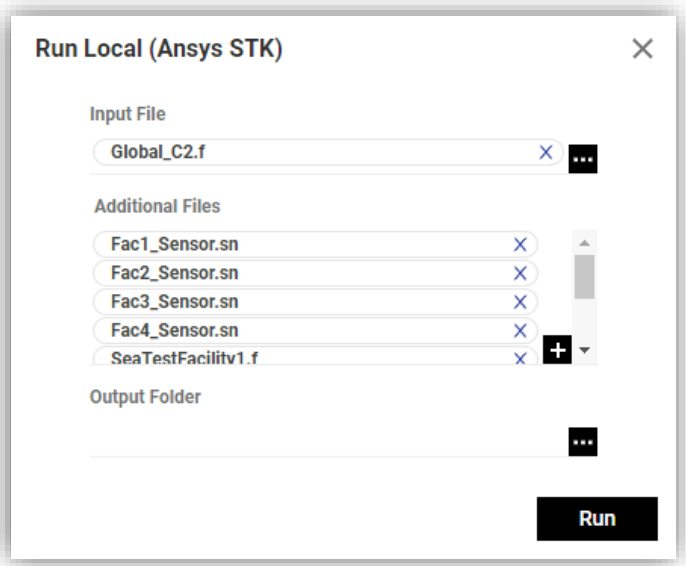


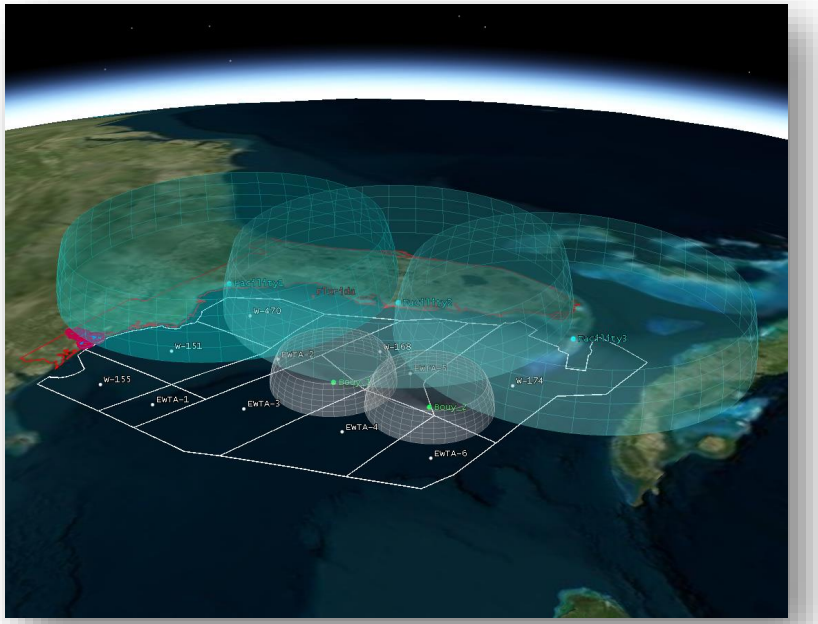
- **Assign members to create and manage specific assets**



Assemble New Design Reference Mission

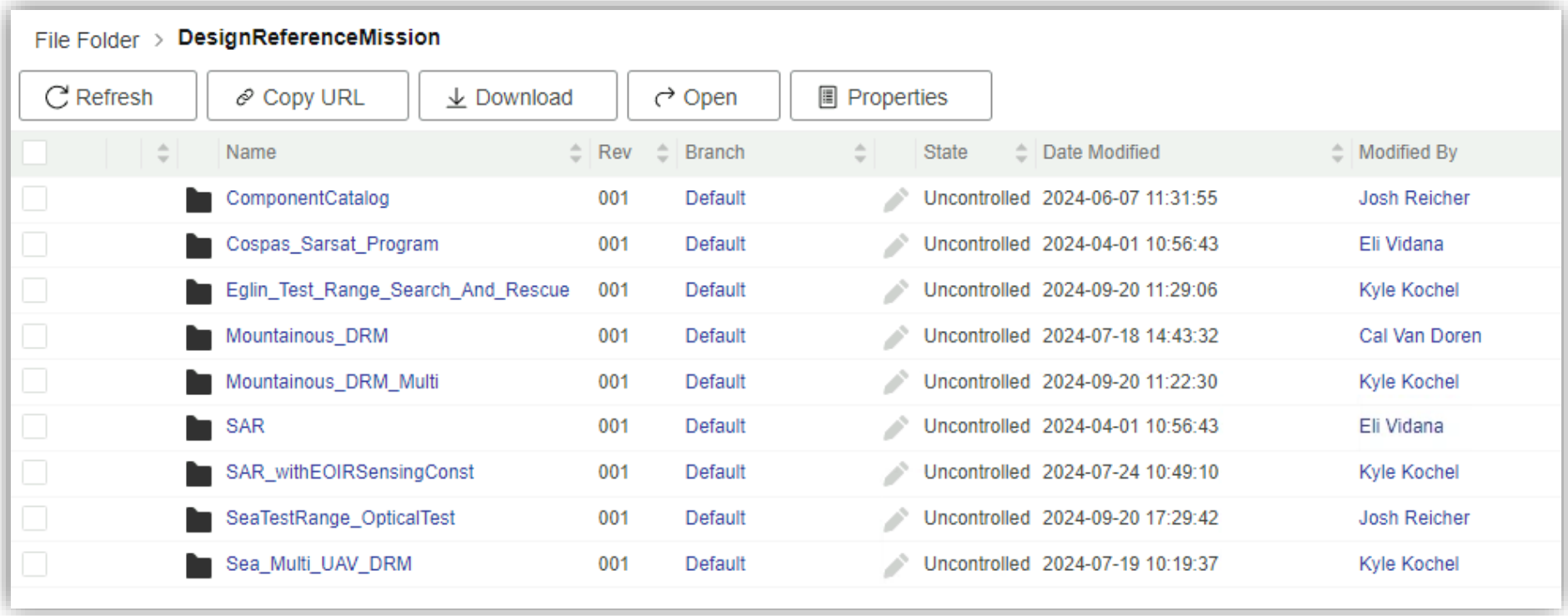
- **Select range assets to use in a new DRM**
- **Auto-launch STK mission simulation application from Minerva**
- **Data files seeded into new mission scenario**





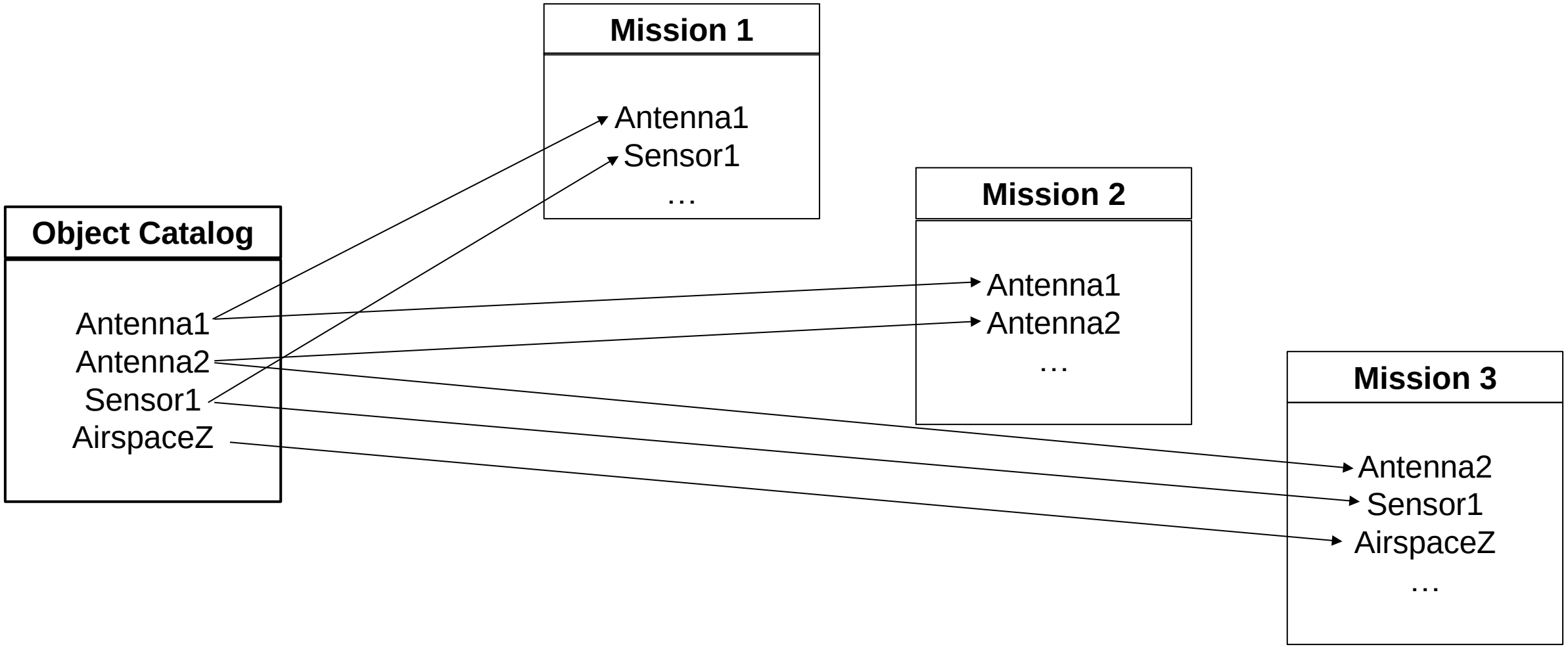
Use and Re-use Design Reference Mission

- **Design Reference Mission can now be used as a baseline for mission planning**
- **Assembled design reference missions can be saved back to Minerva as a library for re-use and iteration**

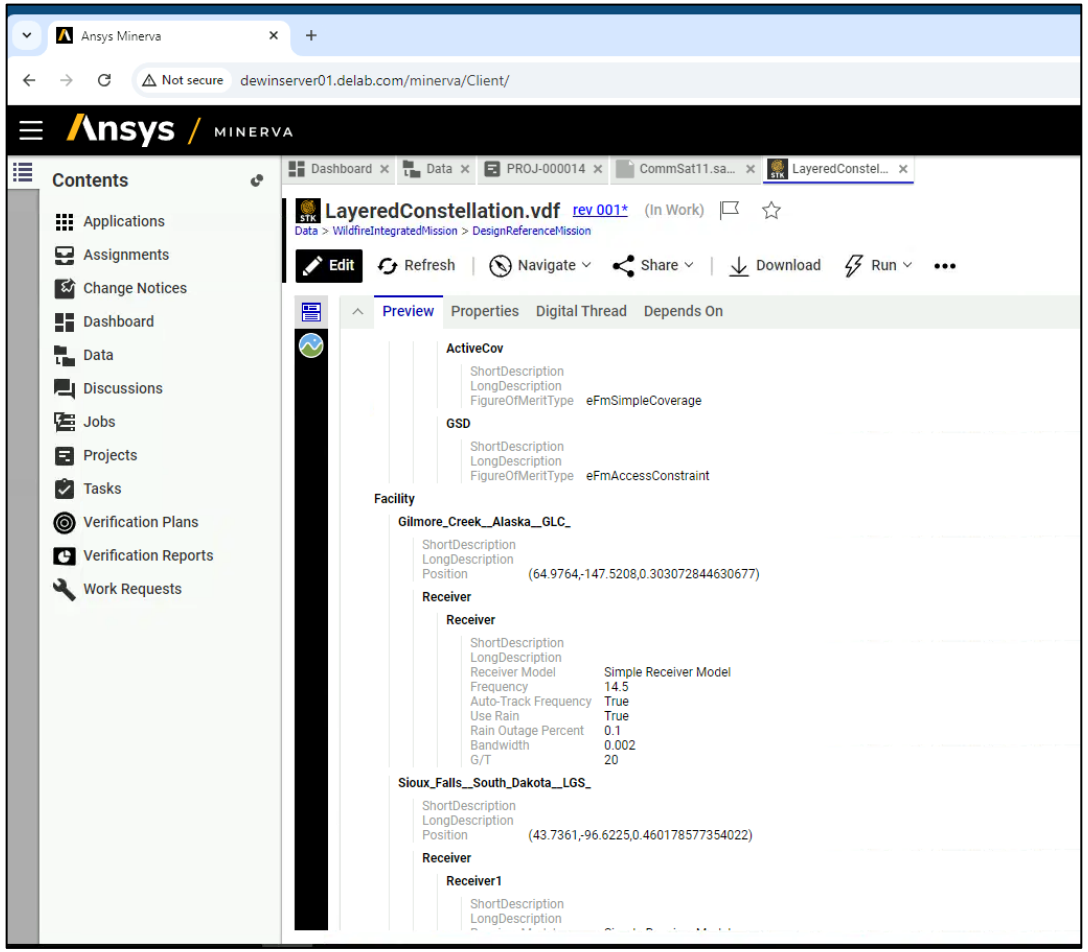


Name	Rev	Branch	State	Date Modified	Modified By
ComponentCatalog	001	Default	Uncontrolled	2024-06-07 11:31:55	Josh Reicher
Cospas_Sarsat_Program	001	Default	Uncontrolled	2024-04-01 10:56:43	Eli Vidana
Eglin_Test_Range_Search_And_Rescue	001	Default	Uncontrolled	2024-09-20 11:29:06	Kyle Kochel
Mountainous_DRM	001	Default	Uncontrolled	2024-07-18 14:43:32	Cal Van Doren
Mountainous_DRM_Multi	001	Default	Uncontrolled	2024-09-20 11:22:30	Kyle Kochel
SAR	001	Default	Uncontrolled	2024-04-01 10:56:43	Eli Vidana
SAR_withEOIRSensingConst	001	Default	Uncontrolled	2024-07-24 10:49:10	Kyle Kochel
SeaTestRange_OpticalTest	001	Default	Uncontrolled	2024-09-20 17:29:42	Josh Reicher
Sea_Multi_UAV_DRM	001	Default	Uncontrolled	2024-07-19 10:19:37	Kyle Kochel

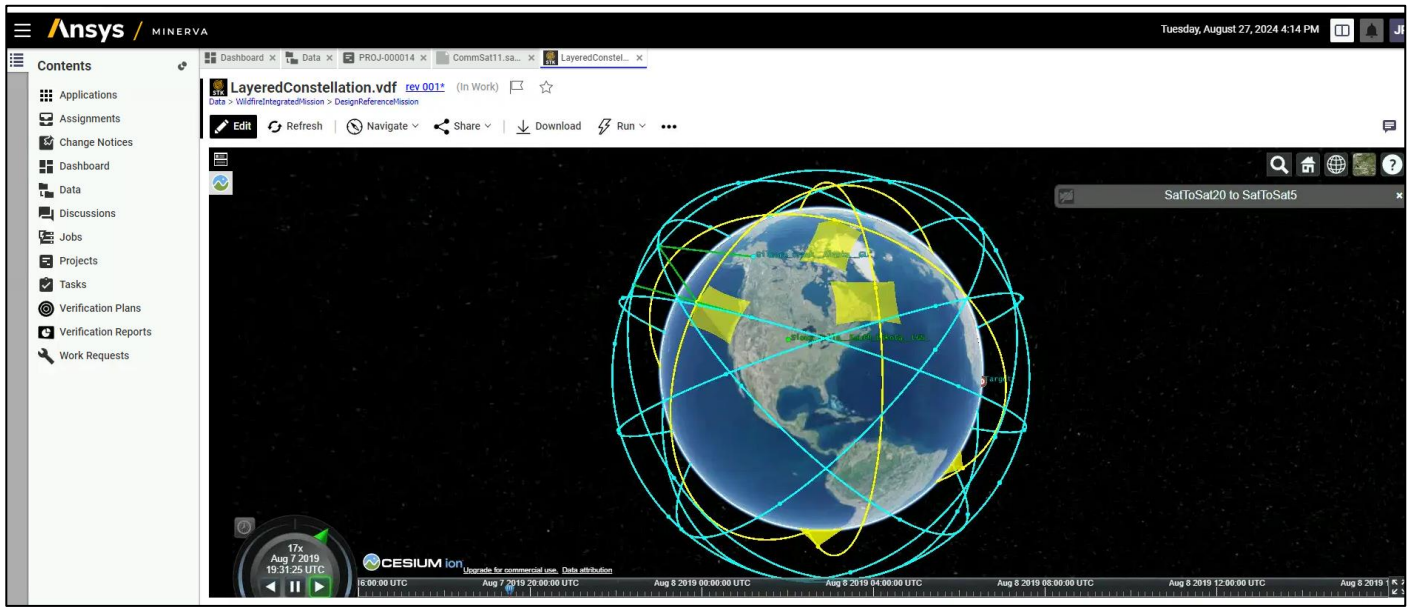
Linking From Standard Object File Catalog



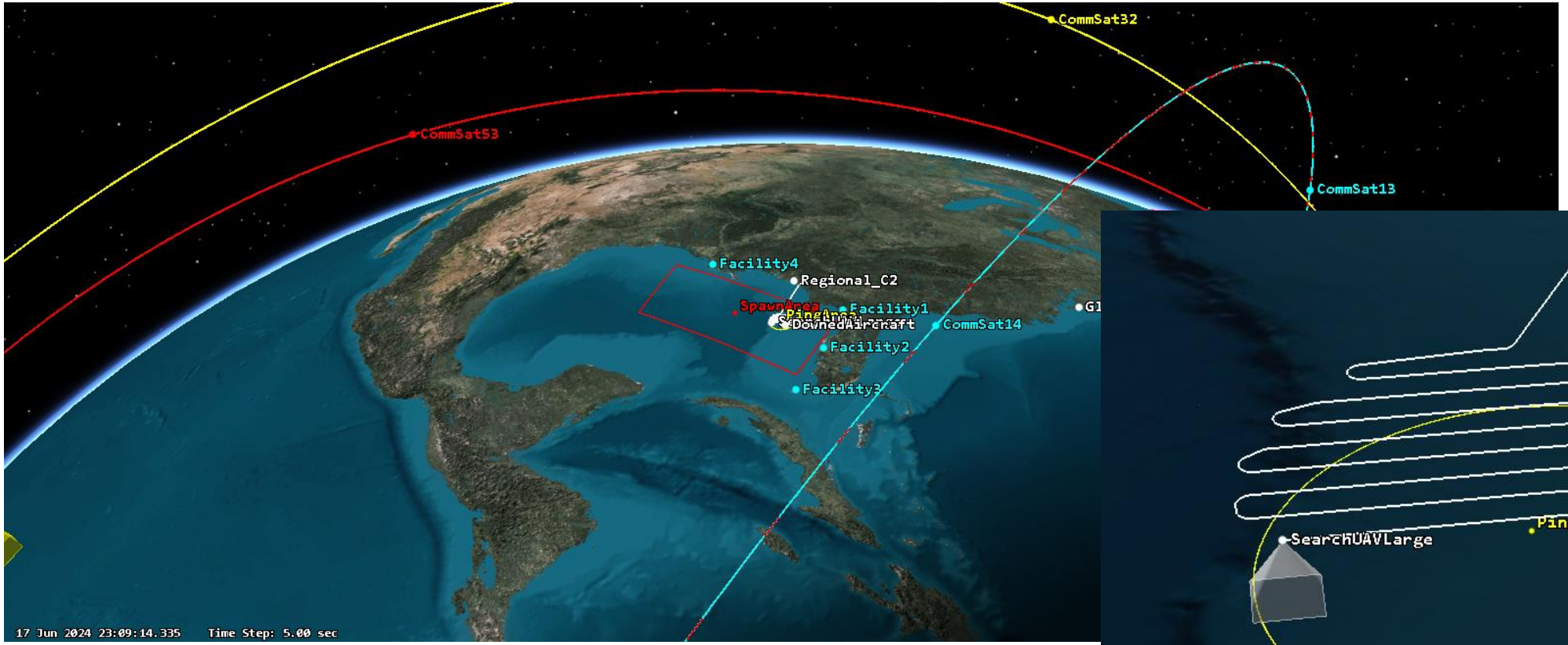
Minerva Provides “Sneak-peek” of DRM

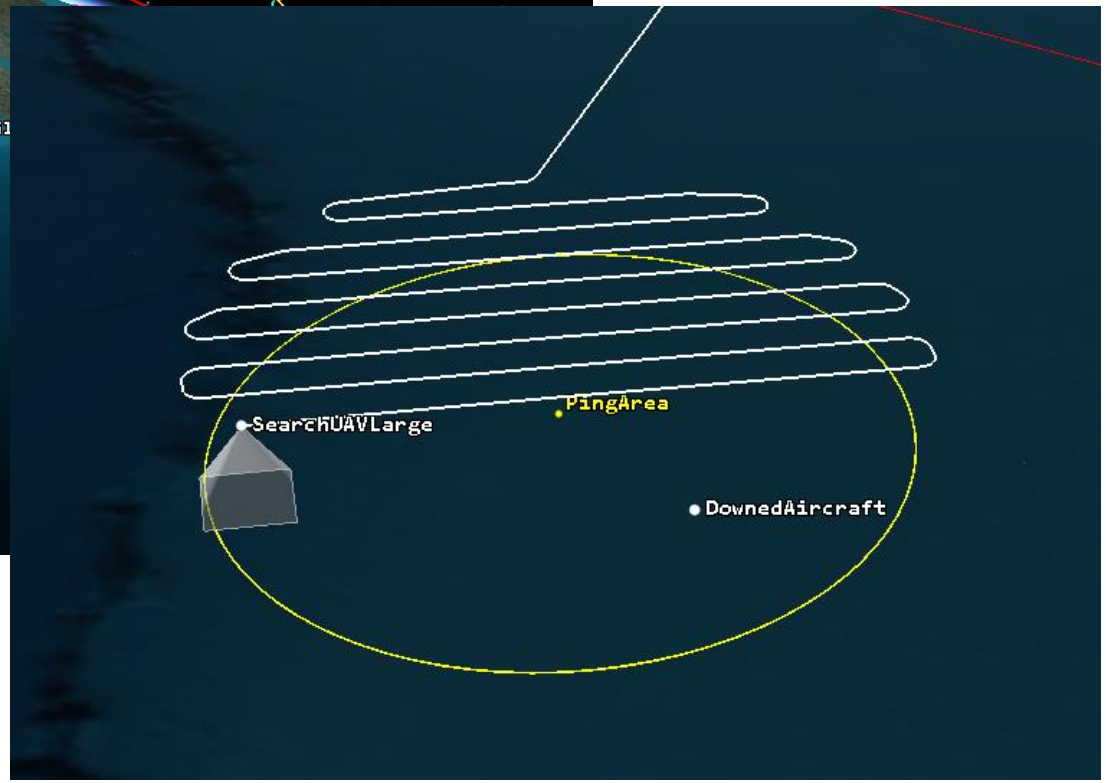


- **Through metadata extraction, Minerva shows all the assets in a DRM and their core properties**
- **A built-in 3D viewer can also be accessed to preview the DRM in the web browser**



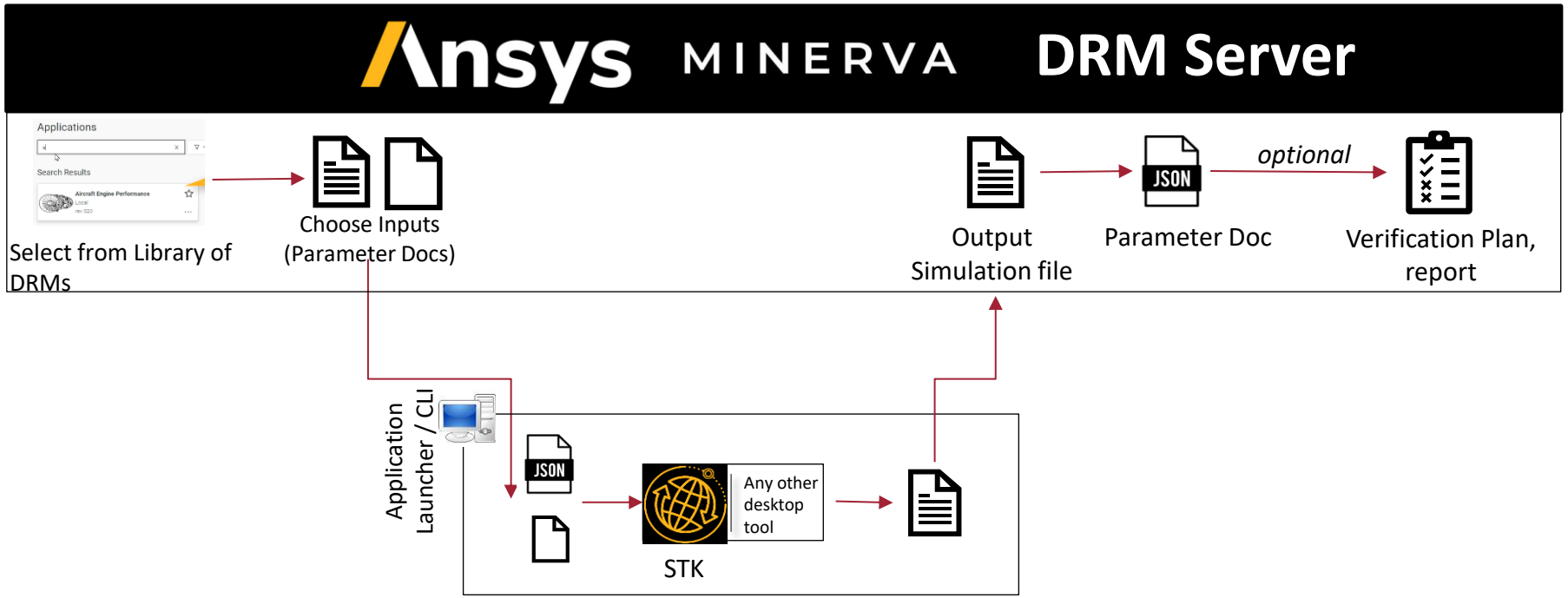
Example DRM: Aircraft Sensor Detection System for Search & Rescue





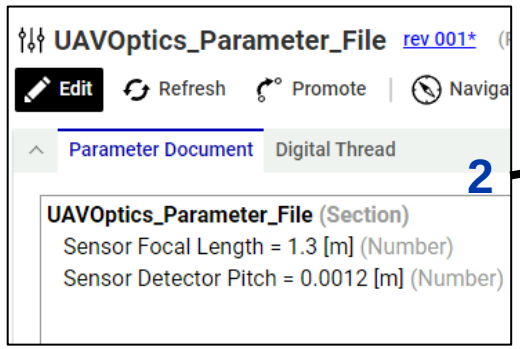
DRM Library Use Case

- **Ansys Minerva can host a library of DRMs (ModelCenter wrapped STK + other simulations), presented to users as “Apps” within Minerva**
- **User selects inputs (parameters, input files etc.) from Minerva for use on user’s local workstation running individual desktop tool(s)**
- **On completion, bring the output file(s) back to Ansys Minerva**



Define Workflow for Varying DRM Parameters

1. **Wrap the STK mission simulation in a ModelCenter workflow**
2. **Parameter File from Minerva used to vary sensor parameters**
3. **ModelCenter links outputs from parameter file to inputs in STK DRM**



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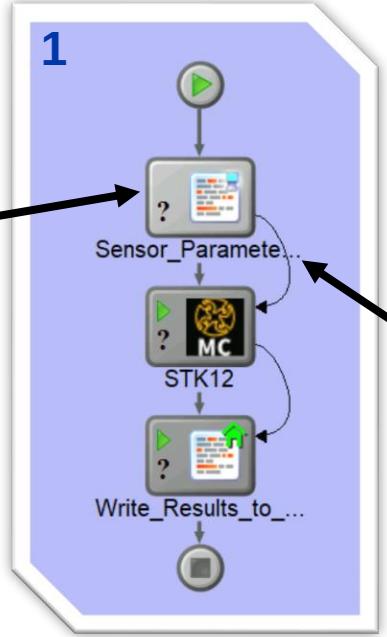
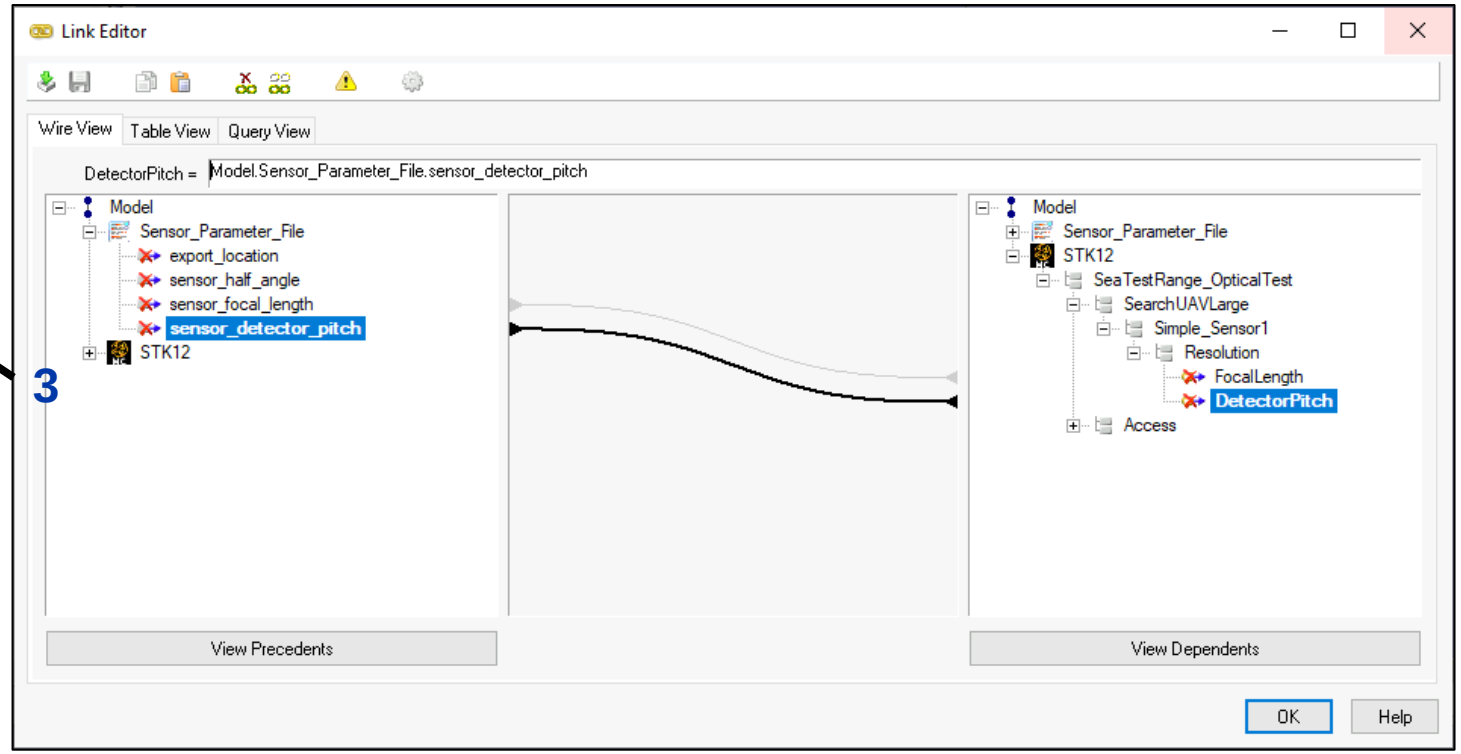


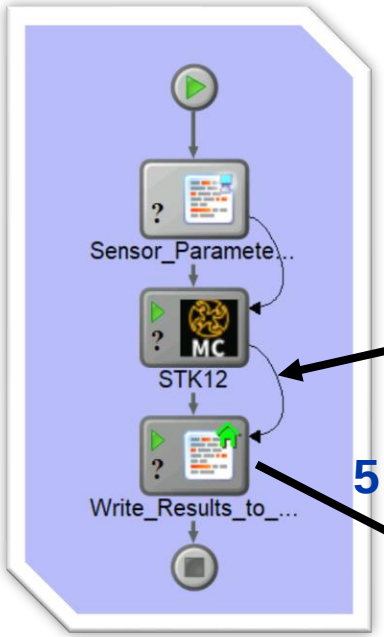
ModelCenter workflow

3



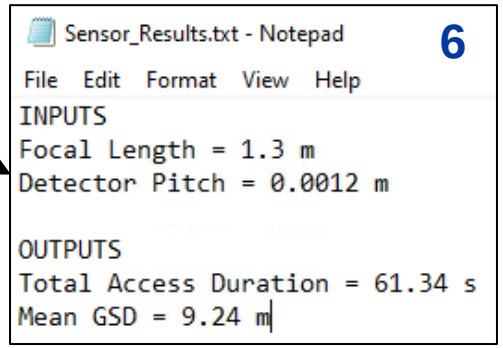
Continue Workflow for Varying DRM Parameters

4. **ModelCenter links outputs from STK DRM to inputs of results script**
5. **Results script writes results to a text file**
6. **Results file is saved back to Minerva for comparison against requirements**

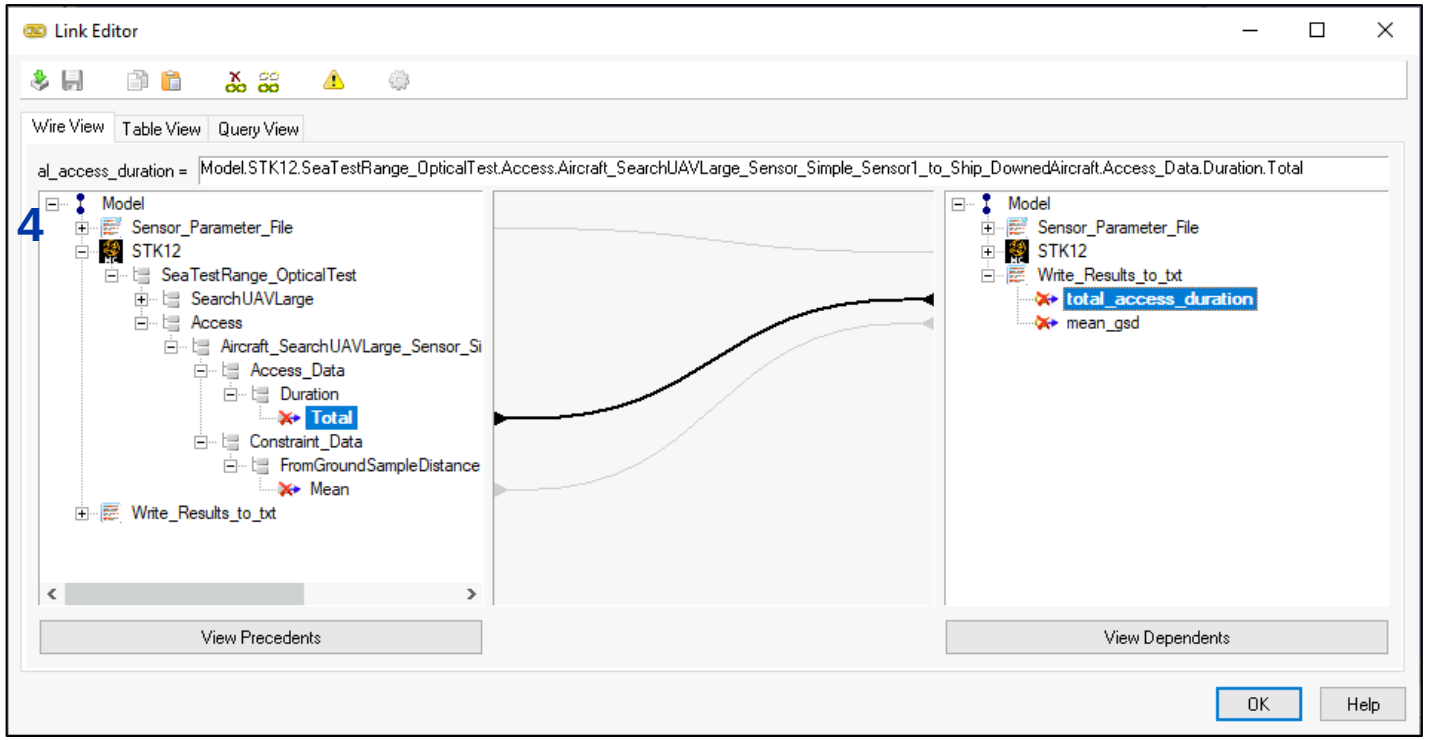


ModelCenter workflow

5

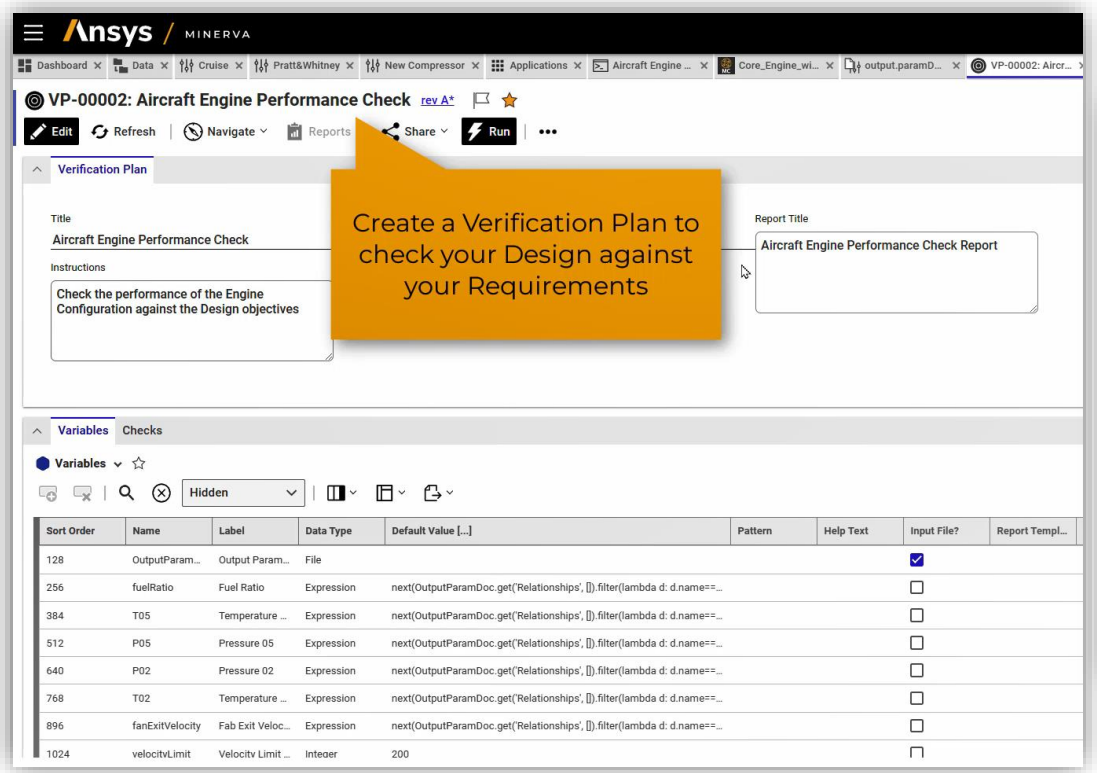


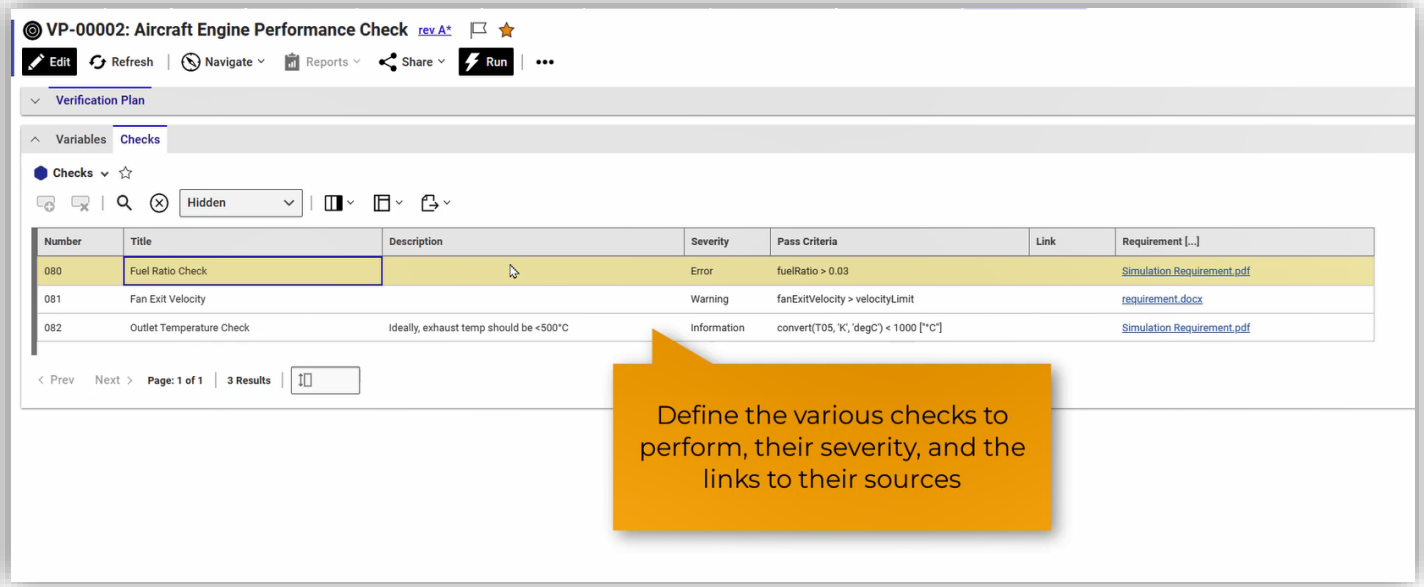
4



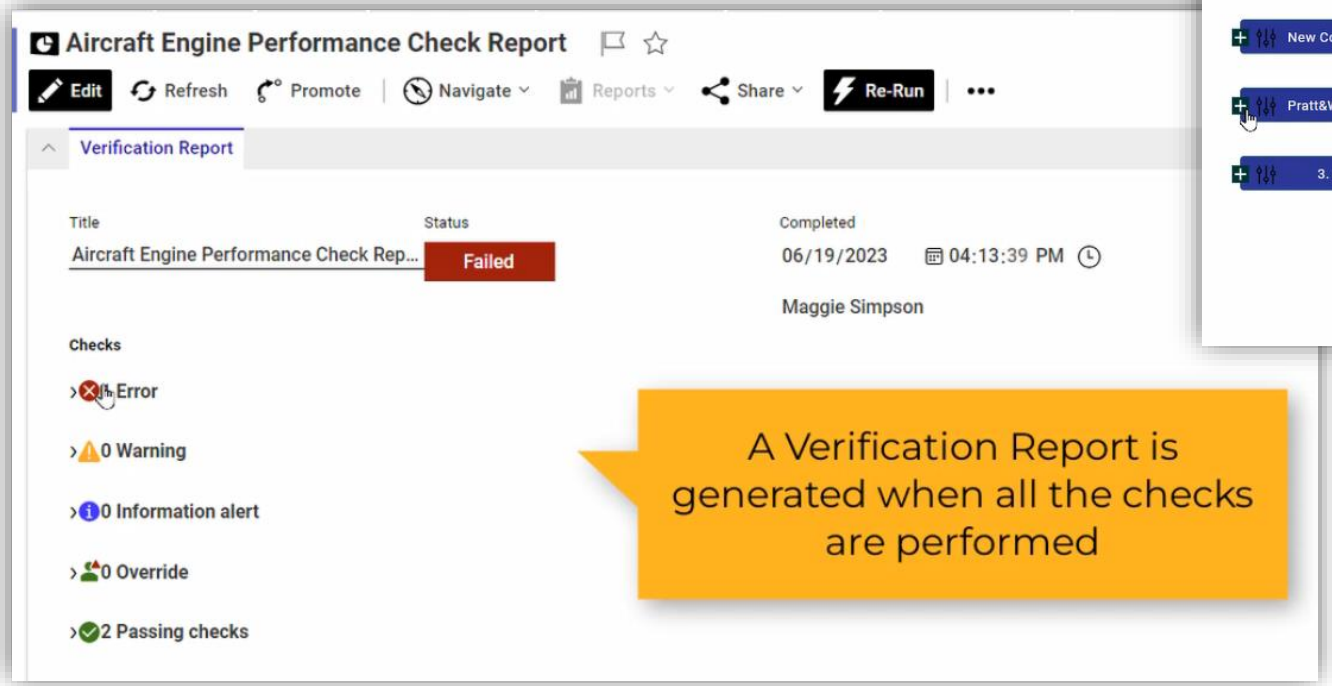
Compare Mission Results Against Requirements

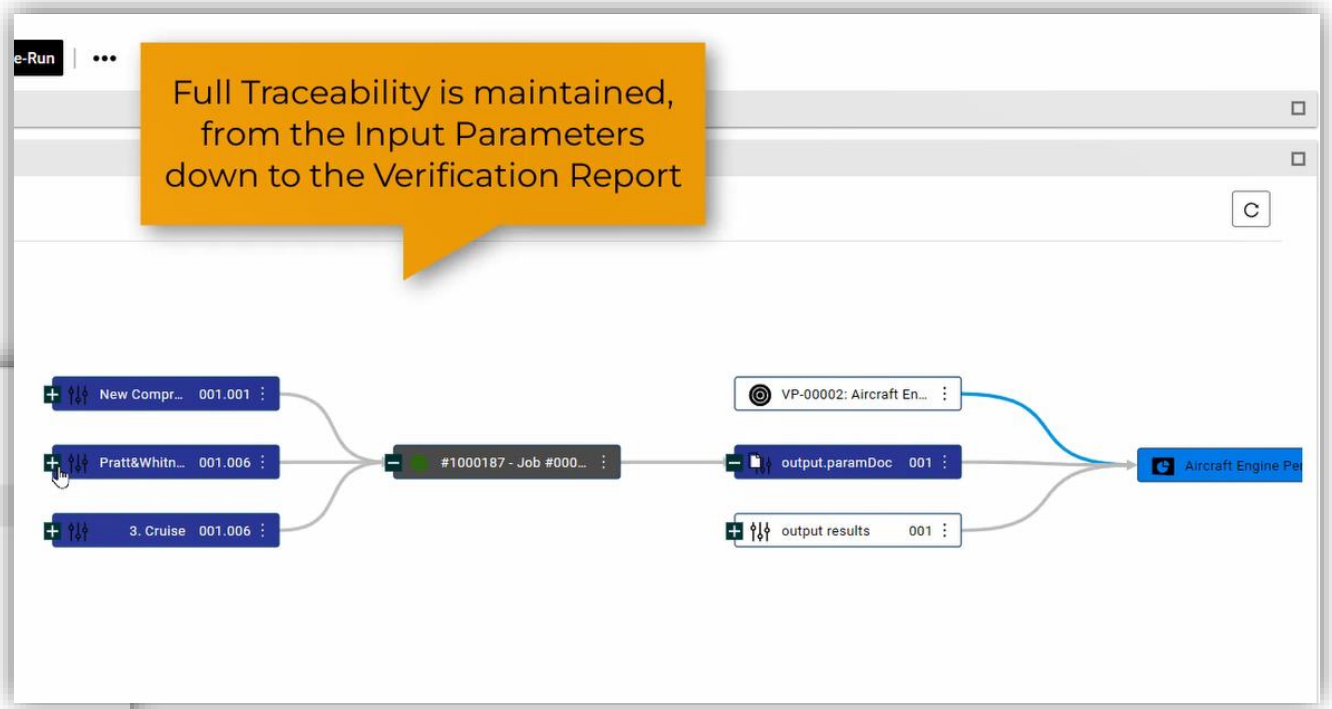
- **Use Verification Plans and Reports to assess mission outcomes against requirements**





Compare Mission Results Against Requirements





Updating Assets

- **Results of mission simulation can inform changes to asset files**

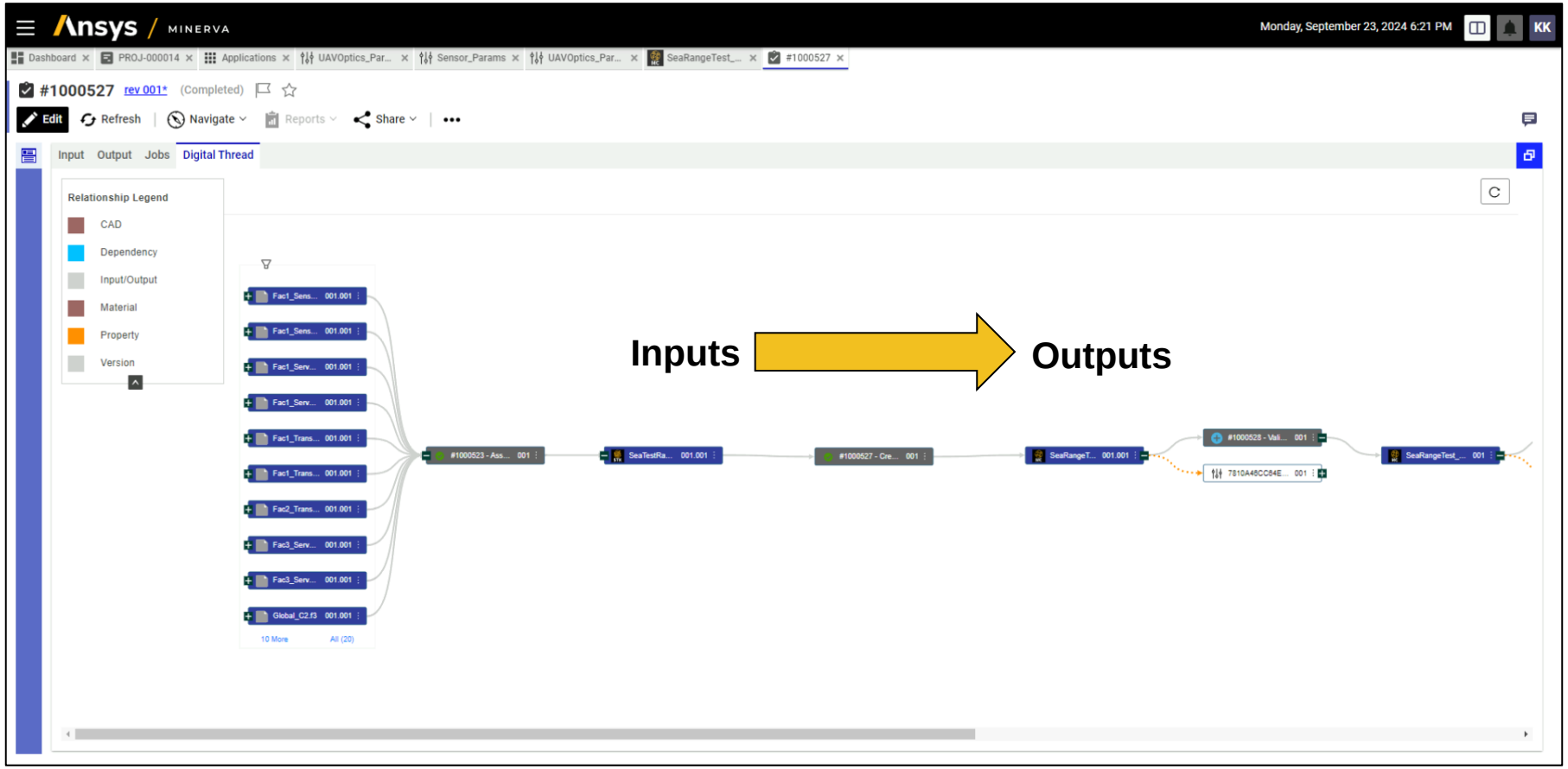
Version	Focal Length	Detector Pitch	Total Access Duration	Ground Sample Distance
1	1.3 m ▬	0.0012 m ▬	61.34 s ▬	9.24 m ▬
2	1.1 m ⬇	0.0008 m ⬇	72.39 s ⬆	7.44 m ⬇

Revisions for Simple_Sensor1.sn

Tree	Revision	State	Description	Modifications	Release
	001 ☆	In Work	Default	2024-09-23 23:02:06 by Kyle Kochel	
	001.001	Superseded		2024-09-23 23:02:04 by Kyle Kochel	2024-09-23 23:02:04

- **All linked items to this object will now use latest parameters**

Preserving Full Digital Thread Traceability



- **Not just the “what” but the “why” behind design decisions and changes**
- **Enhanced collaboration**

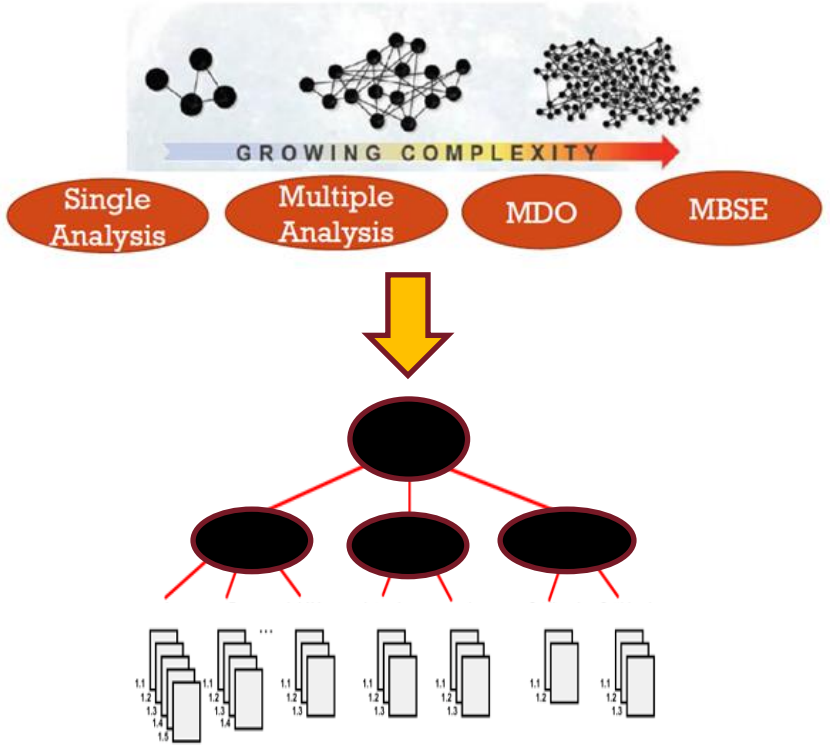
The Problem to Solve

Decisions
Require Information

Information
Requires Context

Context
Requires Traceability

Traceability and Connectivity
Require Data and Configuration Management



In Review…

- **DRMs are essential to modeling missions and verifying requirements**
- **An SPDM system, such as Minerva, provides a central repository for storing and reusing information**
  - **Standard object catalog for test range assets**
  - **Assembled DRMs**
- **SPDM system enables accelerated methods for creating DRMs and launching workflows through custom web apps**
- **SPDM system provides full traceability of the digital thread, preserving the “why” behind the data and the processes involved**

Questions?

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