

**P4-9 JWST Data Management Subsystem Operations:
Rehearsing to Process and Archive JWST Data**



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Abstract

The James Webb Space Telescope (JWST) is a cornerstone in NASA's strategic plan, serving as the premier tool for studying the earliest stars and galaxies and for understanding the origins and future of the universe and the galaxies and solar systems within it. The Data Management Subsystem (DMS) is an integral part of the systems JWST needs to achieve these goals, and it serves as the interface between JWST and the astronomers who use it. We outline the JWST DMS Operations and detail the systems and tools that will be used to ensure that the unprecedented JWST data products are of the highest quality possible and available in the archive as quickly as possible. We also describe the rehearsals that are taking place, in order to ensure the operations systems, personnel, and procedures are ready well in advance of the spacecraft launch.

JWST Science and Operations Center (S&OC) Interfaces

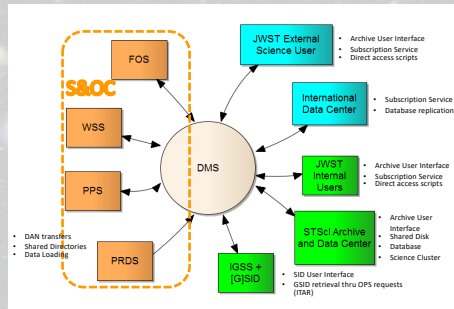


Figure 1- JWST S&OC Interface Diagram

- DMS is one of six subsystems within S&OC, which is a part of the Ground Segment element of the JWST Mission. DMS is responsible for science and engineering data receipt, processing, archiving, and distribution.
- DMS has interfaces with all of the other S&OC subsystems as well as external interfaces to JWST Users and the International Data Centers.
- DMS's main interface is with the Flight Operations Subsystem (FOS) which provides the science and engineering data received from JWST.

JWST DMS Components

The Data Management Subsystem is comprised of 14 components, which together perform data receipt, processing, archiving and distribution functionality. DMS uses inputs from the Flight Operations Subsystem (FOS) and Proposal Planning Subsystem (PPS) to generate data products which are stored and made available for distribution to science users. DMS is also instrumental in generating, storing and distributing data for the Wave Front Sensing & Control Software Subsystem (WSS), which is used for mirror alignment and focusing.

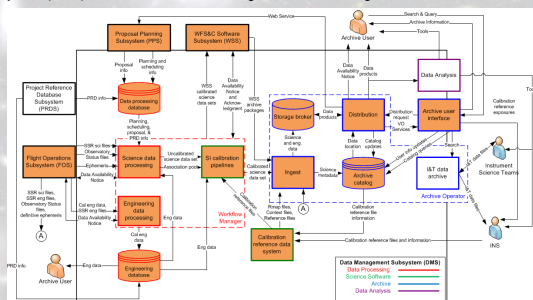


Figure 2 - JWST DMS Components

JWST DMS Operations: Processing Control

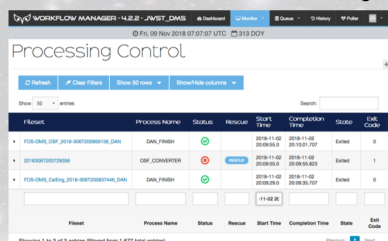


Figure 3 – The Open Workflow Layer (OWL) GUI

- **Data Pipelines: The Open Workflow Layer (OWL) / HTCondor™ workflow manager** controls the flow of:
 - new science and engineering data
 - reprocessed science data
 - **Observatory Status Files** (used for processing science data)
 - spacecraft ephemerides
- OWL augments HTCondor™ with additional capabilities that facilitate tracking the data.
- **The OWL GUI (Fig.3) allows for operations staff to easily monitor and control the data processing workflow, and to rescue failed workflow steps when necessary.**

JWST Simulator Rehearsals

In order to exercise the end-to-end flow of data from JWST to the MAST archive, JWST DMS Operations has participated in a series of rehearsals using the JWST Observatory Test Bed (OTB) simulator.

Rehearsal	Objectives
WaveFront Exercises	<ul style="list-style-type: none"> Rehearse one of the most important activities and tightest constraints on the S&OC as a whole: the Wavefront Sensing & Control (WFS&C) activities necessary to align the mirrors of the telescope.
Science Operations Rehearsals	<ul style="list-style-type: none"> Prepare the Science Operations teams for launch, commissioning, and regular operations. Exercise the JWST Ground System and its capabilities. Test Operational procedures, and identify new procedures that are needed.
Normal Operations Rehearsals	<ul style="list-style-type: none"> Use the JWST OTB simulator to practice what normal, daily operation of JWST on a regular (~monthly) cadence. Exercise data modes to meet the specific needs of daily science operations, and to support ongoing development.

Rehearsal Successes

- DMS participated in multiple rehearsals to date, each one learning from and building on the successes and failures of previous tests.
- Improvement with each rehearsal in ability of all teams to identify, report, and resolve problems in real time.
- DMS able to meet requirements to return WFS&C data products to the Wavefront Software Subsystem (WSS) within 90 minutes of receiving them from the spacecraft.
- Important Calibrated Engineering data duplication issue identified.
- Tested 21 DMS Operations staff procedures.
- Communications channels exercised (Slack, Jabber, email, Voice Loop, in-person).
- Relationships built (getting to know people on the other teams and their areas of expertise).

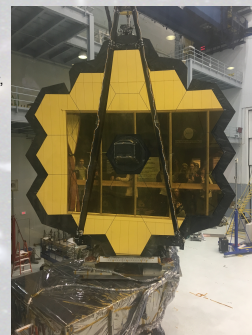


Figure 4 – The James Webb Space Telescope Mirror, which must be aligned using WFS&C data products to maintain optimal image quality. Credit: C. Kalejda

Rehearsal Lessons Learned



Figure 5 – The James Webb Space Telescope Mission Operations Center. This control center is both where the OTB simulator rehearsals are conducted, and where the actual spacecraft will be controlled from. Credit: STScI

- OTB simulator configuration needs to be carefully curated to ensure all systems' versions installed are compatible with one another.
- Include thorough regression testing of the operational string (~20 servers where data is received from the OTB simulator) to confirm proper configuration prior to each rehearsal.
- Improve ability to identify and resolve Common Archive and Observation Model (CAOM) problems.
- Explore ways to better predict what data products will be created from each observation program's Astronomer's Proposal Tool (APT) file.

References

- Fig. 1 and 2 are from the JWST DMS Design Document (SOCCER #JWST-STScI-002729)