National Aeronautics and Space Administration

ENABLING MODERN FLIGHT CONTROL AND GROUND SCIENCE SUPPORT TEAMS USING SOFTWARE SUPPORT SYSTEMS

Matthew Miller, Ph.D.
Exploration Research Engineer
Jacobs/NASA JSC – Astromaterials Research & Exploration Science

Purpose of this presentation

- Informational briefing to highlight the following
  - EVA Mission System Software (**EMSS**) Initiative
    - EMSS is a cross-organization team focused on integrating cross-organization software in the planning, training, execution, and exploration phases of ISS and Artemis EVA operations
  - **Integration** across NASA Orgs and Centers
    - EMSS personnel span JSC, Ames, Goddard, and the broader scientific community
  - **Incorporating** the Exploration Science mindset (and associated data handling needs) to EVA execution
    - Plan/Train/Fly Flight Control Mantra now includes Explore

EVA Flight control structure
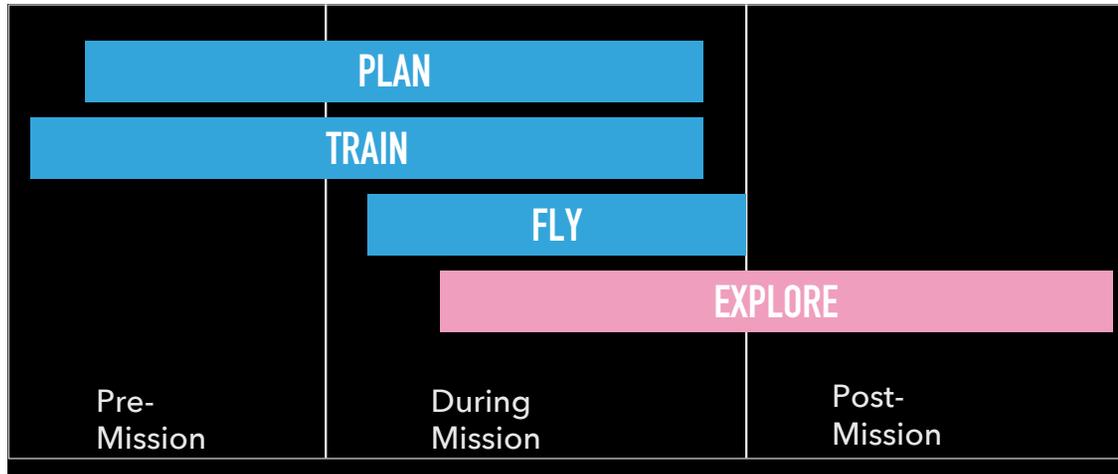
- **Plan:** A way to generate consensus across the team/community
- **Train:** A way to teach the crew what they're going to do days/weeks/months before the activity
- **Fly:** A series of steps to follow on the day of the activity
- **Explore:** Explore-phase depending on what content is recorded along with the procedure

WHAT QUESTIONS PERSIST THROUGHOUT EVA?
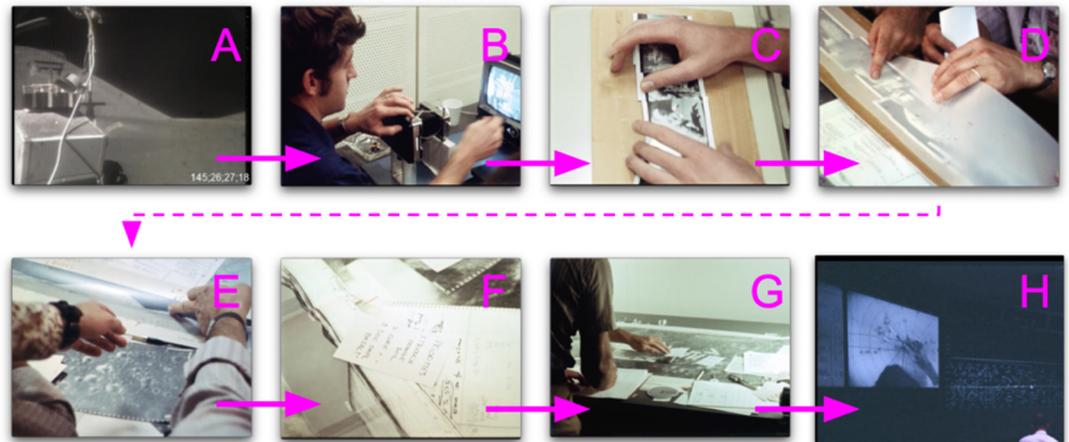
WHERE ARE WE?	WHAT ARE WE DOING?	WHAT ARE WE LEARNING?

EMSS initiative is making software that helps address the where, when, why questions that is ultimately beneficial to both Ops and Science endeavors throughout the Plan/Train/Fly/Explore Structure

Considering Mission Ops - Apollo context

(A) Video footage from the lunar surface

(B) Transferred to Polaroid still photography

(C) Collated into panoramas

(D) Overlaid with precursor imagery to estimate crew location and facilitate scientific interpretation

(E) Images were compared with other map products

(F) Synthesize and articulate real-time science priorities that were passed along the chain of command to impact crew behavior

(G) Estimates of crew location were indicated using icons moved manually on a map alongside operations relevant data such as clock time and event markers

(H) Information shared among the flight team via Main display 2 in the Mission Operations Control Room (MOCR)

Apollo 50+ Years Later

Horizontally Integrate Disparate Data sets via time

VOICE TRANSMISSIONS
VIDEO TRANSMISSIONS
16MM FILM
70MM STILL PHOTOGRAPHY
LUNAR SAMPLE COLLECTION
ALSEP – HEAT FLOW
ALSEP – LACE (ATMOSPHERE)
ALSEP – EJECTA & METEORITES
ALSEP – SEISMIC
ALSEP – GRAVIMETER

Apollo in Real Time

This document does not contain information subject to U.S. Export Control Laws.

6

Linking scientific data to mission ops

Publications

Curation

Integrated Mission Context links the moment data is generated in the mission to all subsequent advancements with that data during and after the mission

Geographic Information System Infusion

WHERE ARE WE?

- Leverage existing Geographic Information Systems software capabilities

- Produce relevant EVA Traverse visualization and coordination capabilities

- Future integration with mission planning to integrate where we hope to be on EVA with where we actually are during execution

- Answering this question is a core way to inject scientific interest/objectives into the mission

EMSS Status: In early concept development

Map planning products
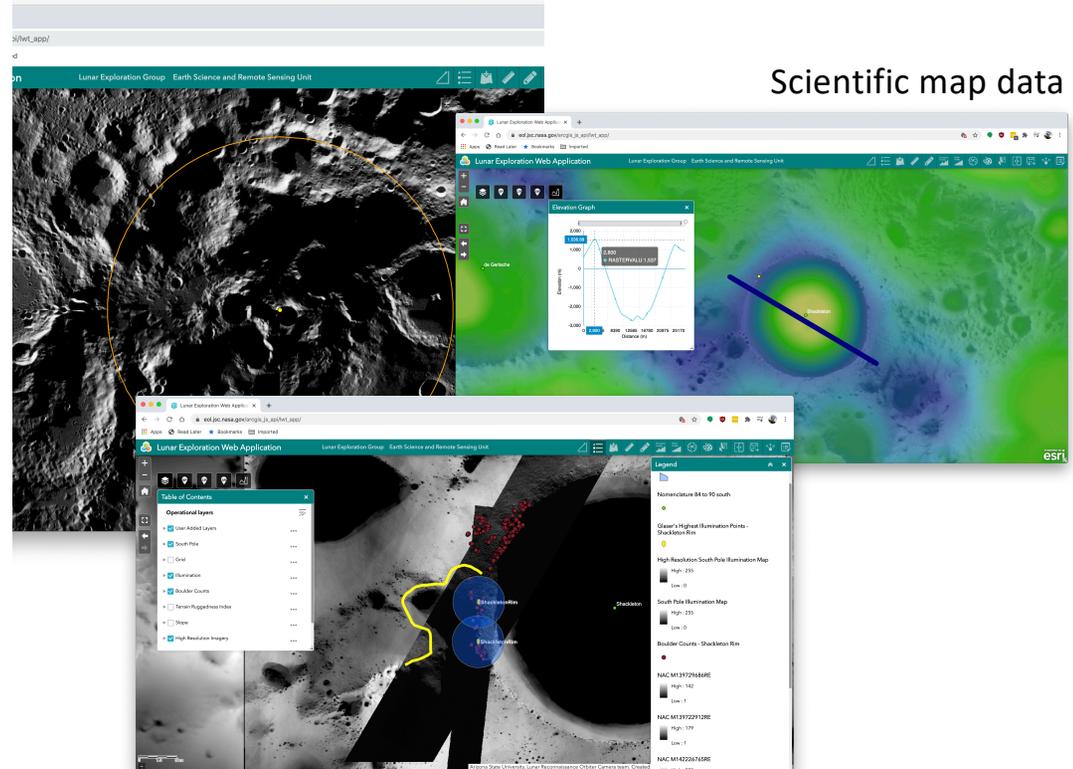
Scientific map data

Operations and Scientific data on maps

Procedure Drafting and Execution

WHAT ARE WE DOING?

- EVA timeline creation via modern timeline tasking approach

- Improved change management

- Establishing structured data for EVA procedures

- Currently focused on ISS EVA with an eye to Artemis (e.g. Mimic the output of MS Word process)

- Creating procedures that are both human and machine readable (this could perhaps replace "establish structured data for EVA procedures")

- Write once, export to digital collaboration systems, mission procedure systems, head-up displays, print, etc.

- Working with these details gets us data formatted in a way that gives context to the mission

EMSS Status: In Active development

Summary Timeline view

Detailed Procedures view

Horizontally Integrated Data

WHAT ARE WE LEARNING?

ISS EVA Operations Interface

- Operations and science data integrated view

- Decoupled from source systems (RISE2, NBL, ISS, Artemis)

- Treat all data as time-series data
  - Record capture-time of non-time-series data to put it in context during analysis
  - For Example:
    - Engineering/Suit data
    - Human health and performance data
    - Audio/Video/Imagery
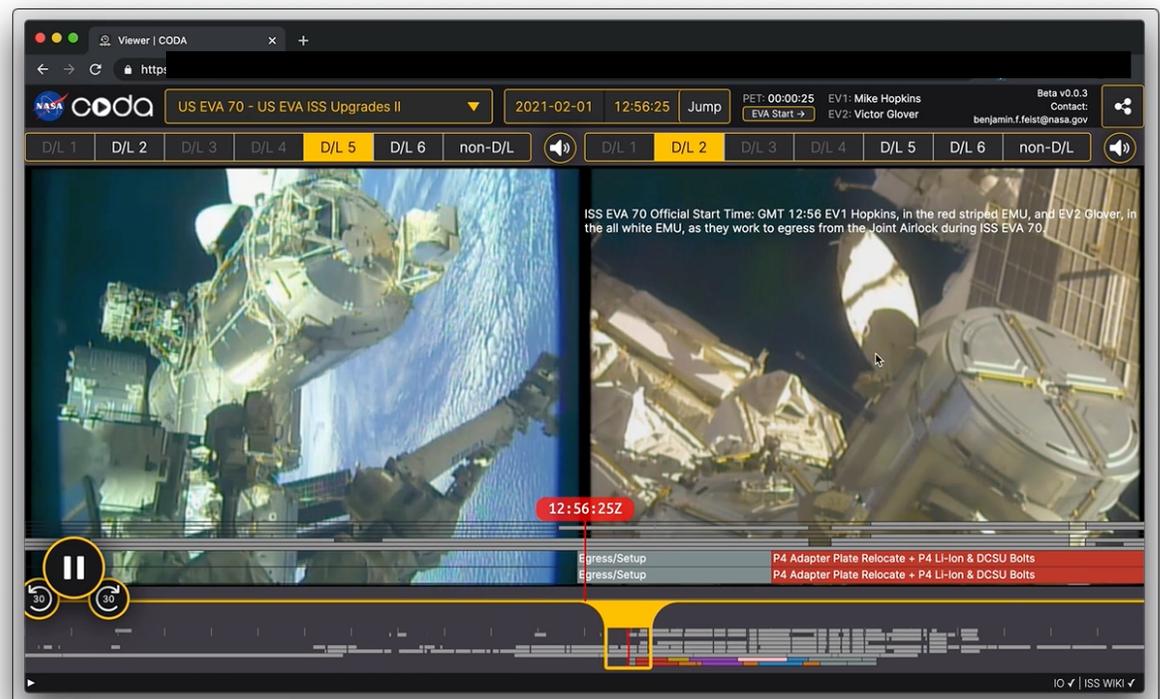
EMSS Status: In Active development

Conclusions and Next Steps

WHERE ARE WE?	WHAT ARE WE DOING?	WHAT ARE WE LEARNING?

EMSS Initiatives (Current)

EVA GIS Software

Data exchange

Maestro

coda

Collaborative Operations
Data Activation

EMSS Team is establishing core capabilities to address these three questions as well as understanding what it might mean to share data between these systems

EMSS Initiatives (Future)

- As the EVA flight control team is built, target more specifically the workers in those consoles and pull data from the **relevant data sources** to ensure those who need it, have it to successfully plan, train, fly, explore
- Incrementally add other systems to the EMSS ecosystem to meet the needs of Artemis Flight Operations

Concluding Thought

Imagine if the Artemis crew, science team, MCC team, and members of the general public all used the same system to experience humanity's return to the Moon.

Michael Collins @AstroMCollins · Jul 20
Happy 51st anniversary of the moon landing! Follow the whole mission at apolloinrealtime.org/11 - my favorite!

📷: @NASAJPL

💬 112   🔁 1.2K   ❤ 6.1K   ↥