### A Remote Vehicle Operations Center's Role In Collecting Human Factors Data

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# Introduction and Background

<sup>4</sup>UAS = Uncrewed Aerial System

- Research is needed to develop a prototype remote vehicle operations center to explore current and future AAM<sup>3</sup> operations.
- Our research is intended to provide data that informs evolving operational concepts, aviation regulations, and standards.
- The design of the operations center is focused on enabling a crew of human operators to remotely manage multiple highly automated small UAS<sup>4</sup> in BVLOS<sup>5</sup> conditions.



<sup>5</sup>BVLOS = Bevond Visual Line Of Sight



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<sup>3</sup>AAM = Advanced Air Mobility

# **Description of the ROAM UAS Operations Center**

### > Twofold purpose:

- To conduct human-in-the-loop experiments that explore different roles and responsibilities of remote operators managing multiple increasingly autonomous vehicles, with the goal of exploring human-autonomy teaming concepts that enable m:N operations.
- To enable multi-vehicle small UAS flight operations from a remote location in BVLOS conditions.
- Use cases tested within the facility focus on small UAS operations and passenger-carrying operations.



# **ROAM Design Philosophy**

#### Overarching design goals:

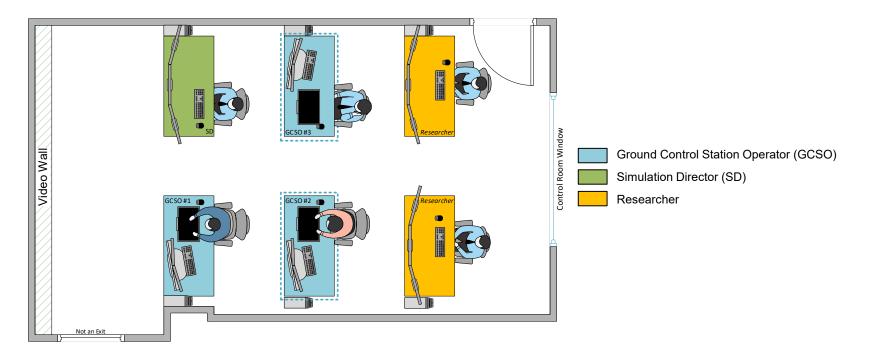
- Relocate existing field operators to the remote vehicle operations center
- Produce a shared situation awareness environment
- Provide the ability to pursue advanced vehicle operations and control

#### > Envisioned to provide:

- > A user training environment
- Flight operations planning and briefing environment
- A research facility for conducting simulated and live operations of small UAS vehicles



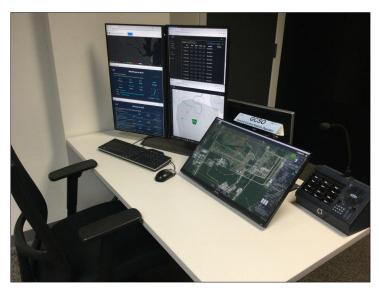
## **ROAM's First Instantiation**



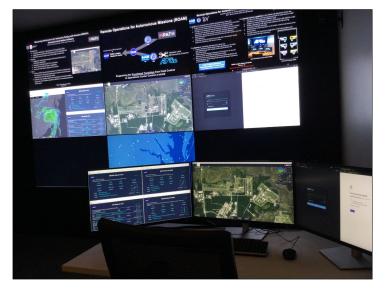
**ROAM UAS Operations Center Generalized Layout, 2021** 



## **ROAM's First Instantiation** (cont.)



**Ground Control Station Operator Workstation** 



Simulation Director Workstation with Video Wall



## **ROAM's First Instantiation** (cont.)

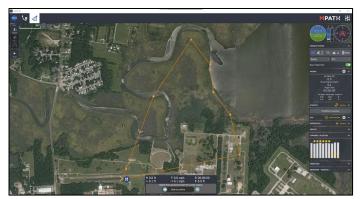


**ROAM Forward Video Wall as used in Simulation** 



# **Capabilities Supporting Human Factors Research**

- MPATH<sup>6</sup> Ground Control Station Software
- Tobii Pro Nano Eye Tracker
  - Mounted to the primary display for the operator
- Custom NASA application to collect questionnaire data from operators





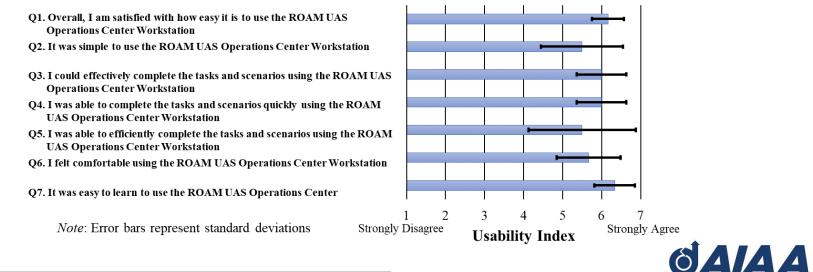


<sup>6</sup>MPATH = Measuring Performance for Autonomy Teaming with Humans

## **Initial Usability Results**

Data was collected from participants with a modified version of the Post-Study System Usability Questionnaire (PSSUQ)

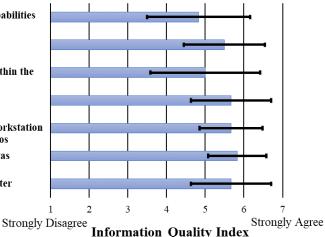
Focused on Usability and Information Quality



## Initial Usability Results (cont.)

- Q8. The ROAM UAS Operations Center Workstation had displays or capabilities that clearly told me how to fix problems
- Q9. Whenever I made a mistake using a ROAM UAS Operations Center Workstation component, I could recover easily and quickly
- Q10. The on-screen messages and communication capabilities provided within the ROAM UAS Operations Center Workstation components was clear
- Q11. It was easy to find the information I needed within the ROAM UAS Operations Center Workstation components
- Q12. The information provided by the ROAM UAS Operations Center Workstation components was effective in heling me complete the tasks and scenarios
- Q13. The organization the ROAM UAS Operations Center Workstation was effective in helping me complete the tasks and scenarios
- Q14. The organization of information on the ROAM UAS Operations Center Workstation was clear

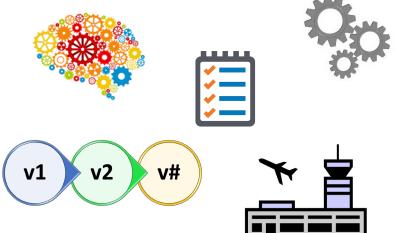
Note: Error bars represent standard deviations





# Extensibility for UAM<sup>7</sup> Research

- A remote vehicle operations center like ROAM can conduct research into several areas of AAM:
  - Technology Performance Studies
  - Procedure Development
  - Human Factors Analyses
  - Integrated Simulation Studies
  - Future Evolutions





# **Concluding Remarks**

- Usability ratings for ROAM are generally high, reflecting a positive start for the facility.
- Based on initial findings, significant changes have already been implemented into the ongoing design of ROAM.
- The ROAM UAS Operations Center can support both the collection of human factors data and multiple needs of researchers answering questions of today and tomorrow on AAM.





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