

HUMAN HEALTH AND PERFORMANCE

Exploring Space | Enhancing Life

Human-In-The-Loop Evaluations

Evaluation to Optimize Design, Improve Safety and Increase Mission Success

Early and iterative human-in-the-loop (HITL) evaluations:

- Provide insight whether concepts of operations (con-ops) are realistic and achievable
- Reveal design and integration problems, and opportunities for cost efficient improvements
- Extend the design process beyond 2D concepts (drawings, PowerPoint slides) to interactive 3D prototypes and mockups, to evaluate task performance
- Help to eliminate design flaws that may contribute to error, fatigue, loss of situation awareness, and other risks
- Support consistent design of safety and mission critical displays and controls
- Pave the way toward successful verifications

Focus areas for HITLs include:

- Displays & Controls
- Piloting, manual control, handling qualities & display usability
- Seat design, ingress, and egress
- Crew vehicle egress, hatch ops, & post-landing survival
- Emergency response
- Habitability & environmental systems
- Net Habitable Volume
- Exercise
- Speech intelligibility (comm system)
- Stowage
- Equipment access and use



Net Habitable Volume HITL



Pre-launch emergency egress HITL



Displays and controls HITL

HITL Success Stories

Displays and Controls: HITL testing of the display formats occurs continually to ensure successful crew interaction for the breadth of tasks required. HITLs have identified colors for displays to use to minimize opportunity for error if viewed from different angles, the acceptable refresh rate for different display elements, and the overall configuration of displays to assist with mission task completion. All hand controllers have undergone extensive testing to ensure that all controls are operable under the conditions required.

Hand controller placement: HITL testing identification of in-board suited hand controller interference resulted in a design change to the mounts to eliminate the interference.

Legibility: HITL teams developed a new legibility method that is affordable for the Orion program and uses real flight-like displays and validated the method through HITL testing. The HITL testing also led to identification of a glare issue that has since

been resolved through revised light locations. Legibility testing under Orion ascent vibration levels was conducted to determine whether the crew could read the ascent displays. HITL testing has also led to identification of lighting levels for the console backlighting and LED indicators to support different phases of flight and operations, including sleep.

Net Habitable Volume: HITL testing has led to development of hardware improvements around the cabin to support on-orbit operations, including restraints, radiation shelter concepts, exercise feasibility, and hygiene operations.

Vehicle egress: HITL testing has improved the efficiency with which the crew can safely egress the capsule, through modifications to hardware placement and operability.

Docking hatch operations: Build-up and evaluation of the docking hatch opening and partial egress testing has led to significant changes in the tunnel and on the hatch.

HH&P Teams with HITLs as a core capability include:



Gateway HALO GTA
Human Factors Team



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For the benefit of all

For more information:
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