



# **Wearable Technologies Workshop Design Challenge:**

## **Exploration IVA Common Tool Kit with Loose Items, Spare Parts Restrain System, and iPad Holder**

Robert C. Trevino, P.E.  
NASA Johnson Space Center

Presented to the Wearable Technologies Workshop  
April 29, 2019



# Origin of Idea for the Design Challenge

**Working on several projects :**

**Advanced Exploration Systems Logistics Reduction Project –**

Significantly reduce the amount of logistics to support long duration space flight (clothing, cleaning products, consumables, tools, etc.)

**New Concept for Deep Space Gateway Habitation Module :**

Small multifunctional habitat that is both a habitat and airlock (more efficient use of volume).

Requires crew cabin to be multifunctional, such as deployable sleep stations and foldable crew seats) and designed for maintainability and repair.

**Observations:**

Large IVA tool kits in rigid tool boxes like in the Space Shuttle and International Space Station are being replaced with soft, compact roll up tool Bag that can be stowed in any stowage compartment.

Paper checklists and procedures are being replaced with electronic tablets (iPADs).



# Crew Member Opening ISS Tool Kit





# Current ISS Tool Kit





# Current International Space Station In-flight Maintenance





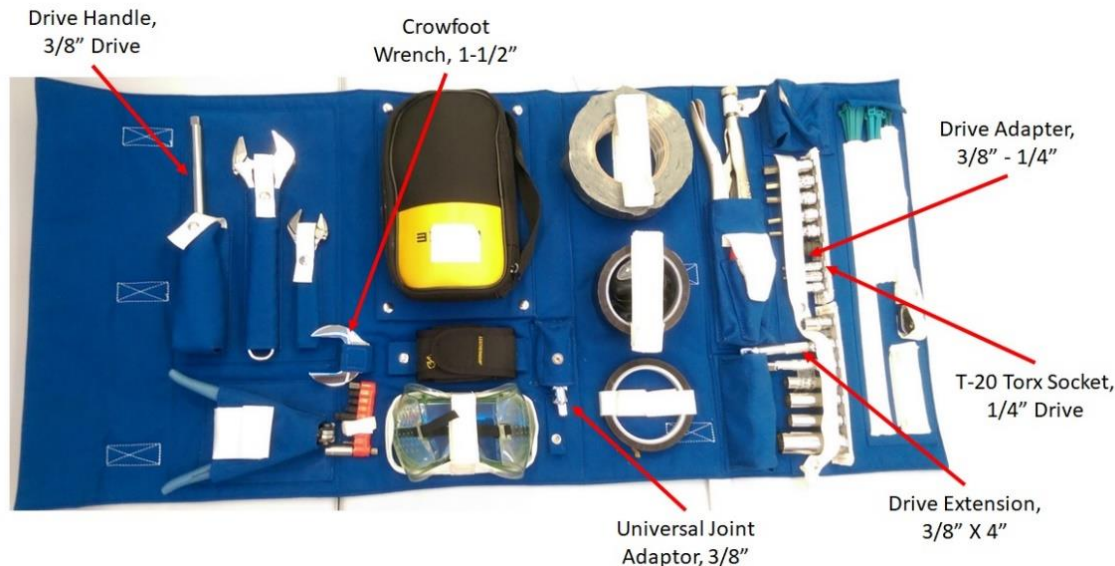
# Prototype Multifunctional Habitat Airlock (HAL)





# Observations During Human in the Loop Testing in the HAL

- Repair tasks are performed using the Exploration IVA common tool kit, no large inventory of tools and tool boxes available.
- All paper checklist and procedures, including in-flight maintenance procedures, are replaced with iPADs. Each crewmember has their own personal iPad.
- During human testing, observed that crewmembers would pick up iPad, read procedures, put down iPad, remove tool, pick up and read iPad, use tool, repeat. Very time consuming.



Exploration IVA  
Common Tool Kit



# Problem and Design Challenge

---

## Problem Statement

- Picking up the iPad, reading it, putting the iPad down, getting tools, picking up the iPad, using the tools, and repeating are time consuming tasks.
- Crew time is very limited and a valuable resource. Anything that reduces crew time and improves performance helps overall mission.

## Design Challenge

- Design integrated IVA maintenance system that integrates iPad and tool kits into a user friendly 0-gravity system that saves crew time and improves performance.