

Advancing Wildland Fire Response with NASA's Second Shift Capabilities

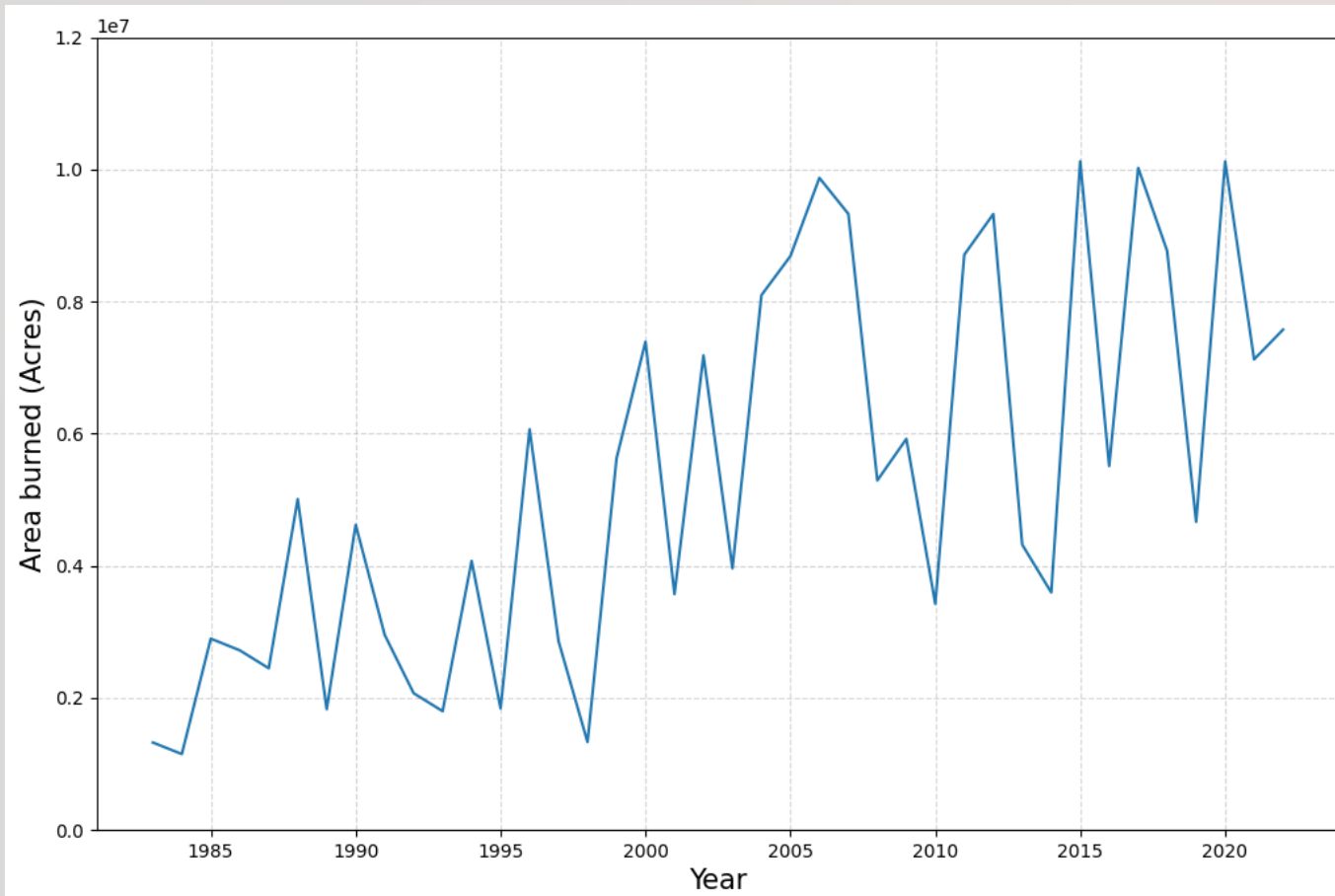
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Introduction

The Growing Threat of Wildfires



Wildfire Extent in the United States, 1983-2022

- Climate change and other factors like continued population growth in the Wildland Urban Interface (WUI) are projected to further increase wildfire frequency, intensity, and season length
- Annual wildfire-burned area of acres from 1983 to 2022 (Source: National Interagency Fire Center)
- The graph shows a notable increase in the area burned by wildfires since 1980s

Problem Statement

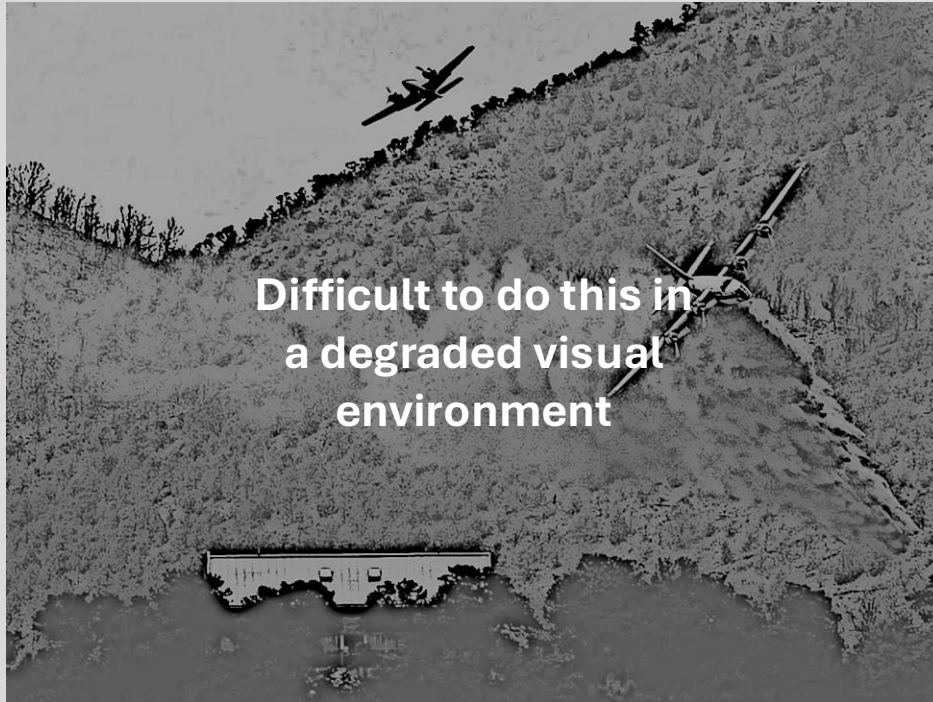
Today's Aerial Firefighting Operation, and Problem



- Aerial operations are crucial for supporting ground crews in fire containment
- However, “crewed” aerial support is mainly restricted to a 6 ~ 8 hour in good visibility conditions.
- These limitations have existed for 94 years ago since aircraft were first used for fire suppression
- Uncrewed Aircraft System (UAS) with advanced sensors (e.g., GPS, LIDAR, IR) can operate in low-visibility conditions and provide continuous 24/7 aerial support

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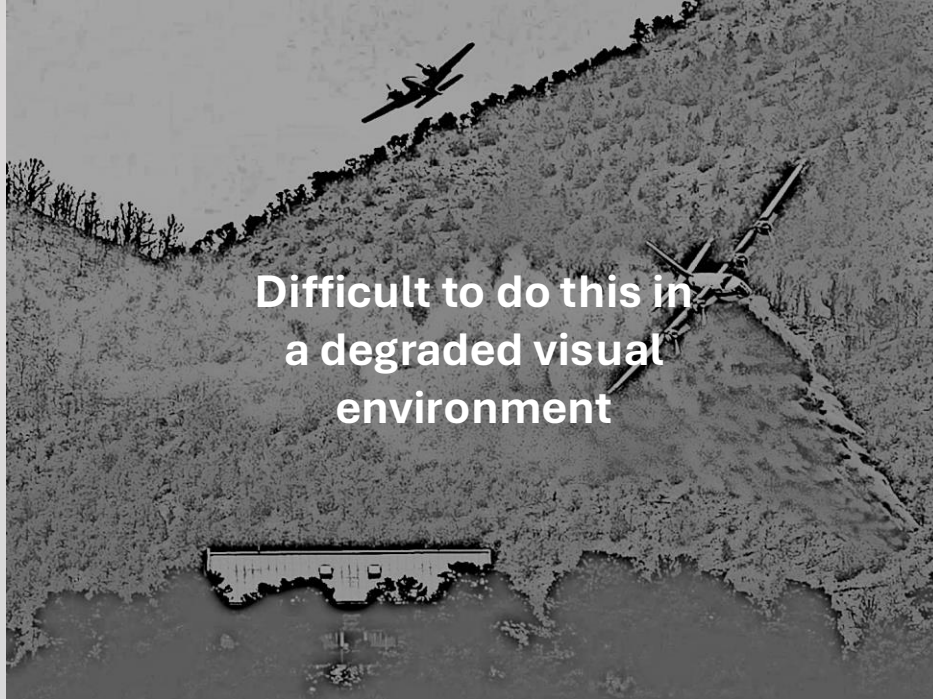
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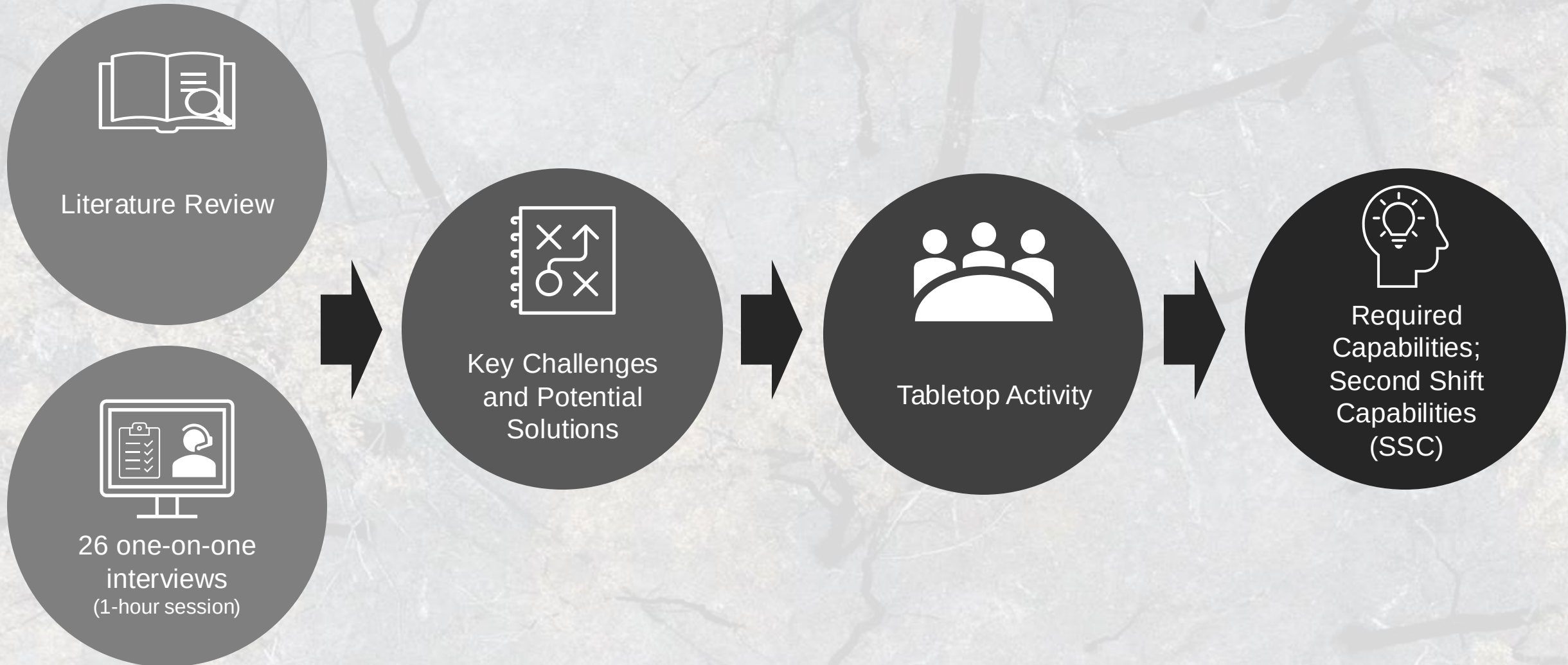
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Objective

Identify Key Capabilities Needed for Scaling UAS Integration in Wildfire Management to Support Extended Aerial Operations

Methodology

Overview of the Process of Identifying Required Capabilities



Methodology (Continued)

Literature Review and Semi-Structured Interviews



Literature Review



26 one-on-one
interviews
(1-hour session)

- Reviewed National Wildfire Coordinating Group (NWCG) documents for established current day wildfire management practices
- Consulted Subject Matter Experts (SMEs) for key documents and articles
- Incorporated input from industry partners on emerging technology trends
- Focused on the recent President's Council of Advisors on Science and Technology (PCAST) report, *"Report to the President: Modernizing Wildland Firefighting to Protect our Firefighters,"* emphasizing need of **NASA's** contribution in modernizing wildland management with its advanced R&D expertise

Methodology (Continued)

Literature Review and Semi-Structured Interviews



Literature Review

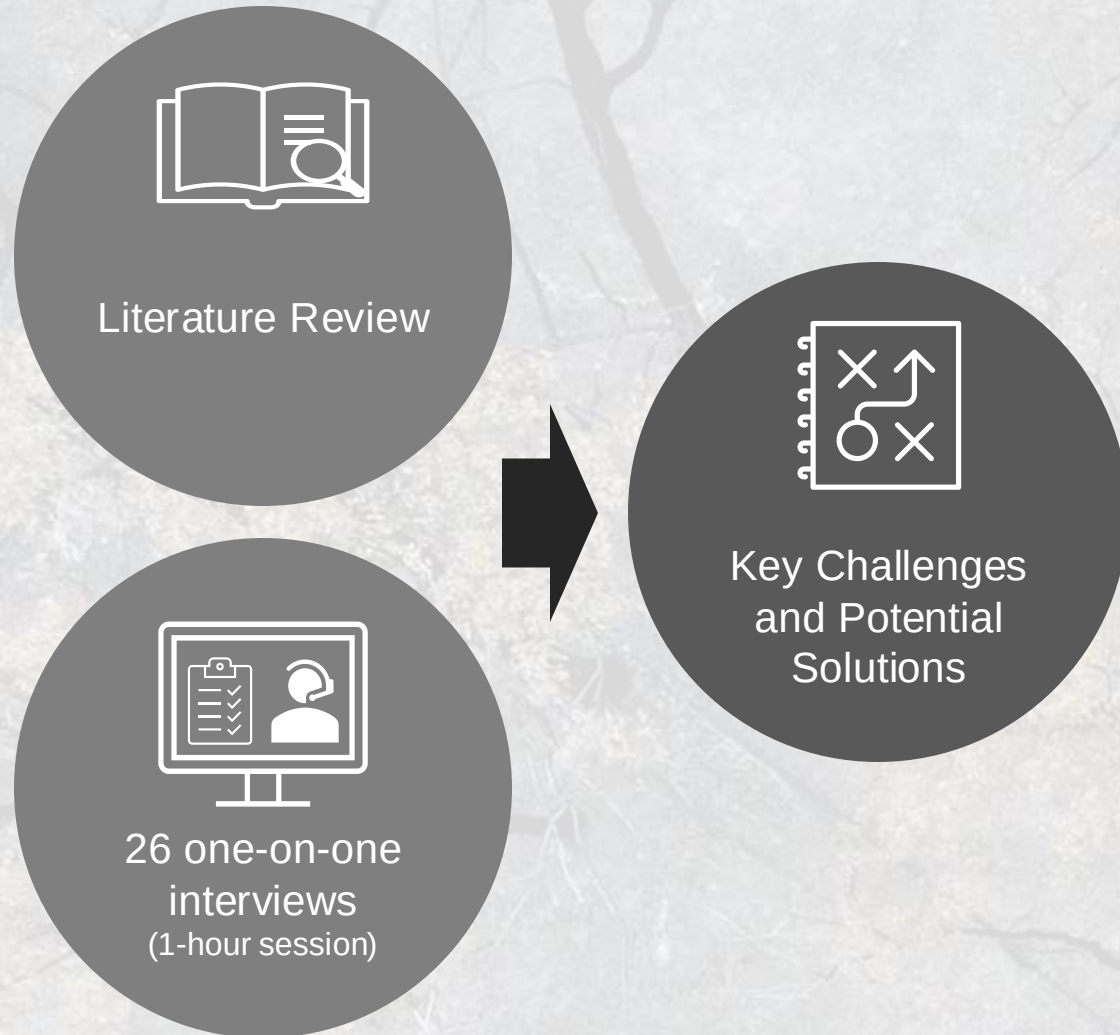


26 one-on-one
interviews
(1-hour session)

- Conducted semi-structured interviews on:
 - Current operations experience and opinions
 - Suggestions for improvements
 - Future vision for wildfire management
- Interviewed experts from various Local, State, and Federal agencies (USFS, CO Fire, CA Fire, Santa Barbara City Fire Department, DOI, etc.) with 15+ years of experience, including:
 - Smoke jumpers
 - UAS pilots
 - Air Tactical Group Supervisor (ATGS)
 - Ground firefighters
 - Helicopter pilots
 - Helitack Crews

Methodology (Continued)

Key Challenges and Potential Solutions



Methodology (Continued)

Key Challenges and Potential Solutions

Key Challenges

Limited Accessibility

Remote or rugged terrain restricts resource delivery; aerial logistics operations are limited by degraded visual environment conditions, low visibility, and safety concerns

Limited Common Operating Picture (COP)

Inadequate real-time wildfire maps hinder decision making and coordination

Last-Mile Connectivity Issues

Continuous and reliable communication is difficult in remote or rugged terrain, affecting logistics coordination



Potential Solutions

Aerial Support in Challenging Environment

Deploy UAS with sensors for equipment/resource transport in tough terrains, even during degraded visual environment

UAS with imaging and mapping capabilities

Integrate UAS with imaging and mapping capabilities to create a comprehensive, accurate Common Operating Picture (COP), improving decision-making with near real-time aerial data

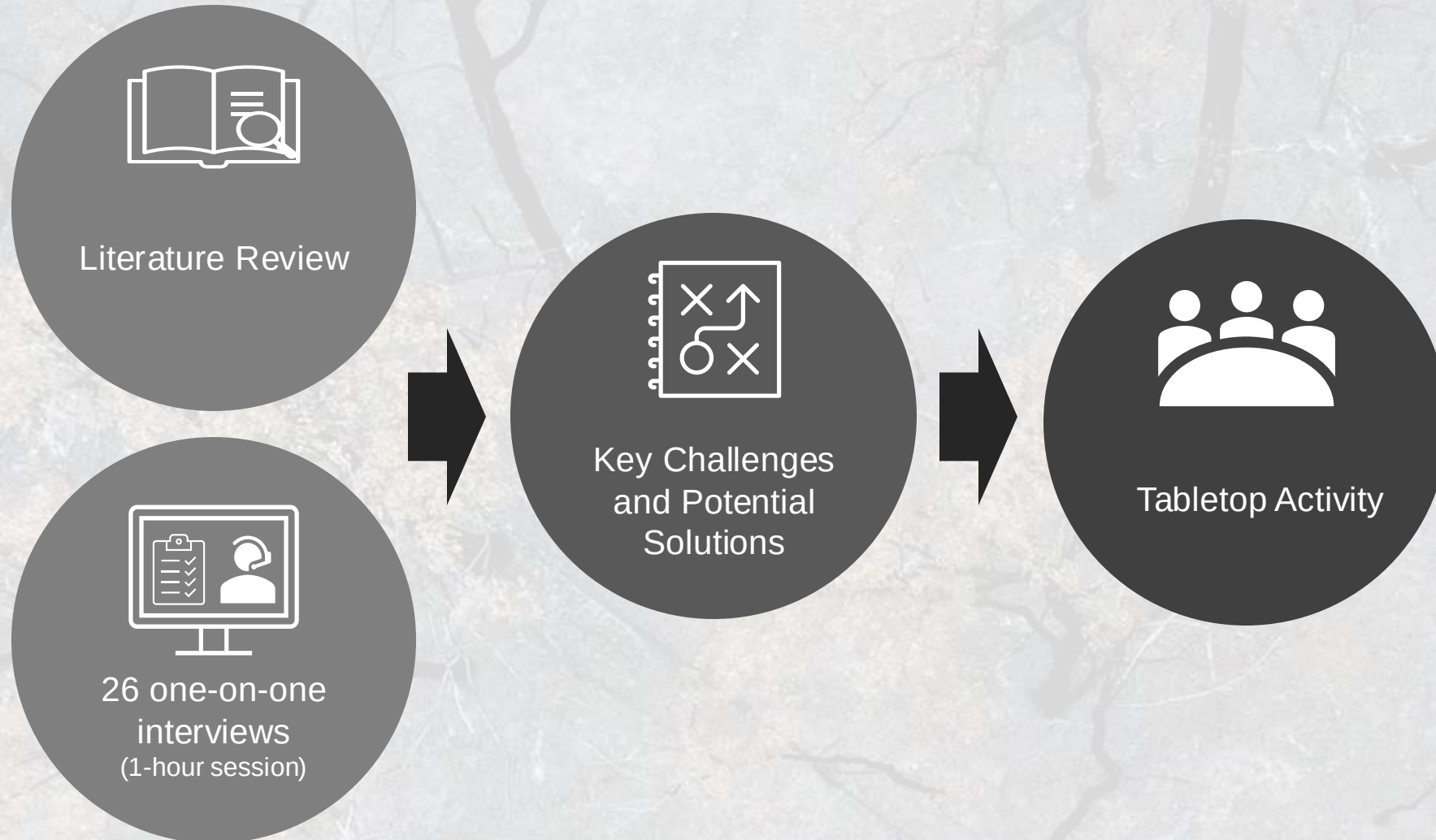
UAS with communication relay capabilities

Implement UAS as a communication relay to maintain connectivity in remote areas

Whitepaper was developed and shared for community feedback on the identified challenges and proposed potential solutions using UAS

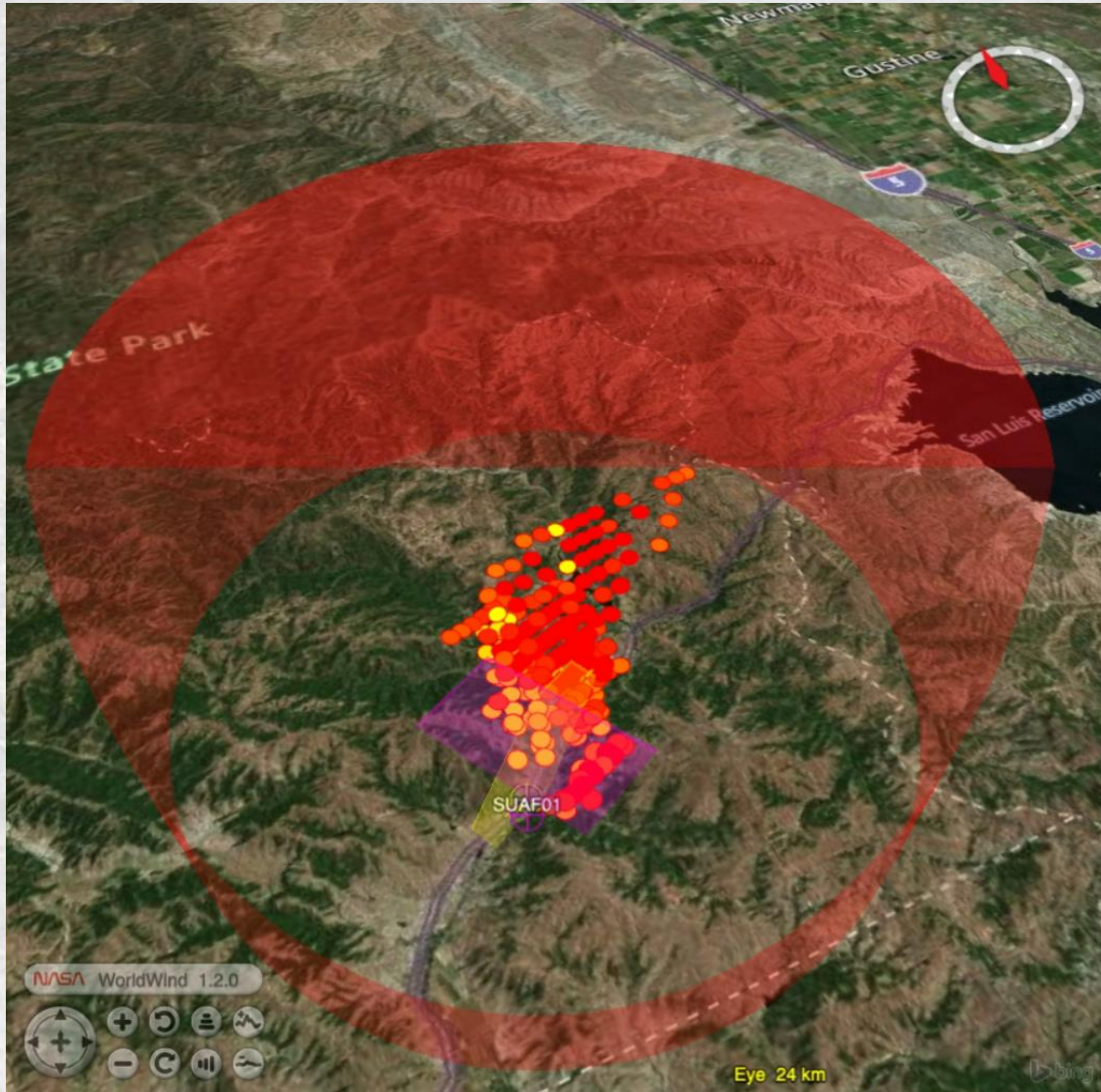
Methodology (Continued)

Tabletop Activity



Methodology (Continued)

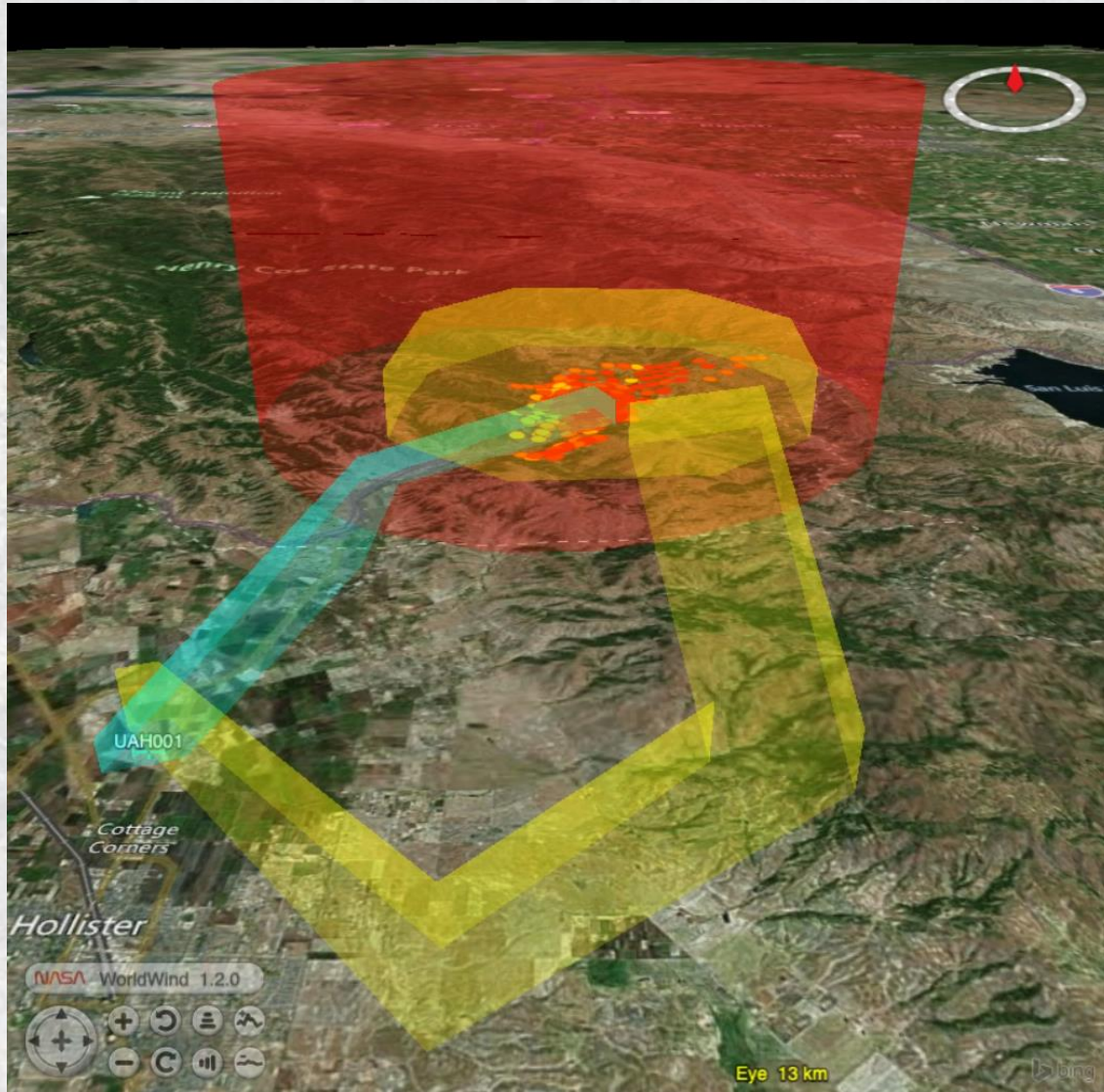
Tabletop Activity



Use Case Scenario Example 1:
Last Leg Delivery by sUAS

Methodology (Continued)

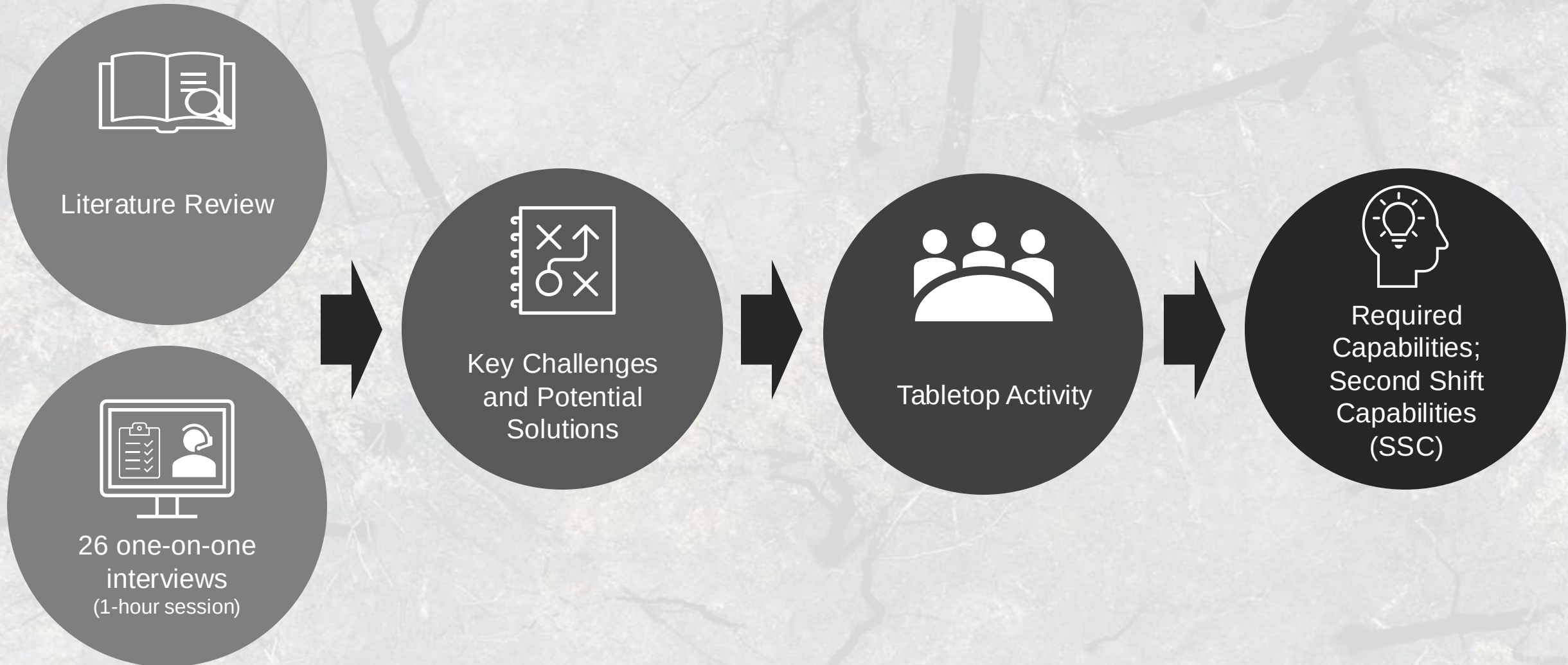
Tabletop Activity



Use Case Scenario Example 2:
UAS Performing Mid-leg delivery Use case

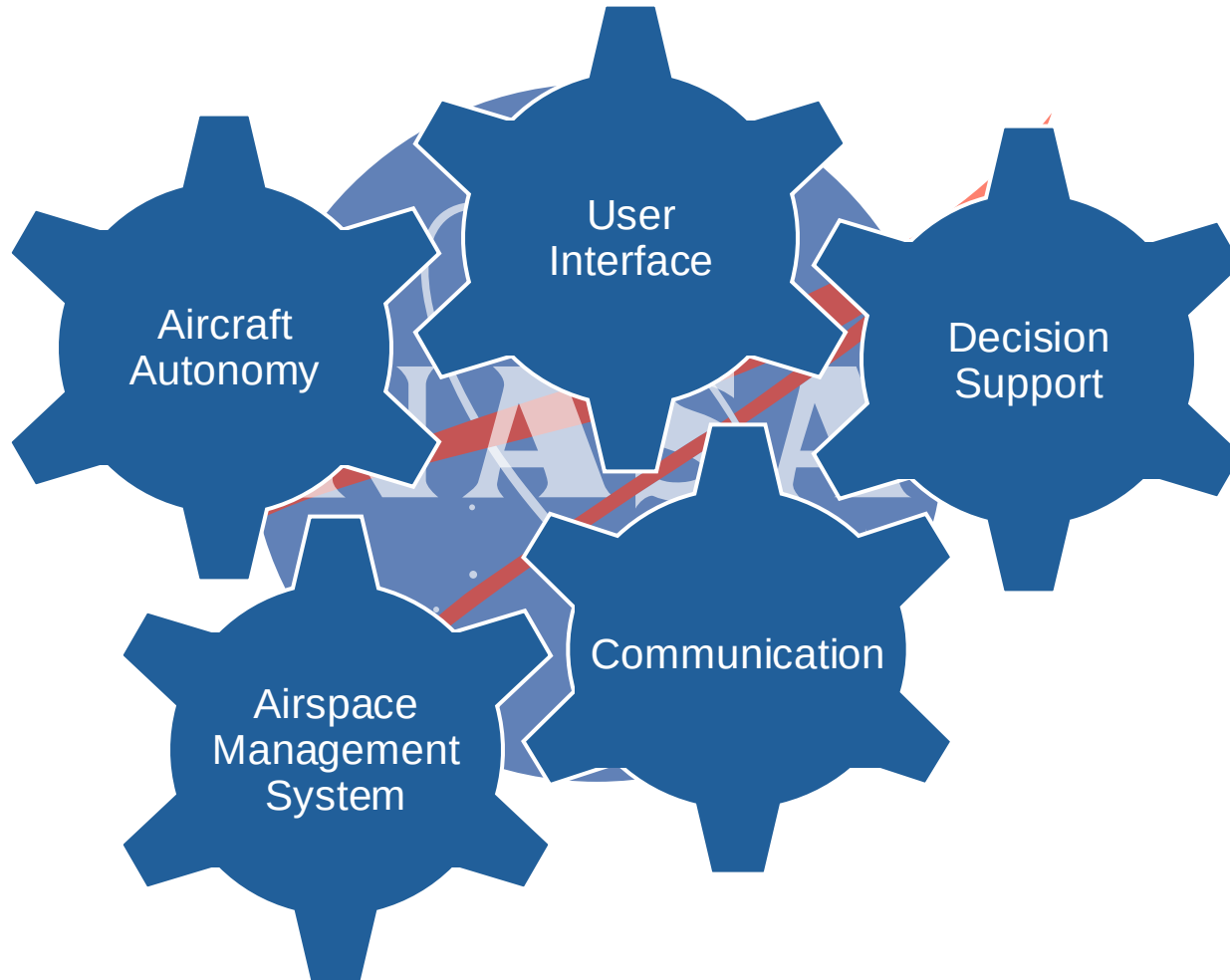
Methodology (Continued)

Identifying Required Capabilities



Results

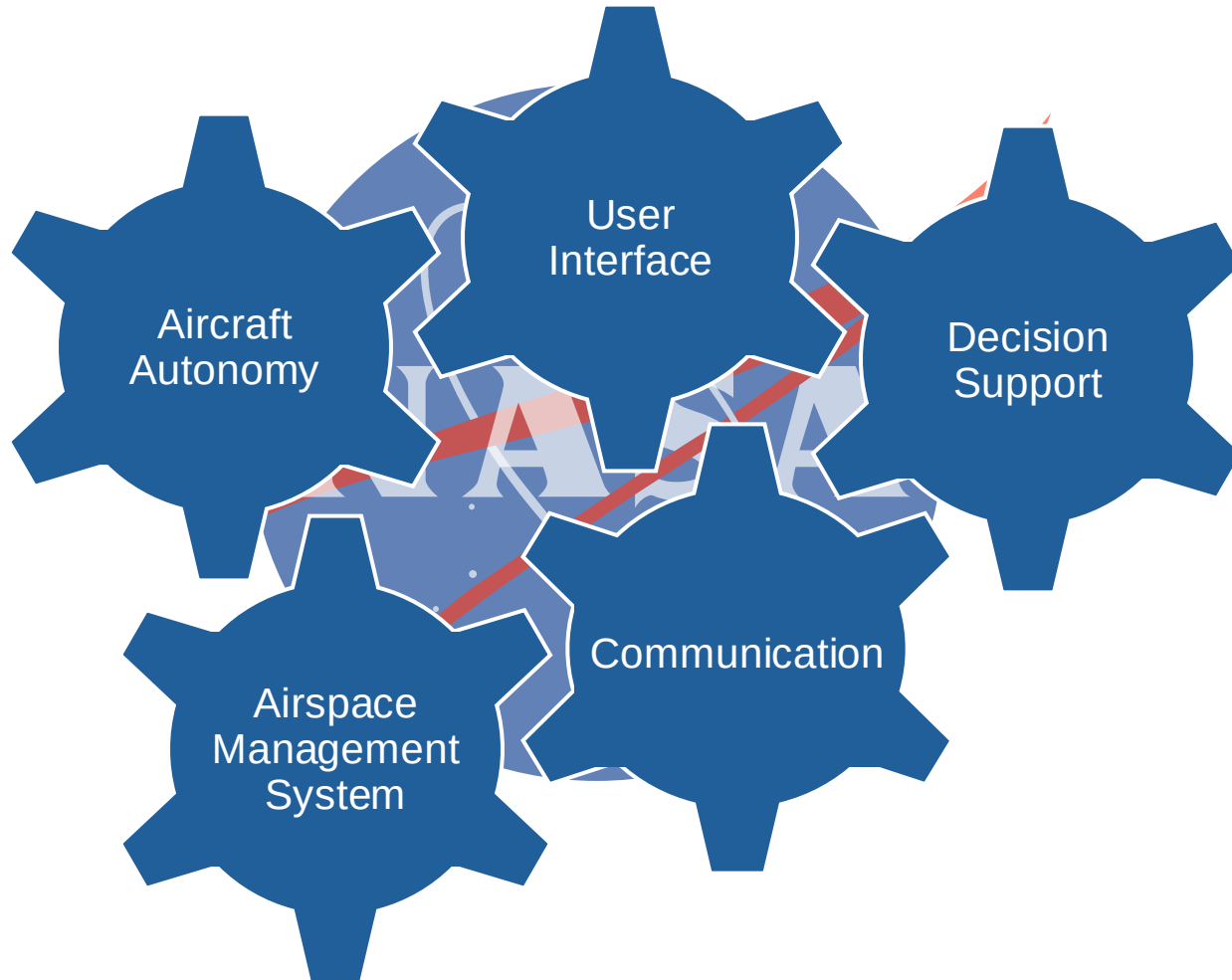
Required Capabilities; Second Shift Capabilities (SSC)



- **Airspace Management System**
 - Portable Field Deployable UTM-in-a-Box
- **Communication**
 - Reliable Digital Information Exchange
- **User Interfaces**
 - Increased Situation Awareness for Multiple Stakeholder Roles
- **Decision Support**
 - Enhanced Locational Fire Data Dissemination
- **Aircraft Autonomy**
 - Scale the Usage of UAS

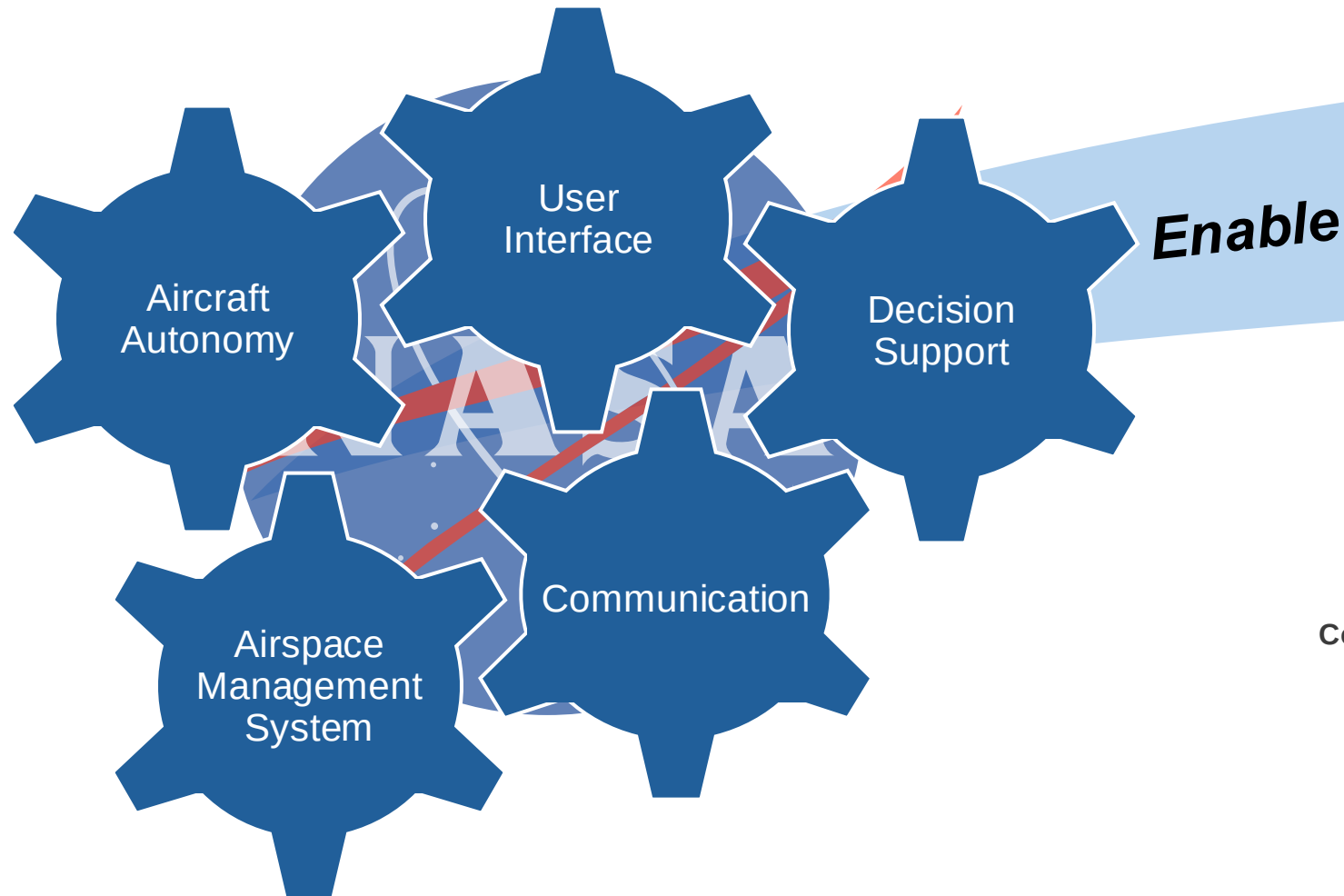
Results (Continued)

Required Capabilities; Second Shift Capabilities (SSC)



Results (Continued)

Required Capabilities; Second Shift Capabilities (SSC)



**Optionally Piloted Helicopter (OPH)
Cargo Delivery and Suppression**



**Common Operating Picture (COP)
technologies**



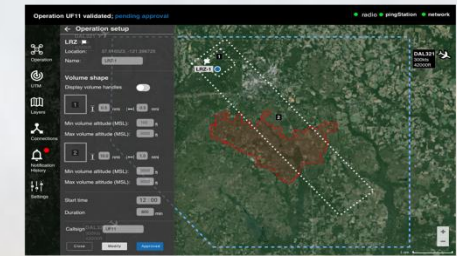
UAS Cargo Delivery

Next Steps

Prototyping + Field Test & Demonstration

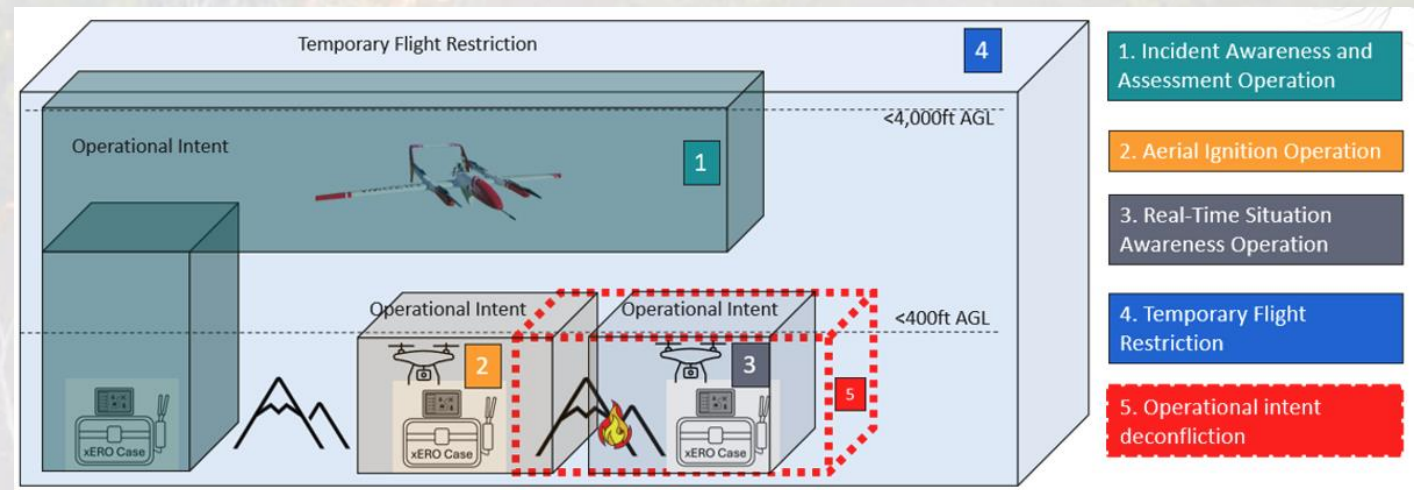
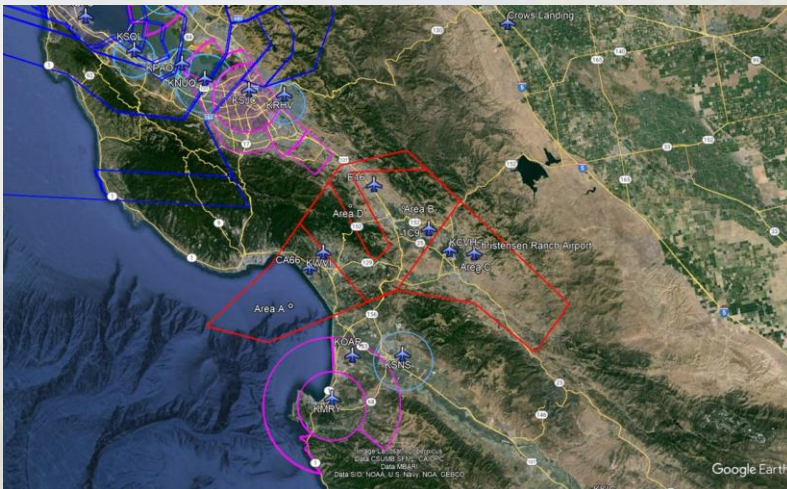
○ Prototyping

- Develop prototypes to bring the conceptual design to life and incorporate feedback from the wildfire community to refine and enhance concept elements



○ Field Test & Demonstration

- Crawl-Walk-Run/Incremental Testing Approach for addressing key challenges and gaps using UAS with the support of our Second Shift Capabilities (SSC) through phased testing across multiple Technical Capability Levels (TCLs) to validate and refine the systems



Questions ?

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