

MITRE

**SOLVING PROBLEMS
FOR A SAFER WORLD®**



FIRST RESPONDER DRONE INITIATIVES

FIRST RESPONDER INNOVATION INSTITUTE

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The MITRE Corporation offers first responders affordable Uncrewed Aerial Systems (UAS) initiatives tailored to fit their communities specific needs and interests, ultimately reducing human resource requirements and exposure, while increasing the safety of both first responders and the citizens they serve.

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INTRODUCTION

First responders across our country are called to dangerous and hazardous environments daily, not knowing what to expect upon arrival.

They must immediately assess the situation and make quick decisions such as:

- What is the best approach?
- What are the resources and quantity needed?
- How to mitigate risks to humans, animals, and the environment?

Too often, on-the-ground observations do not afford enough information about the situation to support timely, comprehensive courses of action; however, drones can mitigate that disadvantage. Drones have the capability to survey unassailable or hostile locations, quickly giving first responders the needed situational awareness to make sound, safe decisions.

Using drones early on at the scene can drive resource management and allocation decisions, lessening demand and reducing costs. Evaluating a situation using drones informs how many resources are needed and avoids deploying excess people and equipment to the area; thus freeing them to respond to other calls. Drones are less costly than deploying manned aircraft (e.g., helicopters) and are less intrusive, as they are quieter and can navigate smaller spaces at lower elevations.

OVERVIEW

Solving problems that make communities safe and secure for all citizens through the application of leading-edge technology is one of The MITRE Corporation's primary goals. As such, MITRE is partnering with police and fire associations, federal agencies, city fire and police departments, county sheriff's offices, and academia across the country in creating drone forces specifically tailored for first responders.

The First Responder Drone Initiatives program comprises five initiatives that come together to benefit and prioritize safety measures, including:

1. Designing drones that identify and locate persons of interest (e.g., bad actors or missing persons)
2. Providing a standard for drone training specific to first responder needs
3. Building a tool to help the user identify "best fit" drones on the market
4. Providing technical analysis on available commercial drones
5. Inventing a drone adapter that incorporates HazMat detection equipment.

MITRE takes a hands-on approach at every step to build user confidence in the drone program. MITRE has assembled a team of uniquely qualified subject

matter experts to identify, assess, and test the resilience of the recommended drones to provide first responders the most accurate information.

Because understanding how drones can aid first responders by applying advanced technology goes beyond simply flying drones, MITRE is confident the initiatives prioritized in this program will ease the demands on first responder communities while increasing the safety of the citizens they serve, and first responders themselves.

While the uses of drones by first responder communities are vast, MITRE will initially focus on the specific needs of the five initiatives introduced in this paper.

MITRE HAS ASSEMBLED A TEAM OF UNIQUELY QUALIFIED SUBJECT MATTER EXPERTS TO IDENTIFY, ASSESS, AND TEST THE RESILIENCE OF THE RECOMMENDED DRONES TO PROVIDE FIRST RESPONDERS THE MOST ACCURATE INFORMATION.

INITIATIVES

INITIATIVE #1: PERSISTENT OVERWATCH

Scenarios

There are several U.S. regions where the vast terrain law enforcement agencies cover creates particular challenges. Local law enforcement lack the financial and human resources needed to detect movement and locate activities (e.g., identifying nefarious behaviors or finding missing persons) in their jurisdictions.

MITRE's Solution

MITRE's Persistent Overwatch initiative is to develop an inexpensive, repositionable, long flight-time drone with a sensor package that addresses both challenges. These drones will reliably detect potential or actual threats, like those posed by criminal gangs, and transmit detailed images of what it observes and precise locations of the activity to the law enforcement agency. With that knowledge, they can evaluate which situations require immediate intervention.

Further, given a recent photograph of a missing person, the agency would monitor the drone's transmitted images and if they match an image to the photograph, they can dispatch the necessary personnel or rescue equipment to the exact location.

For this initiative, MITRE is using a fixed wing drone. Once it has developed the best drone for this type of overwatch, MITRE would make it available, inexpensively, to law enforcement agencies, and provide training on how to employ it.

First Responder Benefits

Sheriffs' departments along the southern U.S. border area can use drones with Persistent Overwatch capabilities to reduce transnational gang crime (e.g., human trafficking, drug smuggling, etc.). These drones



MITRE's solar-powered VTOL drone supports law enforcement across the country.

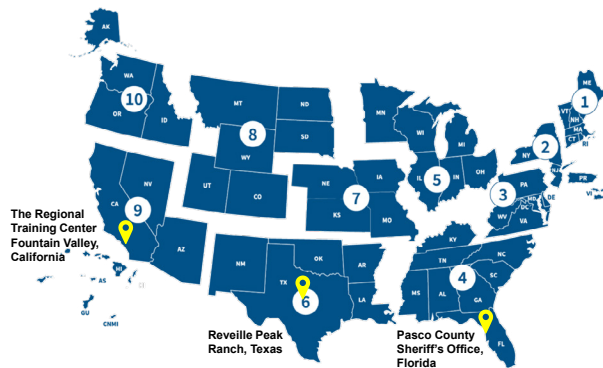
could also detect signs of other threats and empower first responders to take steps to prevent dangerous situations from escalating at prisons, nuclear power plants, government buildings, and so forth, reducing or eliminating risk to their staff.

INITIATIVE #2: PUBLIC SAFETY DRONE PILOT TRAINING AND CREDENTIALING

Scenario

Most commercial drone training courses are designed for members of the public who want to fly drones recreationally and do not satisfy first responder needs.

While local first responder communities do conduct drone training, there is no national standard they must meet to ensure their staff are adequately trained to deploy drones efficiently, effectively, and in compliance with the Federal Aviation Administration (FAA) rules.



Initial training centers aligned with FEMA regions.

MITRE's Solution

MITRE's pilot training courses will be designed for first responder drone operators to understand how drones can be used for their specific tasks (e.g., law enforcement, fire, hazardous materials) and operated in their unique territories (e.g., rural, urban, etc.).

Courses will include flight practice, practical training, scenario training (e.g., active shooter, crime scene analysis, etc.), and a completion of the National Institute of Standards and Technology (NIST) performance test course confirming first responder pilots are trained correctly and consistently across the country.

MITRE's training will be conducted at designated training sites across the United States, in a compact format that takes into account personnel shortages and will ensure adequate training opportunities for first responders.

First Responder Benefits

This curriculum is being constructed with external partners from the first responder and drone community to ensure margins are met and will be credentialed as the standard for first responder drone training.

Honing their public safety piloting skills as they gain familiarity with drone capabilities specifically designed to support their needs will build first responders confidence in operating and employing drones. Drone training across first responder organizations will create a strong drone force to replace/supplement human intervention.

INITIATIVE #3: DRONE TRUTH™

Scenario

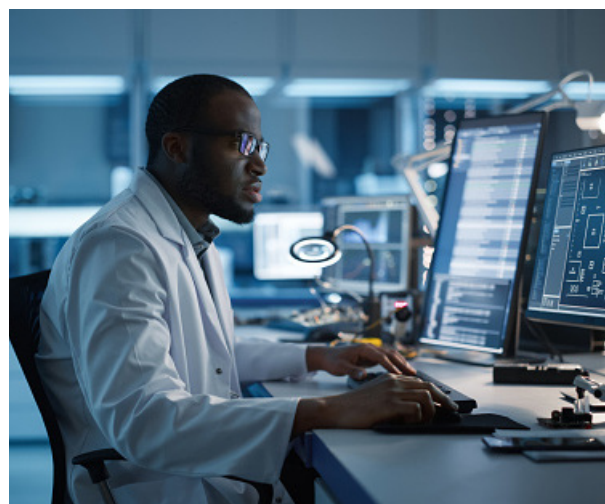
To learn about a drone's capabilities (their own or purchasing one), first responders often rely on marketing slick sheets or vendor web pages. They have no objective, trusted source providing comprehensive data about the capabilities and reliability of different drones on the market.

MITRE's Solution

For the MITRE's Drone Truth™ initiative, the MITRE team will test drones and compare the data to customer reviews, drone manufacturer details, and reports from current drone users. In its role as a not-for-profit, working in the public interest, MITRE will assess the data and provide the first responder community an overview of currently marketed drones: capabilities, performance, software applications, and associated technologies.

First Responder Benefits

Unbiased, objective assessments of commercially available drones for first responders will improve the FAA-mandated safety cases, guide first responder drone purchases, and enhance standard operating procedures.



INITIATIVE #4: DRONE SELECTOR™

Scenario

First responders often rely on salespeople and occasional word-of-mouth to decide which drones to purchase for their specific needs using their limited funds. However, because the needs and goals of first responder organizations vary (e.g., law enforcement, fire, hazardous materials), there is not a singular drone that works universally, and salespeople may not understand the nuances involved with each organization. It is important they select a small uncrewed aerial system (sUAS) that not only supports their task, but one that effectively works in their climate and abides by their local and state regulations.

MITRE's Solution

MITRE will develop the Drone Selector™ as a web-based tool that allows each first responder to input the tasks they want their drone to perform. The tool will list all drones which meet those requirements and identify the drones prohibited within the user's home state.

Because some state governments are compiling/ updating lists of prohibited drones, the Drone Selector™ will be updated to keep the community informed about the legislative decisions as they occur.

First Responder Benefits

The Drone Selector™ tool will offer first responders a starting point by narrowing the field of drones they might otherwise consider for purchase to those that meet requirements and comply with guidelines set by local and state authorities.

Whether open source or as a subscription service, the Drone Selector™ will give first responders a lot of crucial information and a great starting place from which to base their drone purchases, dependent on their specific needs and budgets.

INITIATIVE #5: HAZMAT RESPONSE DRONE

Scenario

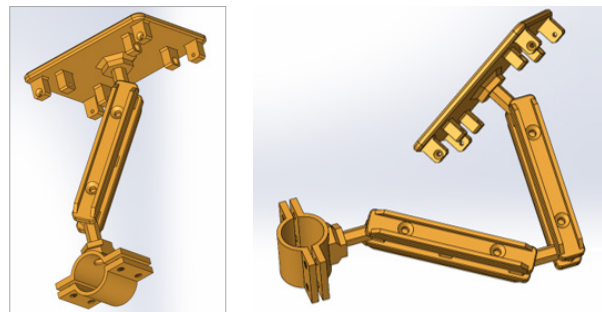
First responders are often in the precarious position of responding to hazardous material (HazMat) spills that put humans, animals, and the environment at risk. HazMat releases and incidents occur for a myriad of reasons (e.g., faulty equipment, careless or accidental handling, or even intentional mismanagement), but all require first responders to use a risk-based response process. Currently, first responder staff follow numerous protocols to physically assess the situation and evaluate/ mitigate the dangers it poses. Agencies often cannot determine what special equipment they need to control the incident and protect humans without putting themselves, and possibly bystanders, at risk.

MITRE's Solution

MITRE invented a universal adapter that holds nearly any handheld chemical or radiological detection sensor in use today. This mountable, articulating arm is incredibly strong and securely holds sensors close to the body of the aircraft/drone, thus improving aircraft flight performance and stability versus existing mounting option.

First Responder Benefits

This purpose-built HazMat handheld sensor/detector articulating arm will speed HazMat response activities and reduce risk for both first responders and bystanders.



Dual-Universal Mount Prototype.

GENERAL USE SCENARIO

The following captures a general scenario showing how first responder agencies could use drone capabilities in their daily operations.

- The first responder community has one or more drones equipped with 5G connectivity, available for deployment at any given time to support an emergency response operation. The remote pilot in command (RPIC) of each drone commands the drone using a ground control station (GCS) and receives mission telemetry and video from the drone during the response operation.
Note: RPICs can operate drones that are within visual line of sight (VLOS) or beyond VLOS in support of the mission. They can also operate multiple drones simultaneously.
- The drones can use one or more of the following controller modes:
 - The RPIC prepares the drone for the mission, performs a pre-flight inspection, and identifies a drone flight path for quickly responding to the incident. The drone flies in a pre-programmed (or programmatic) manner.
 - The RPIC may control the drone in a preprogrammed manner (through waypoints) from take-off until the drone arrives near the incident area.
 - At any time, the RPIC may control the drone directly (direct stick steering).
- While en route to the incident location, the drone follows the pre-programmed route and flight altitude. This scenario assumes an FAA-approved maximum flight altitude of 400 feet above ground level. The RPIC can update the drone route as needed during the operation.
- The drone periodically reports its current position, velocity, remaining battery life, sensor outputs, heading, and current flight duration. While en route to the incident, the drone sends broad, aerial view video to the user.

- Either while en route or at the incident location, the drone employs its acoustical or optical sensors to avoid obstacles, such as power lines or overpasses. If it is equipped with Automatic Dependent Surveillance–Broadcast cooperative traffic sensors, it can also avoid flying too close to manned aircraft (i.e., a police/medical helicopter responding to the same incident) or other drones.
- Once at the incident location, the drone sends high-quality video (4K, up to 8K) and other sensor data (e.g., air quality, thermal images) to first responders in one or more locations.
- Once the home station receives initial information (video and sensor data) from the incident, if needed, the RPIC can use the drone’s video transmissions to reposition the drone within the incident area.
- After reviewing the initial information transmitted by the drone, first responders may deploy additional resources or drones to the incident location.
- If necessary, depending on the expected time needed to deal with the incident, the first responder can deploy a temporary NextGen Prototyping Network (NPN) at the incident location to facilitate transmitting high-quality video and sensor data, and assess progress towards resolving the incident. The temporary NPN may also have internet connectivity.
- If the drone operates in a pre-programmed manner, at the end of its specific mission, it returns to its landing position, lands safely, turns off its camera and/or video stream, and powers off.
- If the RPIC controls the drone directly, at the end of its specific mission, the drone will land per RPIC command.

HOW CAN FIRST RESPONDER AGENCIES USE DRONE CAPABILITIES IN THEIR DAILY OPERATIONS?

FOR MORE INFORMATION

For more information about the First Responder Innovation Institute, please contact Dr. Steve King sking@mitre.org.

Law enforcement agencies may contact Brian Dorow bdorow@mitre.org regarding MITRE's direct support to state and local law enforcement agencies.

MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our public-private partnerships and federally funded R&D centers, we work across government and in partnership with industry to tackle challenges to the safety, stability, and well-being of our nation.

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