



BUILDING A SEARCH & RESCUE DRONE PROGRAM

DJI's step-by-step guide to successfully build a drone program for search and rescue missions

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INTRODUCTION

All over the world, search and rescue (SAR) teams from NGOs, emergency services, and voluntary groups are on standby. Their operations span oceans, coastlines, mountain ranges, cities, forests, deserts, glaciers, and everything in between. Anywhere that people are bold enough to go, SAR crews are brave enough to follow.

The performance of these organizations isn't measured with standard metrics. Every mission's success is determined by the ability of the SAR team to locate and recover people in danger. Instead of profit to be made, there are lives to be saved.

By definition, those who require the help of SAR teams are at risk or in danger. This means that SAR personnel have to take care to avoid the same predicaments as the people they are saving, which range from environmental hazards to challenging weather conditions.

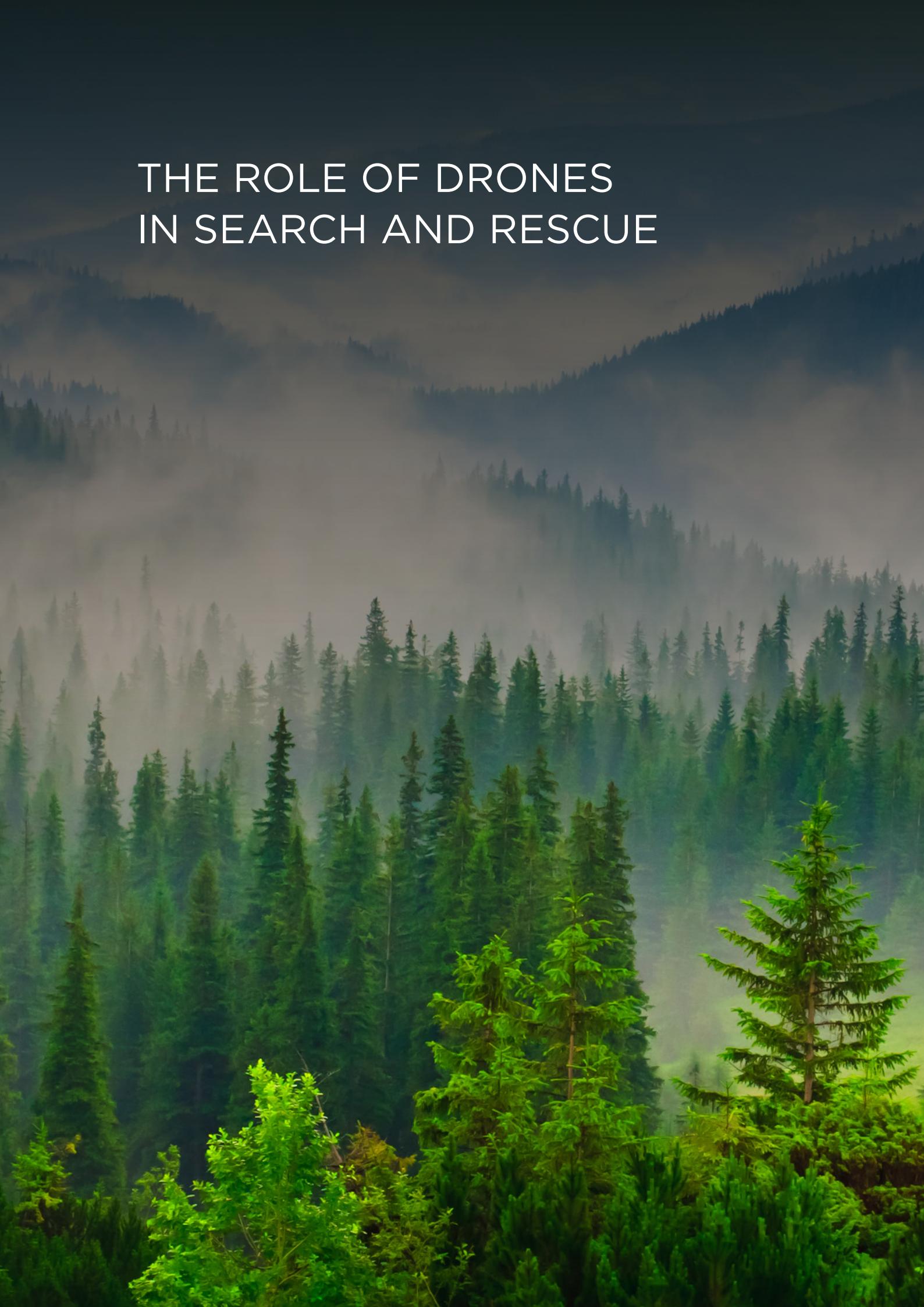
As a result, SAR operations have always been rigorously standards-driven. Protocols are long-established and staff receive intensive training. It's a dynamic that doesn't necessarily lend itself to the adoption of new technologies; adding elements to an equation that already produces positive results isn't easy.

In 2018, a [study conducted by the European Emergency Number Association](#) (EENA) and DJI found that SAR teams equipped with drone technology can locate missing people faster when compared to traditional procedures.

But there were caveats. As with any industry, the introduction of flying robots means that processes have to change. A new tool doesn't guarantee better results overnight. To get the most from this transformative technology, drones have to be deployed as part of carefully planned workflows. The impact and implementation of aircraft, payload, technology, tactics, and training must all be carefully considered.

We've teamed up with SAR organizations from around the world - both veteran and newly-founded - to learn from their success and help others navigate the journey ahead. This guidebook will provide everything you need to overcome the multidisciplinary challenges involved in building a SAR drone program, from pitching to decision-makers to selecting the right hardware.

THE ROLE OF DRONES IN SEARCH AND RESCUE

A photograph of a dense forest of tall evergreen trees, likely Douglas firs, silhouetted against a bright sky. The forest extends into the distance, with layers of trees visible through a thick mist or fog. The foreground shows the tops of smaller trees and shrubs. The overall atmosphere is mysterious and serene.

Flying robots are unlike any tool harnessed by SAR teams in history. They combine the situational awareness of manned aircraft with far greater portability, persistence, and ease of use - all at a fraction of the cost.

Drones with advanced sensors can be deployed and transmit high-definition video from above a scene in a matter of minutes. They can allow first responders to see through the darkness, gain insights from a bird's-eye perspective, and cover ground quickly when every second counts. Below are just some of the benefits drones are bringing to SAR operations.

OPERATIONAL EFFICIENCY

The 'Search' stage of SAR is often the most time-consuming, the most dangerous, and the most critical for mission success.

During this phase of an operation, deploying resources efficiently is a high priority.

Even if the missing person is not located, ground teams will have ruled certain areas out of contention and narrowed down the search. These initial sweeps give crews an idea of the lay of the land and are the foundation for a more thorough search if it's needed. With eyes in the sky, these opening sweeps can be carried out in a fraction of the time.

Drones are also extremely effective when there is challenging terrain to navigate. High elevations, shorelines, and rocky or icy conditions slow down the progress of ground teams. UAVs can be deployed to take a closer look and streamline operations.

Last but not least is the perspective the adoption of drone technology enables. With an aerial view of a scene as it unfolds, SAR commanders can more easily monitor the progress of multiple crews and their environmental context. They can then intelligently

deploy resources, again tapping into drones to sweep areas quickly, home in on coordinates of interest, or provide eyes on specific locations when every minute counts.

TIME SAVINGS

Time is of the essence in every SAR scenario. In some cases, drones can successfully locate a missing person within minutes of launch. In others, they can scan large areas in a fraction of the time it would take crews on the ground, leaving those teams free to search alternative locations.

In both scenarios time is saved, granting commanders greater flexibility in the deployment of resources.

COST SAVINGS

SAR missions are focused on the most precious commodity we have: human lives. As such, judging expenditure and outlay in purely financial terms isn't easy.

What we do know is that per flight and per minute in the air, drones are a far more cost-effective approach to gathering intelligence from above compared to manned aircraft. And, in supporting the safety of rescue crews, they can help to reduce additional medical and liability costs.

Many SAR crews are faced with tight budget constraints and don't have significant funds set aside for equipment investments. Fortunately, the latest drone hardware is relatively inexpensive, while the value they add to missions is clear from day one.

Drones can also be viewed from a liability and insurance savings standpoint. Every hour saved is an hour that a searcher doesn't have to spend in a high-risk environment, reducing the risk of a costly accident.

BUILDING THE BIG PICTURE

During large-scale operations following a landslide or avalanche, drones can be used to build precise, up-to-date, high-resolution maps of the disaster area. Within a matter of hours, detailed maps and models can be made available to emergency teams on the ground, enabling them to pinpoint potential search areas and safety hazards.

Mapping flights can be carried out at regular intervals to track changes in the environment over time. They can also take place at night with thermal vision, to provide rescue teams with up to date information by morning.

Drone technology can augment conventional imaging solutions during a natural disaster. When a 6.2 magnitude earthquake struck near Petrinja, Croatia in December 2020, high altitude cloud cover prevented emergency teams from getting access to up to date satellite images. For the first week after the disaster, rescue crews relied on drones to build a picture from above.

ENHANCED SAFETY FOR GROUND TEAMS

In most cases, searching for missing people and bringing them to safety involves exposing SAR crews to some degree of danger.

Whether it's unknown terrain, hazardous conditions, or a combination of the two, navigating these areas quickly during a search can lead to injury.

Drones can carry out high-speed sweeps of dangerous areas, reducing and in some cases removing the need to put crews in harm's way. This is particularly the case at the beginning of an operation, when search teams use rapid sweeps to improve overall situational awareness and narrow down search areas.

AERIAL PERSISTENCE

Having drones in your SAR toolkit offers far more than a single aerial snapshot during an operation. There is enormous situational value in the persistence a drone can provide.

SAR crews are invariably split up into pairs or small groups during an operation. Keeping tabs on the whereabouts of everyone and ensuring the right areas are thoroughly searched is a priority for every incident commander.

In recent years, battery technology and flight times have evolved to the point whereby drones can offer round the clock situational awareness and be a persistent presence as an incident unfolds.

The technology is particularly effective in the case of natural disasters. Earthquakes, floods and fires are dynamic scenarios that demand agility from emergency services. Drones can guide SAR efforts from above, pinpointing safe routes for crews to take and providing vital logistics information in real-time.

DRONES IN ACTION: SAR CASE STUDIES





SEARCHING THROUGH THE DARKNESS

[On February 25th, 2018](#), England's Lincolnshire Police responded to reports of a vehicle collision in the early hours of the morning. A car was overturned but the driver was nowhere to be found; witnesses had seen a man leaving the scene.

Concerned about the man's safety in the freezing temperatures, police and local fire services searched a 1.5-mile area around the accident location.

More than an hour later, the driver had still not been located. The search was hindered by the darkness, the limited area that could be covered by a small team of officers, and the fact they had only a rough idea of the direction the man had headed.

Alongside his presumed injuries, the sub-zero temperatures posed a serious threat. The clock was ticking.

At 3:33 am, a DJI Inspire 1 equipped with the Zenmuse XT thermal camera took off to scan the crash site and an area of 500 meters around it. Twelve minutes into the flight a heat source was detected. Officers on the ground were directed to the location, where they found the injured man in a six-foot deep ditch, unconscious and hypothermic.

The enhanced perspective and thermal capabilities of a DJI drone saved a man's life that night. He was given first aid at the scene and escorted to the local hospital where he made a full recovery.



SUPPORTING SAR OPERATIONS AFTER DEVASTATING LANDSLIDES IN VIETNAM

In October 2020, Cambodia and Vietnam were devastated by seasonal monsoons. The resulting floods and landslides impacted millions of people.

When Cyclone Linfa struck Central Vietnam on October 11th, historic levels of precipitation caused a huge landslide near the Rao Trang Hydropower plant, trapping seventeen workers inside and blocking surrounding roads.

Over a hundred soldiers and rescue workers mobilized to free the trapped workers. [DJI drones were used during the operation](#) to improve situational awareness and help rescue crews get to work safely.

Having drones on the scene enabled:

- The gathering of aerial footage of the affected area, streamed to the command center to support decision making
- Detailed damage assessment surveys and post-disaster event reconstruction
- Sweeps for thermal signatures from above during low light and at night, carried out from the safety of the command center to avoid putting rescuers at risk



SAVING ADVENTURERS IN ICELAND

In 2016, two Polish hikers were stranded on a mountain in Siglufjordur, Iceland. As the sun set, a dangerous path turned treacherous when rocks started to crumble underfoot. Unable to descend or continue climbing, the only option was to call the emergency services for help.

The Dalvik Search & Rescue Team was [dispatched to the location](#), but darkness and poor reception made it difficult for them to locate the hikers using GPS.

Fortunately, Haukur Arnar Gunnarsson, a drone pilot for the Dalvik SAR team, was able to search for and locate the hikers from above, even though the stranded pair were 2km away and at an altitude of 1200 ft.

Not only did the drone locate the stranded pair in deteriorating conditions, but it was also able to guide the rescue team's descent back down the mountain.



Photo: Anders Martinsen, UAS Norway

ASSISTING ONE OF THE LARGEST RES-CUE OPERATIONS IN NORWAY'S HISTORY

In December 2020, the biggest landslide disaster in Norway's history struck in [Gjerdrum](#). With temperatures dropping as low as -23°C and an affected area spanning two square kilometers, rescue crews needed to locate survivors fast. The challenge was doing so without risking their own safety in the process.

The Norwegian emergency services used drones to gain a detailed overview of the disaster site, which included the village of Ask. They were able to search for locations of possible survivors and mark out hazards for teams on the ground.

Using DJI Matrice 300 RTKs to conduct regular infrared mapping missions, searchers also had the timely information they needed to safely navigate the disaster site in the dark.

DJI drones were continuously in the air for more than 40 days, making the December 2020 landslides in Norway Europe's largest drone rescue operation ever.



For a comprehensive list of successful SAR drone missions from around the world, take a look at DJI's [Drone Rescue Map](#).

ESTABLISHING A SAR DRONE PROGRAM: THE CHALLENGES

A scenic mountain trail leads through a forest of tall evergreen trees, winding through rocky terrain. In the background, majestic mountains rise against a sky filled with large, billowing clouds.



FUNDING AND MANAGEMENT BUY-IN

One of the greatest challenges facing SAR drone programs is management buy-in, both conceptually and financially.

Conceptually, the challenge is to prove to decision-makers that UAVs are tools, not toys. This task is growing easier as awareness and success stories spread. It can take a single demonstration to highlight the many benefits. However, it remains the case that SAR organizations, like any involved in public safety, are rigorous and standards-driven. Inevitably this means leaders tend towards conservatism when it comes to adopting new technologies and processes.

Many SAR organizations operate with limited budgets and often rely on charitable donations for new equipment. Convincing decision-makers that funds should be spent on drones requires a pitch from several angles.



NAVIGATING REGULATIONS

Local and national regulations represent a significant barrier to SAR drone programs. Increasingly, national aviation agencies require non-recreational pilots to be registered and licensed - a process that usually involves both a practical and a written examination. There are also likely to be further hurdles restricting missions at night or beyond the visual line of sight.

Both of these applications are key to SAR missions. The process of certifying pilots and applying for waivers can be arduous but as we will see, there is a silver lining to working closely with authorities and adopting aviation standards from day one. Building a program with professional protocols at every stage provides a strong foundation for scalable success.



DEVELOPING WORKFLOWS AND BUILDING A PROGRAM IN UNCHARTED TERRITORY

Deciding your organization wants to incorporate drones into its SAR operations is a significant step. But working out what comes next isn't easy when there are so few established programs to use as templates.

Inevitably, the journey will involve learning from mistakes and trial and error. But many solid processes can be adapted from law enforcement, the world of aviation, and more general SAR workflows.



DEVELOPING IN-HOUSE EXPERTISE

Successful SAR drone programs are multi-disciplinary efforts. Expertise and experience in developing operational processes, aviation, and the mechanics of SAR operations are all vital.

Developing the capabilities you need in-house takes time, money, know-how, and commitment.

You'll also need to fill the role of drone program coordinator. Someone to drive processes forward from the inside, win the backing of all stakeholders, and integrate drones where they are needed is key.

None of this is easy in SAR, when volunteers are relied upon and approaches are entrenched.



PUBLIC PERCEPTION

In some jurisdictions, the adoption of drones for public safety has been held back by negative public perception. Often this is grounded in privacy concerns or the 'toy-not-tool' first impression.

However, public perception is improving as positive applications become more widespread and familiar. And, unlike the use of drones in law enforcement operations, the public tends to be more open to drone programs setup explicitly for SAR purposes. It also helps that the majority of SAR events are in rural areas, carried out by teams of volunteers embedded into their communities.



FINDING TIME TO INNOVATE

Most SAR organizations rely heavily on the time and dedication of volunteers. These constraints are an additional challenge to the adoption of new technologies and tactics.

The drone industry is also fast-moving, with new hardware and software developments coming to market every year. Getting the most out of the technology requires regular training, a commitment to learning from the experience of others, and a finger on the pulse of the wider drone industry.

ESTABLISHING A SAR DRONE PROGRAM: BEST PRACTICES

A wide-angle photograph of a mountainous landscape. The foreground shows a grassy, slightly hilly slope with some low-lying plants. In the middle ground, there are more steep, green-covered hillsides. Dark, tall evergreen trees are scattered across these slopes, particularly on the right side. The background features a range of mountains, with one prominent peak on the left and others fading into a cloudy sky. The overall lighting suggests either early morning or late afternoon, with strong shadows and highlights on the terrain.

THE ROLE OF DRONE PROGRAM MANAGER

Integrating drones into SAR operations requires effort, coordination, and finesse. Drone Program Managers will have to tackle plenty of challenges, including internal scepticism, the development of operational procedures, and the need to build a capable team.

The ideal SAR Drone Program Manager will:

- Be familiar with the latest in drone technology and/or come from an RC/aviation background
- Have a strong understanding of the operational challenges faced by your SAR organization
- Be able to deal with the politics of introducing a new technology to organizations steeped in conservatism

Your Drone Program Manager will be responsible for implementing protocols and standard operating procedures (SOPs), pilot training, working closely with established team leaders, communicating effectively with the relevant aviation authority, and evolving the program on a day to day basis. Dedication, determination, attention to detail, and good people skills are a must.

IDENTIFY THE PROBLEMS YOU WANT TO ADDRESS

Broadly speaking, SAR teams face similar challenges and measure results with similar metrics. Operations are focused on locating people as quickly as possible while keeping rescue crews safe. But digging deeper, there are a variety of barriers to successful operations. Most of those are environmental.

For example:

- Mountainous terrain can make it difficult and dangerous to search quickly.
- Where there's a threat of avalanches or landslides, rescue crews can easily get into difficulty themselves.
- In areas where nightfall brings plummeting temperatures, finding missing people in the darkness is both a challenge and a life or death situation.
- In operations of all kinds, it can be difficult for those in command to keep track of teams on the ground.

It may be that all of the above is relevant. It may be that just one or two are. Identifying the problems you want to address and figuring out how drones can help will allow you to develop specific training exercises and choose the right equipment for the job.

HOW TO OVERCOME RELUCTANCE AND SKEPTICISM

The best way to pitch an investment in drone technology is to highlight its potential impact on challenges in the field. The details will be specific to the type of SAR situation your organization usually faces. But there are three broad themes you can draw upon when dealing with sceptical decision-makers. Drones provide:

- Faster and more effective searches, particularly in challenging terrain
- Enhanced situational awareness that helps keep SAR teams safe
- A platform for game-changing sensors



Drones mean less time on the mountain and less risk of having our own team members being stranded or hurt.

Kyle Nordfors
Drone Team Coordinator
Weber County Search & Rescue

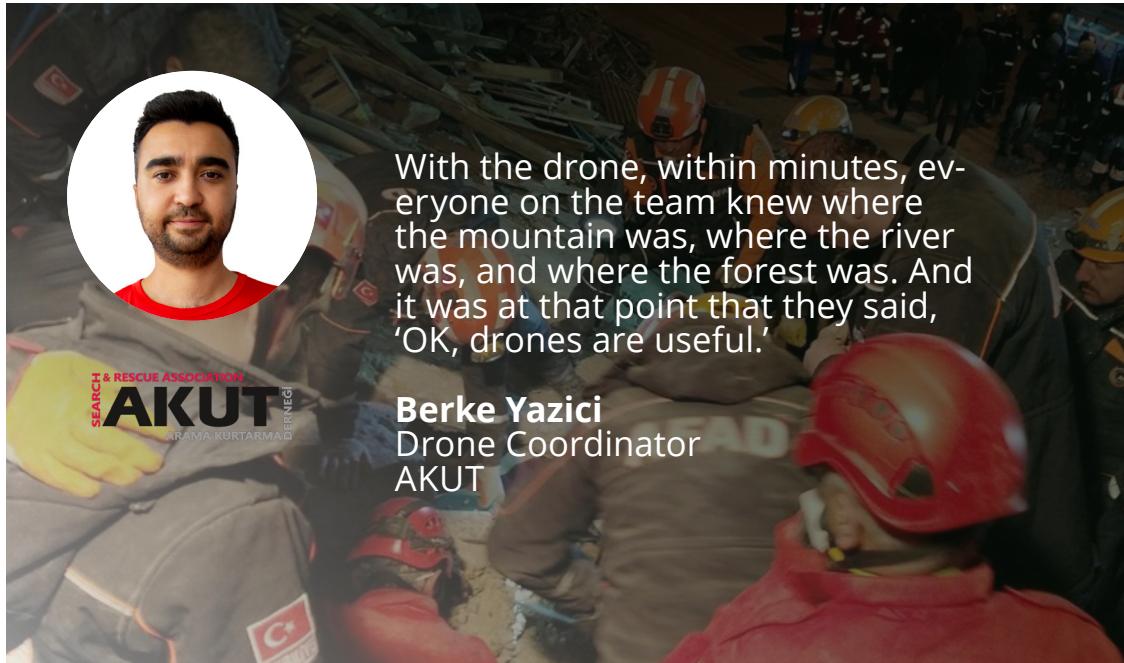
For Weber County Search and Rescue in Utah, United States, drones have offered a way to speed up operations and reduce the amount of time personnel have to spend in dangerous scenarios.

In Utah's mountains avalanches are common. Weber County's backcountry snow/ski team wear beacons in case the worst should happen. If a team member is caught up in an avalanche, rescuers use sensors to home in on the person buried. They then use probes in the snow to locate colleagues stranded underneath. When the probe hits something hard, the digging starts. In simulations of post-avalanche debris fields with buried beacons, drones have the potential to significantly reduce the time it takes to locate survivors.

"On average it takes probers 25-30 minutes to find the beacon," says Nordfors. In an effort to bypass the challenges that slow down post-avalanche searches, he rigged a sensor to the front of a DJI Phantom 4 so that he could fly while scanning.

"Every single time I deployed I found the beacon within 90 seconds."

If you're looking for compelling evidence to present to decision-makers, applications that reduce a search team's exposure to dangerous conditions and quickly locate colleagues in need are a good way to go.



With the drone, within minutes, everyone on the team knew where the mountain was, where the river was, and where the forest was. And it was at that point that they said, 'OK, drones are useful.'

Berke Yazici
Drone Coordinator
AKUT

At AKUT, a mountain rescue organization in Turkey, Drone Coordinator Berke Yazici started as a junior search and rescue crew member. His day job is in civil engineering, and he was familiar with drones through his interest in aerial photography.

On several occasions, Yazici asked his team leader for approval to bring a Phantom 4 Pro to an operation and test it in a real scenario. He was turned down. The feeling was that the technology was more toy than tool.

Then, the team was called out to search for an elderly lady reported missing in a mountain village. Yazici offered to use the drone to orient the search and highlight the different terrain the ground team would have to overcome.

Usually, the area would be scouted on foot, a standard practise that's not without its risks in challenging terrain.

Berke suggests that the best way to convince doubters is for them to see firsthand what drones are capable of. "Showing what drones can do, either in a presentation or, if you have the chance, in a real-life scenario is in my opinion the only way."

Where search and rescue operations are closely connected with local law enforcement organizations, there can be a reluctance to embrace drone technology despite its obvious uses. At the root of this mindset are two common assumptions: that drones are toys rather than tools, or that the threat to privacy (or the public concern about those threats) outweigh the potential benefits.

Nordfors suggests that in the United States at least, this is a problem of education. "Almost all organizations that aren't well educated on drones shy away from them. Most don't understand the laws associated with the national airspace."

THE IMPORTANCE OF STARTING SMALL IN UNCHARTED TERRITORY

We recommend that drone programs should start small and demonstrate their capabilities before scaling up. In search and rescue, this approach allows you to gather the evidence you need to overcome skepticism and win approval.

It also provides an opportunity to target the problems identified at the outset, develop scalable processes and effective search tactics, and learn from early mistakes - all without the pressure of being integral to operations from day one.

In general, starting small begins with developing a proof of concept for a single application. This process includes identifying the hardware and software you plan to use for data-gathering and analysis, including any specialist payloads, and the setup of your SOPs.

Developing SOPs with new technology is a challenge. You'll likely have to lean on others who have experience and an understanding of what drones are capable of and what SAR teams on the ground require to work more effectively.

To begin with, you may want to deploy a single drone team to incidents in roles that aren't necessarily mission-critical. Providing overwatch during a daytime search is one example. But ultimately every SAR scenario is different.

There may be situations in which the benefits of throwing an inexperienced drone team in at the deep end outweigh the risks of false positives or negatives.

For experienced search and rescue crews, adopting drone technology can feel like a step into the unknown. "We had nowhere to look for an example," says AKUT's Berke Yazici.

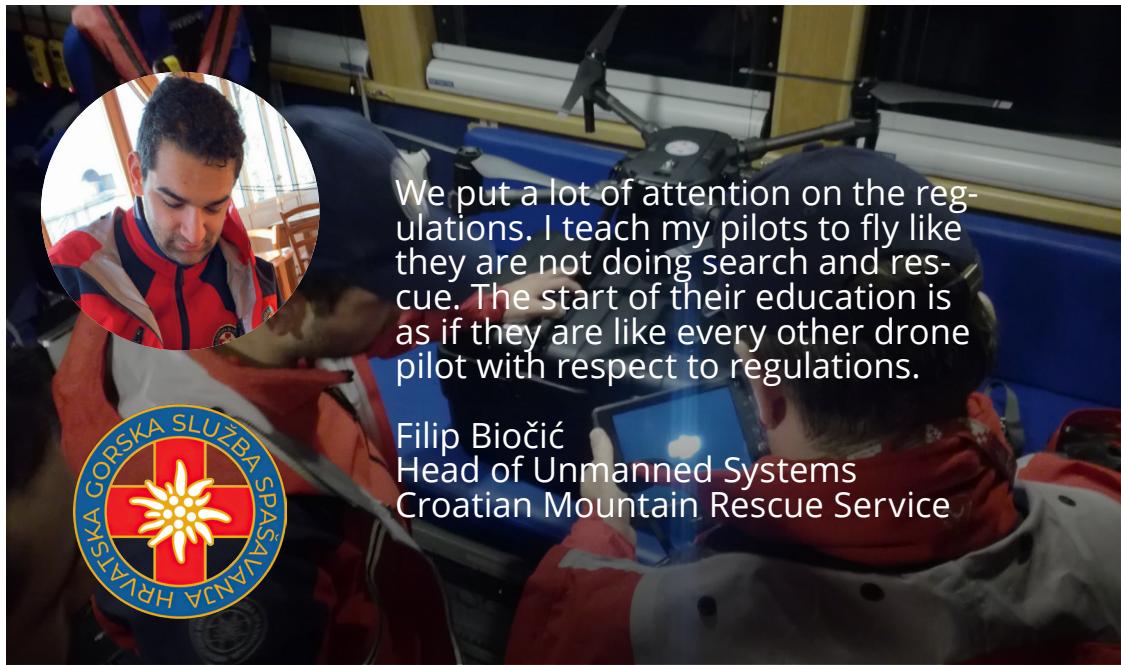
AKUT operates in thirty locations around Turkey. Its members include a number of ex-military pilots, commercial pilots, and professional drone pilots. To build drone protocols and procedures, Berke Yazici reached out to members and invited them to share their collective knowledge. "The beginning was very challenging for us. Everyone had an idea, and most of the ideas were bad," he said.

But that information, alongside search pattern concepts borrowed from the Turkish Coast Guard and the US Coast Guard, is being developed into an operational checklist that spans pre, during and post-mission.

In an early mission, Yazici's team forgot to take an HDMI cable required to put the drone feed onto a larger monitor. "I was mad about it at the time, but it wasn't written down."

Mistakes are a necessary part of the process. With written protocols and checklists that have to be signed by a team member, accountability has been introduced into every mission. "We have a small notebook for lessons learned and we are filling it fast!"





We put a lot of attention on the regulations. I teach my pilots to fly like they are not doing search and rescue. The start of their education is as if they are like every other drone pilot with respect to regulations.

Filip Biočić
Head of Unmanned Systems
Croatian Mountain Rescue Service

Filip Biočić is the Head of the Unmanned Systems Department for Croatian SAR organization CMRS. He thinks the best way to get started is to follow in the footsteps of SAR drone programs that have been successful. Reaching out across borders and between organizations is a great way to share knowledge and tactics. In his role at CMRS, Biočić has also assisted in the development of drone programs for the Croatian police and border force.

"I've driven thousands of kilometres for meetings and educational programs for others. Come to us and we'll teach you what you need to know. We are always open for cooperation."

WHY YOU SHOULD BUILD A DRONE PROGRAM FROM AN AVIATION PERSPECTIVE

There's been a long debate in the drone industry around the classification of UAVs as aircraft, with some stakeholders arguing that treating them as such has led to more restrictive regulations.

In the case of Search and Rescue, programs founded on aviation principles have a stronger chance of being successful, scalable, and in harmony with regulations.

With well-trained pilots, established SOPs, the right equipment, and pre and post-flight checklists, fewer mistakes are made and processes are more repeatable.

Approaching things from an aviation standpoint also allows SAR drone teams to more easily integrate into large-scale operations, when manned aircraft may also be involved. Nordfors recalls one operation in which a Department of Transportation helicopter was also involved in the search for a missing woman. He reassured the pilot that the Weber County drone program followed aviation protocols and was able to support the search alongside her as a result.

With over 20 years as a commercial airline pilot, Nordfors has a clear perspective on how drones should fit into the airspace. "I've approached the whole program from an aviation perspective," says Nordfors. In practice, that means SOPs and checklists that wouldn't look out of place inside a commercial airline. Weber County's drone program also looked to [FEMA's emergency management](#) protocols when setting up a command structure.

"It's often said that people have died for [the introduction of] certain FAA regulations, that they are written in blood. I would prefer our protocols not follow the same pattern, hence why our protocols follow aviation's 'best practices'", he says.

"We have very strict checklists and operating procedures. It's paramount for any organization to approach it from the perspective of the airspace being shared with manned aircraft. Just because these pilots have their feet on the ground, that doesn't negate their responsibility to protect everybody up in the air. As organizations, we need to take the responsibility to regulate ourselves."

Filip Biočić was put in charge of HGSS's Unmanned Systems Department and tasked with creating an education program for SAR drone pilots in 2018.

From day one, he sought to work closely with the Croatian Civil Aviation Agency and Croatia Control, the national air traffic control authority.

His aim was ambitious: to build an education program from scratch that would incorporate both a government-approved drone license and the foundations for SAR flying.

After six months of collaboration with the CCAA and Croatia Control, Biočić's program - which includes three days of basic education and training, a theoretical exam, and a practical flying test - was approved.

Pilots have to complete 30 hours behind the controls before they can attempt to get a one-year license, which is where monthly departmental training sessions come in handy. These meetups are an opportunity to run through specific SAR scenarios and practice with new equipment.

"Even though we are volunteers, from day one we wanted to do this like professionals. We approached the authorities and got them involved in our education program."



Although SAR crews are technically free from the regulations that other drone pilots have to adhere to in Croatia, Biočić believed the best way to build a responsible and scalable program was to do so within the established regulations.

"We put a lot of attention on the regulations. I teach my pilots to fly like they are not doing search and rescue. The start of their education is as if they are like every other drone pilot with respect to regulations.

"If you overstep the boundaries of the law, you end up with a bad reputation and everything can fall apart. It's better to put yourself within those boundaries from the start and build that attitude inside the people that are flying."

CMRS now has six drone education programs catered towards emergency services beyond search and rescue. You can read an in-depth case study on integrating drones into the airspace, which CMRS created in partnership with EENA, [here](#).

BUILDING A TEAM AND EFFECTIVELY MANAGING RESOURCES

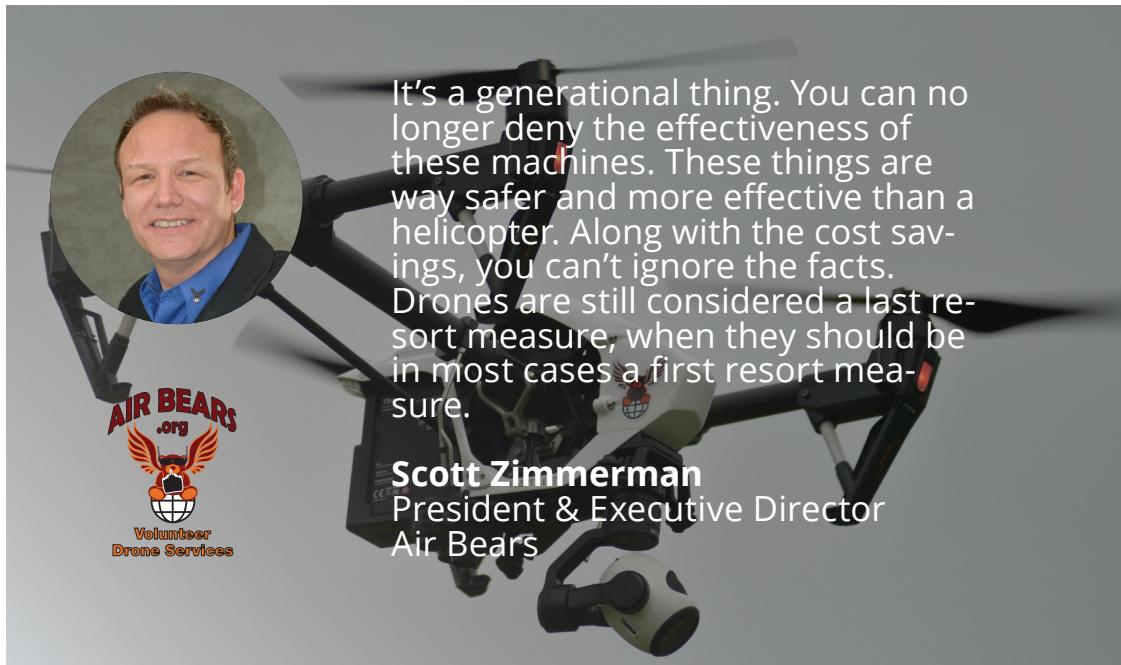
Every drone program should place personnel where they are most effective. In search and rescue, these details can be the difference between life and death.

In the early stages, the line between operator and program coordinator may be blurred due to budgetary constraints or a lack of expertise. Despite managing every aspect of Weber County's Search and Rescue Drone Team, Nordfors admits that he's most comfortable as an operator behind the controls. Managing people and dealing with the politics inside an organization are aspects of the role that have required more time as his program has grown.

"The most challenging part for me has been managing other people, managing the program and managing the politics involved," he says.

Nordfors explains that leaning on the skills of others during operations is vital. By separating managers from operators and other assistants, pilots are free to do what they do best. This notion is built into the SOPs for SAR drone operations. For example, pilots shouldn't also be tasked with actively searching. That part is generally left to sensor operators and/or team members watching a live feed on a separate monitor.





It's a generational thing. You can no longer deny the effectiveness of these machines. These things are way safer and more effective than a helicopter. Along with the cost savings, you can't ignore the facts. Drones are still considered a last resort measure, when they should be in most cases a first resort measure.

Scott Zimmerman
President & Executive Director
Air Bears

Zimmerman agrees. "Flying a drone for search and rescue is not a single operator job. We recommend that for every drone you have a three-man crew: A pilot, someone to handle communications and be your visual observer, and a 'squinter'" - a separate member of the team looking at the images on a high-resolution monitor.

If the squinter spots something, they can inform teams on the ground of the location or ask the pilot to take a closer look. Both options could lead to outcomes that save a huge amount of search time. Effectively managing personnel within your drone team results in more efficient resource deployment on the ground.

In practice that means structuring a command hierarchy as you would in a conventional airline, and being explicit about the roles and responsibilities of each individual.

TRAIN SKILLED PILOTS AND OPERATE WITH TRANSPARENCY

SAR missions often require challenging drone flights and high-pressure scenarios. Nordfors says that he pushes his DJI hardware to the limit and that all SAR drone programs should be prepared to do the same.

"You can't be a timid flyer. Trust in the capability of the technology and that it's going to do what you're asking it to do. You can't hesitate; that's the big difference between a good and a bad drone operator."

According to Zimmerman, pilot fatigue is also an issue for newcomers. "They're not used to flying. You have to concentrate so hard on what you are doing.

You can only be on the sticks for 2 or 3 hours at a time before you need to hand it off to someone else." It's here that regular drills and training sessions that encompass a wide range of scenarios are key. Practice makes perfect. Time behind the controls is the best way to prepare.



The public perception of drones is improving, but skepticism and distrust remain barriers to adoption. Zimmerman believes SAR drone pilots should always be clear and open with the public about what they are doing. This approach preempts any negative response, reduces concerns around invasions of privacy, and reinforces the idea of drones as a useful tool for emergency teams.

"Public perception is one of our biggest hurdles... You have a better chance of changing somebody's mind when they find out that the machine can be used to save people's lives. It quickly changes the dynamic from apprehensive to curious. I'm happy to say that we've changed some minds," he says.

BUILD WITH A HUMBLE ATTITUDE

Nordfors now provides advice and training for SAR crews at the start of their drone adoption journey. The single most important piece of guidance he offers is for programs to start from a humble perspective.

His team has been designed to be an auxiliary unit to conventional SAR efforts. "We are not the boots on the ground. We are not replacing the heroes that

are saving the lives out there." Having said that, Nordfors admits that his team is the only one that gets called out all the time, in almost every type of situation.

For any drone program to get off the ground, SAR organizations may need to "open the door to more experienced people to come in and help you out," he says.

"The idea that there's a useful tool out there that you don't know how to operate can feel like it's intruding on your territory or field of expertise. But drones are an amazing, life-saving asset and you need to have an operator that is equally as talented and capable. Seek out the proper individuals and explore the edges of the technology."

This perspective is rooted in the idea that drones are an aviation asset to be tapped into, rather than a ground-based tool. There is a learning curve, no matter your level of experience in conventional SAR tactics.



"This is an aviation asset. It's completely different and needs to be run completely differently to ground operations. New protocols need to be adopted in order to successfully implement this aviation portion of your operations."

That humble attitude goes both ways. Even skilled drone pilots will be faced with a steep learning curve when it comes to SAR best practices and developing procedures that will be effective in the field. At Weber County Search & Rescue, Nordfors has made an effort to train pilots from each of the ground teams, which include Climb, Snowmobile, Backcountry Ski, Mounted, and Motorcycle divisions. The move reflects the reality that the drone team can't be present every time they are needed. It's also something of a Trojan Horse, a way to gradually integrate the technology into teams that might otherwise be reluctant to get on board.

"I took them through the FAA Part 107 process. They're subject to the drone team SOPs, they train with us, and they know all of our searching protocols," he says.

The result is an experienced pilot that knows how to run search patterns, clear an area, and understand the situation from the air. There's also an intangible

value to having drone operators who are familiar with the challenges and requirements of operations on the ground.

A familiar theme across established SAR drone programs is that it's rare to have all the expertise you need from day one. It's unlikely that skilled drone pilots will have experience with SAR procedures and tactics. And you'll be lucky to find a volunteer-based SAR organization with a deep knowledge of the drone industry and aviation protocols. It's vital to accept any internal limitations and find the right people and information sources to push your ambitions forward.

MEASURE SUCCESS AND INNOVATE FOR THE FUTURE

In any drone program, it's important to define what constitutes success, measure your results, and compare new outcomes to those of traditional methods.

In SAR this process should be fairly straightforward. You will never have a real-world A-B test where all variables are precisely controlled, but it should be easy to see the impact drones are having on the speed and efficacy of operations more generally.

By measuring your results, taking on board feedback from colleagues on the ground, and iterating processes as you go, your program can develop for the better with each mission.

The measuring of success should also guide how you innovate for the future. With new platforms, sensors, and software coming out all of the time, it's important to keep your fleet up to date to get the maximum benefits from drone technology.

Hold regular training days to give pilots experience behind the controls, assess past performance, run specific search drills, and explore how your operations could be enhanced by the latest equipment.

Many SAR organizations depend on the time of volunteers. Fixed training days each month provide the continuity you need to introduce new recruits while upskilling existing ones.

STANDARDISE AND SCALE

With detailed SOPs and comprehensive training programs in place, scaling your SAR drone operations should be relatively straightforward. The key is to ensure all processes are written down and repeatable, and that lessons learned are incorporated into an always-improving feedback loop. Armed with plenty of examples of the technology providing value during operations, overcoming reluctance and scepticism should no longer be an issue.

Instead, the greatest challenge is likely to be financial. Some organizations conduct SAR operations across entire countries. The costs can quickly add up when equipping and training multiple teams. But as we will see, when the outcomes are priceless, it's easy to justify the investment.

Many SAR organizations have budgets that vary year by year, with a heavy reliance on charitable donations. The push to innovate and embed drones into operations is therefore likely to be a gradual process. This isn't necessarily a disadvantage. With funding hard to come by, drone program managers can focus on building strong foundations and perfect their SOPs to make scaling as seamless as possible.

Your existing fleet can also be used to capture compelling footage for fundraising videos. Not many SAR tools are *that* adaptable.



CHOOSING THE RIGHT SAR DRONE SOLUTIONS



DJI'S SEARCH AND RESCUE SOLUTIONS

Selecting the right equipment as you launch a SAR drone program is vital. There are three major considerations you should take into account when deciding which platforms to invest in, including:

- Your budget
- The role you want drones to play
- The kind of environment and scenarios you are usually faced with
- The additional sensors you want to be able to use

For coastal and mountain operations, a platform that can handle strong winds and cold weather may be necessary. For urban or night-time operations, a quick-to-deploy model with thermal capabilities may be your best bet. If you anticipate using your drone as a communications tool, as well as for actively searching, a platform that's compatible with speakers and a spotlight.



Mavic 2 Enterprise Dual

Visible and thermal imaging on a portable, quick-to-deploy platform.

Key features

- 2x Optical Zoom, 3x Digital Zoom, 4K Video Recording at 30 fps
- Integrated Radiometric FLIR® Thermal Sensor
- Foldable design with an additional port for DJI's spotlight, speaker, or beacon payloads
- 31 minutes of flight time

Ideal for

- Early-stage drone programs and proof of concept efforts
- Night SAR operations
- Communicating with search teams, people in need, and the public
- Integrating into ground team SOPs



Mavic 2 Enterprise Advanced

A versatile yet compact tool with high-resolution thermal and visual cameras and centimeter-level positioning accuracy.

Key features

- 640 × 512 px Thermal Camera
- 48MP Visual Camera
- 32× Digital Zoom
- Centimeter-level Positioning with RTK
- 10 km HD Transmission
- Omnidirectional Obstacle Sensing
- DJI's AirSense technology
- Spotlight, Loudspeaker, Beacon, and RTK accessories

Ideal for

- Established drone programs
- Night operations
- Rapid deployment
- Working alongside manned aircraft
- Operating in challenging conditions



Matrice 300 RTK + H20T

DJI's flagship enterprise platform with outstanding performance and game-changing payload compatibility.

Key features

- 15 km Max Transmission
- 55-min Max Flight Time
- 6 Directional Sensing & Positioning
- IP45 Rating
- -20°C to 50°C Operating Temperature
- Hot-swappable Battery
- UAV Health Management System
- Multiple payload configurations, including the Zenmuse H20T, which combines a 20 MP Zoom Camera with a 12 MP Wide Camera, 1200 m Laser Range Finder, and a 640×512 px Radiometric Thermal Camera

Ideal for

- Established drone programs
- Extensive SAR operations
- Sharing airspace with manned aircraft
- Aerial persistence
- Operating in extreme environments

Budgeting and Startup Costs

- Entry level thermal drone
- Multi-payload drone platform
- Additional sensors or payload
- Spare batteries
- Large External Monitor, HDMI cables, etc
- Tents/portable structures
- External power supply for use during operations
- A separate truck to carry all the drone gear
- Radios to connect drone and field teams
- Pilot training and tuition
- Pilot licenses, depending on the jurisdiction
- Insurance
- Relevant software subscriptions

SAR Equipment Checklist

Drone Hardware



Entry level thermal drone

\$1,000-6,500



Multi-payload drone platform

\$2,000-13,200



Additional sensors or payloads

\$3,500-11,300



Spare batteries

\$75-700

Additional Hardware



Large external monitor, HDMI cables, etc.

\$250-600



Tents / portable structures

\$80-150



External power supply for use during operations

\$250-1,800



Radios to connect drone and field teams

\$45-1,500

Tuition, License Fees, Insurance, and Software



Pilot training and tuition

\$1,200-1,800 /pilot



Pilot licenses, depending on the jurisdiction

\$200 /pilot



Insurance

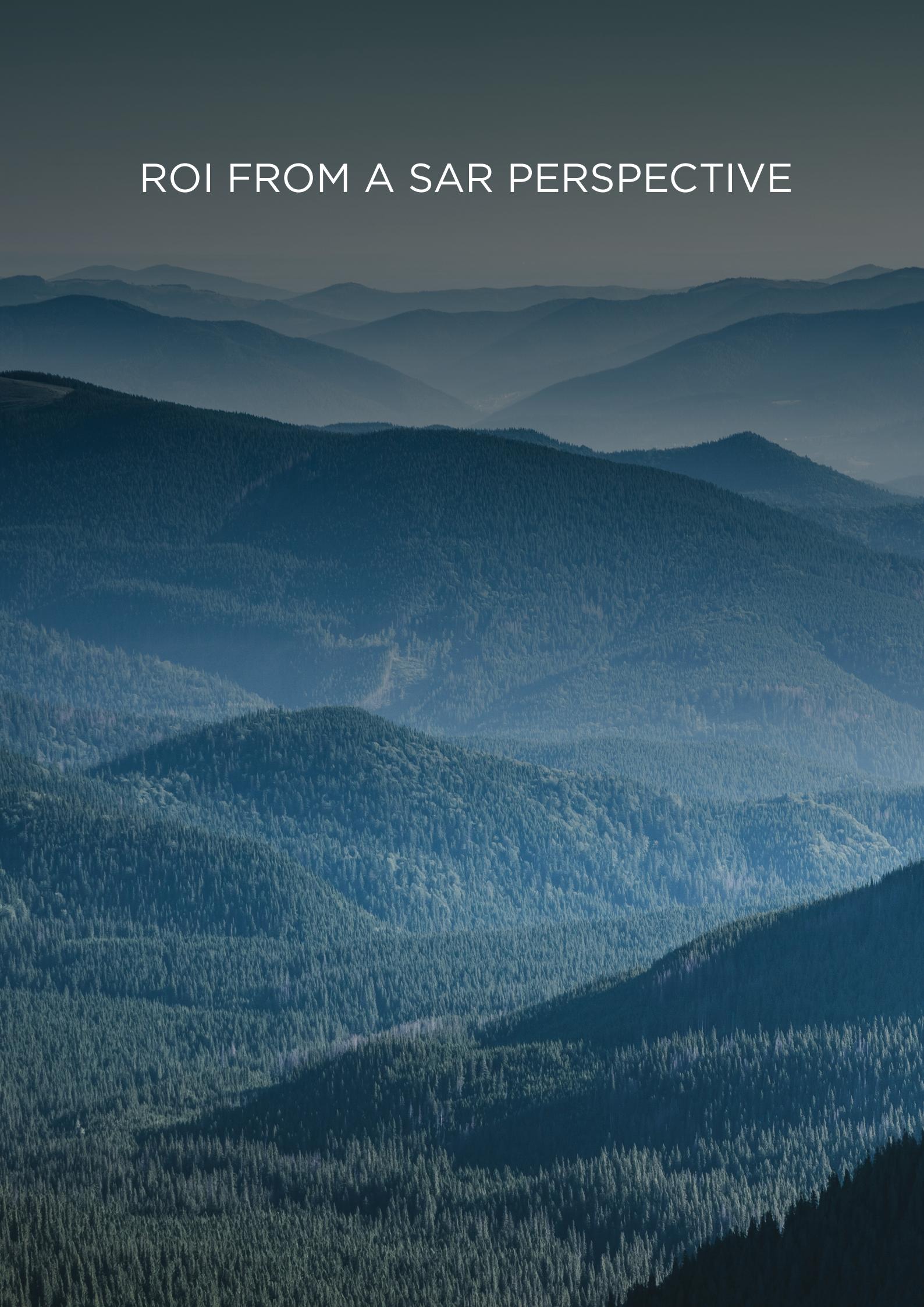
\$90-500 /month



Relevant software subscriptions

\$150-2,500 depending on product

ROI FROM A SAR PERSPECTIVE

An aerial photograph of a dense forest covering a mountainous landscape. A single, light-colored road or path winds its way through the trees, starting from the bottom right and curving upwards towards the center-left. The terrain is rugged and covered in a mix of green and brown vegetation, suggesting a transition between forest and more open land. The lighting is bright, casting long shadows and highlighting the texture of the trees and the path.

ROI FROM A SAR PERSPECTIVE

In the hands of skilled pilots and embedded into SAR operations, drone technology can assist in saving the most precious commodity we have: human lives. That compelling fact outweighs any counter-argument to investing in drones.

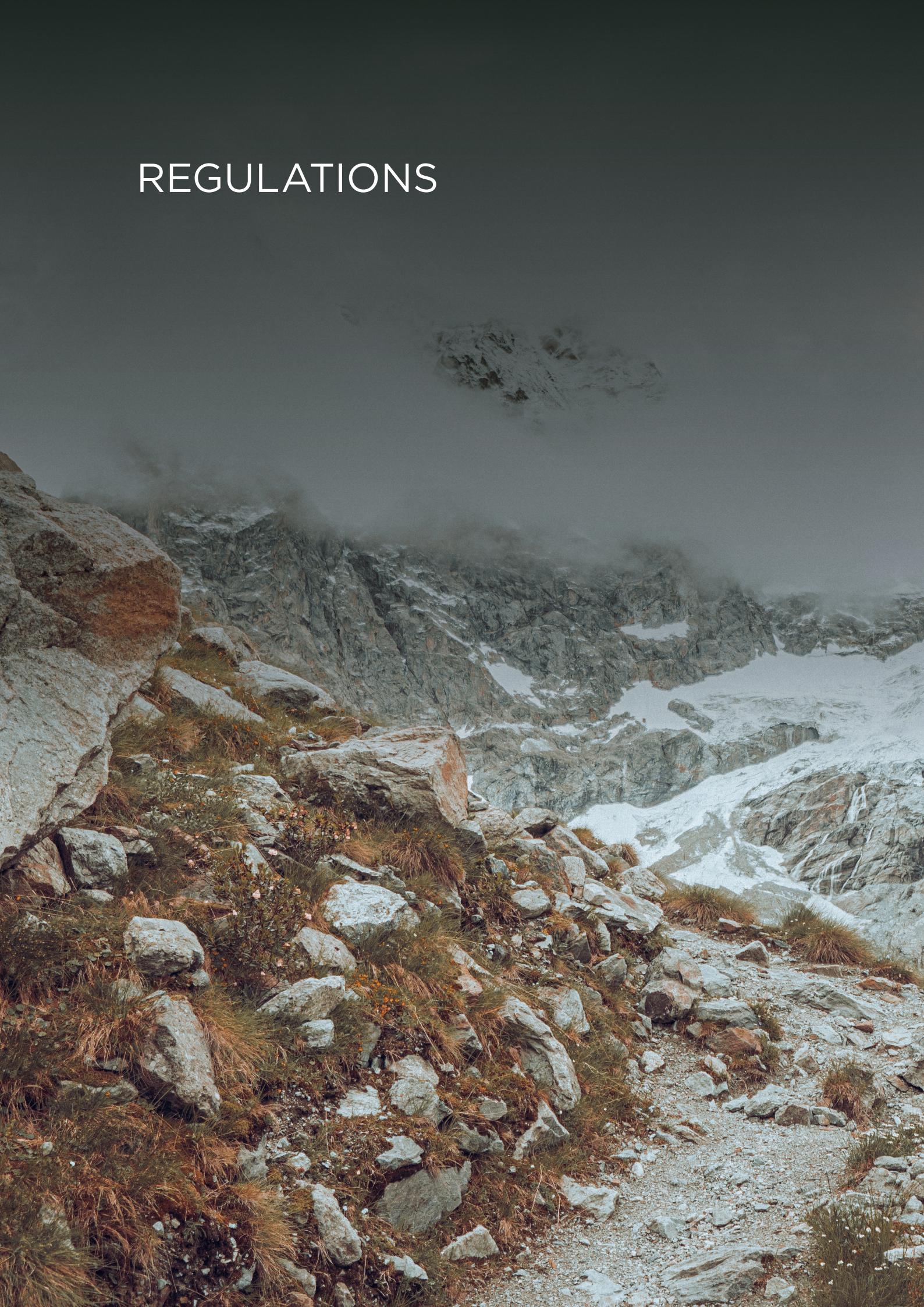
If those in charge of financial decisions do need convincing, they need only look to the economists and government agencies around the world who put the value of a single human life at close to \$10m. And if that figure isn't persuasive enough, you also have to account for the liability, insurance, and medical costs of the SAR crews whose operations are safer with an eye in the sky.

Drones offer an affordable alternative to manned aircraft while providing unmatched persistence, deployment times, adaptability, and portability.

For SAR organizations, there are lives to be saved rather than profits to be made. Beyond the clear moral imperative, justifying the adoption of drones is easy because saving human lives is the ultimate return on investment.



REGULATIONS

A wide-angle photograph of a rugged mountain landscape. In the foreground, there's a mix of large grey rocks and patches of green grass with small orange flowers. To the right, a steep mountain face is covered in patches of white snow and grey rock. The background features more mountain peaks, some obscured by a thick layer of dark, heavy clouds. The overall scene is one of natural, untamed beauty.

The regulatory picture can complicate efforts to build an effective SAR drone program. You'll need to navigate local regulations and gain the relevant licenses to operate.

EUROPE

In the European Union, the [European Aviation Safety Agency](#) (EASA) is in the process of building a continent-wide framework of aviation policies for member states.

There are set to be three categories of drone users: [Open, Specific, and Certified](#).

Rather than categorize operations by purpose (commercial or recreational) the EASA has determined operational categories based on risk.

- The 'open' category addresses operations in the lower risk bracket, where safety is ensured provided the drone operator complies with the relevant requirements for its intended operation. This category is subdivided into three further subcategories called A1, A2, and A3. Operational risks in the 'open' category are considered low, and therefore no authorization is required before starting a flight.
- The 'specific' category covers riskier operations, where safety is ensured by the drone operator obtaining an operational authorization from the national competent authority before starting the operation. To obtain the authorization, the drone operator is required to conduct a safety risk assessment, which will determine the requirements necessary for safe operation of the drone(s).
- In the 'certified' category, certification of the drone operator and the aircraft is required to ensure safety, as well as the licensing of the remote pilot(s).

EU regulations represent the first harmonised regulatory framework for risk-based operation worldwide. It's being rolled out across the 27 EU Member States as well as Iceland, Norway, Switzerland and the UK.

In practise, this approach will help SAR drone programs scale without having to undergo new registration processes, training, and authorizations.

You can read more about the latest EU drone regulations in our blog post [here](#).

NORTH AMERICA

UNITED STATES

Commercial operations in the United States take place under the FAA's recently updated Part 107 Rule, which means:

- You must hold a [Remote Pilot Certificate](#) issued by the FAA
- You must register your UAV with the FAA on the [FAA DroneZone](#) website
- Your UAV must weigh less than 55 pounds, including payload, at takeoff
- Permission must be granted to fly in controlled airspace
- You must keep your UAV within visual line-of-sight
- You must fly at or below 400 feet
- As of April 2021, pilots operating under Part 107 may fly at night, over people and moving vehicles without a waiver - [with some caveats](#)
- You must not fly at speeds exceeding 100mph
- You must yield right of way to manned aircraft
- You must not fly directly over people
- You must not operate a drone from a moving vehicle, unless in a sparsely populated area

*Many above restrictions can be eased with a Part 107 waiver from the FAA.

CANADA

Drone rules in Canada also rely on a risk-based distinction with Basic and Advanced Operations categories for operators.

Basic Operations

If you meet all 3 of these conditions, you're conducting basic operations:

- You fly it in uncontrolled airspace
- You fly it more than 30 meters (100 feet) horizontally from bystanders
- You never fly it over bystanders

You will need to:

- [Register your drone](#) with Transport Canada before you fly it for the first time
- Mark your drone with its registration number
- Pass the [Small Basic Exam](#)
- Be able to show your Pilot Certificate – Basic Operations and proof of registration when you fly

Advanced Operations

If you meet any 1 of these conditions, you are conducting advanced operations:

- You want to fly in controlled airspace
- You want to fly over bystanders
- You want to fly within 30 meters (100 feet) of bystanders (measured horizontally)

You will need to:

- Register your drone with Transport Canada before you fly it for the first time
- Mark your drone with its registration number
- Pass the [Small Advanced Exam](#)
- [Pass a flight review](#) with a flight reviewer
- Be able to show your Pilot Certificate – Advanced Operations and proof of registration when you fly your drone
- Seek permission from air traffic control (likely NAV CANADA) to fly in controlled airspace (request an [RPAS Flight Authorization](#) from NAV CANADA)
- Fly within the operational limits of your drone



TRAINING

PILOT TRAINING

Being comfortable behind the controls and understanding what drones are capable of are two key elements of SAR drone program training. But that's only half of the equation. You'll also need to develop specific tactics and procedures for the use of drones in SAR scenarios.

If you're using DJI hardware, it makes sense to sign up for one of our Unmanned Aerial System Training Center (UTC) courses, which combine practical experience behind the controls of our latest technology alongside all the knowledge you need to use them in the field.

Our UTC program spans over 200 training centers, worldwide, including the United States, Mainland

Trainees get access to:

- A professional curriculum that includes standard drone operation procedures using the latest DJI drone technology
- UTC's global training network, delivering high-quality service to all trainees
- DJI's ecosystem, including continuous skills training, extensive drone knowledge resources, and more
- An official manufacturer training certificate provided upon successful completion of the course
- Join the global community of certified, professional drone pilots [here](#).

DATA MANAGEMENT



DATA MANAGEMENT

SAR drone programs tend to rely on data in real-time, although there are some scenarios and applications in which analysis and storage are required.

Whether it's for training purposes or mapping a disaster area, the right software and storage solutions will simplify the process.

SAR operations often involve footage from operations that shouldn't end up in the public domain. You'll need to ensure that data is secure at every stage. Have measures in place to protect your data security, and consider using DJI's [Local Data Mode](#) to keep sensitive data confidential.

You may opt to keep data in secure servers at your headquarters. There are several enterprise cloud solutions to choose from that simplify the process of managing, sharing, and organizing your drone data.

If you want to learn more about the security measures DJI has implemented to bolster security and protect the integrity of user data, read [our Security Whitepaper](#).



MAINTENANCE

DJI MAINTENANCE

Keeping your fleet in good condition is key to getting the most out of drone technology.

The DJI Maintenance Program provides lifetime support for your aircraft, ensuring you achieve peak performance every time you fly and keep your operations as safe as possible.

There are three [DJI Enterprise Aircraft Maintenance Programs](#) to choose from.

DJI CARE ENTERPRISE

Our technology has an outstanding safety record. But this is aviation, and sometimes things go wrong. With [DJI Care Enterprise](#), you can secure comprehensive coverage across our Enterprise product range, with unlimited replacements or free repair services in the case of accidental damage.

Basic Service

Through detailed inspection, deep cleaning, firmware updates and calibration, the im...

- ✓ Deep Clean
- ✓ Parts Inspection
- ✓ Update & Calibration

Standard Service

Apart from the detailed inspection, deep cleaning, firmware updates and calibrati...

- ✓ Deep Clean
- ✓ Parts Inspection
- ✓ Update & Calibration
- ✓ Easily Worn Parts Replacement

Premium Service

In addition to the Standard Service, the Premium Service includes the core com...

- ✓ Deep Clean
- ✓ Parts Inspection
- ✓ Update & Calibration
- ✓ Easily Worn Parts Replacement
- ✓ Core Components Replacement





CONCLUSION

DRONES ARE A GAME-CHANGING TOOL FOR EVERY SAR ORGANIZATION

The upside of using drones for SAR operations is now too obvious to ignore. But there are hurdles to overcome if you want to get a program off the ground.

Introducing UAVs into naturally conservative organizations requires open minds and a willingness to accept external guidance. And, because a SAR drone program is a multidisciplinary undertaking, experience in aviation and innovation is a must.

No matter the scale you want to achieve, everything starts with a drone program manager. This individual will need to train a team to explore the technology's potential and develop SOPs to integrate drones into SAR operations.

It's also important to remember that no SAR organization starts with all the pieces of the puzzle. For that reason, a humble attitude from day one is required.

Flying robots bring a host of benefits to all kinds of SAR operations. The technology is here to stay and is getting smarter. The question is no longer why should you invest in life-saving drones, but why haven't you already?



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