

The Application of Drones in the Costa Rican Fire Department



Abstract:

The Costa Rican Fire Department (CRFD) has begun implementing drones into its emergency operations. The goal of our project was to develop a protocol for the efficient application of drones by the CRFD in their emergency response program to ensure human safety by supplementing manpower with aerial surveillance. We found that there were five main scenarios in which the CRFD could use drones as well as three adverse conditions that impacted the use of drones. We gave the CRFD recommendations

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Executive Summary

Background and Introduction:

Drones are an emerging technology that are revolutionizing a variety of applications, from commerce and recreation to military and safety. Ana Maria Ortega, the Chief of the Information Technology Department, believes that the aerial view drones provide can aid the Costa Rican Fire Department (CRFD) in emergency mitigation

by providing data unattainable from the ground. The CRFD acquired four drones and has been using them since the start of 2015. Drones provide information that is otherwise unattainable without the use of more expensive equipment. Drones are able to capture information such as the location of the fire line, wind speed and direction, and general information about an emergency. A drone is an alternative and a more cost effective means of gathering aerial



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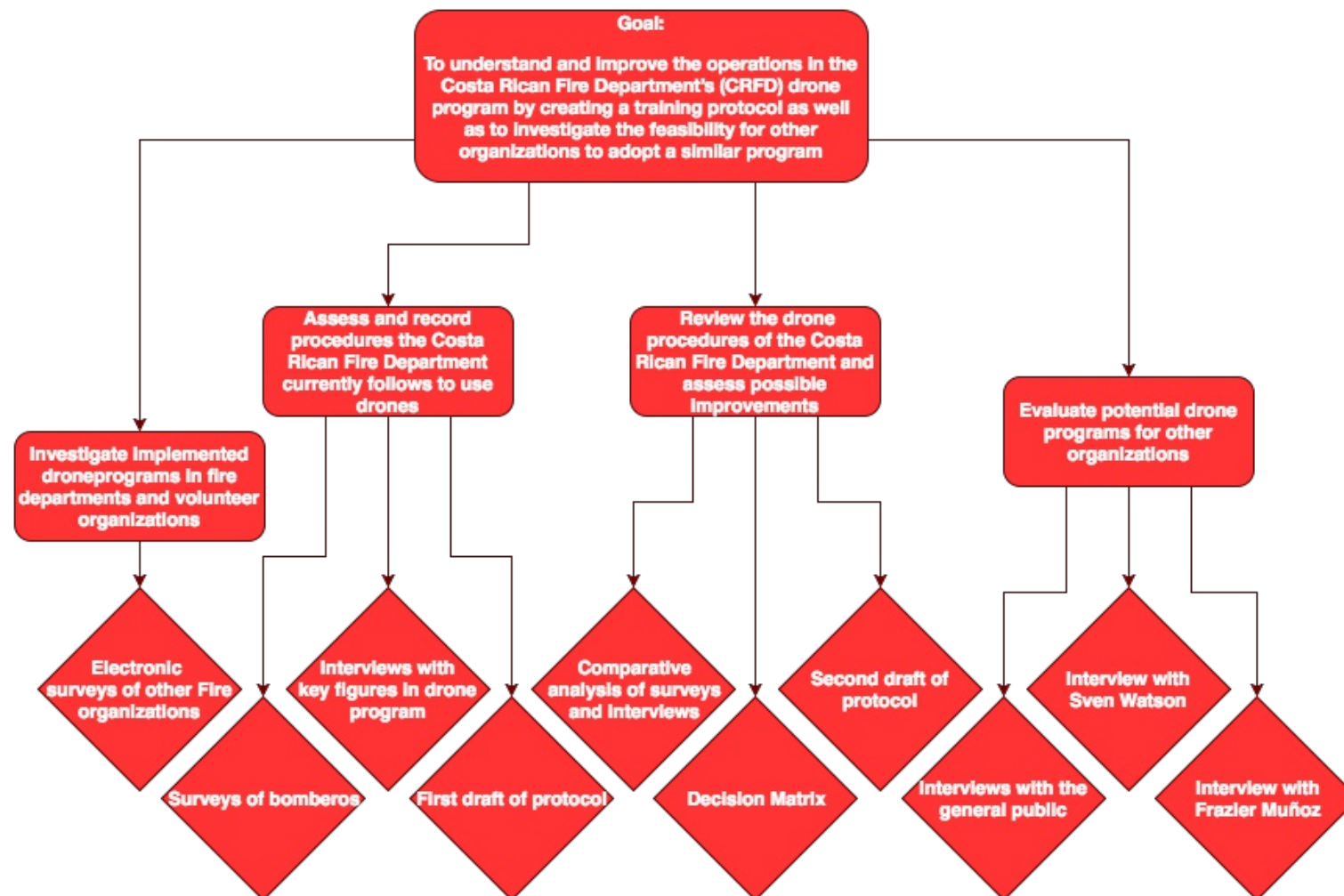
data than using a helicopter. While drones provide many benefits for the CRFD, they still have their limitations, including battery life and inability to operate in inclement weather. There are also many ethical issues to consider when using drones. Drones are

notorious for harming and spying on people due to their versatility and surveillance capabilities. There are few regulations on the use of drones to provide structure and order for people who use them. Currently, Costa Rica is looking to increase regulations on

drone operation to manage the growth in interest and ensure that recreational drone use does not interfere with emergency operations.

There are five main scenarios in which the CRFD deploys drones: forest and brush fires, structure

fires, hazardous materials incidents, traffic incidents, and remote sensing. All of these emergencies share one common problem, the lack of visibility, and drones can be the solution. Forest and brush fires are the most common emergency that the CRFD has to address. These fires are often caused by unattended fires and improperly discarded cigarettes and can spread quickly, especially in the dry season. Structure fires pose a threat to living spaces, some of which can be congested, causing fires to spread faster and put more lives at risk. Hazardous materials incidents endanger the health of firefighters and the general public when a chemical spill occurs. Traffic incidents are a common occurrence in Costa Rica, however they are not always severe that the CRFD responds. Remote sensing can be used as a safety measure for managing risk, code enforcement, and a tool to report statistics.



Methods:

In this project, we set the following goal: to understand and improve the operations in the

CRFD's drone program to ensure human safety by supplementing manpower with efficient aerial surveillance protocols. To accomplish this goal, we established four objectives. (1) Investigate implemented drone programs in fire departments and volunteer organizations. We sent electronic surveys to 12 fire departments as well as two search and rescue groups around the world to understand how they use drones in their operations. (2) Assess and record procedures the CRFD currently follows to use drones. We conducted interviews and sent electronic surveys to personnel

involved in the drone program at the CRFD to assess the methods they used when flying the drones. (3) Review the drone procedures of the CRFD and assess possible improvements. We completed a comparative analysis between the responses we received from personnel at the CRFD and outside programs to determine which aspects of programs would work best for the CRFD. (4) Evaluate potential drone programs for other government organizations. We conducted interviews with the Civil Aviation Authority (CAA) and a local drone oriented business owner to

understand how the protocol we proposed to the CRFD could be adapted to other organizations. We set criteria, similar to the ones we set for determining a successful program, to determine the potential of a program for other organizations. We identified four findings with regards to the CRFD's drone program, perceptions of drones, regulations surrounding drones, and implementing drones in other organizations.

Finding #1:

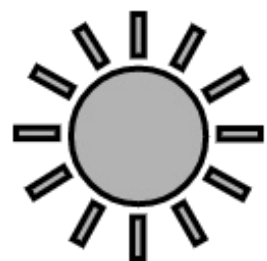
There are three main adverse conditions that affect drone use in emergency situations, including rain, solar radiation, and wind. Rain poses a problem to the drone because a small amount of water can cause a short circuit and systematic failure. Solar radiation affects the video feed from the drone to the operator at a UV index of four and stops video transmission in indices higher than five. In mild and strong winds, it takes more effort from the pilot to maintain stability in the air while continuing to fly a drone, which in turn uses more battery power. Unfortunately, when these conditions present themselves, the only course of action is to ground the drone to

prevent any damage from occurring, causing the CRFD to lose an important source of information.

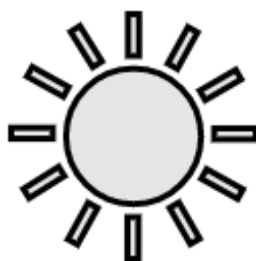
Finding #2:

While still an issue, privacy concerns have not significantly affected the implementation of drone programs. Drones are versatile tools that are useful for recording data but unfortunately sometimes people maliciously abuse this. From the surveys and interviews we conducted, all parties agreed that privacy was a concern of the public when using drones. There was a consistent trend that all members of the public we spoke with were alarmed when seeing a drone in the air and feared for his/her privacy.

We also found that despite the privacy concerns associated with drones, programs have still been successful and are expanding. This is due to the public's understanding of how drones are beneficial to the operations of the CRFD. This understanding has resulted in a lack of political opposition for drone programs. Our team outlined four criteria that a drone program must pass to be considered successful. Although drones can cause the public to worry about privacy, a greater



UV Index 1-3:
Ideal Flying
Conditions



UV Index 4:
Fly at your own
discretion



UV Index 5+:
Do Not Fly



Night:
Do Not Fly



Rain:
Do Not Fly



Max Wind Speed:
40km/h

understanding of drones' helpfulness allows drone programs to become more prominent throughout Costa Rica.



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Finding #3:

The lack of regulations surrounding drones has hindered the operations of the CRFD, and potentially other groups in the future. Without regulations on recreational drone use, hobbyists can interfere with emergency practices. The CAA has passed one law that creates no fly zones around airports and certain government buildings. As of April 2016, the legislation establishing more restrictions and creating mandatory drone certification program is still in deliberations within the Costa Rican government. The lack of regulations has impacted the CRFD through a lack of



prioritization of the skies during an emergency.

Finding #4:

Drones can be implemented into other organizations, but it will not always be a good investment. Numerous organizations have reached out to the CRFD and inquired about the feasibility of using drones within their own operations. We used the four criteria in our methods to determine if a drone program could be implemented into other organizations. While some

organizations may pass all of the criteria for success, it may not be a good investment if they do not have enough uses for drones in their operations.

The Protocol:

The CRFD's drone program demonstrated signs of success, but it was lacking an important component: a formal protocol. The creation of a protocol allows for standardized practices when using drones in emergencies. Without a

protocol, procedures were based on intuition, which can lead to uninformed decisions that can cause harm to wildlife, people, and property in emergencies. A protocol also allows for the program to exist within the CRFD when its drone expert is absent or unavailable for reference. The protocol was made through the analysis of the five scenarios. In the protocol, we included the definition of each scenario, important information for drone operation, and procedures to follow.

Recommendations & Conclusion:

Although the CRFD has had success with its drone program, there is still room for improvement. We recommend that the CRFD make improvements to its drone program to allow for its growth. If possible, the primary drone pilot should allocate time to teach other pilots how to use drones since his schedule is sporadic. Because the bomberos will be learning to fly from a basic level, the CRFD should purchase inexpensive drones to practice with before upgrading to the DJI drones. The DJI drones only have



commercial capabilities and it is suggested that the CRFD purchase drones more suited to deal with adverse conditions and the emergencies the CRFD faces. The bomberos should learn to fly advanced drones last because pilots will be flying them upon graduation from the training program.

We also recommend that the CRFD initiate public outreach programs to help the public understand the drones' utility in emergencies to alleviate the privacy concerns of drones. This should be done primarily by generating positive press about the use of drones in the department, leading to more positive news stories regarding drones. The CRFD should also start a drone awareness campaign through the use of posters as well as notify the public in areas where the pilots will be training.

The last recommendation is for the CAA to certify a drone training program. The CAA can follow the protocol created for the CRFD as a baseline for safe flying practices and can create a licensing program for drones. The CAA also should create electronic

restrictions to where a drone can fly, called geo-barriers, and program drones with them during routine inspection to prevent drones from entering restricted airspace.

The CRFD recently implemented drones into their fire protection program but lacked a formal protocol. A protocol provides consistent data to the bomberos and aids the program as it moves into the future and expands throughout the CRFD and other organizations. The drone program allows for aerial data and faster decision making in emergency situations. Although these implementations are still likely years away as of the completion of this project in May 2016, the impact of our project is only beginning.



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