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FIRE INFORMATION GROUP

FIG Mind the Gap Seminar 2019

London, 2019

Missions in the use of Drones (AKA UAS/RPAS) for Public Safety and Search and Rescue (SAR) – Future ways of working (?)

Professional RESCUE

www.professional-rescue.co.uk

SKYBOUND RESCUER

Introduction

Today’s Presenter: David Lane, CEO/MD of LJA Ltd/”ProRescue”, Director of SAR Academy, Director of Training SkyBound Rescuer

David Lane: technical adviser to national and international level projects e.g. ICARUS, AF3 Wildfire, Heli4Rescue where RPAS/UAVs and aviation are involved; an organiser of leading edge conferences and strategic personnel development events. Specialising in ‘Emergency Management’, water safety, search and rescue, major weather related and flood events’ management, strategic command matters and emergency management. Rescueboat and Powerboat Trainer, designer and builder. Pilot Drones and PPL.

Colleague: Gemma Alcock, CEO/MD of SkyBound Rescuer

Gemma Alcock: an award-winning innovator and UAS designer, with 3 years of professional water rescue experience. She is the founder and managing director for The SkyBound Rescuer Project. She is responsible for many cutting-edge SAR UAS research projects, including National level research.

INTRODUCTION

What do we do?

OPTIMISING DRONE PERFORMANCE FOR EMERGENCY SERVICES

#DRONESSAVELIVES

SKYBOUND RESCUER

SkyBound Rescuer is a leading organisation of specialists in the use of drones for public safety, with an aim to optimise drone performance for Emergency Services through our research-driven approach to problem solving. **We research, we innovate,** and **we educate** to ultimately enable Emergency Services to use drones **to save lives that couldn't be saved before.**

WE RESEARCH.

We strive to bridge gaps in drone research for public safety use cases, and have been involved in several cutting-edge National-level research projects for the UK and abroad. Research is at the heart of every product and service we deliver.

WE INNOVATE.

We innovate directly with Emergency Services to further develop their drone operations and with drone-related companies to create better drone solutions for public safety.

WE EDUCATE.

We bring the market together for workshops and events to share learning, we present at conferences around the world to share our research findings, and we produce online campaigns and research articles to educate the masses on drones for public safety.

OUR MISSION:
To optimise drone performance for all Emergency Services

OUR VISION:
To enable all Emergency Services to save lives that couldn't be saved before

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Find **@skyboundrescuer** on:

1. INTRODUCTION

- A look at how ‘Public Safety Emergency Services’ employ remotely piloted aircraft system (RPAS) – Drones in their missions and search and rescue (SAR) operations.
- Highlight some areas for future development considerations.
- Implemented correctly, this “disruptive technology” stands to offer significant value to public safety and SAR operations – but without a coherent RPAS Concept of Operations (CONOPs), maximum effectiveness may not be achieved.
- We’ll be highlighting use cases, followed by a little about technology analysis for selection, culminating in thoughts for RPAS CONOPs generation.
- We hope Emergency Services will strive to follow a similar process in reaching for effective RPAS integration. To RESEARCH – INNOVATE – and EDUCATE their staff in their missions.

SOME TERMS AND DEFINITIONS

Pictures: www.uavexpertnews.com
Gene Robinson

- Terms "**Unmanned Aerial Vehicle**" or "**UAV**", and "**Remotely Piloted Aircraft**" or "**RPA**" have both become common within the industry.

UAVs/RPAs more widely known by colloquial name of "**DRONES**".

- **Drone/UAV/RPA** can mostly only be operated as part of a system, so the terms "**Unmanned Aerial System**" or "**UAS**" and "**Remotely Piloted Aircraft System**" or "**RPAS**" have become widely utilised.
- Typical **Drone/UAS/RPAS** consists of:

Drone/UAV/RPA, a remote pilot station – also known as a **Ground Control Station** (GCS), and the command and control (C2) communication links that join.

- Term "**unmanned**" can be misconceiving; legally speaking, the Drone/RPAS must always remain "**manned**".
- Despite a proliferation of terms:

DRONE (RPAS) can be **defined** as "a powered aerial vehicle that does not carry a human operator. It is designed to be recoverable, and can either fly autonomously or be remotely controlled."

CLASSIFICATIONS

DISTINCT DRONE/RPAS CONTROL CLASSIFICATIONS:

- "remotely piloted" - self-explanatory and
- "autonomous" aircrafts - "an unmanned aircraft that does not allow pilot intervention in the management of the flight". (**ICAO, 2011**) Aircraft is capable of taking off, landing, and flying itself but with human supervision and intervention where necessary.

ASSET TYPE

- Emergency Drone/RPAS is a **tactical, organic asset** that will travel with response staff and is immediately available and used on demand to produce information immediately.
- In contrast to what Emergency Services currently use for aerial assistance – a **strategic asset,** such as a Coastguard helicopter, which is deployed and tasked by an agency that then passes and filters information to the tactical teams as it becomes available.

CLASSIFICATIONS
AIRFRAME CATEGORIES

Two categories of RPAS: fixed wing and multi-rotor.

- **FIXED WING RPAS**

Fixed wing RPAS have the following characteristics:

Fixed wing RPAS have solid aerofoils and will depend on moving through the air to generate the required lift to remain airborne;

Require a means of propulsion, which may be an electric or internal combustion engine driving a propeller, or a jet engine; and

Range in size from tiny, hand-held electrics to 737-size jets. (NSARC, 2016)

- **MULTI-ROTOR RPAS**

Multi-rotor RPAS have following general characteristics:

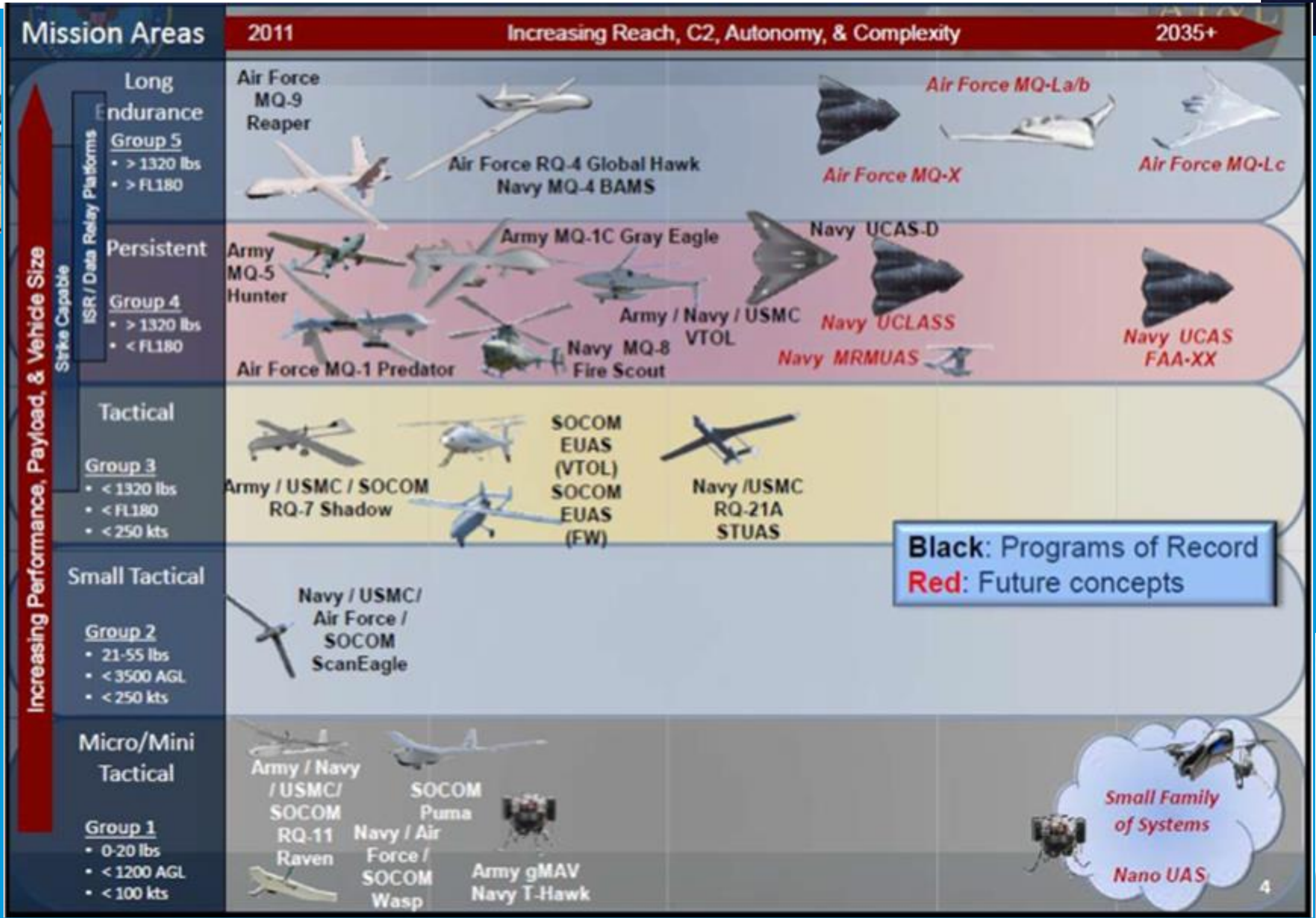
Use multiple spinning propellers to generate lift, independent of airframe movement; and

Have the ability to hover – remain motionless – over a target area. (NSARC, 2016)

CLASSIFICATIONS

AIRFRAME CATEGORIES & SIZES (BIG TO SMALL!)

Picture: Insitu



Source: UAS SAR Addendum to the National SAR Supplement to the International Aeronautical and Maritime SAR Manual, NSARC

WHAT DO THEY USE DRONES FOR?


Picture: Insitu

Police:

- Tactical response operations
- Intelligence & evidence gathering
- HAZMAT/CBRN management
- Emergency/Incident response
- Accident reconstruction
- Traffic & crowd control
- Missing person searches
- Support of other emergency services

Fire and Rescue Services:

- Fires/Tactical fire fighting operations
- Flooding/water rescue
- CBRN/Hazmat incidents
- Search & Rescue (SAR)
- Person-in-danger missions (e.g. attempted suicide)
- Road Traffic Collisions/Accidents (RTC/As)
- Support of other emergency services
- Wildfires
- Infrastructure inspections

CHAPTER 2:
DRONES IN SEARCH & RESCUE

Picture: Alligator Drone and UAV Technology

Higher height of eye is of the greatest advantage to search teams.

Until recently Emergency Services have been relying on the costly involvement of (SAR) helicopters for an aerial view.

Introduction of small affordable Drone into commercial market became a game-changer to the SAR domain.

Small Drone cannot physically conduct a rescue or casualty extrication like manned SAR helicopter can.

There can be no rescue without first locating the casualty - emphasises how RPAS capabilities can save life.

As costs fall and capability rises, Drone technology is vastly becoming a serious contender as the go-to asset for higher height of eye advantage, the boost this technology can offer Emergency Services towards saving lives CANNOT be underestimated.

RPAS are NOT a replacement for manned air units, should be considered a force multiplier, to "provide the Incident Commander with a new set of tools in order to make informed decisions". (Kessler et al., 2015)

CHAPTER 2: DRONES IN SEARCH & RESCUE


Picture: Alligator Drone and UAV Technology

Ultimately, main functions of SEARCH AND RESCUE (SAR) team are to:

LOCATE – define specific location of point last seen or identify casualty location

ACCESS – establish rescue teams access to the casualty and safe **EGRESS** from the scene (with casualty) by appropriate transport methods e.g. walk/wade/boat/helicopter. **ASSESS** equipment requirements.

STABLIZE – scene environment, medical and physical stability to secure casualty

TRANSPORT – transport of casualty and rescuers to safety

Drone technology offer many capabilities that can greatly assist the **LOCATE** and **ACCESS** functions of the SAR operation.

Emergency Services, SAR agencies, and First Responder communities all have different requirements and not all would benefit from RPAS as part of their toolkit.

We'll focus firstly a little on water-related SAR practices – in both maritime and flood environments.

CHAPTER 2:
DRONES IN SEARCH & RESCUE

Picture: Alligator Drone and UAV Technology

- 'Search' element of 'search and rescue' is a complex, arduous, time-consuming, and costly task.

  (Office of SAR US Coast Guard, 1996)

- This justifies developing more efficient search procedures, e.g. using Drones for "rapid search and clearing of large open areas to conserve ground personnel". (NSARC, 2016)
- Uncertainty regarding location of casualties in a marine environment increases rapidly with time, therefore faster methods will increase chances of survival.
- In resource restricted worlds where budget cuts frequent, manned aircraft and highly skilled crews they require may be otherwise tasked or unavailable.
- Report for UK's Her Majesty's Coastguard (HMCG) helicopter service said very few searches took place more than 3 nautical miles out to sea; 9 callouts for maritime search over a 3-month period (UK Government Department for Transport, 2016).
- Same time the Royal National Lifeboat Institution (RNLI) were tasked to over 2,000 maritime SAR incidents, in stark contrast to what the HMCG statistics report suggests. (RNLI, 2015)
- HMCG helicopters rarely deployed to search only tasks due to their lengthy response time and expense, despite their inherent height of eye advantage necessary for rapid search. FOR future, RPAS may be the only aerial asset option available in a search-focused operation.

CHAPTER 2:
DRONES IN WATER RESCUE
SITUATIONAL AWARENESS

Picture: Alligator Drone and UAV Technology

In emergency situations, one of the first requirements is to gain up-to-date 'Incident Intelligence' (Situational Awareness) information of highest quality available and as quickly as possible;

Therefore Drones is a key strategic asset by:

- **Increasing the safety of the first responders but also**
- **to support better decision-making by**
- **providing videos and images to the Incident Commander on the ground.**

CHAPTER 2:
DRONES IN WATER RESCUE
SITUATIONAL AWARENESS


Picture: Alligator Drone and UAV Technology

During severe floods, all that was known about an area prior to a flood becomes secondary data.

AND it may no longer be true.

AND until it is confirmed it cannot be reliably acted upon.

Added to the challenge of holding potentially inaccurate situational information about a flooded area are sudden gaps in information:

Where are on-going hazards, such as strainers or weirs?

Are there sources of contamination as a result of the flood?

A Drone could supply the Incident Commander with this crucial real-time information, BEFORE sending teams into unknown hazardous areas.

CHAPTER 2:
DRONES IN SEARCH & RESCUE
REAL CASE STUDIES

Picture: Dailymail.co.uk

- **How Drones can aid public safety, a selection of real-life use cases where Drones have made a difference for personnel. Here are three – there are now many more e.g. SLSNSW shark detection and monitoring, police investigations of RTCs etc etc:**

A UK MIDLANDS FIRE SERVICE: MISSING CHILD

- **UAS "negated having to put responders into a potentially dangerous situation by having to search the whole of the lake in very poor weather conditions." (NSARC, 2016)**

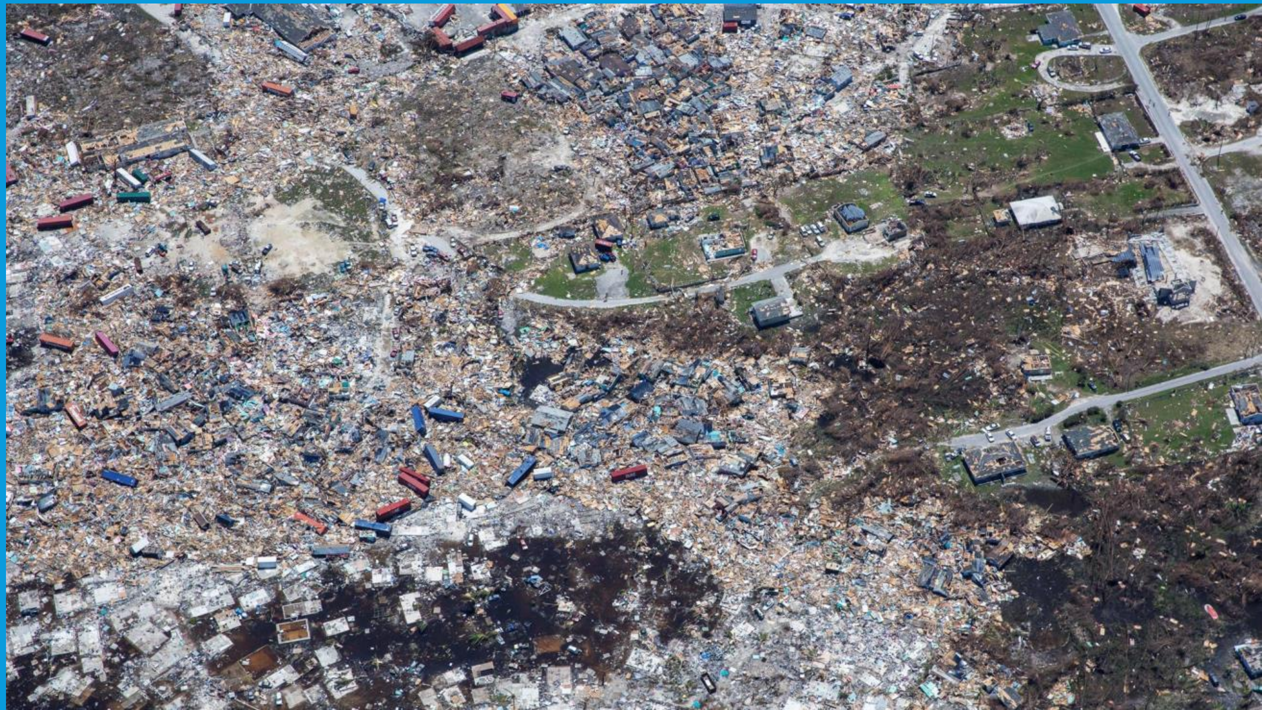
Hurricane Dorian: Incident Intelligence

- **USAR Unit unmanned aviation unit**

performed different operations throughout the event.

All contributed to SAR of those lost.

GENOA, ITALY:
Bridge on E80 motorway collapses 14.08.18




AIRBORNE INTERNATIONAL RESPONSE TEAM
AIRT
AIRT
FLORIDA REGION 7
All-Hazards Incident Management Team

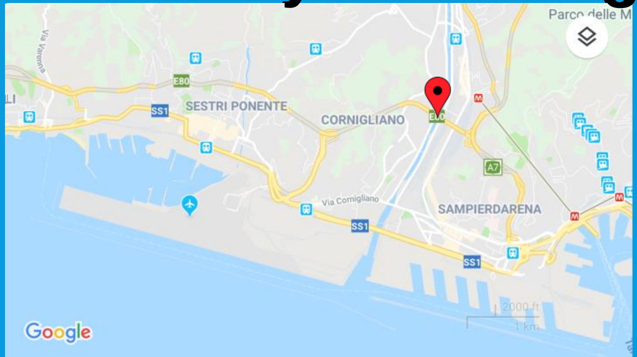
GENOA DEPLOYMENT

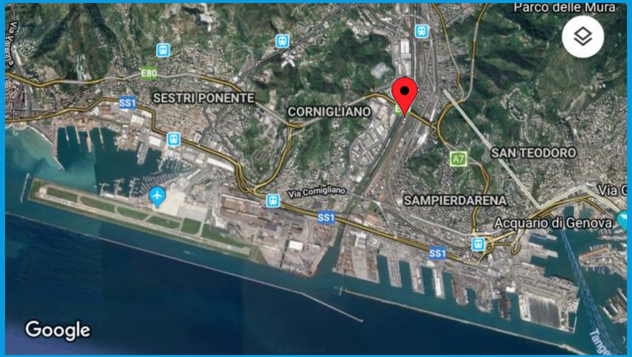
Bridge on E80 motorway collapses 14.08.18: Collapse 11.36

Drones used to:

- **Assure safety of CNVVF USAR Teams involved in Rescue Operations**
- **Overview Scenario and 2D/3D models to identify USAR targets (casualties) and to plan Rescue Operations**
- **Evaluation of other parts of bridge**
- **3D models "*to freeze*" scenario and parts for Law Authority Investigation**

Daily streaming to CNVVF National Crisis Room






Vigili del Fuoco

CHAPTER 3: DRONE SELECTION
(ISSUES TO BE ADDRESSED)

Picture: www.service-drone.com

Drone models an Emergency Service purchases dictates what RPAS capabilities they have and the level of performance they can achieve, thus making Drone selection an integral variable in establishing best practices.

EENA / DJI Pilot Project Report highlighted the following as the minimum RPAS configuration for first responders:

1. Reliable platform with redundant systems; i.e. dual IMUs (Inertial Measurement Unit, an electronic device that measures and reports a body's specific force and angular rate and allows a RPAS to work when there is no GPS), dual compass, dual battery etc. I.E. TWO OF EVERYTHING FOR REDUNDANCY!

2. GPS (USA navigation system) and GLONNAS (Russian Ministry of Defence satellite-based navigation system) systems

3. Integrated camera systems, preferably modular, with live downstream capabilities in HD format

4. Able fly in moderate winds and light rain – FEW CAN!

5. Integrated SDK (Software Development Kit) so specific apps can be written to help operators.

E.G. the DJI/DroneSAR Search and Rescue app, DroneDeploy for 2D and 3D mapping etc. (EENA, 2016)

Several organisations claim to offer "search and rescue drones", yet seem to be simply transferring a consumer or commercial RPAS into the SAR market without any or very little adaptation. SAR RPAS needs to be more than just a consumer/commercial RPAS with a thermal camera attached to it; its SAR capabilities need to extend further than its payload. For this reason, airframes have been analysed for their SAR use separately to payloads.

CHAPTER 3: DRONE SELECTION
AIRFRAME SELECTION

Picture: www.service-drone.com

Most Emergency Services seem to have converged on small multi-rotor Drones as the default platform – BUT fixed wing models should not be dismissed.

Lets examines both airframe categories for use in SAR applications:

Picture: Pinterest

Fixed wing strengths:

- Will generally have longer range, higher speed, and greater payload capability than a similarly sized multi-rotor RPAS; and
- Will usually be able to fly at a higher altitude.

Fixed wing weaknesses:

- Most are limited by the need to take-off and land laterally, so terrain will affect launch and recovery sites;
- Cannot be used in restricted or congested areas because of their need to move through the air to generate lift; and
- Without a stabilised camera, video imagery from a fixed wing RPAS can be difficult to interpret due to the constant airframe motion.

CHAPTER 3: DRONE SELECTION
AIRFRAME SELECTION

Picture: www.service-drone.com

Multi-rotor strengths:

- Multi-rotors, with three, four, six, eight, or more powered rotors, benefit from mechanical simplicity and redundancy in higher-number configurations;
- Have the ability to launch from, manoeuvre in, and recover to very restricted terrain;
- Can provide a steady video picture from a stationary, top-down perspective.

Multi-rotor weaknesses:

- Hovering requires more power than fixed wing flight, so multi-rotor platforms will have shorter flight-times, lower top speed, and lower altitude limits than equivalently-sized fixed wing airframes.

Given Emergency Services’ clear preference towards small multi-rotor RPAS, the ability to hover and ease of launch/recovery must outweigh the requirement of long endurance.

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION

Picture: www.service-drone.com

Drones/RPAS evolution from flying device to be a data collection device, and type of data that it can collect is defined by the choice of payload.

Drones/RPAS technology currently lacks adversarial compatibility, i.e. the airframe selected is highly likely to significantly restrict the payload choice. Therefore, should choose payload prior to selecting an airframe, as the payload is the component of the system that adds the most value.

USA's National Search and Rescue Committee (NSARC) have divided remote sensing into four functions, each requiring greater resolution to accomplish:

1 **Surveillance:** Wide-area observation of an area, providing general awareness of terrain or environment;

2 **Detection:** ability to distinguish an object from the background (e.g. heat source, white/orange object);

3 **Classification or Recognition:** ability to determine what type of object has been detected (e.g. person, bird, buoy, etc.); and

4 **Identification:** ability to determine the exact identification of the object (e.g. vessel characteristics, car make and model). (NSARC, 2016)

CHAPTER 3: DRONE SELECTION
PAYLOAD SELECTION

Picture: www.service-drone.com

WHAT ARE - Essential functions for the conduct of SAR operations?

THEY are **detection** and **recognition**. (NSARC, 2016)

Given this relatively high level of remote sensing required for SAR, any given Drone and its sensors' specifications may limit its applicability for this application.

It may not be able to look closely enough to identify a search object, or may not be able to sweep large areas with sufficient resolution to detect an object.

Therefore, it is vital for SAR personnel to be able to decipher Drone payload specifications.

Lets briefly look at two most commonly used payloads amongst response staff – **visual cameras and thermal cameras**

NOTE: Emergency Services should strive to achieve a similar level of understanding should they choose to purchase one of the many other payload options available, e.g. **LiDAR, low-light cameras, multi-spectral sensors, etc.**

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION

Picture: www.service-drone.com

In one of our papers we attempted to explain the theory of both visual and thermal cameras in sufficient detail to provide the general reader with a practical understanding of the subject, but the level of the mathematics and science used was kept to the minimum required to achieve a pragmatic appreciation of the necessary concepts.

Mathematical and scientific rigor may be found in the references provided in the bibliography for readers who require it.

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION - VISUAL CAMERA - CONSIDERATIONS

Picture: www.service-drone.com

Electro-optical (EO) sensor sensor's size has a direct impact on quality.

Many Emergency Services use the DJI's Inspire and Zenmuse X3 combo.

Yes it is considered a professional level videography RPAS.

However, their sensor is a mere 6.17mm in contrast to a professional standard DSLR that wields a 35mm sensor size.

Megapixels figure – also considerably influences image quality.

More is more, is better!

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION - VISUAL CAMERA - CONSIDERATIONS

Picture: www.service-drone.com

Camera's optical lens system will define a FOV in degrees, which at a given range will span over a calculable distance. Imagine a camera with 5 degrees FOV that spans 175 metres, using Pythagoras' Theorem its range of 2km can be calculated.

For example, a 1920 x 1080 HD image with a 5 degrees FOV that spans 175 metres wide means each pixel accounts for 9.1cm across of the scene.

Whereas a 1080 x 720 HD image with the same setup means each pixel represents 16.2cm across.

In both examples, this is the minimum detail that can be observed, and will affect the ability of the operator to spot objects in a scene. Each pixel is the recorded light, contrast, etc., which adds to detail; therefore the smaller the area covered per pixel, the better the captured detail.

Furthermore, the effective resolution available to the viewer will be further affected by the viewing system. A HD sensor is only SD (Standard-definition) if viewed on an SD screen, not only this, FPV (First Person View) screen size will also effect detection and recognition capabilities.

CHAPTER 3: DRONE SELECTION

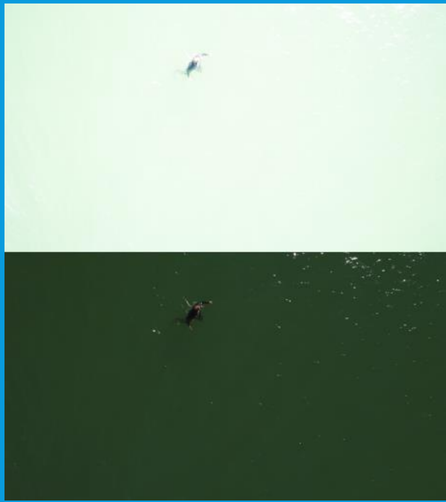
PAYLOAD SELECTION - VISUAL CAMERA - CONSIDERATIONS

Picture: www.service-drone.com

Aperture also plays a part in capturing sufficient detail.

Aperture controls how much light enters the camera.

In sunny conditions, a wide aperture will cause overexposed footage. Overexposure removes all detail and gives a very white image, which will obviously impact performance of emergency RPAS use, and this effect will be augmented further by reflection off the water. While aperture can often be adjusted on handheld cameras, RPAS visual spectrum cameras usually come with a fixed aperture to minimise weight and size.



Solution is neutral density (ND) filters. ND filters reduce the amount of light that enters the lens, "sunglasses for a camera". They are available in a variety of ratings depending on how much light needs to be blocked from entering the camera. Source: The SkyBound Rescuer Project

Visual image is often regarded as the most basic data for a RPAS to collect, there are still numerous variables that will impact performance.

Conclusion: to reach maximum efficiency, all variables need to be understood and purchasing decisions need to be thoroughly backed up with research and evidence; ultimately, the choice of technology purchased will decide how much an RPAS can help with emergency response.

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION - THERMAL CAMERA

Picture: www.service-drone.com

Aerial thermal cameras (TICs) offers vast opportunities to the SAR community.

But **ONLY** when the correct one is chosen.

Key performance criteria of a thermal camera needs to be explained in plain language.

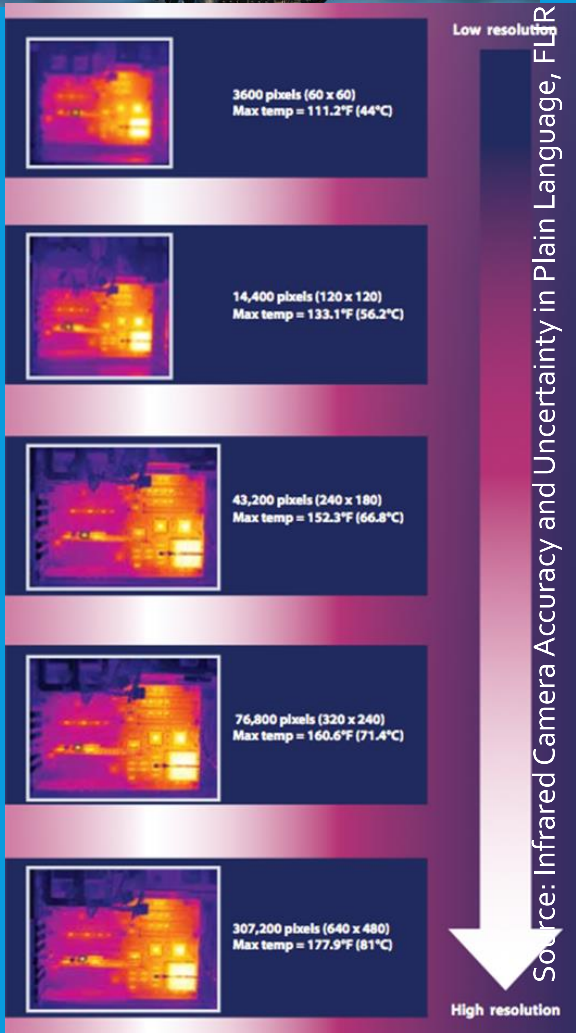
Firstly, infrared wavelengths – are too long for the human eye to detect;

(part of the electromagnetic spectrum perceived as heat).

Infrared is split into categories based on wavelength:

- near-infrared,
- short-wavelength infrared,
- mid-wavelength infrared,
- long-wavelength infrared,
- far infrared.

The "thermal imaging" region usually concerns the latter two types.



Source: Infrared Camera Accuracy and Uncertainty in Plain Language, FLIR

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION - THERMAL CAMERA

Picture: www.service-drone.com

"Thermal imaging" region technology usually concerns:

- long-wavelength infrared, and far infrared.

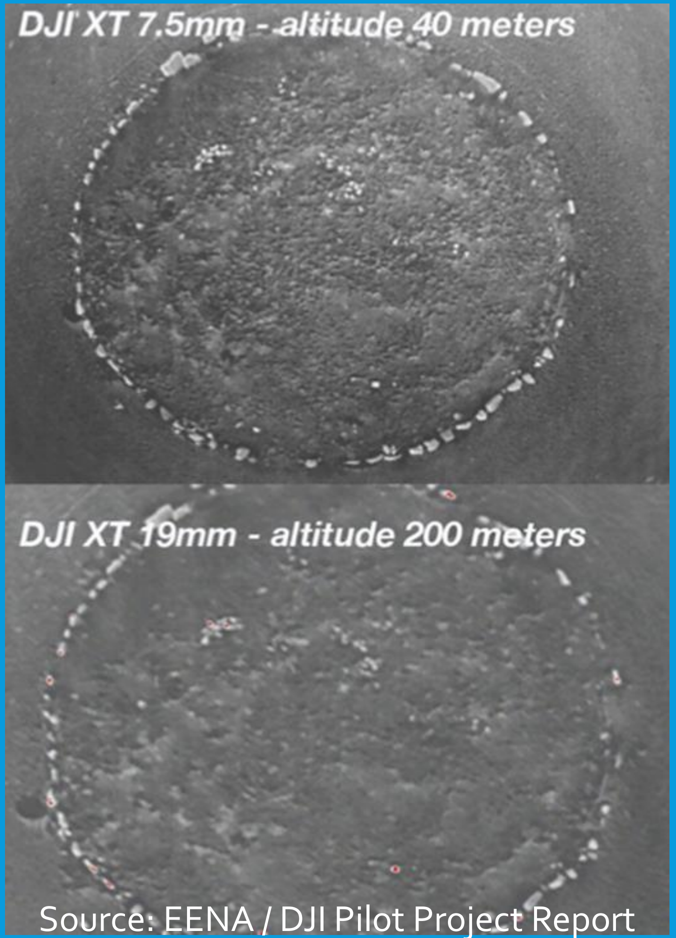
All objects having temperature above absolute zero emit heat:

this is what thermal cameras detect.

Plus, thermal imagers are usually radiometric, meaning they measure and store the temperatures that they've detected at every point in an image.

Nine main specifications are critical in the process of selecting a thermal imager:

frame rate - lens choice - detector resolution - Noise Equivalent Temperature Difference (NETD) - temperature effective range - pixel pitch – accuracy - and picture-in-picture (PiP) imaging.



Source: EENA / DJI Pilot Project Report

CHAPTER 3: DRONE SELECTION

PAYLOAD SELECTION - THERMAL CAMERA - PICTURE-IN-PICTURE (PIP) IMAGING

Picture: www.service-drone.com

Most specifications in the process of selecting a thermal imager can be readily understood e.g.:

frame rate - lens choice - detector resolution - thermal sensitivity (NETD) - temperature effective range - pixel pitch – accuracy - (PiP) Imaging

NOTE - Picture-in-Picture (PiP) Imaging:

Because thermal imaging camera uses infrared radiation, instead of using visible light like photography/videography cameras, familiar surroundings can appear very different looking. (EENA, 2016)

PiP combines thermal and visible-light images by placing a "framed" thermal image over its corresponding visible-light photo. This allows the radiometric data of a thermal camera overlaid a digital photographic image, like a digital camera, to give reference to the environment being measured.

Brings clarity to the feedback you are observing, reducing information overload.

CHAPTER 4: CONCEPT OF OPERATIONS (WHAT ELSE TO CONSIDER)

- CREW ORGANISATION:

CREW ROLES - SPANS OF CONTROL - LEGISLATIONS AND REGULATIONS - QUALIFICATIONS AND TRAINING - NUMBER OF QUALIFIED RESPONDERS REQUIRED - LIST OF QUALIFIED RESPONDERS

- PROCEDURES FOR DEPLOYING THE DRONE(S):

PRE-FLIGHT CHECKS – LOGISTICS – COMMUNICATIONS - SEARCH PATTERNS / STANDARD OPERATING PROCEDURES (SOPS) / LOCAL OPERATING PROCEDURES (LOPS) - NOTES TO AIRMEN (NOTAMS) - COLLISION AVOIDANCE - LANDING AND POST-FLIGHT PROCEDURES - PROCEDURES FOR LANDING - POST FLIGHT CHECKLIST

- EMERGENCY PROCEDURES
- RISK MANAGEMENT
- COMMUNICATIONS

CHAPTER 4: CONCEPT OF OPERATIONS

Once all prior information has been properly assessed, i.e. mission(s) stated & understood and suitable technology selected, **then and only then** can a framework of best practices be established.

Unfortunately, understanding the optimal procedures for DRONES at present seems patchy.

Emergency Services are scrambling to form Drone/RPAS units without fully considering a 'Concept of Operations' (CONOPs) for their use.

We can offer suggestions and guidance towards achieving future-proof DRONE CONOPs.

CHAPTER 5: LATEST RESEARCH PROJECT

This Study is the product of great passion by my colleague Gemma Alcock and considerable efforts from a very small team. She thanks all participants from Essex Police and Essex Fire and Rescue Service for giving their time and assistance to this research project. And for their ongoing support of SkyBound Rescuer's efforts to bring scientific rigor to the implementation of drone technology for public safety.

The SkyBound Rescuer Project are always looking for knowledge sharing and collaborative opportunities to further our research. If you want drone research results that'll directly apply to your practices, let's find out what drones can offer you!

www.SkyBoundRescuer.com

@skyboundrescuer

https://mailchi.mp/0ac42c4cddf4/drone_procedure_optimisation_study

DRONE PROCEDURE OPTIMISATION STUDY:
Raising the Standards
To Save More Lives

CHAPTER 6: CONCLUSIONS

Conclusions:

- Potential for Drone/RPAS/UAS technology in the realm of Public Safety & Emergency Services & SAR is undeniable and truly exciting.
- Many gaps in understanding how this technology should be implemented.
- Use of Drone/RPAS/UAS by the Emergency Services, SAR and first responder communities is growing rapidly and that the technology on-board the aerial asset/Drone is also changing rapidly.
- CONOPs for Drone/RPAS/UAS use should evolve at a similar rate, to avoid detrimental effects.
- DRONES will provide a unique capability that will augment other search assets.

CHAPTER 6: CONCLUSIONS

We follow a strategic method and suggest that Emergency and Public Safety Services should aim to follow:

- highlight DRONE use case studies and full risk assessment analysis,
- thoroughly analyse the technology selection to be 'fit for purpose'and match mission needs,
- then build a 'Concept of Operations' (CONOPs) for their own best practices.

This emerging technology is still in the proof of concept phase for many response communities,

but continuing DRONE/RPAS operations without clear understanding of where and how they should be used could see severe consequences and poor outcomes.

Safe integration of Drones/RPAS involves gaining a better understanding of operational issues, such as training requirements, operational specifications, system equipage, and technology considerations.

WHERE TO GET MORE INFORMATION

- **TeamSOARIZON**
- www.soarizon.io
- **Dronerules.eu**
- https://dronerules.eu/en/professional/authorities/
- **Civil Aviation Authority**
- https://www.caa.co.uk/Consumers/Unmanned-aircraft-and-drones/
- https://dronesafe.uk/
- **Association of Remotely Piloted Aircraft Systems (ARPAS)**
- http://www.arpas.co.uk/
- **Unmanned Aerial Vehicle Systems Association (UAVS)**
- http://www.uavs.org/
- **Association of British Insurers**
- https://www.abi.org.uk/
- **The Information Commissioner's Office (ICO)**
- https://ico.org.uk/your-data-matters/drones/
- **SkyBoundRescuer**
- www.SkyBoundRescuer.com

FIG Mind the Gap Seminar 2019

London, 2019

THANK YOU FOR LISTENING

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