WEST MIDLANDS FIRE SERVICE

Emergency Service Use of UAS

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Towards the end of 2007, West Midlands Fire Service (WMFS) became the first fire and rescue service in the UK to successfully bring into operation an Unmanned Aircraft System (UAS). The first deployment of the UAS was to provide live video for fire investigators at the warehouse site in Atherstone on Stour in Warwickshire where a major fire in November 2007 resulted in the deaths of four firefighters. This article gives a brief insight into the Incident Support Imaging System (ISiS), the UAS now used by the service, and its benefits in assisting incident management.

The military community is widely considered to be the largest UAS user. Since the 1950s, the systems have been deployed in reconnaissance and intelligence-gathering roles and, more recently, for warfare in well-publicised combat missions. UAS are also being introduced into various interesting and diverse initiatives, including: aiding research into predicting when volcanoes are due to erupt, monitoring whales' health by capturing samples of their breath for analysis, and providing live video security on fuel pipeline installations.

Many individuals and organisations are now considering the use of UAS in a variety of applications – this is a process that WMFS went through several years ago, and it is now in a good position to share valuable experience. At the time of writing, more than 15 UK fire and rescue services have shown interest and requested information from WMFS, including copies of operating procedures or even visits to see the system in operation. This is a positive indicator for the future of UAS in the emergency services environment.

Business Case

In drafting the business case to proceed with ISiS (the name given to the WMFS UAS), the project team identified several areas of operations where it was envisaged that deployment of the system may provide benefit. These included:

- to enhance command and control;
- remote operational intelligence gathering;
- urban search and rescue;
- large-scale flooding;
- identifying incidents involving hazardous materials or gas cylinders remotely;
- capturing images/video for incident debrief;
- fire/accident investigation;
- promoting community fire safety.

The project team then had to sensitively consider the following:

- the public debate taking place at the time over closed-circuit television/covert surveillance and a perceived 'Big Brother' state;
- the safety of firefighters and the public, since ISiS would be operating in close proximity of both;
- operating in an complex urban environment;
- responsibility for leading the way in UAS operations in a safe and effective manner.

It was essential to consult with the UK Civil Aviation Authority (CAA) at an early stage of implementation, to discuss WMFS intentions and make available a draft copy of the proposed

operating procedures for the UAS. The CAA accepted the procedures as a good starting point for operations, and was understanding of the fire service's needs and helpfully provided information and guidance.

Selected System

The project team carried out research into many types of UAS and possible alternatives. They spent time assessing fixed-wing UAS, tethered balloons, pole mounted cameras and remote helicopters. The outcome from the research identified a suitable UAS for the project: a Quad Copter Vertical Take Off and Landing system, known as the MD4-200 Microdrone, which is built in Germany and supplied by MW Power Systems UK.

The biggest plus points for this system were the fact that it scored positively in the fire service risk assessment for operational use; it is lightweight and battery operated (with each battery lasting about 20 minutes); and it is very unlikely that, if the rotors came into contact with a human, they would cause harm. The system could also be deployed safely within a building (a specification which proved difficult for the alternatives to achieve).

Weighing just 900g, the MD4-200 is made predominantly of carbon fibre reinforced plastic and has a payload capability of 200gms. It has three main sensors – HQ video, HQ stills 12 mega pixels, and forward-looking infrared. It has a flying range of 3km from the base station. (WMFS operating protocols state clearly that the flying unit will remain within in 'line of sight' of the operator at all times, and the remote control has a range of 500m to ensure this.) The unit also has Global Position Satellite capability, which means that once a suitable observation platform in the air has been found, the drone will work to remain at this location until instructed manually by the pilot on the ground to relocate.

One of the most difficult tasks for the project team was to ascertain who would be best placed to operate ISiS. Many options were considered, ranging from the in-house photographic department, to operational fire crews. The outcome was to give ownership to a team of ten individuals

who were already working as a team (performing another role), and who had incident command experience and were available to provide a primary or secondary response to incidents.

Following selection, the team embarked on a comprehensive training programme. The system is technical, so there was a good deal of theoretical input prior to being let loose with the controls. The flight training commenced over a field, which proved the perfect venue as it provided a much needed soft landing area to practise. The team then progressed to flights over hard standing and was eventually integrated into realistic incident scenarios at various locations.

Learning Points

One of the major learning points from the project is that the deployment and subsequent success of a UAS is almost entirely dependant on the skill of the operators. Using the data collected during the first 14 months of use at incidents where the system has been brought into operation, it is generally the case that it has provided additional benefits to fire service incident commanders.

At an incident involving a collapsed building on West Bromwich High Street in June 2008, the use of ISiS and its 12 megapixel high-quality stills camera provided images that gave full awareness to all agencies attending.

The incident involved a three storey shop and residential premises having had sub standard building alterations which resulted in a complete collapse of the roof and floors one and two. Four persons were rescued but unfortunately one person

lost their life as a result of the collapse. Up to 30 firefighters were involved and one technical rescue team including a canine search team.

The series of 'birds eye view' images which were taken from directly above the structure, clearly showing the condition inside the building after it collapsed proved to be particularly useful.The images were possible to obtain as there is very little downdraft from ISiS. If the drone did cause significant downdraft, it could have disturbed the fragile state of the building and roof, in particular the loose tiles surrounding the opening. The detailed images also provided clear information for the urban search and rescue advisor, which was then used to assist the incident commander when considering tactics and safety.

ISiS was also used during the response to a fire at a residential college in October 2008. Here, the system was used by the

incident command team to view live thermal video showing hot spots across the building's roof. As a direct result of viewing the live moving thermal imagery, the incident command team identified that the roof construction was not quite as they had previously thought, and that there was one particular area of the roof which required attention by fire-fighters in that it was retaining a substantial amount of heat. The footage enabled the command team to monitor and direct

safe working procedures for crew activity.

Other incidents attended have included large and small building fires, a chemical gas cloud release, a special service call to assist police searching for a missing child near a frozen lake, and a large-scale scene assessment at a motorway traffic collision.

Another interesting finding from the first year of UAS operation in WMFS is that the majority of deployments have been between 10m to 40m high; whereas the initial assumption at project initiation was that the aircraft would be deployed much higher.

Wind Speed Considerations

The MD4-200 is an outstanding piece of technology that continues to serve WMFS well. However, due to the fact that it is lightweight (an advantage for the public and fire-fighter safety in the very unlikely event of it crash landing), the system has difficulty in operating in wind speeds above 12mph.
During the initial research phase of the project, the ISiS team interrogated several years' weather data for the West Midlands region. The conclusion was that wind speeds for central Birmingham were above 12mph for about 60 days per year on

average, and therefore ISiS would not be available to operate ‘in the open’ on these days. The team recognised that wind speeds can vary at any given moment, and also that it is not necessarily the case that if the wind speed is too high in one part of the region, it will also be high in another.

Building on the ISiS project, WMFS is shortly to embark on a 16-week operational trial of the newly developed MD4-1000 Microdrone, which weighs about 3.4kg and has a payload-carrying capability of 1kg. The drone has a battery life and flight time of about 60 minutes, and is capable of operating in wind speeds in excess of 24mph – something which will bring potential improvement in delivery.

A further issue is that the UK CAA has recently carried out a consultation for a proposal to amend the Air Navigation Order – a move that could bring unmanned aircraft of 7kg mass or less within the scope of this Order. Comments from the consultation have now been published on the CAA website, and the authority is now reviewing the proposals before moving on to the next stage of the regulatory process. It is likely that the result of this consultation will be an amendment to Article 98 of the Air Navigation Order, which will require operators of certain UAS to apply to the CAA for permission to operate.

Currently, a Fire and Rescue Service implementing a UAS, does not need permission to operate from the CAA. Having the requirement to obtain permission to operate will ensure that users do provide safe system of operating, risk assessments, skills and equipment maintenance programs.

It is early days for UAS deployment in the emergency services, but it is predicted that, within a few years, these lightweight unmanned systems will be commonplace in the fire and rescue service and actively providing aerial imagery to assist services in successful incident management ?

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