



INTEGRATING SEARCH AND RESCUE DRONES INTO AIRSPACE



Case Study:

Croatian
Mountain Rescue
Service

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EUROPEAN EMERGENCY NUMBER ASSOCIATION

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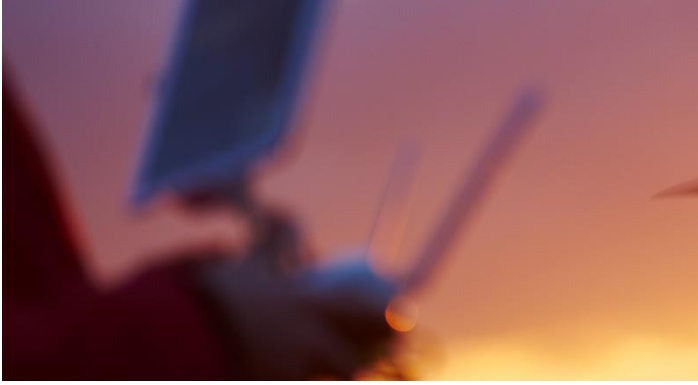
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1 INTRODUCTION.....	4
2 DRONE USE OVERVIEW AT CROATIAN MOUNTAIN RESCUE SERVICE.....	6
3 CURRENT ISSUES IN AIRSPACE.....	8
4 INTRODUCTION TO THE AMC PORTAL.....	10
5 INVOLVEMENT OF THE CROATIAN MOUNTAIN RESCUE SERVICE.....	15
6 USER SATISFACTION.....	17
7 NEXT STEPS IN UTM IN CROATIA.....	18
8 CONCLUSIONS.....	18
9 GLOSSARY.....	19



1 | INTRODUCTION

When we speak about integrating Unmanned Aircraft Systems (UASs) into airspace, we first must understand that there are many other “traditional airspace users”¹ already operating in airspace, who follow present rules and procedures to ensure safe airspace operations. The history of aviation, including the development, experiences, accidents and lessons learned from them made us follow the rules and constantly assess the safety of operations in airspace.

The introduction of UASs into airspace was initially reserved for the military. As a traditional airspace user, the military is distinguished by competent human resources and navigation and communication equipment, which enables it to introduce UASs safely into airspace, according to the aviation safety rules.

However, the recent development of small UASs with integrated cameras and sensors suddenly provided an opportunity for common people to view the world from another perspective. Places which were difficult, expensive and dangerous to reach now became easy and cheap to reach for aerial work (photographing, inspection, oversight, reconnaissance, etc.).

¹ Airliners, general aviation, gliders, parachutes, balloons, military aircraft and activities, etc.



SAR operations as well as other operations by emergency services are high on the priority list, no matter the means of conducting them (aircraft or UAS). That is why it is crucial to make a fast and safe access to airspace possible for them where and whenever.



The use of UASs for emergency services as a new valuable asset is fully recognised. There are already many examples where the accessibility of and fast delivery by UASs to the emergency operation area proved useful for saving human lives.

The use of UASs for emergency services as a new valuable asset is fully recognised without any doubt. There are already many examples where the accessibility of and fast delivery by UASs to the emergency operation area proved useful for saving human lives.

Particular attention should be paid to UASs potential for a quick delivery of medical equipment to specific locations or to be used as assistance in locating missing persons, especially in locations where sending emergency personnel would be dangerous. In addition, wildfire monitoring in real time helps firefighters to allocate resources to where they are needed most.

However, the benefits of using UASs should not be put before the general safety of all airspace users. To integrate UASs safely into airspace, we need to consider significant differences of UASs compared to other aircraft, which is why UAS operations can currently only be performed in segregated airspace.

Emergency operations are specific in that they are not planned activities, since a need for them occurs suddenly and thus all procedures for enabling a safe flight of UASs for emergency operation purposes must be carried out as quickly as possible while maintaining the appropriate level of airspace safety.

Having recognised the benefits of the new UAS technology for saving human lives, Croatia Control Ltd. (CCL) developed new procedures in airspace management in cooperation with Croatian emergency services, along with its unmanned management tool that has already been operationally used for internal purposes – the “AMC Portal”, ultimately enabling the emergency services a fast and safe access to airspace when their assistance is most needed.



2 | DRONE USE OVERVIEW AT CROATIAN MOUNTAIN RESCUE SERVICE

The Croatian Mountain Rescue Service (CMRS) has been using UAV technology for the last 6 years. At first, UAVs were used as a great tool to do a fast search of an Area of Interest (AOI) and scouting of terrain.

Over the course of the last year, the “AMC Portal” has proved to be a perfect tool for 90% of CMRS operations, as CMRS continued developing other ways of implementing UAVs into its operations beside standard SAR operations.

In 2018, CMRS established an UAV department and proposed a new internal training and licensing programme. The programme was written and sent for authorisation to regulatory authorities.

It was accepted and authorised, and started in 2018, with a total of 49 pilots successfully finishing the programme and becoming licensed pilots.



The UAV department established mandatory rules for drone usage and the annual maintenance checkup of all operational drones. CMRS operates 40 drones in total.

The department has a 3-day training on a monthly basis, usually at the end of each month, during which all available licensed pilots gather for training and an exchange of knowledge to work out the current issues. All members who would like to know more about UAVs and try them out can do that in a secure environment and under supervision.



In SAR missions, CMRS uses drones depending on the situation. For instance, if a mission starts at night, one drone is on the ground with another used for a fast search and night-time scouting. The operations are coordinated and commanded by the Commander of Air Group (CAG) who is in constant touch with the Croatian Air Traffic Control and all other relevant parties (Ministry of Defense, Air Force, Coast Guard).

After completing a series of flights, the material is downloaded, processed and used for defining the CMRS procedures, so that people in the base, at home, and in the field can analyse it.

The Air Traffic Control is constantly updated and assists CMRS in airspace.

CMRS uses drones for SAR operations, R&D, border patrol, and other purposes for the government services.

3 | CURRENT ISSUES IN AIRSPACE

When we observe airspace as common citizens, depending on our location, we could get the impression that no one is there and that there is a lot of empty space. Only the occasional airliner trailing high up in the sky could give us a clue that something is going on above our heads. At least that would be the case if we were somewhere in the countryside, far away from big cities and airports.

However, if our location were close to an international or even a military airport, our perspective would be completely different, as in that environment we would witness many aircraft operations being conducted in airspace constantly. Looking deeper into the matter, we would realise that landing and take-off operations of various types of aircraft are following certain patterns and sequences that allow them to safely continue “dancing” in the sky.

Our experience would not be much different in cities, at congested intersections regulated by traffic lights enabling the safe flow of traffic. The right of way rules are simple and the same for all participants, no matter if they are trucks, buses, cars, bicycles or pedestrians: a red light means “STOP” and a green light means “GO”.

But if the traffic lights suddenly stopped working properly during rush hour, we would witness a mess and very likely a few accidents within a couple of minutes.

Let us imagine a case in which all traffic participants follow the right of way rules, apart from one category, for example the relatively new category of electric cars. These cars go through the intersection however and whenever they decide to. Depending on the traffic frequency, common sense of other participants and mostly pure luck, there would be no accidents.

The above example can be used to depict what happens when an UAS operates in airspace without the approval of a competent authority.

Civilian and military air traffic follows the instructions of a competent air traffic control to maintain safe aircraft operations. Aircraft must be inspected and certified for flight, and pilots and air traffic controllers educated and licensed to operate in airspace.





There are also rules of the air for safe airspace operations. These rules must be followed by all participants in airspace without exception, in order to create and preserve a safe environment for all airspace operations.

Soon after airspace had become crowded with traditional aviation and terrible accidents occurred, it was obvious that some rules had to be implemented. In line with the growth of aircraft operations during history, there has also been a need for better equipment and new technology, not only in aircraft, but also on the ground, in the air traffic control. This was necessary in order to enable safe operations in an airspace which was becoming even more congested. New equipment gives an opportunity for new, more efficient rules and procedures. These rules depend on many factors and safety assessments, managed mostly by the air traffic control.

A safe implementation process of UASs into airspace demands considering several aspects: the state of the current airspace organisation, rules applicable to traditional aviation, types of operations performed in airspace, the aircraft operating authority, and the licensing process for aircraft and airline personnel.

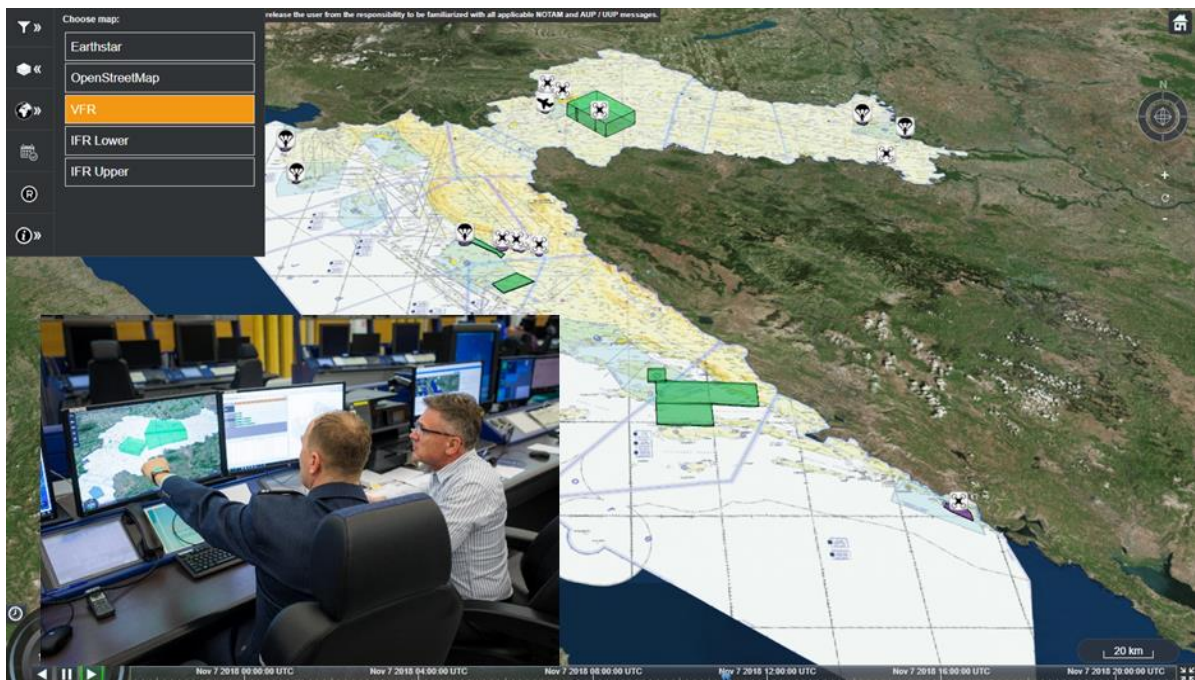
4 | INTRODUCTION TO THE AMC PORTAL

4.1 | About the AMC Portal

The “AMC Portal”² was officially introduced in Croatia in June 2017, followed by the accompanying “AMC Portal Mobile” application designed especially for drone operations. The tool is a powerful means of managing all activities that need to be segregated from normal air traffic flows controlled by the air traffic control.

The “AMC Portal” is a unified Airspace Management (ASM) and Unmanned Aircraft Management (UTM) tool developed by CCL’s experts in cooperation with relevant state stakeholders (aviation authority, the military, police, SAR, etc.).

The web-based “AMC Portal” is a central briefing point for all airspace users (traditional and drone operators), gathering and distributing information about planned and actual activities in real time (AUP/UUP, relevant NOTAMs), textually and graphically, as shown on different layers of maps (satellite, street view, VFR, IFR), and including the information on rules and regulations.



² <https://amc-en.crocontrol.hr/>



The "AMC Portal Mobile" smartphone application (developed for iOS and Android) was introduced in Croatia in January 2019 as the official frontend for drone operators to fly legally in the Zagreb Flight Information Region (FIR). The application significantly shortened the approval process (which now lasts only 5 minutes or less) for UAS flights in certain portions of airspace (where possible, i.e. in uncontrolled airspace up to 120 m above ground level (AGL) and in controlled airspace (CTR) outside the radius of 5 km of the aerodrome reference point (ARP) up to 50 m AGL), according to the automated process approved at national level.

The "AMC Portal" as the central point for all relevant processes was developed as a modular system. At the moment, it consists of several modules for different stakeholder groups (all types of airspace users, including drone operators, national ASM, NSA, CAA, FIC, CESUP, TWR ATC, police, national emergency services: SAR, firefighting, police, etc.).

4.2 | Development

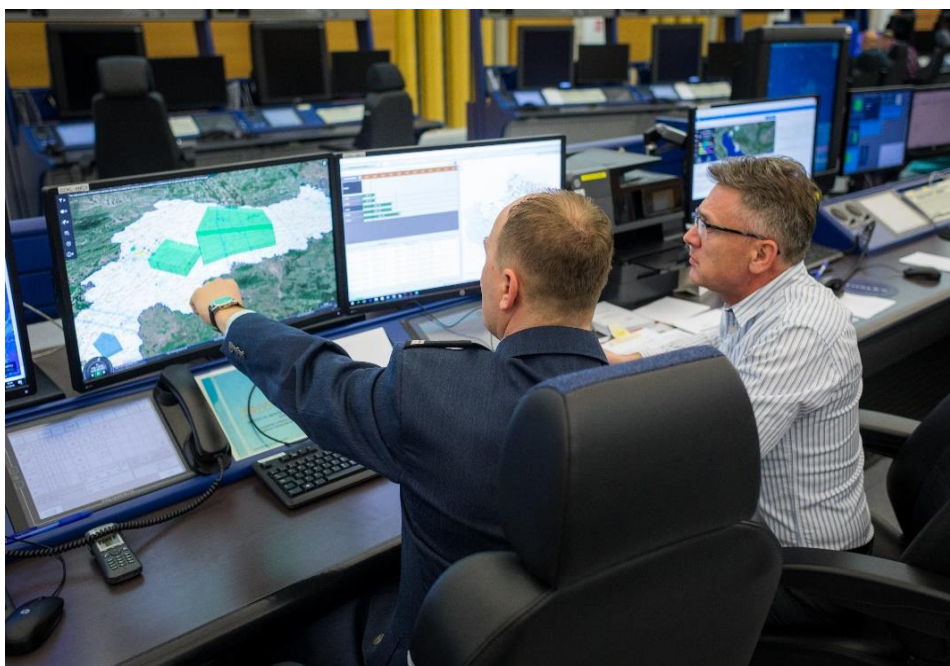
The “AMC Portal” was originally designed to manage airspace according to the dynamic flexible use of airspace principles, in order to enable a fast reservation and release process of segregated airspace for all airspace users (civil or military). With the introduction of mass UAS production and growing demand, it was easy to adopt the originally dynamic ASM tool to provide integrated dynamic processes to new UAS users. However, a constant growth of various types of demands for UAS flights, the dynamics and nature of operations made us develop even faster processes and broaden the capacity of the system.

A real UTM system must be integrated into an ASM system to allow competent decisions in real time.

4.3 | How it works

The tool is an IT solution connecting end users with the competent unit responsible for managing airspace segregations in real time and providing necessary information to ATC units, all other stakeholders and end users about the planned and ongoing status of a segregation in airspace.

The Airspace Management Cell (AMC) is a dedicated unit established by the state according to the European Union Regulation to manage airspace segregations between civil and military air traffic. It consists of civil and military experts whose job it is to make the best judgment and a final decision about the segregations in airspace.



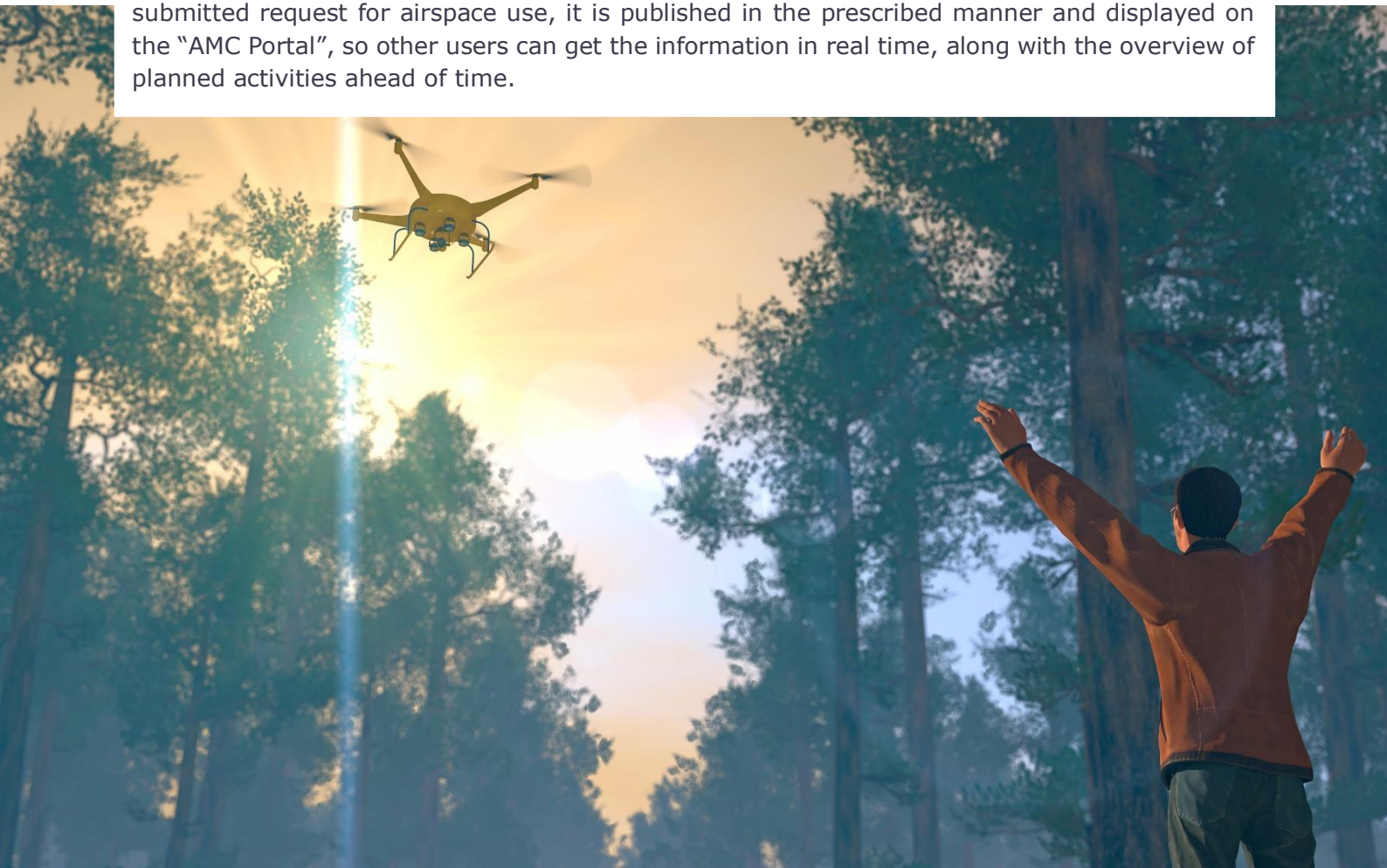
Listening to our airspace users, we realised that the demand for airspace was high and increasing and that we had to adopt certain responsibilities and tasks for this unit to make the processes more efficient and to accommodate various activities into airspace safely. The processes we had in place were too slow and the communication and coordination between end users and competent units was conducted by phone and e-mail. Messages about the airspace status were disseminated to end users in form of textual messages by NOTAM, Airspace Use Plan (AUP) and Updated Airspace Use Plan (UUP). The dissemination process was not appropriate, nor user friendly, so the messages were not provided to end users in real time.

That is why we decided to develop an IT tool which would be available to everyone to see what the situation regarding the activities in segregated airspace was in real time.

4.3 | The AMC Portal supporting emergency services

The "AMC Portal" virtually connected all relevant services and units participating in the airspace approval or activity surveillance process with the user, thus enabling a fast decision-making process for conducting airspace activities.

The strength of the "AMC Portal" lies in the implemented procedures and fast coordination procedures between relevant services. As soon as a decision by a competent body is made on a submitted request for airspace use, it is published in the prescribed manner and displayed on the "AMC Portal", so other users can get the information in real time, along with the overview of planned activities ahead of time.

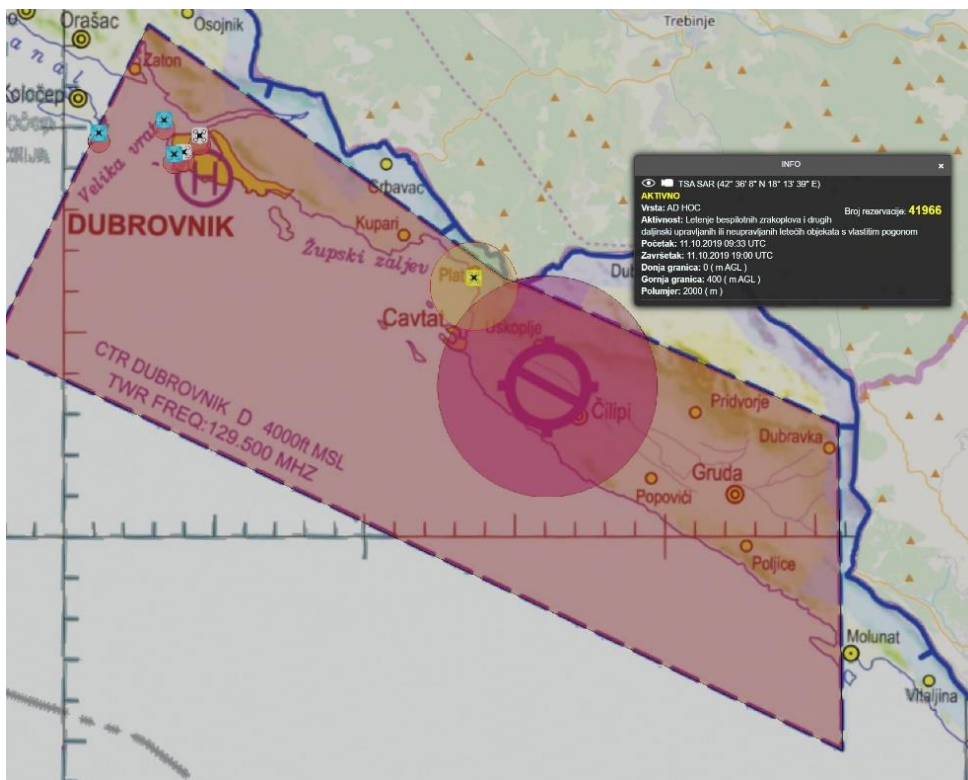


The “AMC Portal” is a central point merging all relevant information on airspace segregations, which is then published to all air space users in real time. The integrated system for planning and approving the activities, as well as canceling the segregations as soon as the activities are finished, enabled our airspace managers to manage airspace dynamically and efficiently. Direct communication between airspace users and a competent flight approval unit via an internal messaging system increased safety and led to better coordination between all participants in the process.

Introducing drones into the system called for an increase of data flow dynamics, so a smartphone application was developed to make the communication even better.

For the needs of state emergency services using drones (police, CMRS, customs, etc.), a special version of the mobile application was developed and aligned with the agreed and prescribed procedures for the emergency services to fly fast and safe when needed.

Emergency services also conduct their drone training flights (planned activities), but on those occasions, they are considered as regular air space users and flight requests are processed under the procedures valid for all other air space users to avoid a negative impact on other air traffic.





5 | INVOLVEMENT OF THE CROATIAN MOUNTAIN RESCUE SERVICE

CMRS as a premium user (like all other emergency services) has its own module of the “AMC Portal”, developed in cooperation with CCL’s experts and based on the agreement between stakeholders.

As part of the agreement, there are mutually agreed procedures for emergency operations with the responsible entities and a priority list to be followed. The procedures are written in line with the present regulatory framework and the “AMC Portal’s” capabilities to deliver a fast service to our users to safely access airspace.

After testing the procedure through common means of communication, both in exercises and real situations, a concept and a technical specification for the implementation were made to implement the procedure in the “AMC Portal’s” system.

To allow the B2B communication and coordination, a specially designed build of the “AMC Portal Mobile” application was made to shorten the process and allow CMRS a safe access to airspace beyond the regular limits. Before the special module and mobile application, SAR personnel were calling the AMC directly on a dedicated telephone number to establish an area for SAR activities. The AMC entered the data about the area into the “AMC Portal” manually and published a respective NOTAM.

A very important part of the agreement was the participation of CCL and AMC experts in the CMRS’s internal education and training programme, which was developed in CMRS with the support of CCL’s experts. All CMRS UAS operators are licensed and all UASs are maintained and licensed according to the internal programme.

On the AMC’s side of the “AMC Portal’s” system, there is a special procedure to clear the airspace of other activities during SAR operations and to notify all airspace users about the ongoing SAR operation to help them avoid that portion of airspace.

After a SAR operation is finished, the AMC restores that portion of airspace and resumes the interrupted activities.

The personnel in charge of developing the “AMC Portal” held some meetings with the CMRS personnel and other emergency services to understand better the nature of their operations in airspace, identify their current capacities and to set together the minimum conditions to be met to access airspace safely according to the special procedures.

CCL developed a safe concept of operations in SAR airspace and conducted a safety assessment of the suggested procedures. Based on that analysis and agreement, some deficiencies were identified, as well as a way to overcome them in the sense of:

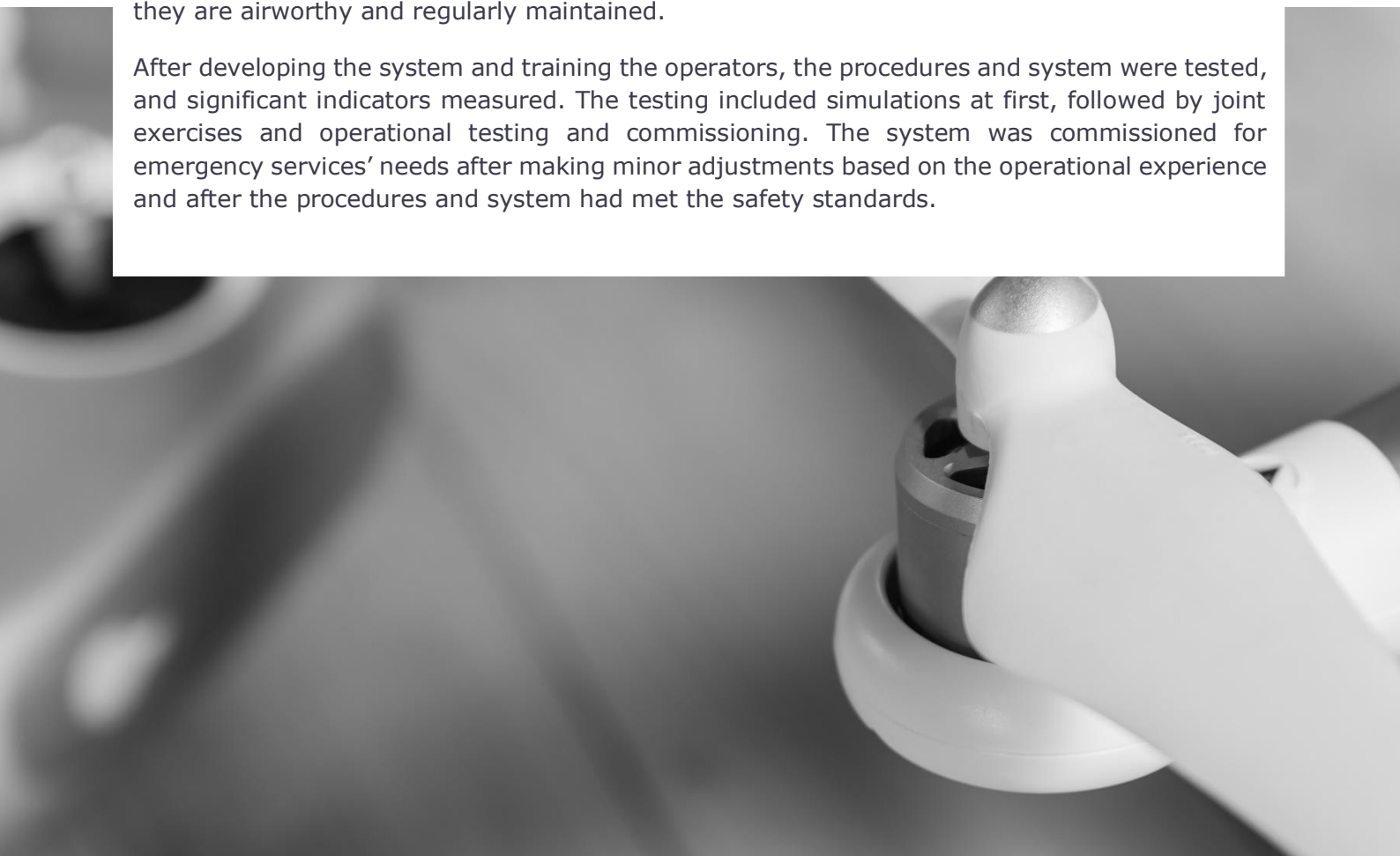
- Technical capacities and UAS equipment,
- The desired area of SAR operation and optimum altitude of operation,
- UAS operators training to conduct UAS operations safely,
- A common procedure for a safe and fast access to airspace.

A technical specification was made for an upgrade of the “AMC Portal” to implement new functionalities based on the requirements of SAR operations, in the sense of a special module and mobile application.

CMRS developed its own UAS operator training and licensing programme for SAR purposes in collaboration with CCL. CCL has an active role in the training, relating to the knowledge of the procedures and rules of the air.

In addition, CMRS defined a way of licensing and maintaining their own UASs to guarantee that they are airworthy and regularly maintained.

After developing the system and training the operators, the procedures and system were tested, and significant indicators measured. The testing included simulations at first, followed by joint exercises and operational testing and commissioning. The system was commissioned for emergency services’ needs after making minor adjustments based on the operational experience and after the procedures and system had met the safety standards.





6 | USER SATISFACTION

CMRS started its drone programme in cooperation with CCL. At the first meeting before the start of the programme and licensing, the usage of airspace for emergency response services was discussed. CCL pointed out what CMRS should do to be a safe airspace user and the first beta version of the "AMC Portal" was presented to CMRS. All Croatian emergency services conduct their missions to save lives. The UAV matter has not been nationally regulated, but the general aviation rules still applied via the civil aviation law.

After the meeting, CMRS and CCL became partners in their joint effort to enhance teamwork and multiservice collaboration. From day one, common rules and SOPs on how airspace should be used safely and quickly were established. CCL and CMRS's joint effort to implement a licensing programme also enriched it with the flexible use of airspace concept.

After testing the beta version of the "AMC Portal", CMRS decided that the tool would prove very useful for all CMRS's UAV activities. From start to finish of a SAR mission, the "AMC Portal" provides information about the airspace in the vicinity, the size of the airspace segment, CTRs nearby, etc.

The tool proved to be great for the Commander of Air Group, since they can follow their pilots' missions, preauthorise them, and keep a flight record of all activities. Another benefit is its usefulness in deciding on the size of a needed no-fly zone (in the event of a SAR mission, CMRS can establish a no-fly zone inside the area of operation via the "AMC Portal").

With the help of the tool, pilots can reserve airspace very quickly with no paperwork or prearranged time slots. It allows great flexibility and makes a difference in the field even in terms of a life saved or a body found.

7 | NEXT STEPS IN UTM IN CROATIA

CCL and its AMC experts constantly work on the development of the "AMC Portal" and actively listen to the current needs to find the best solution for integrating all airspace users, including UASs, into airspace safely.

The "AMC Portal" also manages all military and other activities in airspace and fully supports all airspace segregation needs in real time. The European Maritime Safety Agency's (EMSA) project for maritime traffic reconnaissance and pollution reduction with medium-altitude long-endurance (MALE) UASs is also supported by the "AMC Portal" in Croatia with great success.

The procedures behind the "AMC Portal" system allow fast and dynamic processing of all relevant information and meeting the demand for airspace, so all included stakeholders can make their decisions and inform all airspace users about the actual airspace status in real time.

CCL follows recent developments in the UAS industry to find the best solution for a safe integration of new UASs into airspace with fewer segregations.

8 | CONCLUSIONS

One of the important aspects of a successful UTM system is that the relevant authorities are backing up the system and that competent people from dedicated ATM and ASM units are behind it.

The procedures conducted via the "AMC Portal" are based on the international legal framework. However, by virtually linking all competent services in charge of making airspace use safe to the user on the spot, the concept was able to come into existence. This was because all required decisions could now be made quickly, and all airspace users informed thereof simultaneously.

SAR operations as well as other operations by emergency services are high on the priority list, no matter the means of conducting them (aircraft or UAS). That is why it is crucial to make a fast and safe access to airspace possible for them where and whenever. To enable that, besides a tool such as the "AMC Portal" itself, safe procedures need to be developed. In addition, core personnel need to be adequately educated and trained to use airspace safely to avoid threatening other airspace users during emergency UAS operations.

9 | GLOSSARY

- AGL** - Above Ground Level
- AMC** - Airspace Management Cell
- AOI** - Area of Interest
- ARP** - Aerodrome Reference Point
- ASM** - Airspace Management System
- ATC** - Air Traffic Control
- AUP** - Airspace Use Plan
- CAA** - Civil Aviation Authority
- CAG** - Commander of Air Group
- CCL** - Croatia Control Ltd.
- CESUP** - Centre Supervisor of Air Traffic Control Centre
- CMRS** - Croatian Mountain Rescue Service
- CTR** - Controlled Airspace
- EMSA** - European Maritime Safety Agency
- FIC** - Flight Information Centre
- FIR** - Flight Information Region
- IFR** - Instrument Flight Rules
- MALE** - Medium-Altitude Long-Endurance
- NOTAM** - Notice to Airmen
- NSA** - National Security Area
- R&D** - Research and Development
- SAR** - Search and Rescue
- SOP** - Standard Operating Procedure
- TWR** - Air Traffic Control Tower
- UAS** - Unmanned Aircraft System
- UTM** - Unmanned Aircraft Management
- UUP** - Updated Airspace Use Plan
- VFR** - Visual Flight Rules

