PROPOSAL OF METEOROLOGICAL COMPONENT IN THE NATIONAL PROJECT OF RESEARCH AND INNOVATION CENTER

Małgorzata DOBROWOLSKA
Silesian University of Technology, Gliwice, Poland
Ladislav CHOMA*, Jaroslav JEVČÁK
Faculty of Aeronautics of Technical University of Košice, Slovak Republic
**Corresponding author.* E-mail: ladislav.choma@tuke.sk

Summary. The specialized article presents a proposal for supporting activities for the collection of spatial digital data provided by meteorological means in the field of monitoring and investigation of open-space fires at airports, using the findings in the polygon of the National Research and Innovation Center in Slovakia for the activities of the Integrated Rescue System of the Slovak Republic. The article presents an extended description of the project from the conference paper.

Keywords: air force, meteorological device, research project

1. INTRODUCTION

The components of the Integrated Rescue System of the Slovak Republic have the long expressed their interest in the building of complex polygon for the research, innovation and training purposes. We plan to be part of a team that prepares the concept of a National Research and Innovation Center project that reflects the praxeological protection and rescue issues, and at the same time it would form a polygon for the research and innovation activities to the benefit of the rescue services community.

The basic concept of the project in the specific area of the aviation component was presented as a conference contribution entitled "Design of the Air Component in the National Project of the Research and Innovation Center of the Ministry of the Interior" at the international scientific conference "Airspace for All and Air Navigation Services 2018" [1]. The interest of the professional community required a presentation of the extended project description of the design of the meteorological component. The findings from the data collection on the example of airports will be used for technical solutions on the polygon for the training of components of the Integrated Rescue System (IRS) according to the crisis situation scenarios, including the air accidents, etc. There is also the interest in collecting of the current meteorological data from the more remote areas, interference of IRS components. Pilot findings will be addressed on the example of the small airports that do not have the complex and costly meteorological means.

If there is no professional service / the meteorologist at the airport, the only possible solution is to bring the weather closer to the nearest professional meteorological station if the observation network is sufficiently dense or more stations. In the complex geomorphology of the Slovakia, the local peculiarities have a decisive influence on the weather and the development of the weather, such the approximations do not have to lead to the right results. Moreover, the meteorological observation network is not particularly dense especially in the middle and eastern part of the Slovakia, where there is no source of meteorological information between the station in Stropkov and the station in Poprad. Similarly, it is between Poprad and Žilina, where the relatively rugged territory of the upper Váh and Turiec is uncovered. Such an improvised way of obtaining the meteorological data from the target areas may lead to an increased risk of collision with the dangerous weather phenomena for the aviation activity as well as the activities of the Integrated Rescue System components in this field.

2. PROBLEM IDENTIFICATION

The Key Concept Factors:

- Investment priorities, specific objectives and eligible activities within the Operational Program for the Development and Implementation of a National Project for the Enlargement of the Research Platform and Enhancing Competitiveness in the Field of Internal Security and Compatibility with Foreign Countries.
- Requirements of security practice of actors in Slovakia, with emphasis on the needs of Integrated Rescue System of the Slovak Republic.
- Developing systematic excellence in research, interconnecting universities, research and innovation capacities, and security industry partners.
- Support for the prerequisites for the Slovak Republic's participation in EU security projects: Horizon 2020 and within the framework of the EUROPA 2020 strategy for smart, sustainable and inclusive growth, etc.
- Follow-up of the baseline and approved plan by the Managing Authority in Brussels and the National Monitoring Committee.
- The requirements of the practice and planned activities of the project create a natural space for the use of the potential of meteorological and aviation resources in favor of research, innovation and training activities. Key activities represent the activities of experts primarily for the benefit of members of the Fire Rescue Service of the Slovak Republic.

The current meteorological air traffic safety is governed by L3 regulation [2], which details how to provide the meteorological briefings, distribution of the current weather reports, and TAF aerodrome forecasts. It deals with the obligation to equip both the meteorological service and the workplace of the flying control authorities with the imaging units where the current meteorological data is constantly available. It is clear that this regulation can not be applied to the small airports for its complexity, cost and the need for the qualified meteorological staff at the airport. For this reason, a "gray area" is created, which is not the continuously information covered for the aviation, but also for the components of the Integrated Rescue System. This praxeological problem prevents the effective safeguarding of the State's protected interests effectively [3].

The meteorological component will be the part of complex technical solution to the problem. Our knowledge base for finding solutions to the subdivision of Air Transport is also supported by the results of exploring the synergy of civil, national, international security and new challenges of military science [4], as well as the exploring procedural and situational management of an asymmetric opponent as a possible effective implementation of the implementation of an action-based operation to overcome current and future security problems, the comprehensive use of state-owned instruments in the defense of its security interests [5], and the development of the Slovak Air Force's capabilities for effective participation in Allied air operations [6]. The issue finds partial mirroring as well as complex solutions within the airport security management [7].

3. OBJECTIVE AND METHODOLOGY OF PROBLEM SOLVING

We assume the name of the activity: Research, development and creation of a central expert database of spatial data of material and technical changes of materials and structures in the fires under the specific conditions of the FireExpert Database Research and Innovation Center, within the framework of the Digital Material and Fire Module (MTPM) the C4 system.

The main objective of the research activity:

The creation of expert database of digital spatial data of technical and technical changes of materials and structures during the fires (ExpertFire Database), the technical model testing of flammability of selected materials, constructions, products, the combustion in the specific conditions of firefighting, and their digital analyzes.

"ExpertFire Database" will be a research part of the new Research and Innovation Center "the Operators platform of the Central Expert Database of Spatial Data", material and technical changes to

the FireExpert Database materials and constructions in the framework of the Digital Material and Fire Module MTPM) platform C4.

The key means for collecting the spatial data will be:

- Mobile security technologies,
- Unmanned aerial vehicles,
- Meteorological means.

4. RESEARCH OBJECTIVES WITHIN SELECTED ACTIVITIES

The research intentions within the selected project activity are:

- Investigation of trends in the acquisition and digital investigation of spatial data of material and technical changes of materials and structures in fires in specific conditions of enclosed and open spaces.
- Research of Material and Technical Module Fire Module (MTPM) platform of the integrated security system C4 to improve the digital spatial data analysis of material and technical changes of materials and constructions in the model fires in the specific conditions based on the complex collection, storage, identification, analysis and evaluation of the spatial records of changes materials and constructions, as well as the other relevant spatial digital data from a fire site (research polygon).
- Creation of a central expert database of spatial data of material and technical study of changes of materials and constructions in model fire in the specific conditions (FireExpert Database), based on the collection of experimental spatial material data from the model tests of processes of the fire / fire propagation / consequences of fire / firefighting in the closed and open spaces, and in the polygon tunnel, with the support of a mobile laboratory and scientific research thermo-camera systems, for the needs of project researchers.
- Development and manufacture of mobile research, the digital and thermo-camera equipment for the collection of digital spatial data of model tests and simulated fires (burning of materials, structures, products, etc.) From a fireplace in the open spaces of a research polygon.
- Experimental collection of digital spatial data from the model tests and simulated combustion of materials, constructions, products, etc. from the firefighting (research polygon) using tightly the built-in cable infrastructure (at least in the business center / house, parking house, road tunnels).
- Experimental determination of the fire characteristics of materials and products from the point of view of fire safety and determination of toxic combustion products of typical fires of materials obtained from the firefighters (the polygons with the gas chromatographic by the gas modeling tests and their effects on the human organism and the environment, as well as the protection of incidents of the firefighting units against these burning.

Identification of the aviation component and the research intent within the selected activity:

The experimental verification of the collection of digital spatial data of material and technical changes of materials and structures in the model fires under the specific open conditions spaces through the unmanned vehicles in the airspace of a polygon.

Identification of the meteorological component and the research intent within the selected activity:

The experimental verification of the collection of digital spatial data in model fires in specific open space conditions through meteorological means in the polygon space.

Design of financially acceptable meteorological instrumentation to the field.

Design of the method of distribution of measured data to the meteorological information system.

The reviewing the ability to archive measured data.

The identification of legislative restrictions.

Define the requirements for the qualification of the operating staff, how they are obtained and

maintained.

5. EXPECTED OUTPUTS FROM SELECTED PROJECT ACTIVITY AND DISCUSSION

The planned activity outcomes are:

- the operators' platform of the Central Expert Database of Digital Spatial Data of Material and Technical Changes of FireExpert Database Materials and Structures in the Fire and Fire Module (MTPM) platform of the C4 Platform.

(It will be a new workplace at the Research and Innovation Center).

- the manufacturing of mobile device constructions for the placement of digital and / or the thermal cameras acquired within the project, for the collection of digital spatial data of the model tests and simulated fires (burning of materials, structures, products, etc.) From a fireplace in the open spaces of the research polygon.

- the Experimental Digital Material Data Base Material and Design Changes in FireExpert Database, within the C4 Digital Material and Fire Module (MTPM) platform, including the spatial data from the unmanned firefighting.

- the Experimentally verified technical solutions for the spatial data collection through the unmanned porters and meteorological devices in the open space.

The activities respect the Research and Innovation Strategy for the Intelligent Specialization of the SR (RIS3 SK) [8] and the Classification of Economic Activities of the NACE SK according to the Statistical Office of the Slovak Republic [9].

Within the meteorological component, other sub-targets will be addressed to explore the possibilities of automation and distribution of meteorological data to users, thus excluding the permanent presence of staff at the airport. Identify possible legislative problems and propose solutions for the application of this alternative meteorological information system. Define the requirements for the qualification of service personnel, how they are obtained and maintained. Create a proposal for a directive or methodology for individual workplaces, principles for the location of sensors of meteorological devices. The entire proposal must be consulted with the representatives of the Air Climatic Service, the Transport Authority, the Slovak Hydrometeorological Institute and the operators themselves.

The research activity will also verify the hypothesis that:

- there is not a dense air meteorological observation network in the territory of the Slovak Republic for the needs of general aviation. Given the significant differences in the geomorphological conditions, it is clear that estimating the weather condition by the approximation method according to the nearest available meteorological stations will not provide the sufficiently accurate results. The creation of an alternative network of aeronautical meteorological stations and meteorological support for the general aviation operations will increase the safety of general aviation flying but it will also be used for the information security of components of the Integrated Rescue System in the field.

It will be necessary to establish a minimum level of meteorological system equipment according to the essential needs of light sport aircraft pilots so as to ensure homogeneity of observations at different aerodromes. At the same time, however, these must be devices that small airports can afford from a financial perspective. For these purposes, it is important to communicate and consult with the pilots at the small airports such as Ražňany airport, where we have the promise of maximum friendliness, and at least one other airport, for example Spišská Nová Ves or Svidník.

The possible friction areas in the legislative area will have to be consulted with the representatives of the Slovak Hydrometeorological Authority, which is, by the law, the sole owner of meteorological data in the Slovakia and the representatives of the Air Climatic Service. It will be necessary to clarify that in the event of this, the private information meteorological network would not be a competitive commercial network but only an alternative in the absence of meteorological data because of the insufficiently dense professional meteorological observation network.

We will have to consult with IT specialists who already have experience in automation of data collection and distribution to individual users. We have been able to cooperate with some experts in

the designing of new imaging systems for the military airports. In this sphere, it will be necessary to set the minimum hardware and software requirements and their financial availability. Of course, you will need to do a market research, whether a similar software product is on the market, whether it is in use in the world or in the Europe and how it is experienced with it.

It will also be important to determine the requirements for service personnel from the point of view of hardware and software. The service should be unpretentious to be handled by the air-to-air and desktop or smartphone and should be user-friendly.

In the framework of the air component, the questions can be solved in the project focusing on the design of the tactical use of unmanned means for the collecting digital spatial data from a designated area, as an integral part of the integrated security system C4. The sub-objectives will allow the exploration of the creation of an C4-compatible expert database of UAVs, and the experimental verification of spatial digital data collection capabilities through the UAV within the C4 on a training polygon, simulating crisis situations, including an air accident,

Research activity will further verify 2 hypotheses that:

- the techniques of digital spatial data collection via the UAV enable the creation of a separate UAV Expert Database. It is shown not to be compatible with the C4 platform without a special module control module that will capture data from the installed ground sensors and cameras, to evaluate them, and integrate with the UAV data, and perform the required actions based on decision functions.
- the using a UAV to obtain the digital spatial data from a specified space allows you to complete a complex mosaic of information for the unity decision-making processes. It is proven to extend the possibilities especially in the field of digital image analysis from the inaccessible terrain, the terrain with a lower degree of technical protection and "ad hoc" verification of the ground and air conditions.

The elaboration of the themes will require a complex application of the method of analysis, comparison, deduction and synthesis as well as experimental methods in the research of the subject.

The SWOT will analyze the issue of object monitoring using the UAV, analyze the possibilities of the UAV use as a carrier of monitored equipment and optical sensors for the purpose of effective monitoring of selected breeding areas. The direct field spatial data collection will be implemented by using the special sensors (visible spectrum, infrared and multispectral imaging) installed on the UAV platform. UAVs will be tested under the different conditions, in the different situations, within the training polygon, and in the collecting of different spatial data types as part of the C4 flow. The data and results obtained will be analyzed, correlated and published.

6. CONCLUSION

The development of information and communication technologies, the means of transport, but in particular the development of aviation technology, the robotics and automation, creates a natural space for the use and exploitation of their potential in the protection of critical infrastructure elements, including the intervention areas of the Integrated Rescue System of the Slovak Republic.

The tactical and technical characteristics, performances and ways of deploying the modern technology and technologies, the unmanned vehicles, the meteorological crows, have a specific potential for which we are looking for the effective ways of using them.

The upcoming national project assumes the following primary polygon spaces for the realization of research intentions:

- Road tunnel,
- Business Center - department store,
- Parking House,
- Highway section (and bridge construction),
- Industrial park.

Secondary polygon spaces for the realization of research intentions:

- Rail transport,
- Height object,
- Climbing sector.

The selected project activities create natural space for the use of the already mentioned meteorological and aviation resources in favor of research, innovation and training activities in simulated fires in the open spaces of the polygon. The project is planned by the applicant, the MoI SR with project partners, to be submitted at the invitation of the Ministry of Education, Science, Research and Sport of the Slovak Republic, with the assumption of September 2019 - September 2023.

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