Final Project report

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IPR (foreground)

This deliverable consists of SJU foreground.

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Publishable summary

For effective airport operations an improved weather monitoring system is essential. Therefore, a detailed study of weather phenomena and single sensors, more complex sensor systems and other tools is crucial. The work in the project was split in two parts: the first dealing with meteorological ground equipment, the second concentrating on satellite technologies and the respective products.

Ground sensors

The overall goal was to provide a ground weather sensor catalogue including sensors for the detection, monitoring and nowcasting of meteorological hazards applicable for airport installations. First, we got a general idea about currently available MET sensors not specially meant for airport applications. The measurement principle, installation possibilities or safety constraints for each sensor have been summarised. More than fifty different sensors and sensor systems were classified. The complexity of the sensors or systems varied from a 'simple' measurement unit (thermometer) up to 'highly sophisticated' system (like radar or lidar). Manufacturers worldwide have been identified as well for later contacting if deemed necessary.

Furthermore a review has been done of weather phenomena impacting aerodrome areas mainly based on statistical reports released by dedicated authorities (e.g. Eurocontrol). Twenty-four different kinds of weather parameters/phenomena were identified which are influencing the operational effectiveness of an aerodrome. They comprise a wide range of spatial and temporal resolution and have different effects on air traffic. After this investigation it was known what shall be monitored at an airport and therefore gave feedback on required sensors.

The project needed to be up to date with respect to any formal restrictions on MET sensors to be deployed at airports and requirements for their data. ICAO and WMO documents have been analysed in detail. The documents published by these two authorities build the pillars for the application of meteorological sensors and products within the aviation context all over the world. Since the official publications maybe already outdated, especially with respect to sensor capabilities, research paper were investigated as well. So, we were able to compare state-of-the-art sensors with current regulations/requirements.

Many technical and non-technical facts had to be examined. Data sheets are very useful for a first assessment but they are not standardized or precise enough and don't disclose all available specification. Using the knowledge obtained in former tasks questionnaires have been designed to get unified answers from suppliers to be able to proceed to the sensor specifications. The questionnaires comprised plenty of questions which tackled all kind of specifications like technical parameters, sensor economics, sensor in general (e.g. conformity, safety requirements, research activities) as well as company background details.

In addition, the operational point of view was involved by visiting airports and learning from current installations potential disadvantages or limitations for some sensors but also where benefits have been derived. The operational need for products have been investigated as well as were needs for further improvements still exist. Our investigation was completed by involving AU directly in our project and a test-bed campaign with some sensors at CDG airport, Paris.

Based on this work we have been able to provide specifications for key parameters for each sensor applicable for airport installations. They are directly compared to requirements from ICAO/WMO and sometimes desired values have been specified accompanied by explanations. A matrix was build combining the identified weather hazards with sensors useful for their detection, monitoring and/or nowcasting. Synergies are described when sensor data can be combined for further information.

Finally, recommendations on which MET sensors are necessary for weather monitoring and nowcasting at an aerodrome tailored for specific airport needs are given. The needs are somehow aligned to the size of an airport (number and length of runways, flight movements, types of aircraft, number of passengers, etc.) and experienced weather phenomena. The concepts provide guidance on which, where and how many sensors shall be used to obtain the maximum benefit with minimum installation effort for weather hazard monitoring.

Satellite investigation

Here, the focus was on the evaluation and reporting of present satellite technologies concerning meteorological applications. But also non-meteorological information sources, data and image

analysing techniques have been taken into account if they can be used somehow. Many institutions and researcher have been asked about the current state-of-the-art and what they think could be the next future of weather satellites. Particular attention has been drawn to the European involvement in satellites' usage. This was the basis for the elaboration of typical weather products and new techniques for new weather products.

Algorithms, data processing and data integration have been investigated with respect to retrievable MET products. Indications were given for optimising (and possibly increase) the use of satellite data sets, providing information to support air traffic control and the related aviation community. Potential new data techniques and MET products from future satellite missions were summarized giving an overview about upcoming weather satellite improvements especially for weather sensing and monitoring planned for aviation. Therefore, the work has been divided in three areas: reporting current methods and processing techniques, currently used MET products, new MET products.

Pilots and ANSPs have been involved in order to analyse the real need of the aviation community and to have a better understanding of the specific requirements of each stakeholder. The work was summarized by providing recommendations by listing the satellite products to be used by the aviation community and also distinguished for three different flight phases (en-route, approach and terminal).

1 Project contributions

1.1 Contribution to standardization

Project concentrated on ground sensor specifications, weather hazard concepts for airports and recommendations for satellite MET products. This is based on the current knowledge. Since weather sensors, techniques and products are evolving items a real standardization cannot be given. All documents of the projects can be considered as guidance because there are still individual needs for specific user/airports, so we can give only suggestions. However, this project is the main input source for the following 15.4.9b project, which deals with weather sensor infrastructure details. This infrastructure concept could provide helpful input for new standardizations for the implementation of weather sensors on different airports.

1.2 Contributions to the roadmap for deployment activities

The project 15.4.9a was the initial step of three consecutive projects. It was a study helping in later development of a ground weather monitoring prototype. So, there is no direct contribution for deployment activities but the project was necessary for later weather sensor suite deployments giving recommendations on which sensor is needed for which weather hazard. However, (as mentioned in section 1.1) the second project 15.4.9b studies how the devised sensor concepts can be deployed.

1.3 Progress made toward the ATM Master Plan

Weather is the major delay factor at airports. There is room for improving the weather information itself and the provision of it to enhance situational awareness with respect to efficiency, safety and environmental impact. The project contributed with its work to the first three parts of the following chain: MET sensors → data → products → user. Therefore, there is indirect contribution to situational awareness, better information, and operational improvements based on improved weather information.

1.4 Contribution to the lessons learnt

What worked well?
Small group of project members, coordination was well established.
Knowledge of people / background contributed significantly to the objectives.
Airspace users' contributions have been helpful.
What should be improved?
Management needs definitely more time/effort than expected, especially the coordination with other projects within SESAR.
More time should be planned for final deliverable review.
Missing links to other projects; sometimes not identified who can provide input or can review deliverables (despite willing to do so because of lack of time/effort); the "big picture" is sometimes not clear.

2 Project achievements

2.1.1 Project deliverables

Del. code	Del.Name	Description	Assessment Decision	Explanations
15.4.9.a.D01	Preliminary list of ground sensors and weather phenomena	A first summary of MET sensors for different applications and also a first summary of weather phenomena affecting airport operations will be compiled. From this summary the final list of sensors to be investigated will be generated. This list provides an overview of MET sensors and their applications in a general way, not yet tailored for airport needs.	No reservation	First some minor reservations e.g. typo, better explanation of technical terms, etc. Then accepted. No deviation from the description.
15.4.9.a.D03	Report on ground sensor regulations and publications	Deliverable summarizes the results for each sensor after studying ICAO and WMO guidelines and other useful publications if any regulations, limitations or restrictions for specific MET sensors exist with respect to airport weather sensing. The deliverable includes the final list of sensors which will be studied.	No reservation	No deviation from the description. In addition, state-of-the-art description included.
15.4.9.a.D05	Report on ground sensor investigations	The report summarizes the detailed results for each investigated sensor including measurement description, data characteristics, available MET product, operational and cost issues etc. The deliverable will be a catalogue divided into three sections: MET application, MET hazards and aerodrome area and with sensor lists and their descriptions per section if applicable.	No decision yet	Measurement (state-of-the-art) description in D03. Only two sections, aerodrome area covered in D07.
15.4.9.a.D07	Airport system concepts	The deliverable will comprise system concepts (combination of sensors) for different airport categories (CAT I, II, III) and for different airport	No decision yet	No deviation from the description.

		needs due to special locations or special weather phenomena.		
15.4.9.a.D02	Report on Satellite technology	The report will summarize the results of investigations on currently available and potential future satellite technologies. This will provide information about performances and limits of the technology.	No reservation	No deviation from the description.
15.4.9.a.D04	Report on Satellite MET products and processing techniques	Deliverable will summarize available and potential new MET products based on satellite technology. Results will include algorithm assessment, data processing and data integration possibilities with respect to retrievable MET products. New techniques and therefore new MET products will be summarised to give an outlook about upcoming possibilities.	No reservation	No deviation from the description.
15.4.9.a.D06	Report on applications of Satellite technology and MET products for aviation community	Comprises results of Task 2 + 4 and link them to each other to provide conclusions on the best usage of satellite technology and MET products with respect to airport weather sensing and current and future ATM systems.	No reservation	No deviation from the description.

3 Total Eligible Costs

As this section is based on the Project Costs Breakdown Forms of the eligible costs incurred by project Members during the project, you can do a reference to individual forms as shown below

Information not yet available.

[1] Selex Consortium, Cost Breakdown Form Selex, Edition, date, Location

[2] Thales, Cost Breakdown Form Thales, Edition, date, Location

[3] ENAV, Cost Breakdown Form ENAV, Edition, date, Location

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