

## INNOVATIVE OPERATIONAL UAS INTEGRATION

### Background

Unmanned Aircraft Systems (UAS) are becoming increasingly important for non-military applications such as aerial photography, agricultural remote sensing and application, pipeline and power line surveillance, fisheries and wildlife monitoring, fire-fighting, weather and climate studies, law enforcement, rescue and recovery missions. The integration in non-restricted airspace is currently almost ignored.

A wealth of civil and governmental UAS applications exist, they face similar problems and now strive for a common solution. Furthermore military UAS missions face exactly the same problems and challenges as non-military UAS. The main issue is the integration of all UAS as a new airspace user into the future ATM System. For the time being UAS are only partially considered by SESAR DoWs.

Unmanned aircraft are remotely piloted aircraft, meaning that the pilot is not on board the aircraft. An Unmanned Aircraft System (UAS) consists of one or more remotely piloted aircraft, one or more control station and the command and control links as well as any other system elements.

Today UAS are mainly used for military missions but a non-military UAS market is emerging. UAS are considered to be beneficial in a growing number of civil and non-military governmental applications. In general employing UAS is considered useful for dull, dirty or dangerous missions. These are missions putting a human pilot at risk, i.e. natural disaster reconnaissance. Unmanned Aircraft Systems are therefore becoming increasingly important for non-military applications. A main challenge however is the integration of UAS into the existing and future ATM System.

The INOUI project is a response to that challenge as part of the European Commission Research Program FP6, Directorate-General for Energy and Transport (DG Tren). INOUI represents a holistic approach to UAS integration. The INOUI team is contributing with the project results into the Single European Sky ATM Research (SESAR) Development Phase, with the goal to enable the earliest possible use of UAS applications in current and future ATM environment.

The INOUI project was conducted between October 2007 and March 2010 by a consortium formed of partners from France, Germany and Spain, including a UAS Manufacturer, an Air Navigation Service Provider, Research Centres and Consultancy Companies. More specifically, the following organisations participate:

- DFS Deutsche Flugsicherung GmbH (DFS),
- Ingeniería de Sistemas para la Defensa de España, S.A. (Isdefe),
- Boeing Research & Technology Europe, S.L. (BR&TE),
- Fundación Instituto de Investigación INNAXIS (INNAXIS),
- Rheinmetall Defence Electronics GmbH (RDE),
- Office National d'Etudes et Recherches Aéropatiales (Onera).



The overall objective of INOUI was to assess different domains of the ATM system of today and 2020 to develop a roadmap how to integrate UAS into the operational concept for the future. This activity will complement the activities of the SESAR definition phase and fill the gaps with regard to the specifications of UAS.

The INOUI work packages consist of 21 sub-packages and respective documents. All deliverables of the INOUI project, an Executive Summary per work package and the documentation of the Stakeholder Workshops and the Dissemination Forum are published on the INOUI webpage. A comprehensive glossary of UAS terms and terminology used in the project are available.

Furthermore a booklet provides the UAS stakeholder community an overview of the content and the results of the INOUI project and points the interested reader to the detailed INOUI deliverables. The booklet itself was designed to present the wider public with a broad view on the current problems and the challenges for successful integration of UAS into non-segregated airspace.

The UAS Stakeholder Community is fragmented and the challenges are tackled in several working groups. The INOUI project had been a unique opportunity to conduct a holistic approach to the future UAS integration into the ATM environment 2020+. INOUI is summarizing the existing knowledge, identifying and filling gaps and with that work benefiting the European Roadmap for UAS integration. The results of this coherent approach shall help and accelerate to bring UAS into the air in the earliest possible timeframe.

Please find all INOUI deliverables, a UAS Terms & Terminology List, the INOUI Booklet (print-file) and more information about the INOUI project on the webpage <http://www.inoui.isdefe.es/INOUI> .

### Scope of the INOUI project

The project INOUI, funded by the 6<sup>th</sup> Framework Programme of the European Commission, focuses on the integration of Unmanned Aerial Systems (UAS) in non-restricted airspace. Basic understanding within the UAS Stakeholder Community is that:

- UAS are the 3rd group of airspace users.
- UAS are already in the skies, albeit either at a very low altitude or in segregated airspace.
- UAS usage will significantly increase, especially for civil and governmental purposes.

The INOUI objective, as part European R&D community, is to contribute for the solution of UAS integration in the 2020 Air Traffic Management system, especially the SES implementation programme SESAR.

### UAS are facing significant problems

- Lack of international regulations for UAS > 150 kg and diversified national regulations, certifications and licensing for UAS < 150 kg hamper product development for global markets.
- Manufacturers are ready to start further testing and validation, including UAS flight trials, real time simulation(s) or combination of both. Theoretical concepts valid for practical operations are already available plus experience based on national tests.
- Producers/Manufacturers and potential users need reliability on regulatory and certification issues. Fragmented national rules for non-military UAS prevent an integrated approach from the industry for civil and governmental applications.
- Missing and/or fragmented rules & regulations are cost drivers for the industry.
- Political and public acceptance is necessary to promote flight trials and stepwise implementation.
- Operational safety concepts need to be concluded => Flying in segregated airspace is not an acceptable solution.

### Objectives of the INOUI project

Main objective of the INOUI project is to provide a roadmap to the future of UAS in the context of the ever changing ATM environment. In this respect, INOUI aims at complementing the SESAR activities with regard to the operational concept and the architecture as well as the roadmap for Research and Development activities. In particular INOUI research comprised the following areas:

- Identify the spread of operational concepts for UAS applications and describe the resulting procedures and requirements in the different timeframes up to 2020.
- Identify how the UAS can fit into the ATM System of 2020 and what activities have to be taken especially from the UAS point of view (research roadmap).
- Identify existing certification requirements and processes and suggest an optimum certification blueprint for human resources and as far as required UAS related technologies.
- Identify how UAS can benefit from SWIM and what activities have to be taken to achieve the benefit.
- Identify the safety issues related to UAS and develop high level safety objectives and requirements.
- Identify the potential airport types for UAS operations and describe the operational impact.

### Positioning of the INOUI project in the UAS Stakeholder Community

- SESAR as the future ATM target concept forms the major cornerstone for INOUI.
- The INOUI consortium is well aware that the integration of outside ideas and opinions is crucial to this project. The team members participate in UAS congresses & workshops, UAS research, working groups and publications.
- The input of the Stakeholder community is of the utmost importance. Therefore, INOUI project members invite the UAS stakeholders to participate in workshops to ensure their valuable input, to validate the work done and to get further input for future activities.
- The UAS Stakeholder Community is fragmented and the challenges are tackled in several working groups. The INOUI project represents a holistic approach to the future UAS integration into the ATM environment 2020+.

The goal of INOUI is providing a stepwise approach to enable the earliest possible use of UAS applications.

### INOUI Deliverables

The following deliverables have been the result of the INOUI project activities. They are downloadable and publicly released for use by the

D1.1 - Definition of ATM environment for UAS in 2020

D1.2 - Definition of operational concepts for UAS

D1.3 - Proposal for the Integration of UAS into the airspace

D1.4 - Harmonized proposal for the Integration of UAS

D2.1 - Technology watch

D2.2 - Assessment of the Technology for UAS Integration

D2.3 - Conclusions and Recommendations for Technological Developments

D3.1 - Regulatory Aspects for UAS Operations, Operators and Personnel Qualification

D3.2 - UAS certification

D3.3 - Regulatory Roadmap for UAS integration in SES

D4.1 - UAS within the 2020 ATM SWIM-enabled ATM

D4.2 - New UAS-related Common Operating Picture Actors

D4.3 - Operations depending on the Level of Automation and Autonomy

D5.0 - Scope of Risks and Quantified Safety Criteria

D5.1 - System Description for Safety Analysis

D5.2 - Functional Hazard Analysis

D5.3 - Towards Safety Requirements for the Integration of UAS

D5.5 - Interpretation of Safety Analysis Results in the Context of SESAR

D5.4 - Aerodrome Safety Analysis

D6.1 - Operational Concept for the UAS in the Airports

INOUI Booklet

INOUI Terms & Terminology v1.1.

Retrospective to 1st INOUI Stakeholder Workshop

Retrospective to 2nd INOUI workshop March 2009

Retrospective to INOUI Dissemination Forum