



Final Project Report

Document information

Project Title	Improved surveillance for surface management
Project Number	12.03.01
Project Manager	THALES
Deliverable Name	Final Project Report
Deliverable ID	D51
Edition	00.04.00
Template Version	03.00.04

Task contributors

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Abstract

This document is the closure report of SESAR project 12.03.01 "Improved surveillance for surface management". The 12.03.01 project deals with the improvement of the A-SMGCS Surveillance core function including Mono/Multi Sensors tracking data fusion and classification / identification functionalities. The main project objective is to develop enhanced Data Fusion algorithms and processes, improving the probability of classification / identification and developing data analysis and performance tools in charge of evaluating the performance of sensors and MSDF tracking systems.

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Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
00.00.01	15/09/2015	Draft	██████████	Draft for Gate 2015
00.00.02	15/02/2016	Draft		New template version - completed for review
00.01.00	24/02/2016	Final		Submitted version
00.02.00	24/03/2016	Final		Corrected version following the SJU Assessment

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00.02.01	10/06/2016	Draft		Version following the SJU Assessment 2nd Round
00.03.00	13/06/2016	Final		Version approved and handed over to SJU extranet
00.04.00	05/10/2016	Final		Version handed over to SJU extranet

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Acronyms

Acronym	Definition
ADS-B	Automatic Dependent Surveillance Broadcast
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATM	Air Traffic Management
A-SMGCS	Advanced – Surveillance Monitoring Guidance Control System
CATC	Conflicting ATC Clearances
CMAC	Conformance Monitoring Alerts for Controllers
DFS	Deutsche Flugsicherung (German ANSP)
DSNA	Direction des Services de la Navigation Aérienne (French ANSP)
ED	EUROCAE Document
ED87	EUROCAE Document 87, Minimum Aircraft Systems Performance Specifications (MASPS) for A-SMGCS Levels 1 and 2
EMMA	European Airport Movement Management by A-SMGCS
EMMA2	European Airport Movement Management by A-SMGCS - Part 2
EUROCAE	European Organisation for Civil Aviation Equipment
ICAO	International Civil Aviation Organization
MASPS	Minimum Aviation System Performance Specification
MSDF	Multi Sensor Data Fusion
OFA	Operational Focus Area
SESAR	Single European Sky ATM Research
SESAR 2020	Next Wave of the European ATM Research and Innovation Programme, based on the European ATM Master Plan
SJU	SESAR Joint Undertaking
WG-41	Working Group 41 (EUROCAE, A-SMGCS Working Group)
WP	Work Package

1 Project Overview

The 12.03.01 project aimed at improving of the A-SMGCS Surveillance core function including Mono/Multi Sensors tracking, data fusion and classification/identification functionalities, and so providing the necessary surveillance information to the other airport ATC functional blocks defined in SESAR.

1.1 Project progress and contribution to the Master Plan

The scope of the project 12.03.01 is the improvement of the surveillance core function for surface management. The project aimed to the development of the software prototypes validated through the validation exercises within the scope of Operational Focus Areas OFA01.02.01 "Airport Safety Nets" and OFA04.02.01 "Integrated Surface Management".

At the beginning of the project (Phase 1, 23/09/2010 to 14/08/2013) the partners focused on defining the baseline requirements to be used for further developments, based on a coordinated technical analysis over Operational requirements coming from previous pre-SESAR programs (EMMA, EMMA2, ICAO, EUROCAE). Furthermore during the next steps (Phase 2 01/06/2011 to 07/11/2014 and Phase 3 01/07/2014 to 01/02/2016), a new performance evaluation method was defined and the project partners implemented prototypes with new functionalities, as follows:

- Derived from Phase 1 and Phase 2 requirements;
- Derived from internal operational requirements.

Project 12.03.01 relates to the Operational Focus Areas OFA01.02.01 "Airport safety nets" and OFA04.02.01 "Integrated Surface Management", but as there isn't an associated operational project supplying 12.03.01 with operational requirements, the only three dependencies were:

- Release 2 EXE-06.03.02-VP-401 validation exercise using 12.03.01 INDRA Phase 1 prototype, as part of the Operational Focus Area OFA04.02.01 "Integrated Surface Management";
- Release 3 EXE-06.03.02-VP-614 validation exercise using 12.03.01 INDRA Phase 2 prototype, as part of the Operational Focus Area OFA01.02.01 "Airport Safety Nets";
- Release 5 EXE-06.09.02-VP-679 validation exercise using 12.03.01 DFS Phase 3 prototype within the scope of the Operational Focus Area OFA01.02.01 "Airport Safety Nets".

The contribution of this project to the ATM Master Plan was by developing the enabler AERODROME-ATC-23a (Ref. [50] Integrated Roadmap Dataset 15 of the Master Plan, aligned with the released Edition 2015 of the Master Plan, December, 2015), described in the following table:

Code	Name	Project contribution	Maturity at project start	Maturity at project end
AERODROME-ATC-23a	Enhanced A-SMGCS Core Surveillance function for new A-SMGCS Services	12.03.01 project has contributed to the evolution of this technical enabler by developing software prototypes validated through the validation exercises within the scope of Operational Focus Areas OFA01.02.01 "Airport Safety Nets" and OFA04.02.01 "Integrated Surface Management. Improvements were achieved by new processing and integrating additional data (e.g. ADS-B).	TRL3	TRL4

Another enabler AERODROME-ATC-23b has been also created (not in the scope of SESAR 1, but with the aim to be validated through SESAR 2020), supporting the future deployment of SESAR operational improvements.

1.2 Project achievements

The implementation of the enhanced surveillance tools increased the sensor's reliability which results in a better traffic situation awareness and consequently in a general improvement of safety. The tool also improved other areas such as cost-effectiveness, capacity (improving throughput in low visibility conditions) and efficiency (better quality of surveillance data to improve monitoring of performance). It contributed to manage traffic flows more efficiently due to new functions, such as new airport safety nets, that can be deployed only with an improved surveillance – this is the purpose of the creation of the enabler AERODROME-ATC-23a.

The Project 12.03.01 provided 9 prototypes (3 in each phase, based on the technical requirements specified during each project phase) used in different validation exercises, as follows:

- INDRA:

- Phase 1 prototype: Release 2 EXE-06.03.02-VP-401 validation exercise as part of Operational Focus Area OFA04.02.01 "Integrated Surface Management", Ref. [11];
- Phase 2 prototype: Release 3 EXE-06.03.02-VP-614 validation exercise as part of Operational Focus Area OFA01.02.01 "Airport Safety Nets" Ref. [27];
- Phase 3: Validation has been substituted by a verification session using a simulator that simulates real data like measurement errors, false detections, outliers, Ref [44].

- DFS:

- Phase 1 prototype: no validation activity, but the P12.03.01 prototype was part of the DFS IBP supporting the Release 2 exercise 06.07.01-VP-438 "Conflicting ATC Clearances" Ref. [15];
- Phase 2: no validation activity, but a verification session Ref [34];
- Phase 3 prototype has been used to support EXE-06.09.02-VP-679 validation exercise within the scope of Operational Focus Area OFA01.02.01 "Airport Safety Nets" Ref. [46].

- THALES:

- For all 3 phase prototypes: validation has been substituted by quantitative performance verification sessions using real traffic recorded data from Lyon airport Ref. Phase 1 [16], Phase 2 [32], Phase 3 [43].

The main focus of 12.03.01 has been put in defining and applying a common and advanced verification methodology. The verification process intends to ensure that all prototypes developed in project 12.03.01 phase 3 correctly implement the system requirements defined in Phase 3 System Specifications.

Since all prototypes were developed on different platforms, the common verification strategy described generic test cases that are independent of the respective prototypes and platforms. For each individual prototype these generic test cases were customized with respect to its development and test platform.

The test cases usually provided data input to the system in order to initiate a specific process and determine whether the output matches the given specifications. Thus, each test case included a detailed description of the inputs to be provided to the system, and its expected behaviour as a reaction to them, including a description of the expected outputs.

As part of SESAR 12.3.1 Phases 2 and 3, the MSDF performance verification has been based on a new method which is capable to measure the performances of a Data Fusion system used in the scope of an A-SMGCS system such that:

- It is manufacturer-independent;
- It is self-representative, i.e. the output performances are scalable based on the performances of input data.

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This new approach, which is expected to be provided to appropriate standardisation groups, constitute the base of a type-approval MSDF component qualification process.

The main results of the project are:

- The enhanced Data Fusion algorithms and processes;
- The probability of classification/identification has been improved;
- Data analysis and performance tools in charge of evaluating the performance of sensors and MSDF tracking systems were developed;
- The need of a better surveillance to deploy advanced tools at the airport has been validated.

1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project.

Reference	Title	Description
D02	Phase1 Architecture Design	Created on the beginning of the project during Phase 1, this document describes the system architecture including interface descriptions with other components of the A-SMGCS and with external systems.
D20	Phase2 Technological study Report	This document provides the results from theoretical study, performance and integrity data analysis on: - the existing MSDF capability; - existing surveillance sensors and processing systems; - the effect of weather on the quality of surveillance sensor data.
D50	Phase3 Consolidated verification report	Consolidation of verification tests results performed on the different prototypes developed in Phase3. This document contains the analysis of the results obtained in the Test Execution task regarding the coverage of system requirements.
D52	Phase3 Final Technical Specifications	Finalised set of technical requirements specified in order to develop the prototypes (for all three phases). Iterative versions of this deliverables were produced (one per each project phase) and were used for the verification of the prototypes coming out from the same phase.

1.4 Contribution to Standardisation

The project 12.03.01 brought a significant contribution to Standardisation. One of the project members, being also OFA01.02.01 Coordinator and 06.07.01 Project Manager actively participated in the standardization activities as SESAR representative in EUROCAE WG-41 (in charge of standardization for "Advanced -Surface Movement Guidance & Control Systems, A-SMGCS), Ref. [6] SESAR support to EUROCAE activities for the new PCP Services (CMAC-CATC and Routing & Planning).

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During the project life time, there was an important activity within EUROCAE for amending and updating the ED87 document (MASPS for A-SMGCS Level 1 and 2).

The project introduced a completely new method of defining and measuring a MSDF performance, and accurate definition of performance requirements linked to the method.

The large material produced within 12.03.01 project as standardization requires a vast consensus within all EUROCAE community members, therefore some new advanced and developed functions and verification methodologies of the project were considered not completely mature to undergo a standardization process. Nevertheless, several new concepts elaborated by the 12.03.01 project have been disseminated within the EUROCAE community for future standardization actions.

1.5 Project Conclusion and Recommendations

The project 12.03.01 has made a significant progress on the improvement of the A-SMGCS surveillance function including Mono/Multi Sensors tracking (or any other technique which could result from preliminary analysis), data fusion and classification/identification functionalities.

It is recommended to investigate the potential benefits of the improvement achieved by integrating additional data (e.g. new surveillance tools as Aircraft Derived Data) in future related SESAR 2020 projects. This is the purpose of AERODROME-ATC-23b - Advanced A-SMGCS Core Surveillance function for new A-SMGCS Services, created by DSNA with the aim to be validated through SESAR 2020 for all potential new Airport services requiring better surveillance performances and coverage.

Enhanced airport surveillance provided improved performances regarding the surveillance on runways, taxiways and in the apron/stand/gate area. Improvements are achieved by new processing and integrating additional data (e.g. Downlink Aircraft Parameters).

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