Final Project Report

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Abstract

SESAR project 12.04.03 "Enhanced FDPs at Airports" main objective was to adapt the Airport Flight Data Processing System (AFDPS) to the functionalities being developed in SESAR in terms of storing and sharing flight plan data. For this purpose, the project has monitored and analysed the work on subsystems affecting the AFDPS design, and has developed the corresponding technical specifications and software prototypes. These software prototypes have enabled the integration of several Airport ATC functionalities for validation.

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Acronyms

Acronym	Definition
AF	ATM Functionality
AFDPS	Airport Flight Data Processing System
AGL	Airfield Ground Lighting
AMAN	Arrival Management
ANSP	Air Navigation Service Provider
ASDI	Aircraft Situation Display to Industry
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
CoFlight	Collaborative Flight
CWP	Controller Working Position
DMAN	Departure Management
DSNA	Direction des Services de la Navigation Aérienne (French ANSP
ED	EUROCAE Document
EFS	Electronic Flight Strips
EMMA	European Airport Movement Management by A-SMGCS
EUROCAE	European Organisation for Civil Aviation Equipment
FDPS	Flight Data Processing System
FOIPS	Flight Object Interoperability Proposed Standard
HMI	Human Machine Interface
ITEC	Interoperability Through European Collaboration
OFA	Operational Focus Area
PCP	Pilot Common Project
RMAN	Runway Management

RTS	Real Time Simulation
SESAR	Single European Sky ATM Research
SNETS	Safety Nets
SRS	Surface Routing Server
TRL	Technology Readiness Level
WG	Working Group

1 Project Overview

This project has defined and developed an AFDPS (Airport Flight Data Processing Systems) which aims to store and distribute the entire necessary flight plan data information in the Aerodrome ATC system defined in SESAR

1.1 Project progress and contribution to the Master Plan

The scope of the project was the enhancement of the AFPDS (airport Flight Data Processing System) to adapt to the new functionalities being developed in SESAR. There was no specific operational need associated to the improvement of the AFDPS. The enhancement of the AFDPS has risen from the technical needs of other sub-systems, such as A-SMGCS Routing and Guidance functions, or runway sequencers such as DMAN or AMAN, which needed to use or modify flight plan data information. This information is centralized in the AFDPS for storage and distribution in order to be updated according to ATCO actions and to events affecting the flight. And this constitutes a key element in the aerodrome ATC system.

During phase 1 of the project, a set of technical specifications were created after analysing the current AFDPS in use and the different research projects and standards (ITEC, CoFLIGHT, EMMA-2, ED-133, and FOIPS), with the objective of having a common starting point for the following phases of the project.

Phases 2 and 3 of the project have carried software prototype development activities, followed by an involvement in different validation exercises in which these prototypes have been used:
- One Real Time Simulation (RTS) lead by DSNA has used 12.04.03 Thales prototype from phase 2 of the project. The exercise has tested advanced A-SMGCS routing and control functions integrated in a Controller Working Position (CWP). The exercise was conducted in Paris CDG environment in January-February 2016, and was focused on ATC aspects.
- Another RTS lead by ENAV, the Italian Air Navigation Service Provider (ANSP), using Milano-Malpensa airport layout, and supported by a flight trial with the involvement of Airbus, has used 12.04.03 phase 3 prototype from Selex to assess the integration of several functionalities into the airport domain. The exercise has validated the A-SMGCS Guidance function in representative environments with the provision of ground related instructions and information via data link to flight crew (D-TAXI), the integration between surface and departure management, and the airport safety nets integrated with Virtual Stop Bars.
- And another RTS lead by ENAIRE, the Spanish ANSP, has used 12.04.03 phase 3 prototype from Indra. It was run in February 2016 over Barcelona airport layout with a complex configuration (4 or 5 controllers in the different runs), and the Routing, Safety Nets and D-TAXI functions were tested together for surface operations, and also integrated with a Coupled AMAN/DMAN window.

Project 12.04.03 has been a central actor within Operational Focus Area (OFA) "Integrated Surface Management", which federates all operational and system projects involved in the improvements of operations on the aerodrome surface. Most of the functionalities or subsystems being validated within this OFA use flight plan data information, which is centralized and distributed via the AFDPS. The different SESAR Solutions included in "Integrated Surface Management" for which the AFDPS plays a central role are:

- SESAR Solution #22 – "Automated assistance to controller for surface movement planning and routing" – the AFPS adapted to interface with the SRS (route calculation) and the ATCO HMI (inputting controller actions)

- SESAR Solution #23 – "D-TAXI service for CPDLC application" – the AFDPS centralizing the information to be uplinked to aircrafts, and being able to receive and store downlinked information

- SESAR Solution #47 – "Guidance assistance through Airfield Ground Lighting" – the route information is available to the AGL system through the AFDPS.

- SESAR Solution #24 – "Improved Vehicle Guidance" – the AFDPS is the source of information to be sent to vehicles

The contribution of this project to the ATM Master Plan was to develop a technical enabler supporting the future deployment of SESAR operational improvements and is described in the following table from Dataset 15 [16]:

Code	Name	Project contribution	Maturity at project start	Maturity at project end
AERODROME-ATC-13	Surface movement information processing system enhanced with storage and dissemination of surface routes	The main enhancements of the AFDPS during SESAR activities come from the use of the Surface Routing function and its use for the different guidance means. Flight data information is the starting point for route calculation, and it is updated with any system calculation or ATCO action through the HMI. The AFDPS serves as the central interface which stores this information and distributes it to any other actor.	TRL 3	TRL 6

1.2 Project achievements

The main achievement of this project was the enhancement of the AFDPS so it can support the new functionalities being developed in SESAR. FDP (Flight Data Processing) systems, and more in particular AFDPS, are a transversal artefact in the overall ATC system. Most of the new or upgraded functionalities, communications means, interfaces, etc. need the support of a centralized FDP. Project 12.04.03 has been analysing the inputs being produced in SESAR, especially in the Aerodrome ATC segment, and has been adapting the AFDPS to enable all them working together. This has been done by defining the technical requirements and implementing the software prototypes for the different validation exercises conducted using these prototypes (mentioned in section 1.1).

The enhancement of the AFDPS in the Tower ATC segment has enabled the following functionalities:

- Provision and update of Flight Plan data for surface route calculation and presentation to the controllers, including the complex configurations in which different controllers with different areas of responsibility need different information

- Reception and storage of controller inputs, like clearances and surface routes modifications. This includes the different options of controller inputs via the radar screen (A-SMGCS) or the Electronic Flight Strips (EFS), constituting the fall back source of information.

- Creation of movement plans for vehicles, enabling the creation of surface routes and datalink communications.

- Provision and reception of Flight Plan data for controller-pilot communication via datalink for surface operations.

- Provision of Flight Plan data to support the Runway Management (RMAN) for the Flow and Capacity management service.

- Provision of Aircraft Situational Display to Industry (ASDI) information for the airport performance

- Provision of the relevant up-to-date flight plan data for runway sequencers calculation (DMAN or AMAN). New SESAR functionalities include the dynamic calculation of remaining taxi time, which requires a different flow of information between AFDPS and DMAN. Furthermore, the SESAR concept Coupled AMAN/DMAN requires a dedicated interface with AFDPS.

Generally, the AFDPS ensures information stability for all this functions and allows them working together and support collaborative planning.

Project 12.04.03 has mainly focused its work in "Integrated Surface Management" area, which is part of the AF#2 of the PCP. The upgrades of the AFDPS obtained throughout the lifecycle of this project are a key element of the ATM Functionality (AF) #2.4 "Automated Assistance to Controller for Surface Movement Planning and Routing" which will be deployed based on the contents of the Pilot Common Project (PCP) [4].

This project and the rest of the "Integrated Surface Management" projects have been the basis of the SESAR 2020 project PJ03a "Integrated Surface Management". PJ03a Solution 01 will be the continuation of OFA04.02.01 work, where more specific situations will be investigated, live/shadow mode trials are expected in order to use real surveillance, and more integration of sub-systems working together is expected.

1.3 Project Deliverables

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

Reference	Title	Description
D11	Phase 3- Verification Strategy	This document defines the test objectives, exercises and procedures necessary to evaluate the final set of technical requirements defined in this project. For each verification exercise, a list of verification objectives and related success criteria is provided including their traceability to the technical specifications defined in the D38. Besides, a step-by-step procedure is detailed to show how each verification objectives is expected to be satisfied. In addition to the information about what is expected to be verified and how it should be done, the document summarizes the whole process planned to be performed along the exercise lifecycle including preparatory, execution and post execution activities
D15	Phase 3- Test report	The document provides an overall summary of the verification activities: preparation, conduct, results, analysis, and deviations from planned activities. Results are compared to the success criteria per Verification Objective identified within D11- Phase 3 Verification Strategy, and a set of overall conclusions and recommendations is drawn up. Results from the phase 2 verifications are also considered in this document.
D38	Final technical	This document describes the technical specification of project 12.04.03, which aim to define the

	specifications	enhancement of the Airport Flight Data Processing system (AFDPS) and to implement the Aerodrome Flight Data Processing functional block. It is an evolution over the different phases (1 to 3) of the project. The starting point, the Phase 1 technical specifications, contained the analysis of previous to SESAR work which was the basis for the enhancement of the AFDPS along 12.04.03. These inputs were FOIPS, ED-133, CoFlight, ITEC, and EMMA-2 projects. Prior to the definition of technical requirements, this document explains the different interactions of the airport FDP system with other components and/or functional blocks.
		The final task performed in this document was the identification of the technical requirements that can be considered as V3 validated at the end of the SESAR programme. This task was performed before the actual Validation Report was published. This validation report may have impact in the operational requirements in the final OSED, SPR and INTEROP documents, and hence there is a risk of misalignment with these technical specifications.

1.4 Contribution to Standardisation

Project 12.04.03 has not dealt with interoperability with APP or En-route FDPS, or with SWIM services. The AFDPS descriptions produced should support this work and the future standardization activities within EUROCAE WG59.

1.5 Project Conclusion and Recommendations

12.04.03 project has accommodated the airport FDP systems to a number of SESAR incoming functionalities within the Aerodrome ATC systems. The project has analysed periodically the status and content of other SESAR projects and has considered many new inputs leading to the update of the AFDPs technical specifications, mainly related to interface requirements between sub-systems.

The project has developed the AERODROME-ATC-13 enabler ("Surface movement information processing system enhanced with storage and dissemination of surface routes"), which is considered ready for deployment. The software prototypes developed by this project have all been used in V3 integrated validation exercises, where the AFDPs has fed several subsystems such us surface routing and guidance, DMAN, AMAN, or SNETS. The AFDPs has a key role in maintaining the right updated flight plan data and distributing it to other actors for surface operations. Most of these functionalities are included in the Deployment Programme within AF#2 [4] as the following sub-functionalities:

- "Departure Management Synchronised with Pre-departure sequencing", based upon the distribution of flight plan data among different actors and subsystems for collaborative planning

- "Departure Management integrating Surface Management Constraints", where the AFDPs is in charge of providing flight plan updates, such as remaining taxi times, to the DMAN

- "Automated Assistance to Controller for Surface Movement Planning and Routing", where the AFDPs centralizes the surface route information and the controller inputs to ensure information

coherency, allowing the integration of the Routing and Planning function with the rest of the subsystems (surveillance, safety nets, etc.)

- "Airport Safety Nets", where the AFDPs is the source of flight plan information in order to provide alerts to the controllers for potential conflicts with surface routes and clearances

In terms of future research, the AFDPs will certainly need to evolve in order to adapt to further needs in the Aerodrome ATC functions that will be developed or enhanced during SESAR2020. In particular, the different guidance means are still subject of research, and the AFDPs will remain as the centralized source of information.

One of the limitations of the project is that it has not worked together with other airport systems besides the Aerodrome ATC system. Further research is recommended in order to define what kind of flight plan information is useful to different airport systems based on all the new functionalities developed in SESAR and enabled by an enhanced AFDPs.

Lastly, in order to have a complete description of an AFDPs, it is recommended to focus also on the interface with APP/En Route systems. The use of SWIM within an airport needs to be studied and will surely have a noticeable impact in the AFDP systems.

2 References

[1] SESAR Programme Management Plan, Edition 03.00.01

[2] European ATM Master Plan

[3] Multilateral Framework Agreement ("MFA") signed between the SJU, EUROCONTROL and its 15 selected members on August 11, 2009, amended on 14 June 2010, 19 October 2010 and 2 July 2012

[4] 'Deployment Programme 2015", SESAR Deployment Manager, 26th November 2015

[5] Project_12.04.03   D01 Phase 1 - Technical specifications, 13/10/2011

[6] Project_12.04.03   D02 Phase 2 - Technical specifications, 13/08/2013

[7] Project_12.04.03   D08 Phase 2 - Test report, 11/07/2014

[8] Project_12.04.03   D09 Phase 3 - Technical specifications, 30/04/2015

[9] Project_12.04.03   D14 Phase 3 - Prototype (Indra), 29/09/2015

[10] Project_12.04.03   D05 Phase 2 - Prototype availability note(Thales), 31/03/2014

[11] Project_12.04.03   D13 Phase 3 - Prototype (Selex S.I.), 20/10/2015

[12] Project_12.04.03   D38 Final technical specifications, 18/03/2016

[13] Project_12.04.03   D04 Phase 2 - Verification strategy, 12/03/2014

[14] Project_12.04.03   D11 Phase 3 - Verification strategy, 27/07/2015

[15] Project_12.04.03   D15 Phase 3 - Test report, 04/01/2016

[16] B.01-D83 Integrated Roadmap DS15 Release Note, 00.01.00, 22/12/2015

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