



# Final Project Report

## Document information

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Project Manager	Indra
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## **Abstract**

This project was tasked with developing the Technical Specifications needed to support the integration of the Airport Operations Plan (AOP) with the Network Operations Plan (NOP) through SWIM concept, this integration through was defined by operational project partners as a SESAR Solution. These technical requirements enabled the prototyping and testing along three incremental evolution phases of a system which exchanged data allowing the integration of the AOP in the NOP.

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Rational for rejection
None.

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## Acronyms

Acronym	Definition
A-CDM	Airport Collaborative Decision Making
AINS	Airport Into Network by SWIM
AIRM	ATM Information Reference Model
AO	Airport Operations
AOP	Airport Operations Plan
API	Arrival Planning Information
APOC	AirPort Operations Centre
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATV	Airport Transit View
AU	Airspace User
B2B	Business to Business
DCB	Demand and Capacity Balancing
DLR	Deutsches zentrum für Luft und Raumfahrt
DPI	Departure Planning Information
DS	Data Set
IBP	Industry Based Platform
ISRM	Information Service Reference Model
NM	Network Manager
NOP	Network Operations Plan
OFA	Operational Focus Area
PCP	Pilot Common Project
SEAC	SESAR European Airports Consortium
SJU	SESAR Joint Undertaking
SWIM	System Wide Information Management

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TRL	Technology Readiness Level
TTA	Target Time of Arrival
VP	Validation Plan

# 1 Project Overview

The main objective of this project, named "Integration of CDM in the SWIM environment", was to specify, develop and verify an AINS prototype which is able to provide the capability to share the Airport Operations Plan (AOP) data with the Network Operations Plan (NOP) and vice versa to achieve a consistent rolling airport slots schedule and flight plans information, in order to enhance performance both at the Airport and across the Network.

## 1.1 Project progress and contribution to the Master Plan

The project was conceived in three phases to allow staged development of the AINS tool according to the evolving requirements and defined functionalities specified by the operational concept.

During the first phase, an initial software version of the AINS was developed according to the corresponding operational requirement documentation (specifically referenced in documents [5], [6], [7] and the Validation Plan for the V2 AOP Validation Exercise [8]). This version of AINS, with the core functionalities in a relevant environment (TRL6 maturity level), was integrated into Aena's Industry Based Platform (IBP) at Palma de Mallorca Airport alongside the "Airport Operations Plan" prototype, where it supported testing of the feasibility of the AOP as a performance improvement driver [9] using data exchanged with the NOP. Subsequently it supported a more advanced V3 exercise [10] where both an increase in arrival punctuality and a reduction in reactionary delay were demonstrated [11]. Meanwhile the final data definition to be exchanged between the AOP and NOP was defined, the project supported the V3 Validation Exercise [16] related to passenger processes on Aena's IBP at Palma de Mallorca Airport

A more mature prototype version was developed in Phase 2 that published Departure Planning Information (DPIs) to the NOP based on operational requirements produced by OFA05.01.01 (Airport Operations Management), with specific reference to documents [12], [13], and [14], the Network Operations Plan concept [15] and the Validation Plan for the V3 Validation Exercise [23] related to Airport DCB. For this Validation Exercise, the project supported the installation and verification of AINS, including integration with the AOP and the simulated NOP system on Deutsches Zentrum für Luft und Raumfahrt (DLR) premises in Braunschweig, Germany.

In the final third phase, a new matured version of AINS was developed to allow the publication of Arrival Planning Information (APIs) to the NOP based on the most recent versions of the Airport Operations Management concept documents (see references [18], [21] and [22]) and the V3 Validation Plan addressing "Target Time Management and AOP-NOP Integration" concepts [25], executed on Aena's IBP at Alicante, Barcelona, Madrid and Palma de Mallorca Airports in May 2016. For this exercise, the project contributed by once again providing the AINS TRL6 system in the four airports and supporting the Validation Exercise milestones.

During its lifecycle the project contributed to maturing Enablers referenced in the integrated roadmap version DS15 [4] (see table below) through the technical specification, development and testing of the prototype. In turn the Enablers supported the development and maturity of the Operational Improvement Steps also described in the table

Code	Name	Project contribution	Maturity at project start	Maturity at project end
GGSWIM-26a	Provision and use of Ground-ground data services for Network Operations Planning	The project has contributed to the definition and use of the NetworkOperationPlan Service in several Validation Exercises exploring their data exchange capabilities to have a rolling AOP	TRL3	TRL6

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		synchronized with NOP, and also detecting possible needs.		
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With reference to the Operational Improvement Steps outlined in the table above, the project has therefore contributed to SESAR Solution #21 'Airport Operations Plan and AOP-NOP Seamless Integration' through the delivery of a final Technical Specification document and the development of a pre-industrial AOP prototype.

## 1.2 Project achievements

The project has created an enabling system as the technical driver for the SESAR Airport Operations Plan integration into the Network by SWIM enabled concept; and supported the operational Validations Exercises which demonstrated that the AOP [9][11][17]:

- Can be maintained in real time updated with NOP data to obtain the flight plan representing the visit of an aircraft to an airport;
- Leads to an improvement in arrival predictability by providing arrival information for flights including those in the scheduling phase; and
- Leads to an improvement in departure predictability by providing departure information for flights including those in the scheduling phase.

The project was able to use the AINS prototype in four Aena airports in Spain (Alicante, Barcelona, Madrid and Palma de Mallorca) and on a simulation platform supplied by research partner AT-One, which simulated Amsterdam Schiphol Airport.

Therefore, the latest AINS Technical Specification document produced by the project allows for the development of a system with the following main benefits:

- Receive rolling NOP information and share it with the AOP;
- Publish arrival planning information for reach ATV to the NOP; and
- Publish departure planning information for each ATV to the NOP.

## 1.3 Project Deliverables

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

Reference	Title	Description
D24	Phase 3 Final Specification	<p>This document [30] gathers the final requirements collected throughout the project to be used for the implementation of an AOP tool*.</p> <p>The requirements included in the document have been derived from the Airport Operations Plan concept defined in operational documentation produced by OFA05.01.01 'Airport Operations Management' [20][21][22], aligned with the Validation Plans documents for 'AOP validation'[10], 'Airside-Landside integration'[16], 'Airport DCB'[23], 'Target Time Management/AOP-NOP Integration'[25] Validation Exercises; and updated along the lifecycle of the project in the SESAR Programme through the three [26][28][29] Technical</p>

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		<p>Specification documents delivered by the project.</p> <p>This document represents the result of the technical analysis undertaken to instantiate the Airport Operations Plan into the Network by SWIM, exchange capabilities defined by the corresponding operational projects, once all of the supported Validation Exercises were completed.</p>
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\* Due to the tight schedule at the end of the SESAR Programme, it has been not possible to close the intended Final Technical Specification deliverable to address results that have not yet been obtained from the Validation Report related to the "Target Time Management and AOP-NOP Integration" exercise. Work is on-going on this report and thus subsequent updates to the final Operational Requirements. Therefore it may be possible that some requirements have not reached V3 maturity. This issue needs to be taken into consideration for further activities, in particular future research and development work that will be undertaken in the planned SESAR 2020 Programme.

## 1.4 Contribution to Standardisation

P12.06.09 has contributed with the WP08 standardisation of AIRM and ISRM related to the AOP-NOP integration through the participation in the Service Activity 1 addressing the definition of the AOP-NOP service [26].

## 1.5 Project Conclusion and Recommendations

The project served as a technical enabler to validate the SESAR rolling Airport Operations Plan's integration with the Network Operation Plan concept, through operational Validation Exercises addressing the Operational Improvement Steps that provide for the maturity from proof of concept (TRL3) to demonstration in relevant end-to-end environment (TRL6).

It has been proven that the AINS met the project's objectives because it is able to fully integrate aircraft processes contained in the AOP with the NOP. Furthermore, AINS provides the mechanism to publish arrival and departure information.

According to the validation results obtained in two of the Validation Exercises (see references [11][17]), the project has had a key role in specifying and demonstrating the evolution and maturity of SESAR Solution #21 'Airport Operations Plan and AOP-NOP Seamless Integration', through the coordination and delivery of the AINS's Technical Specification document and a V3 pre-industrial prototype to support the operational concept defined by OFA05.01.01 'Airport Operations Management'. This role was fulfilled by participating in the relevant V2 and V3 Validation Exercises.

Therefore, the project has made its contribution in establishing the Technical Specification as the baseline for future development and implementation related to the SESAR Airport Operations Plan's integration with the NOP concept, which is expected to be deployed in the live operational environment through the framework of the SESAR Deployment Manager (PCP). It will eventually also contribute to the Enhanced Collaborative Airport Performance Management solution, corresponding to the planned Total Airport Management project (PJ04) in the future SESAR 2020 Programme.

The following recommendations are made in order to facilitate the on-going maturity and improvements in technical requirements:

- Include the status of the ATV in the information model so the Network Manager (NM) can assess the accuracy of the provided data.
- Include the link between an aircraft's arrival and departure in the information model.

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- Increase the flight plan period availability based on historic flight plans; and
- Increase the current NM B2B SWIM expanding the time window that the data can be exchanged between AOP-NOP

In addition, there is further scope for defining and modelling the exchanged data based on the ATV concept managed in the AOP instead of the flight concept.

## 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] WPB.01, Integrated Roadmap DataSet15 Release Note, D83, 00.01.00, December 21, 2015
- [5] P06.05.04, Initial Operational Concept\_00.02.00.pdf Ed. 00.02.00, D01, March 04, 2011
- [6] P06.05.01, Airport Operations Plan definition, AOP Functional Requirements and Initial Technical Feasibility Report (V1), D012, 00.01.00, July 20, 2011
- [7] P12.01.07, Step1-3rd Iteration- Airport Technical Architecture Description, D22, 00.03.00, December 06, 2013
- [8] P06.05.02, Airport Operations Plan Validation, Validation Plan: AOP (Lite) feasibility, D16, 00.01.01, February 13, 2013
- [9] P06.05.02, Airport Operations Plan Validation, Validation Report (VALR) for AOP (Lite) feasibility EXE-06.05.02-VP-648, D20, 00.02.00, January 1, 2014
- [10] P06.03.01, The Airport in the ATM Environment, EXE-06.03.01-VP-609 Validation Plan, D03, 00.01.02, February 8, 2013
- [11] P06.03.01, The Airport in the ATM Environment, EXE-06.03.01-VP-609 Validation Report, D08, 00.01.01, April 4, 2014
- [12] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated OSED Edition 2, D08, 00.02.00, April 30, 2013
- [13] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Preliminary Safety and Performance Requirements Document Edition 1, D11, 00.01.00, July 11, 2013
- [14] OFA 05.01.01 Preliminary Interoperability Requirements (INTEROP) document Edition 1, D12, 00.01.01, November 11, 2013
- [15] P07.06.01 Collaborative NOP OSED Step 1, D45, 00.03.00, September 9, 2015.
- [16] P06.03.01, The Airport in the ATM Environment, EXE 549 VALP (Airside - Landside integration) V3, D133, 00.01.00, March 30, 2015
- [17] P06.03.01, The Airport in the ATM Environment, VALR EXE 549 (Airside - Landside integration), D134, 00.01.01, December 17, 2015
- [18] P06.05.04, AirPort Operations Centre (APOC) definition, EXE-06.05.04-VP-013 Validation Plan, D25, May 16, 2014
- [19] P06.05.04 AirPort Operations Centre (APOC) definition, Consolidated EXE-06.05.04-VP-013 Validation Report, D13, 00.02.01, October 21, 2015
- [20] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated OSED Edition 3, D16, 00.03.01, April 08, 2015
- [21] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated SPR Edition 3, D19, 00.02.01, July 09, 2015
- [22] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated INTEROP Edition 3, D20, 00.02.05, July 08, 2015
- [23] P06.03.01, The Airport in the ATM environment, EXE-06.03-01-VP-010 Validation Plan, D135, 00.00.04, August 28, 2015

- [24] P06.03.01, The Airport in the ATM environment, EXE-06.03-01-VP-757 Validation Plan: (Airport Operations Centre: Airport Performance Monitoring and Management) V3, D141, 00.01.01, November 26, 2015
- [25] P13.02.03, Enhanced DCB, Validation Plan Step1 Release 5 - EXE-13.02.03-VP-749, D342, 00.01.02, December 21, 2015
- [26] P08.03.10, Information Service Modelling deliverables, European ATM Service Description for the NetworkOperationPlan Service, D65, 00.03.00, June 1, 2016
- [27] P12.06.09, Integration of CDM in the SWIM environment, AINS V2-early prototype - Technical Specification, D01, 00.01.00, April 24, 2012
- [28] P12.06.09, Integration of CDM in the SWIM environment, Phase 2 Technical Specification (TS), D08, 00.01.01, June 30, 2015
- [29] P12.06.09, Integration of CDM in the SWIM environment, Phase 3 Technical Specification, D19, 00.01.00, December 30, 2015
- [30] P12.06.09, Integration of CDM in the SWIM environment, Phase 3 Final Specification, D24, 00.01.00, May 26, 2016
- [31] P12.06.09, Integration of CDM in the SWIM environment, AINS V2-early prototype - Availability Note, D04, 00.01.00, October 5, 2012
- [32] P12.06.09, Integration of CDM in the SWIM environment, AINS Verification Plan, D05, 00.01.00, June 19, 2012
- [33] P12.06.09, Integration of CDM in the SWIM environment, AINS V2-early - Verification Report, D07, 00.01.00, September 14, 2012
- [34] P12.06.09, Integration of CDM in the SWIM environment, Phase 2 Prototype Availability Note, D11, 00.01.00, December 17, 2015
- [35] P12.06.09, Integration of CDM in the SWIM environment, Phase 2 Verification Plan, D12, 00.01.00, September 25, 2015
- [36] P12.06.09, Integration of CDM in the SWIM environment, AINS Phase 2 Verification Report, D14, 00.01.00, December 2, 2015
- [37] P12.06.09, Integration of CDM in the SWIM environment, Phase 3 Prototype Availability Note, D20, 00.01.00, April 27, 2016
- [38] P12.06.09, Integration of CDM in the SWIM environment, Phase 3 Verification Plan, D21, 00.01.00, March 2, 2016
- [39] P12.06.09, Integration of CDM in the SWIM environment, AINS Phase 3 Verification Report, D22, 00.01.00, April 18, 2016

**-END OF DOCUMENT-**

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