Final Project Report

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Abstract

Project was tasked with developing Technical Specifications to support the Airport Operations Plan concept, which was defined by operational project partners as a SESAR Solution. These technical requirements enabled the prototyping and testing of a system that could balance the planned turn-round processes elements of Airspace Users business trajectories on the ground against the real-time constraints produced by airport, local airspace and network operational restrictions through three incremental evolution phases.

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Acronyms

Acronym	Definition
A-CDM	Airport Collaborative Decision Making
A-DCB	Airport Demand and Capacity Balancing
AO	Airport Operations
AOP	Airport Operations Plan
APOC	AirPort Operations Centre
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATV	Airport Transit View
AU	Airspace User
DCB	Demand and Capacity Balancing
DLR	Deutsches zentrum für Luft und Raumfahrt
DS	Data Set
IBP	Industry Based Platform
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
TRL	Technology Readiness Level
TTA	Target Time of Arrival
VP	Validation Plan

1 Project Overview

The main objective of this project, named "The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport", was to specify, develop and verify an AOP prototype which is able to monitor aircraft and passenger processes at the airport and display them to the user as an Airport Transit View (ATV), in order to enhance the 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 AOP tool according to the evolving requirements and defined functionalities specified by the operational concept.

During the first phase, an initial software version of the AOP was developed based on a feasibility study that was carried out to assess which technical options were the most appropriate for the prototype's architecture and development 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 AOP, with the core functionalities in a relevant environment (TRL5 maturity level), was integrated into Aena's Industry Based Platform (IBP) at Palma de Mallorca Airport alongside the "AOP into Network by SWIM" prototype, where it supported testing of the feasibility of the AOP as a performance improvement driver [9]. 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].

A more mature AOP was developed in Phase 2 based on operational requirement produced by OFA05.01.01 (Airport Operations Management), with specific reference to documents [12], [13], [14] and the Validation Plan for a V3 Validation Exercise [15] related to passenger process. For this validation exercise, the project supported the AOP's installation and integration with the airport's proprietary landside systems and verification on Aena's IBP at Palma de Mallorca Airport.

In 2014, the APOC operational concept was validated at V3 maturity level in AT-One´s simulation platform on Deutsches zentrum für Luft und Raumfahrt (DLR) premises in Braunschweig, Germany. Therefore in the final third phase, a more mature software version of AOP was accordingly developed based on the collaborative airport management modifications made in the most recent versions of the Airport Operations Management concept documents (see references [17], [20] and [21]) and the Validation Plan [22] intended to support this final APOC Validation Exercise at the beginning of 2016. In addition, this same version of the AOP was used to support a V3 Validation Exercise addressing the "Target Time Management and AOP-NOP (Network Operations Plan) Integration" concepts [24], executed on Aena's IBP at Alicante, Barcelona, Madrid and Palma de Mallorca Airports in May 2016. For these two exercises, the project contributed by once again providing the AOP TRL6 system (in the second one 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 **Error! Reference source not found.** (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
AIRPORT-02	TTA Airport Impact Assessment Tool	The project has contributed to the evolution of maturity of the Operational Improvement Step [4] DCB-0310 (Improved Efficiency in	TRL3	TRL6

		the management of Airport and Air Traffic Flow and Capacity Management (ATFCM) Planning) through the Airport Impact Assessment of the Target Time of Arrival (TTA) proposing a more planning alignment solution to be taking into account by Network to reduce the negative impact.		
AIRPORT-03	Airports Operation Plan (AOP) management tool	The project has contributed to the evolution of maturity of the Operational Improvement Step [4] in the following way: - AO-0801 (Collaborative Airport Planning Interface) through the integration of Airport Operations Plan into Network in a rolling way. - AO-0802 (Airport-Collaborative Decision Making (A-CDM) process enhanced through integration of landside (passenger only) process outputs) through a real integration of the passenger process alerting overload landside process and no-show passengers to AUs. - AO-0803 (Integration of Airports into Air Traffic Management (ATM) through Monitoring of Airport Transit View (Extension of Performance Monitoring building on A-CDM)) through the monitoring of the Airport Transit View, combined with resource availability and utilisation and its drivers through performance driver indicators at aircraft level - AO-0804 (Collaborative Airport Performance Management) has not been supported by this project.	TRL3	TRL6
AIRPORT-38	Airport/ATFCM Extended data interface	The project has contributed to the evolution of maturity of the Operational Improvement Step [4] in the following way: - AO-0801 (Collaborative Airport Planning Interface) through the integration of Airport Operations Plan into Network in a rolling way. - AO-0802 (A-CDM process enhanced through integration of landside (passenger only) process outputs) through a real integration of the passenger process alerting overload landside process and no-show passengers to AUs.	TRL3	TRL6

		- AO-0803 (Integration of Airports into ATM through Monitoring of Airport Transit View (Extension of Performance Monitoring building on A-CDM)) through the monitoring of the Airport Transit View, combined with resource availability and utilisation and its drivers through performance driver indicators at aircraft level - DCB-0310 (Improved Efficiency in the management of Airport and ATFCM Planning) through the Airport Impact Assessment of the TTA proposing a more planning alignment solution to be taking into account by Network to reduce the negative impact. - AO-0804 (Collaborative Airport Performance Management) has not been supported by this project.		
AIRPORT-35-A	Airport CDM (level 4 - CDM integrated with passenger process)	The project has contributed to the evolution of maturity of the Operational Improvement Step [4] in the following way: - AO-0802-A (A-CDM process enhanced through integration of landside (passenger only) process outputs) through a real integration of the passenger process alerting overload landside process and no-show passengers to AUs. - AO-0804 (Collaborative Airport Performance Management) has not been supported by this project.	TRL3	TRL6
AIRPORT-40	Airport Performance Monitoring System	The project has contributed to the evolution of maturity of the Operational Improvement Step [4] AO-0803 (Integration of Airports into ATM through Monitoring of Airport Transit View (Extension of Performance Monitoring building on A-CDM)) through the monitoring of the Airport Transit View, combined with resource availability and utilisation and its drivers through performance driver indicators at aircraft level.	TRL3	TRL6

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 concept; and supported the operational validations exercises which demonstrated that the AOP [9][11][16]:

- Can be maintained in real time updated with data from the different external sources needed to represent the visit of an aircraft to an airport;
- Can monitor aircraft processes in real time assessing every update triggering alerts and warnings if proceed;
- Leads to an improvement in arrival predictability of up to 40% more compared to the current disparate and proprietary airport operator systems; and
- Leads to an improvement in departure predictability of up to 30% more than current fragmented systems.

In order to fulfil the project's objectives, a feasibility study of various system architectures was carried out to determine the integration needed to build the Airport Transit View (ATV) and to maintain the timestamps associated with aircraft process milestones.

The project installed the AOP 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 integrated with local external interfaces; and applied each airport's model in order to contribute towards defining and developing a generic solution for airports.

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

- Instantiation of an Airport Operations Plan at an airport;
- Handling the Airport Performance Steering Service;
- Providing common situational awareness for airport stakeholders, including aircraft and passenger processes; and
- Integration of the airport into the Network, in turn increasing predictability.

1.3 Project Deliverables

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

Reference	Title	Description
D60	Phase 3 AOP Final Specification	This document [28] gathers the final requirements collected throughout the project to be used for the implementation of an AOP tool*. 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' [19][20][21], aligned with the Validation Plans documents for 'AOP validation'[10], 'Airside-Landside integration'[15], 'Airport DCB'[22], 'APOC'[23] and 'Target Time Management/AOP-NOP Integration'[24] Validation Exercises; and updated along the lifecycle of the project in the

		SESAR Programme through the three [25][26][27] Technical Specification documents delivered by the project. This document represents the result of the technical analysis undertaken to instantiate the Airport Operations Plan, landside process monitoring and AOP management capabilities defined by the corresponding operational projects, once all of the supported Validation Exercises were completed.

* 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 after the official results that are expected to be obtained from the Validation Report related to "Target Time Management and AOP-NOP Integration" exercise. Work is on-going on these validation results and updates to the final Operational Requirements. Therefore it is possible to conclude that some requirements may not yet have 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

P12.06.02 has not contributed to any standardisation activities and its results did not have an impact on standards.

1.5 Project Conclusion and Recommendations

The project served as a technical enabler to validate the SESAR Airport Operations Plan concept, through operational Validation Exercises addressing the following Operational Improvement Steps evolving the maturity from proof of concept (TRL3) to demonstration in relevant end-to-end environment (TRL6).

It has been proven that the AOP has coped with the project objectives because is able to be fully calibrated according to local conditions and airport operating models, capable of monitoring the airport's performance according to the set Key Performance Indicators (KPIs) that evaluate ATVs, detecting deviations from planned data and generating alerts and warnings when thresholds are exceeded. Furthermore, the AOP provides a mechanism for managing unexpected operational disruptions between APOC stakeholders in a collaborative manner.

According to the validation results obtained in two of the Validation Exercises (see references [11][16]), 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 AOP's Technical Specification document and a V3 pre-industrial prototype to support the operational concept defined by OFA05.01.01 'Airport Operations Management', 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 developments and implementation related to the SESAR Airport Operations Plan concept, which is expected to be deployed in the live operational environment through the framework of the SESAR Deployment Manager (PCP - Pilot Common Project). 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 monitoring of airport baggage processes to improve common situational awareness for airport stakeholders during the aircraft turn-round phase;
- Include monitoring of the Ground Handling Agent activities during the aircraft turn-round phase in order to increase departure predictability; and
- The information model used to exchange messages between the AOP and the NOP should be expanded with more fields in the arrival planning information and including the information needed for the Target Times related to STAM measures, that also should be exchanged using SWIM services.

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

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] P06.03.01, The Airport in the ATM Environment, EXE 549 VALP (Airside - Landside integration) V3, D133, 00.01.00, March 30, 2015

[16] P06.03.01, The Airport in the ATM Environment, VALR EXE 549 (Airside - Landside integration), D134, 00.01.01, December 17, 2015

[17] P06.05.04, AirPort Operations Centre (APOC) definition, EXE-06.05.04-VP-013 Validation Plan, D25, May 16, 2014

[18] P06.05.04 AirPort Operations Centre (APOC) definition, Consolidated EXE-06.05.04-VP-013 Validation Report, D13, 00.02.01, October 21, 2015

[19] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated OSED Edition 3, D16, 00.03.01, April 08, 2015

[20] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated SPR Edition 3, D19, 00.02.01, July 09, 2015

[21] P06.05.04, AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated INTEROP Edition 3, D20, 00.02.05, July 08, 2015

[22] P06.03.01, The Airport in the ATM environment, EXE-06.03-01-VP-010 Validation Plan, D135, 00.00.04, August 28, 2015

[23] 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

[24] P13.02.03, Enhanced DCB, Validation Plan Step1 Release 5 - EXE-13.02.03-VP-749, D342, 00.01.02, December 21, 2015

[25] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, AOP V2 Early Prototype Technical Specification, D03, 00.01.00, April 16, 2012

[26] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 2 AOP Technical Specification, D20, 00.01.01, March 14, 2014

[27] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 3 AOP Technical Specification, D56, 00.01.00, July 06, 2015

[28] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 3 AOP Final Specification, D60, 00.01.00, May 26, 2016

[29] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, DIMT Technical Specification STEP1 V2, D02, 00.01.00, January 9, 2012

[30] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, De-icing Management Tool Safety Analysis Report, D04, 00.01.01, January 18, 2012

[31] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Feasibility Study Report, D06, 00.01.01, January 19, 2012

[32] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, 12.6.2 De-icing Verification Plan, D15, 00.01.05, April 23, 2012

[33] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, AOP Prototype - Feasibility Study Report, D07, 00.01.00, February 27, 2012

[34] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, AOP V2-early prototype - Availability Note, D12, 00.01.00, October 29, 2012

[35] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, AOP V2 Early Prototype Verification Plan, D14, 00.01.01, August 25, 2012

[36] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, AOP V2 Early Prototype Verification Report, D18, 00.01.00, October 15, 2012

[37] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 2 AOP Prototype Availability Note, D25, 00.01.00, August 20, 2014

[38] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 2 AOP Verification Plan, D27, 00.01.00, May 2, 2014

[39] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 2 AOP Verification Report, D30, 00.01.00, July 1, 2014

[40] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 3 - AOP Prototype Availability Note, D57, 00.01.00, December 17, 2015

[41] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 3 AOP Verification Plan, D58, 00.01.00, October 16, 2015

[42] P12.06.02, The Airport Operations Plan (AOP), decision support tools and conflict detection tools to be integrated in APOC for managing the overall performance of the airport, Phase 3 AOP Verification Report, D59, 00.01.00, December 23, 2015

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