



Final Project Report

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Task contributors

Indra

Abstract

The purpose of the project was to develop technical specifications supporting the AirPort Operations Centre concept defined by operational projects as a SESAR Solution. The technical requirements have been served for prototyping and testing a system able to serve as the airport performance monitoring and decision support and collaborative management of the Airport Operations Plan (AOP), reducing the recovery time to normal operations by enhancing the airport's overall performance in key areas such as punctuality, delay and predictability. Their maturity level increased through three evolving phases, supporting two V2 and one V3 validation exercises.

Authoring & Approval

Prepared By - <i>Authors of the document.</i>		
Name & Company	Position & Title	Date
██████████ Indra	██████████	03/03/2016

Reviewed By - <i>Reviewers internal to the project.</i>		
Name & Company	Position & Title	Date
██████████ Indra	██████████	05/03/2016

Reviewed By - <i>Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.</i>		
Name & Company	Position & Title	Date
██████████ SEAC	██████████	18/03/2016
██████████ SEAC		16/03/2016
██████████ EUROCONTROL		18/03/2016
██████████ Indra		16/03/2016
██████████ Selex		31/03/2016

Approved for submission to the SJU By - <i>Representatives of the company involved in the project.</i>		
Name & Company	Position & Title	Date
██████████ Indra	██████████	18/03/2016

Rejected By - <i>Representatives of the company involved in the project.</i>		
Name & Company	Position & Title	Date
<Name / Company>	<Position / Title>	<DD/MM/YYYY>

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Acronyms

Acronym	Definition
A-CDM	Airport Collaborative Decision Making
AMAN	Arrival MANager
ANSP	Air Navigation Service Provider
AO	Airport Operations
AOP	Airport Operations Plan
APAMS	Airport Performance Assessment and Management Support systems
APOC	AirPort Operations Centre
ATM	Air Traffic Management
AU	Airspace User
DCB	Demand and Capacity Balancing
DMAN	Departure MANager
DS	Data Set
IBP	Industry Based Platform
INTEROP	Interoperability Requirements
IOCD	Initial Operational Concept Document
KPI	Key Performance Indicator
MFA	Multilateral Framework Agreement
NOP	Network Operation Plan
OFA	Operational Focus Area
OI	Operational Improvement
OSD	Operational Service and Environment Description
PCP	Pilot Common Project
Pj	Project
SATI	SHAPE Automation Trust Index

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SEAC	SESAR European Airports Consortium
SESAR	Single European Sky ATM Research Programme
SHASA	Situational Awareness for SHAPE
SHAPE	Solutions for Human Automation Partnerships in European ATM
SJU	SESAR Joint Undertaking
SMAN	Surface MANager
SPR	Safety and Performance Requirements
STQ	SHAPE Teamwork Questionnaire
SWIM	System Wide Information Management
TAD	Technical Architecture Description
TRL	Technology Readiness Level
UDPP	User Driven Prioritization Process
VP	Validation Plan
WP	Work Package

1 Project Overview

The main objective of the Primary Project "Airport Performance Management Assessment and Management Support Systems" (APAMS) was to specify, develop and verify the AirPort Operation Centre (APOC) support tool, which is able to collect and evaluate information from the Airport Operations Plan (AOP), allowing monitoring and management of the airport's performance by providing mechanisms to the APOC stakeholders to resolve any unexpected operational disruptions in a collaborative manner.

1.1 Project progress and contribution to the Master Plan

The project was conceived in three phases to allow staged development of the APAMS tool according to evolving specifications and defined functionalities.

During the first phase in 2011/2012 a light software mock-up APAMS was developed based on a feasibility study carried out to assess which technical options were the most appropriate for the architecture and development of the prototype and the corresponding operational documentation, in concrete: Technical Architecture Description [17], Initial Operational Concept Document [5], Airport Performance Monitoring definition and a Key Performance Area analysis. This early TRL3 maturity level version of APAMS was integrated with the AOP used in Aena's Industrial Based Platform (IBP) at Palma de Mallorca Airport, where it supported the validation exercise [13] testing the feasibility of automating airport performance management.

Subsequently in the Phase 2 during 2013/2014 a more mature TRL4 APAMS was developed based on operational documentation produced by the Airport Operations Management Operational Focus Area, specifically [6], [7], [8] and the Validation Plan for the V2 APOC validation exercise [14]. For this validation exercise, the project supported the organization, preparation, installation, verification and generation of a specific Indra IBP on its premises at Torrejón de Ardoz, Spain, where the actions from the APOC stakeholders (Airport, Stand Planner, ANSP, AUs) were simulated. It also required integration with other Airport system prototypes including the Airport Operations Plan (AOP), Airport into A-CDM by SWIM and AMAN, SMAN and DMAN fully integrated into CDM processes.

During 2014, Indra, EUROCONTROL, SEAC, AT-One/DLR and SJU agreed to validate the APOC operational concept to V3 maturity by using AT-One's simulation platform on DLR's premises in Braunschweig, Germany. Therefore in the final third phase during 2015/2016, a mature TRL6 version of APAMS was developed based on the collaborative management modifications made in the most recent version of Airport Operations Management concept documents ([9][10][11]) and the validation plan devised for the V3 APOC validation exercise [16]. The project contributed by once again providing the APAMS prototype and supporting the validation exercise milestones.

During its lifecycle the project contributed to maturing the following Enablers referenced in the integrated roadmap version DS14 [4] (see table below) through the technical specification, development and testing of the prototype within the corresponding technical project.

Code	Name	Project contribution	Maturity at project start	Maturity at project end
AIRPORT-40	Airport Performance Monitoring System	The project has contributed to the evolution of maturity of the Operational Improvement Steps [4] in the following way:	TRL3	TRL6

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		<ul style="list-style-type: none"> - AO-0803 (Integration of Airports into ATM through Monitoring of Airport Transit View (Extension of Performance Monitoring building on A-CDM)) through the KPIs calculation based on the pan-airport performance drivers related to the Airport processes and Airport situation - AO-0818 (Extended Turn-round monitoring within the APOC) through the warnings and alerts indicators of possible delays (KPIs) during the turn-round process. 		
AIRPORT-41	Airport Operations Centre Support Tools	<p>The project has contributed to the evolution of maturity of the Operational Improvements Steps [4] in the following way:</p> <ul style="list-style-type: none"> - AO-0801-A (Collaborative Airport Planning Interface) through the integration of Airport Operations Plan to monitoring the pan-airport performance. - AO-0804 (Collaborative Airport Performance Management) through the detection of the event creation or pan-airport alert/warning deviation that requires the Impact Assessment by the Airport Stakeholders and decision support tools for the agreement of the solution to be applied for the stakeholders. <p>The AO-0802-A (A-CDM process enhanced through integration of landside (passenger only) process outputs) has not been supported by this project</p>	TRL3	TRL6

Taking into account these Operational Improvements Steps supported by the project has therefore contributed to SESAR Solution #21 'Airport Operations Plan and AOP-NOP Seamless Integration' through the technical specification and the pre-industrial prototype of the APOC

1.2 Project achievements

The project has been the technical driver to create an enabling system the SESAR AirPort Operations Centre concept through the support of the operational validations demonstrating that the APOC leads to [15]:

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- Improved situational awareness adding value for the management of adverse conditions;
- Improved decision making process more quickly and to agree on solutions to restore the airport's overall performance.; and
- Increased overall airport performance leading to a quicker recovery to normal operations.

In order to fulfil the project objectives, a feasibility study of the alternatives architectures were carried out to determine if the calculus needed for the KPIs of the airport performance monitoring and the airport performance management workflow could be developed.

After that, the iterative approach was used to define and refine the calculus rules, steering default values and representation of 56 pan-airport Key Performance Indicators (KPIs) for each timeframe (short, medium and large) and different time windows taking into account the adjustments and redefinition of the APOC validation plans. Also, it was defined the entities, the flows, the user actions and information model needed to develop the operational airport performance management service.

Once the successful verification and the first V3 validation was performed during the second phase of the project, it was proven that the airport performance management was very useful to solve the problems and the airport performance monitoring data provided accurate situational awareness being in cases overload of alerts and warnings.

During the third phase of the project, the airport performance management was updated to be more flexible in the adverse conditions decision process flow facilitating the stakeholders the overall impact assessment and the search of solutions, improving also the KPIs steering to reduce the pan-airport alerts and warnings.

Apart of that, the project realized a mock-up of collaborative tools as notifications mechanism and chat and overview of dashboards to favour the initial operational definition.

Therefore, the APAMS technical specification carried out by the project allows to develop systems with the following main benefits:

- Pro-active management of the performance of tactical and pre-tactical airport operations;
- A common operational overview of the airport for all relevant stakeholders; and
- The ability for airport stakeholders to assess the impact of any operational deviation or adverse condition; and to communicate, coordinate and collaboratively decide on the progress of dealing with disruption.

1.3 Project Deliverables

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

Reference	Title	Description
D25	Phase 3 - APAMS Final Technical Specification	<p>This document [32] gathers the final requirements collected throughout the project to be used for the implementation of an APOC tool*.</p> <p>The requirements included in the document have been derived from the Airport Performance Monitoring and Management services defined in the OFA05.01.01 Airport Operations Management operational documentation [6][10][11], aligned with the validation plan documents for EXE-06.03.01-VP-609[12], EXE-06.05.04-VP-013[14] and EXE-06.05.04-VP-757[16] and updated along the lifecycle of the project in the SESAR Programme through the three [20][24][28] technical specification document delivered by the project.</p> <p>This document represents the result of the technical</p>

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		analysis undertaken to instantiate the Monitor Airport Performance and Manage Airport Performance services defined by the corresponding operational projects, once all the supported validation exercises were finished.
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* Due to the tight schedule at the end of the SESAR Programme it has been not possible to close the Final Technical Specification document after the official results that are expected to be obtained from the Validation Report for EXE-06.03.01-VP-757. Work is ongoing on the validation results and the final operational requirements. Therefore it is possible to conclude that some requirements have not reached V3 maturity yet. 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

P12.07.03 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 has served as a technical enabler to validate the SESAR AirPort Operations Centre concept supporting operational validation exercises that address the Airport Performance Monitoring and the Collaborative Airport Performance Management Operational Improvements evolving the maturity from proof of concept (TRL3) to demonstration in relevant end-to-end environment (TRL6).

It has been proven that the APAMS has coped with the project objectives because it is able to monitor the pan-airport performance through the calculation and delivery of KPIs based on common performance framework and the evaluation of the Airport Operations Plan (AOP) during medium, short and execution phases, detecting deviations from planned data and generating alerts and warnings when thresholds are crossed. Besides, the APAMS provides the mechanisms for managing the unexpected operational disruptions in a collaborative manner to the APOC stakeholders.

According to the validation results obtained [15], the project has been a key to specify 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 APAMS technical specification and a V3 pre-industrial prototype to support OFA05.01.01 'Airport Operations Management'; and participating in the relevant V2 and V3 exercises to validate this operational concept.

Therefore, P12.07.03 has made its contribution in establishing the technical specification as the baseline for future developments and implementation related to the SESAR AirPort Operations Centre concept, which are expected to occur through activities of the SESAR Deployment Manager (PCP) and the Enhanced Collaborative Airport Performance Management solution corresponding to the Total Airport Management project (Pj04) in the SESAR 2020 Programme.

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

- Other collaborative tools (i.e: chat, notifications, blinking events) that has been agreed to be part of the APOC during the validation exercises, must be specified in detail to determine for instance: if it is needed private rooms, different types of notifications or what must be blink;

- As consequence of the first V3 validation, the number of KPIs should be reduced, so for this aim the relationships between performance alerts and warnings should be defined to determine when really there is, or will be, an issue that must be dealt with by airport stakeholders triggering only one alert instead of several alerts or warnings;
- As it has been discussed in the second V3 validation, the APOC 'what-if' mode should be introduced that will allow airport stakeholders to assess what the given performance situation will be based on the variables that define the possible solutions;
- Introduce the specification of a mechanism that allow the system to detect automatically a set of possible operational solutions based on past experiences, as it has been discussed in the EXE-06.05.04-VP-757;
- As consequence of the second V3 validation discussions and debriefings, the post-operational analysis needs to be further improved to determine the success variables assessment that could be used to specify the mechanism to evaluate a solution that can be used in future cases with similar inputs; and
- Further research and development work should aim towards achieving the integration of relation airport performance management concepts, notably Airport Demand and Capacity Balancing (A-DCB) which will support User Driven Priority Process (UDPP) and Network Dynamic DCB concepts.
- Define and organize the KPIs in the right dashboards and structure so the system could provide a fast way to show the situational awareness.

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