



SESAR Solution PJ.04-01

Enhanced Collaborative Airport Performance Planning and Monitoring.

Purpose:

This contextual note introduces the SESAR Solution PJ04-01. This Solution already achieved a V2 maturity level at the end of 2018 as foreseen in the H2020 Grant Agreement n°733121. In addition, along 2019, additional activities were performed by giving some first steps towards the V3 maturity level. This report provides to any interested reader (both external and internal to the SESAR programme) an introduction to the SESAR Solution in terms of its scope, main operational and expected performance benefits, relevant system impacts as well as additional activities to be conducted during the following validation phases foreseen until 2022 within SESAR Wave2 stage. This contextual note complements the technical data pack comprising the SESAR deliverables required for further V3 validation.

Improvements in Air Traffic Management (ATM)

SESAR Solution PJ.04-01 'Enhanced Collaborative Airport Performance Planning and Monitoring' is one of two Solutions within the Project PJ04 'Total Airport Management' (TAM). As can be understood by the project title, TAM is concerned with taking a 'holistic' view of airport operations, including the three key processes (aircraft, passengers, baggage) and more importantly, the interaction between them, as it is the degree of coordination between these different processes which constitutes a significant contributory factor to punctual and predictable operations and ultimately therefore passenger satisfaction.

Solution PJ.04-01 'Enhanced Collaborative Airport Performance Planning and Monitoring' builds on the work performed in SESAR1 specifically in relation to Release 5 SESAR Solution #21 ('Airport Operations Plan (AOP) and AOP-NOP Seamless Integration'). Solution PJ.04-01 seeks to further increase the 'quality' of the AOP through the inclusion of an increased set of data capturing the knowledge coming from a wider range of airport processes.

The further development of the collaborative management through the AOP-NOP (Airport Operations Plan - Network Operations Plan) of both en-route and airport capacity constraints through target times will take place leading to more flexible constraint management and with increased involvement of all key stakeholders.

The Solution extends and completes beyond the airside-operating environment and addresses more processes within the terminal infrastructure that have a performance impact on flight predictability and efficiency, in this case monitoring the progress of passengers with reduced mobility and the baggage through the airport from check-in to the gate and through the Baggage Handling systems. Monitoring data is stored in the AOP and allows stakeholders to increase their confidence around Target Off Block Time (TOBT) accuracy and stability.



Turn-round monitoring will be extended and enhanced by inclusion of Landside-CDM information provided by the outputs of the passenger and baggage process chains. The output of these process-chains may affect the overall Air Traffic Management (ATM) performance.

The enhancement of the Turn-round process includes monitoring all the related airport activities and providing a set of indicators for real time monitoring to measure and steer the overall airport performance.

As this concept has not been validated before there is some room left to further detail how information from Ground Handling Agents and landside processes can be utilized to enable all actors to make coordinated and ultimately better decisions that contribute to better overall airport performance.

In addition to integration of extended information relevant for Turn-round processes, it is necessary to further develop the outline of how turn-round processes shall be addressed and specifically how the Turn-round processes should be monitored by the Airport Operations Centre (APOC) enabling collaborative decision-making and performance management.

Post Operations will be enhanced by the provision of analytical tools that will serve to make reports in an automatic and ad hoc way to ensure robust and continuous feedback. Post Operations based on the analysis of recorded data managed in the AOP will foster insights from ad-hoc operational situations and support actions for improvement.

Additionally the solution introduces a new concept that fill the gap between the full A-CDM (Airport Collaborative Decision Making) and the Advanced ATC Tower for medium and small airports that will increase the accuracy and anticipation in traffic prediction, optimizing the CDM algorithm (reduction of milestones from 16 to 7) and increasing the automation to better support the handling service. This new concept is called Regional Network integration (RNI).

Also the solution will tackle cybersecurity aspects that could have an impact in all the data shared among the stakeholders involved.

An airport which deploys SESAR Solution PJ.04-01 once reaching v3 maturity will be one which is at the forefront of holistic process monitoring and is fully integrated into the overall ATM network. Its operational community will have access to rich data source in real-time through its 'advanced' AOP and it will be providing the network with high levels of predictability in relation to its flights.



Operational Improvement Steps (OIs) & Enablers

Prerequisite Baseline Operational Improvement Steps (SESAR Solution #21)

- AO-0801-A: [Collaborative Airport Planning Interface](#) – fully covered.
- AO-0802-A: [A-CDM process enhanced through integration of landside \(passenger only\) process outputs](#) – fully covered.
- AO-0803: [Integration of airports into ATM through Monitoring of Airport Transit View \(Extension of Performance Monitoring building on A-CDM\)](#) – fully covered.
- DCB-0310: [Improved Consistency between Airport & ATFCM Planning](#) – fully covered.

Prerequisite Baseline ENB (SESAR Solution #21)

- AIRPORT-02: [TTA Airport Impact Assessment tool](#)
- AIRPORT-03: [Airports Operation Plan \(AOP\) management tool](#)
- AIRPORT-04: [De-icing support tool in a A-CDM environment](#)
- AIRPORT-31: [Airport CDM \(levels 1, 2 & 3\)](#)
- AIRPORT-35a: [Airport CDM \(level 4 - CDM integrated with passenger process\)](#)
- AIRPORT-38: [Airport/ATFCM Extended data interface](#)
- AIRPORT-40: [Airport Performance Monitoring System](#)
- AOC-ATM-13: [Participating of the FOC/ WOC in the airport triggered CDM process](#)
- CTE-06b: [PENS Phase 2](#)
- HUM-007: [New communication and interaction patterns between stakeholders of airport operations linked to collaborative rolling AOP/NOP management](#)
- HUM-014: [New interactions and communication patterns for the integration of landside process outputs into the A-CDM process](#)
- HUM-015: [New working methods for the integration of landside process outputs into the A-CDM process](#)
- HUM-016: [New working methods for the integration of the Airport Transit View \(ATV\) into the A-CDM process](#)
- METEO-03: [Provision and monitoring of real-time airport weather information, Step 1](#)
- METEO-04b: [Generate and provide MET information services relevant for Airport and final approach related operations, Step 1](#)
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- **NIMS-41:** [NM interface capable to integrate Airport impact assessment](#)
- **PRO-028:** [Procedures to support AOP-NOP collaborative process](#)
- **PRO-073a:** [Procedures to optimise the de-icing process within the constraints of the operational schedule, the optimal runway use and the local de-icing capacity](#)
- **REG-0510:** [Regulatory Provisions for the integration and use of meteorological information in ATM operations and systems in a harmonised manner](#)
- **SWIM-APS-03a:** [Provision of ATFCM Information Services for Step 1](#)
- **SWIM-APS-04a:** [Consumption of ATFCM Information Services for Step 1](#)
- **SWIM-INFR-05a:** [General SWIM Services infrastructure Support and Connectivity](#)
- **SWIM-NET-01a:** [SWIM Network Point of Presence](#)

The Operational Improvement Steps under the scope of the SESAR Solution PJ.04-01 are:

AO-0801-B [Collaborative Airport Planning Interface \(AOP fully integrated with NOP & local business rules\)](#)

This OI is already V2 (SESAR 1) and is going to be V3 validated in Wave 2.

AO-0802-B [A-CDM process enhanced through integration of landside \(passenger and baggage\) process outputs](#)-Fully Covered

AO-0824 [Network-connected Regional Airports](#)-Fully Covered

AO-0821 [Post-Operations Analysis support solutions and reporting capabilities](#)-Fully Covered

AO-0818 [Extended Turn-round monitoring](#) -Fully Covered

The Enablers supporting the SESAR Solution PJ.04-01 are:

AIRPORT-02b [Enhanced Airport Impact Assessment Tool](#)

AIRPORT-03b [Enhanced Airport Operation Plan \(AOP\) Tool](#)

AOC-ATM-20 [Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services](#)

HUM-010 [New role of APOC representative from Ground Handling Agent](#)

NIMS-25 [Integration of Airport CDM data into Network DCB sub-system](#)



NIMS-46	<u>Integrated local DCB working position</u>
NIMS-48	<u>Integrated Network Working Position (iNWP)</u>
NIMS-52	<u>Enhancement of ETFMS for including airport constraints</u>
PRO-095	<u>Airline Operational Procedures for modifying RBT/ATV including agreed TTA to accommodate selected priorities</u>
PRO-096	<u>Airline Operational Procedures for modifying SBT/ATV including agreed TTA to accommodate selected priorities</u>
SWIM-APS-03b	<u>Provision of ASM-ATFCM Information Services for Step 2</u>
SWIM-APS-04b	<u>Consumption of ATFCM Information Services for Step 2</u>
SWIM-INFR-05b	<u>General SWIM Services infrastructure Support and Connectivity</u>
AIRPORT-35b	<u>Airport CDM (level 4 - CDM integrated with landside processes)</u>
AOC-ATM-13	<u>Participating of the FOC/ WOC in the airport triggered CDM process</u>
AIRPORT-40b	<u>Enhanced Airport Performance Monitoring System (Airside/Landside dashboard)</u>
AIRPORT-09	<u>Airport Data Replay System (Optional)</u>
AIRPORT-51	<u>Airport Data Recording System</u>
AIRPORT-54	<u>Airport Data Analysis System (Post-Ops based on Recording)</u>
AIRPORT-03c	<u>Light Airport Operational Plan (AOP) management tool (for regional airports)</u>
AIRPORT-50	<u>Airport Operational Model database for determination of CDM event milestones</u>

Applicable Integrated Roadmap Dataset is DS19.



Background and validation process

During the Wave 1 stage, the solution completed the V2 maturity level through a series of activities:

- V2 exercises using Real Time Simulation (3 exercises), live trial (1 exercise), and shadow mode (1 exercise) validation techniques:
 - AO-0802-B - A live trial exercise at Palma de Mallorca Airport focused on the impact of the landside processes (PRM and baggage) on final TOBT (Target Off Block Time). This validation paid special attention to predictability and punctuality Key Performance Areas (KPA);
 - AO-0824 - A Shadow Mode exercise at Alicante Airport tested the feasibility of adapting the current A-CDM concept to regional airports. This validation results were promising, increasing the accuracy and traffic prediction as much as the automation to better support the handlers with a reduced set of A-CDM milestones (7 instead of 16 in the current A-CDM concept);
 - Real Time Simulations:
 1. AO-0821 - Post Operations Analysis at Bratislava Airport focused on monitoring the status of operations in real time and increasing both situation awareness and predictability with a post operations tool providing reports based on records in automatic way.
 2. AO-0821 - Post Operations Analysis at Madrid Airport, which mainly focused on the data gathered at Madrid Airport, with the additional participation of Palma de Mallorca, Barcelona and Alicante staff. This new tool provided the flexibility to create ad hoc and automatic reports using a friendly interface. This platform helped in increasing the predictability and the punctuality of airport operations, paving the way for machine learning environment in a subsequent step.
 3. AO-0802-B/AO-0818 - Focusing on Transfer passengers and extended turn-round at Lyon Airport helped in increasing the predictability of turn-round and transfer passengers as a key element for decision making, increasing punctuality and avoiding delays.
 - A cybersecurity activity was also conducted at Lyon Saint Exupéry airport.
- V3 on going exercises included exercises using Live Trial (2 exercises), Shadow Mode (2 exercises) and Real-Time (1 exercise) validation techniques. A high-level summary of each validation is presented hereafter:



- o AO-0802-B/AO-0818 - The S1V2 exercise performed at LYS airport using Real Time simulation technics, needed simulators specifically developed in order to test the turnaround and the transfer passenger processes. TRA and PAX processes could not be considered definitively validated without the integration with the real environment. This is the normal continuation of the exercise itself: the simulators used for the V2 phase were completely removed and in V3 the real environment was used instead. In order to proceed with this strategy, specific integrations between Thales AOP Platform and the LYS real environment were necessary: the result is the possibility to test the TRA and PAX processes in a real way. The technique chosen has been Shadow Mode: this technique has the advantage to test the integration with the real environment, avoiding at the same time any kind of interaction with the normal and abnormal airport daily situations.
- o AO-0802-B - A live trial exercise at Palma de Mallorca Airport focused on the impact of the PRM landside process on final TOBT (Target Off Block Time). Although the TSBT (Target Start Boarding Time) concept was successfully validated in the V2 exercise, the algorithm was changed several times based on the observations of the different trial sessions. The next step was to validate the algorithm fine-tuned and provide the AOP information directly to the PRM service provider in a Live Trial. Therefore, this validation paid special attention to the PRM service provider. PRM coordinators used accurate AOP information so as to improve the decision-making process, increasing the predictability, punctuality and flexibility Key Performance Areas (KPA).
- o AO-0801-B - 1 shadow mode in Barcelona airport addressing the collaboration between the destination airport (AOP) and ANSP (AMAN (Arrival Manager)) that helped to improve the level of predictability and punctuality of arrivals.
- o AO-0821 - 1 Real-time Post Operation Data Analysis in multiple Airports. Using data from 7 Spanish airports and with the participation during the validation of PMI, BCN and MAD, this new tool provided the flexibility to create ad hoc and automatic reports using a friendly interface. This V3 activity differed from V2 not only in the scope of the airports included, but also with the integration of METEO information and the use of correlation analyses to see possible degree of impact of METEO on operations. This platform can help to increase the predictability and the punctuality paving the way to the learning environment in next steps.
- o AO-0824 - A Live Trial exercise at Alicante Airport focused on adapting the A-CDM concept to regional airports. The excellent results obtained in the V2 exercise demonstrated its feasibility, with the support of all the local airport partners, Alicante Airport decided to take forward the concept to a level of V3 maturity and perform a Live Trial. The validation exercise was performed in a real environment with all the participants working from their own facilities as they do in normal conditions.



Results and performance achievements

PJ04-01 through the different validations that were performed during Wave 1 confirmed that early alerting capability, and sharing of information, two key aspects of the Solution:

- AO-0802-B/AO-0818/ AO-0801-B/ AO-0824 allow to increase predictability and accuracy by 0,784 min² (1,6% benefit), as they helped identify deviations and disruptions at an earlier stage, which lead to earlier implementation of mitigation actions(allocation of resources within the airport, slot allocation etc);
- AO-0802-B/AO-0818/ AO-0801-B/ allow to increase punctuality by at least 1,9% and up to 18% in some specific scenarios, as consequence of increased predictability and flexibility;
- AO-0802-B/AO-0818 allow to increase fuel efficiency by reducing fuel burn by 3,5kg/ impacted flight (0,04% benefit)
- AO-0802-B/AO-0818 allow to increase flexibility, as they supported earlier and better decision making;

Moreover, this Solution improved the understanding of how specific landside airport processes affected airport and ATM operations, thus leading to improvement in the processes themselves, with a potential benefit to predictability, flexibility, and punctuality. Not only the landside process improve the performance above also the extended monitoring of the turn-round will help to improve predictability and punctuality as long as the observation and analysis of the past and current operation through the post operations analysis will help to understand how the different process and actors affect one another.

Recommendations and Additional activities

The expected maturity of this Solution at the end of Wave 1 is “V3 ongoing”. Below is a list of those remaining activities which are needed to bring the Solution to full V3 maturity and which will be performed in TAM project wave 2 (Dec 2019 - Dec 2022):

OI Step	Known Gaps	Level of Maturity		
		V2	V3	
AO-0801-B	The integration of local business rules of the airport taking into account airlines business priorities.	Achieved (Wave 1)	On-going (Wave 1)	To be achieved (Wave 2)



OI Step	Known Gaps	Level of Maturity		
		V2	V3	
AO-0802-B	Inclusion in the TAM concept description of: - additional airline needs (FOC integration) - additional passenger processes. (e.g. queues at security checkpoints) - Baggage processes	Achieved (Wave 1)	On-going (Wave 1)	To be achieved (Wave 2)
AO-0818	Inclusion in the TAM concept description of additional Ground Handling needs (GH considered as Stakeholder).	Achieved (Wave 1)	On-going (Wave 1)	To be achieved (Wave 2)
AO-0824	Validation took place at one airport only. There is a need for an additional validation exercise in wave 2 for consolidation of the ' <i>Network-connected regional airports</i> ' concept, modelling and results.	Achieved (Wave 1)	On-going (Wave 1)	To be achieved (Wave 2)

The further development of the Solution 1 OIs will be carried out in the framework of PJ04 Wave 2. The structure of this project is articulated around two new solutions focusing on the airport and its role in the network on the one hand, and on airport centric operational issues on the other hand.

The OIs embedded in this Solution are proposed to be addressed in future deployment-oriented solutions in wave 2:

- AO-0824 in a "Connected Regional Airports" solution. The objective will be to close-out V3 validations in order to develop appropriate guidance material and, if needed, applications supporting deployment for regional airports seeking to increase their connectivity to the ATM network;
- AO-0801-B in a "Connected Large Airports" solution with a specific focus on AOP/NOP data exchange including associated quality requirements;
- AO-0818 and AO-0802-B in an "Airside/Landside Performance Management Solution.



All those solutions above will target V3 maturity phase in line with the work already achieved.

Note: AO-0821 is not part of Wave2 as an OI. Nevertheless, its enablers have been cascaded in OIs of Solutions 29.1, 29.2 and 29.3 that needed them. Wave2 will bring those enablers to V3 (but will not bring AO-0821 to V3). AO-0821 will be asked for deletion from the roadmap after Project Wave 1 closure.

Actors impacted by the SESAR Solution

Those actors (as defined in the PJ19 CONOPS) whose operations may be impacted by the deployment of PJ.04-01 are:

1. Airport Operators
2. Aircraft Operators / Handling Agents
3. ATC
4. The ATM Network Manager
5. Airspace Users

Impact on Aircraft System

Not applicable.

Impact on Ground Systems

Solution PJ04-01 assumes that the necessary interfaces are already in place to permit the bilateral exchange of information between the AOP and NOP via a System Wide Information Management (SWIM) compliant B2B connection. Again, the existing ground systems shall have been modified to ensure that the communication protocol is in place. Specifically:

- PRM (Passengers with Reduced Mobility) system shall be adapted in order to allow the exchange of information regarding the PRMs in arrival and departure flights.
- Baggage Holding system shall be prepared to share baggage information
- Access to historic information of the airport shall be permitted from the post analysis point of view
- Turnaround milestones data (planning and execution) shall be available

Regarding Regional Network Integration (RNI), the handling agents will need access to the A-CDM timestamps and the ground system must be capable of transmitting A-CDM DeParture Information (DPI) messages. Similarly ground system must be capable of extracting Estimated Landing Times (ELDT) from Flight Update Messages (FUM) messages.



Regulatory Framework Considerations

Solution PJ04-01 has been developed within the SESAR2020 Programme - the Research and Development arm of the European Single Sky legislation. Of particular relevance is the Single European Sky Interoperability Regulation (EC 552/2004) and amended (SES2) by regulation EC 1070/2009, specifically the pillars relating to managing capacity on the ground as well as EC Implementing Rule IR390/2013 laying down a performance scheme for air navigation services and network functions with respect to the airport-related KPIs (IR390/2013 - Annex 1).

Several EU Regulations and Directives already constrain aviation and airports current operations and future development, and at least impose airports to monitor their impact notably on noise and ambient air quality:

- The Regulation No 390/2013 of 3 May 2013 laying down a performance scheme for air navigation services and network functions with respect to the airport-related KPIs;
- The Regulation No 598/2014 of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC;
- The Directive No 2002/49/EC of 25th June 2002 relating to the assessment and management of environmental noise;
- The Directive No 2008/50/EC of 21st May 2008 on ambient air quality and cleaner air for Europe;
- The Directive No 2016/2284 of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, the National Emission Ceilings Directive (NEC Directive) from the date of its transposition (30 June 2018) ensuring that the emission ceilings for 2010 set in that Directive shall apply until 2020.

Solution PJ04-01 does not fall within the existing Pilot Common Project legislation (EU 716/2014). Nevertheless, future amendments to this regulation – particularly the creation of additional common projects in the areas of integration and throughput and Network collaborative management – could impact PJ04.

Standardization Framework Considerations

It is expected that standardisation will be limited to the definition of the interfaces between those specific data elements needed in the deployment of PJ04-01 and with existing operational systems, as is the case for the EUROCAE (ED145) interface regulation relating to A-CDM. PJ04-01 may therefore lead to an evolution of existing data interface standards.

There are several bodies drawing up standards in Europe and EUROCONTROL is actively supporting ICAO, EUROCAE and other standards bodies. Recently the development of

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EUROCONTROL ‘standards’ (e.g. in the domain of Advanced Surface Movement and Control Systems (A-SMGCS), Time Based Separation (TBS) ...) has been recognised by the European Aviation Safety Agency (EASA) as a means of generating compliance and guidance material. The development of such a EUROCONTROL standard by PJ.04 relating to AOP/NOP information sharing, in collaboration with the Network Manager, is expected to efficiently lead toward the generation of appropriate standards. Indeed, at the project level, and as an inherent part of the V3 validation maturity assessment, the Solution Data Packs will document the need for development of new standards or the modification of existing ones where relevant and ensuring that relevant data and requirements are captured in support of the future (V4) development of standards within the above-mentioned bodies and with whom liaison will take place throughout the course of the project.

Any future Standard would therefore be developed with the aim of ensuring that a common approach to implementation can be achieved provided that ATM actors adhere to the prescribed data exchange elements (for information exchange between stakeholders), that data is exchanged in the prescribed format (i.e. using SWIM); and the new airport performance services are introduced following the principle of achieving increased situational awareness and collaborative management of deviations from the operating plan.

RNI will be added to the A-CDM Manual for regional airports.

Considerations of Regulatory Oversight and Certification Activities

No activities are identified at this stage

Solution Data pack

Although this is V3 Ongoing CN, it is worth to detail the, already delivered in the past, V2 data pack for this SESAR Solution that included the following documents:

- SESAR Solution PJ04-01 SPR-INTEROP/OSED for V2 – D2.1.040- This document defines the operational methods, environments scenarios, uses cases and requirements for the operation concept of the Total Airport Management(TAM).Also the performance requirements associated to the Predictability, Efficiency and Flexibility Key Performance Areas(KPAs) impacting mostly in Airport Operations management and other KPAs impacting in a second stage like Safety, Security and Human Performance besides also interoperability requirements based upon the information Exchange requirements(IERs).
- SESAR Solution PJ.04-01 VALR for V2- D2.1.070- This document provides the results regarding the different validation exercises and how the contribute to the validation of the solution as a whole.



- SESAR Solution PJ.04-01 TS/IRS for V2- D2.1.080 - This technical specification document contains requirements on architecture, functions and capabilities of the technical systems enabling SESAR Solution PJ04-01 validation targets.
- SESAR Solution PJ.04-01 CBA for V2- D2.1.090 - This document provides the Cost Benefit Analysis (CBA) at V2 level. The objective is to identify the main elements and assumptions that will support the development of a CBA Model and to quantify and monetise the costs and benefits of the solution.

The following documents did not form part of the Data Pack, but were relevant to support V2 Maturity Gate.

- SESAR Solution PJ04-01 CN for V2-D2.1.013;
- SESAR Solution PJ.04-01 Roadmap for V3-D2.1.010 – This document describes how validation exercises are planned and organised for the Solution to address V3 stage.

Intellectual Property Rights (foreground)

The foreground is owned by the SJU.



SESAR Solution 04.01 SPR/INTEROP-OSED V3 - Part V - Performance Assessment Report (PAR)

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TAM

TOTAL AIRPORT MANAGEMENT

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Abstract

This document provides the V3 ongoing Performance Assessment Report for solution PJ.04-01 — Enhanced Collaborative Airport Performance Planning and Monitoring. The PAR consolidates solution performance validation results and estimates where no validation results are present.

The solution extends the airport performance monitoring process - developed in SESAR 1 OFA05.01.01 - to the airport landside and ground access processes that may have an impact on the airside operations in both planning and execution timeframes. It sees the development of rationalised dashboard(s) fed with all landside and airside key performance indicators and covering total airport management processes.

The solution plans to address stakeholders' needs specifically within the KPA targets of **Efficiency, Predictability and Punctuality**. Additional activities to complement and further support the development and validation of the Operational Improvements will be conducted within the transversal performance assessments, most notably the safety, security, and human performance assessments.

The solution is expected to be fully compatible with the Network Operations Plan (NOP). SWIM is expected to provide the tools of communication between the local airport and the rest of the European ATM network. It is expected that the initiatives being developed in other solutions will support the PJ04-01 solution through the improvement of data accuracy, timely communications and reliability of individual operator performance.



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1 Executive Summary

This document provides the V3 ongoing Performance Assessment Report (PAR) for solution PJ.04-01 — Enhanced Collaborative Airport Performance Planning and Monitoring.

The PAR is consolidating Solution performance validation results addressing KPIs/PIs and metrics from the SESAR2020 Performance Framework [3].

Description:

The SESAR 2020 Solution - Enhanced Collaborative Airport Performance Planning and Monitoring (PJ.04-01) - will extend the SESAR 1 Airport Performance process monitoring to the airport landside and ground access processes that may have an impact on the airside operations in both planning and execution timeframes.

It reflects the change from the SESAR 1 approach of independently observing ground/landside access, passenger and baggage flows, towards an integrated concept of managing the interactions of these flows with the aircraft process.

The aim is to develop dashboard(s) in the APOC that present clear situational data on all relevant landside and airside areas, monitor and track operational performance against the leading key performance indicators that cover the Total Airport Management processes, both current and forecast.

The APOC shall get an early warning indicator of any problem resulting in possible delays or having any other negative impact on airside operations. This helps to improve predictability and operational resilience. Improved communications between Airspace Users and APOC will help to increase airspace users' awareness of operational targets and improves the management of the turnaround process.

The Airport Operations Plan as defined in SESAR 1 will be further developed in collaboration with techniques for Advanced Demand & Capacity Balancing (PJ.09), mainly in terms of enhancing the benefits of collaborative processes and associated procedures between AOP and NOP in a SWIM environment. With the view of harmonization, the Solution will identify the criteria for effective European standardization for future deployment including minimum data quality requirements necessary to retain the expected benefits.

Apart from the information presented in the dashboards, the system environment will incorporate tools enabling recording from video cameras, radar data and r/t playback together with the timely analysis of specific events and ad-hoc or periodic reporting specific to management requirements.

More Information can be found in Chapter 2

Assessment Results Summary:

The following table summarises the assessment outcomes per KPI and puts them side-by side against Validation Targets from PJ19 [18]. An assessment result of 0 with confidence level N/A, for not applicable, indicates that the Solution is not expected to impact the KPI. An assessment result of 0 with



confidence level other than N/A means that the Solution was expected to (possibly) impact the KPI but has not been assessed to do so.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Expectations at Network Level (ECAC Wide or Local depending on the KPI) ¹	Benefits at Network Level depending on the KPI	Confidence in Results ²
FEFF1: Fuel Efficiency – Fuel burn per flight	1,94%	-1,92 Kg/ total ECAC flights (0,04% benefit) 22191 impacted flight -3,5kg/ impacted flight		low
CAP1: TMA Airspace Capacity – TMA throughput, in challenging airspace, per unit time.	N/A	0%		N/A
CAP2: En-Route Airspace Capacity – En-route throughput, in challenging airspace, per unit time	N/A	0%		N/A
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	N/A	0%		N/A
PRD1: Predictability – Variance of Difference in actual & Flight Plan or RBT durations	4,19	0,98 min ² (2,0% benefit) 11 min/impacted flight		medium
PUN1: Punctuality – % Flights departing within +/- 3 minutes of scheduled departure time due to ATM	1,72%	15%		medium

¹ Negative impacts are indicated in red.

² High – the results might change by +/-10%

Medium – the results might change by +/-25%

Low – the results might change by +/-50% or greater

N/A – not applicable, i.e., the KPI cannot be influenced by the Solution



and weather related delay causes			
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	N/A	N/A	N/A
CEF3: Technology Cost – Cost per flight	0,873% ³	0 EUR/flight 0% change N/A	N/A
SAF1: Safety - Total number of fatal accidents and incidents with ATM Contribution per year	N/A	0%	N/A

Table 1: KPI Assessment Results Summary

Mandatory PI	Performance Expectations at Network Level (ECAC Wide or Local depending on the KPI) ⁴	Benefits at Network	Confidence in Results ⁵
SAF1.X: Mid-air collision – En-Route	0		N/A
SAF2.X: Mid-air collision – TMA	0		N/A
SAF3.X: RWY-collision accident	0		N/A
SAF4.X: RWY-excursion accident	0		N/A
SAF5.X: TWY-collision accident	0		N/A
SAF6.X: CFIT accident	0		N/A

³ In Validation Targets [18] the unit for CEF3 is % reduction in technology cost per flight.

⁴ Negative impacts are indicated in red.

⁵ High – the results might change by +/-10%
Medium – the results might change by +/-25%
Low – the results might change by +/-50% or greater
N/A – not applicable, i.e., the KPI cannot be influenced by the Solution



SAF7.X: Wake related accident	0	N/A
SEC1: Personnel (safety) risk after mitigation	No change	High
SEC2: Capacity risk after mitigation	No change	High
SEC3: Economic risk after mitigation	No change	High
SEC4: A security risk assessment has been carried out	No change	High
SEC5: Risk Treatment has been carried out	No change	High
SEC 6: Mitigated Risk level per Supporting Asset are lowered after risk treatment	No change	High
FEFF2: CO2 Emissions.	-6 kg/total ECAC flights (0,04 benefits)	low
FEFF3: Reduction in average flight duration.	-0,107 min/flight (0,12 benefits)	low
NOI1: Relative noise scale	0	N/A
NOI2: Size and location of noise contours	0	N/A
NOI4: Number of people exposed to noise levels exceeding a given threshold	0	N/A
LAQ1: Geographic distribution of pollutant concentrations		
CAP5: ARES Capacity (Requested/Available ARES Capacity)	0	N/A
CAP3.1: Peak Departure throughput per hour (Segregated mode)	Possible secondary effect, but too low to even estimate.	Low
CAP3.2: Peak Arrival throughput per hour (segregated mode)	0	N/A
CAP4: Un-accommodated traffic reduction	0	N/A
RES1: Loss of Airport Capacity Avoided	1,0%	Low
RES1.1: Airport time to recover from non-nominal to nominal condition	1,0%	Low
RES2: Loss of Airspace Capacity Avoided.	N/A (Possible secondary effect, but ECAC level	Low



	effect cannot be estimated.)	
RES2.1: Airspace time to recover from non-nominal to nominal condition.	N/A (Possible secondary effect, but ECAC level effect cannot be estimated.)	Low
RES4: Minutes of delays.	1,0%	Low
RE5: Number of cancellations.	1,0%	Low
CEF1: Direct ANS Gate-to-gate cost per flight	0	N/A
AUC3: Direct operating costs for an airspace user	0,0%	Low
AUC4: Indirect operating costs for an airspace user	1%	Low
AUC5: Overhead costs for an airspace user	1%	Low
CMC1.1: Available/Required training Duration within ARES	N/A	N/A
CMC1.2: Allocated/ Optimum ARES dimension	N/A	N/A
CMC1.3: Transit Time to/from airbase to ARES	N/A	N/A
CMC2.1: Fuel and Distance saved (for GAT operations)	N/A	N/A
CMC2.2: GAT planning efficiency of Available ARES	N/A	N/A
HP1: Consistency of human role with respect to human capabilities and limitations	No change	High
HP2: Suitability of technical system in supporting the tasks of human actors	No change	High
HP3: Adequacy of team structure and team communication in supporting the human actors	No change	High
HP4: Feasibility with regard to HP-related transition factors	No change	High
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	0	N/A

Table 2 Mandatory PIs Assessment Summary



Additional Comments and Notes:

The benefits shown in this PAR are broken down into three categories; Direct benefits based upon validation exercise result extrapolations, Secondary effect benefits whose numbers are based upon estimations, and Possible secondary effects where there are no estimations possible that would have any credibility.



2 Introduction

2.1 Purpose of the document

The Performance Assessment covers the Key Performance Areas (KPA) defined in the SESAR2020 Performance Framework [3]. Assessed are at least the Key Performance Indicators (KPIs) and the mandatory Performance Indicators (PIs), but also additional PIs as needed to capture the performance impacts of the Solution. It considers the guidance document on KPIs/PIs [3] for practical considerations, for example on metrics.

The purpose of this document is to present the performance assessment results from the V3 ongoing validation exercises at SESAR Solution level. The KPA performance results are used for the performance assessment at a strategic level and provide inputs to the SESAR Joint Undertaking (SJU) for decisions on the SESAR2020 Programme.

In addition to the results, this document presents the assumptions and mechanisms (how the validation exercises results have been consolidated) used to achieve this performance assessment result.

One Performance Assessment Report shall be produced or iterated per Solution.

2.2 Intended readership

In general, this document provides the ATM stakeholders (e.g. airspace users, ANSPs, airports, airspace industry) and SJU performance data for the Solution addressed.

Produced by the Solution project, the main recipient in the SESAR performance management process is PJ19, which will aggregate all the performance assessment results from the SESAR2020 solution projects PJ1-18, and provide the data to PJ20 for considering the performance data for the European ATM Master Plan. The aggregation will be done at higher levels suitable for use at Master Planning Level, such as deployment scenarios. Additionally, the consolidation process will be carried out annually, based on the SESAR Solution's available inputs.

2.3 Inputs from other projects

The document includes information from the following SESAR 1 projects:

- B.05 D72 [5]: SESAR 1 Final Performance Assessment, where are described the principles used in SESAR1 for producing the performance assessment report.

PJ19 will manage and provide:

- PJ19.04.01 D4.7 [3]: Performance Framework (2019), guidance on KPIs and Data collection supports.
- PJ19.04.03 D4.0.1: S2020 Common assumptions, used to aggregate results obtained during validation exercises (and captured into validation reports) into KPIs at the ECAC level, which will in turn be captured in Performance Assessment Reports and used as inputs to the CBAs



produced by the Solution projects. Where are also included performance aggregation assumptions, with traffic data items.

- For guidance and support PJ19 have put in place the Community of Practice (CoP)⁶ within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

See the AIRM Glossary [1] for a comprehensive glossary of terms.

2.5 Acronyms and Terminology

Term	Definition
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
BAD	Benefits Assessment Date
BAER	Benefit Assessment Equipment Rate
CBA	Cost Benefit Analysis
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
DB	Deployment Baseline
KPA	Key Performance Area
KPI	Key Performance Indicator
N/A	Not Applicable
OI	Operational Improvement

⁶

<https://stellar.sesariu.eu/?link=true&domainName=saas&redirectUrl=%2Fisp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Aview%3Aaxrn%3Adatabase%3Aondb%2Ftable%2F59%20anonymous%402333834.13%403834139.13>

Founding Members





PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
QoS	Quality of Service
RBT	Reference Business / Mission Trajectory
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the SJU.

Table 3: Acronyms and terminology



3 Solution Scope

3.1 Detailed Description of the Solution

The SESAR 2020 Solution - Enhanced Collaborative Airport Performance Planning and Monitoring (PJ.04-01) - will extend the SESAR 1 Airport Performance process monitoring to the airport landside and ground access processes that may have an impact on the airside operations in both planning and execution timeframes.

It reflects the change from the SESAR 1 approach of independently observing ground/landside access, passenger and baggage flows, towards an integrated concept of managing the interactions of these flows with the aircraft process.

The aim is to develop dashboard(s) in the APOC that present clear situational data on all relevant landside and airside areas, monitor and track operational performance against the leading key performance indicators that cover the Total Airport Management processes, both current and forecast.

The APOC shall get an early warning indicator of any problem resulting in possible delays or having any other negative impact on airside operations. This helps to improve predictability and operational resilience. Improved communications between Airspace Users and APOC will help to increase airspace users' awareness of operational targets and improves the management of the turnaround process.

The Airport Operations Plan as defined in SESAR 1 will be further developed in collaboration with techniques for Advanced Demand & Capacity Balancing (PJ.09), mainly in terms of enhancing the benefits of collaborative processes and associated procedures between AOP and NOP in a SWIM environment. With the view of harmonization, the Solution will identify the criteria for effective European standardization for future deployment including minimum data quality requirements necessary to retain the expected benefits.

Apart from the information presented in the dashboards, the system environment will incorporate tools enabling recording from video cameras, radar data and r/t playback together with the timely analysis of specific events and ad-hoc or periodic reporting specific to management requirements.

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relationship	Rational of the relationship and calculation of the solution's aggregation
PJ.04-01PJ.04-02	Enhanced Collaborative Airport Performance Management	is pre-requisite to	PJ04-02 is an add-on solution to PJ04-01 to extend the benefits of total Airport Management. PJ.04-01 is the pre-requisite for PJ.04-02
PJ.04-01PJ.07-02	AU Fleet Prioritization and Preferences (UDPP)	No Cross Effect	The relationship PJ.07-02 has is with PJ.04-02. Two exercises have been planned with PJ.04-02



			to measure the impact UDPP can have on the APOC and to identify the interaction between the APOC and the AUs/UDPP Server. The relationship type is seen as: Compatible - dependant – interdependent.
PJ.04-01PJ.09-01	Network Prediction and Performance	No Cross Effect	The relationship with PJ04.01 and PJ07.02 is delicate. PJ09.01 is a pre-requisite to PJ09.03 which is closely linked to PJ07 and PJ04. By consequence, PJ09.01 is indirectly linked to these solutions. If you are looking for direct relationship then indeed, better consider that we do not have any. We are not directly working with them, but more through PJ09.03 and the OSED conception (we have one OSED for the whole PJ09) + our own AUs and APT in PJ09.01 to define the indicators.
PJ.04-01PJ.09-02	Integrated Local DCB Processes	No Cross Effect	The relationship with PJ04.01 and PJ07.02 is delicate. PJ09.01 is a pre-requisite to PJ09.03 which is closely linked to PJ07 and PJ04. By consequence, PJ09.01 is indirectly linked to these solutions. If you are looking for direct relationship then indeed, better consider that we do not have any. We are not directly working with them, but more through PJ09.03 and the OSED conception (we have one OSED for the whole PJ09) + our own AUs and APT in PJ09.01 to define the indicators.



PJ.04-01PJ.09-03	Collaborative Network Management Functions	Interdependent	Link due to their consideration in the Network Performance Management and Monitoring HK: PJ.09-03 provide AOP/NOP integration information exchanged with PJ.04-01 to improve both plans. -PJ.04-01 provide AOP information to PJ.09-03 - PJ.09-03 provide Network information (What if, identified hotspots) to PJ.04-01, as part of the DCB process (DCB collaborative framework)
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Table 4: Interactions with other Solutions



4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

Previous Validation Exercises (pre-SESAR2020, etc.) relevant for this assessment are listed below.

Organisation	Document Title	Publishing Date
OFA05.01.01	OFA 05.01.01 Solution 21 PAR	
OFA05.01.01	EXE 749 VALR	

Table 5: Pre-SESAR2020 Exercises

SESAR Validation Exercises of this Solution (completed ones and planned ones) are listed below.

Exercise ID	Exercise Title	Release	Maturity	Status
PJ04.01 V2.01	Passenger and baggage process on airport process CDM Palma de Majorca AO -802b (		V2	Q1 2018 completed
PJ04.01 V2.02	APOC platform Alicante (ENAI, Crida) AO-0801-b je le vois pas dans la presentation de Ester et le 0824 est nouveau c'est quoi ?		V2	Q2 2018 completed
PJ04.01 V2.03	Airport Post Analysis AO-0821 (ENAI, Crida)		V2	Q2 2018 completed
PJ04.01 V2.04	Landside integration in Airport CDM process Thales Lyon AO-0802b & AO-0818		V2	Q4 2018 completed
PJ04.01 V2.05	Network security and total airport management (TAM) Thales Lyon AO-0802b & AO-0818		V2	Q4 2018 completed
PJ04.01 V2.06	Post analysis Bratislava (LPS) AO-0821		V2	Q2 2018 completed
PJ04-01.V3.01	Integration of a suitable level of turnaround process planning and monitoring into the APOC.		V3	Q2 2019 Completed



PJ04-01.V3.02	A-CDM process enhanced through integration of landside (passenger and baggage) process outputs.		V3	Q3 2019 Completed
PJ04-01.V3.03	Collaborative Airport Planning Interface (AOP fully integrated with NOP)		V3	Q3 2019 Completed
PJ04-01.V3.04	Post Operations Analysis support solutions and reporting capabilities		V3	Q3 2019 Completed
PJ04-01.V3.05	A-CDM process in a simplified way in regional network integrated airports		V3	Q3 2019 Completed

Table 6: SESAR2020 Validation Exercises

The following table provides a summary of information collected from the V3 performance outcomes.

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
PJ04.01 V3.01	AO-0802-B AO-0818	To assess and quantify how the integration of a suitable level of turnaround process planning and monitoring into the APOC improves predictability and efficiency on the airport with positive knock-on effects on the ATM network.	Predictability and Punctuality benefits were inconclusive.	Predictability and Punctuality were not quantitatively measured.
PJ04.01 V3.02	AO-0802-B	To assess that thanks to the extension of the SESAR 1 Airport Performance process monitoring to the airport landside and ground access processes a positive impact on the airside operations in both planning and execution timeframes can be achieved.	Punctuality increase of 18%	
PJ04.01 V3.03	AO-0801-B	To validate and quantify the positive impact of the maintenance of the evolving content of the AOP including AOP-NOP information sharing and data exchange via SWIM as well as AOP-NOP collaborative processes based on information quality requirements on predictability at the airport.	Punctuality increase of 39% Predictability benefit was inconclusive	Predictability results were not aligned with punctuality, but data only represented one day's worth of operations.



PJ04.01 V3.04	AO-0821	To validate that the integration of a POAS supports a continuous airport learning environment leading to quantifiable improvements in predictability, flexibility, and efficiency.	Qualitative Airport Operator Efficiency increase	Performance improvements in the other KPAs would be secondary effects from the Post-Ops analysis
PJ04.01 V3.05	AO-0824	To assess the implementation in a simplified way of the A-CDM process in RNI airports including the Departure Manager as an input	Predictability increase from 11%-36%	Predictability increases as the measured time gets closer to the ATOT

Table 7: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

SESAR 1 estimated 22,000 daily flights affected over 38,740 based upon the 2024 forecast. SESAR 2020 estimate is estimating in 2035.

The PJ.04-01 Operational Improvements are not necessarily applicable everywhere. To answer the need for a scalable solution, a common approach to PJ.04-01 and PJ.04-02 was used to define a set of deployment assumptions and to identify groups of airports where both Solutions could be applicable and having the potential to bring significant benefits compared to the level of investment required.

The following Table 8 summarises the applicable operating environments for PJ.04-01.

OE	Applicable sub-OE	Special characteristics
AIRPORTS GROUP 1 39 airports 54% of traffic share I	highly congested airports that face regular DCB and capacity issues and with already an important volume of traffic	• A high utilisation of the capacity (more than 90% utilisation during 4 or more separate or consecutive peak hours a day) • An important network function (international hub or a primary node). • A highly constrained environment • A high level of airport slots coordination the whole year, winter and summer. • An important volume of traffic from 110.000 to 490.000 mvts per year • An sustained passengers growth A-CDM airports that are candidate to deploy the PCP functionalities related to Initial AOP and AOP/NOP integration
AIRPORTS GROUP 2 42 airports	Medium size airports that are not highly congested but operate close to their capacity and where congestion	• A medium utilisation of the capacity (50 – 90% utilisation during a limited number of hours a day, 1 or 2 peak hours) • Secondary node in the Network with scheduled connections to large hubs or acting as a major base for one or more low fare carriers



18% of traffic share	could rapidly propagate delays into the Network	• No specific environmental constraints • A high level of airport slots coordination the whole year, winter and summer. • A medium to high volume of traffic, between 40.000 to 135.000 mvts per year A medium passengers growth with lot of airports identified in Group 2 or 3 of the ACI 2016 Traffic Report
AIRPORTS GROUP 3 162 airports 21% of traffic share	Small airports that have no capacity issues but could benefit from a post ops analysis function to improve airport operations and optimise local resources	• A medium utilisation of the capacity (50 – 90% utilisation during a limited number of hours a day, 1 or 2 peak hours) • Secondary node in the Network with scheduled connections to large hubs or acting as a major base for one or more low fare carriers • No specific environmental constraints • A high level of airport slots coordination the whole year, winter and summer. • A medium to high volume of traffic, between 40.000 to 135.000 mvts per year • A medium passengers growth with lot of airports identified in Group 2 or 3 of the ACI 2016 Traffic Report

Table 8: Applicable Operating Environments.

Note that the classification used by PJ.04 differs from the classification developed by PJ.20 to define Airports sub operating environments in the EATMA database.

The mapping between the PJ.20 airports' dataset classification and the PJ.04-01 clustering of airports is presented in the table below:

PJ20 Classification	PJ.04 - Clustering of Airports			
	Group 1	Group 2	Group 3	Group 4
Very Large	12	0	0	0
Large	19	0	0	0
Medium	8	42	26	0
Small	0	0	83	0
Others	0	0	53	426
TOTAL	39	42	162	426
Share of Traffic	54%	18%	21%	7%
Volume of movements in 2016	9 334 820	3 164 652	3 686 329	1 155 416

Table 9: Mapping between PJ.04 airports Sub operating environments and PJ20 Airports classification



Note: the way the groups are recorded in the EATMA database is displayed in green colour in the table.

Depending on the group of airports, OIs have been considered as “essential” or “facultative” regarding a potential deployment (See [46])⁷:

- “Essential” means that significant benefits could be expected from the implementation of the OI;
- “Facultative” means that a potential decision for implementation might depend on specific operational characteristics and/or the balance between the expected benefits and the level of investment required.

The following Table 10 summarises the essential deployment details.

BAD	Specific geographical and/or stakeholder deployment
GROUP 1	None
GROUP 2	None
GROUP 3	AO-0821

Table 10: Deployment details.

Equipage details and how equipage influences benefits in the ramp-up phase is given in Table 11.

Min flight equipage rate	Opt flight equipage rate	BAER	AUs that need to equip	Start of flight equipage	End of flight equipage
Min equipage rate for having any benefits.	Equipage rate from which cost of equipping an additional flight exceeds the operational benefit of having the flight equipped	Benefits Assessment Equipage Rate – rate on which the benefit assessment is based.	Not applicable		

Table 11: Influence of Equipage on benefits.

⁷ It is to note that it is not because an OI is not foreseen to be deployed in a given group of airports that it prevents an airport from this group to deploy it.



There are not really any attributes that apply to Airport Operations Centre operations. The Airport Operations Center operates across the Long-term planning, Medium/short term planning, Execution, and Post Operations phases and is not directly related to any phase of flight. These attributes are very Controller centric

Solution PJ04-01 can be divided into three groups. One Group is the combination of OI Steps AO-0801-B, AO-0802-B and AO-0818. These three OI Steps are assumed to be deployed at Large and Medium airports. The second group would replace these three OI Steps with AO-0824, which would be the regional equivalent and be deployed in medium/small airports. These first two groups are not envisioned to ever be deployed in the same airport. The third group is the Post Operations AO-0821, which would be deployed alongside the other two groups. Since the entire solution will not be deployed in any single deployment scenario, the data collection, assessment, and ECAC extrapolations in the following sections are split into the different deployment scenarios.

Due to its nature of occurring after the execution phase has ended, AO-0821 does not contribute directly, nor does it have a clear secondary effect to any of the KPA(KPI)s. What it can provide is insight to inefficiencies in the operations that, if changed, could lead to improvements in most of these KPIs. However, which KPIs would be affected and by how much is very locally dependant, so it impossible to estimate the magnitude of the changes in KPIs that the implementation of a Post Operations analysis could bring, even though it is understood that it will insight on how to bring benefits. Therefore, it is not included in the following sections individually.



4.3 Safety

The Operational Improvements found within Solution 04-01 are similar in function, scope, and operating environment to those in Solution 21, that was validated within SESAR 1 OFA 05.01.01. For that reason, the Safety Criteria and Safety Plan for Solution 04-01 will be adapted from those found in [48].

Solution 04-01 does not contribute to safety benefits

4.3.1 Safety Criteria and Performance Mechanism

Solution 04-01 does not contribute to safety benefits

4.3.2 Data collection and Assessment

Solution 04-01 does not contribute to safety benefits

4.3.3 Extrapolation to ECAC wide

Solution 04-01 does not contribute to safety benefits

4.3.4 Discussion of Assessment Result

Solution 04-01 does not contribute to safety benefits

4.3.5 Additional Comments and Notes

Solution 04-01 does not contribute to safety benefits



4.4 Environment / Fuel Efficiency

Often fuel efficiency is improved through a reduction of flight or taxi time. This time benefit is also assessed, in this section, as it is additional input for the business case.

4.4.1 Performance Mechanism

The solution is expected to have an impact on Fuel Efficiency through reduction of delays brought about through the implementation of improved AOP-NOP coordination, better A-DCB procedures, quicker and improved Post-Ops analysis of causes and solutions of disruptions. Better predictability in the turnaround influences the departure punctuality and also taxi out predictability due to a reduction of the queue at the runway threshold.

The following validation targets taken from [18] are related to these possible benefits described in the OSED

- Environment EFF1 PJ04-01: Saving kg/flight, where the value is set to 1.94%
- Environment EFF1 PJ04-01 TMA VHC: Saving kg/flight, where the value is set to 0,54%
- Environment EFF1 PJ04-01 TMA HC: Saving kg/flight, where the value is set to 0,26%
- Environment EFF1 PJ04-01 TMA MC: Saving kg/flight, where the value is set to 0,42%
- Environment EFF1 PJ04-01 APT Large: Saving kg/flight, where the value is set to 0,40%
- Environment EFF1 PJ04-01 APT Medium: Saving kg/flight, where the value is set to 0,33%

Savings will come from less queuing at the departure runway due to better predictability of the TOBT and optimized departure sequence, therefore a long queue is not necessary to ensure pressure on the runway.

SESAR 1 equivalent for the similar OI Steps was 0,06% ECEC.

4.4.2 Assessment Data (Exercises and Expectations)

Group 1 Expectations

The solution has an impact on Fuel Efficiency through a reduction of delays brought about by the implementation of improved AOP-NOP coordination, better A-DCB procedures, quicker and improved Post-Ops analysis of causes and solutions of disruptions.

Saving will come from lower queueing at the runway because of the increased turnaround predictability where tower controllers are not obliged to keep a large buffer at the runway to keep pressure on it if there is a better adherence to the schedule. The reduction of the queuing will also reduce the duration of the taxi out duration. Improved AOP-NOP coordination should also reduce TMA arrival holdings, thereby also reducing fuel burn.

However, these benefits associated with the reduction of the taxi time were not measured during any of the V3 validation activities. Benefits associated with the TMA arrival holding is a secondary benefit and was not foreseen to be measured.



Group 2 Expectations

No benefits were expected to be seen in group 2 airports, other than possible secondary effects through the implementation of AO-0821.

4.4.3 Extrapolation to ECAC wide

PJ04.01 is a continuation of SESAR 1 OFA05.01.01 where fuel saving was estimated at 0.18% for OIs AO-0801-A, AO-0802-A and AO-0803. PJ04.01 benefits will be of a similar order of magnitude however, the expected additional benefit will be slightly lower than the benefit from those 3 SESAR 1 OIs which represented 0.06% ECAC fuel saving.

The PJ04.01 expert judgment decision is to slightly lower the benefit to **0.04% for PJ04.01**. These results are expected because even though Solution 04-01 is a different set of OI Steps from Solution 21, solution 21 is made up of the predecessors of Solution 04-01 so the improvements should be similar, but not necessarily to a greater extent due to diminishing returns.

Assumptions for extrapolation:

FOC year: 2035

Traffic portion at high-density airports in 2035 (CO2 data): 54%⁸

Fuel flow 900kg/hr (15 kg/min) (source: common assumptions F-0004)

Average fuel consumption per ECAC flight is 4800kg/flight (source common assumption F-0001)

Average ECAC flight time is 1.5 hours (Source common assumptions T-0010).

1.5h = 5400seconds

Group 1

FEFF1 - The 0.04% fuel saving is an ECAC value ($0.04\% \times 4800\text{kg}$ (Source Common Assumption F-0001) = 1.92kg per ECAC flight as average fuel saved, there is a need to estimate the number of impacted flight in order to obtain the kg of fuel saved per impacted flights.

The number of impacted flight is:

This will be mainly for group 1 airport that represent 54% of the traffic (source PJ04.01)0. It does not concern so much group 2 where those airport do not have pressure at runway with large queue at the runway threshold on departure.

$0.04\% / 0.54 = 0.074\%$ per impacted flight

Fuel saved per impacted flights: $0.074\% \times 4800\text{kg} = 3.5\text{kg}$ of fuel saved per impacted flight.

FEFF5 – NB impacted flights in 2035 are: 54% of the traffic in (2016). There will be a need to recalculate the share of traffic the group 1 of airport will have in 2035. Until this become available, 54% is used.

⁸ Computed from percentiles as $\sum (\sum \text{Percentiles_VHC_TMA}_s_{2024} \times 87.6 / \text{Total_Traffic}_{2035})$



Regarding the total NB flights in 2035, the assumption is still missing, only 37839 (Source Common Assumptions M-0015) for 2024 is available.

Statfor (challenge of Growth) prediction for 2035 is 15M flights = 41096 flights/ days
 $41096 \times 54\% = 22191$ flights saving 3.5kg per day.

Average reduction for the taxi out duration is:

60 seconds / (15kg/3.5kg) = **14 seconds per impacted flights.**

14 seconds * (100%-54%)=**6.44seconds flight time reduction per ECAC flight.**

Average reduction in ECAC flight duration:

% of ECAC flight duration= 6.44seconds (see above) /5400secondes=**0,12%**

Group 2

No benefits were expected to be seen in group 2 airports, other than possible secondary effects through the implementation of AO-0821.

KPIs / PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
FEFF1 Actual Average fuel burn per flight	Kg fuel per movement	Total amount of actual fuel burn divided by the number of movements	YES	- 0.22%	- 1.92kg/total ECAC flights	-0,04% average flights all ECAC and 0.074% per impacted flights, 41096 flights impacted (54% of ECAC) in2035
FEFF2 Actual Average CO ₂ Emission per flight	Kg CO ₂ per flight	Amount of fuel burn x 3.15 (CO ₂ emission index) divided by the number of flights	YES	- 33kg	- 6kg/total ECAC flights	-0.04%
FEFF3 Reduction in average flight duration	Minutes per flight	Average actual flight duration measured in the Reference Scenario – Average flight duration measured in the Solution Scenario	YES	-0.22%	- 6.44 seconds (0,107 minutes/total ECAC flights)	-0.12%

Table 12 is showing the impact on flight phases (provided when it is possible).



	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
FEFF1 Actual Average fuel burn per flight	0,01%			0,03%	
FEFF2 Actual Average CO ₂ Emission per flight	0,01%			0,03%	
FEFF3 Reduction in average flight duration	0,02%			0,02%	

Table 12: Fuel burn reduction per flight phase.

4.4.4 Discussion of Assessment Result

The result is not in line with the current expected target benefits of 1,94%, but more closely follow the benefits for SESAR 1 of 0.23%. One would expect the follow-on benefits for this solution to be lower than those seen in SESAR 1 due to diminishing returns. In addition, the benefits assumptions are not based on validation experiment results thus the confidence in the result is low.

4.4.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for environmental issues. However, the focal points for ATM operations are:

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4.5 Environment / Noise and Local Air Quality

4.5.1 Performance Mechanism

There are no benefit mechanisms for Environment / Noise and Local Air Quality described in the OSED

4.5.2 Assessment Data (Exercises and Expectations)

Solution 04-01 does not directly contribute to reductions in Noise. Reductions in Air Quality are summarized in Section 4.4

PIs	Unit	Calculation	Mandator y	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
NOI1 Relative noise scale	-2 to +2	It is a qualitative scale based on expert judgment. -2 very negative effect or benefit, 0 neutral and +2 very positive effects or benefit. The objective of this metric is to provide a global assessment of the noise impact. This metric is built upon the other quantitative noise PIs (NOI2, NOI3, NOI4, NOI5)	YES for Airport OE Solutions	N/A	N/A	N/A
NOI2 Size and location of noise contours	Contours of noise level thresholds (e.g. LDEN 55 see ERM document for the list of recommended PIs). Surface of these contours(Km 2)	Noise contours to be calculated according to the ECAC Doc.29 methodology. Surface of the noise contours calculated using a GIS tool or modules. Suggest the use of IMPACT tool.	YES for Airport OE Solutions	N/A	N/A	N/A
(NOI4) Number of people exposed to noise levels exceeding a given threshold	Number of people inside noise contours.	Population count inside the contours calculated above. Need the availability of population census data. Calculated using a GIS tool or modules. IMPACT tool includes this functionality, using the EEA population database.	YES for Airport OE Solutions	N/A	N/A	N/A



PIs	Unit	Calculation	Mandator y	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
LAQ1 Geographic distribution of pollutant concentratio ns	Airport Local Air Quality Studies (ALAQs) inventory method generally uses mg/m3 for each pollutant	Measurement to be performed within LTO cycle. NOx: Nitrogen oxides, including nitrogen dioxide (NO2) and nitrogen oxide (NO); VOC: Volatile organic compounds (including non- methane hydrocarbons (NMHC)); CO: Carbon monoxide; PM: Particulate matter (fraction size PM2.5 and PM10); SOx: Sulphur oxides. Recommended tools: Open- ALAQs	YES for Airport OE Solutions relative to LTO (=>below 3000ft)	N/A	N/A	N/A

4.5.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.5.4 Discussion of Assessment Result

Benefits to Noise and Air Quality are more directly linked to Solution PJ04-02, than PJ04-01 due to the inclusion of OI Step AO-0822 - Environmental Performance and Restrictions Accommodated in the Airport Operations Plan.

4.5.5 Additional Comments and Notes

N/A



4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

4.6.1 Performance Mechanism

Solution 04-01 does not contribute to Airspace Capacity benefits

4.6.2 Assessment Data (Exercises and Expectations)

Solution 04-01 does not contribute to Airspace Capacity benefits

4.6.3 Extrapolation to ECAC wide

Solution 04-01 does not contribute to Airspace Capacity benefits

4.6.4 Discussion of Assessment Result

Solution 04-01 does not contribute to Airspace Capacity benefits

4.6.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for capacity issues. However, the focal points for ATM operations are:

Eric Derogee – derogee@schiphol.nl

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4.7 Airport Capacity (Runway Throughput Flights/Hour)

4.7.1 Performance Mechanism

Solution 04-01 does not contribute to Airport Capacity benefits

4.7.2 Assessment Data (Exercises and Expectations)

Solution 04-01 does not contribute to Airport Capacity benefits

4.7.3 Extrapolation to ECAC wide

Solution 04-01 does not contribute to Airport Capacity benefits

4.7.4 Discussion of Assessment Result

Solution 04-01 does not contribute to Airport Capacity benefits

4.7.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for capacity issues. However, the focal points for ATM operations are:

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4.8 Resilience (% Loss of Airport & Airspace Capacity Avoided)

4.8.1 Performance Mechanism

Even though there are no benefit mechanisms described for Resilience in the OSED, nor targets in [18], the solution might have an impact on Resilience brought about through the implementation of improved AOP-NOP coordination and better A-DCB procedures coming from quicker and improved Post-Ops analysis of causes, as well as finding and saving solutions of disruptions.

4.8.2 Assessment Data (Exercises and Expectations)

The expected benefits to Resilience brought on through the implementation of solution 04-01 are expected to be in the 1,0% improvement range. These results are assumed to come from the ability to store solutions to previous operational difficulties in the Post Operations Analysis System. This assumption has not been validated, as this is an optional enabler of the OI Step.

PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
RES1 Loss of Airport Capacity Avoided	% and Movements per hour	Loss of Airport Capacity with the concept divided by the loss of Airport Capacity without the concept.	YES	0% No benefits were obtained for solution 04-01 in SESAR 1	1,0%	1,0%
RES 1.1 Airport time to recover from non-nominal to nominal condition	Minutes	Duration of Airport lost capacity from non-nominal to nominal condition.	YES for Airport OE Solutions	0,0%	1,0%	1,0%
RES2 Loss of Airspace Capacity Avoided	% and Movements per hour	Loss of Airspace Capacity with the concept divided by the loss of Airspace Capacity without the concept	YES	N/A	N/A	N/A
RES2.1 Airspace time to recover from non-nominal to nominal condition	Minutes	Duration of Airspace lost capacity compared to non-nominal to nominal condition.	YES for Airspace OE Solutions	N/A	N/A	N/A



PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
RES4 Minutes of delays	Minutes	Impact on AUs measured through delays resulting from capacity degradation ⁹ . RES1 and RES2 KPIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).	YES	0,0%	1,0%	1,0%
RES5 Number of cancellations	Nb flights	Impact on AUs measured through Cancellations resulting from capacity degradation ¹⁰ . RES1 and RES2 KPIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).	YES	0,0%	1,0%	1,0%

4.8.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.8.4 Discussion of Assessment Result

It is foreseen that all the Resilience benefits coming from Solution PJ04-01 stem from the changes implemented by looking at the solutions stored as part of the Post Operations Analysis system, as well as the increased predictability and early advisories of potential problems brought about through the fully integrated AOP-NOP. The quantitative results related to predictability from PJ04.01.V3.03 help increase the confidence level of the estimated 1% gain in resilience from very low to medium.

⁹ Reactionary delay out of the scope since they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.

¹⁰ Reactionary delay out of the scope since they could be due to many different reasons other than capacity degradation, in addition the cause of reactionary delay are not recorded in detail.



4.8.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for Resilience issues. However, the focal points for ATM operations are:

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4.9 Predictability (Flight Duration Variability, against RBT)

4.9.1 Performance Mechanism

The solution does have an impact on Predictability brought about through the implementation of improved AOP-NOP coordination, better A-DCB procedures, and quicker and improved Post-Ops analysis of causes and solutions of disruptions.

There are three validation targets related to Predictability described in the OSED

- Predictability PRD1 PJ04-01: Reduction in variance of block-to-block flight time where the value is set to 4,19%
- Predictability PRD1 PJ04-01 APT Very Large: Reduction in variance of block-to-block flight time where the value is set to 0,69%
- Predictability PRD1 PJ04-01 APT Large: Reduction in variance of block-to-block flight time where the value is set to 0,56%
- Predictability PRD1 PJ04-01 APT Medium: Reduction in variance of block-to-block flight time where the value is set to 0,82%

It is expected that OI AO-0802-B will influence predictability since it will help improve the turnaround process and optimise the airport operations at the gate. The following benefit mechanisms are described specifically for integration of the PRM passenger process in the A-CDM:

- The information related to the number and types of PRM passengers per flight will be fed into the AOP by the airlines (including when the PRM service is requested by the passenger at his arrival at the airport). The information will be automatically shared with the Airport Operator and the ground handling that will have to provide support services (PRM agent and specific Equipment).
- All partners will share the same up-to-date information related to the number of PRM passengers and types of PRM passengers per flight. It will help the airlines optimise their boarding process or anticipate the request of a new departure slot if a PRM passenger is late for boarding. It will be measured through a better allocation of the resources per flight (direct and indirect airline operating costs); but this will not necessarily imply an operating cost reduction. It will also be measured by the time saved in managing PRM passengers before the departure, time saved in the boarding phase and its direct impact on punctuality at the departure (PUN1 + PUN3).
- With a better view on how many PRM passengers and the type of PRM passengers will be present for boarding, GH will adjust, in real time, the number of PRM agents and add the equipment that is needed to provide the service. The benefits will be measured through the optimisation of the resources allocation and PRM agents planning and the time saved in the boarding phase avoid waiting for the dedicated support.
- By knowing in advance the number and the type of PRM passengers that will be present at the gate prior to boarding and by knowing where at the airport those PRM passengers are through the use of RFID technology (Optional enabler) will give more flexibility to the airlines to adapt their boarding process accordingly and to optimise the boarding time. The benefit will be



measured through the time saved in the Boarding Phase and the flexibility to adjust the sequencing of the departure flights.

- Ensuring that the PRM passengers will be taken on charge before departure and that someone is looking for them in the airport in case they are late to the gate for boarding will increase their level of satisfaction (qualitative benefit).
- The information related to the number and types of PRM passengers at the arrival of a flight will be known in advance through the integration of the information by the airline into the AOP and the exchange of data between departure and arrival airports (AOP-NOP exchange). The information will be automatically shared with the impacted services (airport operator and ground handlers).
- The accuracy of the information coming from the departure airport will ensure that the right level of PRM support (staff and equipment) will be available at the gate at the arrival of the flight. It will help the airlines reduce the deboarding time and by knock-on effect optimise the turnaround time and the predictability. It will be measured through a better allocation of the resources per flight (direct and indirect airline operating costs); but this will not necessarily imply an operating cost reduction. It will also be measured by the time saved in managing PRM passengers at the arrival, time saved in the deboarding phase and its direct impact on the turnaround time and the predictability (PRED1).
- With a better view on how many PRM passengers and the type of PRM passengers will be present for deboarding, Ground Handlers will adjust in real time the number of PRM agent and the equipment that is needed to provide the service. The benefits will be the anticipation and optimisation of the resources allocation and PRM agents planning and the time saved in the deboarding phase avoiding waiting for the dedicated support.
- By knowing in advance how many PRM passengers will have to make a connection at the arrival airport, it will help ground handlers support service to dedicate a PRM agent at the gate in order to facilitate the transfer. The benefits will be measured through a connexion time reduced for the passenger and a potential positive impact on the turnaround process of the connected flights improving both Predictability and Punctuality.
- Ensuring that the PRM passengers will be taken on charge at their arrival and that someone is going to help them in case they have a connecting flight, will increase their level of satisfaction (qualitative benefit).

The following benefit mechanisms are described specifically for integration of the baggage process in the A-CDM:

- Baggage process at the Departure
 - There will be more control checkpoints in the baggage process flow allowing ground handlers to effectively track checked baggage situation per flight within the system. The system will indicate for a dedicated flight where the baggage is located in the BHS process and the distance from the aircraft. A calculation can be made about the probability to have the aircraft loaded in time. The predictability of the TOBT will be improved.



BHS disruption can be known earlier and if a luggage is lost in the system, it will be easier for the BHS Agent to identify the area where to look for it. The benefits will be measured through the number of luggage lost in the BHS, the time saved by BHS Agent to look for them, and the impact on TOBT and predictability.

- The integration of the BHS/BRS data into the AOP will provide more accurate information on the number and type of baggage present in the carousel for the picking up process and the information will be shared between BHS Agents and airlines. This will avoid unnecessary delays in the picking-up process at the carousels. Airlines will have a better view on the late luggage for loading and can decide either to wait for the baggage or leave it on the ground for further loading into the next flight. The benefits will be measured through the time saved for loading and the impact on punctuality.
 - The accuracy of the information exchanged before departure will help to reduce the number of time where there is a mismatch between passengers on board and the number of luggage. It will avoid time consuming baggage handlings when a baggage has to be retrieved from the hold of the aircraft before departure because its owner is not on board. Benefits will be measured through the number of mismatch between number of baggage on the aircraft and the number of passengers, the time saved in the boarding process and the impact on Punctuality at the departure.
- Baggage process at the Arrival
 - The accuracy of the information coming from the departure airport about the number and size of the luggage to unload from the aircraft will facilitate the ground handling activities and will improve the resources allocation and the staff planning (vehicles, BHS agents). It will also help selecting the appropriate carousel for the unloading process of the baggage. Benefits should be measured through the impact on predictability and ground handlers operating costs optimisation (not necessarily conducting to an operating cost reduction).
 - It may arise that the tag of a baggage in connection is lost or damaged during the transport and the BHS system can no longer read it.
 - As there will be more control checkpoints in the baggage process flow, it will be easier for handling agents to effectively track checked baggage per flight within the system and to identify where to look for the lost baggage.
 - Moreover, the information provided by the BHS will enhance the information regarding the number of baggage at carousels vs the number of baggage still in the sorter (including baggage in



connection) and will help measure the impact on TOBT. Airlines will have more information to decide whether to wait for the late baggage or leave the baggage on the ground for further loading into the next flight. This will be particularly helpful when connection time is tight. The benefits will be measured through the number of lost baggage in connection, the time saved by BHS Agent to manage the lost baggage, and the impact on punctuality and predictability.

- o The integration in the AOP of the information related to the number and type of baggage that need to be uploaded in the a/c at the departure and the exchange of information with the destination airport will improve the accuracy of the information at the arrival. It will facilitate the unloading process by improving the ground handlers resources needed at the arrival to manage the baggage. The benefit will be measured through the time to unload the baggage at the arrival, the GH operating costs optimisation and the predictability.

4.9.2 Assessment Data (Exercises and Expectations)

As a reference value, the results coming from SESAR1 (PAR OFA05.01 D72) will be used as a maximum for estimations. For more details

EXE04-01.V2.01(PMI Trial)

This exercise focused on the introduction of landside processes within the AOP such as PRM and baggage. One of the Key Performance Areas associated to the behaviour of departure traffic is predictability.

This measured performance was obtained by applying standard operational procedures, a combination of the detected alerts in PRM process and Baggage process and the associated actions taken by the Airport Operator, the Handling Agents.

Slight benefits were found in terms of punctuality performance due to baggage process monitoring. However, the new information on baggage location was assessed as useful by handlers for increasing the baggage quality service as they expect to reduce the number of baggage left on ground.

Qualitative results showed that early information on plan deviations allow mitigation of disruptions and /or early TOBT updates, improving TOBT stability, thus improving predictability. The concept was validated as useful since alarms and derived procedures allowed to early predict the need for TOBT updates.

EXE04-01.V2.02 (ALC Trial)

This exercise validated that a simplified and semi-automated approach to A-CDM Milestone generation is feasible in a regional airport and that network requirements concerning take-off prediction accuracy through the DPI message set can be met. The predictability was improved both in terms of timeliness



and accuracy of target departing times calculation. Improved predictability compared to flight plan estimates was clearly demonstrated whilst at the same time ensuring that handler workload remained at completely acceptable levels.

EXE04-01.V2.04 (LYS Trial)

This exercise validating the transfer passenger, and a subset of turnaround flows. The objective of this exercise was to validate, landside operations in both planning and execution timeframes. One of the KPI ensured was predictability. It was expected that the provision of timely alerts related to the turnaround process and transfer passenger process improved departure predictability and punctuality through the improvement of Target Off-Block Times (TOBT).

EXE04-01.V3.01(Lyon Saint-Exupery Airport Trial)

The exercise focused on validating the transfer passenger and a subset of turnaround flows through the integration of a suitable level of turnaround process planning and monitoring into the APOC. Qualitative responses from the questionnaires suggested that this change would increase predictability, but no quantitative measures were taken.

EXE04-01.V3.02(PMI Airport Trial)

The exercise addressed the enhancement of the airside process with the inclusion of landside processes outputs that can affect ATM performance. Qualitative responses from the questionnaires suggested that this change would increase predictability, but no quantitative measures were taken.

EXE04-01.V3.03(BCN Airport Trial)

This exercise focused on evaluating the feasibility, the benefits mechanisms and potential performance improvement of AOP-NOP information sharing: demand prediction using the AOP-NOP integration, preliminary flight planning and AU/AIMA's priorities via AOP. The AOP - AMAN local coordination based on the ability to communicate flight characteristics as the severity code and the estimated arrival delay. Sharing this information will supply potential improvements from the AMAN management horizon. That horizon could extend the planning phase increasing the chances to gain predictability and efficiency.

Looking at the quantitative results, a change in the standard deviation of the TLDT-ELDT times between the Reference Scenario(5,03 min) and the Solution Scenario (9,64 min.) can be seen, **corresponding to a large decrease in Predictability**. However, these results are just from one day of simulation per scenario, so there could be other mitigating factors taking place that can explain these numbers.

For more information on the exercise results and on the issues found, see [44] [45].

4.9.3 Extrapolation to ECAC wide

Aggregation assumptions:

FOC year: 2035

Current block-to-block variance (TBD: source): 49min^2

Calculation of the PRD1 benefits in min^2 : $1.6\% * 49\text{min}^2 = 0.784 \text{min}^2$

Group 1

Founding Members





PRD1 – The SESAR 1 result was taken as a maximum due to the percentage of related OI Steps contribution (AO-0821-A, AO-0802-A, AO-0803) which gave a 3,63% benefit to PRD1. Therefore, our estimate for the Group 1 set of OI Steps (AO-0801-B+AO-0802-B+0818) is **2%**. This overall RBT variability is the combined effect due to the variability reductions in Taxi out (departure queues) and TMA Arrival (Arrival queues)

PRD3 – Overall, this is 90% of the PRD1 improvement (**1,8%**). AO-0802-B's and AO-0818's contributions are secondary effects that come from reduced runway departure queuing from increased turnaround predictability.

PRD4 – Is a secondary effect that could come from reduced arrival holding due to better TTA assignments due to improved AOP-NOP communication. This is estimated to be 10% of the PRD1 improvement (**0,2%**).

Group 2

No direct benefits are foreseen to come from AO-0824 in the area of block-to-block predictability.

PRD7 - The data from EXE04.01.02 shows inconclusive evidence to a benefit in turnaround predictability at this stage for AO-0824.

KPIs / Pls	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PRD1 Variance ¹¹ of Difference in actual & Flight Plan or RBT durations	Minutes ²	Variance of Difference in actual & Flight Plan or RBT durations	YES	5,4%	0.784 min ²	1,6%

Table 13 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in	Turn-around
PRD1	N/A	N/A	N/A	N/A	N/A	1,6%

¹¹ Standard Deviation is also accepted.



Variance ¹² of Difference in actual & Flight Plan or RBT durations						
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Table 13: Predictability benefit per flight phase, standard deviation improvement.

4.9.4 Discussion of Assessment Result

4.9.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for Predictability issues. However, the focal points for ATM operations are:

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Eugene Leeman - Leeman_e@schiphol.nl

¹² Standard Deviation is also accepted.



4.10 Punctuality (% Departures < +/- 3 mins vs. schedule due to ATM causes)

4.10.1 Performance Mechanism

The solution has an impact on PUNCTUALITY through the five OIs considered. All the OIs are focused on having an accurate TOBT which is one of the main drivers to the Punctuality KPA.

The KPA and KPI description on Punctuality included in the OSED and specifically oriented to the Deployment scenario defined within PJ04 are:

- Punctuality PUN1 PJ04-01: Increase in proportion of flights departing within +/- 3 minutes of SOBT, where the value is set to 1,72%
- Punctuality PUN1 PJ04-01 APT Very Large: Increase in proportion of flights departing within +/- 3 minutes of SOBT, where the value is set to 0,57%
- Punctuality PUN1 PJ04-01 APT Large: Increase in proportion of flights departing within +/- 3 minutes of SOBT, where the value is set to 0,47%
- Punctuality PUN1 PJ04-01 APT Medium: Increase in proportion of flights departing within +/- 3 minutes of SOBT, where the value is set to 0.68%

It is expected that mainly the OI AO-0802-B will influence punctuality. The benefit mechanism designed for this operational improvement describe their impact on punctuality as follows:

- Performance Monitoring of the integration of turnaround process within the airport aircraft process, in a collaborative airport/airline/handling agent decision making environment, will enhance punctuality and TOBT predictability by the enhanced shared information between all involved agents
- Estimation of the start and stop of the processes that compose the turnaround will improve the accuracy of the list and the sequence of the processes that can be performed.
- More detailed information regarding the estimation of the start and stop of the processes that compose the turnaround will allow improving the use of the available resources to perform the processes, which is linked with punctuality.
- More detailed information regarding the estimation of the start and stop of the processes that compose the turnaround will contribute to enhance turnaround process punctuality through better planning of the needed resources, which is linked with Punctuality, and Predictability.
- More detailed information regarding the estimation of the start and stop of the processes that compose the turnaround will contribute to improve turnaround situation awareness to stakeholders as they will be able to anticipate and manage any impact in the turnaround processes, which is linked with Predictability and punctuality.
- The availability of the estimation of the start and stop of the processes that compose the turnaround will contribute to improve the turnaround process flexibility through a better management of the services which are on time or that are expected to finish late, which is linked with Punctuality, and Predictability.



- The knowledge of the actual start and stop of the processes that compose the turnaround will improve the effective accuracy of the list and the sequence of the processes that can be performed.
- The knowledge of the actual start and stop of the processes that compose the turnaround will allow improving effectively the use of the available resources to perform the processes, which is linked with punctuality.
- The knowledge of the actual start and stop of the processes that compose the turnaround will contribute to effectively enhance turnaround process punctuality through better planning of the needed resources, which is linked with Punctuality, and Predictability
- The knowledge of the actual start and stop of the processes that compose the turnaround will contribute to improve turnaround situation awareness to stakeholders as they will be able to anticipate and manage any impact in the turnaround processes, which is linked with Predictability and punctuality.
- The knowledge of the actual start and stop of the processes that compose the turnaround will contribute to improve the turnaround process flexibility through a better management of the services, which is linked with Punctuality, and Predictability.
- The availability of an accurate time to gate for Transfer Passengers will contribute to improve the Transfer Passengers boarding process flexibility through a better management of transfer passengers which are on time at boarding gate and Transfer Passengers that are expected to arrive late, which is linked with punctuality, and predictability.
- The reduction in the number of late Transfer Passengers per flight will contribute to improve the boarding process punctuality, by means of speeding up the arrival of late Transfer Passengers, which is linked with punctuality and predictability.

4.10.2 Assessment Data (Exercises and Expectations)

[The OIs impacting on punctuality are:

- AO-0801-B
- AO-0802-B
- AO-0818

As a reference value we are going to use the results coming from SESAR1 (PAR OFA05.01 D72) and CP2 solution performance as a maximum for estimations, given the law of diminishing return.]

EXE04-01.V2.01

This exercise was focused on the introduction of landside processes within the AOP such as PRM and baggage. One of the Key Performance Areas associated to the behaviour of departure traffic punctuality. This measured performance was obtained by application of standard operational procedures, a combination of the detected alerts in PRM process and Baggage process and the associated actions taken by the Airport Operator, the Handling Agents.



EXE04-01.V2.02

This exercise validated that a simplified and semi-automated approach to A-CDM Milestone generation is feasible in a regional airport and that network requirements concerning take-off prediction accuracy through the DPI message set can be met. The punctuality was improved with the increase of automation of A-CDM milestone procedures and the new functionalities into stakeholders systems or upgrading their current airport support systems.

EXE04-01.V2.04

This exercise validated the transfer passenger, and a subset of turnaround flows at Lyon Saint-Exupéry Airport (LYS, regional airport). The objective of this exercise was to validate, landside operations in both planning and execution timeframes. One of the KPI ensured was predictability. It was expected that the provision of timely alerts related to the turnaround process and transfer passenger process improved departure predictability and punctuality through the improvement of Target Off-Block Times (TOBT).

EXE04-01.V3.02(PMI Airport Trial)

The exercise addressed the enhancement of the airside process with the inclusion of landside processes outputs that can affect ATM performance. Qualitative responses from the questionnaires suggested that this change would increase predictability, which was backed up by the quantitative measures that were taken, **showing an 18,4% increase in Punctuality.**

EXE04-01.V3.03(BCN Airport Trial)

This exercise will focus on evaluating the feasibility, the benefits mechanisms and potential performance improvement of:

- AOP-NOP information sharing: demand prediction using the AOP-NOP integration, preliminary flight planning and AU/AIMA's priorities via AOP.

The AOP - AMAN local coordination based on the ability to communicate flight characteristics as the severity code and the estimated arrival delay. Sharing this information will supply potential improvements from the AMAN management horizon. That horizon could extend the planning phase increasing the chances to gain predictability and efficiency.

The punctuality indicator in this exercise was measured as the difference between real time and scheduled time (ALDT – SLDT). This platform dynamically modified the flight data, simulating the aircraft take off from origin according to the CTOTs generated after the TTAs received by NM. **The data gathered showed a 39,8% improvement in Punctuality.**

For more information on the exercise results and on the issues found, see [44] [45].

4.10.3 Extrapolation to ECAC wide

Given the positive quantitative results from both EXE04-01.V3.02 and EXE04-01.V3.03 of an order of magnitude difference, **the estimated benefits at an ECAC level have been raised in V3 to 15%.** This is lower than the exercise results, but takes into consideration a level of uncertainty due to the limited amount of quantitative data gathered.



Group 1

For this group of OI the main goal on punctuality is to adhere to the TOBT and to reduce the delays.

The exercises showed that improving the visibility of the landside process information, and providing mitigation measure for specific situation, it will derive in a positive impact on punctuality.

Anyhow the results obtain were mainly qualitative, thus the quantitative results did not show a reliable information due to the different inconsistencies found it in the delay codes.

Anyway, this positive impact needs to be considered in a wider extent in the whole ECAC area with more activities in the next phases.

Group 2

No conclusive result in this group for this KPI.

KPIs / Pls	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
PUN1 % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	%	% Departures so that $ AOBT - SOBT^{13} < +/- 3 \text{ min.}$ Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather related delay causes.	YES	4.85%	15%	15%

Table 14 is showing the impact on flight phases (provided when it is possible).

¹³ Taking into account those SESAR concepts working on the planning phase, it is possible for different Stakeholders to request departure changes (outside the tolerance window of +/- 3 minutes) subject to approval by all actors involved before the flight execution. If accepted by all concerned actors, the reference plan against which the departure punctuality is measured will be this updated RBT instead of SBT.



	Taxi out	TMA departure	En-route	TMA arrival	Taxi in	Turn-around
PUN1 % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	N/A	N/A	N/A	N/A	N/A	15%

Table 14: Punctuality benefit per flight phase.

4.10.4 Discussion of Assessment Result

[The target applicable for PJ04.01 from PJ19-04 is 0,665%. The expected gain on PUN1 within PJ.04-01, given the quantitative results in the V3 exercises, is now 15%%.

As it is explained before, the calculation was made based on the results of both EXE04-01.V3.02 and EXE04-01.V3.03. This is lower than the exercise results, but takes into consideration a level of uncertainty due to the limited amount of quantitative data gathered.

For Group 1, the outputs coming from the V3 exercises were rather conclusive in this topic, but limited in the amount of days that made up the dataset. Therefore the confidence in the performance expectations is medium.

More over for Group 2 there is no conclusive results on this KPI thus the OIs implemented will help with the awareness of all the stakeholders in medium/ small airports....]

4.10.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for Punctuality issues. However, the focal points for ATM operations are:

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4.11 Civil-Military Cooperation and Coordination (Distance and Fuel)

4.11.1 Performance Mechanism

The solution does not have an impact on Civil-Military Cooperation. As far as Airport Operations are concerned, military aircraft are just other aircraft. There are no benefit mechanisms described for Civil-Military cooperation and coordination in the OSED

4.11.2 Assessment Data (Exercises and Expectations)

No benefits were obtained for solution 04-01 in SESAR 1. No benefits are foreseen to be obtained for solution 04-01 to Civil-Military Coordination.

4.11.3 Extrapolation to ECAC wide

No benefits were obtained for solution 04-01 in SESAR 1. No benefits are foreseen to be obtained for solution 04-01 to Civil-Military Coordination.

PIs	Unit	Calculation	Mandator y	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CMC1.1 Available/Re quired training Duration within ARES	%	Available training duration / Required training duration. It provides an indication on an available training duration within ARES in regard to the individual training event. The existing ATM system does not generate required data. SESAR WP11.1 WOC offers a solution to use the available training duration within ARES as a leading indicator. It is applicable for a performance assessment of pre-tactical ASM process. It could be used as leading PI.	YES	N/A	N/A	N/A
CMC1.2 Allocated/ Optimum ARES dimension	%	(Allocated ARES surface/ Optimum ARES Surface) x (Allocated FL/Optimum FL) It provides an indication of how closely the allocated ARES conforms to the optimum airspace dimensions. Due to different operational requirements among the states, performance monitoring and target setting is applicable at national level. It is applicable for a performance assessment of pre-tactical ASM and could be used as leading and/or lagging PI.	YES	N/A	N/A	N/A



PIs	Unit	Calculation	Mandator y	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CMC1.3 Transit Time to/from airbase to ARES	Minutes	It provides an indication of the transit time for aircraft which participated in an individual sortie. If it is calculated passed of a flight plan data it could be used as leading PI. If it is calculated based on an actual the flight time from airbase to ARES and back , it could be used as a lagging PI.. Flight time between ARESs could be calculated as the transit time. The existing ATM system does not generate required data. SESAR WP11.1 WOC offers a solution to use the transit time a leading indicator. It is applicable for a performance assessment of pre-tactical ASM.	YES/NO	N/A	N/A	N/A
CMC2.1 Fuel and Distance saved (for GAT operations)	Kg and NM	Kg of fuel and distance flown for GAT due optimisation of the ATM network through Demand Capacity balancing and to the new ARES design and management	YES	N/A	N/A	N/A
CMC2.2 GAT planning efficiency of Available ARES (% GAT flights planning to use ARES / GAT flights for which ARES is available)	%	GAT planning effectiveness use ARES could be captured using the following indicator: % (GAT flights planning to use ARES / GAT flights for which ARES is available). It could be number and time based measure.	YES	N/A	N/A	N/A

Table 15 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
CMC1.1 Available/Required training Duration within ARES					



CMC1.2 Allocated/ Optimum ARES dimension					
CMC1.3 Transit Time to/from airbase to ARES					
CMC2.1 Fuel and Distance saved (for GAT operations)					
CMC2.2 GAT planning efficiency of Available ARES (% GAT flights planning to use ARES / GAT flights for which ARES is available)					

Table 15: Civil-Military cooperation and coordination benefit per flight phase.

4.11.4 Discussion of Assessment Result

N/A

4.11.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for Civil-Military issues, as it does not contribute to this KPA.



4.12 Flexibility

Flexibility means the ability to react to late flight plan changes and requests. The main PI / metric, FLX1, is “Average delay for scheduled civil/military flights with change request and non-scheduled / late flight plan request.”

4.12.1 Performance Mechanism

The solution does not have an impact on Flexibility; therefore, there are no benefit mechanisms described in the OSED

4.12.2 Assessment Data (Exercises and Expectations)

No benefits were obtained for solution 04-01 in SESAR 1. No benefits are foreseen to be obtained for solution 04-01 in the area of Flexibility.

4.12.3 Extrapolation to ECAC wide

No benefits were obtained for solution 04-01 in SESAR 1. No benefits are foreseen to be obtained for solution 04-01 in the area of Flexibility.

PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
FLX1 Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	Minutes	Total delay for scheduled flights with change request and non-scheduled or late filling flights [AOBT – SOBT], divided by number of movements	YES			

Table 16 is showing the impact on flight phases (provided when it is possible).

	Taxi out	TMA departure	En-route	TMA arrival	Taxi in
FLX1 Average delay for scheduled civil/military flights with change request and non-					



scheduled or late flight plan request					

Table 16: Flexibility benefit per flight phase.

4.12.4 Discussion of Assessment Result

N/A

4.12.5 Additional Comments and Notes

Solution 04-01 does not have a dedicated person for Flexibility issues, as it does not contribute to this KPA.



4.13 Cost Efficiency

4.13.1 Performance Mechanism

There are no benefit mechanisms described for ANSP Cost Efficiency in the OSED, therefore there are no performance mechanisms for ANSP Cost Efficiency. This applies to KPIs CEF1, CEF2, and CEF3.

4.13.2 Assessment Data (Exercises and Expectations)

4.13.3 Extrapolation to ECAC wide

As solution PJ04-01 does not contribute to any of the ANSP cost efficiency KPIs, there is nothing to extrapolate to an ECAC level.

KPIs / Pls	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
CEF2¹⁴ Flights per ATCO-Hour on duty	Nb	Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	YES	0%	0%	0%
CEF3 Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment.	YES	0%	0%	0%
CEF1 Direct ANS Gate-to-gate cost per flight	EUR / flight	Derived by PJ19, taking into account results for the other two KPIs as contributing factors.	Yes but derived from the other two KPIs	0%	0%	0%

4.13.4 Discussion of Assessment Result

N/A

¹⁴ The benefits are determined by converting workload reduction to a productivity improvement, and then scale it to peak traffic in the applicable sub-OE category. It has to be peak traffic because there must be demand for the additional capacity (note that in this case the assumption is that the additional capacity is used for additional traffic).



4.13.5 Additional Comments and Notes

N/A



4.14 Airspace User Cost Efficiency

4.14.1 Performance Mechanism

The solution is expected to have a secondary effect impact on Airspace User Cost Efficiency due to the reductions of delays brought about by better AOP-NOP coordination and improved A-DCB procedures, but this is best captured in the Fuel Efficiency KPA and not here to avoid double tracking.

For this reason there are no benefit mechanisms described for Airspace User Cost Efficiency in the OSED. Notwithstanding, since there is no KPI for Airport Operator, these benefits have been decided to be allocated to this KPI.

4.14.2 Assessment Data (Exercises and Expectations)

No direct benefits were obtained for solution 04-01 in SESAR 1 and none are expected to be obtained in this KPA. Secondary benefits might come from improvements in predictability, but they are not being assessed in the validation activities.

Possible secondary benefits could come from the Post Operations Analysis (AO-0821) but as described previously, they are impossible to assess.

There might be possible secondary effects in AUC1 and AUC2 coming from AO-0801-B. There might also be a possible secondary effect in AUC3 coming from AO-0801-B, AO-0802-B and AO-0818.

4.14.3 Extrapolation to ECAC wide

Group 1

The Group 1 airports estimate for the ECAC level gains in Airspace User Cost Efficiency is **1,0%**.

Group 2

No direct benefits are foreseen, only unmeasurable possible secondary benefits.

PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
AUC3 Direct operating costs for an airspace user	EUR	Impact on direct costs related to the aeroplane and passengers. Examples: fuel, staff expenses, passenger service costs, maintenance and repairs, navigation charges, strategic delay, landing fees, catering.	Yes, where an impact is foreseen on AU cost efficiency	0%	0%	0%



PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
AUC4 Indirect operating costs for an airspace user	EUR	Impact on operating costs that don't relate to a specific flight. Examples: parking charges, crew and cabin salary, handling prices at Base Stations.	Yes, where an impact is foreseen on AU cost efficiency	0%	1,0%	1,0%
AUC5 Overhead costs for an airspace user	EUR	Impact on overhead costs. Examples: dispatchers, training, IT infrastructure, sales.	Yes, where an impact is foreseen on AU cost efficiency	0%	1,0%	1,0%

4.14.4 Discussion of Assessment Result

Solution 04-01 does not have a dedicated person for Cost Efficiency issues. However, the focal point for CBA issues is:

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4.14.5 Additional Comments and Notes



4.15 Security

4.15.1 The SecRAM 2.0 methodology and the Security Performance Mechanism

It is known that the use of cyber security techniques involves the introduction of an overhead when considering the operation and management of an infrastructure. In other words, system performance would be better without cyber security. However, a "fast" system may not be effective, especially if there is something or someone that is going to disturb its state. Therefore, the first real benefit introduced by cyber security is to maintain the effectiveness of a system. Secondly, cyber security aims to protect the productivity of the organization, by maintaining the appropriate levels of confidentiality, integrity and availability of the whole infrastructure. In the face of these considerations it is clear that is appropriate to vary the quantity to be measured, in order to define or use more adequate indicators than those that merely measure the performance. A more appropriate metric is that which provides estimates on the value and effectiveness of cyber security efforts undertaken by a company. In order to investigate in this way, it is possible to use some KPIs that measure improvements in terms of situational awareness, and detection/mitigation timing.

4.15.2 Security Assessment Data Collection

In this cyber security exercise, an assessment was carried out on the benefits introduced by the implementation of a Risk Assessment on an effective airport's TAM (Total Airport Management) platform, extending the scope even to the technical staff involved within the APOC (AirPort Operations Centre). Since performance-based KPIs cannot be used to measure changes in threat level, i.e. due to the publication of zero day exploits, other metrics are needed which can reflect the ability of systems and people to identify and resist against cyberattacks. An evaluation of this type on the systems involved is not yet mature at this moment, because not all the designed and defined processes have been applied in the airport test bed. However, it is possible to provide an accurate estimate regarding the technical staff involved in the project.



PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
SEC1 Personnel (safety) risk after mitigation	Risk 3 levels are possible: high, medium or low	Qualitative assessments are derived from application of the SESAR2020 Security Risk Assessment Methodology (SecRAM 2.0). The PI is the maximum risk evaluated for the SESAR Solution after application of the recommended controls and considering the Personnel Impact Area only.	According to the SESAR Solution prioritization list and to the maturity level of the solutions		1	20%
SEC2 Capacity risk after mitigation	Risk – 3 levels are possible: high, medium or low	Qualitative assessments are derived from application of SecRAM 2.0. The PI is the maximum risk evaluated for the SESAR Solution after application of the recommended controls and considering the Capacity Impact Area only.	According to the SESAR Solution prioritization list and to the maturity level of the solutions		2	40%
SEC3 Economic risk after mitigation	Risk – 3 levels are possible: high, medium or low	Qualitative assessments are derived from application of SecRAM 2.0. The PI is the maximum risk evaluated for the SESAR Solution after application of the recommended controls and considering the Economic Impact Area only.	According to the SESAR Solution prioritization list and to the maturity level of the solutions.		2	40%



PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
SEC4 A security risk assessment has been carried out	Binary Vector – with maximum 7 components with Y/N (according to the prioritization and maturity level of the solution)	A security risk assessment has been carried out applying SecRAM 2.0, and the following steps have each been carried out : The identification of Primary Assets, Supporting Assets, Threat Scenarios and Vulnerabilities; The evaluation of Impacts, Likelihoods and Risks.	YES (different steps are mandatory for different prioritization and maturity levels)		5	100%
SEC5 Risk Treatment has been carried out	Binary Vector – 2 components with Y/N	Following SecRAM 2.0, Security controls have been identified by Security Experts and implemented in the Solution.	YES (implementation just at higher maturity levels – V4)		4	80%
SEC 6 Mitigated Risk level per Supporting Asset are lowered after risk treatment	Risk Level – 2 levels are possible: medium or low	After Security Controls have been implemented, the Risk Level achieved per Supporting Asset decreases (H → M, M → L, H → L). It is important to notice that according to SecRAM the Risk Level achieved should be “Low” otherwise justifications must be provided.	YES		4	80%

In particular, the assessment of the situational awareness of the people involved is mainly relevant in this context. In full compliance with the guidelines established during the SESAR 1 project, we have



made use of the SART (Situational Awareness Rating Technique) and SAGAT (Situation Awareness Global Assessment Technique) KPIs, which have been a de facto standard from a long time according to the EUROCONTROL point of view, in order to provide an assessment of the improvements made in terms of perception, comprehension and prediction capabilities.

To be precise we explicitly referred to the 3D SART evaluation method as appraisal, which makes use of 10 evaluation metrics spread over three main reference domains. The Figure 1 summarizes these aspects. SART is a complex construct; therefore, separate measurement dimensions are required in order to extent the situational awareness in all its aspects. To evaluate the cyber security knowledge-based behaviour of airport operators we make use of observation, questionnaires and interviews as foreseen by the SART methodology.

Situation Awareness Rating Technique (SART)	
DEMAND	
Instability of Situation	Likelihood of situation to change suddenly
Variability of Situation	Number of variables which require your attention
Complexity of Situation	Degree of complication (number of closely connected parts) of the situation
SUPPLY	
Arousal	Degree to which you are ready for activity
Spare Mental Capacity	Amount of mental ability available to apply to new tasks
Concentration	Degree to which your thoughts are brought to bear on the situation
Division of Attention	Amount of division of your attention in the situation
UNDERSTANDING	
Information Quantity	Amount of knowledge received and understood
Information Quality	Degree of goodness or value of knowledge communicated
Familiarity	Degree of acquaintance with the situation

Figure 1: 3D SART construct used to measure the airport operators Situational Awareness on Cyber Security Threats

In order to carry out the 3D SART evaluation, a seven point rating scale has been used (from 1=Low to 7=High) to provide a subjective measure to each metric. Specifically, the grid shown in Figure 2 was used to perform this task.



DEMAND				
Instability of situation:	Low	1-----2-----3-----4-----5-----6-----7		High
Variability of situation:	Low	1-----2-----3-----4-----5-----6-----7		High
Complexity of situation:	Low	1-----2-----3-----4-----5-----6-----7		High

SUPPLY				
Arousal:	Low	1-----2-----3-----4-----5-----6-----7		High
Spare mental capacity:	Low	1-----2-----3-----4-----5-----6-----7		High
Concentration:	Low	1-----2-----3-----4-----5-----6-----7		High
Division of attention:	Low	1-----2-----3-----4-----5-----6-----7		High

UNDERSTANDING				
Information quantity:	Low	1-----2-----3-----4-----5-----6-----7		High
Information quality:	Low	1-----2-----3-----4-----5-----6-----7		High
Familiarity:	Low	1-----2-----3-----4-----5-----6-----7		High

Figure 2: Rate level evaluation grid for each of the 10 components of the situation awareness that was used to evaluate airport operators

At the end of the activity a composite 3D SART score has been calculated through the use of the following formula:

$$\text{Situational Awareness} = \text{Understanding}_{\text{average}} - (\text{Demand}_{\text{average}} - \text{Supply}_{\text{average}})$$

The value of the composite 3D SART scored obtained is equal to 11, with an $\text{Understanding}_{\text{average}} = 13$, a $\text{Demand}_{\text{average}} = 14$ and a $\text{Supply}_{\text{average}} = 12$. For any other detail on SART, please refer to [44]

4.15.3 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.15.4 Discussion of Assessment Result

In this context an evaluation was carried out on the situational awareness of airport employees using the SART methodology which represents a subjective and non-intrusive metric to take a picture of the performance. This assessment is necessary to obtain an actual estimate of the improvements introduced by the cyber security exercise performed, but to provide a complete result; an evaluation of the SAGAT value must be followed. Currently it is not possible to use a SAGAT metric in order to

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estimate the situational awareness, because the new operating processes must take over completely within the infrastructure before being estimated. During the V3-05 of the PJ04.01 project, all the appropriate assessments will be carried out and they will serve to obtain a complete and effective feedback on the state of the objective situational awareness to which the airport is subjected.

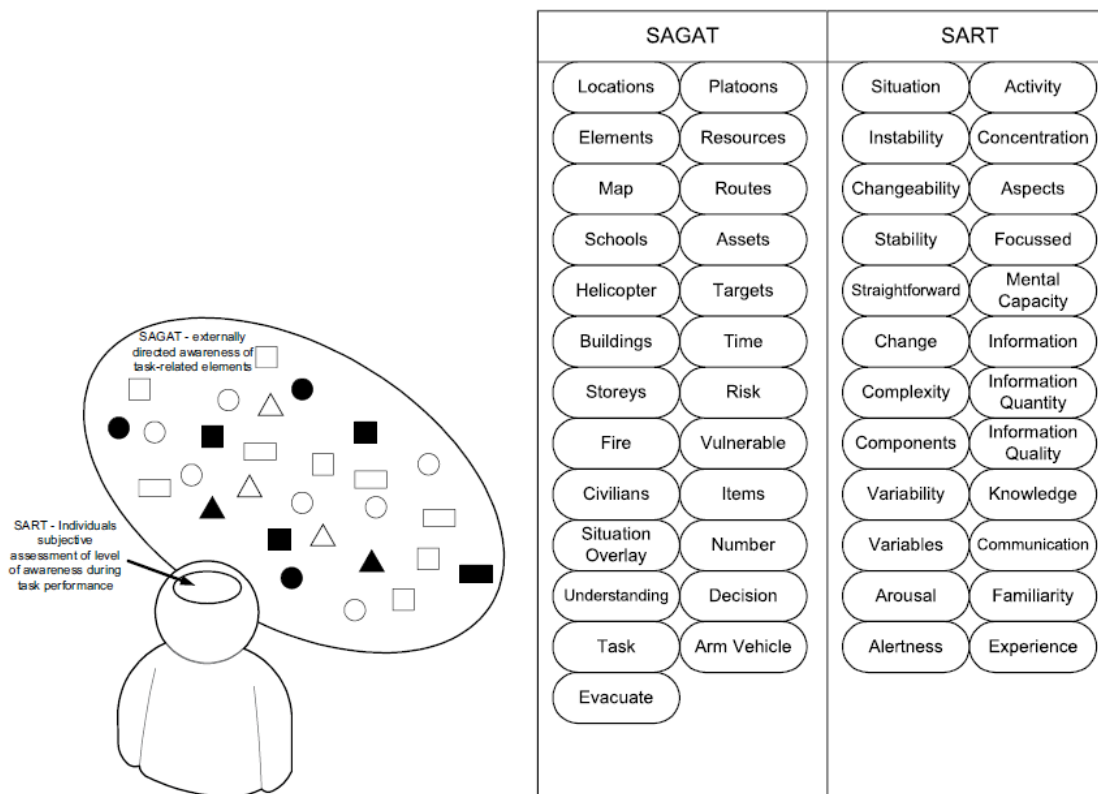


Figure 3: Situation awareness measures content analysis. To get it we need both SART and SAGAT

4.15.5 Additional Comments and Notes

The cyber security exercise that was carried out in this context was mainly focused on the construction of an operational framework that would serve to make the TAM platform secure. However, the framework must still end up being integrated within the airport that has been used as test bed. Therefore, it has not yet been possible to make a precise valuation of the performance achievable by this solution, under all possible points of view. The only metrics that have been evaluated are those related to the Risk Assessment exercise, which was conducted entirely. For this reason it was possible to use the SART (Situation Awareness Rating Technique) to achieve a performance evaluation. In the coming months, the designed framework will permanently become part of the operational procedures of the airport tested and this will allow us to provide more accurate performance estimates during the V3-05 of the PJ04.01 project. In this case, it will be interesting to evaluate the mean value of the TTD (Time To Detect) and TTM (Time To Mitigate) parameters rather than simply assessing the number of vulnerabilities of the infrastructure, completing the work with the application of the KPIs deriving from the SAGAT (Situation Awareness Global Assessment Technique) method which will complement the results provided by the current SART. In fact, these metrics (TTD, TTM and SART/SAGAT) will provide a strong insight into the improvements made to systems and people within a cyber security context.



4.16 Human Performance

4.16.1 HP arguments, activities and metrics

Identification of relevant arguments, HP issues and benefits and HP activities were provided in the PJ.04-01 validation plan Part IV and reproduced in the HP Report.

Those main arguments taking into account within the Report are the following ones:

Arguments	Issues & benefits	Activities
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.	The new concept may lead to an increase of workload of the handling agent impacting on a reduction of the efficiency.	By timely, clear communication, the handling agent can react on special occasions and work more efficient.
Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate	The new information provided in the AOP reading the introduction of PRM and baggage processes were expected to increase the situational awareness of the PRM and Handling agents. Intern this will bring benefit in predictability.	Understandable training and information on the use of the new concepts/procedures
Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.	The new information provided in the AOP reading the introduction of PRM and baggage processes were expected to increase the situational awareness of the PRM and Handling agents. Intern this will bring benefit in predictability.	Provide all stakeholders with timely, clear and identical information and make sure that the given information is understood.
Arg. 2.1.6: The level of trust in automated functions is appropriate.	The new information provided in the AOP reading the introduction of PRM and baggage processes were expected to increase the situational awareness of the PRM and Handling agents. Intern this will bring benefit in predictability.	Alerts should be send in time, so that mitigations to the problem can be taken.
Arg. 2.2.1: The accuracy of information provided by the system is adequate	DPI messages being produced with less quality than the standard A-CDM and this will turn in negative impact on situational awareness.	Make sure that the DPI messages are of the highest possible quality in order to give the human an optimised situational awareness



More over three exercises included some activities on HP to test the situation awareness or the trustfulness of the tool used.

The activities conducted were:

Validation Exercise	Dates
PJ.04-01.v2.01 exercise: A Real Time Simulation at PMI airport validating the landside integration into the A-CDM Processes	Each Tuesday and Thursday in October 2017
PJ.04-01.v2.02 exercise: A shadow mode simulation at ALC airport validating the A-CDM processes in the regional airport setting	October 23 – 27 2017
PJ.04-01.v2.04 exercise: A real time simulation validating the landside integration into the A-CDM process, turnaround monitoring and optimisation;	June 14 – 19 2018
PJ04-01.V3.01 - Integration of a suitable level of turnaround process planning and monitoring into the APOC.	Q2 2019 Completed
PJ04-01.V3.02 - A-CDM process enhanced through integration of landside (passenger and baggage) process outputs.	Q3 2019 Completed
PJ04-01.V3.03 - Collaborative Airport Planning Interface (AOP fully integrated with NOP)	Q3 2019 Completed

The tool selected from the HP repository to measure these issues were questionnaires and debriefings.

For more information on the results and on the issues found, see [44] [45].

PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
HP1 Consistency of human role with respect to human capabilities and limitations	Qualitative or Quantitative	Summary of the evidence collected based on the second-level indicators defined below	YES	N/A	Solution 04-01 is compliant with HP1	Solution 04-01 is compliant with HP1



PIs	Unit	Calculation	Mandatory	Benefit in SESAR1 (if applicable)	Absolute expected performance benefit in SESAR2020	% expected performance benefit in SESAR2020
HP2 Suitability of technical system in supporting the tasks of human actors	Qualitative or Quantitative	Summary of the evidence collected based on the second-level indicators defined below	YES	N/A	Solution 04-01 is compliant with HP1	Solution 04-01 is compliant with HP1
HP3 Adequacy of team structure and team communication in supporting the human actors	Qualitative or Quantitative	Summary of the evidence collected based on the second-level indicators defined below	YES	N/A	Solution 04-01 is compliant with HP1	Solution 04-01 is compliant with HP1
HP4 Feasibility with regard to HP-related transition factors	Qualitative or Quantitative	Summary of the evidence collected based on the second-level indicators defined below	YES	N/A	Solution 04-01 is compliant with HP1	Solution 04-01 is compliant with HP1

4.16.2 Extrapolation to ECAC wide

There is no ECAC wide extrapolation required for this KPI.

4.16.3 Open HP issues

For the issues status see HP log within Part IV of the OSED-Human Performance Assessment Report (Appendix D).

4.16.4 Requirements and recommendations

Refer to Part IV of the OSED - Human Performance Assessment Report (Appendix B and C).

The recommendations resulting from the activities conducted are proposed as a potential means to mitigate the HP issues identified relating to the PMI, ALC and LYS trials in order to validate new systems, procedures and concepts. It should be noted that the recommendations required additional analysis, that is, refinements and/or validation will take place during the V3 validations.

4.16.5 Additional Comments and Notes

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[There is no concrete actions to be developed such as new requirements, after the V2 Activities nevertheless the HP criteria are fully covered currently for the V2 Phase. Besides further analysis will be performed with the V3 validations in 2019. ...]



4.17 Other PIs

Further PIs from the Performance Framework update are assessed qualitatively, or, if possible, quantitatively, in Table 17

KPA	PIs	Benefit (text only)	mechanism	Qualitative Impact ¹⁵

Table 17: Qualitative assessment of QoS KPIs

Detailed descriptions of these PIs can be found in the Performance Framework [3].

NOTE: These PIs are preliminary and the table currently serves as a placeholder!

[...]

4.17.1 Performance Mechanism

[...]

4.17.2 Assessment Data (Exercises and Expectations)

[...]

4.17.3 Additional Comments and Notes

[...]

4.18 Gap Analysis

The objective of the gap analysis is to compare the validation targets and the performance assessment. Table 18 pulls together the comparisons done in sections 4.3.4, 4.4.4, 4.6.4, 4.7.4, 4.9.4, and 4.10.4,.

¹⁵ --, -, 0, +, ++



KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI) ¹⁶	Rationale ¹⁷
FEFF1: Fuel Efficiency – Fuel burn per flight	1,94%	-1,92 Kg/ total ECAC flights (0,04% benefit) 22191 impacted flight	Validation targets are expectations based upon political desires and not necessarily based upon what can be accomplished.
CAP1: TMA Airspace Capacity – TMA throughput, in challenging airspace, per unit time.	N/A	0%	No Validation Target was set for PJ04-01
CAP2: En-Route Airspace Capacity – En-route throughput, in challenging airspace, per unit time	N/A	N/A	No Validation Target was set for PJ04-01
CAP3: Airport Capacity – Peak Runway Throughput (Mixed mode).	N/A	0%	No Validation Target was set for PJ04-01
PRD1: Predictability – Variance of Difference in actual & Flight Plan or RBT durations	4,19% ¹⁸	2%	Validation targets are expectations based upon political desires and not necessarily based upon what can be accomplished.

¹⁶ Negative impacts are indicated in red.

¹⁷ Discuss the outcome if, and only if, the gap indicates a different understanding of the contribution of the Solution (for example, the Solution is enabling other Solutions and therefore is not contributing a direct benefit).

¹⁸ In Validation Targets [18] the unit for PRD1 is % Reduction in variance of block-to-block flight time.



PUN1: Punctuality – % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	1,72%	15%	Validation expectations surpass the targets.
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	N/A	N/A	No Validation Target was set for PJ04-01
CEF3: Technology Cost – Cost per flight	0,873% ¹⁹	0 EUR/flight 0% change N/A	Validation targets are expectations based upon political desires and not necessarily based upon what can be accomplished.
SAF1: Safety - Total number of fatal accidents and incidents with ATM Contribution per year	N/A	0%	No Validation Target was set for PJ04-01

Table 18: Gap analysis Summary

¹⁹ In Validation Targets [18] the unit for CEF3 is % reduction in technology cost per flight.



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5.1 Reference Documents

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Appendix A Detailed Description and Issues of the OI Steps

OI Step ID	Title	Consistency with latest Dataset
AO-0801-B	Collaborative Airport Planning Interface (AOP fully integrated with NOP)	DS18a
AO-0802-B	A-CDM process enhanced through integration of landside (passenger and baggage) process outputs	DS18a
AO-0818	Extended Turn-round Monitoring within the APOC	DS18a
AO-0821	Post-Operations Analysis support solutions and reporting capabilities	DS18a
AO-0824	Network-connected Regional Airports	DS18a

Table 19: OI Steps allocated to the Solution

All OI Steps in Solution PJ04-01 are aligned with Dataset 18a.

[...]



-END OF DOCUMENT-

