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PJ.04-W2 Solution 28.1

CONNECTED REGIONAL AIRPORTS

This Performance Assessment Report is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874472 under European Union's Horizon 2020 research and innovation programme.



Abstract

This document is the solution PJ.04-W2-28.1 SPR-INTEROP/OSED V3 document – Part V and provides the Performance Assessment Report for solution PJ.04-W2-28.1. The PAR consolidates solution performance validation results and estimates where no validation results are present.

The solution Connected Regional Airports focus is on the integration of the regional airports into the network through the sending of DPI messages and the implementation of a quasi-automatic milestone surveillance process, reducing the workload of airlines / ground handlers and increasing the predictability.

The solution plans to address stakeholders' needs specifically within the KPA targets of **Predictability**. Departure predictability (PRD#M1) is equal to network predictability to calculate the impact on the **en-route capacity (CAP2).**

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 human performance assessments.

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1 Executive Summary

This document provides the Performance Assessment Report (PAR) for PJ.04-W2-28.1 “Connected regional airports”

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

Description:

Solution 28.1 seeks to integrate the regional airports into the network through a turnaround process monitoring and including specifically the notion of automated milestone generation in an A-CDM context. It could provide sufficient motivation for regional airports to enhance overall network predictability, reducing substantially the workload and obtaining the benefits of the A-CDM (such as greater predictability and network integration inputs).

The milestone process of A-CDM has been simplified, reducing the milestones, decreasing the complexity of the definition and the operation under this new concept. The inputs by the Ground Handlers / Aircraft Operators have been reduced as a result of automatic determination of the Target Off block time (TOBT) based on the aircraft event-based milestones to ease the process and adapt it to the operations volume of the regional airports. A DMAN (Pre-Departure Sequence) is not mandatory; therefore, the milestones associated are not required either.

The applicability to regional airports is reliant on the high degree of predictability of airport parameters including taxi-times, turnaround times and passenger boarding times. These parameters will be de fined by the regional airports based in their own experience and the historical data, taking into account those variables they consider appropriate to assure the high predictability of the values. Nevertheless, a recommendation is made in this document.

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI and mandatory PI (Table 1: KPI Assessment Results Summary) and puts them side-by side against Validation Targets in case of KPI from PJ19 [7]. In this solution case there are no validation targets assigned by PJ19 to Solution 28.1. The impact of a Solution on the performances are described in Benefit Impact Mechanism in the OSED Part I, and the CBA monetises one network benefits that can be derived from the PRD#M1 which is CAP2. Nevertheless, the benefits are quite more, and are included in the CBA in greater detail (local and network one).

This section focuses in the quantitative results of PRD#M1 that were measured in the validation and the CBA analyses of CAP2, but there were qualitative results (included in the VALR and CBA) that shows the whole pack of benefits.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits at Network Level (ECAC Wide or Local depending on the KPI)[1]
Lost slots	N/A	Network Manager (NM) will issue better and more stable regulations (CTOTs) based on more accurate departure data (TTOT). This benefit will translate into fewer lost slots by airspace users. The results show that the solution would **avoid 12.0% of the currently missed slots** at the implementing airports.
CAP2: En-Route Airspace Capacity - En-route throughput, in challenging airspace, per unit time	N/A	The better departure (and network) predictability should allow for reducing the en-route capacity buffer and therefore increasing the declared capacity up to a closer value to the maximum safe capacity. This implies an increase in the declared en-route capacity, boosting route throughput (CAP2) resulting in a +0.15% increase.

Table 1: KPI Assessment Results Summary

Solution 28.1 will have a positive impact too on predictability when measured in terms of the accuracy of the target take-off time (as provided in the DPI messages) and the actual take-off time. The principal element of the post-exercise analysis has been a comparison between the Target Take-off time (TTOT) in each DPI type compared with the Actual take-off Time (ATOT). In addition the flight plan EOBT + taxi-time was also compared with the ATOT as this is a reflection of the accuracy that will be obtained in the reference scenario and without the deployment of Solution 28.1 [PRD#M1 (TTOT-ATOT)].

[1] Negative impacts are indicated in red.

	AVG (ATOT-TTOT) with DPIs	Standard deviation with DPIs	AVG (ATOT-ETOT) without DPIs	Standard deviation without DPIs	Improved accuracy
9h to ATOT	27,23 min	34,57 min	33,02 min	35,77 min	17,53%
7h to ATOT	22,96 min	29,05 min	28,66 min	30,85 min	19,90%
5h to ATOT	19,79 min	23,51 min	26,43 min	28,57 min	25,13%
3h to ATOT	13,83 min	19,54 min	22,25 min	22,71 min	37,84%
2h to ATOT	11,94 min	14,29 min	19,30 min	18,51 min	38,15%
1h to ATOT	9,78 min	9,43 min	17,79 min	16,48 min	44,99%

Table 2 : DPI performance enhancement compared to flight plan

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Additional Comments and Notes:

Despite not being measured, the solution brings a lot of additional benefits that were not measured and monetised, but are clearly a great improvement in the regional airports operation (For more detail on the benefits go to the CBA):

Local benefits:

- Increase adherence to schedule / turnaround time closer to SLA
- Increase punctuality at the departure for passengers
- Reduction of taxi out time
- Reduce Taxi-in time
- Reduction of ground emission and noise
- Improved ground handling resource and asset utilisation
- Improve stand and gate planning
- Reduce delay at local level
- Reduce in flight activation monitoring (FAM) suspensions
- Reduce ATCO workload
- Increase resilience in case of adverse conditions
- Safety benefit (lower accident repair cost)
- Improve customer service

Network benefits

- Improve fleet utilisation / flexibility of departure
- Increase ATFM slot adherence and CTOT stability
- Fewer lost slots and over delivery, reduced En-route capacity buffer
- Reduce reactionary delays

2 Introduction

2.1 Purpose of the document

The Performance Assessment covers the Key Performance Areas (KPAs) 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 validation exercises at SESAR Solution level. The KPA performance results are used for the performance assessment at strategy level and provide inputs to the SESAR3 Joint Undertaking (S3JU) 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 S3JU 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.

2.3 Inputs from other projects

The document includes information from the following SESAR 2020 Wave1 projects:

- PAGAR 2019 [4]: Performance Assessment and Gap Analysis Report (2019), where are collected the final benefits from SESAR 2020 Wave1.

PJ19 will manage and provide:

- SESAR Performance Framework (2019) [3], guidance on KPIs and Data collection supports.
- 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)[2] within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

Term	Definition	Source of the definition
Advanced ATC Tower Airport (AAT)	Airports that have no plans to implement the A-CDM process but still wish to integrate into the ATM network may do so as an Advanced ATC TWR Airport. Such an Airport may provide a reduced set of DPI messages with a reduced set of advantages (compared to CDM Airports). An Advanced ATC TWR Airport provides Target Take-Off-Time (TTOT) estimations as well as Variable Taxi-Times (VTTs) and SIDs to the NMOC. These are provided from the moment that the aircraft leaves the blocks.	Advanced ATC TWR Implementation Guide Edition Nº 1.6
Aircraft stand	An aircraft stand is the parking position on the apron and thus is part of the "airside" of an airport. It needs to be distinguished between aircraft stands and terminal gates. The gates are usually located inside the terminal building and belong to the landside. A gate change not necessarily implies a change of the aircraft stand and vice versa.	ATM lexicon
Airport Collaborative Decision Making (Airport CDM)	Airport Collaborative Decision Making is the concept, which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources. Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners,	EUROCONTROL IP1 A-CDM Implementation Manual

[2] Go to "Advanced Portfolio Manager" on the left navigation menu, and select "Coordination Group – ATM Performance Assessment (APA)" in STELLAR:

https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Aview%3Axrn%3Adatabase%3Aondb%2Ftable%2FSYS_MESSAGE%402333834.13%40xrn%3AprototypeView%3Adatabase.view.message.private.AllMyMessages

	knowing their preferences and constraints and the actual and predicted situation. The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools. The Airport CDM concept is divided in the following Elements: - Information Sharing - Milestone Approach - Variable Taxi Time - Pre-departure Sequencing - Adverse Conditions - Collaborative Management of Flight Updates	
Airport Operations Plan (AOP)	The AOP (Airport Operations Plan) is the single, common and collaboratively agreed rolling plan used by all involved stakeholders whose purpose is to provide common situational awareness. It requires individual stakeholders to make changes within their own sphere of operations. The AOP interacts with a number of services, systems and external stakeholders (e.g. Network).	ATM Lexicon
Airport Operations Centre (APOC)	A platform / operational structure, which pro-actively manages the performance of present and short-term airport operations, giving relevant airport stakeholders a common operational overview of the airport, and allowing them to communicate, coordinate and collaboratively decide on their progress.	ATM Lexicon
Arrival Manager (AMAN)	A planning system to improve arrival flows at one or more airports by calculating the optimised approach / landing sequence and Target Landing Times (TLDT) and, where needed, times for specific fixes for each flight, taking multiple constraints and preferences into account.	SESAR Concept of Operations Step 1 Edition 2013 (Ed. 01.02.00)
Airport Operations Centre (APOC)	The central organisational unit responsible for airport airside operations. In terms of human actors the role and responsibilities of the APOC may be represented by an APOC Supervisor among APOC Stakeholder Agents.	SESAR Concept of Operations Step 1 Final Edition 2015 Del ID D124 (Ed. 02.02.00)

A-SMGCS	A system providing routing, guidance and surveillance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety.	ICAO Doc 9830: Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual
ATFCM	A service complementary to Air Traffic Control (ATC), the objective of which is to ensure an optimum flow of air traffic to or through areas within which traffic demand at times exceeds the available capacity of the ATC system.	EUROCONTROL, CFMU (2002), Air Traffic Flow Management Operations: ATFM Users Manual, Edition 8.0, 18.3.2002
Demand Capacity Balancing (DCB)	Integrated Local DCB (Demand and Capacity Balancing) Processes see the seamless integration of local network management with extended ATC planning and arrival management activities in short-term and execution phases. It represents the core functionality for the Integrated Network ATM Planning (INAP) process through an enhanced Local DCB tool set. The solution will improve the efficiency of ATM resource management, as well as the effectiveness of complexity resolutions by closing the gap between local network management and extended ATC planning.	SOL PJ09.02
Departure Manager (DMAN)	A planning system to improve departure flows at one or more airports by calculating the Target Take-Off Time (TTOT) and Target Start Up Approval Time (TSAT) for each flight, taking multiple constraints and preferences into account.	SESAR Concept of Operations Step 2 Edition 2014 (Ed. 01.01.00)
DPI	The purpose of the Departure Planning Information (DPI) message is to supply the NMOC with flight data related updates that are made available by DCB tools, sequencing tools (e.g. DMAN), ANI-, CDM-, RNI- or ADV ATC TWR Airport systems. The main data elements to be received via the DPI message are: - An accurate estimation of the take-off time - The taxi-time (EXOT) - The SID	DPI Implementation Guide Edition № 2.3

	- TOBT & TSAT At CDM airports where the Aircraft Type and Registration are verified, the DPI message can also contain updates of: - The aircraft type - The aircraft registration These DPI messages are described in more detail in Reference [23].	
Network Operations Plan (NOP)	A set of information and actions derived and reached collaboratively both relevant to, and serving as a reference for, the management of the Pan-European network in different timeframes for all ATM stakeholders, which includes, but is not limited to, targets, objectives, how to achieve them, anticipated impact.	ATM Lexicon
Regional Network Integrated Airport	Currently the integration of airports into the ATM Network is achieved through either the A-CDM concept or the Advanced Tower concept. A third category of airport (regional airports) is proposed where a reduced set of CDM milestones is implemented and calculated in a quasi-automatic fashion - reducing the need for Airline / Ground Handler inputs. Such an approach relies on the stability and predictability of taxi-times which is considered as feasible in such airports. This will be a way to simplify the work needed to manually update CDM milestones, and also to enable the connection of regional airport to NMOC.	Operational Improvement AO-0824
Total Airport Management (TAM)	The Total airport management (TAM) project (PJ04) is a SESAR 2020 research project that focuses on a range of different airport complexity levels, developing scalable and cost-effective solutions, optimising both the local benefits and the benefits for the European network. Societal concerns will be addressed by ensuring that environmental mitigation measures and impact are included in the airport performance trade-off. The integration of airports into the air traffic management (ATM) network will be addressed through timely information sharing between the	SOL PJ.04 TAM

	Network Operations Plan and the individual airports, with the help of the SWIM technology.	
Validation Targets (VALS)	Targets that focus the development of enhanced capabilities by the SJU Projects. They aim to get from the R&D the required performance capability to contribute to the achievement of a strategic target and, thus, to the SES high level goals.	SESAR Guidance on KPIs and Data Collection Version 1 (D85, Ed. 00.01.01, 2014)

Table 3: Glossary of terms

2.5 Acronyms and Terminology

Term	Definition
ANS	Air Navigation Service
AAT	Airport Advance Tower
ANS	Air Navigation Services
ANSP	Air Navigation Service Provides
AO	Airport Operator
AODB	Airport Operational DataBase
AOP	Airport Operations Plan
APP	Approach
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATOT	Actual Take Off Time
ATS	Air Traffic Services
AU	Airspace User
AVG	Average
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit

CNS	Communication Navigation and Surveillance
CTOT	Calculated Take Off Time
DCB	Demand and Capacity Balancing
DLA	Delay
DMAN	Departure Manager
DPI	Departure Planning Information
ECAC	European Civil Aviation Conference
EEC	EUROCONTROL Experimental Centre
EOBT	Estimated Off Block Time
ETOT	Estimated Take Off Time
EU	European Union
EXE	Exercise
FAM	Flight Activation Monitoring
GOT	Gothenburg
HP	Human Performance
ICAO	International Civil Aviation Organisation
ID	Identifier
KPA	Key Performance Area
KPI	Key Performance Indicator
NM	Network Manager
NOP	Network Operations Plan
OE	Operating Environment
OFA	Operational Focus Area
OI	Operational Improvement
OSED	Operational Service and Environment Definition
PAGAR	Performance Assessment and Gap Analysis Report
PAR	Performance Assessment Report

PI	Performance Indicator
PJ	Project
PPP	Public-Private-Partnership
PRD	Predictability
RBT	Reference Business Trajectory
RNI	Regional Network Integrated
SEAC	SESAR European Airports Consortium
SES	Single European Sky
SESAR	Single European Sky ATM Research
SLA	Service Level Agreement
SOL	Solution
SPR	Safety and Performance Requirements
TMA	Terminal Manoeuvring Area
TOBT	Target Off Block Time
TTOT	Target Take Off Time
TWR	Tower
VALR	Validation Report
VALS	Validtion Strategy
VLD	Validation

Table 4: Acronyms and terminology

The following is a list of the concepts, terms or definitions introduced or commonly referred to in this document.

Term	Definition	Source
Airport Capacity Focus Area	Capture the peak runway throughput in the most challenging (or constrained) environments at busy hours, i.e. the capacity at a "maximum observed throughput" airport.	PAGAR
Airspace Capacity Focus Area	Capture the capability of a challenging volume of airspace to handle an increasing number of movements per unit time – through changes to the operational concept and technology.	PAGAR

Term	Definition	Source
Airspace Reservation/ Restriction (ARES)	Airspace Reservation means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users (Temporary Segregated Area (TSA), Temporary Reserved Area (TRA), and Cross-Border Area (CBA)) wheras Airspace Restriction designates Danger, Restricted and Prohibited Areas.	EC Regulation No 2150/2005
Airspace User Cost-Efficiency Focus Area	Cost-Efficiency obtained by Airspace Users other than direct gate-to-gate ATS costs (CEF1) or AU cost improvements assessed through other KPIs: Fuel Efficiency, Punctuality, etc. Note: Benefits assessed through other KPIs should not be included in this focus area to avoid double counting of benefits. AU Cost-Efficiency includes reduction of direct (AUC3) and indirect (AUC4) operational costs of the AU, as well as overhead costs (AUC5). In addition there are two specific PIs, Strategic Delay (AUC1) and Sequence Optimisation Benefit (AUC2).	PAGAR
ARES Capacity	The ability of an ATM system to accommodate specific training events which require airspace reservations and/or restrictions during a specific period of time, taking into account the duration of the training events, ATM inefficiency, planning inefficiency and weather impact on training and operations.	Performance Framework 2017
ATM Master Plan	The European ATM Master Plan is the agreed roadmap to bring ATM R&I to the deployment phase, introducing the agreed vision for the future European ATM system. It provides the main direction and principles for SESAR R&I, as well as the deployment planning and an implementation view with agreed deployment objectives. Through the SESAR Key Features, the ATM Master Plan identifies the Essential Operational Changes (both Essential Operational Changes featured in the Pilot Common Project and New Essential Operational Changes) and key R&I activities that support the identified performance ambition. The ATM Master Plan is updated on a regular basis in collaboration and consultation with the entire ATM community. Amendments are submitted to the S3JU Administrative Board for adoption. The content of the European ATM Master Plan is structured in three levels (Level 1 – Executive View, Level 2 – Planning and Architecture View, and Level 3 – Implementation View) to allow stakeholders to access the information at the level of detail that is most relevant to their area of interest. The intended readership for Level 1 is executive-level stakeholders. Levels 2 and 3 of the ATM Master Plan provide more detail on the operational changes and related elements and therefore the target audience is expert-level stakeholders.	SESAR2020 Project Handbook, European ATM Master Plan (9 Edition)
Civil-military coordination and cooperation	The coordination between the civil and military parties authorised to make decisions and agree a course of action.	Performance Framework 2017

Term	Definition	Source
Cost-Benefit Analysis	A Cost-Benefit Analysis is a process for quantifying in economic terms the costs and benefits of a project or a programme over a certain period, and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. This process helps decision-makers to compare an investment with other possible investments and/or to make a choice between different options / scenarios and to select the one that offers the best value for money while considering all the key criteria affecting the decision.	PAGAR
Deployment Scenario	Set of SESAR Solutions selected to satisfy the specific Performance Needs of operating environments in the European ATM System and based on the timescales in which their performance contribution is needed in the respective operating environments.	PAGAR
Flexibility KPA	The ability of the ATM System and airports to respond to changes in planned flights and missions. It covers late trajectory modification requests as well as ATFCM measures and departure slot swapping and it is applicable to military and civil airspace users covering both scheduled and unscheduled flights. In terms of specific military requirements, it also covers the ability of the ATM System to address military requirements related to the use of airspace and reaction to short-notice changes.	Performance Framework 2017
Focus Area	Within each KPA, a number of more specific “Focus Areas” are identified in which there are potential intentions to establish performance management. Focus Areas are typically needed where performance issues have been identified.	ICAO Doc 9883
Fuel Efficiency Focus Area	The SESAR performance Focus Area concerned with fuel efficiency. How much fuel is used by aviation or by extension “Fuel efficiency” (how much fuel can be saved?) is one of the performance aspects. Note: Policy places considerable focus on this. Fuel efficiency contributes to 3 of the 11 KPAs defined by ICAO: Cost-efficiency, Efficiency, and Environment.	PAGAR
Gap Analysis	Difference between the validation targets and the performance assessment. It is used to: 1. Anticipate any deviation from the design performance targets; 2. Identify the underlying reasons; 3. Derive the appropriate recommendations to be taken on board to redirect the R&D activities within the Programme towards the ultimate achievement of SESAR2020’s performance ambitions.	PAGAR

Term	Definition	Source
G2G ANS Cost-Efficiency Focus Area	One of the SESAR performance Focus Areas concerned with Cost Efficiency. Direct G2G ANS costs are those costs that are charged to Airspace Users via unit rates, including ATM/CNS costs, regulatory costs, Met costs and EUROCONTROL Agency costs.	Performance Framework new
Human Performance (HP)	Human capabilities and limitations which have an impact on the safety, security and efficiency of aeronautical operations.	EUROCONTROL ATM Lexicon
Key Performance Area	A way of categorising performance subjects related to high level ambitions and expectations. ICAO Global ATM Concept sets out these expectations in general terms for each of the 11 ICAO defined KPAs.	EUROCONTROL ATM Lexicon
Key Performance Indicator	Current/past performance, expected future performance (estimated as part of forecasting and performance modelling), as well as actual progress in achieving performance objectives is quantitatively expressed by means of indicators (sometimes called Key Performance Indicators, or KPIs). To be relevant, indicators need to correctly express the intention of the associated performance objective. Since indicators support objectives, they should not be defined without having a specific performance objective in mind. Indicators are not often directly measured. They are calculated from supporting metrics according to clearly defined formulas, e.g. cost-per-flight-indicator = Sum (cost)/Sum (flights). Performance measurement is therefore carried out through the collection of data for the supporting metrics." In SESAR2020 Performance Framework, Key Performance Indicators are those that have a validation target associated derived from the corresponding Performance Ambition.	ICAO Doc 9883 Performance Framework
Local Air Quality Focus Area	One of the SESAR performance Focus Areas concerned with Environment. Local air quality is a term commonly used to designate the state of the ambient air to which humans and the ecosystem are typically exposed at a specific location. In the case of aviation, local air quality studies are generally conducted near airports.	PAGAR
Noise Focus Area	One of the SESAR performance Focus Areas concerned with Environment. The term Noise is used in this document to designate noise pollution, which is defined as unwanted sound. The impact of unwanted sounds on the recipients (in this case, people living around airports) causes adverse effects.	PAGAR
Operational Environment (OE)	An environment with a consistent type of flight operations.	EUROCONTROL ATM Lexicon

Term	Definition	Source
Performance Ambitions	Performance capability that may be achieved if SESAR Solutions are made available through R&D activities, deployed in a timely and, when needed, synchronised way and used to their full potential.	EUROCONTROL ATM Lexicon
Performance assessment	This term relates to the quantitative estimate of the potential performance benefit of an operational improvement based on outputs from validation projects, collected and analysed by PJ19.04.02	ICAO Doc 9883 updated in PAGAR
Performance Framework	1) The overall performance-driven development approach that is applied within the SESAR development programme to ensure that the programme develops the operational concept and technology needed to meet long-term performance expectations. 2) The set of definitions and terminology describing the building blocks used by a group of ATM community members to collaborate on performance management activities. This set of definitions includes the levels in the global ATM performance hierarchy, the eleven Key Performance Areas, a set of process capability areas, focus areas, performance objectives, indicators, targets, supporting metrics, lists of dimension objects, their aggregation hierarchies and classification schemes.	EUROCONTROL ATM Lexicon
Performance Indicator	PIs are defined in the SESAR performance framework and relate to performance benefits in specific KPAs. However, no validation targets are assigned to PIs. SESAR Solutions projects use the results of validation exercises to report performance assessment in terms of the PIs, reporting the expected positive and negative impacts. Certain PIs are mandatory for measurement and reporting by Solution projects.	SESAR2020 Project Handbook
Performance metrics	Sometimes proxies may be used in a validation exercise when it is not possible to measure an impact directly using the specified KPIs and PIs. In these cases, other metrics may be used provided the solution project later converts the results into the reporting KPIs and PIs.	SESAR2020 Project Handbook
Predictability Focus Area	Predictability is focused on in-flight (i.e. off-block to on-block) variability of flight duration compared to the planned duration. It is expected that this area will be extended in the future to reflect the improvement derived from better planning in pre-tactical phase.	Performance Framework 2019
Punctuality Focus Area	Refers to “ATM Punctuality”. It captures ATM issues as well as events related to ATM that cause a temporal perturbation to airspace user schedules.	PAGAR
Resilience Focus Area	Resilience focuses on the ability to withstand and recover from planned and unplanned events and conditions which cause a loss of nominal performance.	Performance Framework updated

Term	Definition	Source
Safety	The state to which the possibility of harm to persons or damage to property is reduced, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management.	EUROCONTROL ATM Lexicon
Security	(aviation) Safeguarding civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources. Note: ATM Security is concerned with those threats that are aimed at the ATM System directly, such as attacks on ATM assets, or where ATM plays a key role in the prevention of or response to threats aimed at other parts of the aviation system (or national and international assets of high value). ATM security aims to limit the effects of a threats on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17).	EUROCONTROL ATM Lexicon, Note are from PAGAR
SESAR2020	The Programme for SESAR2020 was created with a clear and agreed need for continuing research and innovation in ATM beyond the SESAR 1 development phase. SESAR2020 is structured into three main research phases, starting with Exploratory Research, which is then further expanded within a Public-Private-Partnership (PPP) to conduct Industrial Research and Validation. Finally, it further exploits the benefits of the PPP in Demonstrating at Large Scale the concepts and technologies in representative environments to firmly establish the performance benefits and risks.	Performance Framework 2017
SESAR Programme	The programme which defines the Research and Development activities and Projects for the S3JU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook
SESAR ATM Solution	SESAR Solutions relate to either an Operational Improvement (OI) step or a group of OI steps with associated Enablers (technical system, procedure or human), which have been designed, developed and validated in response to specific Validation Targets and that are expected deliver operational and/or performance improvements to European ATM, when translated into their effective realisation. SESAR Technological Solutions relate to verified technologies proven to be feasible and profitable, which may therefore be considered to enable future SESAR Solutions.	SESAR2020 Project Handbook
Single European Sky High Level Goals	The SES High Level Goals are political targets set by the European Commission. Their scope is the full ATM performance outcome resulting from the combined implementation of the SES pillars and instruments, as well as industry developments not driven directly by the EU.	SESAR2020 Project Handbook
Sub-OE	A subcategory of an Operating environment, classified according to its complexity (e.g. high complexity TMA, medium complexity TMA, low complexity TMA).	EUROCONTROL ATM Lexicon

Term	Definition	Source
Validation targets	Validation targets are the targets that focus on the development of enhanced capabilities by the SESAR Solutions. They aim to secure from R&D the required performance capability to contribute to the achievement of the Performance Ambitions and, thus, to the SES high-level goals. In SESAR2020 validation targets are associated with a KPI.	EUROCONTROL ATM Lexicon

Table 5: Terminology

3 Solution Scope

3.1 Detailed Description of the Solution

Regional Network Integrated Airports (RNI Airports) solution is a cost-efficient way of achieving the connection with the NM reducing the effort of the Stakeholders compared to the one of a full A-CDM operation. As such, the only pre-requisite for a targeted regional airport is the availability of an Airport Operational Database (AODB).

The full A-CDM milestone approach concept relies on an enhanced level of information sharing between the different airport stakeholders and a high degree of monitoring of the turnaround process epitomised through 16 different milestones. In addition, the concept describes 5 different DPI messages (corresponding to different time horizons on a given flight or the cancellation of a previously sent message) for transmission to the Network manager.

A number of airports have been reluctant to implement the full A-CDM concept for a variety of reasons - but perceptions around the milestone complexity, increased workload for airport stakeholders (notably the ground handlers) as well as overall cost have all been cited.

There is therefore the potential for the creation of an additional 'category' of airport, namely the "Regional Network Integrated (RNI) Airport" compared to the three categories described in section 3.3.1 (previous operating method). The high level aims behind the operational concept for such RNI airports are:

- To implement a reduced set of turnaround milestones to be monitored, concentrating on those which are 'event driven' rather than 'time driven'.
- To generate such milestones in a quasi-automatic manner
- To reduce ground handler workload in terms of inputs to the system so as to become the 'exception' rather than the 'rule'
- To offer the full set of DPI messages to the Network Manager and simultaneously respecting the quality criteria inherent in the full A-CDM implementation.

RNI airports will therefore be positioned between full A-CDM airports and AAT airports concerning the degree of turnaround process monitoring and the level of information provided to the Network Manager.

The concept for RNI airports will aim to improve the efficiency of the turnaround process locally at the airport as part of the process of information sharing. The key milestones for each flight will be available to each of the airport CDM partners. In addition, the provision of DPI messages to the Network Manager will satisfy the associated quality requirements and ensure that those airports deploying the RNI process have an affordable means of achieving the Network manager accuracy criteria.

3.2 Detailed Description of relationship with other Solutions

Solution PJ.04-W2-28.1 'Connected Regional Airports' builds on the work performed in SESAR1, specifically in relation to SESAR Solution PJ.04-1 'Enhanced Collaborative Airport Performance Planning and Monitoring' developed from the SESAR Solution 21 (Airport Operations Plan and AOP-NOP

Seamless Integration). Solution 21 focused on demonstrating how the Airport Operations Plan (AOP) improved the situation awareness of Airport Stakeholders, though common information sharing, and how the exchange of information between AOP and the Network Operations Plan (NOP) improved the integration of airports in the overall ATM network. PJ04-01 aims to keep improving the 'quality' of the AOP information through the inclusion of an increased set of data, captured from a wider range of airport processes.

Besides this parents solutions, there is no relation of Sol.PJ.04-W2-28.1 with any other solution.

4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

Previous Validation Exercises (pre-SESAR2020 Wave 2, etc.) relevant for this assessment are listed below.

Organisation	Document Title	Publishing Date
EUROCONTROL	OFA 05.01.01 Solution 21 PAR	08/11/2016
EUROCONTROL	OFA05.01.01 EXE 749 VALR	08/11/2016

Table 6: Pre-SESAR2020 Exercises

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

Exercise ID	Exercise Title	Release	Maturity	Status
Validation Exercise PJ04-01.V2.02	PJ04-01.V2.02 Shadow mode trial at Alicante Airport	N/A	V2	Completed
PJ.04-W2-EXE2811	Shadow mode trial at Gothenburg airport validating the integration of Regional Airports into the ATM network	N/A	V3	Completed

Table 7: SESAR2020 Validation Exercises

Alicante exercise

The high level goal for this exercise can be stated as “To validate 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 validation exercise was therefore intended to demonstrate the feasibility of the quasi-automated DPI message generation in full respect of the minimum accuracy requirements at different time horizons as specified by the Network Manager.

PJ.04-W2-EXE2811

PJ.04-W2-EXE2811 was executed in shadow mode. This means that the validation platform was being fed in real-time by flight data messages from the Network Manager B2B service as well as data from the local GOT Airport Operations Database (AODB). In addition, the platform was providing DPI messages to an operational test system located in the Network Manager in exactly the same way as would be performed for a live operation. There was however, no impact on live operations stemming from the exercise taking place. Specifically, Pilots, Ground Handlers or TWR Controllers in the live environment were not acting in accordance to the information from the AOP, which implies that any performance benefits highlighted in this report could potentially be further accentuated following deployment of the solution into a live environment.

No de-icing procedures were included in the validation platform. However, the timing (late May) of the exercises meant that the inclusion of such procedures was not necessary.

The Reference scenario reflects the current state of operations in GOT with departure estimates based on flight plan data with modifications through DLA or CHG messages. No TOBT values are shared between the airport partners and no DPI message transmission with NM takes place.

In the Solution Scenario, target take-off times are calculated by the validation platform, based on arrival estimates and aircraft-airline known behaviour at Göteborg Landvetter Airport and shared with the NM through the Departure Planning Information (DPI) messages.

Success is obtained when the DPI target times are improved compared to current Flight Plan data and the accuracy of Actual Departure (take-off) Times are within acceptable A-CDM requirements.

The departure predictability is highly increased at a regional airport sending DPIs, when compared to the transmission of flight plan (and revisions) information.

Metric	Solution scenario (ATOT-TTOT)		Reference scenario (ATOT-ETOT)	
Results (minutes)	Mean (μ)	Std. Deviation (σ)	Mean (μ)	Std. Deviation (σ)
9h to ATOT	27.2	34.6	33.0	35.8
7h to ATOT	23.0	29.1	28.7	30.9
5h to ATOT	19.8	23.5	26.4	28.6
3h to ATOT	13.8	19.5	22.3	22.7
2h to ATOT	11.9	14.3	19.3	18.5
1h to ATOT	9.8	9.4	17.8	16.5

Table 8: Validation results – PRDM#1 Departure predictability

4.2 Conditions / Assumptions for Applicability

N/A

4.3 Safety

Solution PJ.04-W2-28.1 does not contribute to safety benefits

4.3.1 Safety Design drivers and Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to safety benefits

4.3.2 Data collection and Assessment

Solution PJ.04-W2-28.1 does not contribute to safety benefits

4.3.3 Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to safety benefits

4.3.4 Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to safety benefits

4.3.5 Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to safety benefits

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4.4 Environment: Fuel Efficiency / CO2 emissions

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.4.1 Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.4.2 Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.4.3 Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.4.4 Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to environment benefits.

4.4.5 Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.5 Environment / Emissions, Noise and Local Air Quality

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.5.1 Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.5.2 Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.5.3 Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.5.4 Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to environment benefits

4.5.5 Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to environment benefits.

4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

4.6.1 Performance Mechanism

The declared capacity, determined by the ANSP and declared to the CFMU, is the number of aircraft per hour that a sector can normally accommodate being protected from overload [20]. This value is typically below the sector maximum safe capacity, i.e., the maximum aircraft per hour that sector controllers can handle without exceeding the overload threshold [21]. The difference between both is the capacity buffer, which covers unexpected traffic, i.e., over-deliveries.

The uncertainty of the aircraft entry time to the en-route sector is one of the factors contributing to the need for a capacity buffer. The better departure (and network) predictability should allow for reducing the en-route capacity buffer and therefore increasing the declared capacity up to a closer value to the maximum safe capacity. This implies an increase in the declared en-route capacity, boosting route throughput (CAP2).

4.6.2 Assessment Data (Exercises and Expectations)

The underlying assumption for this calculation is that the departure predictability (take-off time) measured in the validation exercise is equal to the network predictability (entry-time to the en-route sector).

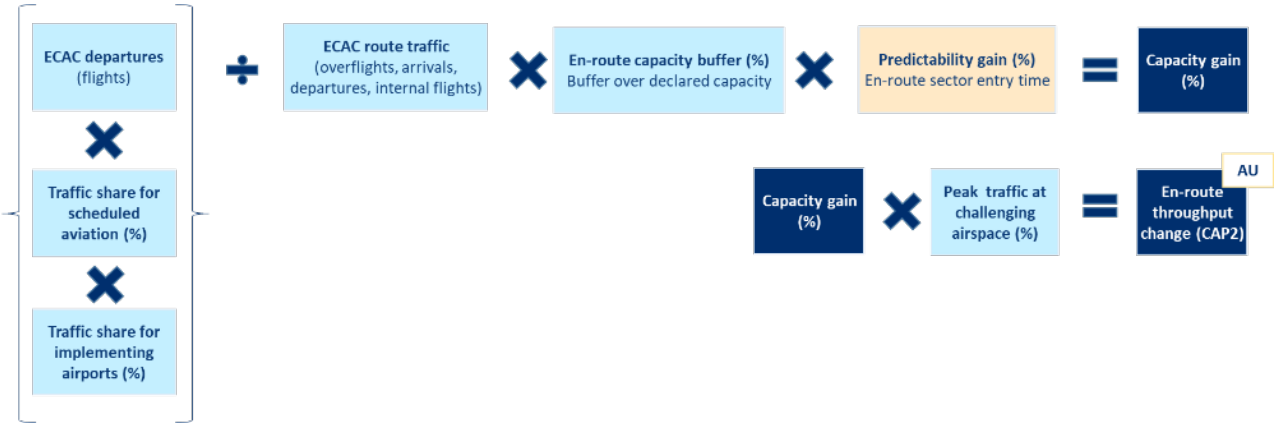


Figure 1: Departure predictability – CAP2 computation

(in orange, results from validation exercise)

Therefore, the predictability gain is calculated as the change in the standard deviation of PRD#M2 (ATOT-TTOT) with and without the solution, as per the following equation:

$$\Delta\mathrm{PRD} = \frac{\sigma_{\mathrm{SOL}} - \sigma_{\mathrm{REF}}}{\sigma_{\mathrm{REF}}}$$

Again, the *2h to ATOT* values from Table 7: Validation results – PRDM#1 Departure predictability are selected for the calculation, resulting in a **+22.8% departure predictability gain.** This result translates in a **+5.9% network predictability gain** and **+0.15% CAP2** as per the calculation depicted in Figure 1.

OI step	Relative benefits contribution to CAP1	Relative benefits contribution to CAP2

AO-0824	N/A	100%
TOTAL	N/A	100%

Table 9: Airspace Capacity relative benefits per OI step

4.6.3 Extrapolation to ECAC wide

The capacity improvement KPI CAP2 is a Network level KPI, therefore benefits explained in the previous section apply directly to the ECAC area and not locally.

The monetisation extrapolated to ECAC wide is contemplated within the CBA analysis, while the assessment data is already computed at ECAC level. The only KPI computed locally is the PRD#M1.

4.6.4 Discussion of Assessment Result

As there was no validation targets assigned by PJ19 to Solution 28.1, there are no gap between the expected values and the computed ones.

Additionally, CAP2 has not been measured, but the Predictability KPI (PRD#M1), which after some assumptions, was included in the CAP2 computation as presented in Figure 1.

4.6.5 Additional Comments and Notes

N/A

4.7 Airport Capacity (Runway Throughput Flights/Hour)

Solution PJ.04-W2-28.1 does not contribute to airport capacity benefits

4.7.1 Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to airport capacity benefits

4.7.2 Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to airport capacity benefits

4.7.3 Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to airport capacity t benefits

4.7.4 Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to airport capacity benefits

4.7.5 Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to airport capacity benefits

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

Solution PJ.04-W2-28.1 does not contribute to resilience benefits

4.8.1 Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to resilience benefits

4.8.2 Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to resilience benefits

4.8.3 Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to resilience benefits

4.8.4 Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to resilience benefits

4.8.5 Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to resilience benefits

4.9 Flight Times

Solution PJ.04-W2-28.1 does not contribute to flight times benefits

4.9.1 Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to flight times benefits

4.9.2 Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to flight times benefits

4.9.3 Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to flight times benefits

4.9.4 Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to flight times benefits

4.9.5 Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to flight times benefits

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4.10Predictability

4.10.1Performance Mechanism

Solution 28.1 will have a positive impact on predictability when measured in terms of the accuracy of the target take-off time (as provided in the DPI messages) and the actual take-off time.

Through an automated monitoring of the flight status, and the last check of the Aircraft Users and/or the Ground Handlers, the Off Block intention is updated according to the flight evolution and the NM DCB processes are updated with more precise data.

The quality of the data contained in the DPI message set leads to an enhanced predictability of departure times particularly when compared to the current information sharing with the Network Manager which is oriented around flight plan revisions.

4.10.2Assessment Data (Exercises and Expectations)

There are no validation targets assigned by PJ19 to Solution 28.1 and the solution does not impact directly PRD1 or PRD2 KPIs as defined in the SESAR Performance Framework. Nevertheless, it is anticipated that Solution 28.1 will have a positive impact on predictability when measured in terms of the accuracy of the target take-off time (as provided in the DPI messages) and the actual take-off time, which could be understood as network predictability.

The improvement in departure planning information and sharing it with the Network Manager results in reduced capacity ‘buffers’ applied by FMPs, reduced need for regulations, combing to lead to an overall reduction in ATFM delay, which directly affects CAP2 and CEF2 KPIs.

The principal element of the post-exercise analysis has been a comparison between the Target Take-Off Times (TTOT) in each DPI type compared with the Actual take-off Times (ATOT). In addition the flight plan EOBT + taxi-time was also compared with the ATOT as this is a reflection of the accuracy that will be obtained in the reference scenario and without the deployment of Solution 28.1 [PRD#M1 (TTOT-ATOT)], following the same method Alicante exercise implemented. The results are presented in Table 7: Validation results – PRDM#1 Departure predictability

4.10.3Extrapolation to ECAC wide

The only KPI computed locally is the PRD#M1, but there is no extrapolation to ECAC wide, nevertheless, it is used as support to compute at ECAC level the other two KPIs, CAP2 and CEF2.

4.10.4Discussion of Assessment Result

The following Table provides the TTOT versus ATOT and ETOT versus ATOT comparison from the transmission of the first DPI – including P-DPI.

	AVG (ATOT-TTOT) with DPIs	Standard deviation with DPIs	AVG (ATOT-ETOT) without DPIs	Standard deviation without DPIs	Improved accuracy
9h to ATOT	27,23 min	34,57 min	33,02 min	35,77 min	17,53%
7h to ATOT	22,96 min	29,05 min	28,66 min	30,85 min	19,90%
5h to ATOT	19,79 min	23,51 min	26,43 min	28,57 min	25,13%
3h to ATOT	13,83 min	19,54 min	22,25 min	22,71 min	37,84%
2h to ATOT	11,94 min	14,29 min	19,30 min	18,51 min	38,15%
1h to ATOT	9,78 min	9,43 min	17,79 min	16,48 min	44,99%

Table 10 : DPI performance enhancement compared to flight plan

The frequently incorrect boarding process monitoring led to a small degradation in the TTOT versus ATOT comparison but still proved more reliable than the reference scenario. A more accurate boarding process monitoring will lead to an improved DPI quality during the 'boarding time horizon'.

Similarly, some of the taxi-out time estimates provided by the AODB to the Solution 28.1 platform proved to be inaccurate. Again, a more reliable taxi-out value will lead to improved DPI accuracy.

4.10.5Additional Comments and Notes

N/A

4.11Punctuality

Solution PJ.04-W2-28.1 does not contribute to punctuality benefits

4.11.1Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to punctuality benefits

4.11.2Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to punctuality benefits

4.11.3Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to punctuality benefits

4.11.4Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to punctuality benefits

4.11.5Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to punctuality benefits

4.12Civil-Military Cooperation and Coordination (Distance and Fuel)

Solution PJ.04-W2-28.1 does not contribute to Civil-Military Cooperation and Coordination benefits

4.12.1Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to Civil-Military Cooperation and Coordination benefits

4.12.2Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to Civil-Military Cooperation and Coordination benefits

4.12.3Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to Civil-Military Cooperation and Coordination benefits

4.12.4Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to Civil-Military Cooperation and Coordination benefits

4.12.5Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to Civil-Military Cooperation and Coordination benefits

4.13Flexibility

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.13.1Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.13.2Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.13.3Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.13.4Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.13.5Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.14Cost Efficiency

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.14.1Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.14.2Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.14.3Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.14.4Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.14.5Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to flexibility benefits

4.15Airspace User Cost Efficiency

Solution PJ.04-W2-28.1 does not contribute to airspace user cost efficiency benefits

4.15.1Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to airspace user cost efficiency benefits

4.15.2Assessment Data (Exercises and Expectations)

Solution PJ.04-W2-28.1 does not contribute to airspace user cost efficiency benefits

4.15.3Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to airspace user cost efficiency benefits

4.15.4Discussion of Assessment Result

Solution PJ.04-W2-28.1 does not contribute to airspace user cost efficiency benefits

4.15.5Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to airspace user cost efficiency benefits

4.16Security

Solution PJ.04-W2-28.1 does not contribute to security benefits

4.16.1The SecRAM 2.0 methodology and the Security Performance Mechanism

Solution PJ.04-W2-28.1 does not contribute to security benefits

4.16.2Security Assessment Data Collection

Solution PJ.04-W2-28.1 does not contribute to security benefits

4.16.3Extrapolation to ECAC wide

Solution PJ.04-W2-28.1 does not contribute to security benefits

4.16.4Additional Comments and Notes

Solution PJ.04-W2-28.1 does not contribute to security benefits

4.17Human Performance

4.17.1HP arguments, activities and metrics

To support the HP assessment, five activities were proposed in order to clarify the full set of identified HP issues; however, due to staffing constraints as a result of the COVID-19 pandemic, two activities could not take place. Nevertheless, the full set of HP issues, benefits and impacts was assessed through a shadow mode validation.

A total of 44 potential HP issues and benefits were identified in the Human Performance Assessment Plan (HPAP). 13 of these items could not be fully assessed and remain with an 'Open' status, with a recommendation to be assessed prior to the deployment phase of the solution. These findings should not prevent the solution from reaching V3 maturity.

A total of 10 HP recommendations and 2 HP requirements have been formulated and should be taken into account in the future development and validation of this concept.

Based on the findings of the HP activities, solution PJ.04-W2-28.1 has been deemed mature to progress to the next V-phase from a HP perspective. No targets were set in relation to the Human Performance for this solution.

It was identified that the Airport Operator will be less impacted by the change brought by this solution, as they will receive access to more refined information with no changes in their operating methods. Therefore, the HP issues identified in this document are not currently foreseen to impact negatively AO's HP. The HP issues that remained 'Open' are a result of limited participation of AO in the validation, however the initial feedback received was positive with benefits identified. Nonetheless, it is recommended that prior to implementation, the impact on the AO's HP is further investigated.

The platform used in this solution for the NMOC was successfully used in SESAR Wave 1. Therefore, the changes are not considered to have a negative impact on the B2B changes. Nevertheless, as the NMOC was not involved in the validation in this Wave, it is recommended that further analysis is done at the next maturity level.

The reader is referred to Part IV of the OSED (HP Assessment Report) for a detailed description of the HP results of the validation.

A 3-day shadow mode trial was conducted where the HP issues, benefits and impacts were successfully assessed. HPs KPIs measured were 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 4.1 & 4.5.

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	Shadow mode and subsequent interviews to the Stakeholders	**HP1.1** Clarity and completeness of role and responsibilities of human actors	**Closed**
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	**Open**
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	**Open**

PIs	Activities & Metrics	Second level indicators	Covered
HP2 Suitability of technical system in supporting the tasks of human actors	Shadow mode and subsequent interviews to the Stakeholders	**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	**Open**
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	**Open**
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	**Closed**
HP3 Adequacy of team structure and team communication in supporting the human actors	Shadow mode and subsequent interviews to the Stakeholders	**HP3.1** Adequacy of team composition in terms of identified roles	**N/A**
		HP3.2 Adequacy of task allocation among human actors	**N/A**
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	**N/A**
HP4 Feasibility with regard to HP-related transition factors	Shadow mode and subsequent interviews to the Stakeholders	**HP4.1** User acceptability of the proposed solution	**Closed**
		HP4.2 Feasibility in relation to changes in competence requirements	**N/A**
		HP4.3 Feasibility in relation to changes in staffing levels, shift organization and workforce relocation.	**N/A**
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	**N/A**
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	**N/A**

Table 11: HP arguments, activities and metrics

4.17.2Extrapolation to ECAC wide

Section non required in HP.

4.17.3Open HP issues/ recommendations and requirements

PIs	Number of open issues/benefits	Nr. of recommendations	Number of requirements
HP1 Consistency of human role with respect to human capabilities and limitations	8	8	2
HP2 Suitability of technical system in supporting the tasks of human actors	3	7	0
HP3 Adequacy of team structure and team communication in supporting the human actors	N/A	N/A	N/A
HP4 Feasibility with regard to HP-related transition factors	0	0	0

Table 12: Open HP issues/ recommendations and requirements

4.17.4Concept interaction

There is one solution above other that might be interested in the HP work and the interactions identified. TOBT management and GHs new responsibilities HP aspects are to be considered by PJ.04-W2-28.2 targeting V2. This aspects have 5 open issues.

Nevertheless, the project members of all of the PJ.04-W2 solutions should find useful reference material within this document with regards to Human Performance transversal area.

4.17.5 Most important HP issues

All relevant HP issues and arguments were investigated sufficiently for V3 maturity in relation to the Ground Handler and Air Traffic Controller. Nevertheless, the issues that remained 'Open' are recommended to be further investigated prior to the deployment stage.

It was identified that the Airport Operator will be less impacted by the change brought by this solution, as they will receive access to more refined information with no changes in their operating methods. Therefore, the HP issues identified in this document are not currently foreseen to impact negatively AO's HP. The HP issues that remained 'Open' are a result of limited participation of AO in the validation, however the initial feedback received was positive with benefits identified. Nonetheless, it is recommended that prior to implementation, the impact on the AO's HP is further investigated.

4.17.6Additional Comments and Notes

Non applicable

4.18Other PIs

4.18.1Performance Mechanism

The Network Manager (NM) will issue better and more stable regulations (CTOTs) based on more accurate departure data (TTOT). This benefit will translate into fewer lost slots by airspace users. Once an aircraft loses its slot, it has to wait until a new one and accumulates further delay. Therefore, the CBA transfers the predictability benefit to airspace users, monetising the avoided tactical and strategic delay, as well as to airport operators, considering the passenger value of time.

4.18.2Assessment Data (Exercises and Expectations)

Figure 3 shows the calculation followed in the CBA to monetise the improved adherence to CTOT.

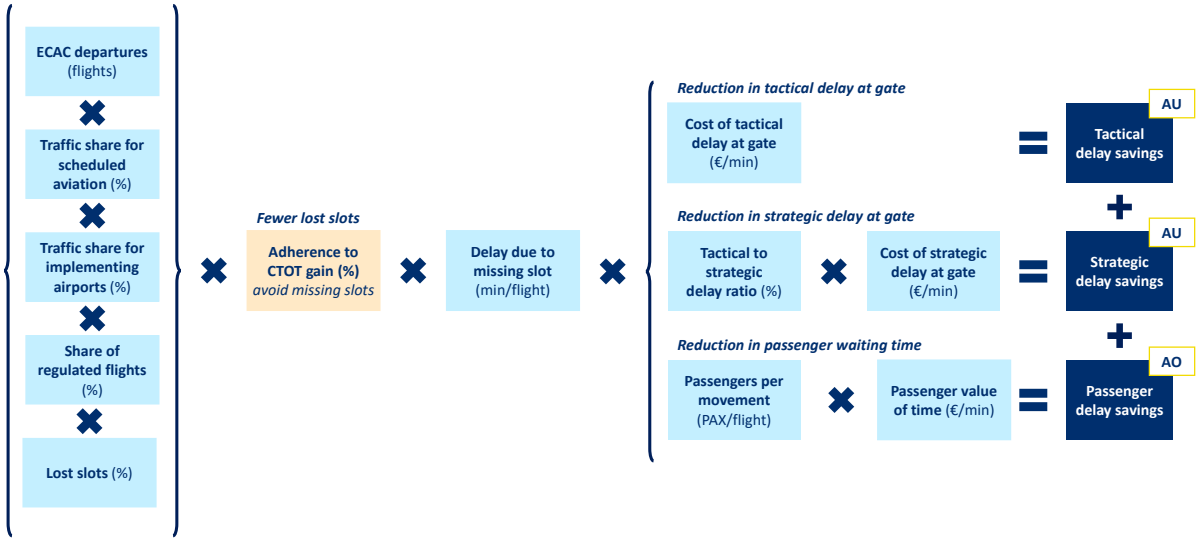


Figure 2: Lost Slots computation

(in orange, results from validation exercise)

The connected airports will send the predicted TTOT (coming out of the TOBT prediction and sequencing processes) to the NM, feeding the calculation of the flight regulations (CTOTs). The NM issues the flight regulations, at least, 2 hours before the estimated off-block time (EOBT). Subsequently, the analysis considers the *ATOT-TTOT* results for *2h to ATOT*, as the best approximation for *2h to EOBT*.

The TTOT and the CTOT shall be therefore compatible. Meeting the TTOT should ensure compliance with the CTOT. The model assumes ± 5 minutes[3] compliance window for the TTOT. Therefore, the CBA

[3] The NM considers a ± 5 minutes tolerance in the TTOT value (Milestone 3, [21]). Dublin Airport: "Take-off clearance will be given at TTOT ± 5 minutes" [22].

estimates the gain in slot adherence (CTOT) based on the reduced probability of infringing the TTOT tolerance brought by the solution.

Assuming that the VALR metrics follow normal (Gaussian) distributions, Table 10 allows computing the probability (P) of *|ATOT-TTOT| > 5 minutes*, which leads to the following expression:

$$\Delta\text{Slot Adherence} = \frac{\text{REF} - \text{SOL}}{\text{REF}} \quad \begin{cases} \text{SOL} = \text{P}([\text{ATOT} - \text{ETOT}]_{\text{REF}}, & > 5 \text{ min}) \\ \text{REF} = \text{P}([\text{ATOT} - \text{ATOT}]_{\text{SOL}}, & > 5 \text{ min}) \end{cases}$$

The results show that the solution would **avoid 12.0% of the currently missed slots at the implementing airports.**

4.18.3Additional Comments and Notes

N/A

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.19Gap Analysis

There are no validation targets assigned by PJ19 to Solution 28.1

5 References

[1] 08.01.03 D47: AIRM v4.1.0

[2] B05 Performance Assessment Methodology for Step 1 PJ19.04.01 Methodology for Performance Assessment Results Consolidation (2020)[4]

[3] SESAR Performance Framework (2019), Edition 01.00.01, Dec 2019

https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Adatabase%3Aondb%2Frecord%2F16414675

[4] Performance Assessment and Gap Analysis Report (2019), Edition 00.01.02, Dec 2019

[5] Methodology for the Performance Planning and Master Plan Maintenance, Edition 0.13, Dec 2017

Content Integration

[6] SESAR ATM Lexicon

Performance Management

[7] PJ19.04 D4.1 Validation Targets - Wave 2 (2020)[5]

Validation

[8] European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

Safety

[9] SESAR, Safety Reference Material, Edition 4.0, April 2016

https://stellar.sesarju.eu/jsp/project/qproject.jsp?objId=1795089.13&resetHistory=true&statInfo=Ogp&domainName=saas

[10] SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

https://stellar.sesarju.eu/jsp/project/qproject.jsp?objId=1795102.13&resetHistory=true&statInfo=Ogp&domainName=saas

[11] SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[4] At the time of the creation of the PAR template, the Methodology (PJ19.04 Internal Document) is foreseen to be update in 2020.

[5] At the time of the creation of the PAR template the Validation Target is foreseen to be delivered in June 2020

[12]Accident Incident Models – AIM, release 2017

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=3658775.13&att=attachment&statEvent=Download

Human Performance

[13]16.06.05 D 27 HP Reference Material D27

[14]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[15]SESAR, Environment Assessment Process (2019), PJ19.4.2, Deliverable D4.0.080, Sep 2019.

https://stellar.sesarju.eu/servlet/dl/DownloadServlet?downloadKey=xrn%3Adatabase%3Aondb%2Frecord%2F14665451&resuming=true&zip=true&disposition=attachment&domainName=saas&domainName=saas

[16]ICAO CAEP – "Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes" document, Doc 10031.

https://www.icao.int/publications/pages/publication.aspx?docnum=10031

Security

[17]16.06.02 D103 SESAR Security Ref Material Level

[18]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[19]16.06.02 D131 Security Database Application (CTRL_S)

Others

[20]EUROCONTROL, Technical note on en-route capacity, A perspective on all aspects of en-route capacity, December 2020

[21]EUROCONTROL, EEC Note No 21/03, Pessimistic Sector Capacity Estimation

[22]D2.1.040 - SESAR 2020 Solution PJ.04-W2-28.1 VALR V3 – Part I, ed. 00.00.03, 27 July 2022

[23]DPI Implementation Guide; Edition 1.800; 19 Mar 2015

[24]PJ04_01 SPR-INTEROP-OSED-FINAL-EDITION (Part V) (1_0)

[25]SESAR Solution PJ04-W2-28.1: Validation Report (VALR) for V3 (Ed. 00.00.04)

[26]SESAR Solution PJ.04-W2-28.1 COST BENEFIT ANALYSIS (CBA) FOR V3 (Ed. 00.00.02)

Appendix A Detailed Description and Issues of the OI Steps

There is only one Operational Improvement and therefore the performance benefits are directly related with this OI. This OI is stable and has no recognisable issues

OI Step ID	Title	Consistency with latest Dataset
AO-0824	Regional network-integrated airports (RNI)	Dataset 23 Draft

Table 13: OI Steps allocated to the Solution