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Founding Members



Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
José Manuel CORDERO / ENAIRE	PJ.19-04 Lead	30/11/2019
Icía GARCÍA-OVIES / ENAIRE	PJ.19-04 Member	30/11/2019
Christian VERDONK GALLEG0 / ENAIRE	PJ.19-04 Alternate	30/11/2019
Leticia SÁNCHEZ-PALOMO BERMÚDEZ / ENAIRE	PJ.19-04-01 Task Lead	30/11/2019
Andrada BUJOR / INDRA	PJ.19-04 Member	10/06/2019
Esther CALVO FERNANDEZ / EUROCONTROL	PJ.19-04 Member	10/06/2019
Laura CARBO / EUROCONTROL	PJ.19-04 Member	10/06/2019
Robin DERANSY / EUROCONTROL	PJ.19-04 Member	10/06/2019
Andreas KANSTEIN / LEONARDO-Telespazio	PJ.19-04 Member	10/06/2019
Remus LACATUS / EUROCONTROL	PJ.19-04 Member	10/06/2019
Marta LLOBET LÓPEZ / EUROCONTROL	PJ.19-04 Member	10/06/2019
Renee PELCHEN-MEDWED / EUROCONTROL	PJ.19-04 Member	10/06/2019
Laurent TABERNIER / EUROCONTROL	PJ.19-04-02 Task Lead	10/06/2019

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Gabriele ZAKI / DFS	PJ19-02 Lead	22/06/2019
Lars Stridsman / COOPANS	PJ19-02 Alternate	22/06/2019
Sujan PERERA / NATS	PJ19-03 Lead	22/06/2019
Anthony VAUDREY / NATS	PJ19-03 Alternate	22/06/2019
Mariya KOLEVA / EUROCONTROL	PJ19-05 Lead	22/06/2019
Juliette ENGEL-KLOPPENBORG / EUROCONTROL	PJ19 Quality Manager	22/06/2019
Andrea RANIERI / INDRA	PJ19 Member	22/06/2019
P01 OLIVELLA / INDRA	PJ19 Member	22/06/2019
Othmar SCHNABEL / DFS	PJ19 Member	22/06/2019

Alexander HEINTZ / DFS	PJ19 Member	22/06/2019
Thomas HELLBACH / DFS	PJ19 Member	22/06/2019
Peter BARTSCH / DFS	PJ19 Member	22/06/2019
Bojana ZIVKOVIC / DFS	PJ19 Member	22/06/2019
Julija ČIZIENE / ON(B4)	PJ19 Member	22/06/2019
Vilma DELTUVAITE/ ON (B4)	PJ19 Member	22/06/2019
Marco GIBELLINI / EUROCONTROL	PJ19-04-03 Task Lead	22/06/2019
Goran REDZEPOVIC / EUROCONTROL	PJ19 Member	22/06/2019
Andreas TAUTZ / EUROCONTROL	PJ19 Member	22/06/2019
Ioanna KATSAROU / EUROCONTROL	PJ19 Member	22/06/2019
John HIRD / EUROCONTROL	PJ19 Member	22/06/2019
Octavian FOTA / EUROCONTROL	PJ19 Member	22/06/2019
Jacques MATHOT / EUROCONTROL	PJ19 Member	22/06/2019
Desiree TEUNISSEN / EUROCONTROL	PJ19 Member	22/06/2019
Paula LEAL DE MATOS / EURONTROL	PJ19 Member	22/06/2019
Adriana Dana BOTEZAN / EUROCONTROL	PJ19 Member	22/06/2019
Irisa CHIU / HELIOS	PJ19 Member	22/06/2019
Francesco PRETI / EUROCONTROL	PJ19 Member	22/06/2019
Valerii BODNAR / EUROCONTROL	PJ19 Member	22/06/2019
Didier DOHY / EUROCONTROL	PJ19 Member	22/06/2019
Fausto BRUNI / LEONARDO	PJ19 Member	22/06/2019
Daniel FERRO / AIRBUS	PJ19 Member	22/06/2019
Thomas MAIER / AIRBUS	PJ19 Member	22/06/2019
Jean-Marc LOSCOS / DSNA	PJ19 Member	22/06/2019
Alessandra TEDESCHI / ENAV	PJ19 Member	22/06/2019
Luca SAVE / ENAV	PJ19 Member	22/06/2019
Paola LANZI / ENAV	PJ19 Member	22/06/2019
Davide DEL VECCHIO / ENAV	PJ19 Member	22/06/2019
Theresa DI LALLO/ ENAV	PJ19 Member	22/06/2019
Giuseppe ROMANO/ ENAV	PJ19 Member	22/06/2019
Jorge BUENO / ENAIRE	PJ19 Member	22/06/2019

Sergio TORRES / ENAIRE	PJ19 Member	22/06/2019
Jesús ROMERO / ENAIRE	PJ19 Member	22/06/2019
Rhona MURPHY / NATS	PJ19 Member	22/06/2019
Greg WALLACE / NATS	PJ19 Member	22/06/2019

Reviewers external to the project

Name/Beneficiary	Position/Title	Date
Tanja Bolic / UNIVERSITY OF TRIESTE	Scientific Committee	22/06/2019
Pilar Calzón Robledo / ENAIRE	PJ06 PCIT	22/06/2019
Andrew Cook / UNIVERSITY OF WESTMINSTER	Scientific Committee	22/06/2019
Hartmut Koelman / EUROCONTROL	ATM Master Plan Performance Expert	22/06/2019
Rita Markovits-Somogyi / HUNGAROCNTR	Scientific Committee	22/06/2019
Olivia Nuñez / SJU	ATM Expert	22/06/2019
Vojin Tosic / Formerly UNIVERSITY OF BELGRADE	Scientific Committee	22/06/2019
Dinesh GOGNA / NATS	PJ01 Coordinator	22/06/2019
Vincent TREVE / EUROCONTROL	PJ02 Coordinator	22/06/2019
Robert GRAHAM / EUROCONTROL	PJ02 Coordinator Contact	22/06/2019
Claudio VACCARO / ENAV	PJ03a-01 Coordinator / PJ03a PCIL	22/06/2019
Nicolas LEON / DSNA	PJ03b Coordinator / PJ03b PCIL	22/06/2019
Olivier DELAIN / SEAC2020	PJ04 Coordinator	22/06/2019
Florian Piekert / DLR	PJ.04-02	22/06/2019
Alan Grosskreutz / ENAIRE	PJ.04-01	22/06/2019
Joern Jacobi / AT-ONE Consortium	PJ05 Coordinator	22/06/2019
Florence SERDOT-OMER / DSNA	PJ06 Coordinator	22/06/2019
Kris DELCOURTE / EUROCONTROL	PJ07 OAUO Coordinator / PJ08 Coordinator Contact	22/06/2019
Nadine PILON / EUROCONTROL	PJ07 Coordinator Contact	22/06/2019
Giuseppe MURGESE / EUROCONTROL	PJ08 Coordinator	22/06/2019
Soenke MAHLICH / EUROCONTROL	PJ09 Coordinator	22/06/2019
Joerg BERGNER / DFS	PJ10 Coordinator	22/06/2019
Matthias POPPE / DFS	PJ10 Coordinator	22/06/2019

Bill BOOTH / EUROCONTROL	PJ11 Coordinator	22/06/2019
Felice MACCARO / LEONARDO	PJ14 Coordinator / PJ14 PCIL	22/06/2019
Alberto ANGUITA / INDRA	PJ15 Coordinator	22/06/2019
Richard BEAULIEU / THALES	PJ16 Coordinator	22/06/2019
Xavier JOURDAIN / THALES	PJ17 Coordinator	22/06/2019
Julian ALONSO / INDRA	PJ18 Coordinator	22/06/2019
Birgit GOELZ / DFS	PJ19.03/04 Cyber-Security team	22/06/2019
Marc BROCHARD / EUROCONTROL	PJ19 Coordinator	22/06/2019
Marie-France DESLANDES / EUROCONTROL	PJ20 Coordinator	22/06/2019
Valentina PICICNELLI / ENAV	PJ22 Coordinator	22/06/2019
Pascal HOP / EUROCONTROL	PJ24 Coordinator	22/06/2019
Nicolas MARCOU / DSNA	PJ25 Coordinator	22/06/2019
Peter GLOMBIOWSKI / DFS	PJ27 Coordinator	22/06/2019
Steffen LOTH / AT-ONE Consortium	PJ28 Coordinator	22/06/2019
Jerome CONDIS / AIRBUS	PJ31 Coordinator	22/06/2019
Sian ANDREWS / NATS	PJ01 PCIT	22/06/2019
Anthony INARD / EUROCONTROL	PJ02 / PJ04 PCIT	22/06/2019
Etienne DE MUELENAERE / EUROCONTROL	PJ07 / PJ08 / PJ09 PCIT	22/06/2019
Pascal LATRON / SKYGUIDE	PJ10 PROSA PCIL	22/06/2019
Cecile COVERI	PJ14 PCIL	22/06/2019
Borja MARTÍNEZ-FERNÁNDEZ / EUROCONTROL	PJ15 PCIL	22/06/2019
Markus DEBUSSMAN / DFS	PJ16 PCIL	22/06/2019
Dario DI CRESCENZO / LEONARDO	PJ17 PCIL	22/06/2019
Gino POMPEI / LEONARDO	PJ17 PCIL	22/06/2019
Gerard MAVOIAN / EUROCONTROL	PJ18 PCIL	22/06/2019
Mehtap KARAARSLAN / EUROCONTROL	PJ18 PCIL	22/06/2019

Approved for submission to the SJU By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
Marc BROCHARD / EUROCONTROL	PJ19 Coordinator	08/07/2019 (Silent Approval)
José Manuel CORDERO / ENAIRE	PJ.19-04 Lead	08/07/2019
Daniel FERRO / AIRBUS	PJ.19-04 AIRBUS PoC	08/07/2019

Thomas HELLBACH / DFS	PJ.19-04 DFS PoC	08/07/2019 (Silent Approval)
Fausto BRUNI / LEONARDO-Telespazio	PJ.19-04 LEONARDO-Telespazio PoC	05/07/2019
Jean Marc LOSCOS / DSNA	PJ.19-04 DSNA PoC	08/07/2019 (Silent Approval)
Rhona MURPHY / NATS	PJ.19-04 NATS PoC	08/07/2019 (Silent Approval)
Vilma DELTUVAITE / ON (B4)	PJ.19-04 ON (B4) PoC	05/07/2019
Andrea RANIERI / INDRA	PJ.19-04 INDRA PoC	08/07/2019 (Silent Approval)
Davide DEL VECCHIO / ENAV	PJ.19-04 ENAV PoC	08/07/2019 (Silent Approval)

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
------------------	----------------	------

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PJ 19 CI

CONTENT INTEGRATION

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Abstract

This document is an update to the D4.1 SESAR2020 “Performance Framework”. It describes the performance-driven approach applied within the development of the technical pillar of the European Commission’s Single European Sky Air Traffic Management Research (SESAR) programme. It provides a framework to ensure that the programme develops the operational concept and technical enablers needed to meet the performance ambitions described in the 2019 edition of the ATM Master Plan.

The SESAR Performance Framework is composed of:

- 1) The performance management process,
- 2) A set of Key Performance Areas (KPAs), Key Performance Indicators (KPIs) and Performance indicators (PIs) for the purpose of measuring performance and tracking the achievement of targets.

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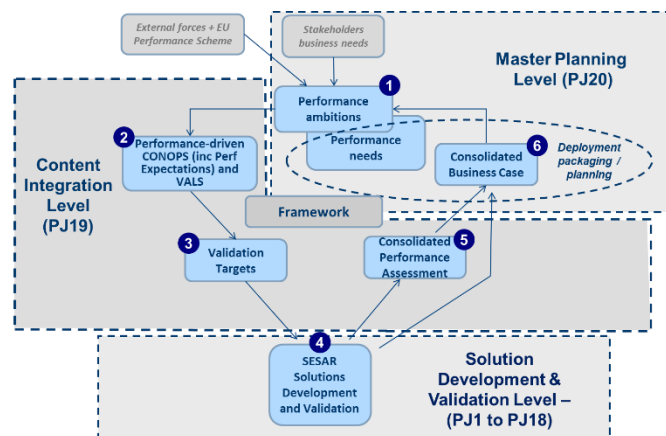
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Executive summary

The purpose of this document is to establish the SESAR2020 Performance Framework (PF) for Industrial Research (IR) activities and demonstrations at large scale of H2020 second call (Wave 2). The Performance Framework supports SESAR2020 in developing the operational concepts and technical enablers needed to meet long-term performance objectives. It comprises the SESAR2020 Performance-Driven Approach, the framework of metrics (Key Performance Areas and Key Performance Indicators) and its contribution to the development of a performance-driven cobtext at European level.

This document details the Performance Framework context and its relation to the SES Performance Scheme. It is key to understand that these two frameworks are different in scope and applicability and, therefore, they use different indicators and targets.

This release updates and extends the SESAR2020 Wave 1 Performance Framework and integrates performance into the European ATM Architecture (EATMA). It updates the description of the SESAR PF in line with the changes in ATM Master Plan Performance Ambitions KPIs, after consultation with Scientific Committee and SJU, and additionally, it considers the needs and improvements suggested by the different stakeholders during SESAR 2020 W1. In general terms, this release enhances alignment with ATM Master Plan.



The main technical changes are included in Operational Efficiency (including On-time Performance, Flight Time and Predictability focus areas) performance area with a reorganisation and redefinition of new KPIs and PIs to be aligned, again, with the new ATM Master Plan Performance Ambitions KPIs. Where required, the former KPIs have been also kept (as mandatory PIs) to secure the capability to aggregate new results with previous SESAR results, with the goal to investigate translation mechanisms which allow a complete change to the new KPIs. Other areas with no Master Plan ambition have also been updated, such as Civil-Military Coordination.

SESAR2020 Performance Management Process

The SESAR Performance Management Process is structured to steer the overall R&I work to meet the SESAR Performance Ambitions set in the European ATM Master Plan **¡Error! No se encuentra el origen de la referencia..** These Performance Ambitions are reconciled and mapped with the operational improvements and related Performance Expectations, described in the CONOPS, at Content Integration level (PJ19 CI).

Then, Performance Ambitions and Expectations at ECAC-level are broken down into Validation Targets that are apportioned to SESAR Solutions.

After that, operational improvements brought by SESAR Solutions are validated and assessed considering performance benefits and costs per Solution Projects (PJ1 to PJ18) through validation exercises and dedicated analysis. The analyses extrapolate the specific results to general ECAC-wide

figures where appropriate. These figures feed a Business Case process, necessary to ensure that the Deployment Planning process executed at the Master Planning level (PJ20) is adequately de-risked against operational, technological and economic/financial issues. In addition, contributions from different projects are integrated and consolidated, including the identification of possible inconsistencies, their communication to projects and taking appropriate resolution actions.

The Performance Framework also presents the performance elements required in order to support this performance-driven approach. These elements include:

- The Key Performance Areas of the ATM Master Plan¹ and associated Performance Ambitions.
- A set of ICAO Performance and Focus Areas relevant to SESAR R&I. In previous versions of the Performance Framework, the ICAO Performance Areas formed the Key Performance Areas.
- Key Performance Indicators (KPIs) for Validation Targets, including how they relate to SESAR Performance Ambitions; these KPIs are then used to measure performance improvements and to create aggregated performance assessments.

¹ Please note that the version used for reference in the present document is European ATM Master Plan Edition 2019.

1 Introduction²

1.1 Purpose of the document and Scope

This document is an update of the D4.4 SESAR2020 “Performance Framework (2018)” [INT7] published by SESAR2020 project 19.04 in August 2018. That document was the second version of the “SESAR2020 Performance Framework” (SESAR PF), which is the performance-driven development approach applied within the technical pillar of the European Commission’s Single European Sky Air Traffic Management Research (SESAR) programme. It is framework supporting the development by the programme of the operational concepts and technology enablers required to meet the performance ambitions described in the 2019 edition of the ATM Master Plan [INT14].

The SESAR Performance Framework is composed of:

- 1) The performance management process, and
- 2) Key Performance Areas (KPAs), Key Performance Indicators (KPIs), Performance indicators (PI),

for the purpose of measuring performance and tracking the status of the solutions with regard to the targets.

The SESAR Performance Framework 2019 updates the description of the SESAR Performance Framework after consultation with Scientific Committee and SJU. The main changes are within the Efficiency and Predictability performance areas, which include a reorganisation and redefinition of new KPIs and PIs aligned with the ATM Master Plan Performance Ambitions [INT14].

1.2 Structure of the Document

The document is structured as follows:

- Chapter 1 introduces the content, context and structure of this document;
- Chapter 2 explains the key elements of the performance-driven approach in SESAR2020;
- Chapter 3 summarises the KPAs, KPIs and mandatory PIs in SESAR2020 Performance Framework;
- Appendix A provides detailed information of the KPAs, KPIs and PIs.
- Appendix B Provides guidance on how to measure the KPIs.

² The opinions expressed herein reflect the status of the SESAR Programme development at the time of the consolidation of this document. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

1.3 Intended readership

This document is principally directed to the Members of the SESAR Development Programme that participate of or make use of the performance elements. This statement refers to:

- All SESAR2020 projects, including their respective PCITs (Project Content Integration Team), for its use in deriving validation objectives for solutions within their areas of responsibility;
- SESAR Programme Management – for its use to drive the content of the V&V (Validation & Verification) Roadmap, Releases, etc.;
- The Content Integration project (PJ19 CI) due to:
 - Their activities coordinate and integrate operational and technical solutions, by supporting and guiding SESAR2020 processes following the principles of completeness, consistency and coherency. Specifically, these activities are comprised by the performance management, including the maintenance and update of this PF, and the SESAR2020 CONOPS development and refinement.
 - to ensure that the validation strategy can be developed supported by appropriate validation targets.
 - to assess the performance of the Solutions.
- PJ20, the Master Plan Maintenance project, as its activities ensure that the SESAR Performance Ambition level is correctly established at the highest level, and that derived ambitions can flow into the programme to drive R&I and deployment prioritisation.

1.4 Relationship to other documents

This document is a reference for the following deliverables:

- Performance aspects of the **SESAR2020 Project Handbook** [SESAR1], which provides project managers with an overall understanding of activities and entry-points for experts to detailed guidance.
- **SESAR2020 Validation Targets** **¡Error! No se encuentra el origen de la referencia.**, the reference point for all Solutions' targets, which provides clear and focused expectations for validation exercises per Solution and in certain sub-Operational Environments (OEs). This deliverable includes the data, assumptions, transformations and calculations to derive Validation Targets from SESAR Performance Ambitions and Expectations.
- **SESAR2020 Performance Assessment and Gap Analysis (PAGAR)** [INT8], which aggregates Solutions' measured performance assessment reports (PARs), assesses the maturity of results and performs a gap analysis against the Validation Targets.
- **SESAR2020 Consolidated Business Case**, which aggregates the expected monetary impact (both costs and benefits) by consolidating Solutions' results in order to provide appropriate information to decision makers. Specifically, this helps to take informed decisions about the clustering and prioritisation of Solutions and deployment planning, and closes the feedback loop with the CONOPS.
- **SESAR ATM Master Plan** which defines the performance ambitions, performance needs, reference operating environment and solution deployment scenarios expectations. This

document reflects the interdependencies among them and how the overall performance management process is conducted and feedback to the MP for further updates.

1.5 Acronyms and Terminology

1.5.1 Acronyms

Acronym	Definition
ACC	Area control centre
AFUA	Advanced Flexible Use of Airspace
AIBT	Actual in-block time
AIM	Accident Incident Model
ALAQs	Airport Local Air Quality Studies
ANS	Air Navigation Services
ANSP	Air Navigation Services Provider
AOBT	Actual off-block times
APP	Approach control service
APT	Airport
APU	Auxiliary Power Unit
ARES	Airspace reservation
ASBU	Aviation System Block Upgrades
ASM	Airspace management
ASMA	Arrival sequencing and metering area
ATC	Air traffic control
ATCO	Air traffic controller
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air traffic flow management
ATM	Air Traffic Management
ATM MP	ATM Master Plan
ATS	Air Traffic Service
AU	Airspace User
AUC	Airspace User Costs
AXIT	Actual Taxi-In Duration
AXOT	Actual Taxi-Out Duration
BIM	Benefit Impact Mechanism
C.02	SESAR 1 Project C.02 Deployment/Performance planning and reporting
CAP	Capacity

Acronym	Definition
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
CDR	Conditional Route
CEF	Cost Efficiency
CEFF	Cost Effectiveness
CFIT	Controlled flight into terrain
CI	Content Integration
CMC	Civil Military Coordination
CNS	Communication, navigation, surveillance
CODA	Central Office for Delay Analysis
CONOPS	Concept of Operations
CWP	Controller Working Position
DMA	Dynamic Mobile Area
DOD	Detailed Operational Description
DUC	Determined Unit Costs
DUR	Determined Unit Rate
EATMA	European ATM Architecture
EC	European Commission
ECAC	European Civil Aviation Conference
EEA	European Environment Agency
ENV	Environment
E-OCVM	European Operational Concept Validation Methodology
EQUI	Equity
ER	En-Route
eRIA	early Regulatory Impact Assessment
EU	European Union
EXIT	Estimated Taxi-In Duration
EXOT	Estimated Taxi-Out Duration
FA	Focus Area
FAB	Functional Airspace Block
FEFF	Fuel Efficiency
FL	flight Level
FPL	Flight Plan
FLX	Flexibility

Acronym	Definition
FOC	Full Operational Capability
FTS	Fast Time Simulation
FUA	Flexible Use of Airspace
G2G	Gate-to-Gate
GA	General Aviation
GAT	General Air Traffic
GIS	Geographic Information System
GPU	Ground Power Unit
GSE	Ground Support Equipment
H2020	Horizon 2020 Framework Programmed
HAZOP	Hazard and Operability Study
HF	Human Factors
HLG	SES High-Level Goals
HP	Human Performance
HPAP	Human Performance Assessment Process
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INTEROP	Interoperability
iOAT FPL	improved Operational Air Traffic Flight Plan
IOC	Initial Operational Capability
ISA	Instantaneous Self-Assessment
IT	Information Technology
JC	Just Culture
KEA	Horizontal flight efficiency of actual trajectory
KEP	Horizontal flight efficiency of last filed flight plan
KPA	Key Performance Area
KPI	Key Performance Indicator
LAQ	Local Air Quality
LTO	Landing and Take-Off
MOD	Ministry Of Defence
MoU	Memorandum of Understanding
MP	Master Plan
MT	Mission Trajectory
NAF	NATO Architectural Framework

Acronym	Definition
NB	Number
NM	NETWORK Manager
NM	Nautical Miles
NOI	Noise
OAT	Operational Air Traffic
OE	Operating Environment
OFA	Operational Focus Area
OI	Operational Improvement
OSD	SESAR Operational Service and Environment Definition
PA	Performance Assessment
PAGAR	Performance Assessment And Gap Analysis Report
PAR	Performance Assessment Report
PCIT	Project Content Integration Team
PERF	Performance
PF	Performance Framework
PI	Performance indicator
PJ	Project
PMP	Project Management Plan
PRD	Predictability
PS	Performance Scheme
PUN	Punctuality
QoS	Quality of Service
R&I	Research & Innovation
RAT	Risk Analysis Tool
RBT	Reference Business Trajectory
RES	Resilience
RMT	Reference Mission Trajectory
ROT	Runway Occupancy Time
RP	Reference Period
RTS	Real Time Simulation
RWY	Runway
SA	Situational Awareness
SAC	Safety Criteria
SAF	Safety

Acronym	Definition
SAGAT	Situation Awareness Global Assessment Technique
SART	Situational Awareness Rating Technique
SBT	Share Business Trajectory
SDS	SESAR Deployment Scenario
SEC	Security
SecRAM	Security Risk Assessment Methodology
SELAT	Selection Requirements for Proactive Analysis Tool
SES	Single European Sky
SESAR	Single European Sky ATM Research Programme
SIBT	Scheduled In-Block Time
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SOBT	Scheduled Off-Block Time
Sub-OE	Sub Operating Environment
SPR	Safety and Performance Requirements
SRM	Safety Reference Material
TA	Transversal Area
TACAT	Training and Competence Analysis Tool
TDZ	Touchdown Zone Elevation
TEFF	Time Efficiency
TIBT	Target In-Block Time
TLX	NASA Task Load Index
TMA	Terminal manoeuvring area
TOBT	Target Off-Block Time
TRA	Temporary Reserved Area
TRL	Technology Readiness Level
TSA	Temporary Segregated Area
TWY	Taxiway
UDPP	User Driven Prioritisation Process
V&V	Verification & Validation
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VPA	Variable Profile Area
VT	Validation Target

Acronym	Definition
WOC	Wing Operations Centre
WP	Work Package

Table 1: Acronyms.

1.5.2 Terminology

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

The PAGAR is an annual report covering the Key Performance Areas (KPA) against which the SESAR2020 Solutions are assessed: Safety, Environment, Predictability, Punctuality, Capacity, Civil-Military Cooperation and Coordination, Cost Efficiency, Human Performance and ATM Security.

Term	Definition	Source
Access and Equity	Equity is a constraint on SESAR Solutions such that they must not result in inequitable impacts between individuals or groups of airspace users. A lack of Equity can arise if, for example, a particular airspace user or group of airspace users is subject to additional cost or additional delay. In addition, lack of Equity can arise where one user receives an advantage or net gain relative to others (i.e. where there is no direct additional cost or delay on a user but instead a relative dis-benefit for the other users). These ideas reflect the view of Equity in terms of Fairness amongst users.	PAGAR
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
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)) whereas 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

Term	Definition	Source
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 SJU 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)
Business Case	Quantitative and qualitative arguments (in addition to financial analysis) about performance and transversal activities to determine the value of a project to allow decision-makers to make a fully informed decision on whether funding should be provided and/or whether an investment should proceed.	PAGAR
Capability	Capability is the ability of one or more of the enterprise's resources to deliver a specified type of effect or a specified course of action to the enterprise stakeholders.	EUROCONTROL ATM Lexicon
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
Civil-military performance-based partnership	Relationship between civil and military ATM stakeholders characterised by mutual cooperation and responsibility, for the achievement of agreed performance objectives through the application of performance-based management.	Performance Framework 2017
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

Term	Definition	Source
CONOPS	The tool used by an organisation to establish the approach it wishes to take to implement a system or service. CONOPS documents the high-level decisions and agreements that define the approach and the organisational structure needed to put that approach into operation.	EUROCONTROL ATM Lexicon
Deployment Needs	Performance Needs relate to a Sub Operating Environment, whereas Deployment Needs (and particularly Deployment Costs) relate to the specific ATC Operational Unit or Airport from where the service is provided.	C.02 D110 Updated D02 after MP Campaign
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
HP assessment	An HP assessment is the documented result of applying the HP assessment process to the SESAR Solution-level. HP assessments provide the input for the HP case.	Performance Framework 2017
Influence factor	An influence factor is considered a particular characteristic or parameter that helps determining performance. Improvements to the identification of these factors drive performance to higher levels.	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
Measure	A certain quantity or degree of something.	Oxford Dictionary

Term	Definition	Source
Measure Category	A standard unit used to express the size, amount, or degree of something.	Oxford Dictionary
Metric or supporting metric	Supporting metrics are used to calculate the values of performance indicators. For example, cost-per-flight-indicator = Sum (cost) / Sum (flights). Performance measurement is done through the collection of data for the supporting metrics (e.g., this leads to a requirement for cost data collection and flight data collection).	ICAO Doc 9883
Mission	One or more aircraft orders to accomplish one particular task, performing a mission as (an) individual flight(s) and/or formation(s).	Performance Framework 2017
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
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 Expectation	<i>A priori</i> estimation of a potential performance outcome or impact which could be achieved as a consequence of the implementation of an envisaged operational improvement, but which still needs to be validated and confirmed.	EUROCONTROL ATM Lexicon
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

Term	Definition	Source
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
Performance Needs	Performance Needs in ATM refer to the performance required in a specific part of the network (Operating Environment) at a specific point in time. Note: Performance needs are driven by the business requirements of stakeholders and are set in relation to traffic forecasts and trade-offs with other factors (e.g. cost). Performance needs are independent of Solutions. Performance Needs also have a relationship with the SES High Level Goals, but in their current form, these goals do not drive Performance Needs. Performance Needs are essentially “bottom up”. The term “capability requirements” is not further used and has been replaced by the term “Performance Needs”.	EUROCONTROL ATM Lexicon
Performance Objectives (Generic and Instantiated)	These define, in a qualitative but focused way, a desired trend from today’s performance (e.g. improvement). A distinction is made between generic objectives and instantiated objectives. Generic objectives specifically focus on what has to be achieved, but do not make statements about the when, where, who or how much. For example, ‘improve safety’ is not specific enough to be an objective, whereas ‘reduce the total number of accidents’ and even more specifically ‘reduce the number of CFIT accidents’ would qualify as performance objectives. Instantiated objectives add the when, where, who and how much to the generic objectives. Instantiated objectives can have indicator values and associated targets. In SESAR2020, Performance objectives are the SESAR Performance Ambitions	ICAO Doc 9883
Performance Scheme	Scheme established by Commission Regulation (EU) No 691/2010 – and superseded by Commission Regulation (EU) No 391/2013 - for air navigation services and network functions to improve the performance of air navigation services and network functions in the single European sky, by means of European Union-wide target setting and the adoption of National/FAB plans consistent with the EU-wide targets, and followed by a periodic review, monitoring and benchmarking of performance.	EUROCONTROL ATM Lexicon

Term	Definition	Source
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
Reference Period	Time frame for which EU-wide targets set in the framework of the Performance Scheme and National/FAB Performance Plans are active. The first reference period for the performance scheme covered calendar years 2012 to 2014 inclusive. This deliverable is being released during reference period 2, which covers calendar years 2015 to 2019 included. The third reference period will be five calendar years, from 2020 to 2024 included.	Commission regulation (EC) No 390/2013 of 3 May 2013
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
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 SJU.	EUROCONTROL ATM Lexicon
SESAR Solution	A term used when referring to both SESAR ATM Solution and SESAR Technological Solution.	SESAR2020 Project Handbook

Term	Definition	Source
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
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.	EUROCONTROL ATM Lexicon
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
Target	Values of performance indicators that need to be achieved or exceeded to consider a performance objective as being fully achieved. Note: ICAO Doc 9883 Performance targets are closely associated with performance indicators.	PAGAR, Note from ICAO Doc 9883
Military Training event	A military activity taking place within an ARES which requires airspace reservation or segregation from general air traffic. A mission may include one or more training events.	Performance Framework 2017
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 2: Terminology

2 Performance Driven Approach in SESAR2020

2.1 Introduction to the Performance Driven Approach

This section presents the processes undertaken within the SESAR programme to ensure that a performance-driven approach is followed. It provides a high-level overview of the performance-related processes to be conducted across relevant work packages and projects, covering roles and responsibilities with regard to the definition of performance targets, measurement and assessment, and planning.

In summary, the Performance Framework is an important resource for Solutions, working as supporting tool for developing the performance assessments and validation activities.

2.2 Overview of the SESAR2020 High-Level Process

The SESAR programme follows a performance-driven approach. Due to the inherent uncertainties associated to lengthy lead times on investments on ATM, the programme defined aspirational Performance Ambitions that may be achieved following a full implementation of the SESAR vision by 2035 in the ATM Master Plan [INT14].

The premise is that the programme can steer its R&I activities by defining and validating a CONOPS made up of a set of discrete operational improvements to achieve these overall performance ambitions. These discrete operational improvements are expected to cover known performance needs, and the programme is organised in *Solutions* as a response to those. Thus, a Solution is a deployable coherent block of operational capabilities that can be combined but not sub-divided.

The SESAR Performance Management Process, illustrated in **¡Error! No se encuentra el origen de la referencia.**, is the gear driving the overall R&I work with regard to these SESAR Performance Ambitions. The SESAR2020 CONOPS reconciles the ambitions with the solutions (driven by **Performance Needs**) by defining the *Performance Expectations* for each solution per operational improvement (marked as **2** in **¡Error! No se encuentra el origen de la referencia.**). Later on, Performance Ambitions and Expectations at ECAC level are used to allocate specific *Validation Targets* to each SESAR Solution and sub-operating environment (marked as **3** in **¡Error! No se encuentra el origen de la referencia.**).

SESAR Solutions evaluates the performance benefits and costs of the operational improvements through validation exercises and dedicated analysis. Although the validation exercises aim at specific sub-operating environments, the SESAR Solutions extrapolate the results at ECAC-level to provide an overall performance assessment of the solution (marked as **4** in **¡Error! No se encuentra el origen de la referencia.**). The Content Integration-level collect and consolidate the results at solution-level using the European ATM Architecture (EATMA) (marked as **5** in **¡Error! No se encuentra el origen de la referencia.**).

The consolidated performance assessment provides the ground for the development of cost-benefit analysis per solution and at programme level (marked as **6** in **¡Error! No se encuentra el origen de la referencia.**).

referencia.). This is necessary to ensure that the Deployment Planning process executed at Master Plan level is adequately de-risked against operational, technological and economic/financial issues.

Note that the iterative nature of the SESAR Performance Management Process means that it is also a cycle, essentially an annual one.

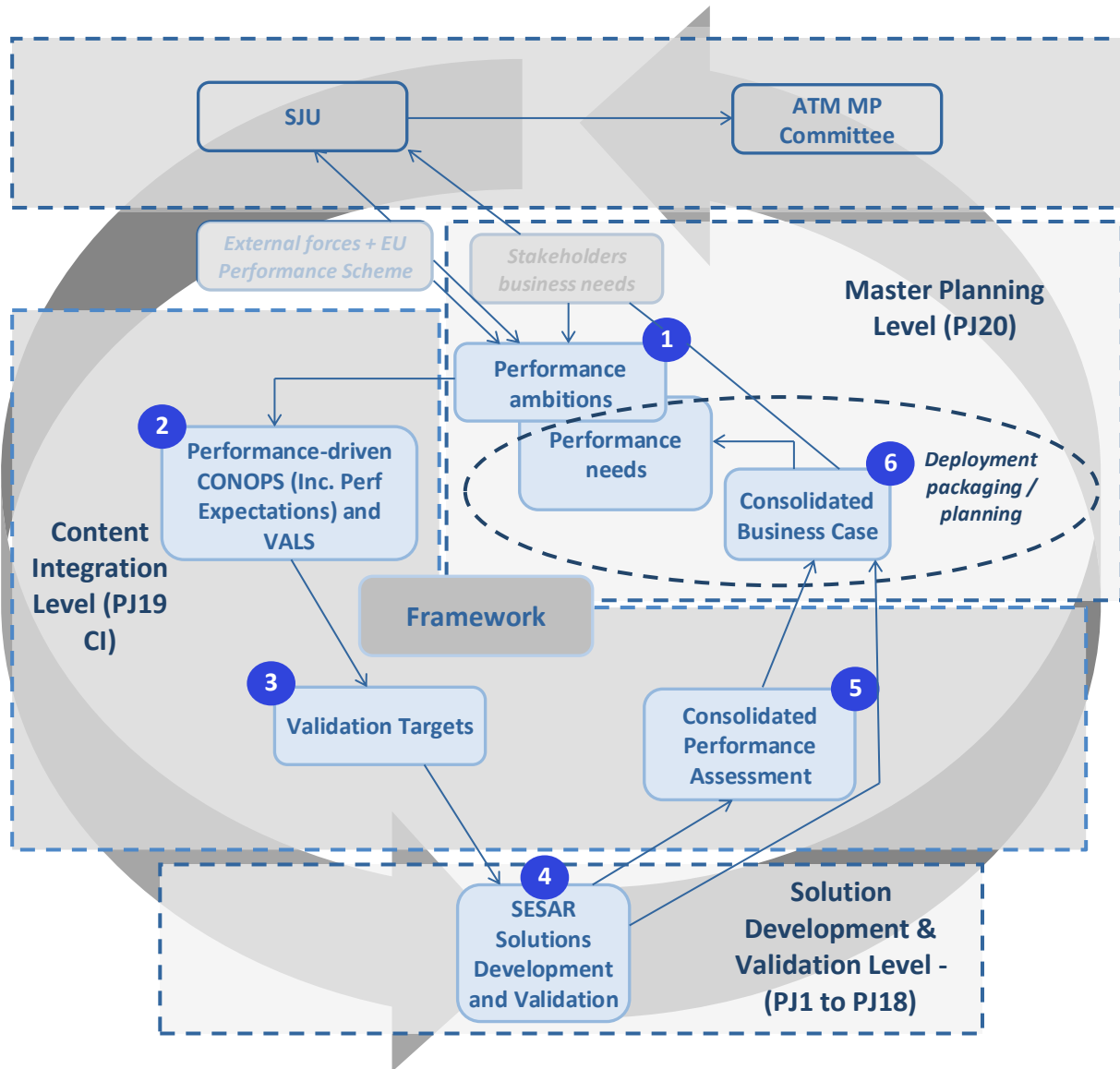


Figure 1: SESAR2020 Performance Management Process [INT7]

2.3 SESAR Performance Management Process

Figure 2, below, shows how the SESAR2020 projects and specific deliverables contribute to managing and assessment of the potential/predicted ATM performance within the Programme.

Coherence of the work conducted within different Solution and Enabling projects, in continuation of the SESAR 1 Programme, is ensured through a continuous collaboration process put in place at Content Integration level. The contributions from different Solutions are integrated and consolidated, possible

inconsistencies identified, communicated to projects and remedial actions taken. Annually, as part of the Content Integration and Master Planning processes, integrated content is used to update respectively the SESAR Reference and the Consolidated Business Case.

There are a number of interactions and iterative loops within the process; however, Figure 2 is kept as simple as possible to help understand the basic flow of the process.

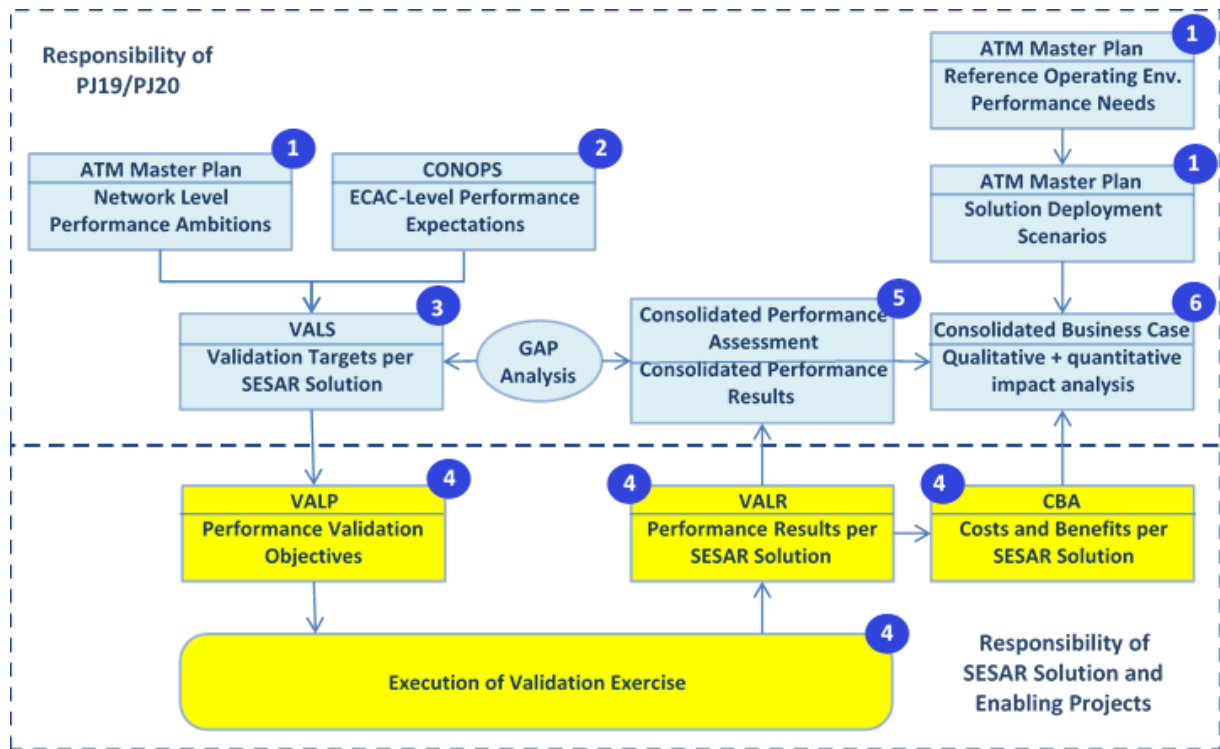


Figure 2: The elements and basic flow of the SESAR2020 Performance Management Process [INT7]

Figure 2 also shows how the gap analysis, done by PJ19 CI, takes place between the targets per solution and the consolidated results at ECAC level.

The SESAR2020 Performance Framework describes both the high-level process and the reference set of structures, interfaces and language (in terms of KPAs, KPIs, PIs and metrics) needed to ensure that the overall activity of the SESAR Projects is coherent and results are meaningful, consistent and usable. It builds upon the Performance Framework defined by SESAR 1, which in turn is based on the ICAO Performance Framework, to set and assess performance at ECAC level.

Specific methods, structure, assumptions, policies and rules needs to be applied when assessing performance along each and every KPA, which are detailed in the SESAR2020 Handbook [SESAR1]. The aim is to ensure that performance assessments and CBAs developed by Solution and Enabling projects are relevant, consistent, comparable and representative for all the SESAR Solutions and at the same time compliant with internal partners' policies.

The elements of the Performance Management Process presented in Figure 2 are described in more detail in the following sections.

2.4 SESAR Performance Ambitions

The initial step of the SESAR Performance Management process is the identification of the SESAR Performance Ambitions. In this sense, the political objective of the SES is to achieve a future European Air Traffic Management system which can, relative to 2005 performance, *“enable a three-fold increase in ATM capacity which will also reduce delays both on the ground and in the air; to improve the safety performance by a factor of 10; to enable a 10% reduction in the effects flights have on the environment; and to provide ATM services to airspace users at a cost of at least 50% less”*.

As the technological pillar of the SES, SESAR is one of the key contributors to these SES High-Level Goals (HLGs) through the delivery and deployment of SESAR Solutions with demonstrated and measurable performance gains, spurred by means of the SESAR Performance Ambitions. In this regard, SESAR Performance Ambitions are aspirational and refer to the performance capability that may be achieved if SESAR Solutions were made available through R&I activities, deployed in a timely and, when needed, synchronised way, and used to their full potential.

The ATM Master Plan describes the Performance Ambitions that SESAR may enable through the full implementation of its vision within the 2035 timeframe. The SESAR Performance Ambitions at general ECAC level are categorised according to several KPAs, and related to those captured in the SES High Level Goals and by the SES Performance Scheme as presented in **¡Error! No se encuentra el origen de la referencia..** The SESAR Performance Ambitions for 2035 are presented as ranges to reflect the uncertainty implied by the long timeframe.

Key Performance Area	SES high-level goals vs. 2005	Key Performance Indicator	Performance ambition vs. baseline			
			Baseline value (2012)	Ambition value (2035)	Absolute Improvement	Relative Improvement
Capacity 	Enable 3-fold increase in ATM capacity	Departure delay ⁴ , min/dep	9.5 min	6.5-8.5 min	1-3 min	10-30%
		IFR flights at congested airports ⁵	4 million	4.2-4.4 million	0.2-0.4 million	5-10%
		Network throughput IFR flights ⁵	9.7 million	~15.7 million	~6.0 million	~60%
		Network throughput IFR flight hours ⁵	15.2 million	~26.7 million	~11.5 million	~75%
Cost efficiency 	Reduce ATM services unit cost by 50% or more	Gate-to-gate direct ANS cost per flight ¹ , EUR(2012)	EUR 960	EUR 580-670	EUR 290-380	30-40%
		Gate-to-gate fuel burn per flight, kg/flight	5280 kg	4780-5030 kg	250-500 kg	5-10%
Operational efficiency 		Additional gate-to-gate flight time per flight ² , min/flight	8.2 min	3.7-4.1 min	4.1-4.5 min	50-55%
		(Within the: Gate-to-gate flight time per flight ³ , min/flight)	(111 min)	(116 min)		
Environment 	Enable 10% reduction in the effects flights have on the environment	Gate-to-gate CO ₂ emissions, tonnes/flight	16.6 tonnes	15-15.8 tonnes	0.8-1.6 tonnes	5-10%
Safety 	Improve safety by factor 10	Accidents with direct ATM contribution ⁶ , #/year Includes in-flight accidents as well as accidents during surface movement (during taxi and on the runway)	0.7 (long-term average)	no ATM related accidents	0.7	100%
Security 	-	ATM related security incidents resulting in traffic disruptions	unknown	no significant disruption due to cyber-security vulnerabilities	unknown	-

¹ Unit rate savings will be larger because the average number of Service Units per flight continues to increase.
² "Additional" here means the average flight time extension caused by ATM inefficiencies
³ Average flight time increases because the number of long-distance flights is forecast to grow faster than the number of short-distance flights
⁴ All primary and secondary (reactionary) delay, including ATM and non-ATM causes
⁵ Includes all non-segregated unmanned traffic flying IFR, but not the drone traffic flying in airspace below 500 feet or the new entrants flying above FL 600
⁶ In accordance with the PRR definition: where at least one ATM event or item was judged to be DIRECTLY in the causal chain of events leading to the accident. Without that ATM event, it is considered that the accident would not have happened

Figure 3: SESAR Performance Ambitions for 2035 (categorised by KPA) [INT14]

Table 3 reflects the SESAR Performance Ambitions for 2035 from the previous figure by identifying the leftmost and rightmost columns.

ATM Master Plan SESAR Performance Ambition KPA	KPI	ATM Master Plan SESAR Performance Ambition KPI
Cost efficiency	PA1	30-40% reduction in ANS costs per flight
Operational Efficiency	PA2	50-55% reduction in additional gate to gate flight time per flight
	PA3	5-10% reduction in fuel burn
Capacity	PA4	10-30% reduction in departure delays
	PA5	5-10% additional flights at congested airports
	PA6	System able to handle 60% more traffic
Environment	PA7	5-10% reduction in CO ₂ emissions
Safety	PA8	Safety improvement by 100%
Security	PA9	No significant disruption due to cyber-security vulnerabilities

Table 3: ATM Master Plan SESAR Performance Ambition KPAs and KPIs for 2035

The scope of the SESAR's Performance Ambitions is:

- Presented at ECAC level (except IFR flights at congested airports);
- Referred to a 2035 timeframe and relative to the 2012 baseline;
- Presented as ranges to reflect the uncertainty implied by the long timeframe;
- Aspirational rather than fixed and binding, since the Programme has to take into account the lengthy investment lead times common to infrastructure industries like ATM and the need to spur sustained R&I activities for the future;

It has to be noted that these ambitions are related to, but not the same as, the SES Performance Scheme targets. SESAR performance concerns expected improvements from deploying SESAR Solutions, whereas the SES Performance Scheme drives performance improvement in the deployed system.

Finally, the SESAR performance ambition levels for 2035, outlined in **¡Error! No se encuentra el origen de la referencia.** and Table 3, are subject to the optimal development and deployment of the operational changes made possible through SESAR Solutions. In this sense, these ambitions also take into account the evolution in ATM service provision, which is expected to further facilitate SESAR deployment.

2.5 Performance Expectations

The SESAR Performance Management Process, illustrated in **¡Error! No se encuentra el origen de la referencia.**, is the gear driving the overall R&I work with regard to these SESAR Performance Ambitions. The SESAR2020 CONOPS reconciles the ambitions with the solutions (driven by **Performance Needs**) by defining the *Performance Expectations* for each solution per operational improvement (marked as **2** in **¡Error! No se encuentra el origen de la referencia.**). Later on, Performance Ambitions and Expectations at ECAC level are used to allocate specific *Validation Targets* to each SESAR Solution and sub-operating environment (marked as **3** in **¡Error! No se encuentra el origen de la referencia.**).

The SESAR Performance Ambitions at 2035 are intended to spur the R&D activities in ATM and drive the programme towards its performance-based vision. On the other hand, performance needs constitute a complementary driving force for these activities, and are the initial triggers for SESAR solutions. In this sense, the qualitative estimation of the expected performance outcomes from the implementation of solutions is of fundamental importance.

As indicated in Section 2.3, performance ambitions and needs have to be reconciled by the SESAR CONOPS. This is carried out by defining the *Performance Expectations* for each solution per operational improvement to be defined in the CONOPS.

The SESAR2020 Transition CONOPS developed in SESAR 1 **¡Error! No se encuentra el origen de la referencia.** and later versions of the SESAR2020 CONOPS **¡Error! No se encuentra el origen de la referencia.** developed at the Content Integration-level (PJ19 CI), were the response to this need to reconcile ambitions and need. In that sense, these developments provide a comprehensive and performance-driven operational concept for all ATM layers, whilst ensuring a stepwise evolution of the entire ATM system.

In these documents **¡Error! No se encuentra el origen de la referencia.**, the Performance Expectations indicate the main initial qualitative source of performance objectives that concept designers expect to be achievable by the SESAR concept components in relevant operational environments. They should be seen as an initial expert judgement of the magnitude of potential benefits for each KPI. The gap between these initial qualitative estimations and more precise quantitative Performance Assessments from solutions and consolidated solutions' results is continuously assessed by expert judgment. This process is continuously conducted by incorporating newer validation results from the Solutions.

This step facilitates the allocation of Validation Targets among the different Solutions. The definition of performance expectations provide a realistic bottom-up picture of the potential performance improvements, particularly when complemented by the aspirational and top-down Performance Ambitions.

2.6 SESAR Validation Targets

Validation Targets are defined as the overall contribution that solutions should make to the achievement of the Performance Ambitions set in the ATM Master Plan [INT14] (both the SES HLGs and the SESAR Performance Ambitions with socio-political and economic requirements).

The Validation Targets are defined starting from the performance ambition level allocated to SESAR in the ATM Master Plan and based on the Performance Expectations highlighted in the CONOPS **¡Error! No se encuentra el origen de la referencia.** Then, VTs are broken down and assigned to each SESAR Solutions providing thus the specific quantitative reference against which they need to be assessed.

Allocating VTs is not a unique and deterministic process. Complex mappings between SESAR Solutions, capabilities, OEs and SESAR projects require expert judgement at several points in the VT allocation methodology to ensure that VT are developed in a transparent yet pragmatic manner. This methodology combines top-down and bottom-up steps to allocate appropriate VTs to each SESAR2020 Solution.

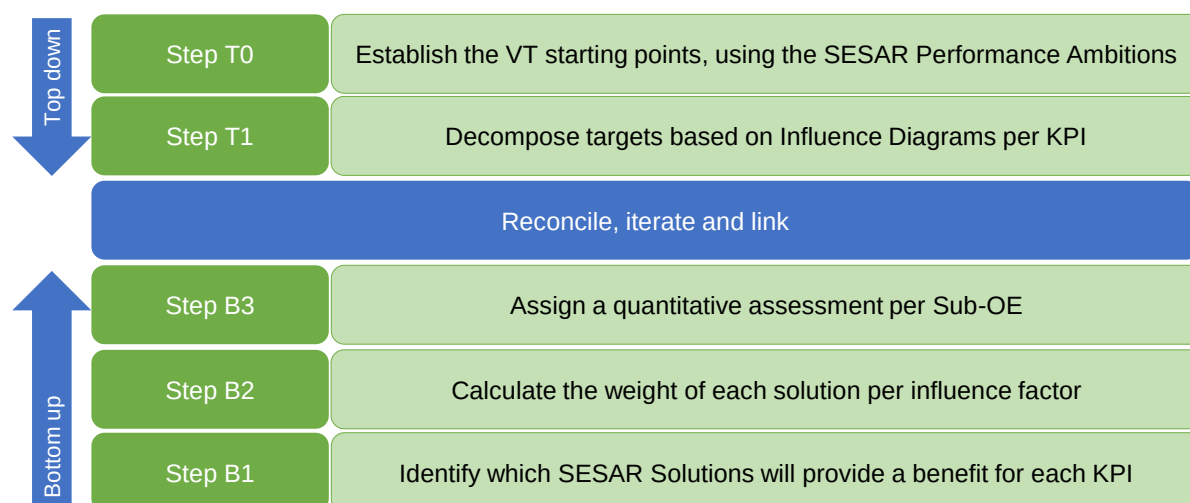


Figure 4: Validation Targets 2018 Methodology Overview

The top-down steps establish the SESAR2020 Validation Targets and break targets down based on the Influence Diagrams per KPI developed by B.04.01 **¡Error! No se encuentra el origen de la referencia.** and updated by PJ.19-04.

The bottom-up steps identify which SESAR Solutions will influence from a performance perspective for each KPI. Then, these steps result on a qualitative, and then quantitative, assessment of the performance impact against each Influence Factor and each Sub-Operating Environment³.

These steps are combined by means of an additional one that ensures the reconciliation and connection between both approaches by iterating among them. This step ensures that the work conducted to allocate the VTs finally produces the most accurate possible representation of expectations for each Solution.

2.7 Performance validation objectives, assessment, results and CBA from validation exercises

The Validation Targets set at Content-Integration level (PJ19) per solution addresses from a performance perspective the conduction of the validation activities of the programme.

These activities are carried out at Solution and Enabling Project level. Each Solution/Enabling project is responsible for defining performance validation objectives and then undertaking performance assessments after the execution of validation exercises. These activities provide a bundle of performance results and a costs and benefits analysis per SESAR Solution, which will be subsequently used for Deployment Planning.

Performance assessments may be conducted as a result of a single or a group of validation exercises, commensurate to obtain sufficiently complete results. Projects are responsible to identify the need for and relationships among these exercises and to structure them accordingly within the available

³ Sub-OEs have been updated with SESAR2020 PJ20 sWP2.2 **¡Error! No se encuentra el origen de la referencia.**

resources/budget. Performance results from the different validation exercises are documented and analysed by project experts and then aggregated per SESAR Solution, with explicit references to the operating environment they were targeting.

The process to define the Validation Plan (VALP) starts with the definition of the High Level Validation Objectives in the Validation Strategy (VALS). These are then further detailed and instantiated into Validation Objectives for each SESAR Solution in its VALP, which is mapped to the Solution's Validation Targets. Validation objectives also relate to ways in which performance is affected in areas where there are no associated Validation Targets.

Benefit Impact Mechanisms (BIMs) [INT6] are the logical description of the cause-effect relationships between the SESAR Solution under validation, the operational changes and the performance impact. BIMs are defined at the earliest maturity phase of the concept and then expanded and updated according to validation results and evidence collected during R&I work by solution projects.

The development of a performance assessment occurs in a progressive way, by means of the production of periodic report (i.e. yearly). The performance assessment per solution is refined as the Solution evolves in its maturity level, in compliance with the Guidance material [SESAR1] as developed by the Content Integration process and in accordance with the following E-OCVM scope [EXT11]. These performance assessments should address per lifecycle V-phase the following elements:

- V0: identification of potential benefits and risks.
- V1: potential benefit and impact mechanisms and influence factors, initial assessment on the primarily affected KPIs.
- V2: quantitative intermediate assessment on all KPIs .
- V3: complete assessment including final quantitative results on all KPIs.⁴

The Performance Assessment integrates all the performance results as identified in the VALR and in the Performance Assessment Report (PAR) into EATMA. This is provided in close coordination with Architecture Coherence, as part of the Continuous Collaboration and Change management process.

It is necessary to point out that:

To measure the performance impact of a SESAR Solution, at least two different situations must be assessed and compared: a Reference Scenario and a Solution Scenario.

One situation should be a scenario that does *not* have the concept element (the **reference scenario**) and, then, a second situation that equals the first except that it includes the new concept element (the **Solution scenario**). The baselines and reference scenarios to be used are specified in Appendix B (previously in D86 SESAR2020 guidance on KPIs and data collection).

⁴ V1 maps to TRL-2, V2 maps to TRL-4 and V3 maps to TRL-6.

Any performance differences measured between these two situations are the combined effect of three factors: (1) the result of SESAR operational improvements, (2) statistical variation, and (3) bias. The last two items are controlled (minimised) by good experimental design in the validation exercise plan.

The comparison of the results from the two scenarios using a common set of key performance indicators should show the benefits that the particular concept element can bring if implemented.

Performance impact is then monetised and analysed in the form of a Cost-Benefit Analysis (CBA), providing key measures on expected costs and benefits for key stakeholders should they invest in a specific SESAR Solution, together with the optimum deployment options to maximise the Solution value. The process and methods to conduct the Performance Assessment and CBAs can be found in the SESAR2020 Project Handbook [SESAR1].

2.8 Consolidated Performance Assessment

Each SESAR2020 solution is responsible to provide an ECAC-wide performance assessment in their Performance Assessment Reports (PARs). Then, individual results are consolidated taking into account different deployment scenarios from PJ20 and the relationship between Solutions to obtain a consolidated view of the expected combined performance. The full methodology for conducting this activity is further detailed in Appendix B and [INT13].

The outcome of this process is the delivery of a yearly Performance Assessment and Gap Analysis Report (PAGAR) [INT8], which covers the following transversal areas (Safety (SAF), Security (SEC), Human Performance (HP), Performance (PERF), Environment (ENV)) and KPAs (Capacity, Safety, Security, Human Performance, Environment, Predictability, Punctuality, Civil-Military Coordination and Cooperation, Flexibility, and Cost Efficiency).

This PAGAR is used by PJ20 in the production of the Consolidated CBA, Business Cases and when refining the deployment scenarios. Additionally, a gap analysis is performed at this level to understand whether the overall performance contribution of the validated SESAR Solutions meets the SESAR Ambitions, taking into account interdependencies among different Solutions.

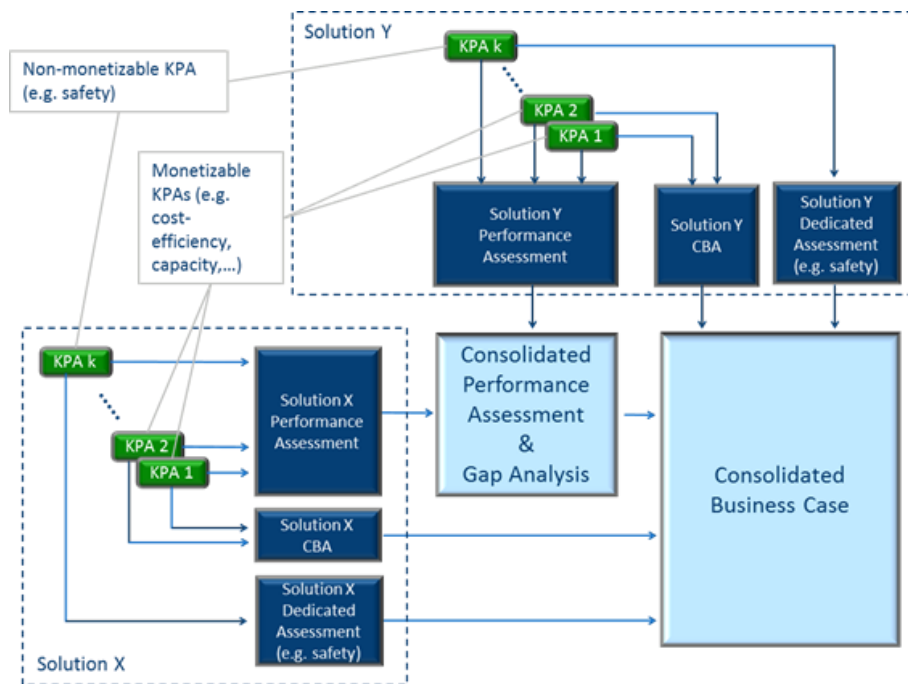


Figure 5: Main links between performance assessment results at different levels

2.9 Consolidated Business Case

This activity consolidates the assessments and the CBA results produced at Solution- and Enabling Project- level with the Consolidated Performance Assessment from the Content Integration process. The consolidation also structures the Consolidated Business Cases to support decision-making, with a particular focus on the transition between development and deployment and the different stakeholders impacted. It is important to note that the content of the Consolidated Business Cases should be based on implementation or deployment choices if they are to add value.

Consolidated Business Cases are developed by PJ20 as part of the Master Plan activity. The project plays an iterative role in defining and assessing the proposed Deployment Scenarios. When gaps or negative impacts are identified, Deployment Scenarios are restructured, closing the feedback loop towards CONOPS **¡Error! No se encuentra el origen de la referencia.** and the Validation Strategy.

The objective of the Consolidated Business Cases is to provide the necessary elements to support a decision to move from V3 of the E-OCVM lifecycle to industrialisation. The rationale must go beyond just financial and economic assessments, providing relevant evidence and arguments to the decision makers that are not necessarily monetary (such as the qualitative impacts on the environment and safety). To achieve this, the business case process is collaborative and brings together inputs from many involved parties, including stakeholder groups and relevant experts (e.g. performance experts, transversal area experts, concept experts). The inputs from all these sources come in various forms – qualitative, quantitative and monetary – and are distilled down to extract the key messages.

To support the production of Consolidated Business Cases, PJ19 CI aims to ensure alignment between the CBAs produced at SESAR Solution level by means of aligning CBA assumptions, sources, solution dependencies, units and terminology, and checking for double counting.

2.10 Performance Needs, and Solution Deployment Scenarios

The concepts of Performance Needs and Solution Deployment Scenarios – in replacement of former Deployment Packages and Deployment Scenarios – have been developed by the SJU to reflect the SESAR2020 programme structure.

The approach for the Master Planning activity encompasses a process for developing the medium to long term deployment of SESAR, which includes developing Solution Deployment Scenarios in response to Performance Needs, using R&D performance assessments and business cases.

Performance Needs, in Air Traffic Management, refers to the performance required in a specific part of the network (Operating Environment) at a specific point in time. Performance needs are driven by business requirements of stakeholders and are set in relation to traffic forecasts and trade-offs with other factors (e.g. cost).

Performance Needs are independent of Solutions. Performance Needs also have a relationship to the SES HLGs, but in their current form these goals do not drive Performance Needs. Performance Needs are essentially “bottom up”. They are currently described in the SESAR 1 C.02 Performance Plan **¡Error! No se encuentra el origen de la referencia.** and its update **¡Error! No se encuentra el origen de la referencia.** and are used as the basis for the development of Deployment Scenarios and the deployment view in the Master Plan. Performance needs enable a performance-led Solution Deployment packaging process, which is key for SESAR Deployment Planning. The process delivers Solution Deployment Scenarios (SDS).

SDSs take into consideration possible dependencies among Solutions, to optimise their deployment in response to specific Performance Needs of Operating Environments in the European ATM System. SDS considers Solutions results for their potential performance benefit and their effectiveness compared with each other.

The content of a SDS is selected through mainly four criteria:

1. The synergies that a combined Solution deployment would provide, not least in terms of shared enablers.
2. Their fit with existing planning structures in SESAR ATM Master Plan, Common Projects and possibly Deployment Programme.
3. Bundled Solutions need to be deployable in the same time frame, ideally within the same Reference Period. Therefore, the earliest SDS dates are defined taking into account assumptions on the duration of deployment, in particular on E-OCVM V4/V5 phases.
4. Their expected performance contribution which should be as specific as possible per Solution using the performance assessment from the validation results.

At this stage, Solutions are not combined yet to satisfy the forecast Performance Needs of specific Operating Environments. On the contrary combining Solutions for deployment across Operating Environments are sought in the search for synergies.

Solution Deployment Scenarios (SDS) then allocates relevant combined Solutions to each Operating Environment and its sub-categories in response to their Performance Needs. SDS define their deployment timeframe taking into account the earliest Solution dates, and proposing deployment

occurrence(s) to provide when and where needed the increase in performance. In other words, a Solution Deployment Scenario sets out the roll-out plan of one or more combined Solution (s) in a sub-OE (the set of characteristic locations corresponding to each sub-OE provided in the Performance Plan **¡Error! No se encuentra el origen de la referencia.**). Consequently, a SDS is a set of Solution deployment instances based upon the timescales in which the performance contribution is needed in sub-OE.

SDS may need associated recommendations for financial incentives and/or regulatory action based on partners' business awareness and the Business Case (these recommendations development and BC activities being also undertaken in PJ20), typically when the SDS require synchronised deployment and one type of stakeholder has to deploy elements without gaining direct benefit from this deployment.

In summary, the Performance Needs and SDS provide deployment assumptions to SESAR2020 Solutions confirmed and updated during validation and consolidated in the performance assessments. SDS in response to Performance needs are also an essential input to develop the Business Case.

2.11 Performance in European ATM Architecture (EATMA)

The European ATM Architecture (EATMA) adopts the NATO Architectural Framework (NAF) to provide the underlying structure linking and classifying individual elements in the model. How NAF is tailored for ATM is defined in the EATMA Guidance Material V10.0 **¡Error! No se encuentra el origen de la referencia.** NAF has the notion of "objective" which is used to identify goals for the architecture. These goals can have specific quantitative indicators or they can be qualitative. The notion of objective can be used to identify the key components of the Performance Framework (PF) such as KPA, KPI, Validation Target and Result. By relating PF components to the correct architectural elements of the EATMA structure it is straightforward to provide clear traceability from the PF to the SESAR Programme Output as maintained within the EATMA Framework.

Performance is integrated in the architecture in the Capability Layer so that it is clear which areas of the overall ATM Enterprise contribute to which Performance areas.

In the EATMA Capability Layer two additional architectural elements have been defined to capture Performance components, i.e. the "Measure" and the "Measure category" architectural elements. In the tables below more details are provided about their definition and their role in EATMA.



Measure

Definition
A certain quantity or degree of something ⁵ .
Guidance
Measures are used to describe required (ambition/need/target) or actual measures for elements in the architecture. This can, for example, be used to define key performance indicators, validation targets and validation results.
Measures are the actual values of something. They are linked to:

⁵ Oxford Dictionary, November 2016, <https://en.oxforddictionaries.com/>

- SESAR Solutions that have Measures as objectives, e.g. validation targets or validation results.
- Phases are measured by Measures
- Operating Environments which define the applicable context for the Measures
- Nodes to describe the required Measure of Node performance
- Services to describe the applicable Service Level Measure
- Capability Configurations to describe the applicable resource Measure

Table 4: Measure Element ¡Error! No se encuentra el origen de la referencia..



Measure Category

Definition
A standard unit used to express the size, amount, or degree of something. ⁶
Guidance
A distinction is made between categories of metrics and the metrics themselves (Measure Category / Measure). This allows the description of how something is to be measured and then describes different values for this Measure Category in different contexts. E.g. it is possible to define the unit of how a Capability is measured and then describe different values of these measures during different Phases of the enterprise evolution. Measure Categories are used to define Key Performance Areas and Key Performance indicators without specified values. Then the Measure element is used to define specific values depending on the context. E.g. the value of the KPI can be different for different Operating Environments or Solutions. Measure Categories are linked to Capabilities and Measures.

Table 5: Measure Category Element ¡Error! No se encuentra el origen de la referencia.

The KPI CAP3 Peak Runway Throughput (Mixed mode) is a Measure Category whereas the value of 7% is a Measure which represents the validation target starting point.

The relationship from SESAR Solutions to Capabilities is mapped within the EATMA framework so that it is then possible to link the Validation Targets for each Solution to the capabilities. The Solution is described in the architecture at both an operational, system and service level.

The operational architecture shows the business function, or node, that is undertaking the process that describes the concept. It is the execution of this process that exhibits the capability. The process model at this level, simply, describes the different activities undertaken by the concerned stakeholders, what they do and what information is used.

The system architecture describes how these activities are undertaken and which technologies are used to fulfil a Capability (Capability Configuration). When the Solution is validated then the result indicates the level of performance improvement related to a particular Capability available from that Solution.

⁶ Oxford Dictionary, November 2016, <https://en.oxforddictionaries.com/>

Figure 6 shows the EATMA v9.0 Meta Model, including the performance measurements related components in the highlighted part of the Meta Model (red dotted rectangle that is enlarged in

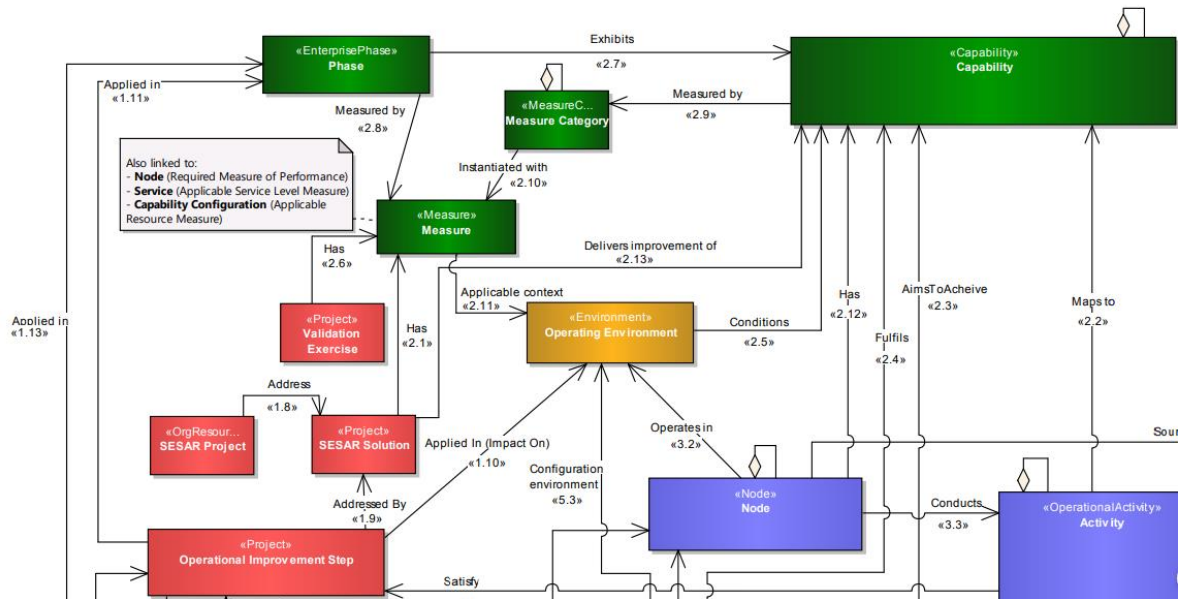


Figure 7).

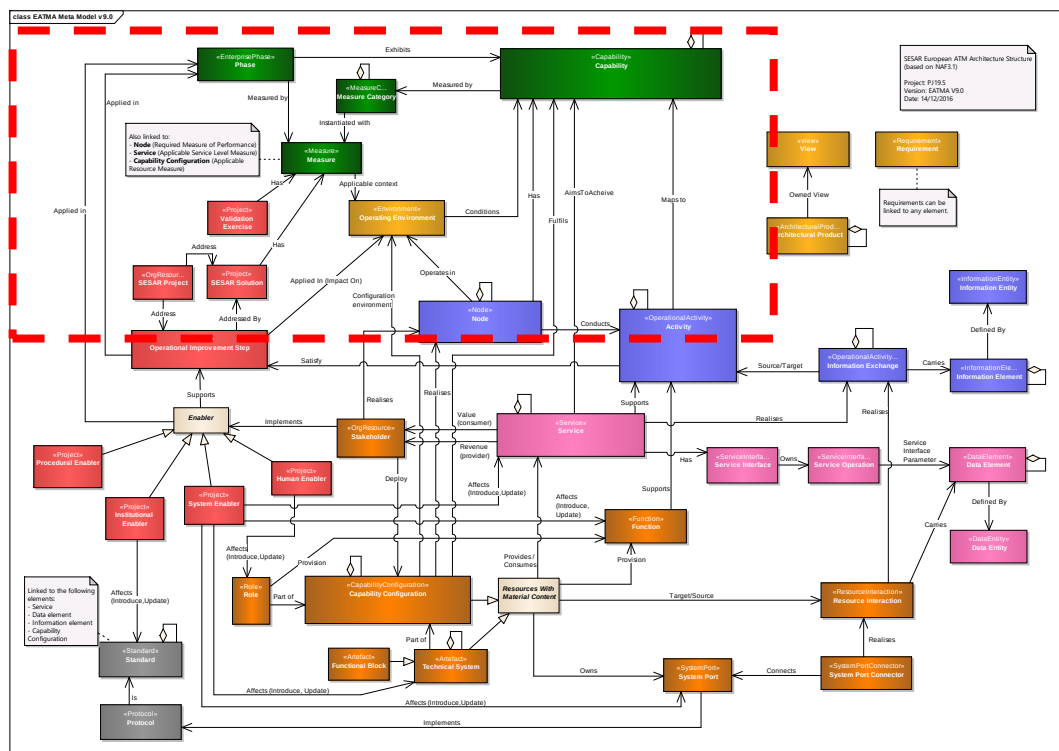


Figure 6: EATMA V9.0 Structure based on NAF V3.1

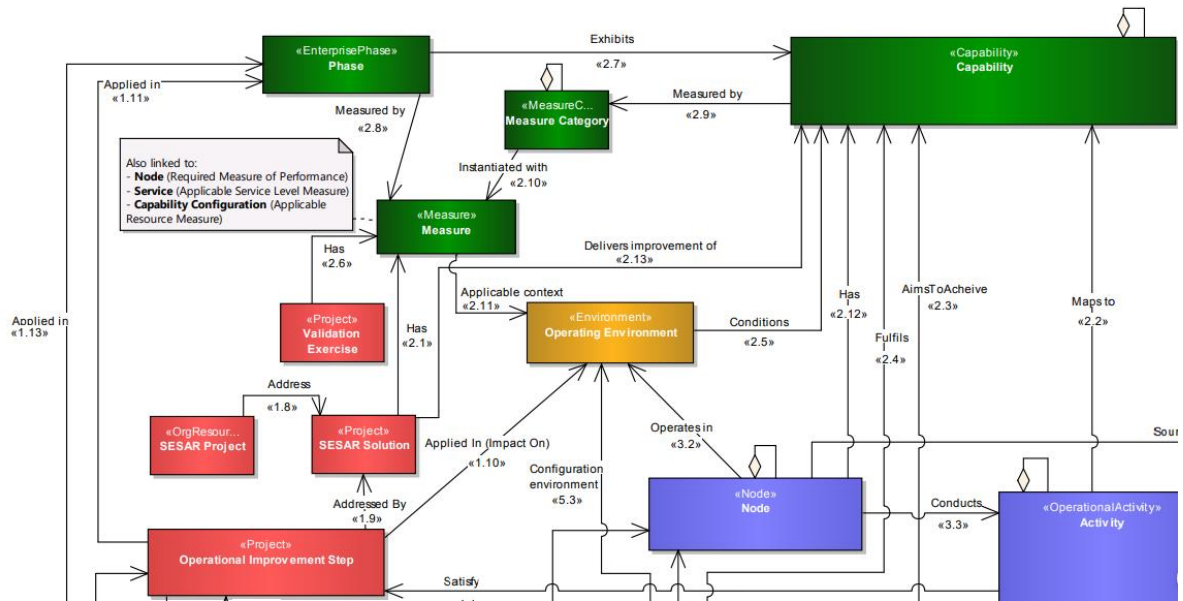


Figure 7: EATMA V9.0 Structure based on NAF V3.1 – Performance measurements

Figure 8 below details the graphical representation of the current Meta Model updates designed to include performance components in EATMA framework.

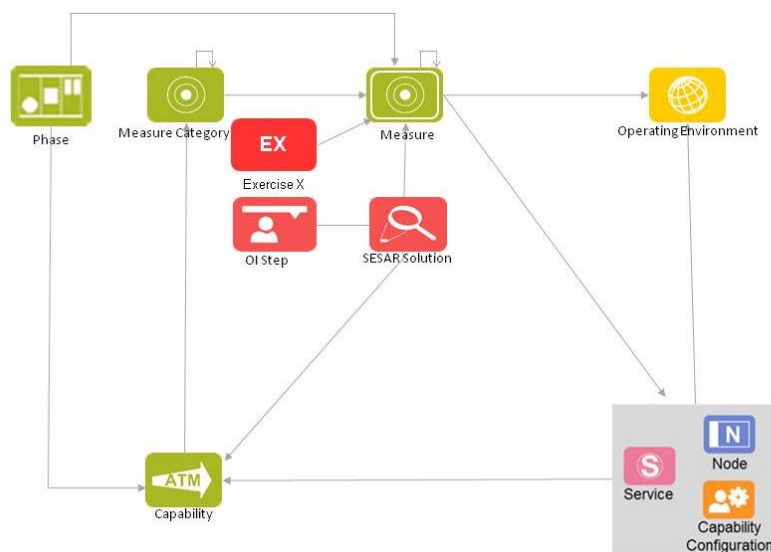


Figure 8: Graphical representation of the Performance Elements Integrated into EATMA V11.

The performance based elements can be used to produce reports related to performance assessment which can be exported from EATMA Repository and displayed in the eATM Portal. The eATM Portal provides a web based presentation of the key elements of the European ATM Architecture among other things.

The portal is intended to be used primarily when developing the future ATM System and support the planning for its deployment with architecture information; it is developed as a part of the SESAR programme. The targeted user categories of the portal are Executives, Deployment and Investment

planners, Architects (Business, Operational and Technical) and Project managers of development projects.

According to the eATM Portal Home Page represented below (see Figure 9) a dedicated Section (see <https://www.atmmasterplan.eu/exec/overview/performance>) related to Performance is presented for both the SESAR “Research and Development” and “Deployment” views.

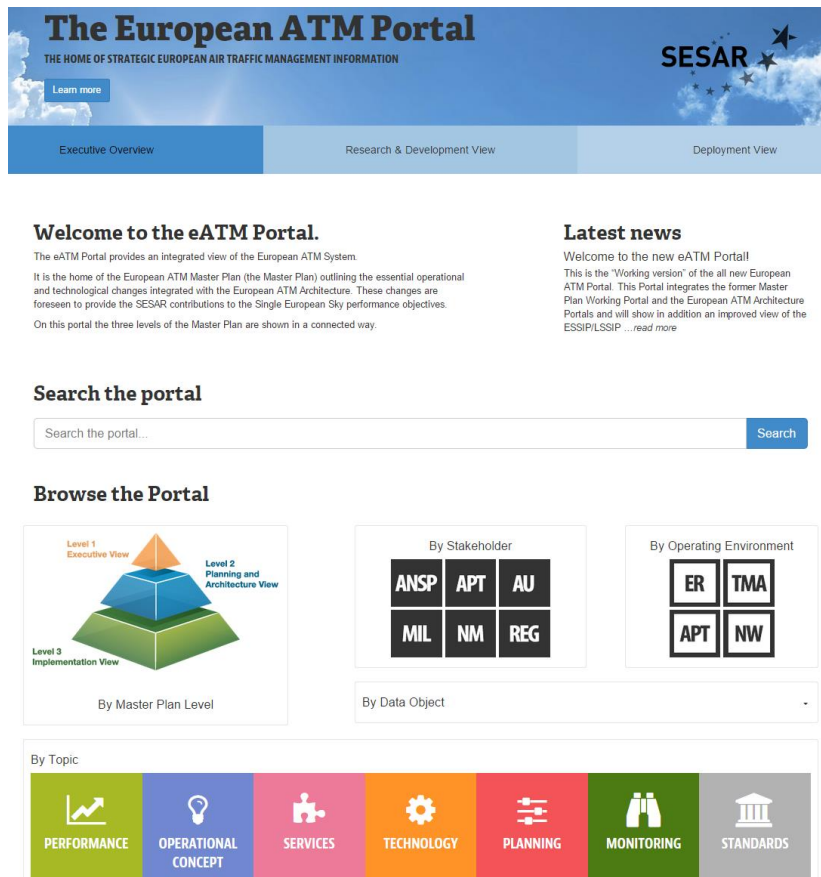


Figure 9: European ATM Portal Home page (working version).

The eATM portal can be set up to display the performance target and validation information in the form of dashboards that provide easy access to the information to portal users in the Portal Section “Performance Overview”. In addition to this, options for analytical tools within the portal are currently being explored.

An example of a dashboard presentation that is being considered is shown below. This has been developed in the scope of SESAR1 so refers to OFAs, but the same presentation could be considered for SESAR Solutions. Note that EATMA can provide an easy link to data showing the analysis made for each of the gap.

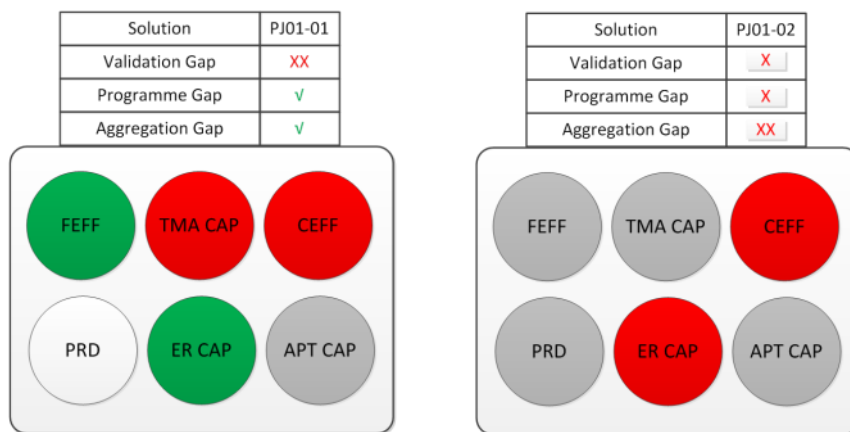


Figure 10: Performance dashboard example.

3 Overview of KPAs and KPIs

3.1 Introduction

This section summarises the KPAs, KPIs and mandatory PIs of the SESAR2020 Performance Framework in line with the SESAR Performance Based Approach and Performance Management Process, as presented in the previous section. Furthermore, it introduces the overall structure of the performance areas, puts them “on one page” and describes how they interact. The specifics of each performance area are described in the Appendix A.

The previous section presented a performance-based approach for development and deployment of operational changes and enabling technology. The selection of performance areas for SESAR2020 reflects this, and it is consequently different to performance areas and metrics used in the regulatory arena (e.g. SES Performance Scheme) or in ANS performance management (e.g. by ANSPs monitoring and tracking performance). A key reason is that some metrics are easy to measure in operational or regulatory environment (e.g. delays), but very hard to assess in the development phase or when planning deployment.

Using the ATM Master Plan’s SESAR Performance Ambitions **¡Error! No se encuentra el origen de la referencia.** as the primary driver, this Performance Framework then uses the framework concept from the ICAO Doc 9883 **¡Error! No se encuentra el origen de la referencia.**, where a step-by-step approach to performance-based planning is provided taking as reference the eleven Performance Areas (PAs) identified in the ICAO Global ATM Operational Concept (Doc 9854) **¡Error! No se encuentra el origen de la referencia.**

In the context of the ICAO generic Performance Framework structure, it is worth noting that the SESAR Performance Framework described in this document includes “KPA”, “Focus Area” and “Performance Indicators” considerations, i.e. the document does not set objectives or targets as these are elaborated in the Validation Target document **¡Error! No se encuentra el origen de la referencia.**

3.2 Principles for including KPIs and PIs in the Performance Framework

The SESAR2020 Performance Framework has both KPIs and PIs, which distinguish between those that have associated a Validation Target (the former) and those that do not (the latter). Of course, numerous metrics could have been selected for targeting and assessment in SESAR. In order to help selection process, the following principles are applied:

- Each KPI must be able to be measured or calculated reliably from validation exercises.
- Each KPI has an associated Validation Target.
- Projects must measure impact on the KPIs (including any negative impact from Solutions aiming to improve any area measured by different KPIs).

- The number of KPIs should be limited, but sufficient to measure the Performance Ambitions⁷.
- Adding additional KPIs in subsequent editions of the Performance Framework should be minimised, in order to support effective and efficient project planning⁸.
- PIs are indicators that help either the calculation of KPIs or the expression of a Solution's impact; PIs may be Solution-specific.
- PIs do not have associated Validation Targets.
- Projects must measure mandatory PIs, including inputs to their CBAs, and may measure a set of Solution-specific or exercise-specific PIs.
- All KPIs are change controlled. Changes with respect to the previous versions are detailed in the KPA specific Appendix.

3.3 KPAs, KPIs and mandatory PIs

Table 6 sets out, for each KPA, the SESAR2020 KPIs (i.e. those that Solutions have targets for), while Table 7 sets out the mandatory PIs (i.e. those that must also, where relevant, be measured for each Solution). Appendix A describes each in more detail. The selection of KPAs uses as reference the set of KPAs defined in ICAO framework **¡Error! No se encuentra el origen de la referencia.** with refinements to support SESAR requirements. The selected ICAO KPAs are:

- Safety
- Security
- Environment
- Capacity
- Operational Efficiency
- Predictability
- Cost effectiveness
- Flexibility
- Access and Equity

⁷ A limited set is needed in order to avoid KPIs that cannot be measured accurately, ill-specified VTs and/or an unreasonably high number of validation activities.

⁸ Some change may be necessary, as political and operational priorities evolve.

The Global Interoperability and Participation by ATM Community KPAs are not used in the Performance Framework but are crucial to the success of SESAR. The treatment of these KPAs in the programme is discussed briefly in Section 3.7 and 3.8, respectively.

In this edition of the Performance Framework, the SESAR2020 Transition Performance Framework numeric labels for KPIs and PIs have been retained wherever possible to support consistency.

KPA	FOCUS AREA	KPI	KPI DEFINITION	Overall Ambition	SESAR2020 VTs ¡Error! No se encuentra el origen de la referencia.
Safety	ATM system safety outcome	SAF1	Total number of estimated accidents with ATM Contribution per year.		30% reduction
Operational Efficiency	Environment-Fuel Efficiency	FEFF1	Actual average fuel burn per flight.	500	392.700 saving Kg/flight
	On-time Performance	PUN1	Average departure delay per flight	7%	7%
	Flight Times	TEFF1	Gate-to-gate flight time	TBD (W2)	TBD (W2)
	Predictability	PRD1	Average of Difference in actual & Flight Plan or RBT durations	96%	61.75%
Capacity	Airspace Capacity	CAP1	TMA throughput, in challenging airspace ⁹ , per unit time.	47%	21.16% increase

⁹ Airspace where the current operating concept and technology is close to the limit of throughput that can be sustainably handled (typically VHC, HC and MC under period of high traffic demand).

KPA	FOCUS AREA	KPI	KPI DEFINITION	Overall Ambition	SESAR2020 VTs ¡Error! No se encuentra el origen de la referencia.
		CAP2	En-route throughput, in challenging airspace ¹⁰ , per unit time.	49%	11.67% increase
	Airport Capacity	CAP3	Peak Runway Throughput (Mixed mode).	10%	7% increase
Cost-Efficiency	G2G ANS Cost Efficiency	CEF2	Flights per ATCO-Hour on duty.	97.71%	31.63% increase
		CEF3	Technology Cost per flight.	43.43% ⁵	12.86% reduction

Table 6: SESAR2020 KPIs.

The selection is consistent with the goal of enhancing the overall efficiency of the “ATM System” as a whole and the SESAR focus primarily on operational concept and technology aspects.

Note there are no KPIs for the Access and Equity, Human Performance, Flexibility, Security and Civil-Military KPAs.

KPA	Focus Area	Mandatory PI	PI Definition	When Mandatory
Safety	ATM system safety outcome	SAF1.x	Mid-air collision – En-Route	En-Route OE Solutions
		SAF2.X	Mid-air collision – TMA	TMA OE Solutions
		SAF3.X	RWY-collision accident	Airport OE Solutions
		SAF4.X	TWY-collision accident	Airport OE Solutions

¹⁰ Idem as above.

KPA	Focus Area	Mandatory PI	PI Definition	When Mandatory
		SAF5.X	CFIT accident	Airport OE Solutions
		SAF6.X	Wake related accident	TMA and Airport OE solutions
		SAF7.X	RWY-excursion accident	Airport OE Solutions
		SAF8.X ...	Other SAF Risks	As relevant
Security		SEC1	A security risk assessment has been carried out.	Always
		SEC2	Risk Treatment has been carried out	Prioritised Solutions at V2 and V3 , implementation at higher maturity levels – V4
		SEC3	Mitigated Risk level per Supporting Asset are lowered after risk treatment	
Operational Efficiency	On-time performance	PUN2	% Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	Always
	Flight Times	TEFF2	Taxi in time	When relevant
		TEFF3	Taxi out time	
		TEFF4	TMA arrival time	
		TEFF5	TMA departure time	
		TEFF6	En-Route time	
	Predictability	PRD1	Average of Difference in actual & Flight Plan or RBT durations	Always
		PRD2	Variance of Difference in actual & Flight Plan or RBT durations	Always
Environment	Emissions	ENV1	CO ₂ Emissions.	Always

KPA	Focus Area	Mandatory PI	PI Definition	When Mandatory
	Noise	NOI1	Relative noise scale	Airport OE Solutions
		NOI2	Size and location of noise contours	Airport OE Solutions
		NOI4	Number of people exposed to noise levels exceeding a given threshold	Airport OE Solutions
	Local Air Quality	LAQ1	Geographic distribution of pollutant concentrations	Airport OE Solutions relative to LTO cycle (i.e. below 3000ft)
Capacity	Airport Capacity	CAP3.1	Peak Departure throughput per hour (Segregated mode)	Always
		CAP3.2	Peak Arrival throughput per hour (segregated mode)	Always
		CAP4	Un-accommodated traffic reduction.	Always
	Resilience	RES1	Loss of Airport Capacity Avoided.	Always
		RES1.1	Airport time to recover from non-nominal to nominal condition	Airspace OE Solutions
		RES2	Loss of Airspace Capacity Avoided.	Always
		RES2.1	Airspace time to recover from non-nominal to nominal condition.	Airspace OE Solutions
		RES4	Minutes of delays.	Always
		RES5	Number of cancellations.	Always
Cost Efficiency	G2G ANS Cost Efficiency	CEF1	Direct ANS Gate-to-gate cost per flight	Always

KPA	Focus Area	Mandatory PI	PI Definition	When Mandatory
	Airspace User Cost-Efficiency	AUC3	Direct operating costs for an airspace user	Where an impact is foreseen on AU cost efficiency
		AUC4	Indirect operating costs for an airspace user	
		AUC5	Overhead costs for an airspace user	
Flexibility	Non-schedule traffic Trajectory modifications Military airspace requirements	FLX1	Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	Where an impact is foreseen on flexibility
Civil-Military Cooperation and Coordination (CMCC)	Impact of ATM on the effectiveness of military operation and training activities	CMC1.1*	Allocated vs. Requested ARES duration	Only where relevant
		CMC1.2*	Allocated vs. Requested ARES dimension	
		CMC1.3*	Deviation of Transit Time to/from airbase to ARES	
		CMC1.3.1**	Allocated ARES duration vs. total mission duration	
		CMC1.3.2**	Deviation of mission total duration between submitted iOAT FPL and validated iOAT FPL	
		CMC 1.4.1**	Rate of iOAT FPLs acceptance by NM systems	
		CMC1.4.2**	Rate of iOAT FPLs acceptance by ATC systems	
	Contribution to Civil ATM Performance	CMC2.1	Fuel and Distance saved by GAT	
Human Performance	-	HP1	Consistency of human role with respect to human capabilities and limitations	Always

KPA	Focus Area	Mandatory PI	PI Definition	When Mandatory
		HP2	Suitability of technical system in supporting the tasks of human actors	
		HP3	Adequacy of team structure and team communication in supporting the human actors	
		HP4	Feasibility with regard to HP-related transition factors	

Table 7: SESAR2020 Mandatory PIs.

Note there are no mandatory PIs for the Access and Equity, Predictability and Punctuality, and Civil-Military Cooperation and Coordination KPAs/FAs.

SESAR2020 Solutions shall measure the KPIs and mandatory PIs. In addition, SESAR2020 Solutions can also use PIs defined in the context of H2020 projects, such as APACHE Performance Framework¹¹, or can also identify additional (or alternative) metrics (e.g. workload, ROT (Runway Occupancy Time) reduction, lateral path distance...) to support measurement of **KPIs or mandatory or non-mandatory PIs**. If they do so, projects should propose and review with the Content Integration Team and Support to Validation PJ19 CI how to translate the metrics into the **KPIs or mandatory or non-mandatory PIs** to ensure that the measurements provide useable information for performance assessment at programme level.

3.4 Interdependencies between KPAs

It is important to understand that there are significant interdependencies between these performance areas. Most operational improvements are aimed at solving or mitigating specific shortcomings in today's ATM system, which have ramifications for more than one performance area. For example, enhanced navigational accuracy enabling tighter route spacing, which has implications for safety, capacity and fuel efficiency performance. However, when deployed in different environments or operational locations the performance improvements across the different KPAs may differ due to the "tuning" of the solution to the local conditions, e.g. in response to specific local priorities or characteristics.

Figure 11 illustrates at a high level how the different performance areas should be viewed.

¹¹APACHE_D3.1_New-KPA-KPI_v02.00.00.pdf, which can be found at the following link: https://apache-sesar.barcelonatech-upc.eu/en/publications/deliverables_publications

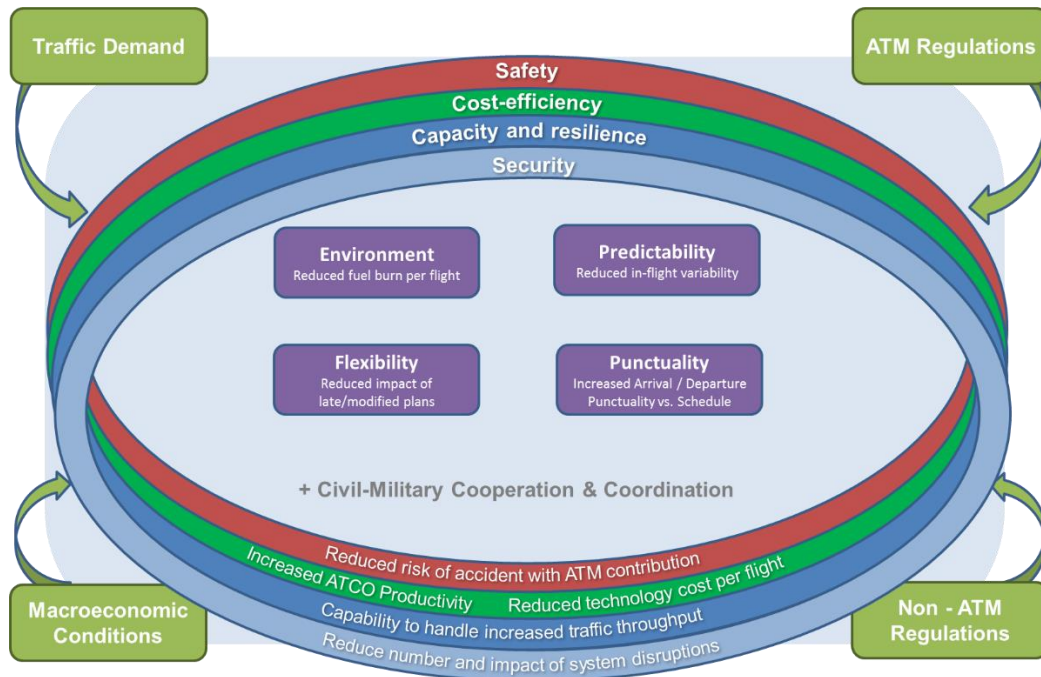


Figure 11: Integrated Framework of Key Performance Areas in SESAR

The figure tries to represent that there are some areas which always interact with the others, due to their nature. Up to some point, one could actually say that some interactions may appear between any pair of chosen areas. However, the picture tries to highlight that:

- All the areas may have an impact in any cost-efficiency aspect. Even when limiting the scope to direct ANS costs, any solution that may imply the deployment of a solution affects cost-efficiency, either positively or negatively, in the short or in the long term.
- **Safety** is also a transversal and overarching area, which is furthermore, the highest priority. The picture tries to reflect that any improvements in the other areas should be seen in the context of always keeping or improving the safety levels. Safety is closely linked to cost as like other improvements, so it comes with a financial cost (investment and operation). It can also be improved by limiting controller workload – which links very directly to Capacity. In essence then, Safety requirements play a large part in defining Capacity.
- **Capacity** also influences results in all the others, especially in those related to quality of service. Obviously, it also relates to cost-efficiency and safety, since Capacity has a cost and the increase in traffic has to be handled safely. Human Performance also influences Capacity.
- **Civil-military coordination and cooperation** is shown as a background of the global picture framework, since it also influences all the performance areas with more or less impact due to the presence of national security requirements, which drive military airspace user requirements. For some of the chosen areas or indicators, this aspect is perceived as more influencing than for others, e.g. as is the case for fuel efficiency.

- **Resilience (Focus Area within Capacity KPA)** is the ability to deliver performance goals during abnormal operating conditions (by reducing impact and decreasing time to recover) and Security is the ability to reduce impact of malicious events. Both affect Capacity.

The remaining KPAs are shown as influencing and being influenced by the “surrounding” ones, but there are also interdependencies between them, e.g. Punctuality vs. Flexibility. In this case, Airspace Users want to be able to adapt the times and trajectories of their flights to unexpected events, like cargo and passengers boarded earlier than planned or a storm en-route, and thus Flexibility is an advantage as it allows the agreed trajectory to be modified. However, the shifts in time or trajectory may bring conflicts downstream to the airspace and the allocation of routes that had been planned originally, which may cause a reduction in Punctuality (departure delayed due to ATFM regulation) and/or Predictability (extended arrival holding due to bunching).

Figure 11 also shows that there are other external aspects that potentially influence the results in the concerned areas:

- **Traffic Demand** has an impact on the capacity requirements, fast growing demand can lead to a short term focus on capacity over and above other QoS goals such as predictability.
- **Macro-Economic Effects** may affect traffic demand in the short term (e.g. create increased volatility of demand).
- **ATM Regulations** can affect many or all areas of performance and indeed may comprise other SES instruments intended to help achieve the HLGs.
- **Non-ATM Regulations** may imply additional costs or constraints (e.g. working time directives) on the ATM system that need to be reflected in the performance assessment.

Specific frameworks for the different key performance areas show some of the external influences that are non-actionable by ATM in their corresponding influence diagrams (see individual sections of Appendix A).

The purpose of this integrated framework approach is not only to introduce the idea of interdependencies but also highlight their importance in the validation of the program Solutions and the later performance assessment. Some of the interdependencies between the chosen areas or related indicators may be positive (i.e. improvement in one area/indicator implies as well an improvement in another), but others may imply a trade-off (improvement in one indicator may imply the degradation of another one). It is important then to identify interdependencies during the validation and performance assessment activities, so that:

- Influences are taken into consideration for a realistic performance assessment
- Potential Solutions for reducing a negative impact in another indicator can be proposed or identified, so that the effects of trade-offs are minimized.

To implement the integrated framework approach at all stages of concept development it is necessary to progressively identify and refine the interdependencies between KPAs/KPIs specific to the proposed concept. Initially, the interdependencies should be assessed to decide for each KPA pair whether:

- a) the KPA impacts are independent of each other e.g. both fuel efficiency and capacity may benefit from an increase in airspace availability enabled by civil-military Solutions such as Advanced ASM and Mission Trajectory driven processes, or
- b) If they are related so that if an improvement in one KPA has a negative impact on another and there is a potential trade-off to consider e.g. if safety were potentially adversely impacted by increase in controller workload associated with procedures to meet environmental restrictions. The identified interdependencies should then be considered in the concept assessment stage, for example through design of exercises or data collection. A suitable point in the concept development process to identify the interdependencies is during the Benefits Mechanism identification, such interdependencies can be refined during the analysis of data collected and included into VAL Report.

3.5 Relation with ATM Master Plan Performance Ambitions KPIs

The interrelationship map between ATM Master Plan Performance Ambitions and SESAR2020 KPAs, FAs and KPIs is presented in Table 8.

ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	SESAR Performance Framework KPA	Perf Fram. ID	Performance Framework KPI/(PI)/<Design goal>
Cost efficiency	Gate-to-Gate direct ANS Cost per Flight	Cost efficiency	CEF1	Direct ANS Gate-to-gate cost per flight
			CEF2	Flights per ATCO hour on duty
			CEF3	Technology Cost per flight
			CEF2	Flights per ATCO hour on duty
			CEF3	Technology Cost per flight
Capacity	Network throughput IFR flights (million) Network throughput IFR flights hours	Capacity	CAP1	TMA throughput, in challenging airspace, per unit time
	IFR flights at congested airports (million)		CAP2	En-route throughput, in challenging airspace, per unit time
			CAP3	Peak Runway Throughput
			RES1	% Loss of airport capacity avoided
			RES2	% Loss of airspace capacity avoided

ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	SESAR Performance Framework KPA	Perf Fram. ID	Performance Framework KPI/(PI)/<Design goal>
	Departure Delay ¹² (min/dep)	Operational Efficiency	PUN1	Average departure delay per flight
Operational Efficiency	Additional gate-to-gate flight time per flight (min/flight)		TEFF1	Gate-to gate flight time
	Gate-to-gate fuel burn per flight (tonne/flight)		FEFF1	Actual average fuel burn per flight.
Environment	CO ₂ emissions (tonne/flights)	Environment	ENV1	CO ₂ Emissions.
Safety	Accidents with ATM contribution	Safety	SAF1	Total number of estimated accidents with ATM contribution
Security	ATM related security incidents resulting in traffic disruptions	Security	SEC1	A security risk assessment has been carried out.
			SEC2	Risk Treatment has been carried out.
			SEC3	Residual risk after treatment meets security objective.
			SEC4	Supply-chain Security aspects addressed.
			SEC5	Dedicated [Cyber-]Security Scenarios during Validation exercises
			SEC6	Successful Penetration Testing performed on key Supporting Assets
			SEC7	Personnel (safety) risk after mitigation

¹² Also treated within Operational Efficiency in the ATM Master Plan.

ATM Master Plan SESAR Performance Ambition KPA	ATM Master Plan SESAR Performance Ambition KPI	SESAR Performance Framework KPA	Perf Fram. ID	Performance Framework KPI/(PI)/<Design goal>
			SEC8	Capacity risk after mitigation
			SEC9	Economic risk after mitigation

Table 8: Mapping between ATM Master Plan Perf. Ambitions and SESAR Perf. Framework.

3.6 Relation with SES Performance Scheme KPIs

SESAR2020 Performance Framework and the SES Performance Scheme **¡Error! No se encuentra el origen de la referencia.** are related. However, these two frameworks are different in scope and applicability and, therefore, they use different indicators and targets. SESAR performance concerns expected improvements from deploying SESAR Solutions, whereas the SES Performance Scheme drives performance improvement in the actual deployed system.

The SESAR2020 Performance Framework describes both the high-level process and the reference set of structures, interfaces and language (in terms of KPAs, KPIs, PIs and metrics) needed to ensure that the overall activity of the SESAR Projects is coherent and results are meaningful, consistent and usable.

The SES Performance Scheme is designed to drive performance improvement in European ATM by setting performance targets at both EU and local levels. In particular, at local level, States set individual short- to medium-term binding targets on specific stakeholders accountable for delivering measurable performance outcomes. These are assessed by the EC for their consistency with EU-level targets. In setting out the binding targets, States take into account performance enhancements expected from the deployment of SESAR Solutions, other SES initiatives (e.g. FABs and Network Management) and from other sources. Performance Targets define specific performance outcomes (delivered performance) to be achieved by specific stakeholders in specific years. The Performance Scheme is not static and for each reference period the selected KPIs and PIs can be amended and/or integrated through the process required by European rules.

Although the SES Performance Scheme uses the same KPAs (derived from ICAO), the selected KPIs are different to the SESAR Performance Framework. Figure 21 sets out the principal rationale for the differences between SESAR2020 Performance Framework and the SES Performance Scheme.

SES Performance Scheme	SESAR2020 Performance Framework
Use of targets (KPIs) and monitoring (PIs) to drive performance improvement in the deployed system	Used to measure expected improvements from deploying SESAR Solutions
Implicitly includes actual world issues (such as indirect ANS costs)	Explicitly excludes actual world issues
Measurements are made in the actual world	Measurements are made in validation exercises

Table 9: Principal rationale for the differences between the SES Perf Scheme and SESAR2020 PF.

The following table presents the proposal for mapping SESPF with SES RP3 IR (Commission Implementing Regulation (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky and repealing Implementing Regulations (EU) No 390/2013 and (EU) No 391/2013).

SES Perf Scheme KPA	Perf. Scheme ID	SES Performance Scheme KPI/PI	SESAR PF KPA	Perf. Fram. ID	PF KPI/(PI)	
Safety	PS1	Effectiveness of Safety Management (both Regulators and ANSPs).	Safety		N/A	
	PS3	Rate of separation minima infringements (at Union level/ Member State/ airspace)		SAF1	Total number of estimated accidents and with ATM contribution	(SAF1.2 SAF1.3) (SAF2.2 SAF2.3)
	PS2	Rate of runway incursions (at Union level/ at airports located in a Member State/ at an airport)				(SAF3.4)
	PS4	Use of automated safety data recording systems by air navigation service providers, when implemented			N/A	
Environment	PS6	Average horizontal en route flight efficiency of actual trajectory	Operational Efficiency	EFF1	Horizontal en-route flight efficiency	
	PS7	Average horizontal en route flight efficiency of the last filed flight plan trajectory		EFF1	Horizontal en-route flight efficiency	
			Civil-Military Cooperation and Coordination	CMC2.1	Fuel and Distance saved by GAT	
	PS8	Average horizontal en route flight efficiency of the shortest constrained trajectory		N/A	N/A	
			Civil-Military Cooperation and Coordination	CMC1.1	Allocated vs. Requested ARES duration	
	PS9	Effective use of reserved or segregated airspace		CMC1.2	Allocated vs. Requested ARES dimension	
				CMC1.3.1	Allocated ARES duration versus total mission duration	

SES Perf Scheme KPA	Perf. Scheme ID	SES Performance Scheme KPI/PI	SESAR PF KPA	Perf. Fram. ID	PF KPI/(PI)
	PS10	Rate of planning via available airspace structures, including reserved or segregated airspace and conditional routes, for general air traffic		N/A ¹³	N/A
	PS11	Rate of using available airspace structures, including reserved or segregated airspace, conditional routes, by general air traffic		PRD15	No. flights GAT for which ARES airspace is offered
	PS12	Additional time in taxi-out phase [minutes per departure]	Operational Efficiency	PRD5 ¹⁴	Average of difference in actual & Flight Plan or RBT taxi-out durations
				PRD6	Taxi out variability
				TEFF3	Taxi out time
	PS13	Additional time in arrival sequencing and metering area (ASMA) [minutes per arrival]		PRD7 ¹⁵	Average of difference in actual & Flight Plan or RBT TMA arrival durations
				PRD8	TMA arrival variability
				TEFF4	TMA arrival time

¹³ CMC2.2 has been removed as it is not measurable in SESAR. Validation scenarios do not cover aspects related to the availability of ARES for GAT planning as published in AIPs or via NOTAMs.

¹⁴ The only difference is that it is not compared to the unimpeded taxi out but the AXOT to the EXOT. The objective is to compare how much a solution improves the situation, not how much it is inefficient, and this is why it is compared a scenario with and without a solution. Not a scenario to compare to the minimum possible.

¹⁵ Idem as above.

SES Perf Scheme KPA	Perf. Scheme ID	SES Performance Scheme KPI/PI	SESAR PF KPA	Perf. Fram. ID	PF KPI/(PI)
	PS14	Share of arrivals applying Continuous Descent Operation (CDO)	N/A	N/A	N/A
Capacity	PS15	Average minutes of en route ATFM delay per flight attributable to air navigation services	Operational Efficiency – on time performance	PUN1	Average departure delay per flight
			Capacity	CAP2	En-route throughput, in challenging airspace, per unit time
	PS16	Average time, expressed in minutes, of arrival ATFM delay per flight attributable to terminal and airport air navigation services		CAP3	Peak Runway Throughput
			Operational Efficiency – on time performance	PUN1	Average departure delay per flight
	PS17	Percentage of flights with en route ATFM delay greater than 15 minutes	Operational Efficiency (on-time performance)	PUN5	% Flights departing within +/- 15 minutes of scheduled departure time due to reactionary delays, ATM and weather related delay causes
	PS18	Average time, expressed in minutes, of all cause-departure delay per flight		PUN1	Average departure delay per flight
	PS19	Percentage of IFR flights adhering to their ATFM departure slots at local level, calculated for the whole calendar year of the reference period		N/A	N/A
	PS20	Average minutes of air traffic control pre-departure delay per flight		PUN1	Average departure delay per flight

SES Perf Scheme KPA	Perf. Scheme ID	SES Performance Scheme KPI/PI	SESAR PF KPA	Perf. Fram. ID	PF KPI/(PI)
	PS21	Percentage of en route ATFM delay saving from the Cooperative Decision-Making network procedures and Network Manager Operations Centre actions		PUN7	Average departure delay per flight due to Airport ATM Factors
	PS22	Percentage of arrival ATFM delay saving from the Cooperative Decision-Making network procedures and Network Manager Operations Centre actions		N/A	N/A
	PS23	Average over a calendar year of the daily number of ATFM regulations that produces less than 200 min delay		N/A	N/A
	PS24	Average over a calendar year of en route ATFM weekend delay expressed in minutes		N/A	N/A
	PS25	Annual percentage of first rotation delay due to capacity and staffing for a pre-selection of area control centres/airports		N/A	N/A
Cost-Efficiency	PS26	DUC for en route air navigation services	Cost-Efficiency	CEF2	Flights per ATCO hour on duty (CEF2)
				CEF3	Technology Cost per flight (CEF3)
	PS27	Actual unit cost incurred by users separately for en-route and terminal air navigation services at Union level		N/A	N/A

SES Perf Scheme KPA	Perf. Scheme ID	SES Performance Scheme KPI/PI	SESAR PF KPA	Perf. Fram. ID	PF KPI/(PI)
	PS28	DUC for terminal air navigation services		CEF2	Flights per ATCO hour on duty (CEF2)
				CEF3	Technology Cost per flight (CEF3)
	PS29	Unit cost for the execution of the tasks of the Network Manager		N/A	N/A

Table 10: Mapping between the SES Performance Scheme and SESAR Perf. Framework.

The SES and SESAR performance terms and indicators are not exactly the same. The Table 10 identifies which indicators in the Performance Framework are equivalent to the indicators in the SES Scheme and for those where there is no equivalent, it suggests other indicators that could provide a similar picture of a particular situation, with the aim to relate SESAR performance figures - whether aspirations or measurements - to SES Performance Scheme.

3.7 Global Interoperability KPA

As stated earlier, the Global Interoperability KPA is not used in the Performance Framework, but is crucial to the success of SESAR, and therefore its treatment in the programme is discussed here briefly.

Interoperability and global harmonisation rely on the synchronised application of standards and common principles, together with common technical and operational Solutions for relevant aircraft and ATM systems. This includes civil-military interoperability.

The ICAO definition for the Global Interoperability KPA is: *“The air navigation system should be based on Global Standards and uniform principles to ensure the technical and operational interoperability of air navigation systems and facilitate homogenous and non-discriminatory global and regional traffic flows”* **¡Error! No se encuentra el origen de la referencia..**

At the level of overall ATM performance, the main purpose of the interoperability KPA is to facilitate homogeneous and non-discriminatory global and regional traffic flows. Applying standards and uniform principles, and ensuring the technical and operational interoperability of aircraft and ATM systems are seen as supporting (enabling) objectives for the main SESAR objectives.

Indeed, within SESAR, Global Interoperability is facilitated through the EU and SJU participation in ICAO fora and in particular the EU/US MoU. The SESAR CONOPS **¡Error! No se encuentra el origen de la referencia.** and Solutions are consistent with the ICAO ASBU concept.

The concept of civil-military interoperability is considered in sub-section 3.9.

3.8 Participation by the ATM Community KPA

Also as stated earlier, the Participation KPA is not used in the PF, but is crucial to the success of SESAR, and therefore its treatment in the programme is discussed here briefly.

This KPA addresses the need for the ATM community to have a continuous involvement in the planning, implementation and operation of the system to ensure that the evolution of the global ATM system meets the expectations of the community.

The ICAO Definition **¡Error! No se encuentra el origen de la referencia.** is: *The ATM Community should be continuously involved in the planning, implementation and operation of the system to ensure that the evolution of the Global ANS system meets the expectations of the community.*

For SESAR this is predominantly a policy-level, not performance-level, issue and therefore addressed through other means: for example, SESAR governance mechanisms reflect required participation. The SJU itself is a public-private-partnership that contains representation from ANSPs, Airport Operators and the Network Manager (through EUROCONTROL).

The ATM community within SESAR2020 comprises the air navigation service providers, the airspace users, the ATM support industry as well as regulatory authorities. There are several key types of stakeholder that are involved in SESAR2020:

- **ATCO Involvement:** ATCOs are involved with real-time simulations, and more generally through inclusion of Human Factors and Performance; **¡Error! No se encuentra el origen de la referencia.** describes Human Performance in more detail.
- **Military Involvement:** Civil-military cooperation and coordination is a major requirement, and affects several KPA: the performance-related aspects are addressed in detail in A.9.
- **Pilot Involvement:** Pilots are involved in SESAR2020 through representative association and individually through review of docs and inclusion in experiments.
- **GA and non-commercial airlines:** Involvement is through representative associations.
- **Airspace User Involvement:** Involvement is through representative associations and direct participation in some projects.
- **Regulator Involvement:** NSAs are involved via framework contracts.

The RPAS community has also been engaged in SESAR2020 Programme with operational and technological Solutions dedicated to the integration of RPAS into ATM environment.

3.9 The Military Dimension

3.9.1 Civil-military approach to SESAR2020 performance framework

As stated in the ATM Master Plan edition 2019, it is vital for SESAR deployment that the future ATM system accommodates both civil and military needs. This shall ensure optimum airspace allocation for all Airspace Users while preserving the capability of the military to safely operate across national and European airspace, either nationally or collectively, including within the most dense and complex areas and airports of Europe. In other words, the aim is to achieve SES objectives and to enhance military mission effectiveness at the same time.

In addition, a civil-military performance-based partnership is recognized as of utmost importance but also as a requirement within all SES and SESAR developments.

Consequently, within the scope of SESAR2020 performance framework, a twofold approach is applied for the implementation of a civil-military performance based partnership:

- To provide evidence on the civil-military cooperation and coordination contribution to SESAR performance ambitions by measuring the performance gains delivered by ATM Solutions such as the Advanced Airspace Management (ASM) based on the concept of Advanced Flexible Use of Airspace (AFUA) and Mission Trajectory (MT) Driven Processes.
- To assess and mitigate the impact of SESAR ATM Solutions on the effectiveness of military mission by analysing performance indicators related to the outcomes of civil-military planning and decision-making processes .

This dual approach enables also better transparency between SESAR ambitions and military expectations concerning ATM performance. In addition to the SESAR2020 transition performance framework, further research is required on two additional KPAs: *Access & Equity* and *Interoperability*.

The *Access & Equity* KPA addresses military expectations concerning access to ATM resources and freedom of operations. *Civil-military interoperability* is a key enabler and a “conditio sine qua non” for safe, efficient and cost-effective civil-military cooperation. It influences all KPAs where civil and military stakeholders interact. A lack of interoperability degrades the performance of ATM systems. Therefore, within Interoperability KPA, civil-military interoperability focus area should be addressed.

3.9.2 Overview on CMC contribution to performance ambitions and military expectations for SESAR2020 performance framework

Accomplishment of mission objective is the primary requirement for military airspace users. Therefore, military expectations from the ATM system could differ from civil ones. Sometimes they can even be opposite. In addition, each State has its own tactical requirements matching a particular national defence or security requirement.

In this regard, the definition of common generic performance objectives and associated indicators is feasible. However, validation target setting should be driven by national military requirements supporting an individual validation exercise. On the other hand, this not precludes (a) common validation target(s), if the States reach an agreement on this.

Military performance and deployment needs have already been captured in the common European ATM Master Plan and integrated in the different roadmaps. The following military needs will be considered within the scope of SESAR 2020:

- Integration of military mission requirements and priorities within the ATM system through the concept of ‘Mission Trajectory’: The trajectory planning processes will facilitate the execution of military mission and provision of Air Navigation Services within and across national borders.
- Improved airspace management and access to airspace reservations/restrictions (ARES) through the implementation of ‘AFUA’ concept: The Dynamic Airspace Configuration processes integrating new ARES design principles (e.g. Dynamic Mobile Areas of type 1 and 2) will enable effective military access to training areas including for the new generation of fighter aircraft and weapon systems.

- Civil-military CDM process at regional and sub-regional/local-Network levels for the management of both trajectories and airspace configuration will support an effective integration of military ATM demand with all attributes of military mission in accordance with the requirements and priorities defined by the military Airspace User.
- Civil-military interoperability at the lowest cost: Improvement to the interoperability between civil and military systems must be implemented at the lowest possible cost for MOD budgets

Recognition of equivalent level of performance: The performance of military equipment in communications, navigation and surveillance shall be exploited in order to avoid Solutions that require implementation of equipment that would be too expensive and/or unfeasible to Military. Table 11 categorises the civil-military performance contribution to the SESAR Ambitions and military expectations across relevant SESAR2020 KPAs. Access & Equity and Interoperability KPAs have been added.

SESAR2020 PF KPA	Civil-military cooperation contribution to the SESAR Ambitions	Military expectations of SESAR
Access and Equity	• Access to ATM resources through the concept of mission trajectory	• Access to the ATM resources supporting national security and defence needs in accordance with a State's priority rules and procedures • Within an area of responsibility, timely and unrestricted freedom of operation for military users in accordance with a State's priority rules and procedures
Capacity	• Optimisation of airspace available and used for military training and operations	• Sufficient airspace and ATM network capacity allowing uninterrupted planning and conduct of training and operations
Cost -Efficiency	• Sharing of ATM/CNS infrastructure • Maximise the re-use of military ATM/CNS capabilities	• Civil-military interoperability at the lowest cost • Minimum non-training related cost incurred by ATM
Environment	• Contribution to the environmental KPA in accordance with national procedures and regulations • Contribution to the environmentally-friendly ASM throughout the civil-military CDM process	
Flexibility	• AFUA application in ARES management across all levels of ASM	• Acceptance by ATM system of military short-term request for mission planning/execution in accordance with the priority rules

SESAR2020 PF KPA	Civil-military cooperation contribution to the SESAR Ambitions	Military expectations of SESAR
Interoperability	- Reduction in the number of exemptions and derogations for State aircraft operating GAT - Military-military ATM interoperability in support of the network - Rationalisation of ATM/CNS infrastructure on the basis of synergies between civil and military organisations - Compliance with ATM/CNS requirements of military on-board and ground equipment as appropriate	- establish processes and mechanisms supporting civil-military CNS functional performance so that an equivalent level of performance of the military system against SESAR ATM/CNS requirements can be demonstrated - Transitional arrangements to ensure the accommodation of legacy military systems
Predictability and Efficiency	Transparent and collaborative planning of military AU requests	Allocation and execution of the requested mission trajectories in line with mission objectives
Safety	Promote the safety of air navigation throughout the military community in line with international standards	Support a required safety level of military operations
Security	Contribution to the resilience of the ATM system	- Continuous collaborative support and seamless flow of information supporting aviation security, national security, defence and law enforcement' - The ATM system, including ATM data and information systems, is resilient against acts of unlawful interference, including cyber threats
civil Military Cooperation and Coordination	Contribution to the optimization of Trajectory Management and Airspace Management in all relevant Key Performance Areas	Accommodate military operational and training needs based on the operational and effectiveness requirements expressed by the military Airspace User

Table 11: Civil-military performance contribution to the SESAR Ambitions and military expectations across the SESAR2020 KPAs.

3.9.3 State aircraft compliance with SESAR ATM/CNS requirements

The recognition of available military capabilities, ground and airborne, and their re-utilisation or adaptation to support ATM functions can drastically reduce retrofit costs and technical impacts.

A “Policy Guidance for the Exemption of State Aircraft from Compliance with Specific Aircraft ATM/CNS Equipage Requirements” was defined at EUROCONTROL in 2003 on the basis of a number of principles that are still to a large extent valid. This policy states that State aircraft conduct a justified and legitimate activity. It recognises that for technical or operational reasons, compliance with specific equipage requirements is not always possible or, indeed, warranted. In particular, it is recognised that combat military aircraft are essentially weapons platforms, and that equipage priorities must therefore be decided accordingly. It stresses that the need for an exemption for State aircraft should be based on compelling technical or military imperative reasons and only used as a last resort.

The new ATM system should:

- Establish processes and mechanisms supporting civil military CNS functional performance so that the equivalent level of performance of the military system against SESAR ATM/CNS requirements can be demonstrated.
- Promote technology convergence among civil and military systems.
- Facilitate the rationalisation of ATM/CNS infrastructure on the basis of synergies between civil and military organisations.
- Facilitate transitional arrangements to ensure the accommodation of legacy military systems.

Metrics could be developed to measure progress against the need to:

- Facilitate the operational and technical interoperability among civil and military systems;
- Reduce the number of exemptions and derogations for state aircraft operating GAT.

3.9.4 Benefits and costs for Military

The military airspace user costs take the civil 'per unit' costs and the military fleet (large aircraft, light trainers, fighters) into account. While it is difficult to calculate military ground investment costs, it is possible to assume that they will be decreased by system integration with civil ANSPs at national or regional level. However, the costs for eventually upgrading military ATM systems, multinational air command and control systems and national air defence systems to SESAR requirements is assumed to be similar to the cost of upgrading a civil ATM system.

Military benefits are not monetised within the Cost Benefit Analysis, but benefits can be expected if the following high-level military operational and system needs are met:

- Unrestricted access to airspace aimed at safeguarding the integrity of national airspace and the provision of support to civil authorities in connection with national security
- Unconstrained training to ensure the readiness of military forces (as well as police and customs) to perform the activities required and to test systems or operational concepts
- Accessibility to civil and military aerodromes
- Accessibility to common ATM information, data repositories and networks
- Light- and cost-efficient transit to operating and training areas
- Ensuring that national airspace is accessible for national and international forces including cross-border operations and access to cross border ATM resources
- Infrastructure sharing and rationalisation;
- Processes and mechanisms supporting performance-based certification so that an equivalent level of performance of the military system against SESAR ATM/CNS requirements can be achieved.

Military stakeholders can expect to see benefits related to capacity, cost efficiency, operational efficiency, flexibility, access and equity, interoperability and (national) security.

3.9.5 Civil-military indicators and metrics

Within SESAR 2020 Performance Framework, CMCC is considered as a key performance area for which there are no KPIs defined because there are no performance targets set for the military engagement in SES/SESAR

It is important to note that CMC PIs should also be addressed, where suitable, within other KPAs where significant impact of/on military operations and training is identified.

Details on CMC metrics are provided in section A.9.

4 Next Steps

The current approach to some of the KPAs described in the present document is not completely satisfactory and presents some caveats that need to be addressed in Wave 2:

- In the latest edition of the ATM Master Plan **¡Error! No se encuentra el origen de la referencia.**, the focus is on predictability of flight arrivals in accordance with commonly agreed reference business trajectories (RBT) prior to push-back, instead of on arrival punctuality or delay with respect to scheduled time of arrival. The definition or inclusion of additional indicators in this area needs still to be encompassed. In addition, the future approach should also reflect the benefits in terms of predictability derived from the improvements in network planning processes.
- The predictability indicators (distribution of differences between actual and flight plans/RBT durations) need to be revisited and its relationship with the difference between horizontal en-route flight efficiency based on actual and planned trajectory explored.
- The list of performance indicators in Flexibility and Resilience areas might be enlarged to reflect the relevance of them in departure delay.
- Flexibility and AU cost-efficiency indicators need further development as well as their interaction with Predictability aspects.
- The research on generic (non geographical) controllers validations requires the definition of new metrics (e.g. # of hours/period (typically 6 months) required for an ATCO to maintain endorsement for a sector) to capture the benefits that this solution may bring. This flexibility in rostering might provide benefits in terms of cost-efficiency and in particular in ATCO productivity but the definition of new metrics and how to translate them into productivity should be further investigated.
- The optimisation of network utilisation and the increase of airspace throughput may lead to an improvement of fuel efficiency. It should be further investigate the relationship between these KPAs and how to translate the increase in Capacity into a reduction of fuel consumption.
- Airport Operator costs Focus Area with their contributing factors (direct and indirect operating costs as wells as depreciation costs from investments) need to be developed.

5 References

5.1 International Organisations (EXTERNAL SESAR)

- [EXT1] European Commission, “Single European Sky Performance Scheme (RP2) Commission Implementing Decision 2014/132,” 2014
- [EXT2] European Commission, “Single European Sky Performance Scheme (RP3) Commission Implementing Regulation (EU) 2019/317,” 2019
- [EXT3] International Civil Aviation Organization, “Doc 9854 Global Air Traffic Management Operational Concept,” *ICAO TECHNICAL PUBLICATIONS The*, no. First Edition. 2005.
- [EXT4] International Civil Aviation Organisation, *Doc 9883 Manual on Global Performance of the Air Navigation System*. 2009.
- [EXT5] International Civil Aviation Organisation, “Doc 9889 Airport Air Quality Manual,” 2011
- [EXT6] International Civil Aviation Organisation, “Annex 17 Security – Safeguarding International Civil Aviation Against Acts of Unlawful Interference (10th Edition),” 2017
- [EXT7] EUROCONTROL/FAA, “Human Factors in ATM Safety, A White Paper,” 2010
- [EXT8] European Organisation for the Safety of Air Navigation (EUROCONTROL), “LINK2000+: Fast Time Simulation to assess the Impact of Data Link on Sector Capacity,” 1999
- [EXT9] European Organisation for the Safety of Air Navigation (EUROCONTROL), “Accident Incident Model - AIM Release 2017,” 2017
- [EXT10] European Organisation for the Safety of Air Navigation (EUROCONTROL), “Standard Inputs for EUROCONTROL Cost-Benefit Analysis, Edition 8,” 2018
- [EXT11] European Organisation for the Safety of Air Navigation (EUROCONTROL), “European Operational Concept Validation Methodology (E-OCVM) - Edition 3.0,” Brussels, 2010.

5.2 SESAR Programme Documents (SESAR)

- [SESAR1] SESAR Joint Undertaking, “Project Handbook (Programme Execution Guidance),” Brussels, 2018
- [SESAR2] SESAR Joint Undertaking, “SESAR Safety Reference Material, Edition 00.04.01,” 2019
- [SESAR3] SESAR Joint Undertaking, “Guidance to Apply the SESAR Safety Reference Material,” Brussels, 2019
- [SESAR4] SESAR Joint Undertaking, “Security Risk Assessment methodology for SESAR2020 (SecRAM 2.0), Edition 02.00.00,” Brussels, 2017
- [SESAR5] SESAR Joint Undertaking “SESAR Solution SPR-INTEROP/OSED Performance Assessment Report (PAR) template, Edition 02.00.02,” Brussels.
- [SESAR6] SESAR Joint Undertaking, “SESAR2020 VALP template, Edition 02.00.02,” 2017

[SESAR7] SESAR Joint Undertaking, “SESAR2020 VALR template, Edition 02.00.01.”

[SESAR8] SESAR Joint Undertaking, “SESAR Solution SPR-INTEROP/OSED template, Edition 02.00.02.”

5.3 SESAR INTERNAL Documents

[INT1] B.04-02, “D106 Transition ConOps SESAR2020,” Brussels, 2016

[INT2] B.05, “D86, Guidance on KPIs & data Collection – Support SESAR2020 Transition,” Brussels

[INT3] C.02, “D110 Updated D02 After MP Campaign – Edition 00.01.01,” 2016

[INT4] C.02 T002, “D2 Performance Plan (pan-European regional and national) for ATM-MP Ed. 3, Edition 01.00.00,” Brussels, 2014

[INT5] PJ16.06.05, “D27 SESAR Human Performance Assessment Process V1 to V3, Edition 00.01.00,” Brussels, 2019

[INT6] PJ16.06.06, “D26 Guidelines for Producing Benefit and Impact Mechanisms,” Brussels, 2016.

[INT7] PJ19 Content Integration, “D4.4 SESAR 2020 Performance Framework (2018),” Brussels, 2018

[INT8] PJ19 Content Integration, “D4.6 Performance Assessment and Gap Analysis Report (2018),” Brussels

[INT9] PJ19 Content Integration, “D4.8 Validation Targets (2019), Edition 01.00.00,” Brussels, 2019

[INT10] PJ19 Content Integration, “D5.7 EATMA Guidance Material V11.0, Edition 01.00.00,” Brussels, 2019

[INT11] PJ19 Content Integration, “D4.0.1 SESAR2020 Common Assumptions, Edition 00.01.00,” 2018.

[INT12] PJ19 Content Integration, “SESAR Operational Concept Document (OCD 2018).”

[INT13] PJ19 Content Integration, “WP04 Methodology for Performance Assessment Results Consolidation 3rd Edition,” Brussels, 2018.

[INT14] PJ20, “Master Plan Companion Document on the Performance Ambitions and Business View European ATM Master Plan 2019 Edition 1.0,” Brussels, 2019

[INT15] PJ20, “WP2.2 Methodology for the Performance Planning and Master Plan Maintenance, Edition 00.00.13,” Brussels, 2017.



Appendix A KPAs in the Performance Framework

In each of the following sections:

KPIs (always associated to a target) are highlighted in red

KPIs are the indicators that have an associated Validation Target. These indicators are the main indicators and are the ones than are consolidated in the assessment.

Mandatory PIs are highlighted in orange

Although mandatory PIs do not have an associated Validation Target, they are important to be measured because they have an associated Performance Ambition or they are useful for CBA purposes.

Non-mandatory PIs are highlighted in pink

Non-mandatory PIs should be considered as secondary metrics, and should always be considered in conjunction with KPIs (which are the main metrics) or mandatory PIs.

A.1 Framework Structure per KPA

Each KPA has a framework structure represented by a high-level diagram. A generic diagram is shown in Figure 12. The structure shown in the generic diagram links to the full scope of the SESAR performance management process (as set out in Section 2) and includes both development / validation aspects and deployment planning.

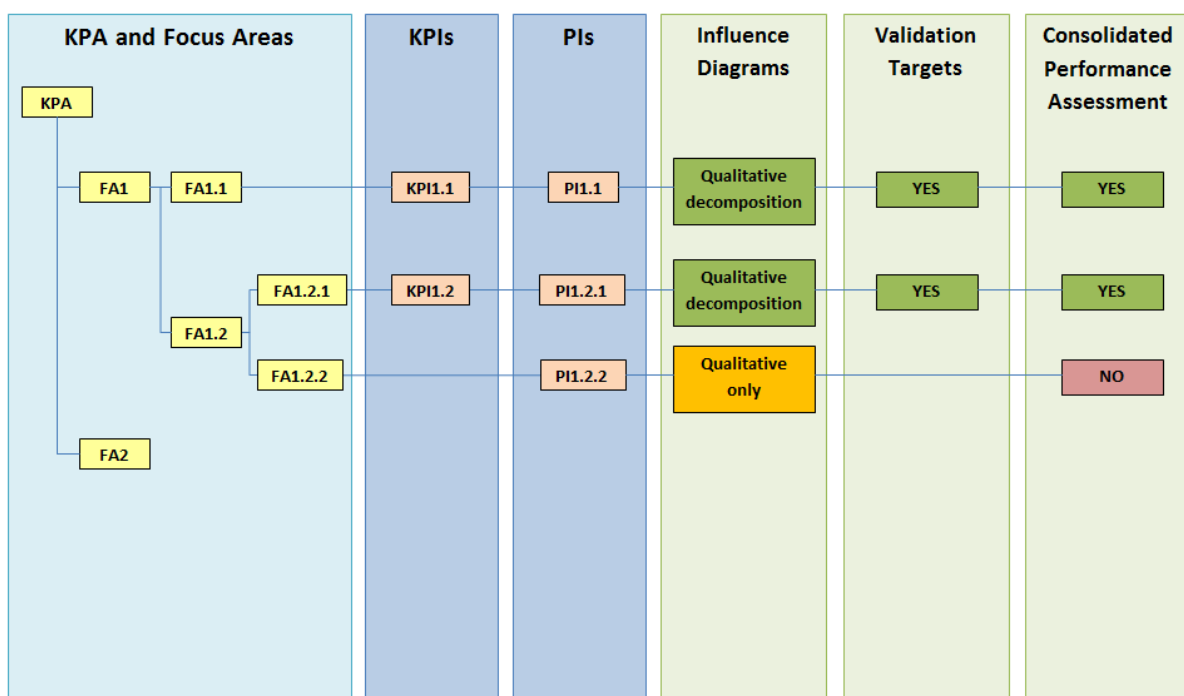


Figure 12: Framework Structure per KPA

The generic framework diagram presents the common structure within which the following programme-wide performance aspects are defined:

- Each **KPA** is shown with its identified **Focus Areas**, which represent sub-areas of the KPA that have been identified as being of particular interest in the SESAR context. Some Focus Areas are broken down into further areas. There may be Focus Areas that are not being addressed directly (i.e. those whose KPIs and PIs have not been developed, etc.). The Focus Areas used to group the KPIs and PIs in later sections are highlighted in bold.
- The **KPIs** are consistent with the ones set in Table 6.
- The mandatory **PIs** are consistent with the ones set in Table 7.
- **Influence factors** are a decomposition of KPIs into the particular characteristics or parameters that determine performance as measured by the KPI in question. They allow a more detailed association of operational changes to the performance expectations and are part of the Validation Target methodology. The influence factors are shown in separate influence diagrams for each performance area. Some are only qualitative at this stage.
- **Validation Targets** indicates those performance areas for which Validation Targets have been allocated.
- **Consolidated Performance Assessment** is the Content Integration activity of aggregating Solution-level performance results into ECAC-level pictures of performance. Where PIs are not mandatory, a consolidated assessment will be made when there is sufficient data to do so. Note that Solution Projects still develop solution-level business cases, safety assessments, security cases and etc.

A.2 SAFETY

The Safety KPA is among the KPAs receiving HLGs and SESAR Performance Ambitions. Safety has two different dimensions: the safety outcome of the ATM system (occurrence of accidents and incidents) on the one hand; and the safety management practices and culture on the other hand. In the context of the SESAR programme and its activities relating to the development of future operating concepts and technology, only the first of these definitions applies.

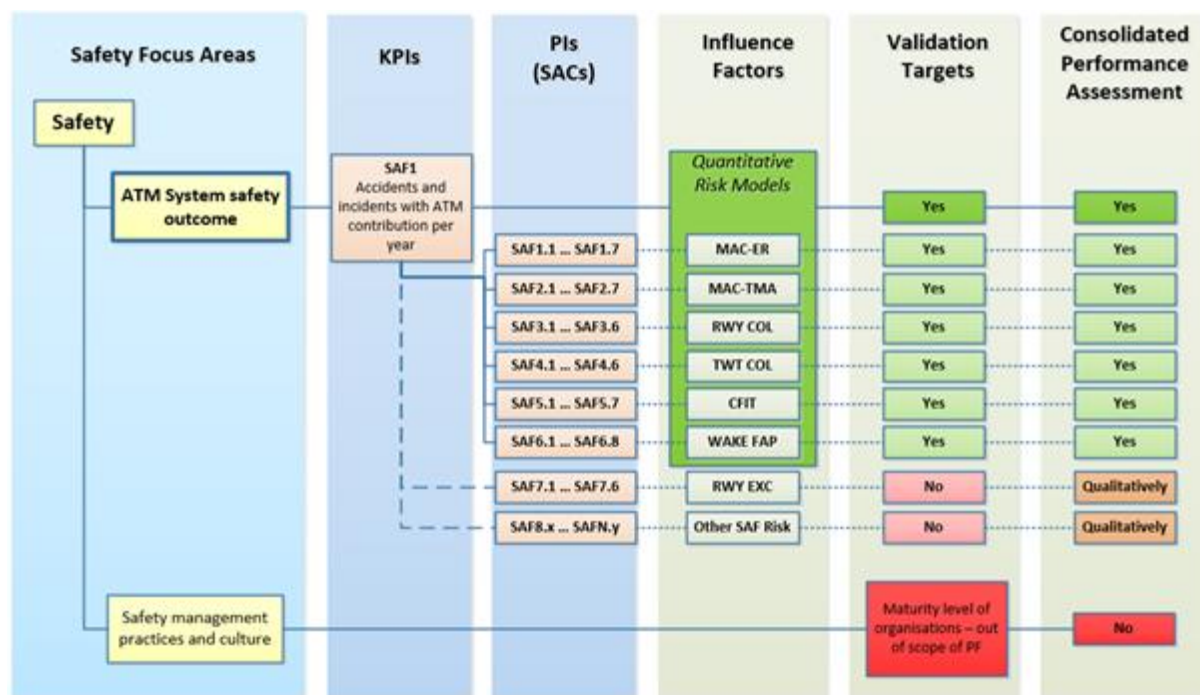


Figure 13: Safety Framework.

The SAF1 KPI is not directly measured through exercises; instead, the SESAR Safety Reference Material - SRM **¡Error! No se encuentra el origen de la referencia.** provides processes to help give assurance that the target can be met. As such, the SAF KPI is not measured then, but calculated¹⁶ using the Accident Incident Model – AIM [EXT9]. SESAR2020 Solutions shall actively collect safety-related data on the precursors of the KPI in terms of the different PIs (Safety Criteria –SAC, as per the SRM) that can be used to assess the trend of safety performance. Specific PI are defined here for the safety risks for which a risk model is available. For other safety risks, each Solution have to define the corresponding PI as relevant.

For each Solution, PJ19 CI WP04.01 provides a Safety Validation Target defined at the level of the SAF KPI and at the level of the corresponding Influence Factors (only for those indicated in Figure 12, having a quantified risk model); from those Targets the corresponding Safety Criteria – SAC are defined at Solution level Note that SACs are also to be defined for other safety risks at Solution level, as relevant,

¹⁶ Note that SAF1 is calculated only based on those AIM risk models that are quantified; they are: MAC-ER, MAC-TMA, RWY COL, TWY COL, CFIT and WAKE FAP.

even if no quantitative Safety Validation Target is provided by PJ19 CI WP04.01 (more detail is available in Guidance D of the SRM **¡Error! No se encuentra el origen de la referencia.**).

The Guidance to Apply the SESAR SRM **¡Error! No se encuentra el origen de la referencia.** provides the safety assurance process allowing deriving, from those SACs, the corresponding Safety Objectives and Safety Requirements at the Solution level. As shown in the figure below, during that process evidences (based on safety-related data) are to be provided, in each step, in order to ensure the satisfaction at the end of the Safety Criteria (corresponding to the PIs).

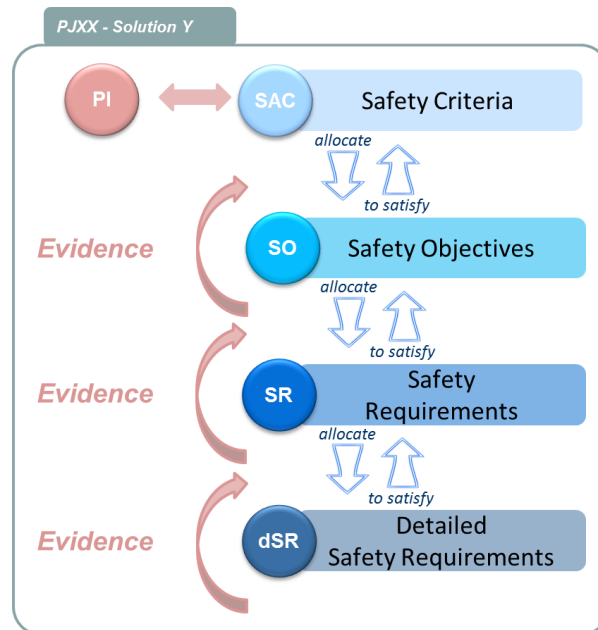


Figure 14: Safety Assurance Process and Safety Performance Indicator

These evidences, or Safety-related data, are to be obtained through the different activities in the Solution.

Solutions should design their exercises to report directly the occurrence of the applicable PIs/SACs or, when that is not possible, the occurrence of the different levels of indicators related to them as shown above (Figure 14). Exercises should be designed to test the different types of risk applicable to the concept through, for example, post-run analysis of hazardous events designed into the exercises. Clearly, rare events are unlikely to occur, and so, the analysis should concentrate on events covered by the more likely PIs (e.g. conflicts rather than imminent collisions). More detail on gaining safety insight in simulations is provided in Guidance M of the SRM **¡Error! No se encuentra el origen de la referencia.**

Other activities performed within the Solution can also provide evidence on the safety performance of the corresponding concept, as for example results from Dynamic Risk Modelling (see more detail in Guidance K of the SRM [SESAR2]).

From the several activities performed in the Solution two types of safety performance evidences are to be collected:

- **Quantitative ones:** related to the measurement of specific a PI during validation exercises. Other tools like fast time simulations and Dynamic Risk Modelling, also provide quantitative evidences, but calculated ones in this case, not measured.

- **Qualitative ones:** related to the application of the safety assurance process by itself (as per the SRM) but also to any qualitative evidence collected from the validation exercises and other assessments performed for the Solution (e.g. Human Performance Assessment, etc.).

The Solutions' team has to complete the safety section of the Performance Assessment Report (PAR) template with all this safety-related data being gathered from:

- the Safety Assessment Report (e.g. from the SAC achievement sections),
- the validation exercises (e.g. Validation Report)
- other assessment in the project (e.g. Human Performance Assessment Report, etc.)

Additionally, and based on these evidences, an estimation of each relevant PI (and thus the satisfaction of the corresponding Safety Criteria (SAC)) is to be done by:

- Setting the assumptions used to obtain the collected evidences (% of high complexity area, traffic density and etc.).
- Comparing them with the assumptions used at ECAC level (the ones used for defining the corresponding Safety Validation Target).
- Extrapolating to the ECAC wide level, taking into account the two sets of assumptions, the SAC satisfaction based on the collected evidence mentioned above.

The information included in the PAR is aggregated within the Content Integration task PJ19.4.2 (Performance Assessment) in order to calculate the corresponding SAF KPI through the use again of the Accident Incident Model.

The following figure shows the relationship between the mentioned Evidences, the PIs, the Influence Factors and the SAF KPI as explained above:

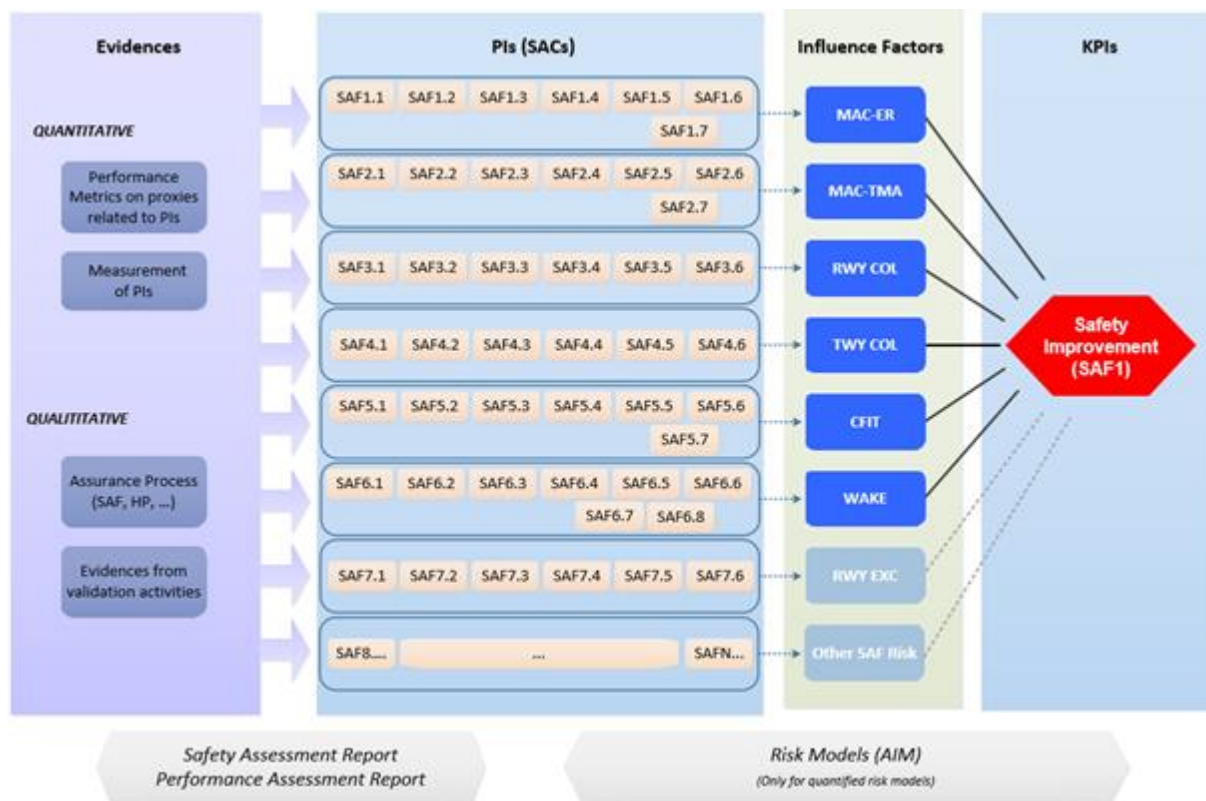


Figure 15 Safety Influence Diagram

SESAR2020 Solutions are requested to provide the following data for each measured KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category¹⁷, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)
- Results of KPIs and PIs in for assessment years (e.g. 2025, 2035)¹⁸ and uncertainty of the measurement

Table 12 below shows the **KPI** and **mandatory PIs** within the SESAR2020 Performance Framework:

[Note that each Solution should only apply the relevant ones depending on the concept they are addressing. For further definition of each type of conflict refer to the Safety Reference Material **¡Error! No se encuentra el origen de la referencia.**, [SESAR3] and the AIM models **¡Error! No se encuentra el origen de la referencia.**].

¹⁷ Category of airport, airspace and etc... according to DOD and PJ20 classification [INT3].

¹⁸ See Appendix B How should Projects Measure the KPIs? Principle 2.

KPIs / PIs	Unit	Calculation	Mandatory
SAF1 Total number of estimated accidents with ATM contribution	Yearly Count of events	Not directly measurable. Determined by Safety practitioners via the Accident Incident Model and validated with the support of the Safety PIs listed below	YES
MID-AIR COLLISION – EN-ROUTE SAF1.1 Mid-Air Collisions SAF1.2 Imminent Collisions SAF1.3 Imminent Infringements SAF1.4 Crew/Aircraft Induced conflicts SAF1.5 Planned conflicts SAF1.6 ATC Induced Tactical conflicts SAF1.7 Pre-Tactical conflicts	% Change in count of events ¹⁹ or Frequency of occurrence per fh	Measured, calculated, or supported by qualitative evidence as relevant	YES (ER)
MID-AIR COLLISION – TMA SAF2. 1 Mid-Air Collisions SAF2.2 Imminent Collisions SAF2.3 Imminent Infringements SAF2.4 Crew/Aircraft Induced conflicts SAF2.5 Planned conflicts SAF2.6 ATC Induced Tactical conflicts SAF2.7 Pre-Tactical conflicts	% Change in count of events or Frequency of occurrence per fh	Measured, calculated, or supported by qualitative evidence as relevant	YES (TMA)
RWY-COLLISION ACCIDENT SAF3.1 Runway Collisions SAF3.2 Imminent Runway Collisions SAF3.3 Runway Conflicts SAF3.4 Runway Incursions SAF3.5 Imminent Runway Incursions SAF3.6 Potential Runway use	% Change in count of events or Frequency of occurrence per flight or movement	Measured, calculated, or supported by qualitative evidence as relevant	YES (APT)

¹⁹ % reduction/increase in the number of <event> per year (or after a certain period) with respect to the year of reference.

KPIs / Pls	Unit	Calculation	Mandatory
TWY-COLLISION ACCIDENT SAF4.1 Taxiway Collisions SAF4.2 Imminent Taxiway Collisions SAF4.3 Imminent Taxiway Infringement SAF4.4 Taxiway Conflicts (planned, induced) SAF4.5 Pre-Tactical Taxiway Conflicts (planned, induced) SAF4.6 Strategic Taxiway Conflicts	% Change in count of events or Frequency of occurrence per flight or movement	Measured, calculated, or supported by qualitative evidence as relevant	YES (APT)
CFIT ACCIDENT SAF5.1 Controlled Flight Into Terrain SAF5.2 Imminent CFIT SAF5.3 Controlled Flight Towards Terrain SAF5.4 Flight Towards Terrain commanded by pilot SAF5.5 Flight Towards Terrain commanded by systems SAF5.6 Flight Towards Terrain commanded by ATC SAF5.7 Flight Towards Terrain commanded by ANS	% Change in count of events or Frequency of occurrence per flight or movement	Measured, calculated, or supported by qualitative evidence as relevant	YES (ER, TMA, APT)
WAKE related ACCIDENT (Final APP) SAF6.1 Wake induced accidents SAF6.2 Wake encounter (moderate, severe, extreme) SAF6.3 Imminent wake encounter under fault-free conditions SAF6.4 Unmanaged under-separation SAF6.5 Unmanaged under-separation induced by ATC through inadequate selection and management of separation mode SAF6.6 Imminent Infringement (during interception, on final approach) SAF6.7 Crew/Aircraft induced spacing conflict during the interception SAF6.8 Crew/Aircraft induced spacing conflict on the final approach path	% Change in count of events or Frequency of occurrence per flight or movement	Measured, calculated, or supported by qualitative evidence as relevant	YES (TMA, APT)

KPIs / PIs	Unit	Calculation	Mandatory
RWY-EXCURSION ACCIDENT (landings) SAF7.1 Runway Excursions SAF7.2 Touchdown outside TDZ SAF7.3 Unstable touchdown (hard, bounce landing) SAF7.4 Approach to a non-suitable runway SAF7.5 Approach to a weather affected runway SAF7.6 Unstable approach	% Change in count of events or Frequency of occurrence per flight or movement	Measured, calculated, or supported by qualitative evidence as relevant	YES (APT)

Table 12 Safety KPIs and PIs

Note: PIs listed in Table 12 are defined based on existing risk models in AIM. For other SAF risks, corresponding PIs are to be defined by each Solution as relevant.

A.2.1 SES Performance Scheme for safety

With respect to the SES Performance Scheme for RP2 **¡Error! No se encuentra el origen de la referencia.**, the list of KPI /PI is not the same as the one presented above for SESAR2020.

Some of them relate more to the Safety management practices and safety culture area mentioned above, which is out of scope of the SESAR2020 Performance Framework. They are listed here after:

- PS1 - Effectiveness of Safety Management (both Regulators and ANSPs).
- PS2- Application of RAT methodology.
- PS3 - Application of Just Culture (JC).
- PS8 - Level of occurrence reporting.
- PS9 - Application of automatic data recording for separation minima infringement monitoring.
- PS10 - Application of automatic data recording for runway incursion monitoring.

These indicators have been modified for SES Performance Scheme RP3 **¡Error! No se encuentra el origen de la referencia.** as follows:

- PS1 - Effectiveness of Safety Management.
- PS4 - Use of automated safety data recording systems by air navigation service providers, when implemented.

The rest of them relate to the “Safety outcome of the ATM system (occurrence of accidents and incidents)” area, and thus they are related to the SAF1 KPI in SESAR2020 as described above. They are listed below:

- PS4 - Separation infringements.
- PS5 - Runway incursions.
- PS6 - ATM-specific occurrences at ATS units.

- PS7 - Airspace infringements.

These four indicators have been also subject to modification for RP3 [EXT2]:

- PS2 - Rate of runway incursions (at Union level/ at airports located in a Member State/ at an airport).
- PS3 - Rate of separation minima infringements (at Union level/ Member State/ airspace).
- PS4 - ATFM over-deliveries above the declared capacity limits where ATFM regulations are imposed.

Note that some of them can directly be related to one or more SESAR2020 PIs from Table 12. In particular, PS3 relates to SAF1.2, SAF1.3 and SAF2.2, SAF2.3 and PS2 relates to SAF3.2, SAF3.3, SAF3.4.

The entire table showing the mapping between the SES Performance Scheme RP3 **¡Error! No se encuentra el origen de la referencia.** and SESAR Performance Framework is shown in section 3.6 (Table 10).

A.3 SECURITY

The SECURITY KPA is among the KPAs receiving Performance Ambitions. According to the ATM Master Plan **¡Error! No se encuentra el origen de la referencia.**, “the ambition implies appropriation of all necessary measures to ensure security that is taken into account in the design of each system development lifecycle and that a holistic approach is used to assess risks”.

Security, in general terms, refers to any measure that protects something of value (an asset) at risk from a broad range of threats such as crime, espionage, sabotage and other attack. These threats exploit system weaknesses (vulnerabilities) and may lead to a security incident that impacts the ATM System (by degrading other KPA).

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 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 threat effects on the overall ATM Network. ATM Security is a subset of Aviation Security (as defined by ICAO in Annex 17 **¡Error! No se encuentra el origen de la referencia.**).

ATM Security is concerned with limiting the effects of unlawful interference (i.e. deliberate acts) on the ATM network and providing outside agencies with support during an incident. ICAO is currently reviewing the definition of security and may, in the future, include unintentional acts.

The performance of the future ATM System must contribute to ensuring that a high level of security is achieved by the aviation industry as a whole. Expectations are that this can be achieved not only by ensuring that the infrastructure which makes up the ATM System is itself resilient to attack, but that the System will provide information which can be used by other organisations who can also act to protect air transport and aviation as a whole.

Three types of Security Performance Indicator (PIs) may be defined, namely:

1. Implementation Measures are used to demonstrate progress in implementing security programs, carrying out periodic security risk assessments, implementing appropriate security controls, and associated security policies and procedures. Implementation measures assess the ‘maturity level’ of processes, procedures and security control implementation in an organisation. As the security culture of the organisation grows, monitoring of implementation measures becomes less relevant.

For SESAR2020, certain Solutions are mandated to perform prescribed security risk assessment activities, specified in SecRAM 2.0 documentation **¡Error! No se encuentra el origen de la referencia.**. In such cases, these measures are applied to indicate that the appropriate work has been carried out. For example, has a security risk assessment been performed? Have recommendations been made regarding risk treatment options? Have risks to Supporting Assets been appropriately reduced as a result of risk treatment?

2. Effectiveness Measures are used to monitor if program/organisation level security processes and system level security controls are implemented correctly and effectively, operating as intended and meeting the desired outcome. Such measures can only be developed for Solutions at higher TRL levels, for example, where a detailed design is available which could be used in simulations, or where a prototype has been developed. One important Effective Measure addresses the issue of Supply Chain Security, and seeks to ensure that procured or developed system hardware or software components are free from, for example, pre-installed

malware, or counterfeit components. The results of a Security Risk Assessment may reveal that system resilience may be improved by hardening the software and/or hardware of certain supporting assets.

3. Impact Area Measures are used to articulate the impact of information security on the organisation/programme mission. These measures are inherently unique to an organization, and may encompass security impacts on business and economics goals, reputation, and other key performance areas (KPAs). An attack on Air Traffic Management could result in a number of consequences, resulting in an undesirable impact in one or more areas:
 - a. Personnel
 - b. Capacity
 - c. Economic
 - d. Performance
 - e. Branding
 - f. Regulatory
 - g. Environment

The figure below shows the Framework for the Security KPA.

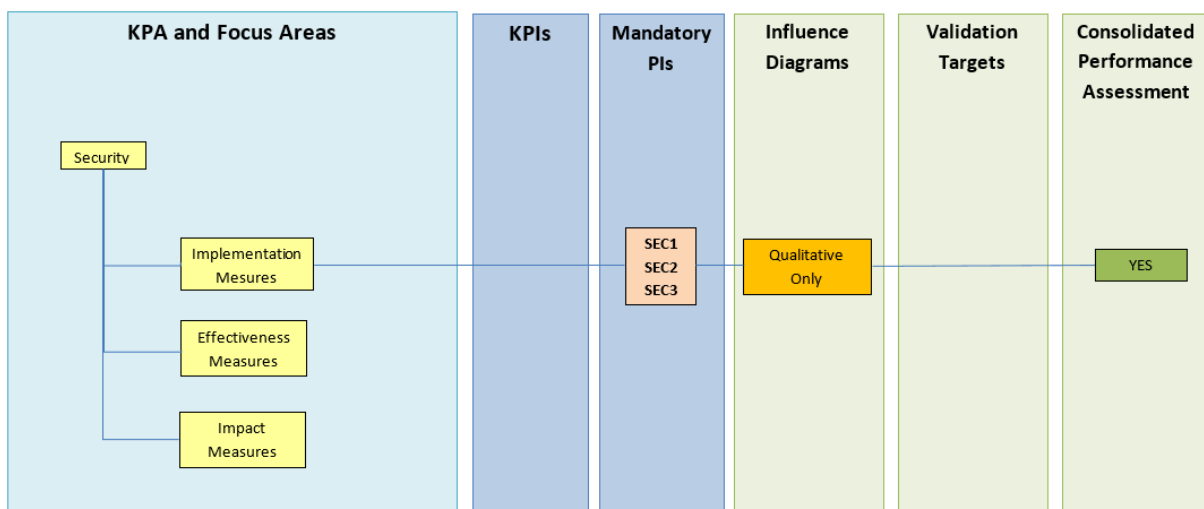


Figure 16: Security Framework

One of the difficulties in defining and assessing security performance is that security risk is an abstract concept until it has been manifested by a successful attack. Whilst security measures may not be seen as adding explicit value to operations, it may be argued that they do so implicitly; through increased availability, integrity and confidentiality over a system's lifetime. If we imagine the consequences of a successful attack, we may find that:

- a loss of availability will lead to a direct loss of operation;
- a loss of integrity could reduce confidence in flight-critical information and lead to a managed reduction in availability - this would have both an immediate and long term impact;

- a loss of confidentiality could undermine information sharing, the essential principle of collaborative decision making - this would also have an immediate and long term impact.

Security impacts may also have combined effects, such as:

- A successful attack signals vulnerability in the whole system, leading to a loss of trust by stakeholders and potentially precipitating further attacks. A deliberate attack can therefore have a more severe and lasting impact on operations than an accidental occurrence. (Conversely, a repelled attack may have the opposite effect, but not of the same order of magnitude.)
- Contemporaneous multiple attacks to different parts of the system.

A security attack on ATM could result in a number of consequences related to other SESAR KPAs, such as Safety, Capacity, or Efficiency. It is the responsibility of security management to reduce the impact of the attack by the implementation of a set of controls, which either reduce the likelihood of the attack, or limit the resulting impact if the attack is successful.

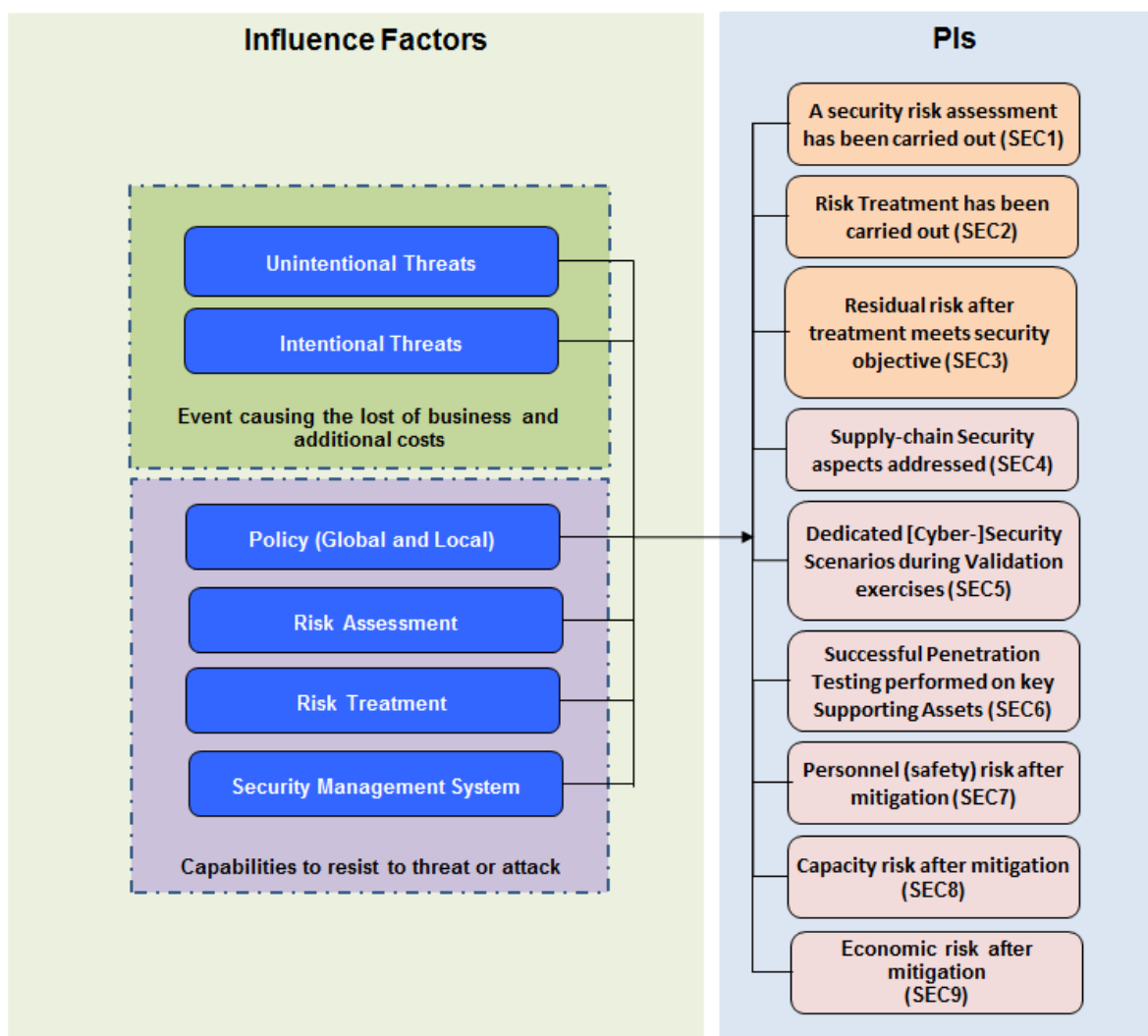


Figure 17: Security Influence Diagram.

Table 13 below shows the mandatory and non-mandatory [Cyber-]Security performance indicators (PIs), related to the afore-mentioned three areas have been identified and are described in the following table. The SESAR2020 SecRAM 2.0 **¡Error! No se encuentra el origen de la referencia.**, in conjunction with the prioritization process developed for Cyber-Security described in the SESAR2020 Cyber-Security Strategy, identify which security activities should be performed by a SESAR2020 Solution. Whenever the performance of these security activities permits the development of a PI, it should be computed.

PIs	Unit	Calculation	Mandatory
SEC 1 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 ¡Error! No se encuentra el origen de la referencia. , 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)
SEC 2 Risk Treatment has been carried out	Binary Vector – 2 components with Y/N	Following SecRAM 2.0 ¡Error! No se encuentra el origen de la referencia. , Security controls have been identified by Security Experts and implemented in the Solution.	YES (identification mandatory for prioritised Solutions at V2 and V3 , implementation at higher maturity levels – V4)
SEC 3 Residual risk after treatment meets security objective.	Risk Level – 2 levels are possible: medium or low	After Security Controls have been implemented, the Risk Level achieved per Supporting Asset decreases ($H \rightarrow M$, $M \rightarrow L$ and $H \rightarrow L$). It is important to notice that according to SecRAM the Risk Level achieved should be “Low” otherwise justifications must be provided.	YES (assessment of the risk level is mandatory for prioritised Solutions at V2 and V3 , implementation at higher maturity levels – V4)

PIs	Unit	Calculation	Mandatory
SEC 4 Supply-chain Security aspects addressed	Binary Value – Yes/No	This would be based on the analysis of documented supply-chain security activities by an independent expert. General Guidelines and checklist to support these activities are provided.	NO
SEC 5 Dedicated [Cyber-]Security Scenarios during Validation exercises	Binary Vector – with 2 components having 3 levels each ([L-M -H], [L - M - H]) for [Coverage and completeness] and [Quality of the Scenarios]	Dedicated [Cyber-]Security Scenarios have been defined in the VALP (optional), they have been used during Validation exercises (e.g., real time simulations, serious game sessions, envisioning sessions and etc.), analysed by experts and reported in the VALR (optional). The coverage and completeness, and the quality of the scenarios are addressed based on expert judgement	NO
SEC 6 Successful Penetration Testing performed on key Supporting Assets	Percentage – %	The number of failed (blocked or prevented) penetration testing attacks relative to the total number of attacks carried out.	NO
SEC 7 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) ¡Error! No se encuentra el origen de la referencia.. 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
SEC 8 Capacity risk after mitigation	Risk – 3 levels are possible: high, medium or low	Qualitative assessments are derived from application of SecRAM 2.0 ¡Error! No se encuentra el origen de la referencia.. 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

PIs	Unit	Calculation	Mandatory
SEC 9 Economic risk after mitigation	Risk – 3 levels are possible: high, medium or low	Qualitative assessments are derived from application of SecRAM 2 ¡Error! No se encuentra el origen de la referencia. 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.

Table 13 Security PIs.

A.4 ENVIRONMENT

The Environmental KPA is one of the KPAs receiving HLGs and SESAR Performance Ambitions, and is considered a priority area by the SES Performance Scheme. This KPA is assessed through three Focus Areas, fuel efficiency, noise and local air quality that are further elaborated below.

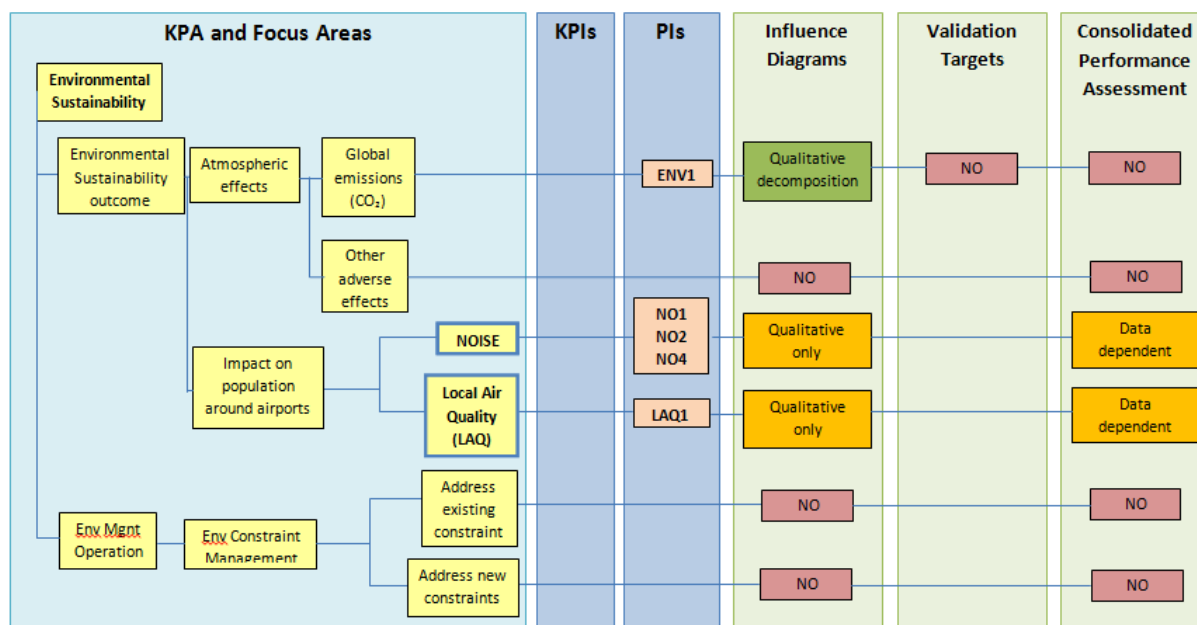


Figure 18: Environment Framework.

A.4.1 Emissions Focus Area

Fuel efficiency is a precursor to the reduction of exhaust emissions resulting from the combustion of jet fuel from flight movements in all phases of flight. Therefore, variation in fuel burnt is a good indicator for evaluating the contribution of aviation to global and local emissions. A good example of this is the direct link between fuel burnt and the amount of CO₂ produced (≈ 3.15 times the mass of fuel burnt); CO₂ emissions are a major contributor to anthropogenic climate change and therefore their reduction, through improved fuel efficiency, is key to reducing the impact of aviation on the environment.

SESAR2020 Solutions are requested to provide the following data for each measured mandatory PI including:

- Location name measured by the exercise, category²⁰, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.

²⁰ Category of airport, airspace and etc... according to DOD and PJ20 classification **Error! No se encuentra el origen de la referencia..**

- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)²¹
- Results of the KPIs and PIs listed in table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 14 below shows the mandatory PI associated with CO₂ emissions:

KPIs / PIs	Unit	Calculation	Mandatory
ENV1 Actual Average CO ₂ Emission per flight	Kg CO ₂ per flight	Amount of fuel burnt x 3.15 (CO ₂ emission index) divided by the number of flights	YES

Table 14: Environment/Emissions KPIs/PIs

A.4.2 Noise Focus Area

Noise is defined as an unwanted sound. Noise impact represents the adverse effect(s) of noise on its recipients (in this case, people living around airports). The noise focus area only covers the aircraft noise source; other noise sources around the airport contributing to the background noise are not considered. This KPA focuses on the quantification of the number of people exposed to aircraft noise, using different types of metric, capturing different aspects of noise impact such as the notion of noise exposure (noise energy perceived on the ground), peaks in noise levels (maximum noise level perceived on the ground), and the frequency of “noisy” events (number of flights/operations exceeding a given noise level threshold during a certain time period).

²¹ See Appendix B How should Projects Measure the KPIs? Principle 2.

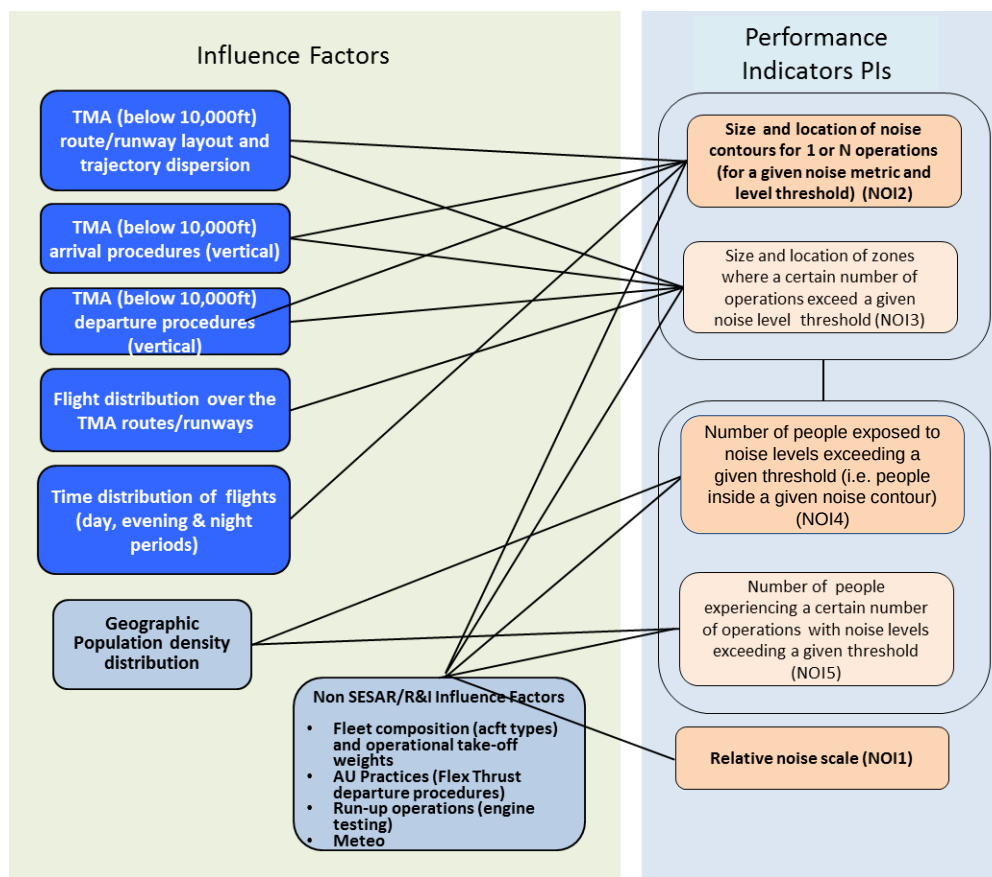


Figure 19: Noise Influence Diagram.

SESAR2020 Solutions are requested to provide the following data for each measured mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category²², OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)²³
- Results of the PIs listed in table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 15 below shows the mandatory and non-mandatory PIs.

²² Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia.**

²³ See Appendix B How should Projects Measure the KPIs? Principle 2.

PIs	Unit	Calculation	Mandatory
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
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(Km2)	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
(NOI3) Size and location of zones where a certain number of operations exceed a given noise level threshold	Contours of number of operations exceeding a certain noise threshold (e.g. NA70 see ERM document for the list of recommended PIs). Surface of these contours(Km2)	NAX 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.	NO In case NOI2 would already show differences between the reference and solution scenarios. Otherwise becomes mandatory
(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

PIs	Unit	Calculation	Mandatory
(NOI5) Number of people experiencing a certain number of operations with noise levels exceeding a given threshold	Number of people inside the NAX 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.	NO In case NOI4 would already show differences between the reference and solution scenarios. Otherwise becomes mandatory

Table 15: Noise PIs.

A.4.3 Local Air Quality Focus Area

Airport local air quality is a commonly used term to designate the condition of the ambient air to which humans and nature are typically exposed in the vicinity of an airport. In most cases, determining the quality of the air around an airport is based on an estimation of the concentration of pollutants. These concentrations are compared with regulations and standards that are established to define acceptable levels of local air quality, including the necessary measures to achieve them. Many issues particular to the local air quality in and around airports are subject to these same regulations. Normally, airport environments comprise a complex mix of emission sources including aircraft, ground support equipment, terminal buildings and ground vehicular traffic (see ICAO Doc 9889). In the context of SESAR, in most cases only exhaust emissions resulting from jet-fuel consumption can be estimated and only these are considered therefore.

The logical PI for Local Air Quality should normally be the geographic distribution of pollutant concentrations around the airport. This is a complex assessment, which requires modelling the dispersion of pollutants and accounting for the typical airport emission sources when developing emissions inventories. The airport emissions sources include both aircraft (SESAR) and non-aircraft sources (outside SESAR), classified according to the four groups summarised below:

Aircraft	Ground Equipment	Infrastructure	Access traffic-parking
a) Aircraft main engines	a) Ground Power Units (GPU)	a) Power plants	a) Access traffic for passengers, workers, freight
b) APU	b) Ground Support Equipment (GSE)	b) Kerosene storage and distribution	b) Car park emissions
c) Brakes and tyres	c) Airside vehicles (service vehicles, passenger buses)	c) Fire training	
	d) Aircraft de-icing	d) Surface snow removal, de-icing	
		e) Aircraft & vehicle maintenance	
		f) Airport building construction, maintenance and cleaning	

Table 16: Airport emissions sources

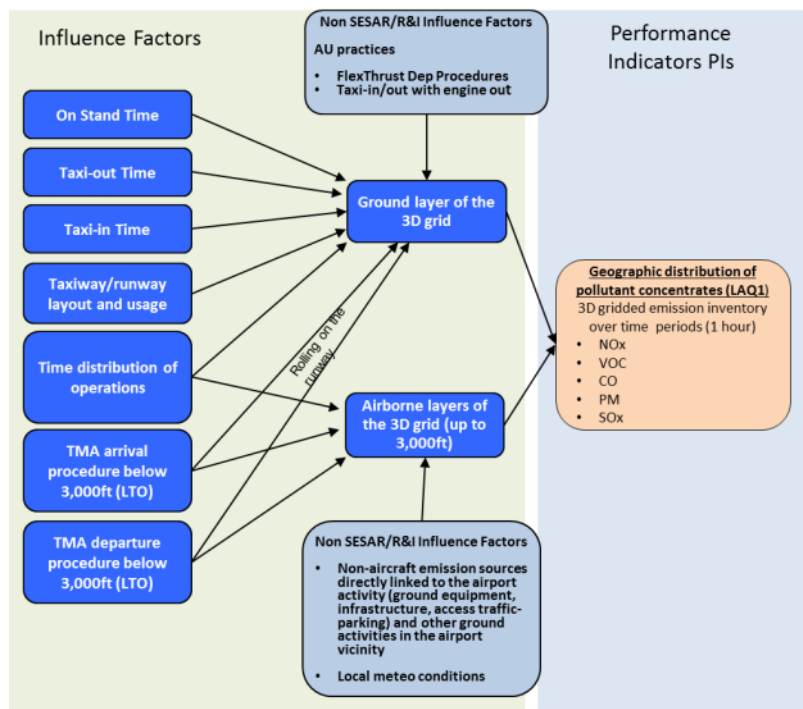


Figure 20: Local Air Quality Influence Diagram.

SESAR2020 Solutions are requested to provide the following data for each measured mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category²⁴, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)²⁵
- Results of the PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

²⁴ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

²⁵ See Appendix B How should Projects Measure the KPIs? Principle 2.

Table 17 below shows the mandatory PIs:

PIs	Unit	Calculation	Mandatory
LAQ1 Geographic distribution of pollutant concentrations	Airport Local Air Quality Studies (ALAQs) inventory method generally uses mg/m ³ for each pollutant	Measurement to be performed within LTO cycle. • NO_x: Mono nitrogen oxides, including nitrogen dioxide (NO₂) and nitric oxide (NO); • VOC: Volatile organic compounds (including non-methane hydrocarbons (NMHC)); • CO: Carbon monoxide; • PM: Particulate matter (fraction size PM_{2.5} and PM₁₀); • SO_x: Sulphur oxides. • Recommended tools: Open-ALAQs	YES for Airport OE Solutions relative to LTO (=>below 3000ft)

Table 17: Local Air Quality PIs

A.4.4 SES Performance Scheme for Environment

The following table identifies the environment metrics used in the SES performance scheme **¡Error! No se encuentra el origen de la referencia..**

KPI/PI	Target Set Since	Monitored Since
En-route Flight Efficiency		
KEP (Average Horizontal en route flight efficiency of last filed flight plan)	RP1	
KEA (Average Horizontal en route flight efficiency of actual trajectory)	RP2	
Average Horizontal en route flight efficiency of the shortest constrained trajectory		RP3
Terminal and Airport Flight Efficiency		
Additional time taxi-out phase		RP2
Additional time in terminal airspace		RP2
Share of arrivals applying Continuous Descent Operation (CDO)		RP3
Civil-Military Airspace Efficiency		
Effective use of reserved or segregated airspace		RP3
Rate of planning via available airspace structures, including reserved or segregated airspace and conditional routes, for general air traffic		RP3
Rate of using available airspace structures, including reserved or segregated airspace, conditional routes, by general air traffic		RP3

Table 18: SES Performance Scheme Environment Metrics.

SES Performance Scheme targets are set on the basis of flight efficiency (this is being measured in terms of both planned (KEP) and actual (KEA) en-route horizontal additional distance) as this is a major contributor to fuel efficiency that is most practically measured and can be more easily correlate to ANS provision.

The reality of course is that KEA and KEP are not as effective as genuine 3D flight efficiency measures; and consultations on the selection of RP2 KPIs suggested the need to move to a wide metric – such as those used in SESAR.

The PF measures expected improvements in fuel efficiency, taking into account the efficiency of aerodrome operations (on the airport surface) as well as both the horizontal and vertical efficiency of flight profiles because the Performance Ambition is to improve overall fuel efficiency. The influence factors used to build up FEEF1 are similar to the SES Performance Scheme metrics.

The key for SESAR is the deployment of Solutions that support the full 10% improvement sought by the HLGs while focussing on gate-to-gate flight efficiency and fuel burnt. This aim is captured with the SESAR Performance Ambition.

In addition to Flight Efficiency, the SES Performance Scheme also targets the effective use of Special Use Airspace by monitoring the effectiveness of Flexible Use of Airspace (FUA) and Conditional Routes (CDRs). The SESAR Civil-Military Focus Area (A.9) includes similar PIs:

- CMC1.7 ARES used duration vs. ARES allocated duration.
- CMC2.2 the percentage of GAT flights planning to use ARES vs. GAT flights for which ARES is available.

A.5 CAPACITY

The CAPACITY KPA is among the KPAs receiving HLGs and is considered a priority area by SES Performance Scheme. The overall capacity framework splits into subsidiary Focus Areas related to Airspace Capacity, Airport Capacity, ARES airspace and Resilience.

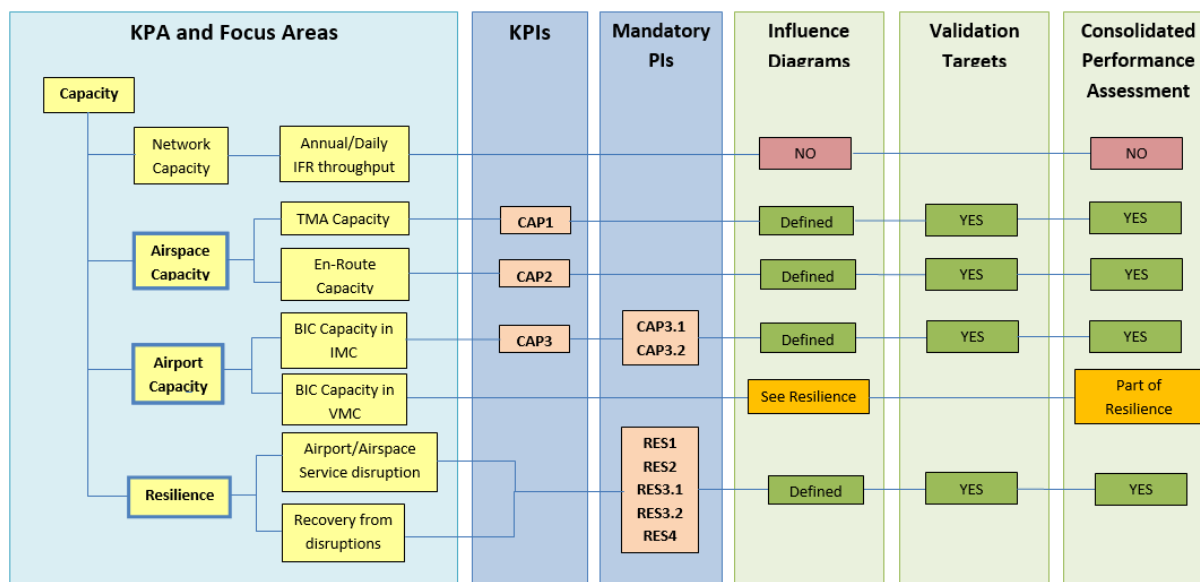


Figure 21: Capacity Framework.

A.5.1 Airspace Capacity Focus Area

Airspace capacity, in the context of the SESAR PF, focuses on the capability of a challenging volume of airspace to handle an increasing number of movements per unit time²⁶ – through changes to the operational concept and technology. The aggregation is at local level.

In the context of developing a strategic capability to handle a greater throughput (i.e. increasing “capacity”) without impacting negatively other performance areas (higher cost from more staff, lower fuel efficiency from airspace rigidity) it is appropriate to target and measure the impact of operational and technological changes on the potential to handle a higher throughput. According to the Master Plan **¡Error! No se encuentra el origen de la referencia.,** these changes include:

- performance-based CNS;
- optimised ATC sectorisation including cross-border sectorisation coupled with flexible rostering and network and local complexity management;

²⁶ For validation target setting it has thus far not been considered appropriate to define “volume of airspace” more specifically, e.g. ACC, Sector groups, single sector and etc. Different volumes are relevant to different concept component under evaluation (e.g. NOP may use ACCs and Conflict Detection tool may use sector and etc.) and the key is that the baseline (reference) volume is the same as the “hypothesis” volume. It is key however, to think of the KPI, targets and assessment as applying to “challenging” airspace, i.e. airspace where the current operating concept and technology is close to the limit of throughput (number of movements per hour) that can be sustainably handled (typically VHC, HC and MC under period of high traffic demand).

- enhanced conflict resolution management supported by high-accuracy information for advanced automation;
- Extended AMAN and multiple airport AMAN;
- and either a more or an enhanced and progressively dynamic demand-capacity balancing approach.

In terms of Deployment Planning, Capacity Performance Needs have been defined by C.02 T002 **¡Error! No se encuentra el origen de la referencia.** and are also based on Throughput per unit time (hour) – in line with Validation targets.

Airspace capacity is considered separately for TMA (Terminal Manoeuvring Area) and en-route airspace.

The influence diagram for Airspace Capacity KPA, shown in Figure 22, considers the TMA and en-route airspace environments essentially as separate environments for the purposes of allocating Validation Targets.

Non-SESAR factors are shown only once. For simplicity, they are considered to relate equally to the domains (though, again, in theory separate judgements could be made).

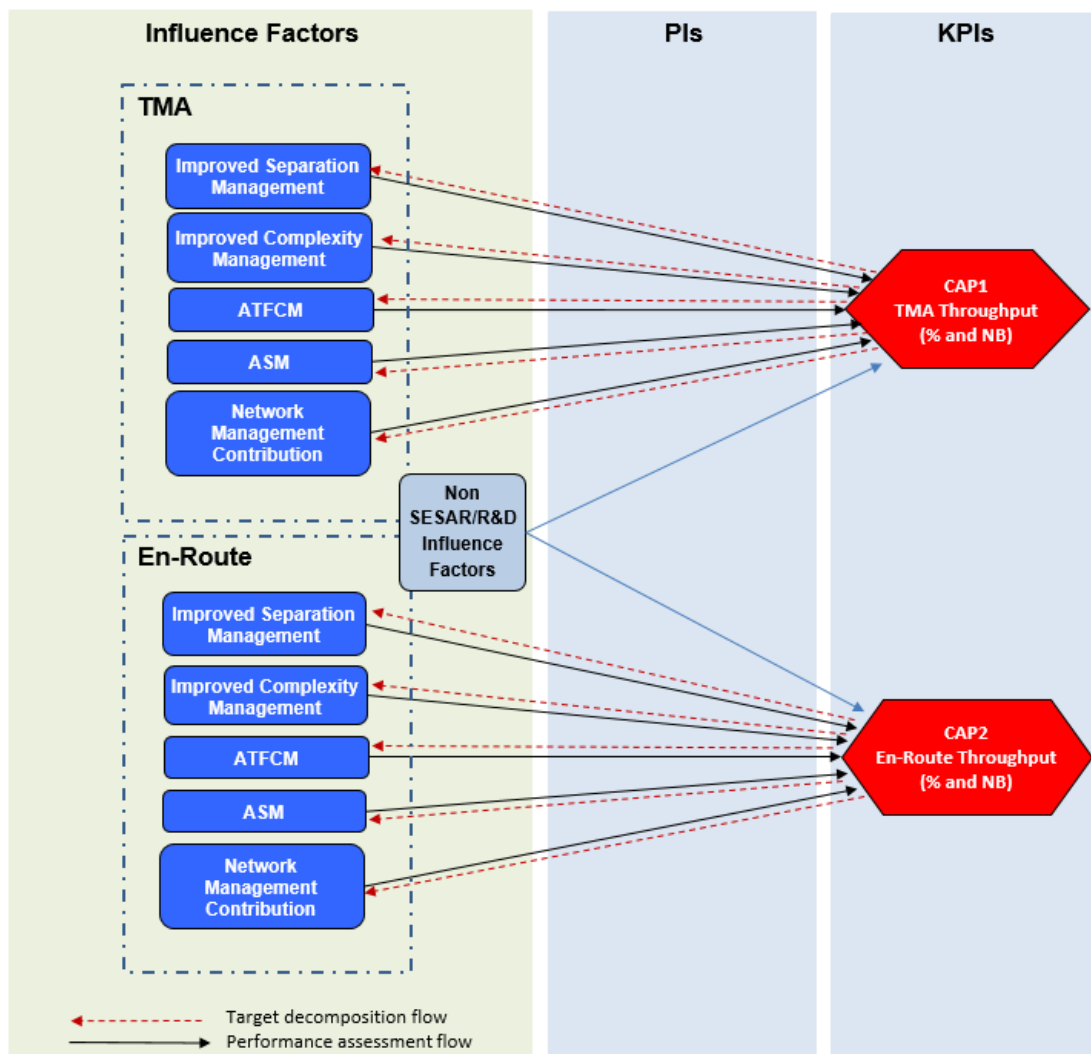


Figure 22: Airspace Capacity Influence Diagram.

SESAR2020 Solutions are requested to provide the following data for each measured KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category²⁷, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035).
- Results of KPIs and PIs in for assessment years (e.g. 2025, 2035)²⁸ and uncertainty of the measurement

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 19 shows the **KPIs** and mandatory PIs.

KPIs	Unit	Calculation	Mandatory
CAP1 TMA throughput, in challenging airspace, per unit time	Relative change of movements (% and number of movement)	% and also total number of movements per volume of TMA airspace per hour for specific traffic mix and density (Very High, High and Medium Complexity TMAs) at peak demand hours.	YES
CAP2 En-route throughput, in challenging airspace, per unit time	Relative change of movements (% and number of movement)	% and also total number of movements, per volume of En-Route airspace per hour for specific traffic mix and density (Very High, High and Medium Complexity) at peak demand hours.	YES

Table 19: Airspace Capacity KPIs

Exercises may measure the change in ATCO workload rather than directly measuring increases in traffic movements. In this case, the project shall apply the following formula to calculate a corresponding potential capacity change²⁹ [EXT8]:

$$\text{Increase in en-route Airspace and TMA}^{30} \text{ capacity (\%)} = (1 / (1 - \text{workload reduction}/2) - 1) \times 100$$

²⁷ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia.**

²⁸ See Appendix B How should Projects Measure the KPIs? Principle 2.

²⁹ Formula previously used in the Link 2000+ work of EUROCONTROL and in the SESAR definition phase

³⁰ Only En-Route airspace and Part of the TMA this is not applicable for APP and TWR CWP

Note that the KPI is an expression of the impact of capacity in already constrained airspace. Consequently, the KPI is unlikely to be impacted if there is already a capacity opportunity in the case for example of medium or low complexity/constrained airspace. Where such claims are made they should be carefully explained. For example, the capacity increase in medium complexity airspace could be explained with reference to peak conditions for a period of the day.

A.5.2 Airport Capacity Focus Area

Airport Capacity, in the context of SESAR2020 Performance Framework, focuses on the most challenging (or constrained) environments, i.e. similar to the approach adopted for Airspace Capacity. For Airport Capacity this means targeting on the basis of busy hours at certain reference airports, i.e. the capacity at “maximum observed throughput” airport per the Sub OE (or even sub OE).

The figure below shows the influences on the Airport Capacity KPA.

The main influencing factors (sources of capacity gain) relate to separation, sequencing, runway occupancy time and buffers applied for departure and arrival traffic respectively. They relate mainly to the use of the runway, which is only one of several sub-systems at an airport (the others being taxiways, platforms and terminal buildings). For the purposes of the SESAR Performance Framework, it is assumed that it is the runway sub-system (and to a lesser extent the taxiways) which is the main object for improvement, i.e. runway throughput is seen as the key bottleneck for the operational concept / technology to solve. However, in assessing actual impact on declared capacity of a potential operational change at an individual airport level, all sub-systems need to be considered.

The KPI CAP3 is defined for mixed mode RWY operations airports but additional PIs have been defined for other specific airport configurations. These indicators are influenced by the traffic mix³¹ of traffic types at the given airport.

³¹ The traffic mix is defined for a given period (peak hour / day) as the proportion of each aircraft group.

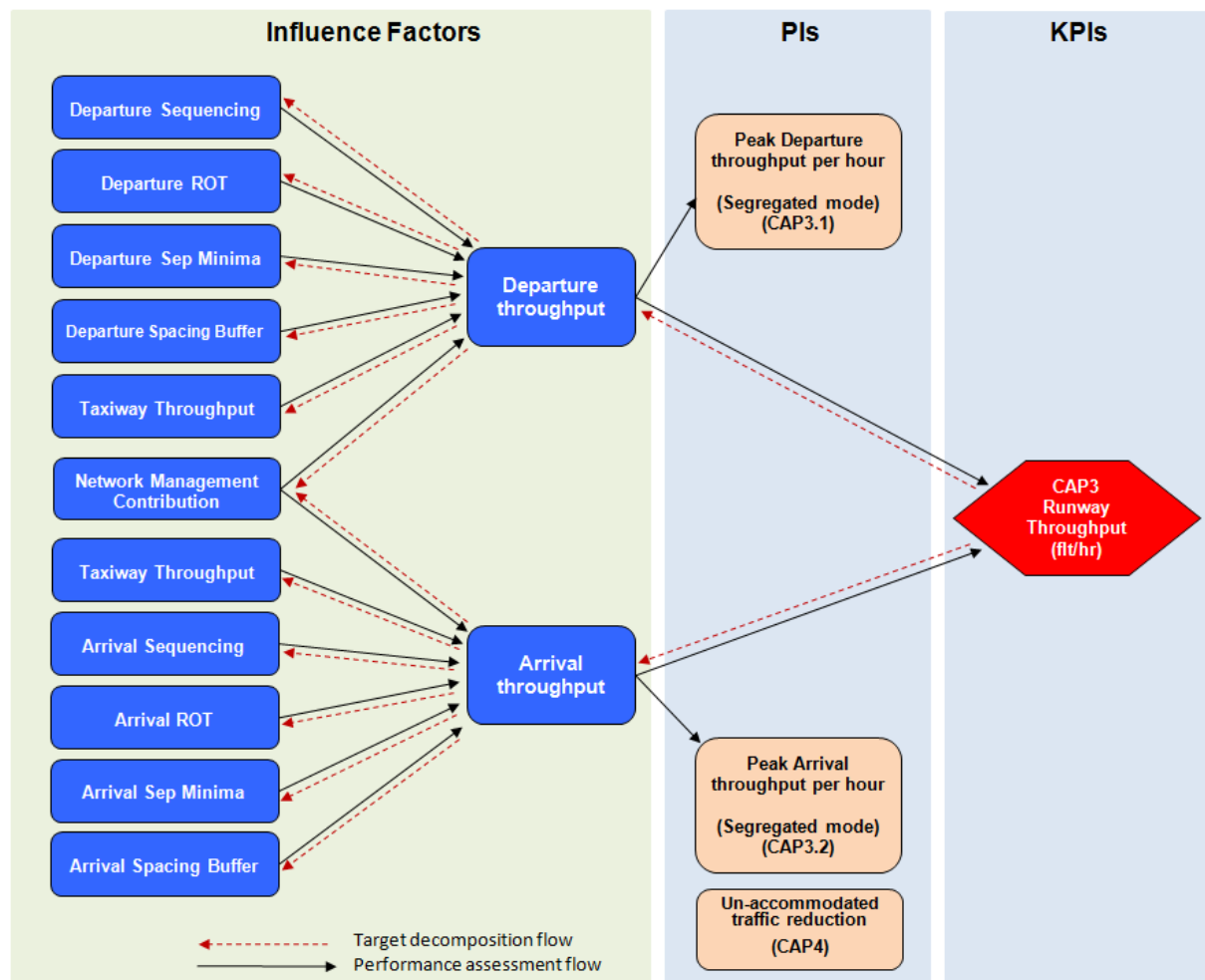


Figure 23: Airport Capacity Influence Diagram.

SESAR2020 Solutions are asked to provide a range of data for each KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category³², OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)
- Results of KPIs and PIs in for assessment years (e.g. 2025, 2035)³³ and uncertainty of the measurement

³² Category of airport, airspace and etc.... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

³³ See Appendix B How should Projects Measure the KPIs? Principle 2.

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.** , which provides further details of the data and aggregated results needed by PJ19 CI.

The Airport Capacity KPIs/PIs concerns the capacity declaration at “maximum observed throughput” airports. As such, the target is not a network-wide target, - instead it refers to what level of throughput can be scheduled (declared) in the busy hours.

Table 20 shows the **KPIs**, mandatory and non-mandatory PIs:

KPIs / PIs	Unit	Calculation	Mandatory
CAP3 Peak Runway Throughput ³⁴ (Mixed mode)	% and Flight per hour	% and also total number of movements per one runway per one hour for specific traffic mix and density (in mixed mode RWY operations). The percentage change is measured against the maximum observed throughput during peak demand hours in the mixed-mode RWY operations airports group.	YES
CAP3.1 Peak Departure throughput per hour (Segregated mode)	% and Flight per hour	% and also total number of departures per one runway per one hour for specific traffic mix and density (in segregated mode of operations). The percentage change is measured against the maximum observed throughput during peak demand hours in the segregated-mode RWY operations airports group.	YES
CAP3.2 Peak Arrival throughput per hour (Segregated mode)	% and Flight per hour	% and also total number of arrivals per one runway per one hour for specific traffic mix and density (in segregated mode of operations). The percentage change is measured against the maximum observed throughput during peak demand hours in the segregated-mode RWY operations airports group.	YES

³⁴ Depending on the modes of operation and given aircraft mix, the distribution operating under arrival-departure-arrival, arrival-arrival or departure-departure will produce different throughputs.

KPIs / Pls	Unit	Calculation	Mandatory
CAP4 Un-accommodated traffic reduction	Flights/year	Reduction in the number of un-accommodated flights i.e. a flight that would have been scheduled if there were available slots at the origin/destination airports. NB: Supports CBA Inputs. NB: Relates to Airport Capacity because this is STATFOR computation. CBA calculate this based on the assessment of the runway throughput we provide with and without the Solutions and STATFOR data.	YES For CBA.

Table 20: Airport Capacity KPIs.

A.5.3 Resilience Focus Area

The occurrence of exceptional weather (and other) events, natural disasters or technical and infrastructure failures could impact airport and airspace capacity³⁵. The extent to which capacity is degraded and the time taken to restore capacity are key aspects of relevance to ATM performance.

Hence, Resilience is the ability to withstand and recover from planned and unplanned events and conditions, which cause a loss of nominal capacity.

Planned and unplanned events and conditions include:

- Weather such as thunderstorms, strong wind, freezing conditions, low visibility conditions;
- Infrastructure degradation such as technical failures, strikes, accidents, runway maintenance.

Nominal, degraded and disrupted conditions³⁶ are defined as:

- Nominal conditions are 90% to 100% of the nominal capacity.
- Degraded conditions are 50% to 90% of the nominal capacity.
- Disrupted conditions are below 50% of the nominal capacity.

The figure below shows the influence diagram for resilience.

³⁵ Resilience is also addressed in other contexts in SESAR e.g. related to Safety/Human Performance. The definition used in those contexts does not cover the aspects of Resilience related to capacity impact and etc. as addressed in this section.

³⁶ This definition is from the "strategic Guidance in Support of the Execution of the European ATM Master Plan"

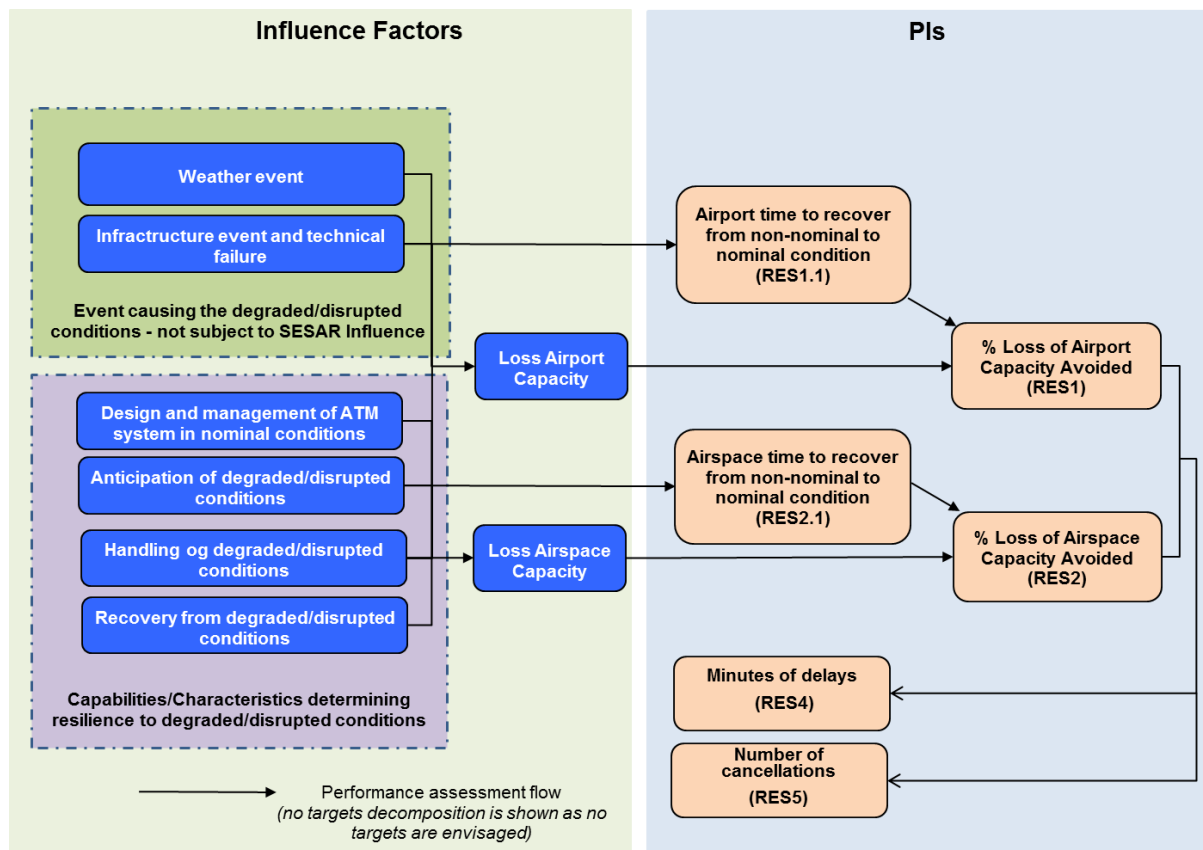


Figure 24: Resilience Influence Diagram.

There are several elements that could cause degraded / disrupted conditions leading to a reduction of the capacity for a certain period, e.g. weather events or similar, such as volcanic ash, fires, earthquakes, flooding and space weather; or an infrastructure and technical failure event or similar, such as a hijack situation, terrorism, flood, chemicals spills, nuclear emissions. These are shown in the green section of the influence factors. Generally, their occurrence characteristics (severity, frequency, duration, etc.) are outside the control of ATM, so although they are depicted as influence factors, there is not an expectation that ATM would address them specifically.

However, ATM interest and influence sits in the lower part of the diagram, where the influence factors relate to the capabilities of ATM to respond to the conditions imposed by the events and the resulting impact on airspace users. The severity of the impact is influenced by the design and the management of the ATM system, the anticipation, the handling and capability to recover from degraded to normal conditions. Mainly the response is influenced by the robustness of ATM, but also indirectly by capabilities within other stakeholder organisations, e.g. civil airspace users' capabilities to re-plan efficiently and coordinate responses, or for military users, a capability to intercept threat flights impacting on capacity and thus limiting the impact on the network and allowing it to recover rapidly.

SESAR2020 Solutions are asked to provide a range of data for each mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category³⁷, SESAR2020 Solutions, OE/sub-OE, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035).
- Results of PIs in for assessment years (e.g. 2025, 2035)³⁸ and uncertainty of the measurement.

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 21 shows the PIs, mandatory and non-mandatory PIs:

PIs	Unit	Calculation	Mandatory
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
RES 1.1 Airport time to recover from non-nominal ³⁹ to nominal condition	Minutes	Duration of Airport lost capacity from non-nominal to nominal condition.	YES for Airport OE Solutions
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
RES2.1 Airspace time to recover from non-nominal ⁴⁰ to nominal condition	Minutes	Duration of Airspace lost capacity from non-nominal to nominal condition.	YES for Airspace OE Solutions

³⁷ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia.**

³⁸ See Appendix B How should Projects Measure the KPIs? Principle 2.

³⁹ Either degraded or disruptive conditions.

⁴⁰ Either degraded or disruptive conditions.

PIs	Unit	Calculation	Mandatory
RES4 Minutes delays	of Minutes	Impact on AUs measured through delays resulting from capacity degradation ⁴¹ due to non-airline caused disruptions. RES1 and RES2 PIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).	YES
RES5 Number of cancellations	No flights	Impact on AUs measured through Cancellations resulting from capacity degradation ⁴² due to non-airline caused disruptions. RES1 and RES2 PIs drive this PI, though the PI may need to be measured on a condition-by-condition basis (e.g. fog, wind, system outage).	YES

Table 21: Resilience PIs

A.5.4 SES Performance Scheme for Capacity

The following table identifies the capacity metrics used in the SES performance scheme.

KPI/PI	Target Set Since	Monitored Since
Average minutes of en route ATFM delay per flight attributable to air navigation services	RP1	
Average time, expressed in minutes, of arrival ATFM delay per flight attributable to terminal and airport air navigation services	RP2	RP1
Percentage of flights with en route ATFM delay greater than 15 minutes		RP3
Average time, expressed in minutes, of all cause-departure delay per flight		RP2
Percentage of IFR flights adhering to their ATFM departure slots at local level, calculated for the whole calendar year of the reference period		RP2
Average minutes of air traffic control pre-departure delay per flight		RP3
Percentage of en route ATFM delay saving from the Cooperative Decision-Making network procedures and Network Manager Operations Centre actions		RP3
Percentage of arrival ATFM delay saving from the Cooperative Decision-Making network procedures and Network Manager Operations Centre actions		RP3

⁴¹ 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 is not recorded in detail.

⁴² 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 is not recorded in detail.

KPI/PI	Target Set Since	Monitored Since
Average over a calendar year of the daily number of ATFM regulations that produces less than 200 min delay		RP3
Average over a calendar year of en route ATFM weekend delay expressed in minutes		RP3
Annual percentage of first rotation delay due to capacity and staffing for a pre-selection of area control centres/airports		RP3

Table 22: SES Performance Scheme capacity metrics

The strategic intent for capacity is to ensure that there is sufficient capacity to meet demand in the network without creating excessive delay.

The HLGs require a three-fold increase in capacity to support two-fold increase in traffic. This creates spare capacity, which can be traded off for additional punctuality, predictability or resilience as required by airspace users.

As the SES Performance Scheme is designed to support long-term planning, the main focus is on keeping delays manageable. For en-route ATFM delay, a long term target of 0.5minutes average delay per flights has been established as representing an optimum balance between the cost of delay and cost of providing additional capacity. Monitoring within the Performance Scheme uses real world data to calculate the delay and its cause. Additional mechanisms are included to offset the impact of weather and crisis events. SES Performance Plans also include investment plans (which are relevant to CEF3, relating to technology costs).

SESAR measures the effective throughput for new operational concepts. The increase in throughput indicates a potential capacity gain (i.e. demonstrating that concepts and prospective Solutions can enable more traffic to be handled than today). Delays are the consequences of how, where and when those Solutions are deployed and utilised, which relates much more to shorter term stakeholder specific decisions. Within SESAR development it is therefore appropriate to target throughput.

It should be noted that when the Solutions do their CBAs capacity is monetised through delay.

The key for SESAR is that Solutions with capacity enhancements are deployed such that delay is maintained or reduced as traffic grows. The Performance Scheme measures success in this regard through the capacity indicators.

SESAR Solutions with cost efficiency benefit leads to a lower cost of capacity, which could in turn lead to the downward revision of the SES Performance Scheme targets.

A.6 OPERATIONAL EFFICIENCY

This section of the SESAR Performance Framework covers elements related to the ICAO Efficiency and Predictability KPAs which are deeply entwined. The focus here is on fuel burn and on Predictability, including punctuality aspects that are related to temporal quality of service aspects of ATM. These ICAO KPAs have been grouped into the Operational Efficiency Area in the ATM Master Plan 2019 **¡Error! No se encuentra el origen de la referencia..** This area is highly complex as not only are the KPAs entwined, but the actions of aviation network participants are also numerous and interrelated. The framework for Efficiency and Predictability that is set out in this section, nevertheless, attempts to focus on specific ATM-related aspects with potential influence and improvement from SESAR developments.

The focus areas of Efficiency and Predictability now covered by the SESAR Performance Framework are set out in figure below. It has to be noticed that SESAR Performance Framework is not defining new KPAs but adopting the organisation proposed in the ATM Master Plan Companion Document on the Performance Ambitions **¡Error! No se encuentra el origen de la referencia..**

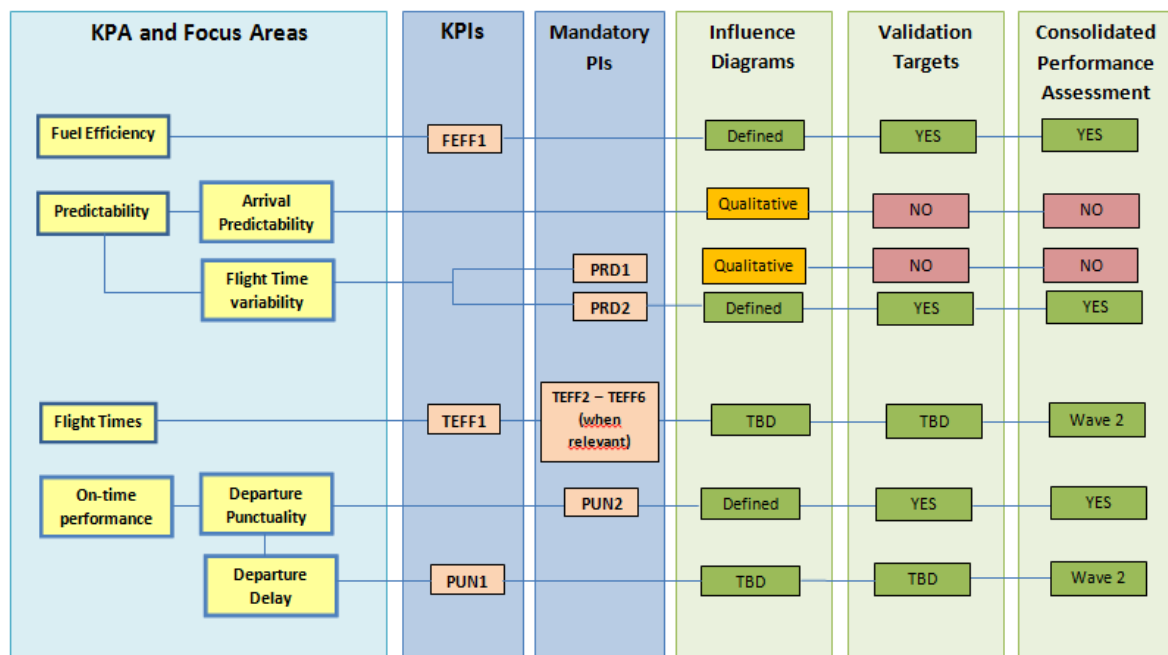


Figure 25: Punctuality and Predictability Framework

The work on Departure Punctuality and Predictability during SESAR1 highlighted the dependencies between each other and presented arrival punctuality as a function of departure punctuality, the extent to which the flight plan corresponds to scheduling assumptions and in-flight variation vs. the flight plan. In the latest edition of the ATM Master Plan **¡Error! No se encuentra el origen de la referencia..**, the focus is on “predictability of flight arrivals in accordance with commonly agreed reference business trajectories (RBT) prior to push-back”, instead of on arrival punctuality or delay with respect to scheduled time of arrival. The definition or inclusion of additional indicators in this area needs still to be encompassed. In addition, the future approach should also reflect the benefits in terms of predictability derived from the improvements in network planning processes.

A.6.1 Fuel Efficiency

The figure below shows the influences on the Fuel Efficiency Focus Area.

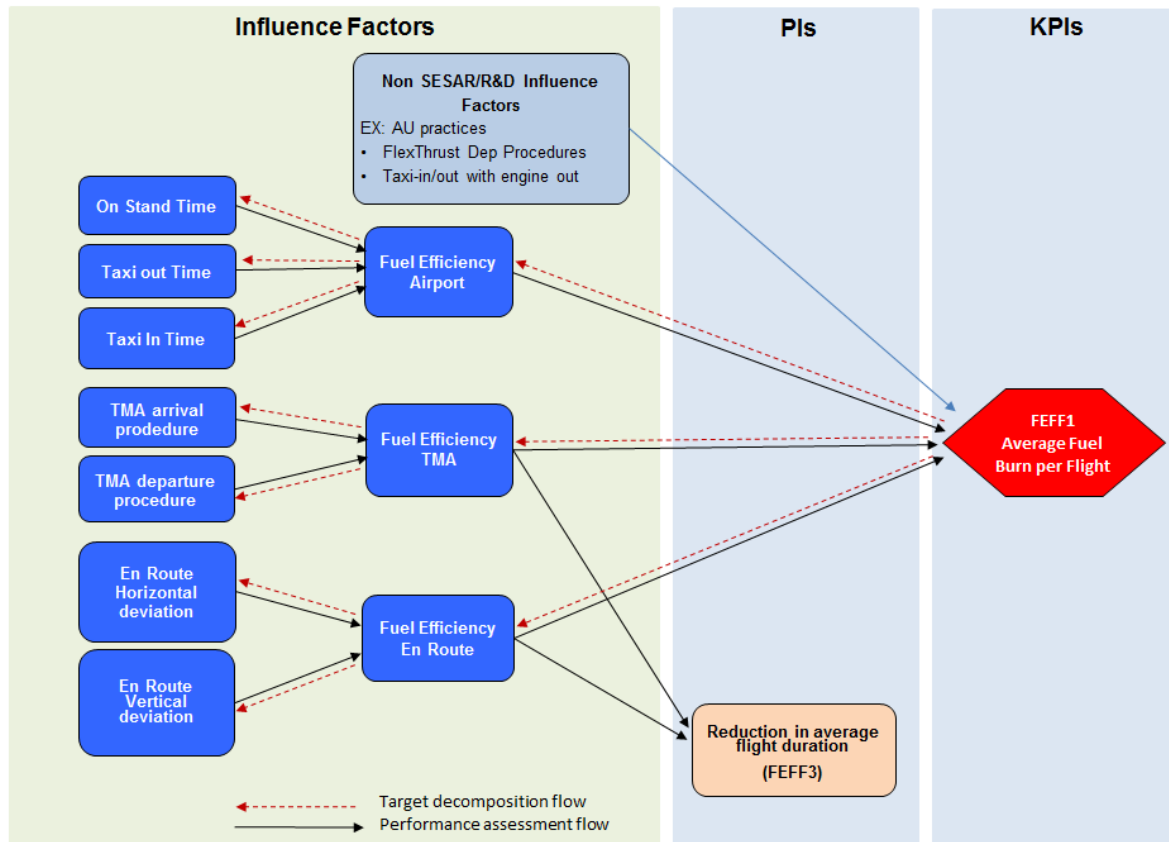


Figure 26: Fuel Efficiency Influence Diagram.

SESAR2020 Solutions are requested to provide the following data for each measured KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁴³, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁴⁴
- Results of the KPIs and PIs listed in table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

⁴³ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁴⁴ See Appendix B How should Projects Measure the KPIs? Principle 2.

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 14 below shows the **KPIs**, mandatory and non-mandatory PIs:

KPIs / PIs	Unit	Calculation	Mandatory
FEFF1 Actual Average fuel burnt per flight	Kg fuel per flight	Total amount of actual fuel burnt divided by the number of flights	YES
FEFF1.1 Planned Average fuel burnt per flight	Kg fuel per flight	Total amount of planned fuel burnt divided by the number of flights	NO
FEFF4 Average On stand fuel burnt per flight	Kg fuel per flight	Amount of fuel burnt on stand divided by the number of flights	NO
FEFF5 Average Taxi out fuel burnt per flight	Kg fuel per flight	Amount of fuel burnt in taxi out phase divided by number of flights	NO
FEFF6 Average Taxi in fuel burnt per flight	Kg fuel per flight	Amount of fuel burnt in taxi in phase divided by number of flights	NO
FEFF7 Average TMA departure ⁴⁵ fuel burnt per flight	Kg fuel per flight	Amount of fuel burnt in the TMA during departure divided by the number of flights.	NO

⁴⁵ The 'TMA Departure' influence factor relates to the airborne portion of the flight to 'Top of Climb', assumed to be approximately 100NM. The 100NM definition captures the performance of many SESAR concepts and is well supported by stakeholders. To consider as well the same calculation with a distance of 40NM, to be consistent with EFF1.

KPIs / PIs	Unit	Calculation	Mandatory
FEFF8 Average TMA arrival ⁴⁶ fuel burnt per flight	Kg fuel per flight	Amount of fuel burnt in the TMA during departure divided by the number of flights.	NO
FEFF9 Average En-Route Horizontal deviation fuel burnt	Kg fuel per flight	In En-Route total amount of fuel burnt due to horizontal deviation measured in the Solution Scenario / fuel burnt in the Reference Scenario divided by the number of flights	NO
FEFF10 Average En-Route Vertical deviation fuel burnt	Kg fuel per flight	In En-Route total amount of fuel burn due to vertical deviation measured in the Solution Scenario / fuel burnt in the Reference Scenario divided by the number of flights	NO

Table 23: Fuel Efficiency KPIs/PIs

A.6.2 On-time performance

Departure Punctuality

The approach for Departure Punctuality is to focus specifically on airspace user punctuality issues that are considered within the scope of SESAR2020 projects to address. This is referred to here as “ATM Punctuality”. It captures ATM issues as well as events related to ATM that cause a temporal perturbation to airspace user schedules. In the current European ATM system these issues and events manifest in terms of delays which are captured against standard industry (IATA) cause codes and collated by the EUROCONTROL Network Management Directorate’s Centre of Delay Analysis (CODA).

The proposed KPI for Departure Punctuality is the **average departure delay due to reactionary delays, ATM and weather related delay causes (PUN1)**. This indicator has been changed from previous edition of SESAR Performance Framework in order to get alignment with ATM Master Plan Performance Ambitions **¡Error! No se encuentra el origen de la referencia..** According to **¡Error! No se encuentra el origen de la referencia.**, “the performance ambition is to reduce the 2012 baseline delay of 9.5 minutes per flight to 7.0 minutes, which is a reduction of 2.5 minutes or 26% [...], these improvements are expected to come, to a large extent, from a reduction in reactionary delay (-2.26 min) and, to a lesser extent, from a reduction in airport ATFM delay (-0.16 min) and in ATFM weather delay (-0.04 min). Note: to reduce reactionary delay it is essential to improve the level of predictability”. It has to

⁴⁶ This aligns approximately with the “Top of Descent” and is considered an appropriate boundary in terms of relevance to airspace users and to SESAR CONOPS **¡Error! No se encuentra el origen de la referencia.** / validation exercises. Similarly, the ‘TMA Departure’ influence factor relates to the airborne portion of the flight to ‘Top of Climb’, assumed to be approximately 100NM. The 100NM definition captures the performance of many SESAR concepts and is well supported by stakeholders. To consider as well the same calculation with a distance of 40NM, to be consistent with EFF1.

be noted that the underlying objective is the reduction of significant delays (e.g. > 15 minutes) that can be achieved through the improvement of ATFM processes and the management of disruptive situations (also analysed within Resilience Focus Area) as well as through the increase of capacity to accommodate expected increase of demand.

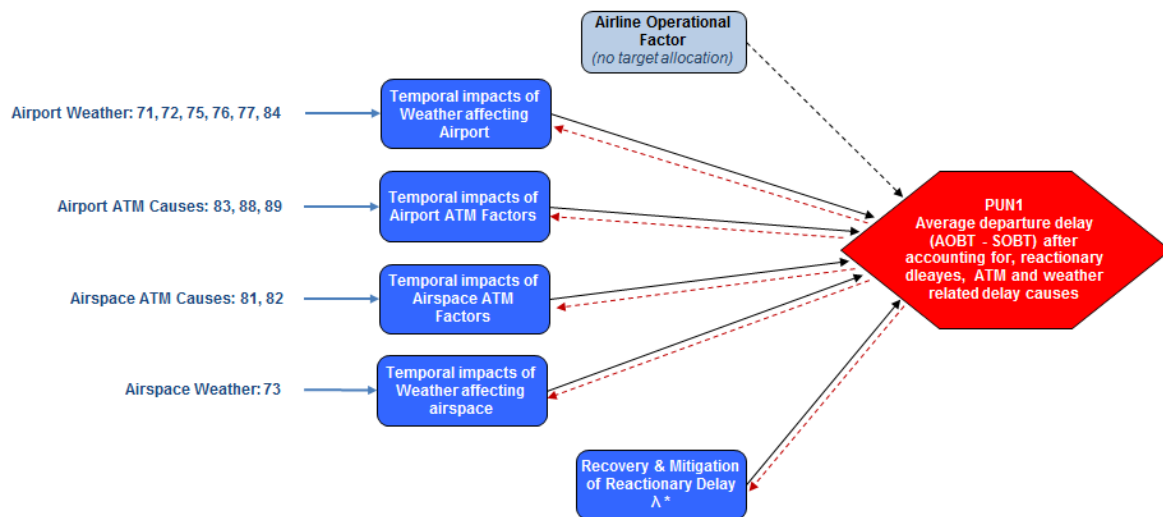


Figure 27: Punctuality Influence Diagram.

Airline Operational Factors cannot be addressed by SESAR and are therefore expressed in the influence diagram as 0%, while Recovery and Mitigation of Reactionary Delay is shown as a multiplier (λ) of the primary delays caused by other factors. Current data / delay capture does not allow impacts of primary delays to be traced to downstream operations and hence correlated with reactionary delays. However, the inclusion here of the Reactionary Delays influence factor should be seen as a call for SESAR Solutions to consider and address these impacts – in effect, for relevant operational improvements to reduce the value of λ .

SESAR2020 Solutions are requested to provide the following data for each measured KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁴⁷, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁴⁸
- Results of the KPIs and PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

⁴⁷ Category of airport, airspace and etc... according to DOD and PJ20 classification **Error! No se encuentra el origen de la referencia..**

⁴⁸ See Appendix B How should Projects Measure the KPIs? Principle 2.

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 24 shows the **KPIs** and non-mandatory PIs for Departure Punctuality. Nonetheless SESAR2020 are encouraged to provide the complete punctuality distribution.

KPIs / PIs	Unit	Calculation	Mandatory
PUN1 Average departure delay per flight	min/flight	Average delay (AOBT – SOBT) per flight due to reactionary delays, ATM and weather related delay causes.	YES
PUN2 % Flights departing within +/- 3 minutes of scheduled departure time due to ATM and weather related delay causes	%	% Departures so that $ AOBT - SOBT < +/- 3 \text{ min.}$ Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather related delay causes.	YES
PUN3 % Flights departing within +/- 5 minutes of scheduled departure time due to reactionary delays, ATM and weather related delay causes	%	% Departures so that $(AOBT - SOBT) < +/- 5 \text{ min.}$ Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather related delay causes.	NO
PUN4 % Flights departing within +/- 10 minutes of scheduled departure time due to reactionary delays, ATM and weather related delay causes	%	% Departures so that $(AOBT - SOBT) < +/- 10 \text{ min.}$ Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather related delay causes.	NO

KPIs / Pls	Unit	Calculation	Mandatory
PUN5 % Flights departing within +/- 15 minutes of scheduled departure time due to reactionary delays, ATM and weather related delay causes	%	% Departures so that $(AOBT - SOBT) < +/- 15 \text{ min.}$ Difference in Actual Departure Time vs. Scheduled Time due to ATM and weather related delay causes.	NO
PUN6 Average departure delay per flight due to Weather affecting Airport	min/flight	Average delay $(AOBT - SOBT)$ per flight due to weather affecting airport.	NO
PUN7 Average departure delay per flight due to Airport ATM Factors	min/flight	Average delay $(AOBT - SOBT)$ per flight due to airport ATM factors.	NO
PUN8 Average departure delay per flight due to Airspace ATM Factors	min/flight	Average delay $(AOBT - SOBT)$ per flight due to Airspace ATM factors.	NO
PUN9 Average departure delay per flight due to Weather affecting Airspace	min/flight	Average delay $(AOBT - SOBT)$ per flight due to Weather affecting Airspace.	NO

KPIs / Pls	Unit	Calculation	Mandatory
PUN10 Average departure delay per flight Airspace due to Recovery and Mitigation of Reactionary Delay	%	Average delay (AOBT – SOBT) per flight due to Recovery and Mitigation of Reactionary Delay.	NO

Table 24: Departure Punctuality KPIs and Pls⁴⁹.

A.6.3 Flight Times

According to the ATM Master Plan **¡Error! No se encuentra el origen de la referencia.**, "With SESAR, improved gate-to-gate flight trajectories will result in more than 50% reduction in additional flight times by 2035 compared to 2012. This represents an average gain of about 4.5 minutes in the block-to-block time. This 'additional time' driven approach decouples the ATM-related ambition from an expected significant increase in the average unimpeded gate-to-gate flight time. The ambition will be achieved by a reduction in additional taxi-out and taxi-in time, increase in direct routing in en-route airspace, and reduced holding and vectoring upon arrival. The shorter times contribute to fuel savings".

The associated performance indicator selected in the ATM Master Plan is **Additional gate-to-gate flight time per flight**, where "additional" means the average flight time extension caused by ATM inefficiencies. SESAR2020 Solutions may demonstrate their contribution towards the achievement of this ambition by comparing the gate-to-gate flight time per flight (actual times), or per flight phase, in reference and solution scenarios. It is important to remark that this reduction must be associated with the reduction of ATM inefficiencies.

The results for the selected KPI – **TEFF1: Average gate-to-gate flight time** – should be analysed in conjunction with other performance indicators (e.g. fuel efficiency).

The following figure shows the influence diagram for TEFF1 and the decomposition per flight phase. As can be seen, an initial macro-decomposition is carried out between TMA and En-route and in this context it is important to define the "TMA", which is considered to be a 40NM radius⁵⁰ around the airport (in addition, calculation considering a radius of 100NM can also be performed). This aligns with the standard calculation of additional times in Arrival Sequencing and Metering Area (ASMA) and horizontal En-route flight inefficiency and facilitates further aggregation. When the arrival

⁴⁹ PUN6, PUN7, PUN8, PUN9 & PUN10 can be complemented by additional indicators that allow the full characterisation of the distribution.

⁵⁰ If not possible, SESAR Solutions should guarantee that the selection of the simulation environment allows the measurement of all affected flight phases (either positively or negatively impacted).

management processes occur beyond the ASMA, SESAR2020 Solutions must also calculate the ASMA delay that is absorbed in en-route⁵¹ by applying path stretching or by speed reductions.

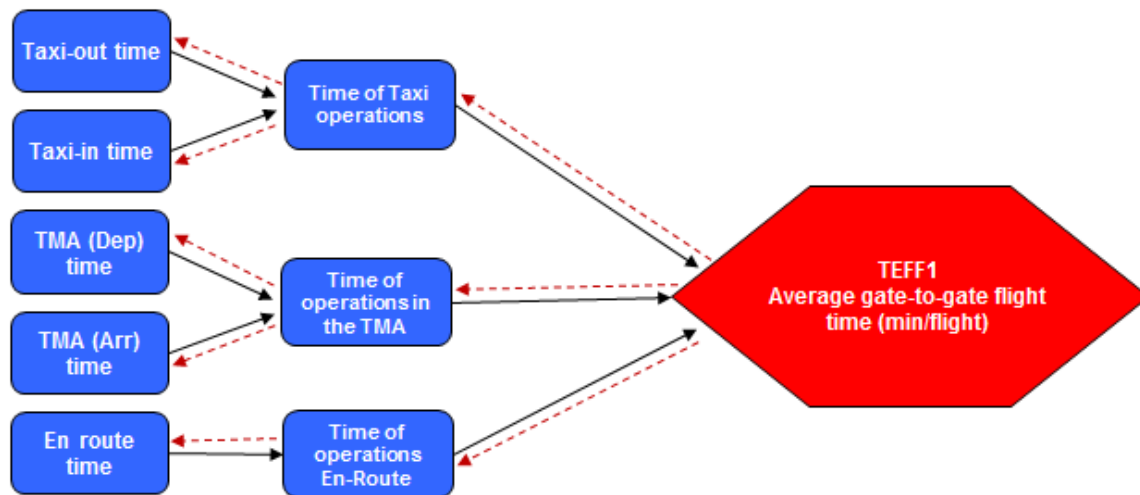


Figure 28: Flight Times Influence Diagram.

SESAR2020 Solutions are requested to provide the following data for each measured KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁵², OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project;
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁵³;
- Results of the KPIs and Pis listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement;

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 26 shows the **KPIs** and mandatory PIs:

⁵¹ This is linked to horizontal en-route flight efficiency, which might be also an equivalent indicator of the additional time in en-route as long as speed management is not applied.

⁵² Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁵³ See Appendix B How should Projects Measure the KPIs? Principle 2.

KPIs / Pis	Unit	Calculation	Mandatory
TEFF1 Gate-to gate flight time	Min/flight	Average of the distribution of actual gate-to-gate flight durations	YES
TEFF2 Taxi in time	Min/flight	Average of the distribution of actual taxi-in (including ground queuing during taxi-in) durations	When relevant
TEFF3 Taxi out time	Min/flight	Average of the distribution of actual taxi-out (including ground queuing during taxi-out) durations	When relevant
TEFF4 TMA arrival time	Min/flight	Average of the distribution of actual TMA arrival (including holdings) durations	When relevant
TEFF5⁵⁴ TMA departure time	Min/flight	Average of the distribution of actual TMA departure durations	When relevant
TEFF6 En-Route time	Min/flight	Average of the distribution of actual en-route durations	When relevant
EFF1 Horizontal en- route flight efficiency	NM	See PRU definition for KEP and KEA and adapt it to the simulation environment.	NO
TEFF7 Turnaround time	Min/flight	Average of the distribution of actual turnaround durations	NO

Table 25: Flight Times KPIs and Pis

A.6.4 Predictability

As described in §A.6, in the latest edition of the ATM Master Plan **¡Error! No se encuentra el origen de la referencia.** the focus is on “predictability of flight arrivals in accordance with commonly agreed reference business trajectories (RBT) prior to push-back”, instead of on arrival punctuality or delay

⁵⁴ Although no major time inefficiencies occur during climb, this phase has been included for consistency.

with respect to scheduled time of arrival. The definition or inclusion of additional indicators in this area needs still to be encompassed. In addition, the future approach should also reflect the benefits in terms of predictability derived from the improvements in network planning processes.

Regardless the approach that might be adopted in the future, one of the key factors that affects predictability of arrivals is the flight time variability, which provides valuable information for airlines in flight scheduling. It has to be noted that for scheduling purposes the flight variability refers to ‘intra’ flight variability ((calculated for flights with identical profiles (minimum of 20 flights) as the standard deviation for each flight segment (actual departure compared to schedule, taxi duration, flight duration, arrival compared to schedule)). However this cannot be calculated in the type of simulations exercises that are carried out to validate the concepts in SESAR, thus other indicators have been defined in the SESAR Performance Framework (Table 26). It is still to be explored the relationship between these PRD indicators and the flight time indicators defined in §A.6.3.

The ATM Master Plan **¡Error! No se encuentra el origen de la referencia.** does not include a specific performance ambition for flight time variability. Therefore, the former PRD1 –***variance of differences between actual and flight plan of Reference Business Trajectory (RBT)***⁵⁵ durations – is no longer a KPI, albeit it has been retained as mandatory PI during the transition phase to SESAR2020 Wave 2⁵⁶, along with an additional one related to average. The former non-mandatory PIs per flight phase⁵⁷ has been modified to measure the mean but SESAR2020 Solutions are encouraged to provide the complete distribution.

SESAR2020 Solutions are requested to provide the following data for each measured KPI, mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁵⁸, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁵⁹
- Results of the KPIs and PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

The Solution’s team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

⁵⁶ To be confirmed is they are finally dropped from the SESAR Performance Framework by DMSC.

⁵⁷ As per flight phases described in §A.6.3.

⁵⁸ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁵⁹ See Appendix B How should Projects Measure the KPIs? Principle 2.

Table 26 shows the **KPIs** and non-mandatory **PIs**:

KPIs / PIs	Unit	Calculation	Mandatory
PRD1 Average of Difference in actual & Flight Plan or RBT durations	Minutes ²	Average of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES
PRD2 Variance ⁶⁰ of Difference in actual & Flight Plan or RBT durations	Minutes ²	Variance of the distribution of the differences between flown trajectories & Flight Plans or RBT durations	YES
PRD3 Average of difference in actual & Flight Plan or RBT taxi-in durations	Minutes	Mean of the distribution of actual taxi-in durations vs. planned taxi-in durations. AXIT - EXIT (RBTs)	NO
PRD4 Taxi in variability	Minutes	Standard Deviation of the distribution of actual taxi-in durations vs. planned taxi-in durations. AXIT - EXIT (RBTs)	NO
PRD5 Average of difference in actual & Flight Plan or RBT taxi-out durations	Minutes	Mean of the distribution of actual taxi-out (including ground holding) durations vs. planned taxi-out durations AXOT - EXOT (RBTs)	NO
PRD6 Taxi out variability	Minutes	Standard Deviation of the distribution of actual taxi-out (including ground holding) durations vs. planned taxi-out durations AXOT - EXOT (RBTs)	NO

⁶⁰ Standard Deviation is also accepted.

KPIs / Pls	Unit	Calculation	Mandatory
PRD7 Average of difference in actual & Flight Plan or RBT TMA arrival durations	Minutes	Mean of the distribution of actual TMA (arrival) durations vs. planned TMA (arrival) durations	NO
PRD8 TMA arrival variability	Minutes	Standard Deviation of the distribution of actual TMA (arrival) durations vs. planned TMA (arrival) durations	NO
PRD9 Average of difference in actual & Flight Plan or RBT TMA departure durations	Minutes	Mean of the distribution of actual TMA (departure) durations vs. planned TMA (departure) durations	NO
PRD10 TMA departure variability	Minutes	Standard Deviation of the distribution of actual TMA (departure) durations vs. planned TMA (departure) durations	NO
PRD11 Average of difference in actual & Flight Plan or RBT en-route durations	Minutes	Mean of the distribution of actual En-route durations vs. planned En-route durations	NO
PRD12 En-Route variability	Minutes	Standard Deviation of the distribution of actual En-route durations vs. planned En-route durations	NO
PRD13 Average of difference in actual & Flight Plan or RBT turnaround durations	Minutes	Mean of the distribution of actual turnaround durations vs. planned turnaround durations. ((AOBT-AIBT)-(TOBT-TIBT))	NO
PRD14 Turnaround variability	Minutes	Standard Deviation of the distribution of actual turnaround durations vs. planned turnaround durations. ((AOBT-AIBT)-(TOBT-TIBT))	NO

KPIs / PIs	Unit	Calculation	Mandatory
PRD15 No. flights GAT for which ARES airspace is offered	No. flights	ARES efficiency of availability could be captured using the following indicator: No. flights GAT that potentially could cross the ARES airspace offered	NO

Table 26: Predictability KPIs and PIs

A.7 COST EFFICIENCY

The Cost Efficiency KPA is among the KPAs receiving HLGs and is considered a priority area by SES Performance Scheme. From the Cost Efficiency KPA two focus areas are being assessed by PJ19 CI. The first cost impact considered is the direct gate-to-gate ANS cost, and the second cost impact area is the Airspace User costs. Airport Operator costs Focus Area with their contributing factors (direct and indirect operating costs as well as depreciation costs from investments) has not been developed in this document.

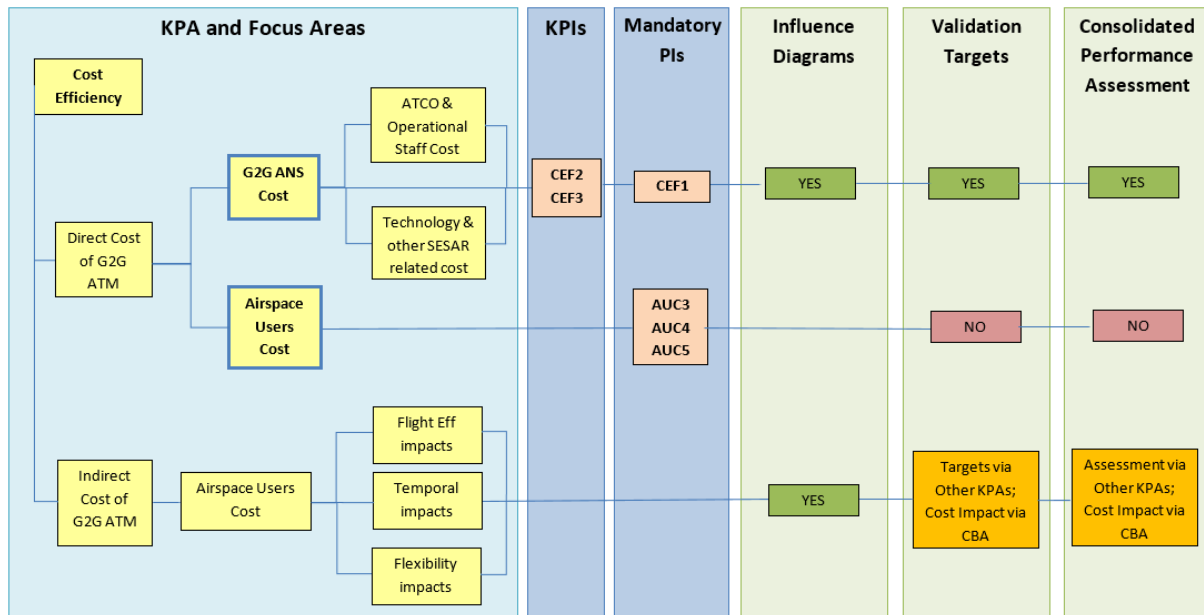


Figure 29: Cost Efficiency Framework.

A.7.1 G2G ANS Cost-Efficiency Focus Area

The KPI Flights per ATCO Hour on Duty expresses the benefit of increasing the number of flights that an individual controller can handle safely with the same workload, i.e. reducing the workload per flight. This can drive a reduced requirement for controllers and operational support staff (for a given level of traffic) as fewer sectors / control positions need to be opened in order to handle the traffic.

It is considered to comprise productivity of all operational ATC staff, i.e. ATCOs, Network management staff and operational support staff and therefore is assumed to influence around 35% of the current ANS cost base. Roistering efficiency and manpower planning are also potentially within the scope of SESAR Solutions and would influence this KPI.

The KPI Technology Cost per Flight addresses operational engineering staff costs, system-related capital and operating costs as well as training costs. Training costs, reduced by improving the efficiency with which operational staff can be trained, could equally be considered to be related to “productivity”, but are classified under Technology Costs to retain a cleaner operational focus for ATCO Productivity.

SESAR is expected to contribute to reducing these costs through reductions in lifecycle costs associated with the technology and systems required to support ANS.

It is also important to note that technology cost per flight applies to the current distribution of technology. In some instances a further cost reduction can be achieved through deploying the

functionality in a different manner – for example as a common service. This element is taken into account when determining the most beneficial deployment scenario.

Figure 30 shows the influencing factors on the G2G ANS Cost Efficiency Focus Area.

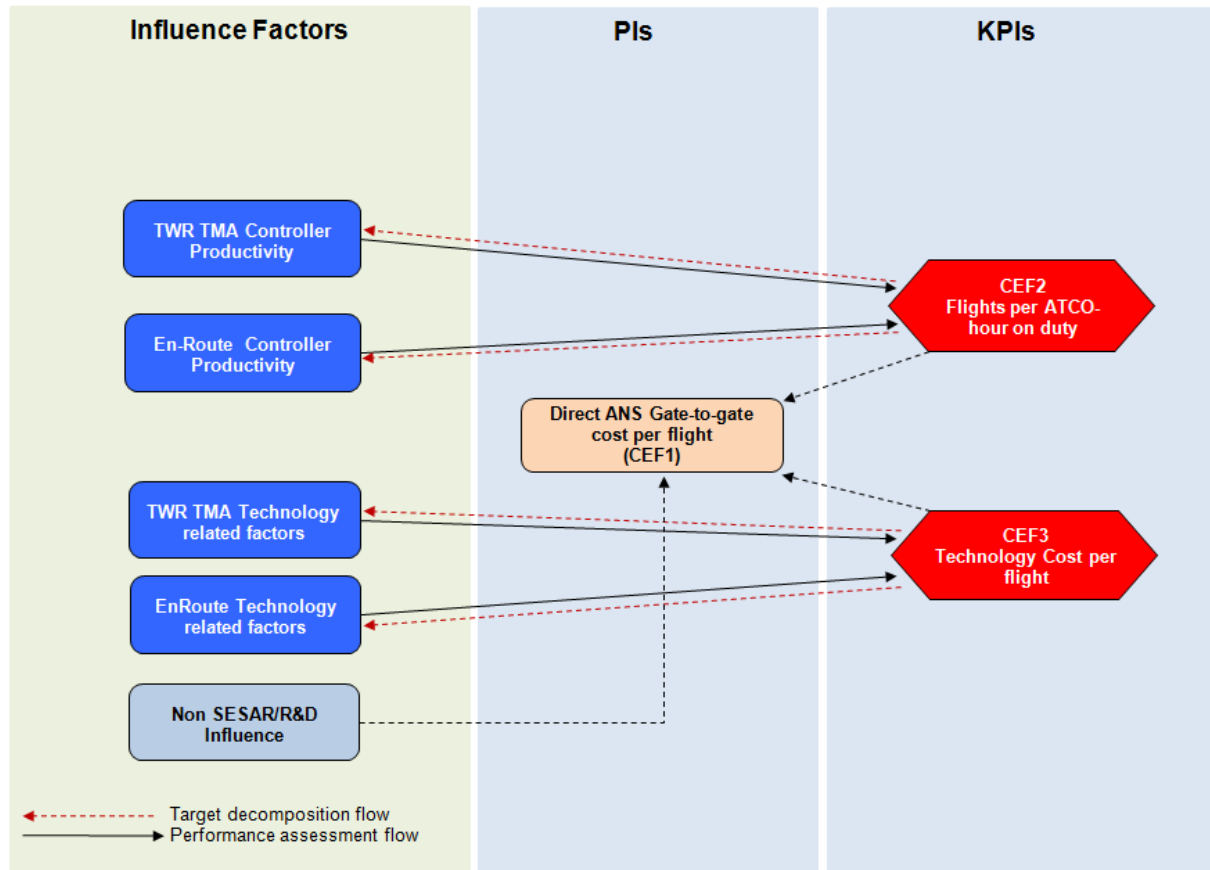


Figure 30: Cost Efficiency Influence diagram.

SESAR2020 Solutions are asked to provide a range of data for each KPI, mandatory PI or non-mandatory PI measurement including:

- Location name measured by the exercise, category⁶¹, SESAR2020 Solutions, OE/sub-OE, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁶²

⁶¹ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁶² See Appendix B How should Projects Measure the KPIs? Principle 2.

- Results of the KPIs and PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 27 shows the **KPIs** and mandatory PIs:

KPIs / PIs	Unit	Calculation	Mandatory
CEF1 Direct ANS Gate-to-gate cost per flight	EUR / flight	Derived by PJ19 CI, taking into account results for the other two KPIs as contributing factors.	YES Derived From the other two KPIs below.
CEF2⁶³ Flights per ATCO-Hour on duty	No.	Count of Flights handled divided by the number of ATCO-Hours applied by ATCOs on duty.	YES
CEF3 Technology cost per flight	EUR / flight	G2G ANS cost changes related to technology and equipment.	YES

Table 27: Cost Efficiency KPIs and PIs.

The focus of the cost efficiency assessment is on the change in productivity of operational staff⁶⁴. The measure may be directly related for example to the number of flights controlled per ATCO hour or to a workload per flight hour reduction. When measuring in already constrained (high complexity / density) airspace, there are both an impact on Airspace Capacity and on Cost Efficiency. However, when measuring in low and medium complexity airspace, only Cost Efficiency is generally improved. The principle behind this approach is that it can be assumed that operational benefits demonstrated in very high / high density environments generally also apply in low / medium density environments, but the reverse is not generally appropriate to assume.

For the assessment, the ATCO workload is collected through several means, including questionnaires. Then, this workload is analysed by an HP or validation expert and compared between the reference and solution scenarios. Finally the workload variation is converted into a productivity variation with the following formula to calculate a corresponding potential productivity change:

⁶³ 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).

⁶⁴ ATCOs, ATCO Operations support staff, Network Manager Operation staff, flight planning staff and etc.

$$\text{Increase in productivity (\%)} = (1 / (1 - 0.75 * \text{workload reduction}^{65} / 2) - 1) \times 100$$

Technology-related ANS Cost efficiency improvements are usually expected with a reduction in operating costs, for example through lower maintenance costs and/or through lower asset costs (depreciation), resulting from SESAR-related changes to technology and systems required to deliver ANS. Technology-related costs are considered to comprise operational engineering staff costs, system-related capital and operating costs as well as training costs. SESAR is expected to contribute to reducing these costs through reductions in lifecycle costs by deploying alternative technologies (with lower replacement costs), greater interoperability between systems (leading to cost savings resulting from fewer bespoke elements), reductions in technical staff costs and general non-staff operating costs (lower running costs) and deploying the capabilities in a different manner (common services). The efficiency with which operational staff can be trained is also a contributing influence in this cost category.

The assessment of these is more complicated because deployment is influenced by the existing infrastructure and therefore the benefit is linked to local conditions.

A.7.2 Airspace User Cost-Efficiency Focus Area

Airspace User Cost Efficiency refers to Cost Efficiency obtained by Airspace Users other than gate-to-gate ATM costs. This may include benefits noted in other KPIs, especially when considering efficiency benefits. These already measured benefits should not be included, to avoid double-counting of benefits. Furthermore, benefits which may affect other stakeholders (like Predictability) should not be measured as AU Cost Efficiency, because the benefit other stakeholders might have would then go unnoticed.

SESAR2020 Solutions are asked to provide a range of data for each KPI, mandatory PI or non-mandatory PI measurement including:

- Location name measured by the exercise, category⁶⁶, SESAR2020 Solutions, OE/sub-OE, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁶⁷
- Results of the KPIs and PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

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⁶⁵ Where the workload reduction is expressed as a decimal fraction (i.e. 10% = 0.1)

⁶⁶ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁶⁷ See Appendix B How should Projects Measure the KPIs? Principle 2.

Table 28 below shows the mandatory and non-mandatory PIs:

KPIs / PIs	Unit	Calculation	Mandatory
AUC1⁶⁸ Strategic Delay	min	Determine the minutes of strategic delay saved with the solution. The strategic delay shall be in line with the definition from the Standard Inputs for EUROCONTROL Cost-Benefit Analyses ¡Error! No se encuentra el origen de la referencia..	NO
AUC2 Sequence Optimisation Benefit	EUR/movement	Determine the direct benefit obtained by swapping a slot (on average). To be able to aggregate the information, the cost has to be provided per movement (one movement is the arrival plus the departure).	NO
AUC3 Direct operating costs for an airspace user	EUR	Impact on direct costs related to the aeroplane and passengers. Examples: staff expenses, passenger service costs, maintenance and repairs.	Yes, where an impact is foreseen on AU cost efficiency
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, AOC costs.	Yes, where an impact is foreseen on AU cost efficiency
AUC5 Overhead costs for an airspace user	EUR	Impact on overhead costs. Examples: training, IT infrastructure, marketing and sales.	Yes, where an impact is foreseen on AU cost efficiency

Table 28: Airspace User Cost Efficiency PIs.

The direct and indirect operating costs and the overhead costs for an airspace user are new PIs defined in the SESAR2020 Transition Performance Framework [INT7] and they are very generic. The direct operating costs are the costs related to handling the aeroplanes and passengers. For example, fuel, staff expenses, passenger service costs, maintenance and repairs, navigation charges, landing fees, catering. The indirect operating costs don't relate to individual flights. Examples are parking charges, crew and cabin salary, handling prices at Base Stations. Overhead costs are, for example, IT infrastructure and cost of sales.

⁶⁸ AUC1 is measuring an indirect cost; the reason to measure minutes instead of strategic delay cost is for transparency. When assessing AUC1 a possible double-counting of benefits with PRD1 should be taken into account.

Two specific AU direct operating cost PIs are being added mentioned as examples. “Strategic Delay” means all costs associated with avoiding or reducing possible ATFM delays during flight planning, especially buffer times. In business cases these costs are often expressed in terms of a hypothetical additional delay, which explains the name. One minute strategic delay corresponds to a minute of actual delay (averaged from numbers accumulated over an accounting period of one year). The Sequence Optimisation benefits are being obtained when an AU is permitted to change the order of departures (slot swapping), for example, in order to make best economic use of the resource. So far there has not been a PI for this benefit even though it is known from the UDPP for some time already.

A.7.3 SES Performance Scheme for Cost-Efficiency

The cost efficiency metrics for the SES Performance Scheme **¡Error! No se encuentra el origen de la referencia.** are set out in the table below.

KPI/PI	Target Set Since	Monitored Since
DUC for en route air navigation services	RP1	-
Actual unit cost incurred by users separately for en-route and terminal air navigation services at Union level		RP3
DUC for terminal air navigation services	RP2	RP1
Unit cost for the execution of the tasks of the Network Manager		RP2

Table 29: SES Performance Scheme Cost Efficiency Metrics

Cost Efficiency in the Performance Scheme is considered to have a wider definition than the cost efficiency KPA used in SESAR. The SES Performance Scheme seeks a year on year reduction in Determined Unit Costs (DUC). DUC is calculated by dividing Determined Costs by forecast traffic. The cost categories used in establishing determined costs are:

- Staff – including salaries, bonuses and pensions;
- Other operating costs – maintenance, rents, consumables;
- Depreciation;
- Cost of Capital;
- Exceptional Items.

It is clear that SESAR deployment:

- Requires capital expenditure (which impacts on depreciation costs and cost of capital);
- Improves maintenance procedures (which may reduce/affect staff and other operating costs);
- Improves ATCO productivity (which reduces staff costs per flight hour).

However, the impact of Determined Unit Cost from a technology change is also dependent on factors outside of SESAR’s remit such as traffic, interest rates and numerous other factors including cost reductions across the ANSP. Hence SESAR correctly targets the direct operational impact on cost per flight.

The key for SESAR is that ATCO productivity and technology costs enable a reduction of direct ANS gate-to-gate costs as traffic grows. The Performance Scheme measures success in this regard through DUR achieved.



A.8 FLEXIBILITY

This KPA addresses the ability of the ATM System and airports to respond to changes in planned flights and mission. It covers late trajectory modification requests as well as ATFCM measures and departure slot swapping and 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. Due to uncertainty on D-1 (weather, crew, aircraft and facilities availability), the military very often requests an allocation of ARES to accommodate a primary as well as alternate mission/training event. As a consequence, double ARES allocation or an extended ARES allocated time occurs very often. On the other hand, the current system limits ARES allocation/relocation on the day of operation at short notice. In order to facilitate efficient ASM, for the benefit of civil and military airspace users, the system should have the flexibility to secure the ARES allocation/relocation at short notice on the day of operations.

The high level Flexibility Framework is shown in Figure 31. The framework identifies for main parameters (shown as four PIs) which cover broadly the requirements of most airspace users for flexibility. Note that prospective slot swapping capabilities within ATFCM are not reflected as explicit dimensions in the framework as they are Solutions that enable civil airspace users to exercise a degree of choice in the flights that are impacted by demand / capacity imbalances. This element is shown, but is not taken forward in the Influence Diagram at this stage.

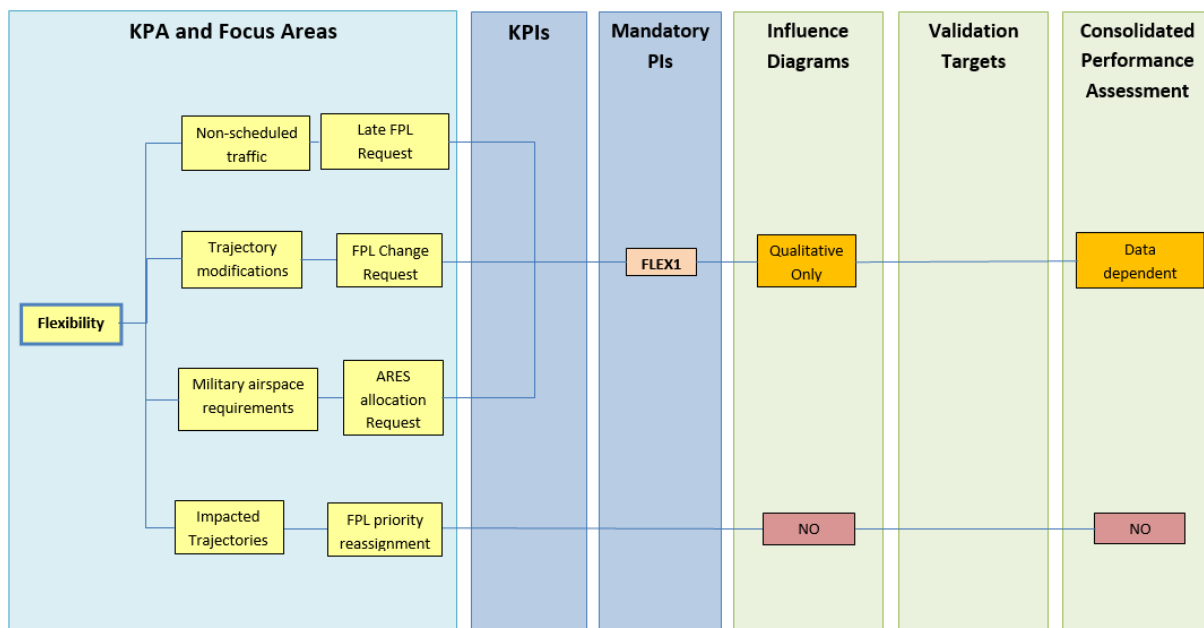


Figure 31: Flexibility Framework KPA

Figure 10 shows the influences on the Flexibility KPA.

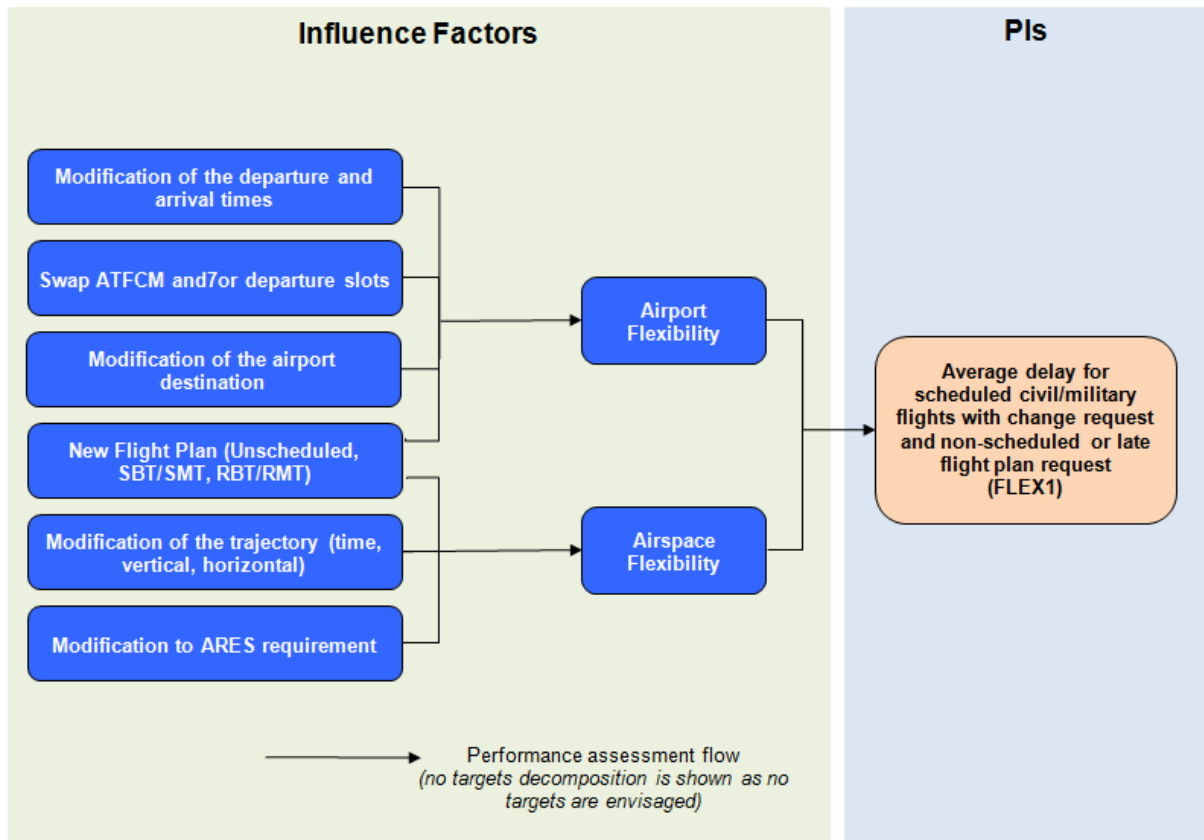


Figure 32: Flexibility Influence Diagram.

SESAR2020 Solutions are asked to provide a range of data for each mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁶⁹, SESAR2020 solution, OE/sub-OE, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁷⁰
- Results of PIs in the table below for assessment years (e.g. 2025, 2035) and uncertainty of the measurement.

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⁶⁹ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁷⁰ See Appendix B How should Projects Measure the KPIs? Principle 2.

Table 30 shows the mandatory and non-mandatory PIs:

PIs	Unit	Calculation	Mandatory
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
FLX2 Average delay for non-scheduled civil/mil flights delayed	Minutes	Total delay for non-scheduled flights delayed $ AOBT - SOBT $ divided by number of movements	NO
FLX3 % of non-scheduled civil/mil flight arriving on time	%	% Arrival so that $ AIBT - SIBT < +/- 3 \text{ min.}$	NO
FLX4 ARES allocation at short notice	Nº.	Nº. ARES allocated vs. Nº. ARES requested at short notice by military with less than one hour notice	NO

Table 30: Flexibility PIs

With regard to the PI ARES allocation at short notice, the system must respond in a timely manner in order to support an individual mission's requirements. This PI and the associated influence factor are closely related to the Civil-Military Cooperation and Coordination performance focus area. They reflect the need for flexibility in the ATM System to support military requirements set out above whilst minimising impacts on civil airspace users.

A.9 CIVIL-MILITARY COOPERATION AND COORDINATION

The SESAR2020 Performance Framework addresses civil-military cooperation and coordination decomposed in the following two categories:

- Impact of ATM on military operation and training activities: How civil ATM affects mission effectiveness.
- Contribution to Civil ATM Performance: How civil-military cooperation and coordination, improved by ATM concepts such as (AFUA) Advanced Flexible Use of Airspace and Mission Trajectory, contribute to the performance of civil ATM.

The goal is to reflect the importance of interactions of Civil and Military actors in the ATM system aiming towards a civil-military performance based partnership in ATM.

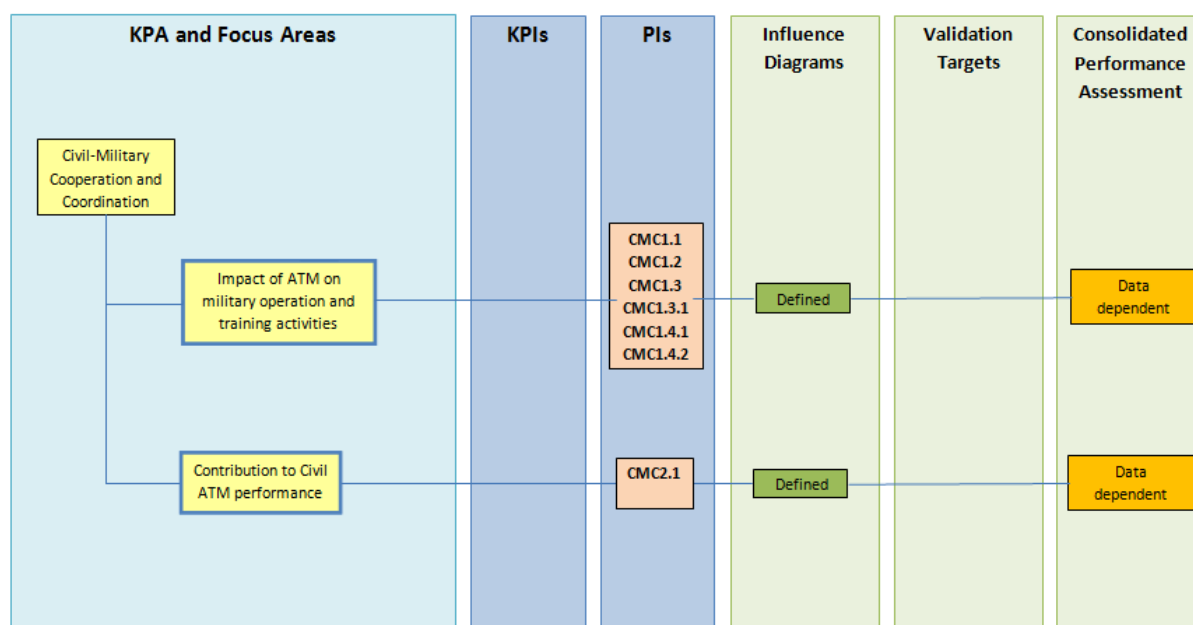


Figure 33 Civil-Military Cooperation and Coordination Framework.

Figure 24 shows the influences on the Civil-Military Cooperation and Coordination KPA.

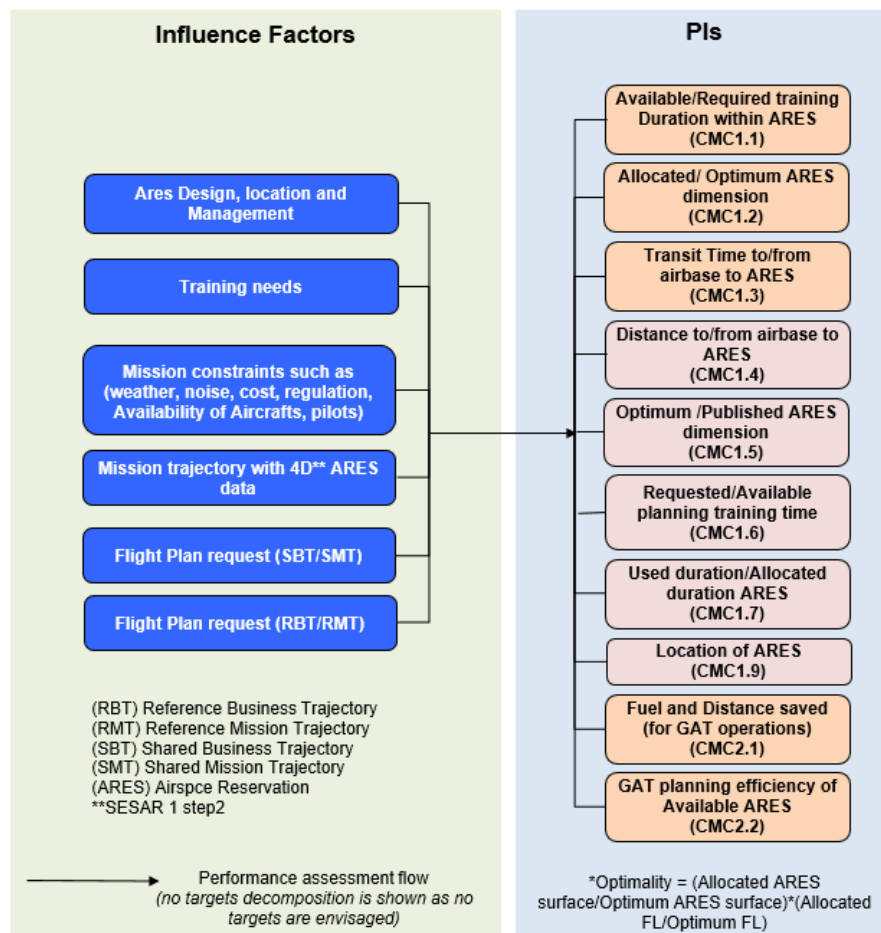


Figure 34: Civil-Military cooperation and coordination Influence Diagram.

SESAR2020 Solutions are asked to provide a range of data for each relevant PI including:

- Location name measured by the exercise, category⁷¹, SESAR2020 Solutions, OE/sub-OE, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁷²
- Results of PIs in the table below for assessment years (e.g. 2025, 2035) and uncertainty of the measurement.

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

⁷¹ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁷² See Appendix B How should Projects Measure the KPIs? Principle 2.

Category	PIs	Unit	Calculation	Mandatory
Impact of ATM Solutions on the effectiveness of military mission	CMC1.1 Allocated vs. Requested ARES duration	%	It is calculated the proportion between the time allocated for ARES after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the time initially requested by the user: Time allocated / time requested for airspace reservation/restriction. It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to Variable Profile Area (VPA), Dynamic Mobile Area (DMA), and modular types of design for ARES. The indicator supports the assessment of the impact of ASM planning and civil-military decision-making processes on the training time for military mission inside ARES.	When relevant

Category	PIs	Unit	Calculation	Mandatory
	CMC1.2 Allocated vs. Requested ARES dimension	%	It is calculated as the proportion between the volume of the ARES allocated after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the volume initially requested by the user: $\frac{\text{Allocated ARES surface}}{\text{Requested ARES Surface}} \times \frac{\text{Allocated FL band}}{\text{Requested FL band}}$ It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to VPA, DMA, and modular types of design for ARES. It provides an indication on how closely the allocated ARES conforms to the required airspace dimensions for the execution of the training inside ARES.	

Category	PIs	Unit	Calculation	Mandatory
	CMC1.3 Deviation of Transit Time to/from airbase to ARES	+/- Minutes	It represents the difference between the transit time in the initial request of the military Airspace User and the transit time resulting from the airspace configuration processes (including the civil-military CDM for ASM). Transit time is defined as the time to be flown from the airbase of departure to the entry point in ARES or from a reference point specified by the military user to the entry point in ARES. It is applicable in situations where a time/distance constraint is defined by the military airspace user for the location of ARES. It could be calculated for individual ARES and then the results could be summed up to provide a global figure for the entire military airspace use plan. It is applicable to VPA, DMA type 1, and modular types of design for ARES. It provides an indication on the effectiveness of ARES location.	

Category	PIs	Unit	Calculation	Mandatory
	CMC 1.3.1 Allocated ARES duration vs. total mission duration	%	It is calculated as the difference in mean values of the ratios between time spent in DMA(s) versus total mission time (based on mid-speed) before (initial military request) and after the completion of airspace configuration (ARES allocation throughout civil-military CDM) processes. It could be calculated for individual ARES or a group of ARES depending on the missions defined in the exercise scenarios. It is applicable to VPA, DMA, and modular types of design for ARES. It supports the assessment of the achievement of military training objectives inside ARES.	
	CMC 1.3.2 Deviation of total mission duration by iOAT FPL validation	+/- Minutes	It is calculated as the difference between the duration of the mission in the validated iOAT FPL (Reference Mission Trajectory RMT) and the duration of the mission in the submitted iOAT FPL (Shared Mission Trajectory SMT). It could be calculated for a single or the total FPLs submitted by WOC to the Network Manager (NM). It supports the assessment of the impact of NM flight plan validation processes on the effectiveness of military Mission Trajectory planning, especially for cross border flights.	

Category	PIs	Unit	Calculation	Mandatory
	CMC 1.4 Rate of iOAT FPLs acceptance by NM systems	%	The indicator it is calculated as a proportion between the number of FPLs submitted by WOC to NM and the number of FPLs validated by NM systems against the flight planning and ATM route network rules. The measurements could include both of the validation and tactical flow management systems of NM or could be limited to one of them. It supports the assessment of the acceptability of military requirements and exemptions by NM systems.	
	CMC 1.4.1 Rate of iOAT FPLs acceptance by ATC systems	%	The indicator is calculated as a proportion between the number of FPLs distributed after processing by NM to ATC systems and the number of FPLs accepted by the ATC systems. It supports the assessment of the viability of IOAT FPL to ATC as well as of the ability of ATC systems to provide services to OAT flights.	
Contribution of CMCC to ATM performance gains	CMC2.1 Fuel and Distance saved by GAT	Kg and NM	Kg of fuel and distance saved by GAT due optimisation of the ATM network through Demand Capacity balancing and to the new ARES design and management	

Table 31 shows the CMCC PIs:

Category	PIs	Unit	Calculation	Mandatory
Impact of ATM Solutions on the effectiveness of military mission	CMC1.1 Allocated vs. Requested ARES duration	%	It is calculated the proportion between the time allocated for ARES after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the time initially requested by the user: Time allocated / time requested for airspace reservation/restriction. It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to Variable Profile Area (VPA), Dynamic Mobile Area (DMA), and modular types of design for ARES. The indicator supports the assessment of the impact of ASM planning and civil-military decision-making processes on the training time for military mission inside ARES.	When relevant

Category	PIs	Unit	Calculation	Mandatory
	CMC1.2 Allocated vs. Requested ARES dimension	%	It is calculated as the proportion between the volume of the ARES allocated after completing the ASM planning phase (including the civil-military CDM process for airspace configuration) and the volume initially requested by the user: $(\text{Allocated ARES surface} / \text{Requested ARES Surface}) \times (\text{Allocated FL band} / \text{Requested FL band})$. It could be calculated for an individual ARES or for a group of ARES depending on the validation scenario objectives and specifications. It is applicable to VPA, DMA, and modular types of design for ARES. It provides an indication on how closely the allocated ARES conforms to the required airspace dimensions for the execution of the training inside ARES.	

Category	PIs	Unit	Calculation	Mandatory
	CMC1.3 Deviation of Transit Time to/from airbase to ARES	+/- Minutes	It represents the difference between the transit time in the initial request of the military Airspace User and the transit time resulting from the airspace configuration processes (including the civil-military CDM for ASM). Transit time is defined as the time to be flown from the airbase of departure to the entry point in ARES or from a reference point specified by the military user to the entry point in ARES. It is applicable in situations where a time/distance constraint is defined by the military airspace user for the location of ARES. It could be calculated for individual ARES and then the results could be summed up to provide a global figure for the entire military airspace use plan. It is applicable to VPA, DMA type 1, and modular types of design for ARES. It provides an indication on the effectiveness of ARES location.	
	CMC 1.3.1 Allocated ARES duration vs. total mission duration	%	It is calculated as the difference in mean values of the ratios between time spent in DMA(s) versus total mission time (based on mid-speed) before (initial military request) and after the completion of airspace configuration (ARES allocation throughout civil-military CDM) processes. It could be calculated for individual ARES or a group of ARES depending on the missions defined in the exercise scenarios. It is applicable to VPA, DMA, and modular types of design for ARES. It supports the assessment of the achievement of military training objectives inside ARES.	

Category	PIs	Unit	Calculation	Mandatory
	CMC 1.3.2 Deviation of total mission duration by iOAT FPL validation	+/- Minutes	It is calculated as the difference between the duration of the mission in the validated iOAT FPL (Reference Mission Trajectory RMT) and the duration of the mission in the submitted iOAT FPL (Shared Mission Trajectory SMT). It could be calculated for a single or the total FPLs submitted by WOC to the Network Manager (NM). It supports the assessment of the impact of NM flight plan validation processes on the effectiveness of military Mission Trajectory planning, especially for cross border flights.	
	CMC 1.4 Rate of iOAT FPLs acceptance by NM systems	%	The indicator it is calculated as a proportion between the number of FPLs submitted by WOC to NM and the number of FPLs validated by NM systems against the flight planning and ATM route network rules. The measurements could include both of the validation and tactical flow management systems of NM or could be limited to one of them. It supports the assessment of the acceptability of military requirements and exemptions by NM systems.	
	CMC 1.4.1 Rate of iOAT FPLs acceptance by ATC systems	%	The indicator is calculated as a proportion between the number of FPLs distributed after processing by NM to ATC systems and the number of FPLs accepted by the ATC systems. It supports the assessment of the viability of IOAT FPL to ATC as well as of the ability of ATC systems to provide services to OAT flights.	

Category	PIs	Unit	Calculation	Mandatory
Contribution of CMCC to ATM performance gains	CMC2.1 Fuel and Distance saved by GAT	Kg and NM	Kg of fuel and distance saved by GAT due optimisation of the ATM network through Demand Capacity balancing and to the new ARES design and management	

Table 31: Civil-Military Cooperation and Coordination PIs.

A.10 HUMAN PERFORMANCE

Human Performance (HP) is used to denote the human capability to successfully accomplish tasks and meet job requirements. The capability of a human to successfully accomplish tasks depends on a number of variables that are usually investigated within the discipline of “Human Factors (HF)”. These are procedure and task design, design of technical systems and tools, the physical work environment, individual competences and training background as well as recruitment and staffing. HP also depends on the way in which Social Factors and issues related to Change & Transition are managed. Therefore, adequate considerations of HF and HP in all phases of development and implementation is critical to reach the objectives of SESAR2020, in terms of achieving the benefits related to human centred systems.

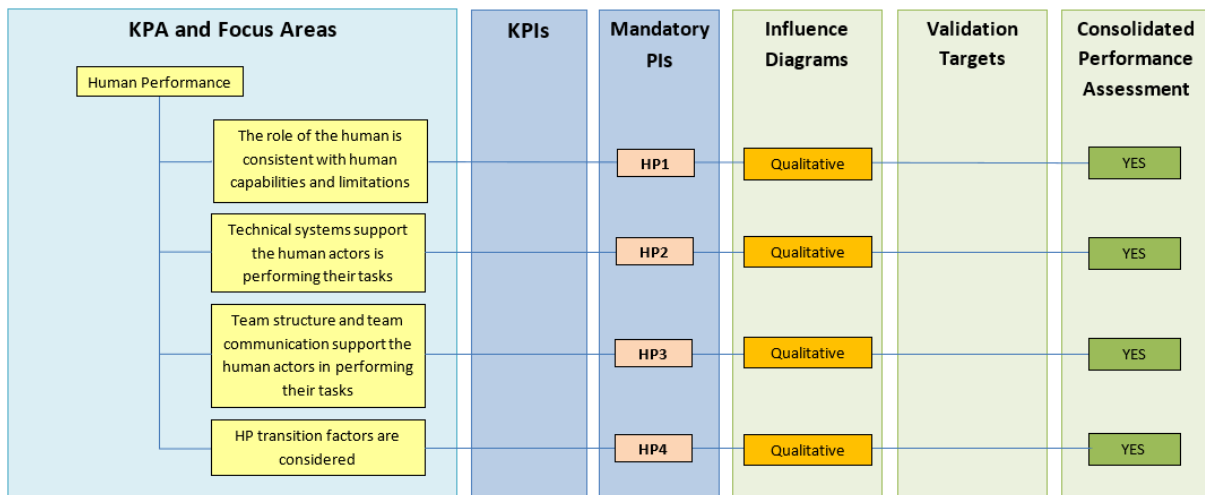


Figure 35: Human Performance Framework

Figure 36 shows the influence diagram for Human Performance.

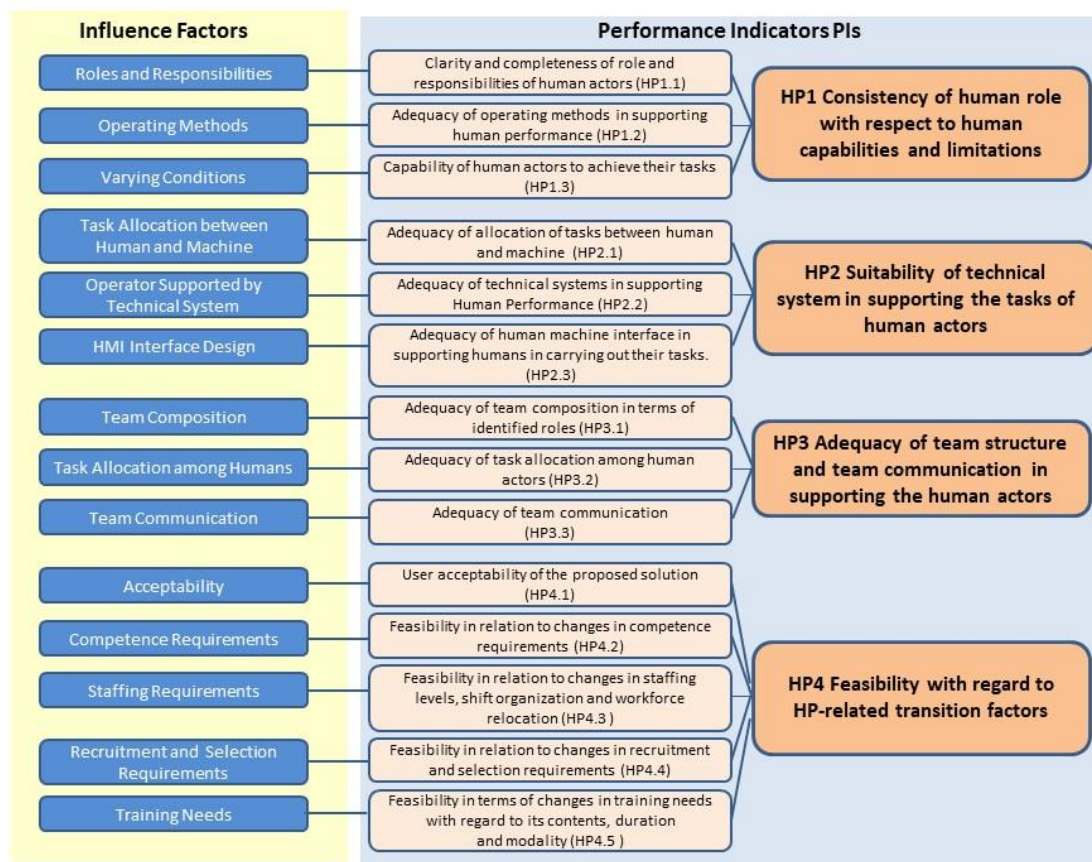


Figure 36: Human Performance Influence Diagram

The Human Performance Assessment Process (HPAP) **¡Error! No se encuentra el origen de la referencia.** serves to ensure that HP is taken into account in the SESAR Solutions.

The HPAP provides evidences on two levels: (a) HP assessments to be used at the level of SESAR Solutions (and possible integration of several Solutions) and SESAR Projects; (b) HP cases at the level of larger clusters (e.g. operational sub packages, deployment packages). In this section we are providing guidance on how the HP assessment process can support PIs assessment for the HP TA at SESAR2020 Solution level.

SESAR2020 Solutions are requested to provide the following data for each measured mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁷³, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁷⁴
- Results of the PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement.

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Carrying out an HP assessment for every operational and technical change proposed in SESAR is a requirement by SJU. As outlined above, one of the main reasons is to provide evidence that airborne and ground ATM actors will be able to contribute to the SESAR expected performance benefits. In addition, HP assessments are needed as the basis for subsequent HP and Business case-building.

In addition, the application of the HP assessment process generates outputs that can be directly used for other SESAR documentation such as SPR-INTEROP/OSED **¡Error! No se encuentra el origen de la referencia.**, VALP **¡Error! No se encuentra el origen de la referencia.**, VALR **¡Error! No se encuentra el origen de la referencia.** and technical specifications.

The Solution project team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

Table 32 below shows the mandatory PIs to assess Human Performance TA and the suggested evidence collection activity, with references to the corresponding HP assessment methods proposed in the HPAP. The methods can vary depending on the different maturity level (ranging from V1 to V3) of the proposed Solutions. A description of all the HP Activities mentioned in the column 'Assessment Methods' of the table below is available in the SESAR HP Repository at the following URL: <https://ext.eurocontrol.int/ehp/?q=Home>. To note that all PIs should be considered taking into account both normal and abnormal conditions of the operating environment as well as in degraded mode of operation.

PIs	Unit	Assessment Method	Mandatory
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

⁷³ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁷⁴ See Appendix B How should Projects Measure the KPIs? Principle 2.

PIs	Unit	Assessment Method	Mandatory
HP1.1 Clarity and completeness of role and responsibilities of human actors	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected for the description of roles and responsibilities: - contains all affected human actors - covers all identified tasks - is clear and consistent Examples of relevant HP Activities are task analyses and workshops involving users.	At least one HP1.X
HP1.2 Adequacy of operating methods (procedures) in supporting human performance	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that the operating methods (procedures): - cover normal, abnormal and degraded operating conditions - are clear and consistent - can be followed in an accurate, efficient and timely manner. Examples of relevant HP Activities are requirement identification techniques with involvement of safety and operational experts.	At least one HP1.X
HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that tasks are achieved: - in a timely manner - with limited error rate - with acceptable workload, situational awareness and task demands... Examples of relevant HP Activities are task analysis, simulations based on low fidelity mock-ups, focus groups carrying out HP Issue Analysis, questionnaires, HAZOP and ISA/NASA TLX workload measurements.	At least one HP1.X
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

PIs	Unit	Assessment Method	Mandatory
HP2.1 Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the task allocation between human and machine is appropriate and supports human performance - the transition from automatic to manual mode (and vice-versa) is properly supported - the workload induced by automation level is acceptable - the human actors can acquire an adequate mental model of the machine and its functions - the level of trust in automated functions is adequate. Examples of relevant HP Activities are, according to the different maturity levels: elicitation of task allocation requirements in accordance with 'SESAR 16.5.1 Guidance Material for HP Automation Support', (cognitive) task analysis, simulations based on low fidelity mock-ups, focus groups, think-aloud techniques, subjective and objective HP methods used in real time simulations and operational trials.	At least one HP2.X
HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the timeliness of information is adequate for carrying out the task - the accuracy of information is adequate for carrying out the task. Examples of relevant HP Activities are, according to the different maturity levels: elicitation of requirements with end-users, (cognitive) task analysis, simulations based on low fidelity mock-ups, subjective and objective HP methods used in real time simulations and operational trials.	At least one HP2.X

PIs	Unit	Assessment Method	Mandatory
HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the user information requirements are satisfied - the design of input and output devices is compliant with HF Principles and the workstation adhere to ergonomic principles - that alarms and alerts have been developed according to HF principles - the user interface design reduces human error potential and support situation awareness as far as possible - the user interface design supports team situational awareness Examples of relevant HP Activities are, according to the different maturity levels: elicitation of requirements with end-users in accordance with 'SESAR 16.5.3 Guidance for Effective Information Presentation', (cognitive) task analysis, simulations based on low fidelity mock-ups, cognitive walkthrough techniques, subjective and objective HP methods used in real time simulations and operational trials.	At least one HP2.X
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
HP3.1 Adequacy of team composition in terms of identified roles	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - The changes to existing roles and the introduction of possible new roles are properly identified. Examples of relevant HP Activities are updated description of human actors affected by the change, task analysis.	At least one HP3.X

PIs	Unit	Assessment Method	Mandatory
HP3.2 Adequacy of task allocation among human actors	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the changes to the task allocation among human actors do not lead to adverse effects - the proposed task allocation between human actors is supported by the technical system - the human error in individual and team performance is reduced - the team tasks are achieved timely and efficiently. Examples of relevant HP Activities are, according to the different maturity levels: (cognitive) task analysis, HP issues analysis, focus groups with end-users, cognitive walkthroughs, simulations based on low fidelity mock-ups, analysis of operational impacts of team errors with safety specialists, subjective and objective HP methods used in real time simulations and operational trials.	At least one HP3.X

PIs	Unit	Assessment Method	Mandatory
HP3.3 Adequacy of team communication with regard to communication modalities, technical enablers and impact on situation awareness/workload	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the intra and inter-team communication support the information requirements of team members - the phraseology supports communication in all operating conditions - the changes in communication means and modalities are identified and acceptable - the communication load is acceptable in all operating conditions. - The team members can maintain a sufficient level of SA Examples of relevant HP Activities are, according to the different maturity levels: task analysis, simulations based on low fidelity mock-ups, subjective and objective HP methods in real time simulations and operational trials, application of Situation Awareness Global Assessment Technique (SAGAT) and the Situational Awareness Rating Technique (SART).	At least one HP3.X
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
HP4.1 User acceptability of the proposed solution	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the changes in role and responsibilities are acceptable - the impact of changes on job satisfaction has been considered. Examples of relevant HP Activities to get feedback on acceptability are review of proposed roles and responsibilities with end-users, questionnaires and debriefings during real time simulations and operational trials.	At least one HP4.X

PIs	Unit	Assessment Method	Mandatory
HP4.2 Feasibility in relation to changes in competence requirements	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - knowledge, skill and experience requirements for human actors have been identified - the impact on operator licensing have been identified - the potential interferences between existing and new knowledge and skills have been identified. Examples of relevant HP Activities are Cognitive Task Analysis, use of Training and Competence Analysis Tool (TACAT) to determine training and competence assessment impact, performance of early Regulatory Impact Assessment (eRIA).	At least one HP4.X
HP4.3 Feasibility in relation to changes in staffing levels, shift organisation and workforce relocation.	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the impact on staff level is identified - the impact on shift organisation is identified - the impact on workforce relocation is identified. Examples of relevant HP Activities are use the e-tool for Social Factor Evaluation and Intervention Framework (developed in SESAR 16.4.4), use of the Selection Requirements Proactive Analysis Tool (SELAT) to determine the impacts on staff level (developed in SESAR 16.04.03).	At least one HP4.X
HP4.4 Feasibility in relation to changes in recruitment and selection requirements.	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the changes in operator profile have been identified. - the changes in selection criteria have been identified. Examples of relevant HP Activities are Cognitive Task Analysis, use of the Selection Requirements Proactive Analysis Tool (SELAT) to determine impacts on ability requirements for selection.	At least one HP4.X

PIs	Unit	Assessment Method	Mandatory
HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	Qualitative or Quantitative	In accordance with the HPAP, appropriate and sufficient evidence is collected that: - the content, duration and type of training (classroom, simulator, on-the job, e-learning and etc.) are identified. Examples of relevant HP Activities are use Training and Competence Analysis Tool (TACAT), or other relevant material developed by SESAR 16.4.3, use of the training costs estimation sheet developed by SESAR 16.6.5 and available to the CBA team.	At least one HP4.X

Table 32: Human Performance PIs.

A.11 ACCESS AND EQUITY

Access and equity in the services and benefits of SESAR Solutions is a guiding principle of the programme. In fact, SESAR is concerned only with Equity because SESAR Solutions are not expected to impede Access, which is an institutional issue.

SESAR Solutions must not result in inequitable impacts between individuals or groups of airspace users. A lack of Equity can arise if, for example, a particular airspace user or group of airspace users is subject to additional costs or additional delays. In addition, lack of Equity can arise where one user receives an advantage or net gain relative to others (i.e. where there is no direct additional cost or delay on a user but instead a relative dis-benefit for the other users). These ideas reflect the view of Equity in terms of Fairness amongst users.

The high level Access and Equity Framework is shown in Figure 37.

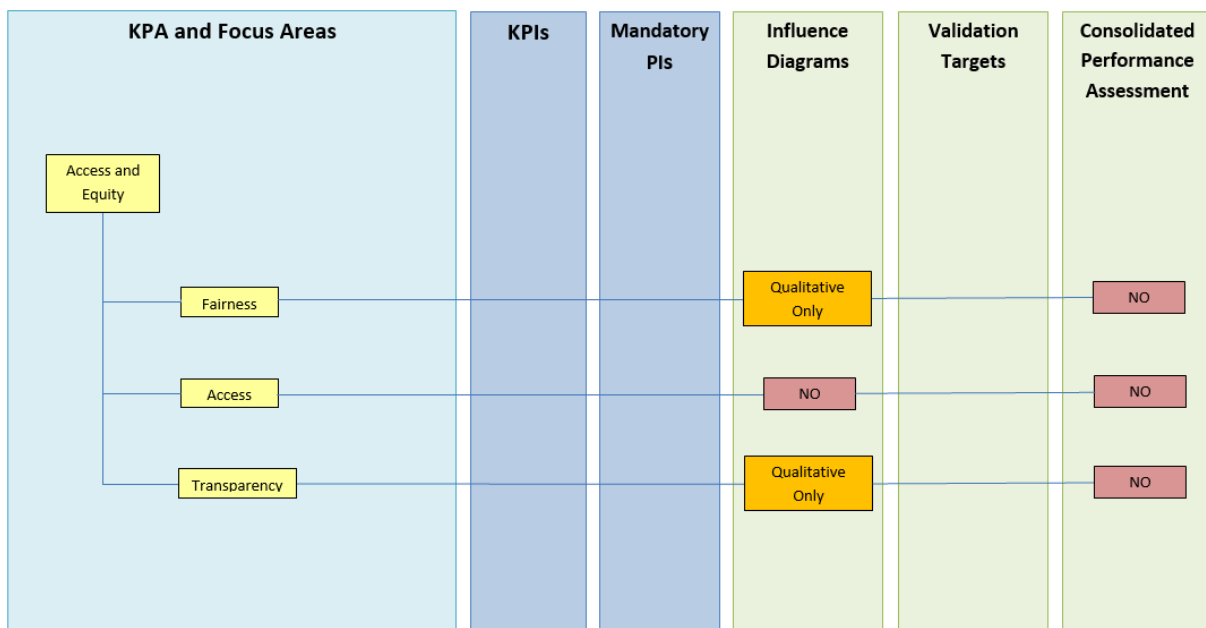


Figure 37: Access and Equity Framework KPA.

In addition, Equity is also important from the perspective that there must be no significant overall detrimental impact on the ATM system as a whole from a SESAR Solution, even if some individual or groups of airspace users are benefitting.

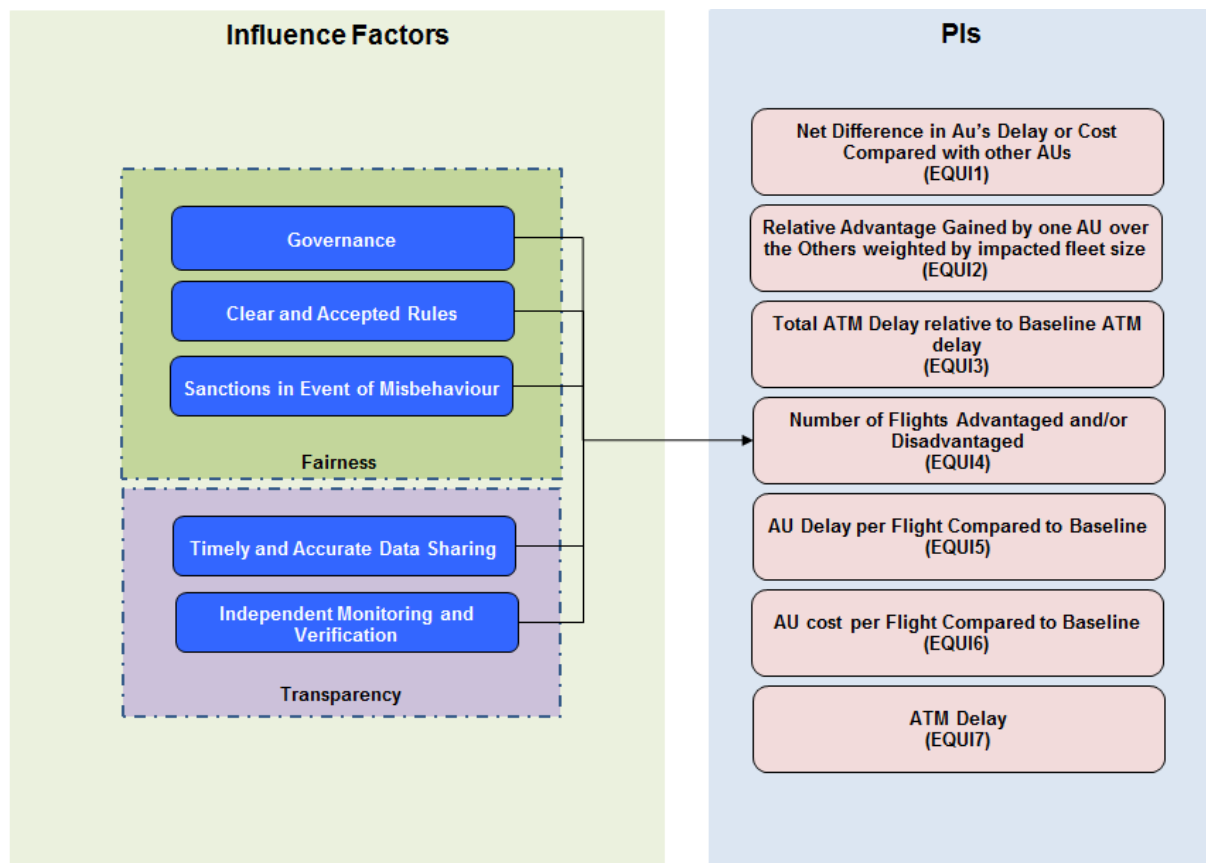


Figure 38: Access and Equity Influence Diagram.

SESAR2020 Solutions are requested to provide the following data for each measured mandatory PI or non-mandatory PI including:

- Location name measured by the exercise, category⁷⁵, OE/sub-OE, SESAR2020 Solutions, validated OI steps, ENs, deployment, equipage & fleet assumptions, exercise conditions, project.
- 2012 baseline movements and movements for assessment years (e.g. 2025, 2035)⁷⁶
- Results of the PIs listed in Table below for assessment years (e.g. 2025, 2035) and an assessment of the uncertainty of the measurement

The Solution's team has to complete the PAR template **¡Error! No se encuentra el origen de la referencia.**, which provides further details of the data and aggregated results needed by PJ19 CI.

⁷⁵ Category of airport, airspace and etc... according to DOD and PJ20 classification **¡Error! No se encuentra el origen de la referencia..**

⁷⁶ See Appendix B How should Projects Measure the KPIs? Principle 2.

Table 33 shows the non-mandatory PIs:

PIs	Unit	Calculation	Mandatory
EQUI1 Net Difference in Au's Delay or Cost Compared with other AUs	+/-%	Change in Delay (or Cost) of the AU concerned / Total Delay (or Cost) of All the AUs	NO
EQUI2 Relative Advantage Gained by one AU over the Others weighted by impacted flights	+/-%	Change in Delay (or Cost) of AU1 divided by Number of Movements of AU1 / Change in Delay (or Cost) of AU2 divided by Number of Movements of AU2	NO
EQUI3 Total ATM Delay per AU relative to Baseline ATM delay per AU	+/-%	Total delay (per airspace user) in the Solution Scenario / Total delay (per airspace user) in the Reference Scenario	NO
EQUI4 Number of Flights Advantaged and/or Disadvantaged	No.	Number of Flights impacted (+ or -) by the change	NO
EQUI5 AU Delay per Flight Compared to Baseline	%	Delay per Flight of AU concerned in the Solution Scenario / Delay per Flight of AU concerned in the Reference Scenario	NO
EQUI6 AU cost per Flight Compared to Baseline	%	Cost per Flight of AU concerned in the Solution Scenario / Cost per Flight of AU concerned in the Reference Scenario	NO

Table 33: Access and Equity PIs.

Appendix B How Should SESAR2020 Solutions measure the KPIs?

In order to ensure that the lists of KPIs and mandatory and non-mandatory PIs defined in Appendix A are correctly measured by SESAR2020 Solutions the following validation principles are required. The aim is to ensure that performance assessments and CBAs developed by Solutions are relevant, consistent, comparable and representative for all the SESAR Solutions and can be afterwards consolidated by PJ19 CI. These principles apply to both ATM Solutions and Technological Solutions.

However, there is a difference between ATM Solutions and Technological Solutions. Looking at their definitions:

- a) SESAR ATM Solution: These contain outputs from R&I activities which relate to either an operational improvement (OI) step or group of OI steps and associated enablers which have been designed, developed and validated in response to validation targets that when implemented, will deliver performance improvements to European ATM.
- b) SESAR Technological Solutions: New technology that enables future SESAR ATM Solutions, verified as feasible, safe and to support or enable ATM Performance Improvements.

According to above definitions, SESAR Technological Solutions support or enable SESAR ATM Solutions in order to deliver ATM Performance Improvements. In accordance with that, the potential benefits brought by Technological Solutions should be measured within ATM Solutions. So, if Technological Solutions have coordinated the validation of their Enablers or their support within an ATM Solution's validation (and this is reflected in their Grants or PMPs, proper functioning of the programme), their expected impacts on performance (if any identified) are allocated to that ATM Solution. This means that the Technological Solutions do not need to evaluate the KPAs on their own. Therefore, PJ19.04 does not allocate targets to the Technological Solution.

On the other hand, if the coordination is not done, two different possibilities arise. In the first one, PJ19.04 would allocate, according to its expertise, a target to the different KPAs impacted by the Technological Solution; this implies that the Technological Solution should assess the KPAs. In the second case, if PJ19.04 has not allocated a target in certain KPAs but according to Technological Solution expertise, certain KPA is impacted by it, Technological Solution should assess the target if no coordination with ATM Solution is done.

Figure 39 shows when Technological Solution should assess, on their own, certain KPAs and in consequence when to use the Performance Framework.

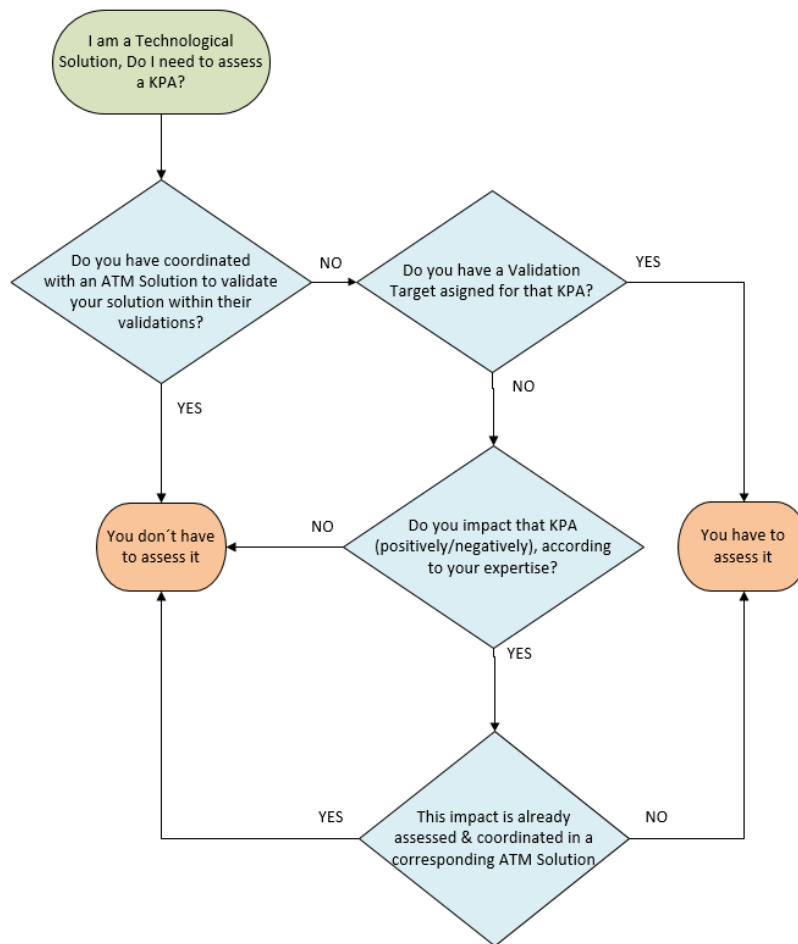


Figure 39: Technological Solutions assessment on KPAs.

Principle 1: SESAR Solutions to carry out QUANTIFIED Performance Assessment including from previous V1/V2 phases.

SESAR Solutions must provide quantified results for the KPIs and Mandatory PIs including the estimated levels of confidence⁷⁷ for every result. Quantified results should also be provided for Non-Mandatory PIs, depending on the scope of the Solutions. In general, V1 and V2 Phase results (or external non-SESAR results) are expected to be most useful in providing useful quantified results due to the controllability of the experimental environment, but so far as possible and justifiable V3 results should also be used to complement and confirm the V1 and V2 performance results.

⁷⁷ High – Results come from complementary simulations and modelling with multiple data points and scenarios and it is considered that the results might change by +/-10%

Medium – Results come from complementary simulations and modelling with multiple data points and scenarios and it is considered that the results might change by +/-25%

Low – Results come from complementary simulations and modelling with multiple data points and scenarios and it is considered that the results might change by +/-50% or greater

SESAR2020 Maturity assessment processes enable steering of the activities of the validation process itself, within V-phases as well as between them. Through continuous review of the maturity and coverage of validation content (the quality of understanding and demonstrated benefits and risks of the concept, how and where it delivers performance and etc.), it is possible to identify validation gaps and set validation objectives and priorities to enable the quantitative performance assessment to progress more effectively. A Maturity Assessment Tool is available on STELLAR to support maturity assessment.

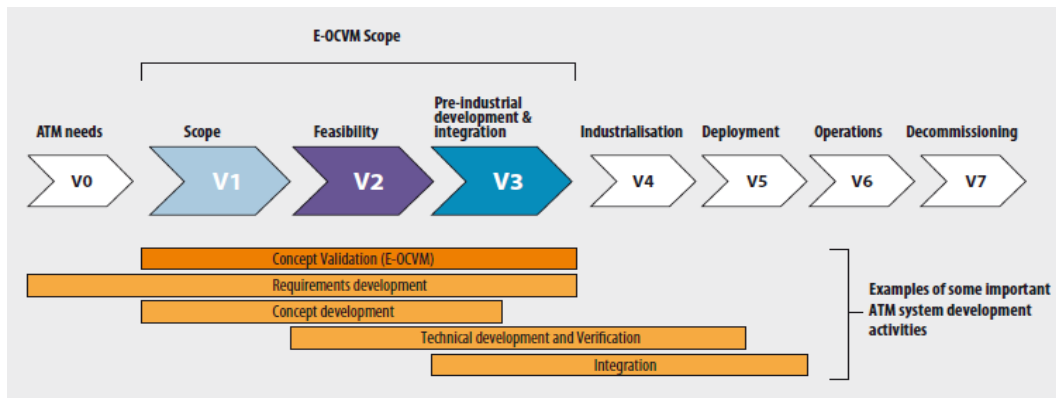


Figure 40: The Lifecycle V-Phases, validation and other ATM system development activities.

Principle 2: Projects to measure at least in two scenarios, REFERENCE and SOLUTION.

A validation exercise should demonstrate the change in performance brought about by SESAR improvements. To do this, validation exercises have to assess performance in at least two different situations. The first scenario includes traffic and operational environment including SESAR operational improvements – named the **Solution Scenario**, and a second scenario that includes the **same traffic** except without the SESAR2020 exercise’s operational improvements - named the **Reference Scenario**. In addition, the assessment of performance benefits should ideally be evaluated at two different time frames to enable trends to be derived, e.g., the IOC and the FOC of the concept being assessed⁷⁸. The exercises must be set up with the level of traffic and other assumptions, such as equipage levels, corresponding to their **IOC and FOC** dates, and reflect “business as usual”.

Furthermore, the exercises must be set up taking into account any deployment assumptions about dependencies on other concepts. This might mean, for example, that if a SESAR2020 concept relies on or builds on a SESAR1 concept, the earlier concept needs to be included in the scenarios becoming this SESAR 1 the reference scenario.

⁷⁸ The FOC date chosen in SESAR2020 is 2035, which represents the date when a significant deployment of the SESAR2020 concepts is achieved. Note that ECAC-wide FOC may not be achieved until after 2035 but this single date is chosen to permit comparison of SESAR Solution performance at SESAR2020 programme level: SESAR Solutions should indicate in the assumptions if they expect FOC will not be reached by 2035. The IOC date is chosen as 2024, representing early deployment of the SESAR Solutions concept. Note that the FOC per SESAR Solutions has been identified according to the most constraining OI.

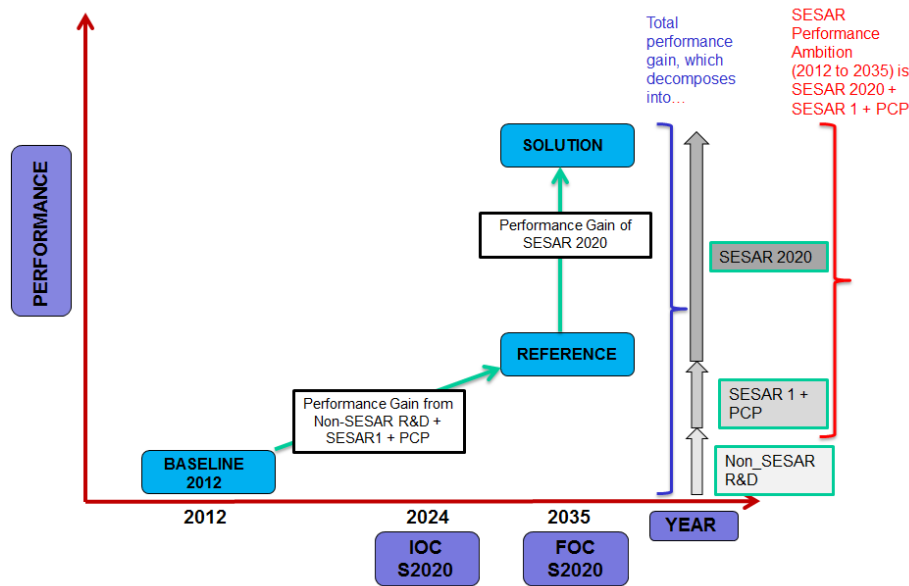


Figure 41: Baseline, Reference and Solution Performance.

Finally, to obtain an estimate of the performance contributions that the SESAR2020 solution will bring compared to the Performance Ambitions in the ATM Master Plan **¡Error! No se encuentra el origen de la referencia.** baseline values must be defined. Baseline scenario is a point of reference. The Scenario at a specific date to be used in the validation in order to perform measurements from a well-known and consistent origin. The Baseline year has been set as 2012, which is in line with the start point of the Performance Ambitions defined in the ATM Master Plan **¡Error! No se encuentra el origen de la referencia.** and in line with performance validation targets defined in PJ19.04.

The table below provides a summary of the different scenarios and important dates:

Scenario	Year
Baseline Scenario	2012
Reference Scenario	2024 (Initial Operational Capability) - Desired 2035 (Full Operational Capability) - Required
Solution Scenario	2024 (Initial Operational Capability) - Desired 2035 (Full Operational Capability) - Required

Table 34: Scenarios and Dates for SESAR2020.

Principle 3: SESAR Solutions to record all assumptions clearly - Balancing “Generic” to “Local” Assessment.

Assumptions are used to build and aggregate coherent performance measurements across SESAR2020 Solutions. Assumptions concerning airspace organisation, traffic demand and behaviour, and equipage requirements and levels (among others) need to be clearly understood and well documented if data from different exercises are to be assessed on a common basis. PJ19 CI has listed a set of common assumptions [INT11].

To address the applicability of a concept, particular emphasis should be placed on providing information to understand how results obtained at a local level in a particular operating environment

(e.g. a specific airport) or obtained in a generic operating environment can be used to construct ECAC-wide performance assessments. e-ATM portal has defined a set of categories of Operating Environments and sub-Operating Environments (at airport and airspace levels) that are to be used to indicate the representativeness of the local benefits in other environments [INT15]. In addition to documenting the applicability in terms of these defined (sub-) Operating Environments, SESAR2020 Solutions should provide more specific information about the (sub-) Operating Environments where the concept under validation is applicable that is also taken into consideration on the SESAR2020 benefit aggregation process. For example, a concept might be identified to be applicable at High Utilisation, High Complexity airports but also to only be applicable to a specific subset of named airports that are subject to frequent strong winds. In such cases, the SESAR2020 Solution must identify the specific subset.

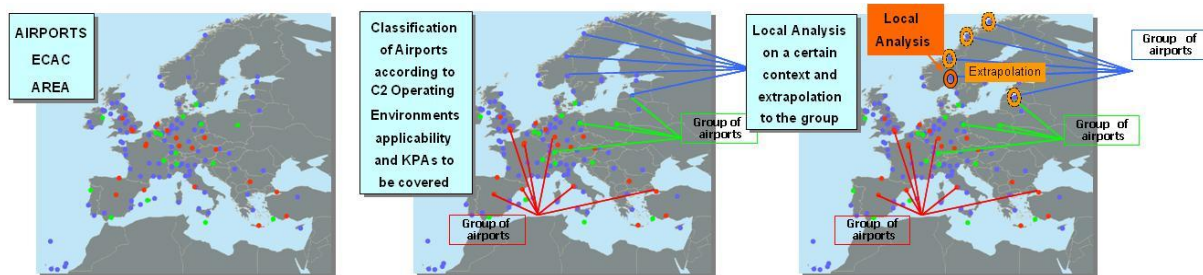


Figure 42: Assumption from local analysis to ECAC.

Principle 4: SESAR Solutions should run sufficient and representative experiments that provide results with a significant level of confidence - Application of Validation Techniques

The experimental significance and hence the confidence in the validation result can generally be improved by performing multiple experimental runs with different operating scenarios and conditions. This should be approached from two perspectives:

- Run multiple solution scenarios to explore the range of different situations under which the concept applies to explore the boundaries;
- Run multiple scenarios under the same conditions to examine the impact of randomness on the results.

These cases imply that control is applied to the exercise environment, which is achievable particularly during V2 phase where techniques such as modelling and FTS would be expected to be primary experimental methods. In the V3 phase validation environment (live/shadow / RTS) it is generally less feasible to control input parameters to enable clear comparison between scenarios. Nevertheless, projects should define and/or demonstrate an exercise reference scenario from which they can compare their validation results obtain from the solution scenario. There is also a need to relate the benefit from the Baseline scenario 2012. For example, in the case of live/shadow trials projects should be clear about representativeness of the traffic levels and operating environment, and they should extrapolate their results to the FOC.

Principle 5: Recording Data and Traceability

SESAR Solutions in VALRs record exercise results. These results are consolidated by SESAR Solutions into PARs to map individual exercise results to OIs and Solutions, and these consolidated results are recorded by the Solutions in EATMA. The SESAR Content Integration processes use these data in

EATMA and the source data (VALRs, PARs) to build the annual overall SESAR2020 Consolidated Performance Assessment.

The source data (VALRs, PARs) produced by the Solutions are particularly important as part of the data verification. For example, if assumptions have changed then some data can still be used while other may no longer be valid. This allows data to be re-evaluated and re-aggregated in later steps if necessary.

The key points to consider are:

- Consolidation of data for input to EATMA;
- The traceability of information sources must be ensured;
- Justification of quality of data provided, e.g. plausibility, coherence, completeness, as well as the level of confidence associated to the data (e.g. as more validation activities provide quantitative results, the initial estimates are revised and the level of confidence in the results should increase).

Principle 6: Aggregation of Results for Content Integration

In order that SESAR Content Integration processes can develop the annual Consolidated Performance Assessment (PAGAR), SESAR2020 Solutions as well as exercise assessment results for each KPA, the Solutions have to report assessment results at the appropriate level of aggregation when completing PARs. Justification of the aggregated performance is required, including the calculation steps. Examples for extrapolation and aggregation of validation results are included in Common Assumptions document produced by PJ19 CI **¡Error! No se encuentra el origen de la referencia..**

The aggregation level depends on the KPA. In some KPAs (e.g. Safety, Environment, Cost efficiency (ATCO Productivity), Predictability, Efficiency, Civil-Military cooperation and coordination, Flexibility, Access and Equity the aggregation is to ECAC-wide level whereas for others (e.g. Security, Environment (Noise, Local Air Quality), Capacity (Airport, Airspace, Human Performance, Resilience) the typical unit (ACC, airport) level benefit must be reported.

The following figure shows the consolidation process of individual SESAR Solutions performance assessments and CBAs to build the PAGAR and Business Case. Further information can be found in Methodology for Performance Assessment Results Consolidation **¡Error! No se encuentra el origen de la referencia..**

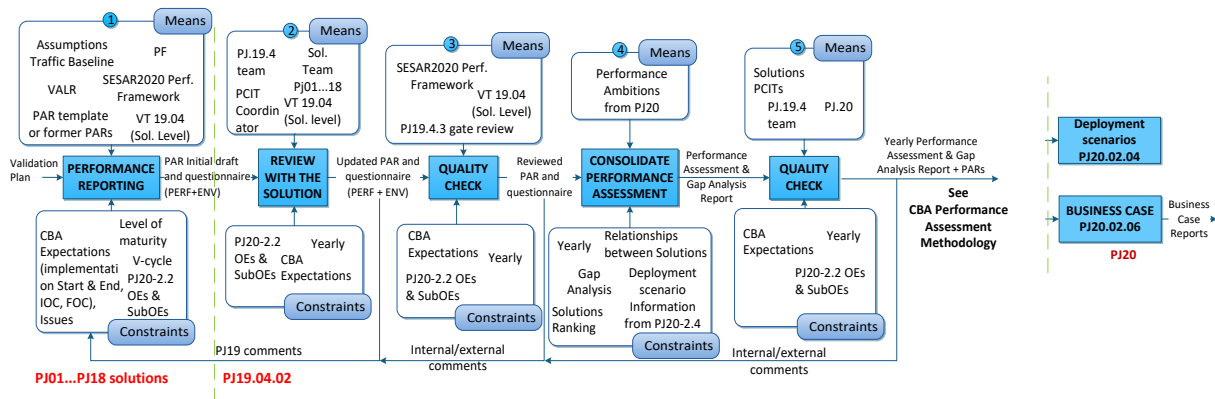


Figure 43: Performance consolidation process

Principle 7: Selection of KPIs/Pis

SESAR Solution must review the KPIs and PIs for each KPA described in Appendix A when developing their VALPs and also identify what target have been set and which indicators to report. In addition, each KPI and PI must be reviewed to determine its applicability to the concept and the exercise. All Mandatory KPIs/Pis must, as a principle, be reported on even if the expected or assessed performance impact is zero.

- Concept applicability: does the concept have the potential to impact on the KPI/PI? If not, this must be justified in the VALP. The Benefit & Impact Mechanisms help in deciding on these impacts.
- Exercise applicability: does the exercise have the potential to impact on the KPI/PI? If not, but the KPI/PI might impact on the concept this must be explained in the VALP so that the KPI/PI can be assessed in other ways.

The conclusion of this analysis should be reviewed with the Content Integration Performance team.