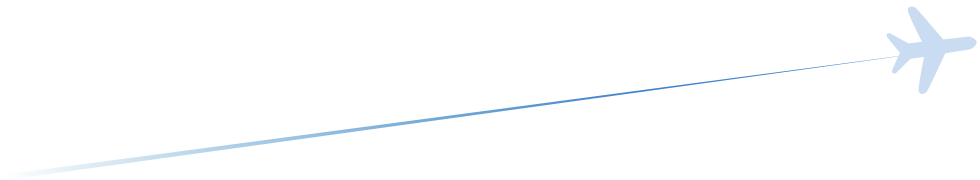

SESAR Solution 05.02 SPR/INTEROP-OSED for V3 - Part V - Performance Assessment Report (PAR)

Deliverable ID:	**D2.4**
Dissemination Level:	**CO**
Project Acronym:	**Multiple Remote Tower**
Grant:	**730195**
Call:	**[H2020-SESAR-2015-2]**
Topic:	**PJ.05.02-V3**
Consortium Coordinator:	**AT-One**
Edition Date:	**15 July 2019**
Edition:	**00.01.01**
Template Edition:	**02.00.01**

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EUROPEAN UNION EUROCONTROL

SESAR JOINT UNDERTAKING

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Document History

Edition	Date	Status	Author	Justification
00.00.01	02/05/2019	Draft	S. Pastore Carbone M. Molinario	First Draft

00.00.02	24/05/2019	Draft	S. Pastore Carbone M. Molinario	Template change and All Sections Updated
00.00.03	16/06/2019	Draft	L. Carbo	Safety Section Updated
00.01.00	09/07/2019	For Review	S. Pastore Carbone M. Molinario A.D. Schmitz	Cost Efficiency and Human Performance Sections Updated
00.01.00	15/07/2019	Final	M. Filipp S. Pastore Carbone M. Molinario	Final
00.01.01	31/10/2019	Final	M Filipp S Widell N Veljanovski	Update after PJ.19 review

Copyright Statement

PJ05 Multiple Remote Tower

REMOTE TOWER FOR MULTIPLE AIRPORTS

This Performance Assessment Report V3 is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 730195 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document is the V part of the concept document for the Solution 02 of the Project PJ05 Remote Tower.

This document describes the Validation Report for PJ05-Solution 02. The objective for PJ.05-02 is to develop and validate a Multiple Remote Tower Module (MRTM) that allows the ATCO to maintain situational awareness for 2 or 3 airports simultaneously targeting V3 maturity. PJ05-Solution 03 is connected solution developing and validating Remote Tower Centre functionalities.

- 2 aerodromes, category small environment airports, 15.000 to 40.000 annual movements
- 3 aerodromes, category other environment airports, 0 up to 15.000 annual movements

The document contains the (V3) Performance Assessment Report related to the concept. The contents are based on the results of the V3 validation exercises performed at the Solution.

The addressed OI step is:

SDM-0207: Multiple Remote Tower Module, MRTM (for up to 3 airports).

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1 Executive Summary

This document provides the Performance Assessment Report (PAR) for PJ05.02 – Multiple Remote Tower

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

Description:

PJ.05.02 main driver is increased cost efficiency by an increase of ATCO productivity. The increase of ATCO productivity is reached with the Multiple Remote Tower concept where one ATCO controls more than one aerodrome. The goal for all of the validation exercises was to validate two or three aerodromes controlled simultaneously by one ATCO with a total traffic level of 15 to 20 movements per hour. This compared to SDM-0205 which in SESAR 1 validated approximately 6 movements per hour.

This to enlarge the scope of the multiple remote tower solutions addressing higher traffic volumes and more type of airports that can be simultaneously controlled by one ATCO in. The validations focus on evaluation of human performance and safety aspects.

More Information can be found in Chapter 2!

Assessment Results Summary:

The following tables summarises the assessment outcomes per KPI (Table 1) and mandatory PI (Table 2) puts them side-by side against Validation Targets in case of KPI from PJ19 [18]. The impact of a Solution on the performances is described in Benefit Impact Mechanism. All the KPI and mandatory PI from the Benefit Mechanism were the Solution potentially impact have to be assessed via validation results, expert judgment etc.

There are three cases:

1. An assessment result of 0 with High, Medium or Low confidence level indicates that the Solution is expected to impact in a marginal way the KPI or mandatory PI.

2. An assessment result (positive or negative) different from 0 with confidence level High, Medium or Low, indicates that the Solution is expected to impact the KPI or mandatory PI.

3. An assessment result of N/A (Not Applicable) with confidence level N/A indicates that the Solution is not expected to impact at all the KPI or mandatory PI consistently with the Benefit Mechanism.

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide)[1]	Confidence in Results[2]
FEFF1: Fuel Efficiency – Fuel burn per flight	0.000%	N/A	N/A
CAP1: TMA Airspace Capacity – Throughput / airspace volume & time	0.000%	N/A	N/A
CAP2: En-Route Airspace Capacity – Throughput / airspace volume & time	0.000%	N/A	N/A
CAP3: Airport Capacity – Peak runway throughput (mixed mode) flights/hour	0.000%	N/A	N/A
PRD1: Predictability – Flight duration variability, against RBT	0.000%	N/A	N/A
PUN1: Punctuality – % AOBT within +/- 3 minutes of SOBT	0.000%	N/A	N/A
RES1: Airport Resilience – % avoided loss of capacity	0.000%	N/A	N/A
RES2: Airspace Resilience – % Avoided loss of capacity	0.000%	N/A	N/A

[1] Negative impacts are indicated in red.

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

CEF2: ATCO Productivity – Flights per ATCO hour	1.333%	2.79%	Low
CEF3: Technology Cost – Cost per flight	0.000%	N/A	N/A

Table 1: KPI Assessment Results Summary

Mandatory PI	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[3]	Confidence in Results[4]
SAF1.X: Mid-air collision – En-Route	N/A	N/A
SAF2.X: Mid-air collision – TMA	N/A	N/A
SAF3.X: RWY-collision accident	N/A	Medium
SAF4.X: RWY-excursion accident	N/A	Medium
SAF5.X: TWY-collision accident	N/A	Medium
SAF6.X: CFIT accident	N/A	Medium
SAF7.X: Wake related accident	N/A	N/A
SEC1: A security risk assessment has been carried out	N/A	N/A
SEC2: Risk Treatment has been carried out	N/A	N/A
SEC3: Residual risk after treatment meets security objective.	N/A	N/A
SEC7: Personnel (safety) risk after mitigation	N/A	N/A
SEC8: Capacity risk after mitigation	N/A	N/A

[3] Negative impacts are indicated in red.

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

SEC9: Economic risk after mitigation	N/A	N/A
FEFF2: CO2 Emissions.	N/A	N/A
FEFF3: Reduction in average flight duration.	N/A	N/A
NOI1: Relative noise scale	N/A	N/A
NOI2: Size and location of noise contours	N/A	N/A
NOI4: Number of people exposed to noise levels exceeding a given threshold	N/A	N/A
LAQ1: Geographic distribution of pollutant concentrations	N/A	N/A
CAP3.1: Peak Departure throughput per hour (Segregated mode)	N/A	N/A
CAP3.2: Peak Arrival throughput per hour (segregated mode)	N/A	N/A
CAP4: Un-accommodated traffic reduction	N/A	N/A
RES1: Loss of Airport Capacity Avoided	N/A	N/A
RES1.1: Airport time to recover from non-nominal to nominal condition	N/A	N/A
RES2: Loss of Airspace Capacity Avoided.	N/A	N/A
RES2.1: Airspace time to recover from non-nominal to nominal condition.	N/A	N/A
RES4: Minutes of delays.	N/A	N/A
RE5: Number of cancellations.	N/A	N/A
CEF1: Direct ANS Gate-to-gate cost per flight	0.753%	Low
AUC3: Direct operating costs for an airspace user	N/A	N/A
AUC4: Indirect operating costs for an airspace user	N/A	N/A
AUC5: Overhead costs for an airspace user	N/A	N/A
CMC1.1: Available/Required training Duration within ARES	N/A	N/A
CMC1.2: Allocated/ Optimum ARES dimension	N/A	N/A

CMC1.3: Transit Time to/from airbase to ARES	N/A	N/A
CMC2.1: Fuel and Distance saved (for GAT operations)	N/A	N/A
CMC2.2: GAT planning efficiency of Available ARES	N/A	N/A
HP1: Consistency of human role with respect to human capabilities and limitations	N/A	Medium
HP2: Suitability of technical system in supporting the tasks of human actors	N/A	Medium
HP3: Adequacy of team structure and team communication in supporting the human actors	N/A	Medium
HP4: Feasibility with regard to HP-related transition factors	N/A	Medium
FLX1: Average delay for scheduled civil/military flights with change request and non-scheduled or late flight plan request	N/A	N/A

Table 2 Mandatory PIs Assessment Summary

Additional Comments and Notes:

The confidence in the results regarding CEF2 is High due to the fact that all performed validation exercises provided benefits in terms of ATCOs

For CEF2, the performance assessment exceeds the Validation targets because it has been considered the application of the solution to small and other environment airports. The target OE of solution PJ.05-02 has been changed from medium + small airports to small + other airports, there is an incongruence among Validation Target allocated by PJ.19 and the results obtained from simulations. In any case, performed validation exercises provided subjective evidence that ATCOs are able to manage simultaneous movements with an improvement in terms of ATCOs number with respect to reference scenario. Since the assessment is subjective, the confidence level is Low.

Performed validation exercises had provided only qualitative results regarding SAF and HP but the confidence in them is considered Medium as all validation exercises addressed and confirmed the obtained results

2 Introduction

2.1 Purpose of the document

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

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

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

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

2.2 Intended readership

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

Produced by the Solution project, the main recipient in the SESAR performance management process is PJ19, which will collect and combine KPI results at network level and provide the data to PJ20 for considering the performance data for the European ATM Master Plan.

2.3 Inputs from other projects

The document includes information from the following SESAR 1 projects:

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

PJ19 will manage and provide:

- PJ19.04.01 D4.1: Performance Framework (2017), guidance on KPIs and Data collection supports.
- PJ19.04.03 D4.0.1: S2020 Common assumptions, used to aggregate results obtained during validation exercises (and captured into validation reports) into KPIs at the ECAC level, which will in turn be captured in Performance Assessment Reports and used as inputs to the CBAs produced by the Solution projects. Where are also included performance aggregation assumptions, with traffic data items.

- For guidance and support PJ19 have put in place the Community of Practice (CoP)[5] within STELLAR, gathering experts and providing best practices.

2.4 Glossary of terms

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

2.5 Acronyms and Terminology

Term	Definition
ACC	Area Control Centre
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATS	Air Traffic Service
BAD	Benefits Assessment Date
BAER	Benefit Assessment Equipment Rate
CBA	Cost Benefit Analysis
CFIT	Controlled Flight into Terrain
CTR	Control Zone
CWP	Controller Working Position
E-ATMS	European Air Traffic Management System

5 https://stellar.sesarju.eu/?link=true&domainName=saas&redirectUrl=%2Fjsp%2Fproject%2Fproject.jsp%3FobjId%3Dxrn%3Aview%3Axrn%3Adatabase%3Aondb%2Ftable%2F59_anonymous%402333834.13%403834139.13

ECAC	European Civil Aviation Conference
IFR	Instrument Flight Rules
KPA	Key Performance Area
KPI	Key Performance Indicator
MRTM	Multiple Remote Tower Module
N/A	Not Applicable
OE	Operational Environment
OI	Operational Improvement
PAR	Performance Assessment Report
PI	Performance Indicator
PRU	Performance Review Unit
PTZ	Pan-Tilt-Zoom
RBT	Reference Business / Mission Trajectory
RTC	Remote Tower Centre
RTM	Remote Tower Module
SESAR	Single European Sky ATM Research Programme
SESAR2020 Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SWIM	System Wide Information Management
TMA	Terminal Maneuvering Area

Table 3: Acronyms and terminology

3 Solution Scope

3.1 Detailed Description of the Solution

PJ05.02 goal is to enlarge the scope of the multiple remote tower solutions addressing 2 Small environment or 3 Other environment airports controlled from a single ATCO from one MRTM. This will enable larger airports to be controlled from one ATCO thus reducing cost for local Air Traffic Service. The validations focus on evaluation of human performance and safety aspects.
The validations for PJ.05-02 aimed to develop and validate a MRTM that allows the ATCO to maintain situational awareness for 2 small environment airports or 3 other environment airports simultaneously with the following traffic characteristics regarding simultaneous movements (including mix of IFR and VFR):

- 20 movements per hour is possible for 2 ADs in category Small environment airports paired in a MRTM. Annual traffic levels between 15.000 and 45.000 movements
- 15 movements per hour is possible for 3 ADs in category Other environment airports paired in a MRTM. Annual traffic levels between 0 and 15.000 movements
- Even more traffic occurred in some scenarios. Increased workload can occur due to other reasons. Examples to mitigate a high workload due to different situations are;
    - Split of one or more aerodromes
    - Support from back up staff
    - Delay traffic, e.g. hold traffic on ground or VFR outside CTR
    - Temporary traffic termination at one of the aerodromes
    - Closure of an airport as last option.

The traffic characteristics are just providing an **indication of the traffic volumes** – traffic volumes in specific situations might deviate from this indication depending on traffic complexity and other factors influencing workload. Traffic volumes in this document refer to the amount of movements per hour at each airport.

In order to be able to allow more airports and/or higher traffic volumes to be controlled simultaneously from one MRTM compared to SESAR 1 solution #52 or #12, the solution validates advanced features of the visual reproduction as well as additional voice services being integrated into the MRTM.

It is assumed that an ATCO can hold endorsements for up to 3 (single) different airports.

There is a fixed allocation of airports to a set of MRTMs. In order to balance ATCO workload and traffic volumes, the ATCO can split a MRTM if required. The ATCO is supported in evaluating traffic volumes and workload by a planning tool that considers the grouped/clustered airports.

EATMA airport definitions used for the validations:

- Other environment airports – 0 up to 15.000 annual movements
- Small environment airports – 15.000 up to 40.000 annual movements

Example airports for deployment are for 2 Small airport environment; ESMS, Malmö-Sturup, ESSV-Visby, EDDR-Saarbrücken, EDDC-Dresden, EHTW-Twente, EICK-Cork.

Example airports for deployment are for 3 Other environment airports; ESNO-Örnsköldsvik, ENHD-Haugesund, ENBO-Bodö, LHDC-Debrecen,

A short description of the Solution can be found in the Executive Summary!

3.2 Detailed Description of relationship with other Solutions

Solution Number	Solution Title	Relationship	Rational of the relationship and calculation of the solution's aggregation
PJ.16-04	Workstation, Controller productivity	Compatible independent for PJ05.02	Project 16.4.2 will provide enhanced voice services (CTE-C14 – Advanced Voice Services) that can be used to support the controller, which is optional in multiple remote tower. Under those conditions, where the ATCO provides ATS for more than one airport simultaneously, the task load increases. The higher task load will increase the ATCO workload, which makes the air traffic control process more failure-prone. A mitigation means might be increased. Highlighting frequency calls in the visual presentation, can establish a better situational awareness
PJ.05.03	Highly flexible allocation of aerodromes from a RTC	Compatible pre-requisite to flexible allocation within an RTC.	PJ.05.02 deliver results on development and needs for a Multiple Remote Tower Module and how parameters effect distribution of aerodromes between MRTMs in an RTC.

Table 4. Interactions with other Solutions

4 Solution Performance Assessment

4.1 Assessment Sources and Summary of Validation Exercise Performance Results

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

Organisation	Document Title	Publishing Date
NORACON	SESAR1 P6.9.3 D13 – Remotely Provided Air Traffic Services for Two Low Density Aerodromes Validation Report	31/08/2015
DFS	SESAR1 P6.8.4 D94 - OSED Single Remote Tower	27/07/2016

Table 5: Pre-SESAR2020 Exercises

SESAR V3 Validation Exercises of this Solution are listed below.

Exercise ID	Exercise Title	Release	Maturity	Status
EXE-05.02-V3-002 – COOPANS	Remotely Provided Air Traffic Service for Multiple Aerodromes for two small density aerodromes	R9	V3	Completed
EXE-05.02-V3-003 - INDRA	Multiple Remote Tower Module for up to three simultaneous aerodromes	R9	V3	Completed
EXE-05.02-V3-004-FSP	The ATS provision by one ATCO at a time to two other size aerodromes and a medium-sized aerodrome including a military aerodrome from a MRTM.	R9	V3	Completed
EXE-05.02-V3-005 – ENAV	Remotely Provided Air Traffic Service for Multiple Aerodromes for two aerodromes	R9	V3	Completed

Table 6: SESAR2020 Validation Exercises

The following table provides a summary of information collected from available performance outcomes. For detailed information see the PJ.05-02 VALR.

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
EXE-05.02-V3-002 –	SDM 0207 - Remotely Provided Air	Real Time Simulation aimed to develop and validate the MRTM to allow a single ATCO to	Results show that capacity of in total 20 movements can be	

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
COOPANS	Traffic Services for Two Low-density Aerodromes	conduct Air Traffic Control and maintain situational awareness for 2 small sized aerodromes simultaneously with the following traffic characteristics regarding simultaneous movements (including mix of IFR and VFR and vehicle traffic): - 2 airports with 4 to 5 simultaneous movements in total - 10 - 20 movements (a/c and vehicles) in total per hour for the connected aerodromes	handled in Multiple mode. This enables deployment of the concept for aerodromes with 5 to 15 movements per hour depending on distribution over the aerodromes paired together. Goal was to keep requested level of capacity for small environment aerodromes without delays for commercial traffic or a need for change of traffic schedules due to staggering needs of traffic between the aerodromes. A safe service is a must wherefore safety was the key area to measure in questionnaires. The only deployed solution when validations occurred is Single Remote Tower for small and medium density aerodromes. Capacity could be maintained during the validations indicating that one ATCO controlling each aerodrome can in Multiple mode be replaced by one ATCO controlling 2 simultaneous aerodromes.	
EXE-	SDM 0207 -	The objective of this exercise	Results show that	

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
05.02-V3-003 – INDRA	Remotely Provided Air Traffic Services for Two Low-density Aerodromes	was to assess the ATCO capability when providing ATS to three aerodromes at a time from an integrated Controller Working Position. The ATCO covered the roles of Clearance Delivery, Ground Controller and Tower Runway Controller for the three aerodromes simultaneously. The validation addressed the situation awareness, maximum total amount of traffic per hour in a Multiple Remote Tower Module (MRTM) and maximum simultaneous movements handled by the ATCO.	capacity of up to 25 movements for three aerodromes may be handled by one controller in one MRTM. Safety was not compromised during the validation. It was seen that with a high workload, efficiency was slightly lowered in some situations as the controller needed to hold traffic while dealing with other situations.	
EXE-05.02-V3-004- FSP	SDM 0207 - Remotely Provided Air Traffic Services for Two Low-density Aerodromes	The objective was the assessment of the ATCO's capability to provide ATS to three small sized aerodromes simultaneously, taking into account situational awareness, amount of traffic handled over time and at a time, complexity of traffic distribution over the aerodromes. One aerodrome had different wind shear warnings to support the ATCOs. The ATCO had the roles of Clearance Delivery, Ground Controller and Tower Runway Controller for all three aerodromes simultaneously. The exercise was a real-time simulation on three aerodromes had adapted traffic levels to fit the objectives of the exercise.	Results indicate a good situational awareness that is not considerably impaired by providing ATS to three aerodromes at a time. Overall workload remained at a medium level. ATCOs experienced no major problems foreseeing traffic to plan ahead. This was due to the efficient short-term planning tool, which was most frequently set to 30 minutes (up to 90 minutes was possible). The given traffic volume (21 mov/h) was set high in order to challenge ATCOs and reveal safety issues. The additional abnormal situations	Nominal and non-nominal events explored

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
			added up to the complexity. As the communication requirements have mounted up, ATCOs' workload consequently increased. Yet, there were no safety-critical situations reported. No problems were reported with the unplanned RWY closure. Even during the induced emergency, ATCOs only stated to have caused delays. While capacity to control the traffic was generally acceptable for the majority, the amount of R/T experienced was considered too high. Communication capacity is therefore seen as a bottleneck, which would also impact workload, and therefore a challenge to be addressed with adapted systems and strategies. If the amount of traffic is kept at approx. 20 mov/h, and the complexity is high, more technical support or supporting staff is required to provide continuous high-quality ATC and to keep workload within acceptable range.	

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
			The data reveal most of the ATCOs felt that MRT was appropriate to control the traffic on all three aerodromes. Individual differences can be attributed to individual satisfaction with the performance during challenging situations. Taking into account the high traffic volume and abnormal situations induced, MRT operating methods can be seen as a valid tool for controlling three aerodromes at a time. Yet, if the amount of traffic should be kept at approx. 20 mov/h, and the traffic is complex, a second ATCO or support staff is recommended to help with communication and coordination in order to facilitate high-quality ATC. Otherwise traffic levels should be reduced for MRTM operations with three aerodromes.	
EXE-05.02-V3-005 – ENAV	SDM 0207 - Remotely Provided Air Traffic Services for Two Low-density Aerodromes	Real Time Simulation with the aim to assess the ATCO capability when providing ATS to two aerodromes from an ad-hoc developed MRTM and under varying traffic volume and traffic complexity conditions.	The results obtained by the Real Time Simulation are significant for the HP and SAF Assessment and note a positive trend in the evaluations received. The ATCOs had highlights not any specific issue neither in terms of mental	Nominal and non-nominal events explored

Exercise	OI Step	Exercise scenario & scope	Performance Results	Notes
			workload or situational awareness but highlighted that the effective implementation of this new operating method needs accurate case-by-case assessment according to scenarios considered. They reported a positive expectation regarding the level of provided service by which the overall manage of two aerodromes simultaneous will be potentially improved.	

Table 7: Summary of Validation Results.

4.2 Conditions / Assumptions for Applicability

The following Table 8 summarises the applicable operating environments.

OE	Applicable sub-OE	Special characteristics
Airport	Other	An Other Airport Operating Environment corresponds to the aerodrome movement area and the volume of controlled airspace around an airport with a number of annual movements less than 15000, where a movement is either an IFR departure or an IFR arrival.
Airport	Small	A Small Airport Operating Environment corresponds to the aerodrome movement area and the volume of controlled airspace around an airport with a number of annual movements greater or equal to 15000 and less than 40000, where a movement is either an IFR departure or an IFR arrival.

Table 8: Applicable Operating Environments.

The following Table 9 summarises the essential deployment details.

BAD	Specific geographical and/or stakeholder deployment
30-06-2030	Deployment in Other and Small Airports

Table 9: Deployment details.

Equipage details and how equipage influences benefits in the ramp-up phase is given in Table 10.

Min flight equipage rate	Opt flight equipage rate	BAER	AUs that need to equip	Start of flight equipage	End of flight equipage
N/A	N/A	N/A	N/A	N/A	N/A

Table 10: Influence of Equipage on benefits.

Some assumptions were done to perform validation as below listed:

- PTZ control to be accurate due to the nature of simulation platform;
- Object bounding to be accurate due to the nature of simulation platform;
- Controllers to be familiar with environment and tools;
- Each ATCO can hold up to 3 local endorsements.

Other:

Visual reproduction is critical to maintain standards and rules for separation. Visual reproduction quality is crucial for the ATCOs a possibility to monitor traffic visually.

It was shown that a harmonisation of airspace and methods, e.g. VFR traffic procedures, would be beneficial for ATCOs working with Multiple aerodromes.

ATCOs need training and continuity for more than one aerodrome to keep endorsement for all ADs.

4.3 Safety

The information reported here refers to V3 phase outcomes of PJ05 Solution 2; it has been collected from the Safety Plan – SafPL [48] and the Safety Assessment Report – SAR [43], both available in STELLAR in PJ05 folder (for more detail refer to those documents).

4.3.1 Safety Criteria and Performance Mechanism

Safety Criteria are defined considering risk targets for each aerodrome when ATC service is provided through Remote Towers. They set the acceptable level of safety for Multiple Remote Tower as being at least the same as for Single Remote Tower.

The Safety Criteria presented as risk targets are detailed in the Section 3.5 of the SAR-PJ05.02-V3 [43]. They define the level of safety for Multiple Remote Tower concept with respect to:

- Mid-Air Collision in TMA and CTR area
- Controlled Flight into Terrain (CFIT)
- Wake Vortex Induced Accidents
- Taxiway Collision
- Runway Collision
- Runway Excursion
- Landing accidents

No traffic increase is foreseen with the introduction of Multiple Remote Tower; this solution is mainly driven by cost-efficiency.
No dependencies with other Solutions have been identified.

The OI step being addressed in PJ05-02 is: SDM-0207. It is fully covered in the safety assessment for the provision of ATC services (AFIS does not have more requirements on the RTC than ATS).

4.3.2 Data collection and Assessment

The information reported here has been extracted from sections 3.10 and 3.11 from the SAR-PJ05.02-V3 [43]Error! Reference source not found.:

As for Single Remote Tower, no quantitative evidence on the achievability of the Safety Criteria through the specification of the Safety Objectives has been collected for Multiple Remote Tower.

From the Safety Criteria listed in section 3.5 of the SAR-PJ05.02-V3 [43], and following the SRM process, the Safety Objectives and Operational Hazards have been developed and identified. Therefore the Safety Criteria are implicitly achieved through the demonstration of the before mentioned.

The Validation Report [47] captured the Safety Validation Objectives, among others. These Safety Validation Objectives were covered by the Validation exercises and/or the HP and Safety workshop (see Appendix E of the SAR-PJ05.02-V3 [43] and Appendix C of the Validation Report [47]).

Appendix A.4 of the SAR-PJ05.02-V3 [43] presents the traceability table that links the Safety Objectives covering all Safety Validation Objectives.

All **nominal** Safety Objectives have been covered by either the Validation exercises or the Safety and HP workshop. Particularities on how to implement different aspects are to be developed in local implementation and therefore considered covered in V3.

The Safety Validation Objectives for **abnormal conditions** were validated in some cases during Validation Exercises. Discussions show that the Multiple Remote Tower setting would not impede ATCOs to deal with abnormal situations, although further assessment needs to be conducted locally for implementation, including the mitigations (additional ATCO, silent communication, etc.).

As in the previous case, the Safety Validation Objectives related to **degraded modes** of operations have been partially covered during the validations and discussions during the HP and Safety workshop. At this stage of V3 we observe that further assessment before implementation needs to be performed before we can consider that this solution is ready for implementation. We consider that at V3 this is OK as the degraded modes need to be studied locally.

In addition, Table 19 of the SAR-PJ05.02-V3 [43] assesses the achievability of the Safety Criteria via the coverage of those by the validated Safety Requirements.

Issue: evidences collected for abnormal and failure conditions are mainly subjective feedback from operational people involved in the project and in the validation exercises, together with some scenarios that were simulated but that do not cover all cases. This feedback has been collected by questionnaires and group discussions in a Safety and Human Performance workshop with ATCOs in Brussels, 03-04 April 2019.

4.3.3 Extrapolation to ECAC wide

The results obtained from the validation activities are for the moment limited to a specific set of aerodromes, in terms of layout and configuration (only aerodromes with one active runway were tested) as well as in terms of traffic (up to 20 movements per hour).

These results could be extrapolated to similar aerodromes in ECAC, meaning that the level of safety would not be degraded when remotely providing ATC service to up to three of them from the same module (even if abnormal and degraded modes still need to be further assessed).

Further definition for an MRTM is expected at local level, hence extrapolation to ECAC wide is not relevant for this solution.

4.3.4 Discussion of Assessment Result

This solution is not safety driven. However, some remaining work to be done is mentioned in the SAR-PJ05.03-V3[43] regarding the testability of the Safety Requirements and the lack of quantitative data. This, together with the rest of recommendations for future activities, needs to be addressed before future implementation.

4.3.5 Additional Comments and Notes

No additional comments and notes.

4.4 Environment / Fuel Efficiency

N/A for PJ.05.02

4.5 Environment / Noise and Local Air Quality

N/A for PJ.05.02

4.6 Airspace Capacity (Throughput / Airspace Volume & Time)

N/A for PJ.05.02

4.7 Airport Capacity (Runway Throughput Flights/Hour)

4.7.1 Performance Mechanism

The goal for all validations was to validate peak traffic levels equal to the type of aerodromes validated within each scope. This to ensure that results from the solution will fit a deployment with kept capacity at each aerodrome in peak time.

Aerodrome capacity will not change with Multiple Remote Tower Operations.

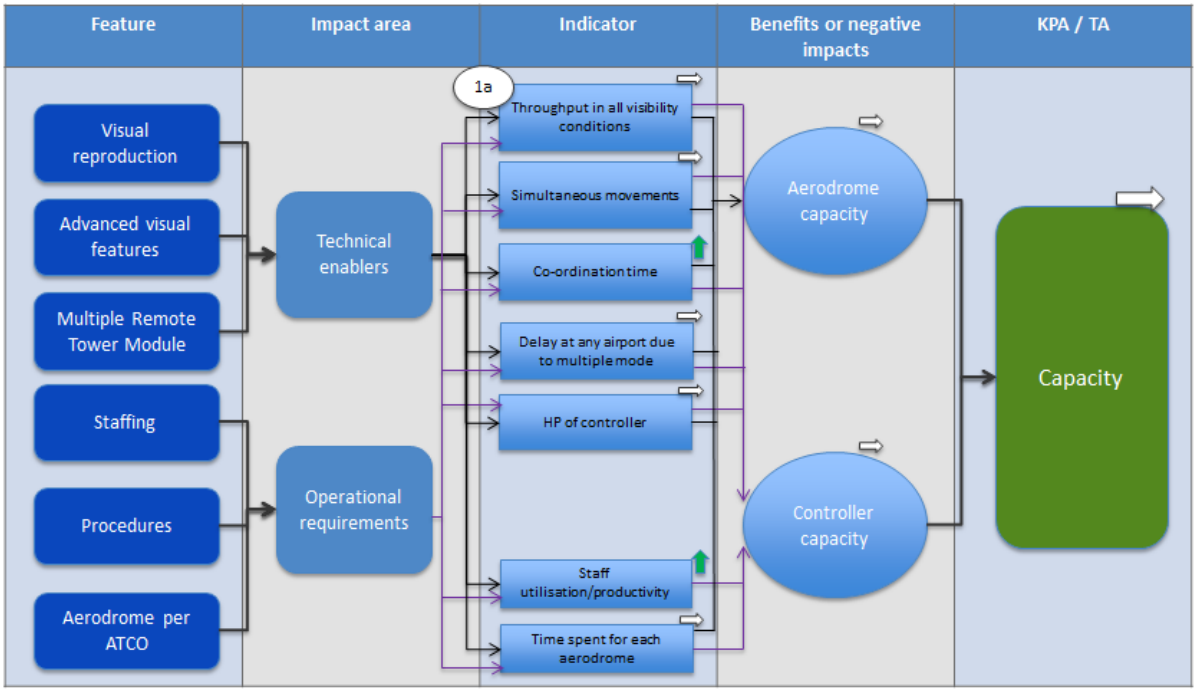
As aerodromes can be transferred to a different MRTM the required capacity can always be met. The main question is about how many airports can be controlled at a time by one ATCO. That will affect cost-effectiveness (but not airport capacity).

In current operations, these aerodromes are usually handled with a single ATCO and back up staff available for specific situations. These aerodromes are equipped with a limited amount of support tools for automation purposes. The introduction of tools and features to support automation enables one ATCO to focus on less administrative duties. Opening and Closing of positions are already common in an ACC environment.

Nevertheless, the following aspects should be highlighted:

- Throughput in all weather conditions
  The visual presentation may include infrared images that enhance ATCO situation awareness in low visibility conditions. But as the pilot still has to cope with low visibility conditions, no increase in capacity is to be expected.
- ATCO workload / human performance
  Increasing traffic volumes and other factors can increase ATCO workload while at the same time system design and support tools will increase human performance. ATCO and Supervisor planning tools aim to ensure that airports are transferred in time to a different MRTM if forecasted workload at a certain MRTM is too high.
  The impact will therefore be on cost-effectiveness rather than on capacity.
- Simultaneous runway operations at different airports
  It needs to be validated to what extend simultaneous runway operations (simultaneous landings and take-offs at different airports) are feasible.
  Procedures might be introduced in order to limit simultaneous runway operations (e.g. delay departure) that might impose some delay to certain flights. If there is a forecasted expected impact on capacity, airports can be transferred in time to a different MRTM.
  The impact will therefore be on cost-effectiveness rather than on capacity.
- Local procedures
  depending on specific local factors, local procedures might need to be adjusted to multiple remote tower operations (e.g. change in use of traffic patterns). Validations will show potential factors that need to be considered. It has already shown that this needs to be evaluated on a case-by-case basis.

PJ.05 Multiple Remote Tower



4.7.2 Assessment Data (Exercises and Expectations)

Capacity benefit in the frame of Multiple Remote Tower concept was measured using the results of EXE-05.02-V3-002, EXE-05.02-V3-003 and EXE-05.02-V3-004.

EXE-05.02-V3-002 results show that there where up to 5 simultaneous movements in some occasions and ATCOs' had a capacity to maintain requested traffic levels. The numbers used are equivalent to small environment aerodromes.EXE-05.02-V3-003 results show that ATCOs were able to handle 25 movements with up to 6-9 simultaneous movements per hour. Although the actual traffic handled (on the frequency) at specific times was up to eight, the traffic of concern was up to 8-10 simultaneous movements at times. It was commented that controller capacity was also affected by type and complexity of traffic and distribution between the aerodromes as well as complexity of the aerodrome.

EXE-05.02-V3-004 results show that while capacity to control the traffic was generally acceptable for the majority, the amount of R/T experienced was considered too high. Communication capacity is therefore seen as a bottleneck, which would also impact workload, and therefore a challenge to be addressed with adapted systems and strategies. If the amount of traffic is kept at approx. 20 mov/h, and the complexity is high, more technical support or supporting staff is required to provide continuous high-quality ATC and to keep workload within acceptable range.

4.7.3 Extrapolation to ECAC wide

N/A

4.7.4 Discussion of Assessment Result

Validation results showed that aerodrome layout, traffic mix or increased numbers of VFR could impact the capacity. Some validations had up to 5 or 6 simultaneous movements and ATCOs were able to maintain requested capacity levels. Depending on specific situations and how ATCOs dealt with traffic during the runs the number of simultaneous movements was different in the same scenario.

4.7.5 Additional Comments and Notes

No additional comments.

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

N/A for PJ.05-02

4.9 Predictability (Flight Duration Variability, against RBT)

N/A for PJ.05-02

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

N/A for PJ.05-02

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

N/A for PJ.05-02

4.12 Flexibility

N/A for PJ.05-02

4.13Cost Efficiency

The main driver for Remote Provision of ATS for multiple aerodromes is Cost Effectiveness. PJ05 is addressing the Cost-Efficiency KPA promoting the remote provision of ATS services to multiple airports. The Cost efficiency is assessed through one main KPI addressing the ATCO productivity measuring the number of flights per ATCO hours. The other KPI assessing the technology cost, remain unchanged if compared with Single Remote Tower.

The KPI Flights per ATCO Hour on Duty expresses the benefit of increasing the number of flights that an individual controller can handle safely in Multiple Remote Tower. Here by increasing the number of aerodromes each ATO controls while traffic at each aerodrome remains the same.

The qualitative feedback available from VALR is here processed to gather required performance assessment output.

4.13.1Performance Mechanism

PJ.05-02 targets the improvement of cost-efficiency, as it proposes to reduce the number of controllers required to provide ATS services.

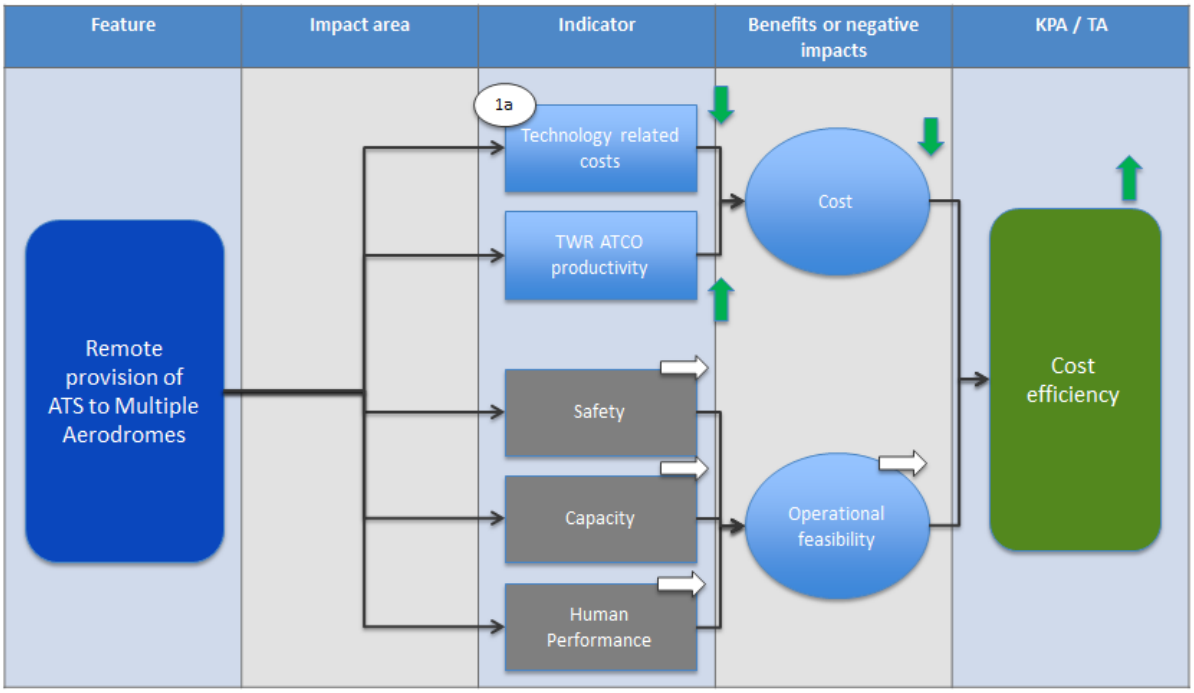
Solution PJ.05-02 have proposed to extend the remotely controlled capabilities up to three airports.

The solution focuses on the safety and Human Performance impact of multiple remote ATS provision, exploring all relevant issues arising from MRTM implementation.

Validation exercises showed that almost all of the ATCOs* rated the Workload at acceptable level for all the validation exercise when an ATCO had to control and manage up to three airports simultaneously. It was possible to manage the same traffic levels at each aerodrome when controlled in Multiple Remote Tower mode, compared to traffic levels if controlled as from a Single Remote Tower. At the same time have been provided such feedback for Situational Awareness.

Note: Validations with traffic levels above the targeted volumes, 20 movements per hour and 4-6 simultaneous movements, showed a negative result on ATCO workload .

PJ.05 Multiple Remote Tower



4.13.2Assessment Data (Exercises and Expectations)

PJ.05-02 V3 includes four exercises, each of them addressing key issues related the MRTM implementation such as safety and HP.

From the exercises performed by COOPANS, INDRA and FSP it has been highlighted that ATCOs' could keep up with capacity for 2 or 3 aerodromes simultaneously.

- Less than one ATCO per aerodrome
- Flexibility in staffing
- Flexibility in airport/ATS opening hours

Note: Increased traffic during example peak time would need proper mitigations, e.g. split or traffic limitations

4.13.3Extrapolation to ECAC wide

4.13.3.1 Assumption for aggregation at ECAC level

- Number of TWR/APP ATCOs in Europe = 7802 (SOURCE: PRC ACE 2015)
- Total number of ATCOs in Europe = 14075 (SOURCE: PRC ACE 2015)
- Applicable number of small airports with TWR/APP units = 92 (SOURCE: SESAR 2020 PJ20 Performance Needs for OEs_February 2019 version)

- Applicable number of other airports with TWR/APP units= 957 (SOURCE: SESAR 2020 PJ20 Performance Needs for OEs_February 2019 version)
- % reduction in ATCOs per airport = 25%
- ATCOs in OPS employment costs contribution to ANS cost = 27% [SOURCE: D4-0-1 PJ19 SESAR 2020 Common Assumptions 2017 Annex (1-3)]
- Number of ATCOs used for these calculations:
    - 6 per aerodrome, small environment airports
    - 6 per aerodrome, other environment airports

The chart below presents an example of the different number of ATCO required in the reference scenario (Single Remote Tower), with solution **PJ.05-02 (objective of the PAR)** and with solution PJ.05-03 to manage 4 different aerodromes per shift in a RTC:

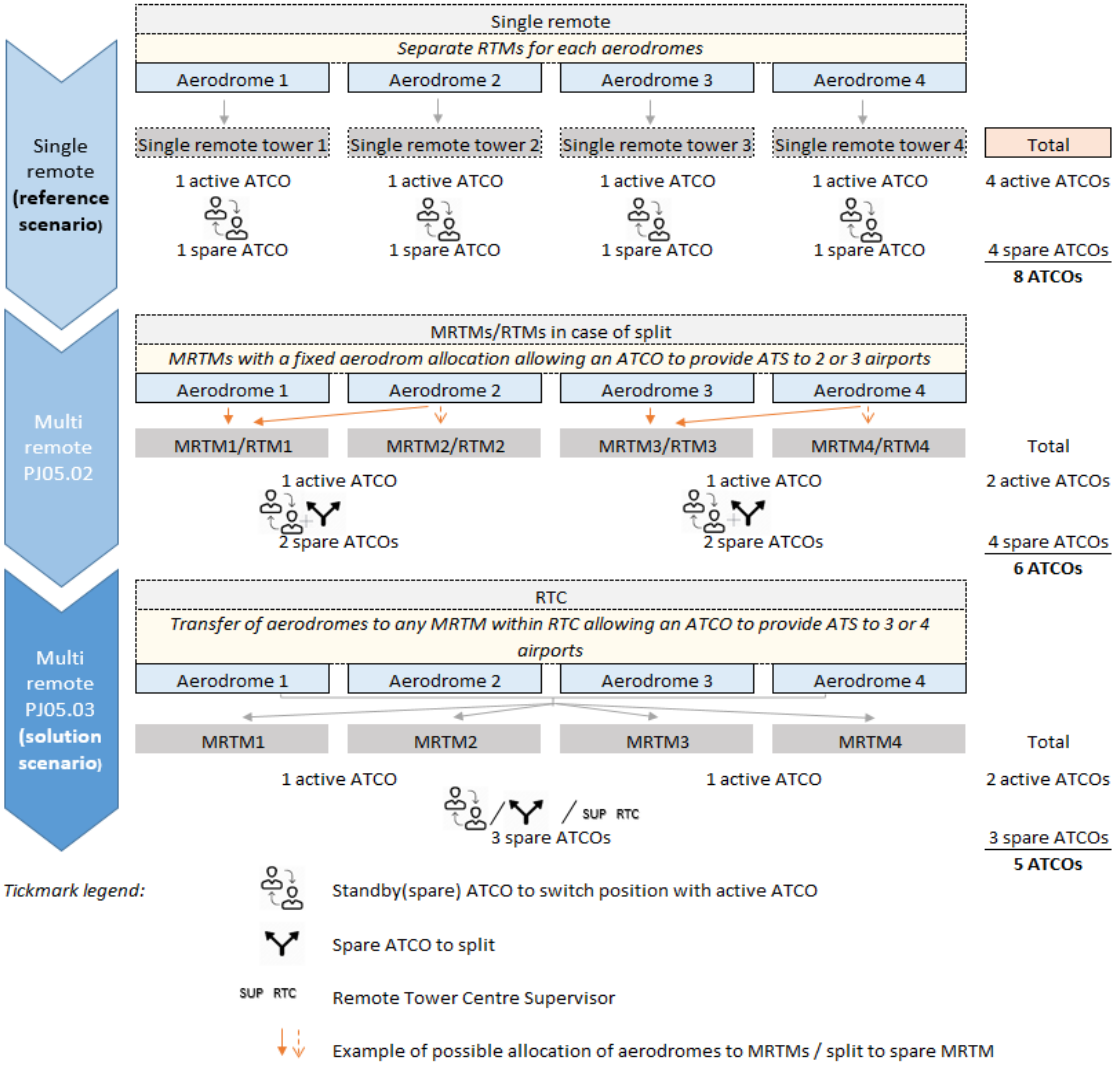


Figure 1: Assumptions on ATCO number improvements

User characteristics presented in Figure 1 above are assumed as follows:

- ATCO (both the active and the spare ones): The ATCO will have main responsibility for the provision of ATS. It is assumed that the TWR ATCO is responsible for assuring safe operations and provision of air traffic control services for the aerodrome manoeuvring area and the vicinity of the aerodrome. This includes responsibility for clearance delivery, ground control, arrival management, departure management and flight data processing.

- Remote tower centre supervisor (SUP RTC): A new role for consideration when providing ATS remotely is the RTC supervisor. In the same way that an ACC/Approach supervisor is responsible for the general management of all activities in the Operation Room, an RTC supervisor is responsible for the general management of all activities in the RTC. An ATCO or alternatively a separately appointed person may fill this role.
  During a shift, an RTC supervisor role can manage the allocation of staff and CWP´s at any time during the shift in order to provide an efficient set up at all times and guarantee a flexible system. The supervisor role can be performed by a dedicated person, or can be handled by one of the shift staff in addition to their ATCO role.

The role of the supervisor is not considered in the PJ.05-02.

Regarding the ***number of ATCOs*** required in the solution scenario to manage 4 different aerodromes compared to the reference scenario the following it is assumed that:

a. providing ATC from Single Remote Towers (**reference scenario**) for 4 aerodromes characterized by 6 simultaneous movements and 20 to 30 movements (air and ground) per hour in total for all airports requires a ***staff of 8*** (SOURCE: SESAR 1 Business Case for SESAR Solutions #71 Single remote tower 16.06.06 D51). At this scenario four distinct RTM are assumed and ATS is provided for the four aerodromes with a one-to-one configuration. For an illustration of this assumption, see 'Single remote' section of Figure 1 above.

b. providing ATC from Multi Remote Towers (**solution PJ.05-02 – objective of this PAR**) for 4 aerodromes with the same traffic characteristics requires a staff of 6. The assumption is that with this solution 1 ATCO can hold endorsements for up to 3 (single) different airports. For an illustration of this assumption, see 'Multi remote PJ.05-02' section of Figure 1 above.

The improvement with this solution is a **reduction of** ATCO numbers that is **25%** because instead of the staff of 8 in single remote towers, a ***staff of 6*** is sufficient. This assumed reduction is in line with V2 PJ.05-02 Performance Assessment Report according to which the number of ATCO can be reduced by up to 25%. The calculation is based on generic approach, not limited to validation exercises. From single remote to Multi remote (solution PJ.05-02) the reduction is in the number of 'active' ATCOs, since only **2 ATCOs** are required to **actively control 4 aerodromes** as from one MRTM up to 3 aerodromes can be controlled (**instead** of the **4** 'active' **ATCOs** which required **in distinct single remote towers**). Nevertheless, with solution Multi remote towers (solution PJ.05-02) we still need 4 'spare' ATCOs considering the followings:

- firstly, each active ATCO need a 'spare' one to switch its position during the shift as needed (2 'standby' ATCOs) according to:

  - the maximum time at a position without a fatigue break,

- the number of night duties permitted,
- the length of the shift cycle,
- the policy regarding including break times as working time or not
- other local working conditions, and

- secondly, with solution PJ.05-02 it is assumed that:
  - there is a fixed allocation of airports to a set of MRTMs,
  - no possibility to allocate airports from MRTM1/MRTM2 to MRTM3/MRTM4 or vice versa, only to split to spare RTMs/MRTMs, consequently

in case of ATCO overload (due to e.g. emergency, high traffic volumes or degraded mode) the ATCO can split an airport into a spare RTM/MRTM if required. So there should be spare RTMs/MRTMs (MRTM2 and MRTM4 in 'Figure 1' above are considered as spare positions) as backup behind each 'active' MRTMs (MRTM1 and MRTM3 in 'Figure 1' above are considered as active positions) and the remaining 2 'spare' ATCOs could take over one/more aerodromes when such a split is required.

c. providing ATC from **Remote Tower Centre** with **solution PJ.05-03** for 4 aerodromes with the same traffic characteristics requires a ***staff of 5***.

- Similar to solution PJ.05-02 the improvement with this solution is **reduction of** ATCO numbers that is a further **16.7% compared to solution PJ.05-02** as instead of the staff of 6 in multiple remote towers with solution PJ.05-02, a staff of 5 in Remote tower centre is sufficient. From solution PJ.05-02 to solution PJ.05-03 the reduction is in the number of 'spare' ATCOs. Two 'active' ATCOs are still required to actively control 4 aerodromes (as from one MRTM position up to 3 aerodromes is assumed to be controlled at a time) and 2 'standby' ATCOs are also needed to switch the position of the 'active' ones during the shift as needed (considering fatigue break, night shifts permitted, policies regarding breaking times, etc.).

4.13.3.2 Calculation

(Number of airports*percentage of ATCO reduction*number of ATCOs per airport)/ATCOs in OPS considering the following data:

For PJ.05-02:

- Number of small airports: 92
- Number of other airports:957
- Percentage of ATCO reduction: 25%
- ATCOs per airport: 6
- ATCOs in OPS 14075

- Calculation:
- For PJ.05-02:
- o A=[(92/4)*25%*6]/ 14075= 0.25%
- o B=[(957/4)*25%*6]/ 14075= 2.55%
- CEF2=A+B=2.79%

Results for **Small Airports OE**

1. Applicable number of small airports with TWR/APP units= 92
2. % reduction in ATCOs per airport = 25%
3. Number of ATCOs per small aerodrome = 6
4. ECAC-wide productivity improvement for small airports = 92 (Applicable number of small airports with TWR/APP units) x 25% (% reduction in ATCOs per airport) x 6 (Number of ATCOs)/14075 (Total number of ATCOs in Europe) = 0,25%

Results for **Other Airports OE**

1. Applicable number of other airports with TWR/APP units= 957
2. % reduction in ATCOs per airport = 25%
3. Number of ATCOs per other aerodrome= 6 (used in these calculations based on Baseline Single RTWR)
4. ECAC-wide productivity improvement for other airport = 957 (Applicable number of other airports with TWR/APP units) x 25% (% reduction in ATCOs per airport) x 6 (Number of ATCOs)/14075 (Total number of ATCOs in Europe) = 2,55%

Absolute ATCO productivity at ECAC level (CEF 2) = 0,25% (ECAC wide productivity improvement for small airports) + 2,55% (ECAC wide productivity improvement for other airports) = 2,79%

Absolute ANS Cost Effectiveness at ECAC level (CEF 1) = 2,79% [Absolute ATCO productivity at ECAC level (CEF 2)] x 27% (ATCOs in OPS employment costs contribution to ANS cost) = 0,753%

4.13.4Discussion of Assessment Result

The obtained results take into account Validation Results coming from the V3 set of Validation Exercises (Real Time Simulations EXE-05.02-V3-002 – COOPANS; EXE-05.02-V3-003 – INDRA; EXE-05.02-V3-004– FSP and EXE-05.02-V3-005 – ENAV).

The performance assessment for this KPA exceeds the Validation targets when considering the applicability of the solution to small and other environment. In fact, the target OE of solution PJ.05-02 has been changed from medium + small airports to small + other airports, so there is incongruence among Validation Target allocated by PJ.19 and the results obtained from simulations. In any case, performed validation exercises provide subjective evidence that ATCOs' were able to

maintain requested capacity by managing more than 4 simultaneous movements with an improvement in terms of ATCOs number with respect to reference scenario. Productivity is increased by reduction of ATCO with up to 25%. Since the assessment is subjective, the confidence level is Low.

4.13.5Additional Comments and Notes

No additional comments

4.14Airspace User Cost Efficiency

N/A for PJ.05-02

4.15 Security

Security Assessment was performed using SecRAM (SESAR ATM security risk assessment methodology) but, due to the confidentiality of the results, they cannot be shared in this document.

4.16Human Performance

4.16.1 HP arguments, activities and metrics

The HP Assessment performed for PJ.05-02 ensured that relevant HP aspects have been identified and considered for the operational and technical development of the Multiple Remote Tower concept, based on the HP Assessment Process methodology. The conclusions of the HP Assessment work can be found in Part IV of the OSED - the HP Assessment Report where the requirements and recommendations identified for V3 have been formulated.

PIs	Activities & Metrics	Second level indicators	Covered
HP1 Consistency of human role with respect to human capabilities and limitations	Stakeholder Workshop RTS	**HP1.1** Clarity and completeness of role and responsibilities of human actors	**covered**
		HP1.2 Adequacy of operating methods (procedures) in supporting human performance	**covered**
		HP1.3 Capability of human actors to achieve their tasks in a timely manner, with limited error rate and acceptable workload level	**covered**
HP2 Suitability of technical system in supporting the tasks of human actors	Stakeholder Workshop RTS	**HP2.1** Adequacy of allocation of tasks between the human and the machine (i.e. level of automation).	**covered**
		HP2.2 Adequacy of technical systems in supporting Human Performance with respect to timeliness of system responses and accuracy of information provided	**N/A**
		HP2.3 Adequacy of the human machine interface in supporting the human in carrying out their tasks.	**Covered**
HP3 Adequacy of team structure and team communication in supporting the human actors	Stakeholder Workshop RTS	**HP3.1** Adequacy of team composition in terms of identified roles	**N/A**
		HP3.2 Adequacy of task allocation among human actors	**covered**
		HP3.3 Adequacy of team communication with regard to information type, technical enablers and impact on situation awareness/workload	**N/A**
HP4 Feasibility with regard to	Stakeholder Workshop RTS	**HP4.1** User acceptability of the proposed solution	**covered**
		HP4.2 Feasibility in relation to changes in competence requirements	**covered**
		HP4.3	**covered**

PIs	Activities & Metrics	Second level indicators	Covered
HP-related transition factors		Feasibility in relation to changes in staffing levels, shift organization and workforce relocation. *Note: Assuming baseline of Single Remote Tower already in place with all ATCOs already relocated to the RTC.*	
		HP4.4 Feasibility in relation to changes in recruitment and selection requirements .	**N/A**
		HP4.5 Feasibility in terms of changes in training needs with regard to its contents, duration and modality.	**covered**

4.16.2 Extrapolation to ECAC wide

No ECAC wide extrapolation is required for this KPI.

4.16.3 Open HP issues/ recommendations and requirements

A total number of 41 issues have been identified for PJ.05-02. All issues have been closed.

PIs	Number of open issues/ benefits	Nr. of recommendations	Number of requirements
HP1 Consistency of human role with respect to human capabilities and limitations	**0 open issues**	**1 recommendation**	**10 requirements**
HP2 Suitability of technical system in supporting the tasks of human actors	**0 open issues**	**10 recommendations**	**41 requirements**
HP3 Adequacy of team structure and team communication in supporting the human actors	**0 open issue**	**N/A**	**1 requirements**
HP4 Feasibility with regard to HP-related transition factors	**0 open issues**	**N/A**	**3 requirements**

4.16.4 Concept interaction

PJ.05-03 has been identified as the only solution interacting with PJ.05-02. The applicable issues and findings for PJ.05-02 apply for PJ.05-03 as well and they have been taken on board for the validation activities.

4.16.5 Most important HP issues

Given the fact that through the stakeholder workshops and real time simulations all issues have been addressed and closed, the table below is not seen as applicable for the PJ.05-02 concept.

PIs	Most important issue of the solution	Most important issues due to solution interdependencies
HP1 Consistency of human role with respect to human capabilities and limitations	N/A	N/A
	N/A	N/A
	N/A	N/A
HP2 Suitability of technical system in supporting the tasks of human actors	N/A	N/A
	N/A	N/A
	N/A	N/A
HP3 Adequacy of team structure and team communication in supporting the human actors	N/A	N/A
	N/A	N/A
	N/A	N/A
HP4 Feasibility with regard to HP-related transition factors	N/A	N/A
	N/A	N/A
	N/A	N/A
	N/A	N/A
	N/A	N/A

4.16.6 Additional Comments and Notes

No further comments.

4.17 Other PIs

Not Applicable for PJ05

4.18Gap Analysis

The results of the validation exercises differ from the expected validation targets as defined in **Error! Reference source not found.**.

The following table summarizes the gap between the expectations and the results obtained, providing explanation and remarks based on the V3 validation exercises experience:

KPI	Validation Targets – Network Level (ECAC Wide)	Performance Benefits Expectations at Network Level (ECAC Wide or Local depending on the KPI)[6]	Rationale[7]
CEF2: ATCO Productivity – Flights per ATCO -Hour on duty	1.333%	2,79%	The performance benefit exceeds the Validation targets because the obtained results take into account the application of the solution to small and other environment airports. The target OE of solution PJ.05-02 has been changed from medium + small airports to small + other airports, differently from the Validation Target (allocated by PJ.19 for small + medium airports). In any case, performed validation exercises provided subjective evidence that ATCOs

[6] Negative impacts are indicated in red.

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

			are able to manage simultaneous movements with an improvement in terms of ATCOs number with respect to reference scenario. Expected benefits is low as all performed validation exercises provided benefits in terms of ATCOs productivity that is increased by reduction with up to 25%

Table 11: Gap analysis Summary

5 References

[1] 08.01.03 D47: AIRM v4.1.0

[2] B05 Performance Assessment Methodology for Step 1

[3] PJ19.04 D4.4 Performance Framework (2018), Edition 01.00.00, August 2018

[4] B.05 Guidance for Performance Assessment Cycle 2013

[5] B.05 D72, Updated Performance Assessment in 2016

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=1669873.13&att=attachment&statEvent=Download

[6] B05 Data Collection and Repository Cycle 2015

[7] Methodology for the Performance Planning and Master Plan Maintenance (edition 0.13)

https://stellar.sesarju.eu/servlet/dl/ShowDocumentContent?doc_id=4731333.13&att=attachment&statEvent=Download

Content Integration

[8] B.04.01 D138 EATMA Guidance Material

[9] EATMA Community pages

[10] SESAR ATM Lexicon

Content Development

[11] PJ19.02.02 D2.1 SESAR 2020 Concept of Operations Edition 2017, Edition 01.00.00, November 2017

System and Service Development

[12] 08.01.01 D52: SWIM Foundation v2

[13] 08.01.01 D49: SWIM Compliance Criteria

[14] 08.03.10 D45: ISRM Foundation v00.08.00

[15] B.04.03 D102 SESAR Working Method on Services

[16] B.04.03 D128 ADD SESAR1

[17] B.04.05 Common Service Foundation Method

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[45]SESAR Solution 05-02 SPR/INTEROP-OSED V3 - Part IV - Human Performance Assessment Report

[46]SESAR Solution PJ.05-02 Validation Plan (VALP) for V3 - Part I

[47]SESAR Solution PJ.05-02 Validation Report (VALR) for V3

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Appendix A Detailed Description and Issues of the OI Steps

OI Step ID	Title	Step	Consistency with latest Dataset
SDM 0207	Multiple Remote Tower, MRTM (for up to 3 Airports)	Full coverage in V3	DS19