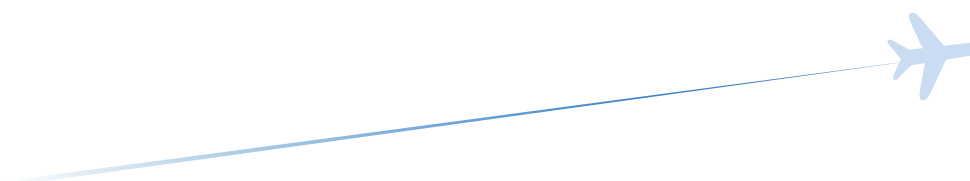


SESAR Solution 05-02 SPR/INTEROP-OSED Template for V3 - Part IV - Human Performance Assessment Report

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Authoring & Approval

Authors of the document

| Name/Beneficiary | Position/Title | Date |
|-----------------------------|---------------------------------------|------------|
| Renée Pelchen-Medwed | Human Performance Expert/ Eurocontrol | 06/06/2018 |
| Adriana-Dana Schmitz | Human Performance Expert/ Eurocontrol | 08/07/2019 |

Reviewers internal to the project

| Name/Beneficiary | Position/Title | Date |
|--------------------|----------------------------|------------|
| Marcus Filipp | Solution 2 leader/ COOPANS | 19/07/2019 |
| Susanne Widell | Team member/ COOPANS | 19/07/2019 |
| Nikola Veljanovski | Team member/COOPANS | 19/07/2019 |
| Rainer Kaufhold | Solution 3 leader/ DFS | 19/07/2019 |

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

| Name/Beneficiary | Position/Title | Date |
|---------------------------------------|-------------------------|------------|
| Marcus Filipp / COOPANS | Solution lead, PJ.05.02 | 25/07/2019 |
| Rainer Kaufhold / DFS | Solution lead, PJ.05.03 | 25/07/2019 |
| Tomas Tamasauskas / B4 | Project member | 25/07/2019 |
| Lindsey M Hermosilla / COOPANS | Project member | 25/07/2019 |
| Sarai Costa / Indra | Project member | 25/07/2019 |
| Peter Kantor / HC | Project member | 25/07/2019 |
| Patrizia Criscuolo / TechnoSky (ENAV) | Project member | 25/07/2019 |
| Guillaume Assire / ECTL | Project member | 25/07/2019 |

Rejected By - Representatives of beneficiaries involved in the project

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

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PJ05 Multiple Remote Tower

MULTIPLE REMOTE TOWER

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Abstract

This document contains the Human Performance (HP) assessment report for the PJ05-02, which consists of the HP assessment plan, the results of the HP activities conducted according to the HP assessment process, newly identified issues and the HP recommendations & requirements. It corresponds to the completion of the four steps of the Human Performance assessment process, namely: Step 1 – Understand the concept: Baseline, Solution and Assumptions, Step 2 – Understand the Human Performance Implications, Step 3 – Improve and Validate the concept and Step4 – Collate findings & conclude on transition to next V-phase..

Table of Contents

| | | |
|-------------------|--|-----------|
| 1 | <i>Executive Summary</i> | 7 |
| 2 | <i>Introduction</i> | 8 |
| 2.1 | Purpose of the document | 8 |
| 2.2 | Intended readership | 8 |
| 2.3 | Scope of the document | 8 |
| 2.4 | Human performance work schedule within the Solution | 8 |
| 2.5 | Structure of the document | 9 |
| 2.6 | Acronyms and Terminology | 9 |
| 3 | <i>The Human Performance Assessment Process: Objective and Approach</i> | 11 |
| 4 | <i>Human Performance Assessment</i> | 13 |
| 4.1 | Step 1 Understand the ATM concept | 13 |
| 4.1.1 | Description of reference scenario | 13 |
| 4.1.2 | Description of solution scenario | 14 |
| 4.1.3 | Consolidated list of assumptions | 15 |
| 4.1.4 | List of related SESAR Solutions to be considered in the HP assessment..... | 16 |
| 4.1.5 | Identification of the nature of the change | 16 |
| 4.2 | Step 2 Understand the HP implications | 17 |
| 4.2.1 | Identification of relevant arguments, HP issues & benefits and HP activities | 17 |
| 4.3 | Step 3 Improve and validate the concept | 17 |
| 4.3.1 | Description of HP activities conducted | 17 |
| 4.4 | Step 4 Collate findings & conclude on transition to next V-phase | 23 |
| 4.4.1 | Summary of HP activities results & recommendations / requirements..... | 23 |
| 4.4.2 | Maturity of the Solution..... | 46 |
| 5 | <i>References</i> | 2 |
| Appendix A | <i>– HP Recommendations Register</i> | 1 |
| Appendix B | <i>– HP Requirements Register</i> | 6 |
| Appendix C | <i>– HP Log</i> | 30 |

List of Tables

| | | |
|----------|---------------------------------------|----|
| Table 1: | Acronyms and terminology | 10 |
| Table 2: | Consolidated list of assumptions..... | 16 |
| Table 3: | Description of the change | 17 |

Table 4: Table of proposed HP activities and their priority..... 18

Table 5: Description of Activity 1 21

Table 6 Description of Activity 2..... 22

Table 7: Summary of the HP results and recommendations/ requirements for each identified issue & related argument 45

Table 8: HP recommendations 5

Table 9: HP Requirements..... 29

List of Figures

Figure 1: Steps of the HP assessment process 12

1 Executive Summary

This document describes the human performance assessment for PJ05-Solution 02 “Remotely Provided Air Traffic Services from a Multiple Remote Tower Module, MRTM” targeting V3 maturity.

The goal of the project at this stage was to validate two small environment airports or three other operating environment airports controlled simultaneously by one ATCO with a total traffic level of up to 20 movements (IFR/VFR and vehicle traffic) per hour.

The Human Performance assessment commenced with the drafting of the HP plan [1]. The HP assessment report outlines the activities that were conducted, the issues, the validated mitigations, and the results of the validations. The results of the HP assessment are the HP recommendations and requirements.

The SESAR HP assessment process provides a framework to help ensure that HP aspects related to SESAR 2020 technical and operational developments are systematically identified and managed in the concept design, development and validation process. The SESAR HP assessment process uses an ‘argument’ and ‘evidence’ approach. A HP argument is a ‘HP claim that needs to be proven’. The aim of the HP assessment is to provide the necessary ‘evidence’ to show that the HP arguments impacted have been considered and satisfied by the HP assessment process. This includes the identification of HP requirements and recommendations to support the design and development of the concept.

Specific HP issues and benefits relating to the multiple remote tower concept for each of the relevant arguments were identified by performing a review of existing literature and work performed in SESAR 1. The HP related validation activities conducted to date include:

Three activities have been identified for the Multiple Remote Tower concept:

1. Task Analysis and HP issue analysis
2. Validation exercises (real time simulations, passive shadow mode trial etc.).
3. HP-SAF user workshops (with relevant experts- ATCOs & concept developers)

The output or ‘evidence’ collected from each of these activities that are relevant to the HP assessment are summarised in this report together with recommendations and / or requirements that have been proposed to help prevent or mitigate each of the potential HP issues identified. These recommendations and requirements relate to: the operational concept, and procedures; the technical system and HMI and the training of the end user.

Considering the evidence gathered during the HP validation activities, with the respect to HP maturity criteria it can be concluded that the “Multiple Remote Tower Concept” concept has reached the V3 level of HP maturity. As a result, the status of the issues and benefits is closed.

2 Introduction

2.1 Purpose of the document

The purpose of this document is to describe the result of the activities conducted according to the Human Performance (HP) assessment process [2] in order to derive the HP assessment report for PJ05-02 including requirements and recommendations.

2.2 Intended readership

The intended audience for this document are primarily all the partners involved in SESAR 2020 (PJ05) addressing solution 02 and solution 03.

The intended readership for this document are:

- PJ05 Partners addressing PJ05 solution 03 and solution02

Stakeholders are to be found among:

- ANS providers;
- ATM infrastructure and equipment suppliers.
- Airspace users;
- Airport owners/providers;
- Affected NSA;
- Affected employee unions;

2.3 Scope of the document

The human performance assessment for PJ05-02 was divided in three separate activities related to each of operational improvements:

1. Task Analysis and HP issue analysis
2. Validation exercises (real time simulations, shadow mode trials etc.).
3. HP- SAF user workshops (with relevant experts- ATCOs & concept developers)

The main focus of assessment was ATCO role as they are considered most impacted by the change. The other actors such pilots and ground staff are considered in the assessment in limited extend.

2.4 Human performance work schedule within the Solution

The Human Performance Assessment for for PJ05-Solution 02 “Remotely Provided Air Traffic Services from a Multiple Remote Tower Module, MRTM” and finished in June 2019. The work is followed up by activities for maturity phase V3.

2.5 Structure of the document

This document contains 5 chapters.

- Chapter 1 contains an executive summary which gives information about the purpose and scope of the validation exercise, including a reference to results and conclusions, as well as recommendations and recommendations.;
- Chapter 2 describes the purpose and the scope of the document, introducing the intended readership and detailing the HP work schedule within the Solution. It entails a list of acronyms and terminology.
- Chapter 3 provides information with regard to the HP Assessment Process
- Chapter 4- in line with the HP reference material [2], it describes the 4 steps defined in the HP Assessment Process
 - Step 1: Understand the ATM Concept
 - Step 2: Understand the HP Implications
 - Step 3: Improve and validate the concept
 - Step 4: Collate findings & conclude on transition to the next V-phase.

Chapter 5- is intended to include all relevant reference material as well as additional information in the Appendixes:

- Appendix A: Additional HP activities conducted
- Appendix B: HP recommendations Register
- Appendix C: HP Recommendations Register
- Appendix D: empty, as it was considered the Word documentation is sufficient for the development of both the HP Plan and the HP Assessment Report, for PJ05-02.

2.6 Acronyms and Terminology

| Term | Description |
|------------------------|--|
| Human Factors (HF) | HF is used to denote aspects that influence a human’s capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, “Human Factors” can be considered as <i>focussing on the variables that determine Human Performance</i> . |
| Human Performance (HP) | HP is used to denote the human capability to successfully accomplish tasks and meet job requirements. In this way, “Human Performance” can be considered as <i>focussing on the observable result of human activity in a work context</i> . Human Performance is a function of Human Factors (see above). It also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well |

| | |
|-----------------------|---|
| | as Social Factors and Change Management. |
| HP activity | An HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies. |
| HP argument | An HP argument is an HP claim that needs to be proven through the HP Assessment Process. |
| 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. |
| HP assessment process | The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. The development of this process constitutes the scope of Project 16.04.01. It covers the conduct of HP assessments on the Solution-level as well as the HP case building over larger clusters of Solutions. |
| HP benefit | An HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance. |
| HP case | An HP case is the documented result of combining HP assessments from Solutions into larger clusters (SESAR Projects, deployment packages) in SESAR. |
| HP issue | An HP issue relates to those aspects in the ATM concept that need to be resolved before the proposed change can deliver the intended positive effects on Human Performance. |
| HP impact | An HP impact relates to the effect of the proposed solution on the human operator. Impacts can be positive (i.e. leading to an increase in Human Performance) or negative (leading to a decrease in Human Performance). |
| HP recommendations | HP recommendations propose means for mitigating HP issues related to a specific operational or technical change. HF recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional analysis is performed, HF recommendations may be transformed into HF requirements. |
| HP requirements | HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable result of the HF contribution to the Solution, leading to a redefinition of the operational concept or the specification of the technical solution. |

Table 1: Acronyms and terminology

3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in SESAR Human Performance Assessment Process V1 to V3- including VLDs [2] is to ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed. The SESAR HP assessment process uses an ‘argument’ and ‘evidence’ approach. An HP argument is an ‘HP claim that needs to be proven’. The aim of the HP assessment is to provide the necessary ‘evidence’ to show that the HP arguments impacted have been considered and satisfied by the HP assessment process. This includes the identification of HP requirements and recommendations to support the design and development of the concept.

The HP assessment process is a four-step process. **Error! Reference source not found.** provides an overview of these four steps with the tasks to be carried out and the two main outputs (i.e. HP plan and HP assessment report).

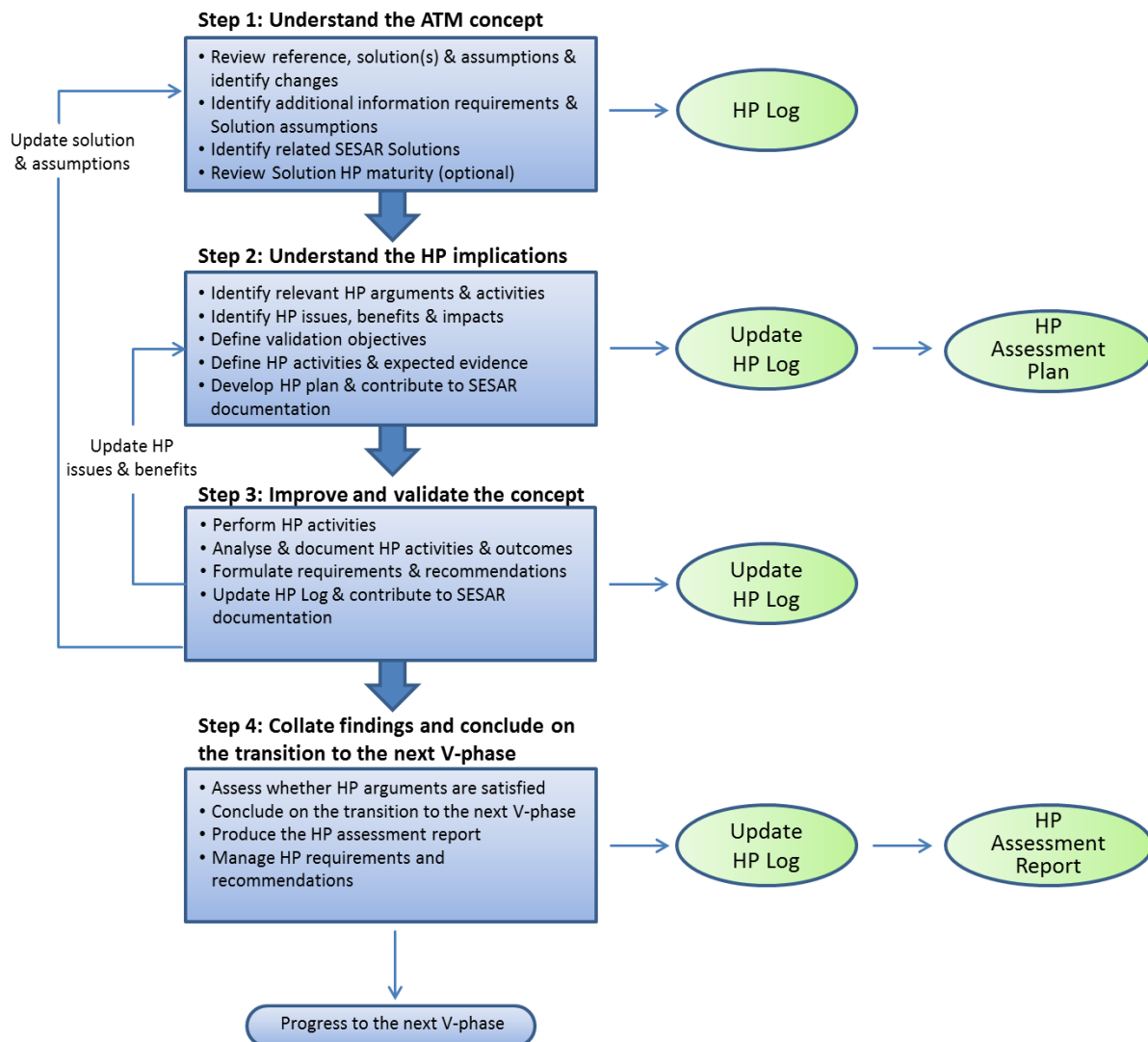


Figure 1: Steps of the HP assessment process

Throughout the HP assessment process the HP experts collaborate with the other Transversal Areas (TAs) in order to ensure that there is not overlap between the objectives defined or that there are no issues/benefits that have not been considered. Safety is one of the TAs with whom the HP experts interact the most, from identifying the list of changes and activities that will be included in the HP Plan to conducting joint workshops following the validation exercises. A detailed overview of the synergies with other TAs can be found in the HP reference Material **Error! Reference source not found.**

4 Human Performance Assessment

4.1 Step 1 Understand the ATM concept

4.1.1 Description of reference scenario

The baseline for multiple remote tower operations is the single remote tower operations as defined in SESAR 1 P06.09.03 [3]. The single remote tower is characterised by the ATCOs providing ATS to a single aerodrome while the air traffic control unit for aerodrome control is a 'standard' building (i.e. not a tower building) not necessarily located within the aerodrome. The MRTM will provide ATS for the aerodrome. A number of staff resources (ATS personnel) and a number of MRTMs may be co-located in a RTC. An RTC may be a separate facility located far from any airport or it may be an additional facility co-located with a local facility at an aerodrome. Technical enablers, AVFs, communications, radar displays and other features/function to assist with the provision of ATS are related to only one aerodrome. The traffic situation will be viewed using a high-resolution panoramic display located in the remote 'tower' control unit. State of the art video cameras located at various locations on the aerodrome will be used to project a real time image of the aerodrome and traffic situation onto the panoramic display together with selectable options to choose the ambient noise of the aerodrome. There will be up to two different primary roles in an RTC (not necessarily all at once, in the same RTC or to the same aerodrome): ATCO; RTC supervisor. One ATCO provides ATS to a single aerodrome (one-to-one). The (optional) RTC supervisors' main responsibilities will be with regard to staff/MRTM/aerodrome allocation. The concept assumes the basic and advanced features:

- The visual presentation of aerodrome and PTZ camera.
- Flight Progress Strips (electronic or paper);
- Radio Telephony Communications (ground and air);
- Aerodrome sound;
- Functionality for manoeuvring and controlling:
 - Airport lights;
 - Signal Light Gun;
 - Navigation aids;
 - ILS;
 - Alarms and;
 - Other airport systems.

Advanced features

- Overlay information (including geographic, meteorological, operations and service and visual reminder information).

The information will be enhanced through the use of additional sensors such as hot spot cameras or infrared cameras will be used etc. This could potentially further improve the visual reproduction in CAT II/III low visibility conditions or in darkness.

The aim of the Single remote tower concept is to provide the same set of services that are provided from conventional towers, albeit in a more efficient and improved way.

The MRTM are configurable to any of the aerodromes. At any given time the ATCO can switch from one aerodrome to another. The ATCO can therefore provide ATS service to more than one aerodrome but not in parallel. The use of collaborative planning and/or traffic coordination would increase the ability of a single ATCO to provide ATS service to multiple aerodromes in sequence.

Airspace and ATS at a specific aerodrome will normally be established in conjunction with an IFR departure or arrival, allowing the Remote ATCO to then sequentially handle traffic from/to more than one airport.

4.1.2 Description of solution scenario

The general operating principle is that two or three aerodromes will be provided with ATS from one MRTM by one ATCO, hence the ratio of operators to aerodromes would be up to 1:3 with a minimum of 1:2. The number of aerodromes which can be provided with ATS will be dependent upon a number of factors, primarily relating to the peak hour traffic level and how the traffic schedule at each aerodrome interacts with the others (10 > 20 movements ground-air/ hour for all airports). Other factors, such as technical configuration of the MRTM will also have an influence. PJ.05-02 addresses the next implementation step aiming for V3 maturity level at the end of wave 1.

When providing ATS to multiple aerodromes from an MRTM there are certain specific considerations that should be taken, due to the requirement to share or duplicate certain features required for the provision of ATS to more than one aerodrome.

Technical enablers, AVFs, communications, radar displays and other features/function to assist with the provision of ATS shall have varying degrees of integration and sharing between aerodromes. Other features that are required continuously (such as the surveillance display etc.) may require duplication for each aerodrome. Any duplication of equipment/features that occurs in the MRTM may be accompanied by distinctive features to allow easy and instant recognition of the aerodrome the feature relates to.

The provision of ATS to more than one aerodrome will be made possible by the provision of visual presentations that allow for the monitoring of each aerodrome. The screens will display each aerodrome either simultaneously or sequentially (with some information being temporarily hidden in order to avoid an overload of information to the ATCO). It is vitally important that the operator is, at all times, able to distinguish which aerodrome they are currently operating and which aerodrome any single set of displays or peripherals are linked to.

The screen layout options and the controller working position available within the MRTM will enable the provision of ATS to multiple aerodromes simultaneously. The primary methods to achieve this will depend on the number of aerodromes being controlled. It is predicted that the continuous visual monitoring of aircraft shall be provided via a visual presentation set up to view aerodromes horizontally (side-by-side), vertically (up-down) or combination of both.

The distribution of screens may be switchable and hence fluid, allowing the ATCO to change the number of screens each aerodrome is displayed on. This will allow the controller to select which aerodrome to have on the larger visual presentation (likely to be the aerodrome with active traffic) or to view all aerodromes on an equal screen split. There may also be the option to completely hide the visual display of an aerodrome, which should be applicable only if that specific aerodrome does not require ATS for a given time).

In addition to the controller tool support introduced for single remote tower, supplementary support tools may be introduced in the context of Multiple Remote Tower Operations (MRTO):

Integrated flight data processing systems FDPS: The configuration of the ATCO working desk could consist of consolidating the flight data information of all relevant aerodromes into one FDPS. Thus all flight strips are merged into one system and for example distinguished through colour coding. On the MRTM (e.g. visual reproduction screen) an indication could be made highlighting where a radio transmission is coming from. Thus the ATCO may easily bring together a station calling and its origin – situational awareness may be increased.

4.1.3 Consolidated list of assumptions

| Assumptions Title and Description | PJ05-02 | PJ05-03 |
|--|---------|---------|
| Single Remote Tower as baseline | | |
| <ul style="list-style-type: none"> Provision of remote ATS for a single aerodrome is already available, i.e. ATCOs are used to providing ATS from a MRTM | X | X |
| Operating Methods / Traffic Characteristics | | |
| <ul style="list-style-type: none"> The remote provision of ATS for multiple aerodromes is applicable to aerodromes with simultaneous traffic at both airports. | X | X |
| <ul style="list-style-type: none"> different operating methods at the controlled airports (e.g. different operating direction, different views on the runway) are possible | X | X |
| Weather Conditions | | |
| <ul style="list-style-type: none"> different visibility conditions might occur at the controlled airports (resulting in different operating methods e.g. different CAT conditions, night and daytime) | X | X |
| <ul style="list-style-type: none"> different wind conditions might occur at the controlled airports | X | X |
| Remote Tower Modules within an RTC | | |
| <ul style="list-style-type: none"> A unified Multiple Remote Tower Module (MRTM) solution will be developed and implemented (rather than different or even bespoke solutions) within an RTC. | X | X |

| | | |
|--|---|---|
| <ul style="list-style-type: none"> the same systems are available at all controlled airports (i.e. air surveillance, electronic flight strips) and the HMIs of the systems of the controlled airports is harmonised | X | X |
| Allocation of airports to one MRTM can be: | | |
| <ul style="list-style-type: none"> fixed to MRTM, i.e. no change | X | |
| <ul style="list-style-type: none"> flexible to MRTM, i.e. changing at certain times (short term planning) or due to emergencies | X | X |
| <ul style="list-style-type: none"> dynamic, i.e. changing depending on traffic demand (long term planning) which requires a supervisor role | | X |
| Human actors are: | | |
| <ul style="list-style-type: none"> ATCO: one single ATCO for one MRTM, i.e. no workshare between two MRTMs | X | X |
| <ul style="list-style-type: none"> RTC Supervisor | | X |
| Training/ Licensing: | | |
| <ul style="list-style-type: none"> Controllers are familiar with the operating environment and tools. | X | X |
| <ul style="list-style-type: none"> ATCO can hold endorsements for up to 3 (single) different airports | X | X |

Table 2: Consolidated list of assumptions

4.1.4 List of related SESAR Solutions to be considered in the HP assessment

The work that was done in SESAR 1 in Project 06.09.03 [3] was taken into account for Project 05. This HP assessment report document encompasses the work corresponding to PJ05-02 for the maturity phase V3. PJ05-03 will have a separate V2 HP assessment report.

4.1.5 Identification of the nature of the change

The HP argument branches of the table cover the second level of HP arguments in Appendix A of [2] and so is not only used to help identify and capture changes to ATM actors work but can also be used to help screen and scope the HP assessment. Therefore, the table helps to narrow down and focus the list of HP arguments that were investigated in V3.

| HP argument branch | Change & affected actors |
|------------------------------|---|
| 1. ROLES & RESPONSIBILITIES | |
| 1.1 ROLES & RESPONSIBILITIES | ATCO will be responsible for providing ATS to more than one |

| | |
|--|--|
| | <p>aerodrome in parallel.</p> <p>Any tasks that have to be performed at the aerodrome will be performed by personnel located on-site at the aerodrome.</p> <p>One ATCO provides ATS for APP and one ATCO provides ATS for TWR and not simultaneously to both, as it might have been the case in some aerodromes.</p> |
| 1.2 OPERATING METHODS | The operating methods as such do not change for each airport, however an ATCO might work simultaneously on different airport with different operational modes (e.g. LVP at only one airport) |
| 1.3 TASKS | The ATCOs will be providing ATS for one or more aerodromes in parallel, so the individual tasks may not change significantly compared to single RTO. However, the number of tasks an ATCO will have to perform and the working methods will change, e.g. switching from one aerodrome detail display to another. |
| 2. HUMAN & SYSTEM | |
| 2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM) | <p>Compared to single remote tower no current change in task allocation between the ATCOs and the system is currently foreseen. Although as for single RT automated a/c identification and tracking may be implemented to enhance ATCOs situation awareness.</p> <p>The system will support monitoring tasks that are currently performed by the ATCO (conformance monitoring, task prioritisation, etc.) as well as the planning task might be supported by a planning tool to allow the ATCOs to forecast their expected workload more accurately.</p> |

Table 3: Description of the change

4.2 Step 2 Understand the HP implications

4.2.1 Identification of relevant arguments, HP issues & benefits and HP activities

For the HP issue identification, please refer to the HP plan [1] chapter 4.2

4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

The following activities have been conducted:

| HP activity | By when |
|---|-----------|
| REAL-TIME SIMULATION & PASSIVE SHADOW MODE TRIALS | 2018/2019 |
| STAKEHOLDER WORKSHOP | 2019 |

Table 4: Table of proposed HP activities and their priority

| ACTIVITY 1. | Validation exercise – Real Time Simulation, Passive Shadow Mode Trial |
|-------------|--|
| Description | <p>A Real time Simulation is used to validate complex airspace configurations, new tools or concepts in a realistic simulated Air Traffic Management environment. The simulator is replaying real traffic data and the ATCO works as he would work in real life.</p> <p>During a passive shadow mode (PSM) trial life operational data are used to feed into the system under test, but information provided by the demonstrated solutions has no influence on the operational system. This modus operandi allows the evaluation of the system and concept with realistic/real operational data without affecting the safety and processes of the real airport. However, this also implies that workload and situational awareness measurements are not reliable as the traffic is indeed handled by OPS actors on duty. Please consider the listed measurements respectively for RTS and PSM.</p> <p>The indicators measured and data collected are:</p> <ul style="list-style-type: none"> • Workload measurements (objective & subjective) • Situational Awareness (objective & subjective) • Task Load (simulator recording) • Trust • Usability • Acceptability/ job satisfaction • Feasibility • Mental and physical demand <p>The means to collect the data are detailed below.</p> |

| | |
|---|--|
| <p>Arguments & issues to be addressed</p> | <p>1.1.2-1., 1.1.3-1, 1.2.1-1, 1.2.1-2, 1.2.2-1, 1.2.3-1, 1.2.5-1, 1.3.1-4, 1.3.1-6, 1.3.2-3, 1.3.3-1, 1.3.4-1, 1.3.5-1, 1.3.5-6, 1.3.5-7, 2.1.6-1, 2.3.1-1, 2.3.2-1, 2.3.3-1, 2.3.6-1,</p> |
| <p>HP objectives</p> | <p>Roles & Responsibilities:</p> <ul style="list-style-type: none"> -If an additional responsibility and role is needed the coordination procedures have to be determined. -The new roles and responsibilities (e.g., assistant has to be described in detail) Back-up ATCO for the split procedure could be needed. (The availability of the spare ATCO needs to be defined Split and merge procedures have to be validated in a validation exercise In case there are more positions needed the coordination procedures have to be determined) <p>Procedures:</p> <ul style="list-style-type: none"> -Split and merge procedures have to be validated in a validation exercise -In case there are more positions needed the coordination procedures have to be determined -Assess workload in real-time simulation -Assess acceptability of operating methods in real-time simulation -Assess the clustering option of ADs based on local procedures -Investigate split procedure in emergency situation -Define and assess different emergency situation/ abnormal conditions -Assess and validate degraded modes -Assess acceptance of operating methods in real-time simulation -Overlays shall be further investigated -Assess phraseology for air-ground communication; (The AD designator shall be included in the phraseology ; taxiways shall be easily distinguishable) -Assess phraseology for ground-ground communication. The phraseology (including vehicle call signs) has to be assessed -Assess situation awareness -Assess workload in RTS (the traffic level has to be assessed newly, including a |

| | |
|--|---|
| | <p>more realistic traffic sample - VFR; and more mature tools)</p> <p>-Assess ATCO trust in concept and associated CWP/HMI procedures.</p> <p>HMI, support system:</p> <p>-Assess integrated HMI (incl. Squelch/highlight function etc.)</p> <p>-Assess acceptability of display presentation with partially/ wholly compressed areas. (including assessment of camera positions and filtering function)</p> <p>-Assess the system support (e.g. planning tool).</p> <p>-Assess the ATCO trust in the system in RTS</p> <p>-Assess usability and utility of human machine interface</p> <p>-Assess usability (e.g. as few clicks as possible) and utility of input devices</p> <p>-Assess the usability of the visual display and all containing elements. (with regard to usability, completeness of displayed information</p> <p>-Assess the usability of the user interface (including, output devices , VP, PTZ, input devices like e-pen flight strips, alarms and alerts)</p> |
| Required Evidence | See Chapter 4 |
| Tool selected out of the HP repository | <p>SATI</p> <p>NASA TLX</p> <p>Bedford scale</p> <p>CHINA LAKES scale</p> <p>CARS SCALE</p> <p>SUS</p> <p>Etc.</p> |
| Planning and Approach | <p>Definition of required scenarios</p> <p>Specification of the experimental scenario</p> <p>Validation exercise runs</p> <p>Analysis of the data</p> |
| resources | |

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| timeline | |
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Table 5: Description of Activity 1

The following table outlines were considered in the stakeholder workshop.

| ACTIVITY 2. | Stakeholder workshop |
|------------------------------------|--|
| Description | <p>The purpose of the stakeholder workshop is twofold</p> <ul style="list-style-type: none"> (1) to clarify requirements with the pilot community ; those requirements related mainly to phraseology and procedures (2) To clarify ATCO training needs and requirements. Training experts shall be involved in these discussions and local strategies have to be taken into account. |
| Arguments & issues to be addressed | 1.1.3-1, 4.1.1-1, 4.1.2-2, 4.1.2-3, 4.1.2-4, 4.2.2-1, 4.3.2-1, 4.4.2-1-4.4.2-3 |
| HP objectives | <p>The new roles and responsibilities (e.g., assistant has to be described in detail) Back-up ATCO for the split procedure could be needed. (The availability of the spare ATCO needs to be defined Split and merge procedures have to be validated in a validation exercise In case there are more positions needed the coordination procedures have to be determined)</p> <p>Obtain feedback on acceptability of the proposed changes of responsibilities, and feed mitigations in to the design (following review with affected stakeholders).</p> <p>Assess job satisfaction Review endorsements procedures</p> <p>Identify requirements and recommendations for local implantation on shift organisation</p> <p>Identify recommendations: e.g.: on-site visits included into the training (physical conditions)</p> <p>Recommend aerodrome specific procedures and operating conditions into the training.</p> <p>Identify technical training needs</p> |
| Required Evidence | See Chapter 4 |

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| Tool selected out of the HP repository | n/a |
| Planning and Approach | The workshop shall take place in 2019 after the V3 validation exercises taking into account their results. |
| resources | |
| timeline | |

Table 6 Description of Activity 2

4.4 Step 4 Collate findings & conclude on transition to next V-phase

4.4.1 Summary of HP activities results & recommendations / requirements

Note: The HP recommendations and requirements have been formulated only once, although they apply to other closed issues as well. The full list of recommendations and requirements are to be found in the Appendix.

| Issue ID | HP issue / Benefit | HP Issue/ Benefit Status | HP/ Valid. Obj. ID | activity conducted | results / evidence | recommendations | requirements |
|---|--|--------------------------|--------------------|--------------------|--------------------|-----------------|--|
| Arg. 1.1.2: The description of roles & responsibilities cover all tasks to be performed by a human actor. | | | | | | | |
| 1.1.2-1 | The description of the roles & responsibilities does not cover all task to be performed by a human actor | closed | OBJ-PJ05.02-V3-HP1 | workshop | | | REQ.05.00_HPops_12: If an additional spare ATCO or assistant is required, the corresponding roles and responsibilities and the coordination procedures shall be locally defined. |
| Arg. 1.1.3: Roles and responsibilities are clear and consistent (in V1: non-contradictory). | | | | | | | |
| 1.1.3-1 | Roles & responsibilities are not clear & consistent | closed | OBJ-PJ05.02-V3-HP2 | Workshop | | | REQ.05.00_HPdesign_19: In case the TWR ATCO's responsibility covers the apron area as well, the apron shall be visible on the cameras. |

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| | | | | | | | REQ.05.00_HPops_30: Roles and responsibilities shall be locally defined, ensuring they cover all actors involved for normal, abnormal and degraded modes of operations. |
| Arg. 1.2.1: Operating methods cover operations in normal operating conditions. | | | | | | | |
| 1.2.1-1 | Operating methods do not cover normal operating condition | closed | OBJ-PJ05.02-V3-HP3 | RTS | | | <p>REQ.05.00_HPtraining_3 2: Split and merge procedures shall be locally defined with a clear description of the associated roles and responsibilities and corresponding coordination</p> <p>REQ-05.00-SPRINTEROP-TM02.0004: During Transfer of an aerodrome both ATCOs should shall be presented with the same information on the aerodrome being transferred all available technical systems as replicas until the handover is performed. procedures.</p> <p>REQ.05.00_HPops_31: Operating methods shall be locally defined</p> |

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| | | | | | | | covering normal, abnormal and degraded modes of operations. |
| 1.2.1-2 | Operating methods might not be appropriate to control the required traffic volume in normal operating conditions | closed | OBJ-PJ05.02-V3-HP4 OBJ-PJ05.02-V3-HP5 OBJ-PJ05.02-V3-HP6 | RTS | | | |
| 1.2.1-5 | Different aerodromes have different procedures and different characteristics. This may add confusion, increase the amount of information ATCOs have to remember, and as a consequence increase the potential for human error. This could have an impact at the system level on safety | closed | OBJ-PJ05.02-V3-VALP-HHP6a | RTS | | | |

Arg. 1.2.2: Operating methods cover operations in abnormal operating conditions.

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| 1.2.2-1 | Operating methods in abnormal conditions (like in emergency situations) might be inefficient and increase workload | closed | OBJ-PJ05.02-V3-HP7 OBJ-PJ05.02-V3-HP8 | RTS | | | REQ-05.00-SPRINTEROP-TM01.0001: The ATCO shall be able to provide uninterrupted service shall be provided during transfer of responsibility between MRTMs REQ-05.00-SPRINTEROP-TM02.0001: The ATCO shall be able to transfer |
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| | | | | | | | one of the controlled aerodromes to another MRTM |
| Arg. 1.2.3: Operating methods cover degraded modes of the ATM system. (see Safety) | | | | | | | |
| Arg. 1.2.4: The content of operating methods is clear and consistent (in V1: non-contradictory). | | | | | | | |
| 1.2.4-1 | The content of the operating methods is unclear & contradictory. | closed | OBJ-PJ05.02-V3-HP8a | RTS | | REC.05.00_HPops9: Local guidelines with regard to when the support from an additional ATCO or assistant shall be asked for, should be locally defined | REQ.05.00_HPops_13: : In case a back-up ATCO or an assistant is needed, the availability of the additional ATCO/assistant needs to be locally defined. REQ.05.00_HPops_6: NOTAM and AIP information shall clearly indicate to the flight crew that they are going to fly to a "multiple remote" TWR, in order to ensure appropriate awareness about the possibility of hearing multiple clearances on frequency that apply to other aerodromes. |
| Arg. 1.2.5: The operating methods can be followed in an accurate, efficient and timely manner | | | | | | | |
| 1.2.5-1 | The operating methods cannot be followed in an accurate, efficient and timely manner | closed | OBJ-PJ05.02-V3-VALP-HP8b | RTS | | | |

Arg. 1.3.1 The potential for human error is reduced as far as possible

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| 1.3.1-1 | ATCO might confuse displayed airports when searching for flights (search in wrong display) as some information is displayed in a combined HMI integrating the different airports or as information is displayed only temporarily. | closed | OBJ-PJ05.02-V3-HP11a | RTS | | | |
| 1.3.1-2 | Wrong procedures applied to wrong APT. If an ATCO confuses the aerodromes she/he may provide erroneous control actions. Safety implications. | closed | OBJ-PJ05.02-V3-HP11b | RTS | | | |
| 1.3.1-4 | ATCOs confuse geographical local details of two airports. Pilots refer often to local geographic positions, therefore the ATCO needs to be aware of the local geographical details for all aerodromes they are controlling. | closed | OBJ-PJ05.02-V3-HP11 | RTS | | | |
| 1.3.1-5 | ATCO might confuse / have difficulty to find the information for an a/c as some information is displayed in a combined HMI integrating the different airports or as information is displayed only temporarily | closed | OBJ-PJ05.02-V3-HP11c | RTS | | | |
| 1.3.1-6 | Confusion related to phraseology | closed | OBJ-PJ05.02-V3-HP13 OBJ-PJ05.02-V3-HP14 | OBJ-PJ05.02-V3-HP13 | | | |

Arg. 1.3.2. Tasks can be achieved in a timely manner

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| 1.3.2-3 | ATCO might focus on tasks at one airport neglecting priorities at other airport | closed | OBJ-PJ05.02-V3-HP15 | RTS | | | |
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Arg. 1.3.3 The level of workload (induced by cognitive and/ or physical task demands) is acceptable

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| 1.3.3-1 | Exceeding workload (increased number of aerodromes to be controlled) might lead to errors | closed | OBJ-PJ05.02-V3-HP16 | RTS | | | |
| 1.3.3-2 | Simultaneous activities at different aerodromes may overload the ATCO increasing thus the potential for human errors. | closed | OBJ-PJ05.02-V3-HP16a | RTS | | | <p>REQ.05.00_HPops_11: The simultaneous control of 3 aerodromes shall ensure the availability of a spare controller or an assistant, in case the termination of service is not locally acceptable.</p> <p>REQ.05.00_HPops_7: The airport name should be integrated in the phraseology in order to increase the situational awareness for the ATCOs and pilots.</p> |

1.3.4 The level of trust in the new concept/the new procedure is appropriate

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| 1.3.4-1 | The level of trust in the new concept and system is not appropriate | closed | OBJ-PJ05.02-V3-HP17 | RTS | | | |
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1.3.5 Human actors can maintain a sufficient level of situational awareness

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| 1.3.5-2 | ATCO might not be able to maintain Situation awareness if there are various operating | closed | OBJ-PJ05.02-V3-HP15 | RTS | | | REQ.05.00_HPops_15: A harmonised working |
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| | conditions. | | | | | | method for all aerodromes clustered in a multiple remote tower shall be envisaged. |
| 1.3.5-3 | ATCO might not be able to maintain situation awareness if there are various weather conditions (wind or visibility) at the different airports | closed | OBJ-PJ05.02-V3-HP15a | RTS | | | REQ.05.00_HPops_16: The clustering of aerodromes shall be done taking into account local factors such as: aerodrome layout, geographical specificities, runway directions, working procedures/operational conditions, traffic type and complexity, weather patterns. |
| 1.3.5-4 | ATCO might not be able to maintain Situation awareness if there is a geographical difference between the aerodromes | closed | OBJ-PJ05.02-V3-HP15b | RTS | | | |
| 1.3.5-5 | ATCO might be overlooking or missing movements on one APT, while focusing on the other one. | closed | OBJ-PJ05.02-V3-HP15c | RTS | | | |
| 1.3.5-6 | ATCO ability to judge distance/separation may be impacted by compressed OTW presentation. | closed | OBJ-PJ05.02-V3-HP18 | RTS | | | |

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| 1.3.5-10 | Various similarities on the airports controlled (landscape, buildings, runway configuration etc.) induce a risk to mismatch signal/cue and relate that to the wrong airport. (configuration of airport) | closed | OBJ-PJ05.02-V3-HP15d | RTS | | | REQ-05.00-SPRINTEROP-CO03.0001: When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall be able to listen to all aeronautical mobile service (air-ground communications) communication channels for all aerodromes being served. |
| Arg 2.1.6 The level of trust in automated functions is appropriate | | | | | | | |
| 2.1.6-1 | ATCO might not trust in the system if: - the reliability of the automated task priorities is too low - the reliability of the conformance monitoring is too low - the reliability of the voice recognition is too low (Sol. 3) | closed | OBJ-PJ05.02-V3-HP20 | RTS | | | |
| Arg. 2.3.1 The type of information provided satisfies the information requirements by the human | | | | | | | |
| 2.3.1-1 | The type of information provided does not satisfy the information requirements of the ATCOs (and SUP). This will lead to inefficient and possibly erroneous task execution and loss of trust in the system. | closed | OBJ-PJ05.02-V3-HP21 | RTS | | | REQ-05.00-SPRINTEROP-VS01.0001: The ATCO shall, from the remote location, apply ICAO Doc 4444 - Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as |

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| | | | | | | <p>vehicles and personnel on the manoeuvring area. - Visual observation shall be achieved through direct out-of-the-window observation, or through indirect observation utilizing a visual surveillance system which is specifically approved for the purpose by the appropriate ATS authority.</p> <p>REQ.05.00_HPdesign_18: The VP shall ensure the ATCOs can easily access specific areas of interest, using predefined location -using the binoculars function- to access "hotspots".</p> <p>REQ-05.00-SPRINTEROP-AP01.0001: The ATCO shall be presented with planning information (e.g. forecasted traffic, forecasted weather, etc.) in order to adjust/plan traffic to any constraints or foresee the need for a</p> |
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| | | | | | | | split or transfer of the merged aerodromes |
| Arg 2.3.2 Input devices (e.g. keyboard, mouse, touch screen) correspond to HF principles | | | | | | | |
| 2.3.2-1 | Wrong APT input device is used to control function in the different APT. Some errors would be readily identified and corrected, others not. If ATCOs are controlling more than one APT they may have different input devices for different APT, these may lead to the wrong input device being used to control a function in a different APT. This may affect the efficiency with end user can execute a task. | Closed | OBJ-PJ05.02-V3-HP22 | RTS | | | |
| Arg. 2.3.3 Visual displays and other types of output devices adhere to HF principles | | | | | | | |
| 2.3.3-1 | Visual displays and other output devices are not usable and there is confusion with regards to which aerodrome is displayed on which visual display. | Closed | OBJ-PJ05.02-V3-HP23 | RTS | | | <p>REQ-05.00-SPRINTEROP-CO02.0001: The ATCO shall observe visual communication from aircraft that are within the ATCO visual range, i.e.: - aircraft flashing or showing landing lights (in darkness).- aircraft repeatedly changing its bank angle – “rocking wings” (in daylight)</p> <p>REQ-05.00-SPRINTEROP-CO02.0002:The ATCO shall observe visual communication from aircraft that are within visual range on the</p> |

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| | | | | | | <p>aerodrome manoeuvring area, i.e.:- moving ailerons (or rudder). (in daylight)- flashing or showing landing lights (in darkness)</p> <p>REQ.05.00_HPdesign_2: The possibility to visually distinguish which aerodromes are active shall be available (e.g. grey out, removing the inactive one).</p> <p>REQ-05.00-SPRINTEROP-AF01.0001: The ATCO should be provided with an indication of a radio transmission related to an aerodrome, e.g. either in in the visual presentation or the flight strip system</p> <p>REQ.05.00_HPdesign_3: The display of aerodromes shall allow the ATCO to easily distinguish which information is related to</p> |
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| | | | | | | <p>which aerodrome (VP, radar, EFSS etc.)</p> <p>REQ.05.00_HPdesign_16: The radar label font shall follow current displaying standards</p> <p>REQ.05.00_HPdesign_24: If Radar Labels are to be provided, they shall be available for all aerodromes.</p> | |
| 2.3.3-2 | The visual presentation does not contain complete information and therefore impacting the detection, recognition, identification and ranging of objects relevant for service provision | closed | OBJ-PJ05.02-V3-HP23b | RTS | | <p>REC.05.00_Hpdesign24: An additional Weather Display and Information is recommended on an additional screen if not available on the VP.</p> <p>REC.05.00_HPdesign16: If the pan and tilt functionality is available then a feature that would allow the camera to return to a "fixed" position should be available.</p> <p>REQ-05.00-SPRINTEROP-BF01.0006: The binocular functionality should include predefined and user-definable automatic scanning patterns, such</p> | <p>REQ-05.00-SPRINTEROP-MT01.0002: The current MET report, actual wind information, actual QNH and, if measured for the particular airport and relevant, RVR values shall continuously be presented to the ATCO for all aerodromes being controlled from the MRTM.</p> <p>REQ-05.00-SPRINTEROP-VS01.0002: The ATCO shall have access to a visual presentation of flight operations on and in the vicinity of the aerodrome as well as vehicles and personnel on the manoeuvring area. Note: The vicinity</p> |

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| | | | | | | <p>as runway sweeps</p> <p>REQ-05.00-SPRINTEROP-BF01.0007: The binocular functionality should include automatic tracking of moving aircraft, vehicles or obstructions (e.g. personnel or large animals).</p> <p>REC.05.00_HPdesign15: If the automatic binocular function is available, an indication should be visible to show which a/c or vehicle is selected on the automatic binoculars.</p> | <p>of an aerodrome is defined in Doc 4444 as: "aircraft in, entering or leaving an aerodrome traffic circuit".</p> <p>REQ-05.00-SPRINTEROP-VS02.0004: The visual presentation shall provide a smooth and regular impression of moving objects to the human eye.</p> <p>REQ-05.00-SPRINTEROP-VS02.0005: the ATCO's ability to perform the ATS service shall not be affected by the time delay between image/data capture and presentation on the visual presentation</p> <p>REQ-05.00-SPRINTEROP-VG01.0002: The visual reproduction may be augmented with additional (digital) information to provide the ATCO a greater level</p> |
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| | | | | | | | <p>of situational awareness.</p> <p>REQ.05.00_HPdesign_20: The filtering option shall ensure the provided image remains realistic and does not mislead the ATCOs.</p> <p>REQ-05.00-SPRINTEROP-BF01.0001:The ATCO shall be provided with use a functionality corresponding to the binoculars in a traditional Tower, giving the possibility to zoom/enlarge specific areas and objects in the visual presentation.</p> <p>REQ-05.00-SPRINTEROP-BF01.0002: The visual presentation provided by the binocular functionality shall be of sufficient quality (image sharpness, magnification, contrast) to support the related ATCO tasks.</p> <p>REQ-05.00-SPRINTEROP-BF01.0003: The binocular functionality shall be as simple, quick and easy to use as manually operated binoculars (in a local</p> |
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| | | | | | | | <p>tower).</p> <p>REQ-05.00-SPRINTEROP-BF01.0004: The binocular functionality shall include a moveable zoom feature with a visual indication of the direction of bore sight.</p> <p>REQ.05.00_HPdesign_18: The ATCOs shall be able to easily access specific areas of interest, using predefined location -(e.g. through the binoculars function)- to access "hotspots".</p> <p>REQ.05.00_HPdesign_22: The pan and tilt functionality or VP shall allow the ATCO to scan the remaining part of the CTR</p> |
| 2.3.3-3 | The visual presentation for multiple aerodromes should incorporate overlaid information to indicate / high light specific parts of the aerodrome, such as runways, taxiways, in order to enhance the ATCO (and | closed | OBJ-PJ05.02-V3-HP23c | RTS | | | <p>REQ.05.00_HPdesign_23: The overlay options shall be embedded on the VP using HF design principles.</p> |

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| | SUP) situational awareness, specifically in darkness and low visibility conditions | | | | | | <p>REQ-05.00-SPRINTEROP-VS02.0006: The ATCO shall be provided with UTC clock in the MRTM. The UTC clock should be presented in the visual presentation.</p> <p>REQ-05.00-SPRINTEROP-VG01.0007: It shall be possible for the ATCO to toggle on/off as well as adjust in light intensity any overlaid information in the visual reproduction for each aerodrome separately toggle on/off.</p> <p>REQ-05.00-SPRINTEROP-VG01.0008: Wind indication shall be presented as an overlay in relation to the operating directions in use for each RWY and/or both RWY directions</p> |
| Arg 2.3.4 Alarms and alerts have been developed according to HF principles | | | | | | | |
| 2.3.4-1 | ATCO do not notice or wrongly interpret alarms and alerts provided by the events | closed | OBJ-PJ05.02-V3-HP24a | RTS | | <p>REQ-05.00-SPRINTEROP-FN01.0003: The ATCO may should be warned by the surveillance system about an aircraft or vehicle entering the runway without clearance.</p> <p>REC.05.00_HPdesign13:</p> | <p>REQ-05.00-SPRINTEROP-TS01.0001: The ATCO shall be notified about any technical status of systems that can affect the safety or efficiency of flight operations and/or the provision of air traffic</p> |

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| | | | | | | In case stop bars and/or ground sensors are available, there should be a visual indication when stop bar overrun occurs. | <p>service.</p> <p>REQ.05.00_HPdesign_25: Alarms and alerts shall be developed in line with HF design principles.</p> <p>REQ.05.00_HPdesign_26: The same type of alarms and alerts used shall be available on all aerodromes clustered for multiple remote tower operations.</p> |
| Arg. 2.3.6 The usability of the user interface is acceptable | | | | | | | |
| 2.3.6-1 | The usability of the user interface is not acceptable (e.g. display of two APT on one screen at the same time is not acceptable) | | OBJ-PJ05.02-V3-HP24 | RTS Workshop | | REC.05.00_Hpdesign22: The information on the status of the lights and no-visual aids should be always visible for the controller, making it easy to identify to what aerodrome they correspond to. (linked to REQ-05.00-SPRINTEROP-CO01.0004 and SR49) | <p>REQ-05.00-SPRINTEROP-CO01.0004: The ATCO shall be able to communicate via a signalling lamp with the respective aircraft on each aerodrome being controlled from the MRTM, in accordance with ICAO Annex 14 section 5.1.3.</p> <p>REQ-05.00-SPRINTEROP-VS02.0003: The visual</p> |

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| | | | | | | <p>presentation reproduction shall be designed so as to avoid unnecessary discontinuities or non-uniformities in terms of the presented scale, orientation and field of view of the area under observation by the ATCO.</p> <p>REQ-05.00-SPRINTEROP-WE01.0002 : Working Environment (noise, temperature etc.) shall be according to national regulations for normal office establishments.</p> |
| 2.3.6-2 | The handling of input devices for more than one airport is not acceptable | closed | OBJ-PJ05.02-V3-HP24b | RTS | <p>REC.05.00_HPdesign1: The possibility to create flight strips (e.g. with electronic pen) should be available.</p> | <p>REQ.05.00_HPdesign_1: In the RTC environment with at least 20 movements (for 2 aerodromes) and 15 movements (for 3 aerodromes), electronic flights strips shall be implemented.</p> <p>REQ.05.00_HPdesign_4: The section dedicated to electronic flight strips shall be large enough in order to allow the adequate visibility at all</p> |

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| | | | | | | | <p>times for the ATCO (the handwritten notes shall be visible at all times-even if collapsed).</p> <p>REQ.05.00_HPdesign_5: The e-strips shall be big enough in order to allow ATCOs to adequately input information manually (e.g. they could be expandable).</p> |
| Arg. 2.3.7 the user interface is acceptable | | | | | | | |
| 2.3.7-1 | Confusion of which information (e.g. strips, meteo etc.) is linked to which APT. This could increase the potential for human error, as ATCOs may give the wrong information, instruction to wrong a/c at another aerodrome. Therefore, this could have a potential negative impact on system safety. | Closed | OBJ-PJ05.02-V3-HP24d | RTS | | <p>REC.05.00_HPdesign3: The full airport name should be displayed both in the Visual Presentation (VP) and the radar display in order to easily link OTW view, radar display and EFSS info.</p> | <p>REQ-05.00-SPRINTEROP-VS02.0007: The ATCO shall be provided with the Airport name (spelled out or designator or both) shall be displayed for each aerodrome in operation in the MRTM.</p> <p>REQ.05.00_HPdesign_10: The ground frequency push buttons have to be integrated in the CWP in a way that they are easily distinguishable between airports (e.g if airports are represented side by</p> |

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| | | | | | | | side the push buttons shall be respectively located on each side). REQ-05.00-SPRINTEROP-WE01.0004: Sufficient writing space shall be available in the MRTM to the ATCO in order to make manual notes. |
| Arg. 2.3.8 The user interface design supports a sufficient level of individual situation awareness | | | | | | | |
| 2.3.8-2 | Simultaneous radio calls on different frequencies (decoupled) might lead to the loss of information. | Closed | OBJ-PJ05.02-V3-HP24e | RTS | | | REQ-05.00-SPRINTEROP-CO03.0005: The ATCO shall be able to listen to all surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) communication channels for all aerodromes being served. |
| 2.3.8-3 | Coupling of frequencies might lead to ATCO, pilot and vehicle driver's confusion. (refer to Arg. 1.3.1) | closed | OBJ-PJ05.02-V3-HP24f | RTS | | | REQ-05.00-SPRINTEROP-CO03.0001: When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall for the aeronautical mobile service (air-ground communications), be able to transmit either to "all aerodromes" |

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| | | | | | | | <p>being served from the MRTM, or to an “individual aerodrome”.</p> <p>REQ-05.00-SPRINTEROP-CO03.0003: When ATS is performed to more than one aerodrome simultaneously from one MRTM, aeronautical mobile service (air-ground communications) shall be retransmitted / relayed between all aerodromes being served from that MRTM.</p> <p>REQ-05.00-SPRINTEROP-CO03.0004: The ATCO shall use aeronautical fixed service (ground-ground communications) extended to cover communications with all units relevant for all aerodromes being served.</p> <p>REQ-05.00-SPRINTEROP-CO03.0006: The ATCO shall, for the surface</p> |
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| | | | | | | | movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes), be able to transmit to individual aerodromes. |
| 2.3.8-4 | Confusion relating to which pilot at which APT, ATCO is communicating / How to ensure that the ATCO understand which aircraft is calling. | Closed | OBJ-PJ05.02-V3-HP24g | RTS | | | |
| 3.3.2. The phraseology supports the communication in all operating conditions | | | | | | | |
| 3.3.2-1 | APTs having the same or similar RWY designators could lead to confusion. (the inclusion of airport names in clearances / radio transmissions shall be considered as a standard procedure) (Arg. 1.3.1) | closed | OBJ-PJ05.02-V3-HP24h | RTS | | | REQ.05.00_Hpops_14: Coordination procedures between the TWR ATCO and the aerodrome personnel shall be locally defined. (linked to REQ-05.00-SPRINTEROP-CO03.0004/ SR12, SR 13, SR14) |
| Arg. 4.1.1 Changes in roles and responsibilities are acceptable to the affected human actors | | | | | | | |
| 4.1.1-1 | The concept and resulting changes in roles & responsibilities are not acceptable to the affected actors | closed | OBJ-PJ05.02-V3-HP25 | RTS | | | |
| Arg. 4.2.1 Knowledge, skills and experience requirements for human actors have been identified | | | | | | | |
| 4.2.1-1 | New MRTM system might require new knowledge, skills and experience | closed | OBJ-PJ05.02-V3-HP25a | workshop | | | |

Arg. 4.3.2 The impact on shift organisation is identified

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| 4.3.2-1 | The maximum shift length of an ATCO might be reduced with Multiple Remote Tower compared to single remote tower | closed | OBJ-PJ05.02-V3-HP28 | workshop | | | REQ.05.00_HPtraining_2 9:Local assessment shall be done to determine shift lengths |
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Arg. 4.5.The content of training for each actor group is specified.

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| 4.5.1-1 | <p>The training does not sufficiently contain a technical part on the new MRTM</p> <p>The ATCOs are not sufficiently familiarised with the aerodrome (physical characteristics, procedures, operating conditions etc.)</p> <p>The ATCO is not sufficiently familiarised with the technical behaviour of the camera and other RT specific technical components.</p> | Closed | OBJ-PJ05.02-V3-HP28 | workshop | | | <p>REQ.05.00_HPtraining_2 7: The diversity of the different aerodromes in terms of geographical specificities and procedures have to be included in the training</p> <p>REQ.05.00_HPtraining_2 8: The training curricula shall familiarize the ATCOs with the new concept and the corresponding tools (e.g. binoculars), in order to ensure they have an adequate level of trust</p> |
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Table 7: Summary of the HP results and recommendations/ requirements for each identified issue & related argument

4.4.2 Maturity of the Solution

| Maturity checklist for finalising the V3 assessment | | | |
|---|---|-------------------------------|--|
| ID | Question | Answer | Comments |
| | | <i>Fill in 'yes' or 'no'.</i> | <i>Please substantiate your answer.</i> |
| 1 | Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported? | Yes | <p><i>Based on the Change and Argument Identifications section, a total of 41 issues have been identified, covering all 4 HP Arguments.</i></p> <p><i>All 4 high-level HP Arguments have been covered.</i></p> <p><i>2nd level HP Arguments covered:</i></p> <ul style="list-style-type: none"> - <i>Argument 1.1. Roles and Responsibilities</i> - <i>Argument 1.2. Operating Methods</i> - <i>Argument 1.3. Tasks</i> - <i>Argument 2.1 Allocation of tasks (between the human and the machine)</i> - <i>Argument 2.3. Human-machine interface</i> - <i>Argument 3.2. Allocation of tasks (between human actors)</i> - <i>Argument 4.1. Acceptance and job satisfaction</i> - <i>Argument 4.2. Competence requirements</i> - <i>Argument 4.3. Changes in staffing requirements and staffing levels</i> - <i>Argument 4.5. Training</i> <p><i>Based on the validation activities (task analysis, workshops) all aforementioned arguments have been properly addressed in relation to the expected evidence for a V3 maturity level.</i></p> |
| 2 | Are the benefits and issues in terms of human performance and operability related to the proposed solution sufficiently assessed (i.e. on the level required for V3)? | Yes | <p><i>All parts of the solution/concept have been considered, on the basis of the change and argument identification step- which represented the starting point of the HP activities. For a detailed description of the issues addressed in validation activities, please refer to Chapter 4.4 above.</i></p> |
| 3 | Have all the parts of the solution/concept been considered? | Yes | <p><i>The solution is considered to have reached a V3 maturity level. All parts of the solutions have been covered for Pj05.02 and all corresponding issues have been closed.</i></p> |

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| 4 | Have potential interactions with related projects/concepts been considered and addressed? | Yes | <i>The list of the related projects/solutions has been identified - as documented in the OSED and the HP Plan- Part IV of the VALP. No direct relations except with PJ05-03 were identified.</i> |
| 5 | Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities? | Yes | <i>The level of human performance needed to achieve the desired system performance has been assessed and confirmed as consistent with human capabilities. see VALR.</i> |
| 6 | Are the assessments results in line with what is targeted for that concept? If not, has the impact on the overall strategic performance objectives/targets been analysed? | Yes | <i>Arguments addressed and associated actual evidence in the form of recommendations and requirements (Appendix A and Appendix B).</i> |
| 7 | Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions? | Yes | <i>The validation activities were built and conformed to experimental design principles, ensuring realistic conditions and allowing the participants to get sufficiently familiar with the new concept through training sessions before the real time simulation was conducted. For all the issues that were not fully covered during RTS due to simulation limitations, the workshop discussions have ensured an in depth coverage of the remaining open issues. The latter have been closed based on "expert judgement" of both operational experts and HP experts.</i> |
| 8 | Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements? | Yes | <i>The validation results confirm that the interactions between human and technology are operationally feasible and consistent with agreed HP requirements. For a detailed view on the identified issues and the results of the validations, please consult Chapter 4.4 above.</i> |

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| 9 | Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)? | Yes | <i>The outcome of the HP activities is to be found in the Recommendations and Requirements register sections of this Excel document. Full coordination with all partners involved has been done in order to ensure the HP requirements are included in the list of project requirements in OSED Part I and a crosscheck with Safety has been performed as well in order to ensure there is no overlap between the HP and SAF requirements.</i> |
| 10 | Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA? | Yes | <i>The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document.</i> |
| 11 | Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training? | Yes | <i>The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document.</i> |
| 12 | Have the major factors that can influence the transition feasibility (e.g. changes in competence requirements, recruitment and selection, training needs, staffing requirements, and relocation of the workforce) been addressed? Are there any ideas on how to overcome any issues? | Yes | <i>The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document.</i> |
| 13 | Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine. | Yes | <i>All related recommendations and requirements relevant to changes in roles & responsibilities, competence requirements, or the task allocation between human & machine, are to be found in the Recommendations and Requirements sections.</i> |
| 14 | Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)? | Yes | <i>All identified issues for Pj05.02 have been closed.</i> |

5 References

Human Performance

- [1] SESAR Solution 05-02 SPR/INTEROP-OSED Template for V3 - Part IV - Human Performance Assessment Report
- [2] SESAR Solution 05-02 SPR/INTEROP-OSED Template for V3 - Part IV - Human Performance Assessment Report
- [3] SESAR Solution 05-02 SPR/INTEROP-OSED Template for V3 - Part IV - Human Performance Assessment Report for Single Remote Tower, SESAR1

Appendix A – HP Recommendations Register

| Reference | Type of recommendation | Recommendation | Rationale | Assessment source + Reference report | Recommendation status | Rationale in case of rejection |
|-----------------------|------------------------|--|---|--------------------------------------|-----------------------|--------------------------------|
| REC.05.00_Hpdesign22: | Design | The information on the status of the lights and no-visual aids should be always visible for the controller, making it easy to identify to what aerodrome they correspond to. | The ATCO must be able to monitor airport systems, lights, NAV to ensure a safe service. | Workshop V3 | Open | |
| REC.05.00_HPdesign24: | Design | An additional Weather Display and Information is recommended on an additional screen if not available on | For ensuring the ATCO has quick access to relevant MET data. | Workshop/R TS | Open | |

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| | | the VP. | | | |
| REC.05.00_HPdesign3: | design | The full airport name should be displayed both in the Visual Presentation (VP) and the radar display in order to easily link OTW view, radar display and EFSS info. | To allow the ATCOs to easily associated the display of information to the corresponding aerodrome. | RTS | Open |
| REC.05.00_HPdesign16: | design | If the pan and tilt functionality is available then a feature that would allow the camera to return to a "fixed" position should be available. | In order to avoid having the ATCO "look" for a location. | RTS/Workshop | Open |
| REQ-05.00-SPRINTEROP-BF01.0006 | design | The binocular functionality should include | Assisting the ATCO/AFISO performing e.g. runway sweeps or sweeps of any of other area of interest within the area of | Workshop | Open |

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| | | predefined and user-definable automatic scanning patterns, such as runway sweeps. | responsibility. In order for the binocular functionality to be simple, quick and easy to use, this forms an important feature. Validated in SESAR1 REQ-06.09.03-OSED-BF03.1505 | | | |
| REQ-05.00-SPRINTEROP-BF01.0007 | design | The binocular functionality should include automatic tracking of moving aircraft, vehicles or obstructions (e.g. personnel or large animals). | Assisting the ATCO/AFIS to follow moving targets. In order for the binocular functionality to be simple, quick and easy to use, this forms an important feature. Validated in SESAR1 REQ-06.09.03-OSED-BF03.1506 | RTS/Workshop | Open | |
| REC.05.00_HPdesign15: | design | If the automatic binocular function is available, an indication should be visible to show which a/c or | To allow the ATCO to remain aware at all times of what the information on the VP refers to. | RTS | Workshop | |

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| | | vehicle is selected on the automatic binoculars. | | | | |
| REQ-05.00-SPRINTEROP-FN01.0003 | design | The ATCO may should be warned by the surveillance system about an aircraft or vehicle entering the runway without clearance. | To assist in identifying/avoiding RWY incursions. Validated in SESAR1 REQ-06.09.03-OSED-FN03.3006 | RTS/Workshop | Open | |
| REC.05.00_HPdesign13: | design | In case stop bars and/or ground sensors are available, there should be a visual indication when stop bar overrun occurs. | The indication could be either in the panorama and/or the planning tool (e.g. the label could turn red or if possible it could be linked to the electronic planning tool that blocks the occupied section). | WS | Open | |
| REC.05.00_HPops9: | operational | Local guidelines with regard to when | The local guidelines are meant to support the ATCOs in making the right decision (avoiding reaching an overload). | RTS/Workshop | Open | |

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| | | the support from an additional ATCO or assistant shall be asked for, should be locally defined | However, it is recommended that the decision remains with the ATCO, as inter-subject variabilities will influence the way an ATCO perceives workload as compared to another. | | | |
| REC.05.00_HPdesign1: | design | The possibility to create flight strips (e.g. with electronic pen) should be available. | Especially relevant for ground movement and unexpected calls (e.g. having flight strips prepared and completing them). | Workshop | Open | |

Table 8: HP recommendations

Appendix B – HP Requirements Register

| Reference | Type of requirement | Requirement | Rationale | Assessment source + Reference report if available | Requirement status | Rationale in case of rejection |
|--------------------------------|---------------------|--|--|---|--------------------|--------------------------------|
| REQ.05.00_HPops_14: | Operational | Coordination procedures between the TWR ATCO and the aerodrome personnel shall be locally defined. | To ensure all actors are aware of their roles and responsibilities when communicating to each other. | Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-CO01.0004 | Design | The ATCO shall be able to communicate via a signalling lamp with the respective aircraft on each aerodrome being controlled from the MRTM, in accordance with ICAO Annex 14 section 5.1.3. | To ensure feasibility of communication as in the conventional tower. | Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-CO02.0001 | Design | The ATCO shall observe visual communication from aircraft that are within the ATCO visual | To ensure proper situation awareness of the ATCO in terms of visibility from the VP. | RTS/ Workshop V3 | Open | |

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| | | range, i.e.: - aircraft flashing or showing landing lights (in darkness).- aircraft repeatedly changing its bank angle - “rocking wings” (in daylight) | | | | |
| REQ-05.00-SPRINTEROP-CO02.0002 | Design | The ATCO shall observe visual communication from aircraft that are within visual range on the aerodrome manoeuvring area, i.e.: - moving ailerons (or rudder). (in daylight)- flashing or showing landing lights (in darkness) | To ensure proper situation awareness of the ATCO in terms of visibility from the VP. | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-CO03.0001 | Operational | When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall be able to listen to all aeronautical mobile service (air-ground communications) communication channels for all aerodromes being | To ensure the appropriate level of attention is given to all aerodromes clustered in the MRTM. | RTS/ Workshop V3 | Open | |

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| | | served. | | | |
| REQ-05.00-SPRINTEROP-CO03.0001 | Design | REQ-05.00-SPRINTEROP-CO03.0001: When ATS is performed to more than one aerodrome simultaneously from one MRTM, the ATCO shall for the aeronautical mobile service (air-ground communications), be able to transmit either to “all aerodromes” being served from the MRTM, or to an “individual aerodrome”. | This requirement is based on validation exercise feedback, particularly EXE-060 Validated in SESAR1 REQ-06.09.03-OSED-MC04.2002 | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-CO03.0003 | Design | When ATS is performed to more than one aerodrome simultaneously from one MRTM, aeronautical mobile service (air-ground communications) shall be retransmitted / relayed between all aerodromes being served from that MRTM. | This is to facilitate avoidance of simultaneous transmissions on the different frequencies /aerodromes under the responsibility of one RTM. This requirement is based on validation exercise feedback; particularly from EXE-060. Validated in SESAR1 REQ-06.09.03-OSED-MC04.2003 | RTS/ Workshop V3 | Open |



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| REQ-05.00-SPRINTEROP-CO03.0004 | Operational | The ATCO shall use aeronautical fixed service (ground-ground communications) extended to cover communications with all units relevant for all aerodromes being served. | Communication needs are to use standardized phraseology for all aerodromes in multiple mode. Silent communication may be preferred | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-CO03.0005 | Operational | The ATCO shall be able to listen to all surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes) communication channels for all aerodromes being served. | This requirement is based on validation exercise feedback, particularly from EXE-060. Validated in SESAR1 REQ-06.09.03-OSED-MC04.2005 | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-CO03.0006 | Operational | The ATCO shall, for the surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes), be able to transmit to | Most ATCOs confirm that by having un-coupled frequencies on the ground, the risk of vehicle drivers assuming a wrong clearance (from another aerodrome) will significantly lower. The conclusion is attributed to the fact that vehicle drivers are less | RTS/ Workshop V3 | Open | |

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| | | individual aerodromes. | experienced with coupled frequencies, as opposed to pilots that have an appropriate training and practice e.g. en-route). | | | |
| REQ-05.00-SPRINTEROP-MT01.0002 | Operational | The current MET report, actual wind information, actual QNH and, if measured for the particular airport and relevant, RVR values shall continuously be presented to the ATCO for all aerodromes being controlled from the MRTM. | ICAO Doc 4444 Chapter 7.3.1.2 & ICAO Annex 11 Chapter 7.1.4. This is essential information used frequently by the ATCOs to inform pilots in real time. Validated in SESAR1 REQ-06.09.03-OSED-MT02.2002 | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-VS01.0001 | Operational | The ATCO shall, from the remote location, apply ICAO Doc 4444 - Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area. - Visual observation shall be achieved through | CAO Doc 4444, Chapter 7.1.1.2 (Watch shall be maintained by visual observation, augmented in low visibility conditions by an ATS surveillance system when available) The vicinity of an aerodrome is defined in Doc 4444 as: "aircraft in, entering or leaving an aerodrome traffic circuit". The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used for the take-off, landing and | RTS/ Workshop V3 | Open | |

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| | | direct out-of-the-window observation, or through indirect observation utilizing a visual surveillance system which is specifically approved for the purpose by the appropriate ATS authority. | taxiing of aircraft, excluding aprons". Requirement valid for ATC (TWR) only. Validated in SESAR1 REQ-06.09.03-OSED-VS02.3001 | | | |
| REQ.05.00_HPdesign_18: | Design | The VP shall ensure the ATCOs can easily access specific areas of interest, using predefined location -using the binoculars function- to access"hotspots". | In order to allow the a "head-up" quick access to relevant information without having to search for information (e.g holding, RWY threshold). | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-VS01.0002 | design | The ATCO shall should have access to a visual presentation of flight operations on and in the vicinity of the aerodrome as well as vehicles and personnel on the manoeuvring area. Note: The vicinity of an aerodrome is defined in Doc 4444 as: "aircraft in, entering or leaving an | For details on what the operator needs to be able to see with help of the visual presentation, see the lower level requirements under section "Visualisation – Quality". The vicinity of an aerodrome is defined in Doc 4444 as: "aircraft in, entering or leaving an aerodrome traffic circuit". The manoeuvring area is defined in Doc 4444 as: "that part of an aerodrome to be used | RTS/ Workshop V3 | Open | |

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| | | <p>aerodrome traffic circuit”.</p> | <p>for the take-off, landing and taxiing of aircraft, excluding aprons". In order to fulfil the task of keeping watch by visual observation while not being physically present at the aerodrome, a technical solution is needed that presents visual sensor data - collected from the aerodrome and its vicinity and transmitted to the remote tower facility - to the ATCO/AFISO in a way that provides him/her with the situational awareness required for conducting the associated services. This technical solution will be termed the Visual Presentation. This requirement is valid in both daylight and darkness, however dependent on the visibility conditions at the aerodrome and its vicinity. (Note: Personnel /objects without its own light source may be difficult to detect during darkness.) This requirement is also valid in all weather conditions (the most common except for the very extreme/unusual weather</p> | | | |
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| | | | phenomena) existing at the particular aerodrome. Validated in SESAR1 REQ-06.09.03-OSED-VG03.1001 | | | |
| REQ-05.00-SPRINTEROP-VS02.0003 | design | The visual presentation reproduction shall be designed so as to avoid unnecessary discontinuities or non-uniformities in terms of the presented scale, orientation and field of view of the area under observation by the ATCO. | Additionally, existing discontinuities and non-uniformities needs to be clearly indicated so as to avoid misleading impressions of the observed area. Validation experiences have showed this to be an essential requirement. Avoid eventual (screen) seams / joints in the visual presentation located at "hot spot" areas, e.g. holding positions, RWY entrance / exits etc as far as possible. If that is not possible, consider to implement mitigations such as hot spot cameras (if the PTZ camera is not sufficient) in order for the ATCO/AFISO to get an undivided/unbroken/unobscured presentation of these "hot spot" areas. Validated in SESAR1 REQ-06.09.03-OSED-VC03.1101 | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP- | design | The visual presentation shall provide a smooth | Moving objects must not give a "jumping" impression to the | RTS/ Workshop | Open | |

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| VS02.0004 | | and regular impression of moving objects to the human eye. | operator. This requirement is also related to transient phenomena, e.g. flashing lights such as Runway Guard Lights (RGL) or aircraft strobe lights. It is of high operational importance for an ATCO/AFISO to be able to see/judge if a light is flashing or not, e.g. confirm on/off status of RGL. Validated in SESAR1 REQ-06.09.03-OSED-VC03.1104 | V3 | | |
| REQ-05.00-SPRINTEROP- VS02.0005 | design | the ATCO's ability to perform the ATS service shall not be affected by the time delay between image/data capture and presentation on the visual presentation | The ATCO/AFISO must be able to trust the information presented. Time delay must be small enough (negligible) and fairly constant in order to be able to perform the service. Validation results have given a recommended maximum latency of 1 second. Validated in SESAR1 REQ-06.09.03-OSED-VC03.1105 | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP- VS02.0006 | design | The ATCO shall be provided with UTC clock in the MRTM. The UTC clock should be presented in the visual presentation. | The ATCO must be able to at all time be able to access correct UTC time without a loss of situation awareness while searching for the information. | RTS/ Workshop V3 | Open | |

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| REQ.05.00_HPdesign_23: | design | The overlay options shall be embedded on the VP using HF design principles. | The overlay options shall be embedded ensuring an appropriate location of the information, no clutter on the screens, harmonised displays between the aerodromes etc. | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-VS02.0007 | design | The ATCO shall be provided with the Airport name (spelled out or designator or both) shall be displayed for each aerodrome in operation in the MRTM. | The information should be displayed on the visual presentation. The ATCO must be able to have support information presenting which aerodrome the ATCO has under control at each time. Validation results have shown that that information support ATCOs . | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-VG01.0002 | design | The visual reproduction may be augmented with additional (digital) information to provide the ATCO a greater level of situational awareness. | The aim with this requirement is to present additional information directly in the OTW view (compare with head up displays in aircrafts) in order to minimise ATCO/AFISO head down time. Validated in SESAR1 REQ-06.09.03-OSED-VG03.1003 | RTS/ Workshop V3 | Open |
| REQ.05.00_HPdesign_20: | design | The filtering option shall ensure the provided image remains realistic and does not mislead the | The filtering options could shall keep the realistic view on the VP (e.g. removing clouds could give the wrong perception over | RTS/ Workshop V3 | Open |

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| | | ATCOs. | weather conditions in one aerodrome). | | | |
| REQ-05.00-SPRINTEROP-VG01.0007 | design | It shall be possible for the ATCO to toggle on/off as well as adjust in light intensity any overlaid information in the visual reproduction for each aerodrome separately toggle on/off. | Based on validation feedback. It is particularly important to be able to dim such overlays during darkness so as not to dazzle the operator Validated in SESAR1 REQ-06.09.03 OSED-VA03.1404 | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_2: | design | The possibility to visually distinguish which aerodromes are active shall be available (e.g. grey out, removing the inactive one). | The possibility to grey out the inactive aerodrome or to remove it from the display would remove the non-relevant information from the ATCOs visual range, allowing the focus on the active aerodromes. NOTE: For PJ05.03 the possibility to grey out information is not an option-only the "removal" from the screen of the inactive aerodrome. | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-VG01.0008 | design | Wind indication shall be presented as an overlay in relation to the operating directions in use for each RWY and/or both RWY | During landing or departure the ATCO provide correct wind information (according to doc 4444) to aircrafts. Easy access to wind information support ATCOs | RTS/ Workshop V3 | Open | |

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| | | directions | in heads up time and enables focus in departure/touch down area. | | |
| REQ-05.00-SPRINTEROP-BF01.0001 | design | The ATCO shall be provided with use a functionality corresponding to the binoculars in a traditional Tower, giving the possibility to zoom/enlarge specific areas and objects in the visual presentation. | ICAO Doc 9426 (Planning manual), Appendix B, (Aerodrome Control Tower Equipment Checklist) states binoculars as equipment. Validated in SESAR1 REQ-06.09.03-OSED-VS02.3004 | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-BF01.0002 | design | The visual presentation provided by the binocular functionality shall be of sufficient quality (image sharpness, magnification, contrast) to support the related ATCO tasks. | For details on the required quality/performance in order to support the ATCO/AFISO tasks, see the related requirements under section “Visualisation – Quality” (which details what the operator needs to be able to see with help of the binocular functionality.) Validated in SESAR1 REQ-06.09.03-OSED-BF03.1502 | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-BF01.0003 | design | The binocular functionality shall be as simple, quick and easy to | Local assessment to establish the best option for handling the binoculars ensuring the design | RTS/ Workshop | Open |

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| | | use as manually operated binoculars (in a local tower). | and the feature fit in the overall CWP design. | V3 | | |
| REQ-05.00-SPRINTEROP-BF01.0004 | design | The binocular functionality shall include a moveable zoom feature with a visual indication of the direction of bore sight. | In order for the binocular functionality to be simple, quick and easy to use, this forms an essential feature. Validated in SESAR1 REQ-06.09.03-OSED-BF03.1503 | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_18: | design | REQ.05.00_HPdesign_18: The ATCOs shall be able to easily access specific areas of interest, using predefined location -(e.g. through the binoculars function)- to access "hotspots". | In order to allow the quick access to relevant information without having to search for information (e.g holding, RWY threshold). | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_22: | design | The pan and tilt functionality or VP shall allow the ATCO to scan the remaining part of the CTR | This would allow the ATCOs to access the remaining part of the CTR which is not covered by the standard VP (for weather observations, specific traffic situations etc.) | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-TS01.0001 | design | The ATCO shall be notified about any technical status of | ICAO Doc 4444, Chapter 4.14 "Failure or irregularity of systems and equipment", states; "ATC | RTS/ Workshop V3 | Open | |

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| | | <p>systems that can affect the safety or efficiency of flight operations and/or the provision of air traffic service.</p> | <p>units shall immediately report in accordance with local instructions any failure or irregularity of communication, navigation and surveillance systems or any other safety-significant or equipment which could adversely affect the safety or efficiency of flight operations and/or the provision of air traffic control service." ICAO Doc 4444, Chapter 7.1.3 "Failure or irregularity of aids and equipment", states; "Aerodrome control towers shall immediately report in accordance with local instructions any failure or irregularity of operation in any equipment, light or other device established at an aerodrome for the guidance of aerodrome traffic and flight crews or required for the provision of air traffic control service." Note: This corresponds to requirements on local tower operations, with the addition of systems that are specific to remote tower operation, such as detecting corrupt/delayed visual</p> | | | |
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| | | | presentation. Validated in SESAR1 REQ-06.09.03-OSED-FN02.5006 | | |
| REQ.05.00_HPdesign_25: | design | Alarms and alerts shall be developed in line with HF design principles. | To ensure appropriate visibility and user frindliness, without confusions. | RTS/ Workshop V3 | Open |
| REQ.05.00_HPdesign_26: | design | The same type of alarms and alerts used shall be available on all aerodromes clustered for multiple remote tower operations. | The symmetry of information between the aerodromes would help the ATCO easily identify the relevant information. | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-AP01.0001 | operational | The ATCO shall be presented with planning information (e.g. forecasted traffic, forecasted weather, etc.) in order to adjust/plan traffic to any constraints or foresee the need for a split or transfer of the merged aerodromes | SESAR 1 results delivered a need of a tool to support the ATCO with a forecast of e.g. traffic, weather, airport work that affect the workload in situations when serving more than two low density aerodromes simultaneous. The need for this tool is to cover a more complex Multiple Remote Tower environment. | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-AF01.0001 | design | The ATCO should be provided with an indication of a radio | As for the visual input, the ATCOs shall be able to easily distinguish the information | RTS/ Workshop V3 | Open |



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| | | transmission related to an aerodrome, e.g. either in the visual presentation or the flight strip system | associated to each of the aerodromes they are controlling. | | | |
| REQ.05.00_HPdesign_10: | design | The ground frequency push buttons have to be integrated in the CWP in a way that they are easily distinguishable between airports (e.g if airports are represented side by side the push buttons shall be respectively located on each side). | With a multiple remote tower display, symmetry is considered a strong supporting barrier in helping ATCOs distinguish the input/ output devices per each aerodrome. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPops_11: | operational | The simultaneous control of 3 aerodromes shall ensure the availability of a spare controller or an assistant, in case the termination of service is not locally acceptable. | The spare ATCO or assistant could assist the TWR ATCO in order to manage workload and prevent overload by supporting with communication and coordination tasks or by adding delays in traffic or reducing capacity for emergency or complex situations. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPops_12: | operational | If an additional spare ATCO or assistant is required, the corresponding roles and | In order to ensure all actors understand and accept their roles and responsibilities as well as the corresponding tasks/ | RTS/ Workshop V3 | Open | |

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| | | responsibilities and the coordination procedures shall be locally defined. | coordination. | | | |
| REQ.05.00_HPops_13: | operational | In case a back-up ATCO or an assistant is needed, the availability of the additional ATCO/assistant needs to be locally defined. | Local assessment shall define the availability of the spare ATCo or assistant in order to ensure an appropriate response time in case of emergency/ complex situations. | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-TM01.0001 | operational | The ATCO shall be able to provide uninterrupted service shall be provided during transfer of responsibility between MRTMs | This includes functional supporting of a handover sequence. Validated in SESAR1 REQ-06.09.03-OSED-RTC3.0007 | RTS/ Workshop V3 | Open | |
| REQ-05.00-SPRINTEROP-TM02.0001 | operational | The ATCO shall be able to transfer one of the controlled aerodromes to another MRTM | There is a need to split aerodromes in case of high workload due to e.g. increased traffic load, emergency situations. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPtraining_32: | operational | Split and merge procedures shall be locally defined with a clear description of the associated roles and responsibilities and | To ensure all actors involved are aware of their responsibilities and associated tasks. | RTS/ Workshop V3 | Open | |

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| | | corresponding coordination | | | |
| REQ-05.00-SPRINTEROP-TM02.0004 | operational | During Transfer of an aerodrome both ATCOs should shall be presented with the same information on the aerodrome being transfered all available technical systems as replicas until the handover is performed. | There is a need for both ATCOs to have a correct overview of aerodromes to be merged or split in order to maintain a correct situational awareness. | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-WE01.0002 | operational | Working Environment (noise, temperature etc.) shall be according to national regulations for normal office establishments. | In order to ensure good working environment to avoid fatigue etc. Validated in SESAR1 REQ-06.09.03-OSED-WE03.5002 | RTS/ Workshop V3 | Open |
| REQ-05.00-SPRINTEROP-WE01.0004 | operational | Sufficient writing space shall be available in the MRTM to the ATCO in order to make manual notes. | Based on validation feedback, particularly from VP-058. The space shall be properly lit as required, minding the difference in daylight/night-time operations. Taking manual notes are often common practice in small towers due to e.g. lot unplanned traffic. Making | RTS/ Workshop V3 | Open |

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| | | | <p>manual paper notes is ultimately also the final fall-back procedure if all technical systems would stop functioning. Using paper strips may satisfactory fulfil this need, hence if using paper strips no additional separate space for making notes may be needed. Validated in SESAR1 REQ-06.09.03-OSED-WE03.5005</p> | | |
| REQ.05.00_HPops_15: | operational | A harmonised working method for all aerodromes clustered in a multiple remote tower shall be envisaged. | <p>In order to reduce the potential for human error with regard to a possible confusion between different procedures (e.g. emergency procedures) associated with the wrong aerodrome. ATCOs perceive a risk in making errors related to mixing local procedures. They consider they might not be so vigilant in assessing situations involving local procedures (hence losing more time in providing answers to pilots) as they would if controlling only one aerodrome. In simulations it was observed that under high workload, ATCOs would go back to using the local procedures</p> | RTS/ Workshop V3 | Open |

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| | | | they were used to from the aerodrome they normally work for in real operations, therefore harmonising procedures could minimise such a risk. | | | |
| REQ.05.00_HPops_16: | operational | The clustering of aerodromes shall be done taking into account local factors such as: aerodrome layout, geographical specificities, runway directions, working procedures/operational conditions, traffic type and complexity, weather patterns. | In order to identify/ avoid any potential interactions that could potentially create confusions for ATCOs. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_3: | design | The display of aerodromes shall allow the ATCO to easily distinguish which information is related to which aerodrome (VP, radar, EFSS etc.) | It is paramount that ATCOs are able to easily identify which information relates to which aerodrome, on all corresponding displays (visual, auditory) | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_1: | operational | In the RTC environment with at least 20 | Digital strips enable a decrease in workload due to the possibility | RTS/ Workshop | Open | |

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| | | movements (for 2 aerodromes) and 15 movements (for 3 aerodromes), electronic flights strips shall be implemented. | to develop automatic functionality as well as silent coordination. | V3 | | |
| REQ.05.00_HPdesign_4: | design | The section dedicated to electronic flight strips shall be large enough in order to allow the adequate visibility at all times for the ATCO (the handwritten notes shall be visible at all times-even if collapsed). | An adequate visibility would reduce the time for looking for relevant information from one aerodrome to another- allowing quick access to notes, further supporting an adequate level of situation awareness. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_5: | design | The e-strips shall be big enough in order to allow ATCOs to adequately input information manually (e.g. they could be expandable). | This would reduce the input time and the amount of "head-down" time from the ATCO. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPops_6: | operational | NOTAM and AIP information shall clearly indicate to the flight crew that they are going to fly to a "multiple remote" TWR, in order to ensure | The NOTAM and AIP information is considered a strong barrier for the flight crew that shall be informed about the fact that the aerodrome they are flying to is part of an RTC, in order to be | RTS/ Workshop V3 | Open | |



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| | | appropriate awareness about the possibility of hearing multiple clearances on frequency that apply to other aerodromes. | aware of the possibility of hearing multiple clearances on the coupled frequencies. | | |
| REQ.05.00_HPops_7: | operational | The airport name should be integrated in the phraseology in order to increase the situational | Most of the ATCOs participating in the validation activities have confirmed their preference for using the airport name as part of the standard phraseology as this was seen as a further improvement of situation awareness for both the ATCOs and pilots, that would reduce the potential of giving or assuming wrong clearances. Nonetheless, to date the pilot community has not been involved in any of the simulation activities or workshops, hence further clarification of the matter is required, involving the pilot community as well. Furthermore it has to be further investigated if the airport name will be part of the standard phraseology, whether it should be mentioned at the beginning of every | RTS/ Workshop V3 | Open |



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| | | | communication or not. | | | |
| REQ.05.00_HPdesign_16: | design | The radar label font shall follow current displaying standards | In order to ensure a proper integration in the HMI, in line with HF design principles. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_24: | design | If Radar Labels are to be provided, they shall be available for all aerodromes. | The symmetry of information would enhance the awareness of the ATCO with regard to where to find the appropriate information. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPdesign_19: | operational | In case the TWR ATCO's responsibility covers the apron area as well, the apron shall be visible on the cameras. | This will ensure the ATCO has an appropriate level of situation awareness. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPtraining_27: | training | The diversity of the different aerodromes in terms of geographical specificities and procedures have to be included in the training | To appropriately familiarize the ATCOs with each aerodrome they are going to work with. Field trips could enhance their awareness. | RTS/ Workshop V3 | Open | |
| REQ.05.00_HPtraining_28: | Training | The training curricula shall familiarize the ATCOs with the new concept and the corresponding tools (e.g. binoculars), in order to | In order to be familiar with the input/ output devices and to feel comfortable working in an RTC under normal, abnormal and degraded modes of operations. | RTS/ Workshop V3 | Open | |

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| | | ensure they have an adequate level of trust | | | |
| REQ.05.00_HPtraining_29: | training | Local assessment shall be done to determine shift lengths | The fact of looking onto screens might have an impact and is different from the conventional tower work, in comparison with SRT the amount of traffic has to be taken into account when determining the shift lengths. | RTS/ Workshop V3 | Open |
| REQ.05.00_HPops_30: | operational | Roles and responsibilities shall be locally defined, ensuring they cover all actors involved for normal, abnormal and degraded modes of operations. | To ensure all actors are aware of their roles and responsibilities under all operating conditions. | RTS/ Workshop V3 | Open |
| REQ.05.00_HPops_31: | operational | Operating methods shall be locally defined covering normal, abnormal and degraded modes of operations. | To ensure operating methods are clear under all modes of operations. | RTS/ Workshop V3 | Open |

Table 9: HP Requirements

Appendix C – HP Log

No HP Log is available for PJ05.02 as all relevant information is available in the current Word document.



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Founding Members



Founding Members

