Human Performance Assessment - Contingency Tower

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Abstract

This document contains the Human Performance (HP) assessment report for the OFA06.03.01 OI step SDM-0204 Remotely Provided Air Traffic Service for Contingency Situations at Aerodromes with a single main Runway concept. The HP assessment report describes the changes resulting from the introduction of the concept from a HP perspective and identifies the potential human performance issues and benefits associated with those changes. A description of the HP related activities conducted to date to address the potential HP issues and benefits identified is provided. The results and HP recommendations & requirements generated from these activities are then presented. The HP recommendations and requirements resulting from the HP assessment will be used to help further the design and development of the concept. In addition recommendations are made with regards to future activities that need to be performed in the next stages of concept development for the remote contingency tower concept.

The HP Assessment is an update to P06.09.03 D27 HP considering results from VP752.

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Executive summary

This report describes the results of the activities conducted to date according to the SESAR Human Performance (HP) assessment process applied on the Remotely Provided Air Traffic Service for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway concept within OFA06.03.01 (SDM-0204). The assessment for the remote contingency tower concept develops on the results obtained from Remote Provision of ATS to a Single Aerodrome (SDM-0201) and should be considered as complementary.

The SESAR HP assessment process provides a framework to help ensure that HP aspects related to SESAR 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.

The level of maturity of the concept at the start of the HP assessment was considered to be V2. Therefore the argument structure for V2 was applied on the project. From the changes that would result from the introduction of the remote contingency tower concept, it was concluded that ten V2 second level HP arguments needed to be considered in the HP assessment, namely:

- Argument 1.1 The roles and responsibilities of the human are clear & exhaustive
- Argument 1.2 The operating methods are clear, exhaustive and support human performance
- Argument 1.3 Human actors can achieve their tasks in normal, abnormal and degraded modes of operation
- Argument 2.1 There is appropriate allocation of tasks between the human and the machine
- Argument 2.2 The performance of the technical system supports the human in carrying out their tasks
- Argument 2.3 The design of the Human machine interface (HMI) supports the human in carrying out their tasks
- Argument 3.2 The allocation on tasks between human actors support human performance
- Argument 4.1 The proposed solution is acceptable to the affected human actors
- Argument 4.2 Changes in competence requirements are identified
- Argument 4.3 Changes in staffing requirements and staffing levels are identified.

Specific HP issues and benefits relating to the concept for each of the relevant arguments were identified by performing a review of existing literature as well as conducting interviews with subject matter experts.

Based on the HP arguments and issues / benefits identified, several HP activities were recommended. The HP related validation activities conducted to date include:

- Two passive shadow mode trials for ATCOs - EXE-VP-059 (V2), EXE-VP-062 (V3)
- Two passive shadow mode trials for ATCOs - EXE-VP-751 (V2), EXE-VP-752 (V3)
- Workshops with end-users conducted in relation to the above mentioned trials.

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. The HP recommendations relate to each HP argument that had to be considered in the HP assessment for the concept. These recommendations relate to: the operational concept, and procedures; the technical system and HMI and the training of the end user. In addition HP recommendations for future validation activities that need to be conducted to investigate the HP issues and benefits in more detail are also provided.

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1 Introduction

1.1 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 OFA06.03.01 OI step SDM-0204 Remotely Provided Air Traffic Service for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway, including requirements and recommendations.

1.2 Intended readership

The intended audience for this document are the team members of the projects P06.08.04.

Other stakeholders that may be interested in this document are to be found among:

- Affected employee unions
- ANS providers
- Airport owners / providers
- Airspace users

1.3 Scope of the document

The aim of the SESAR OFA06.03.01 Remote and Virtual Towers is to develop and assess an operational concept that enables the cost effective provision of Air Traffic Services (ATS) at one or more aerodromes from a control facility that is not located in the local ATS Tower.

The concept is divided into three main application areas (detailed description is provided in [4]):

- Remote Provision of ATS to a Single Aerodrome (SDM-0201);
- Remotely provided ATS for two low density multiple aerodromes (SDM-0205);
- Remotely Provided ATS for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway (SDM-0204).

This document describes only the HP results for Remotely Provided ATS for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway (SDM-0204). Separate HP assessments are conducted for the single- and multiple remote tower concepts.

The HP assessment process considers those personnel whose work is directly affected by the introduction of the proposed remote tower operations in contingency situations. However, the main focus will be the tower ATCOs. Aircrew will not be considered. Data specialists, engineers and technicians are not currently included within the scope of the HP Assessment Process.

1.4 Human performance work schedule within the project

The HP activities for OFA06.03.01 OI step SDM-0204 Remotely Provided ATS for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway have been on-going since the beginning of the program P06.09.03 completed the previous instance of this document in 2015[1], and is reflected in the authoring section. Updates following the VP-752 exercise were included in 2016 by ENAIRE as part of P06.08.04. This work schedule deviates from the original schedule due to a delay in the execution of Contingency trial 2. This HP assessment report has therefore been delivered later than expected. It should also be emphasized that although HP work has been performed in the past in the project, 16.6.5 representatives have only been involved in the work since March 2014, but not as part of the 06.08.04 updates.

1.5 Structure of the document

- Section 1 (this section) introduces the document
- Section 2 describes the objective and approach to the four stages of the SESAR Human Performance Assessment Process
- Section 3 describes the Contingency tower concept from a HP perspective, relevant HP implications, HP activities that have been conducted, and the results from these activities.
- Section 4 lists the documents referenced in this document

1.6 Acronyms and Terminology

Term	*Description*
AFIS	Aerodrome Flight Information Service
AFISO	Aerodrome Flight Information Service Operator
AMAN	Arrival Manager
ANS	Air Navigation Service
APP	Approach
A-SMGCS	Advanced Surface Movement Guidance & Control System
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Services
AVF	Advanced visual features
AWOS	Automated Weather Observing System
CARS	Controller Acceptance Rating Scale
CTA	Cognitive Task Analysis
CWA	Cognitive Work Analysis
CWP	Controller work position
DMAN	Departure Manager
HMI	Human machine interface
HP activity	A 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	A HP assessment is the documented result of applying the HP assessment process to the SESAR project-level (i.e. WP4-15 projects). 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 project-level as well as the HP case building over larger clusters of projects.
HP benefit	A HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance.
HP case	A HP case is the documented result of combining HP assessments from projects into larger clusters (e.g. Operational Focus Areas, deployment packages) in SESAR.
HP impact	A 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 issue	A 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 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 project, leading to a redefinition of the operational concept or the specification of the technical solution.
HRA	Human Reliability Analysis
HTA	Hierarchical Task Analysis
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 *focussing on the variables that determine Human Performance*.

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 focussing on the observable result of human activity in a work context*. 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.
ICAO	International Civil Aviation Organization
IMC	Instrument meteorological conditions
IR	Infrared
KPA	Key Performance Area
MET	Meteorological
NASA TLX	National Aeronautics and Space Administration Task Load Index
OSED	Operational Services and Environment Description
OTW	Out the Window
PSM	Passive Shadow Mode
PTZ	Pan Tilt Zoom Camera
RCT	Remote Contingency Tower
RTS	Real-time Simulation
RWY	Runway
SASHA	SHAPE measurement technique for Situational Awareness in ATM systems
SATI	SHAPE Automation Trust Index
SDM	SESAR Deployment Manager
SESAR	Single European Sky ATM Research Programme
SHAPE	Solutions for Human Automation Partnerships in European ATM
SJU	SESAR Joint Undertaking (Agency of the European Commission)
TWR	Aerodrome Control Service (which is a subset of ATC Service)
VALP	Validation plan
VALR	Validation Report
VFR	Visual Flight Rules

2 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in the *HP assessment process for projects in V1, V2 and V3* document [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. 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.

The HP assessment process is a four-step process. Figure 1 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). In addition, a HP Log is maintained throughout the lifecycle of the project in which all the data/ information obtained from all HP activities conducted as part of the HP assessment is documented. This HP Log is a living document and is continuously updated and / or added to as the project progresses.

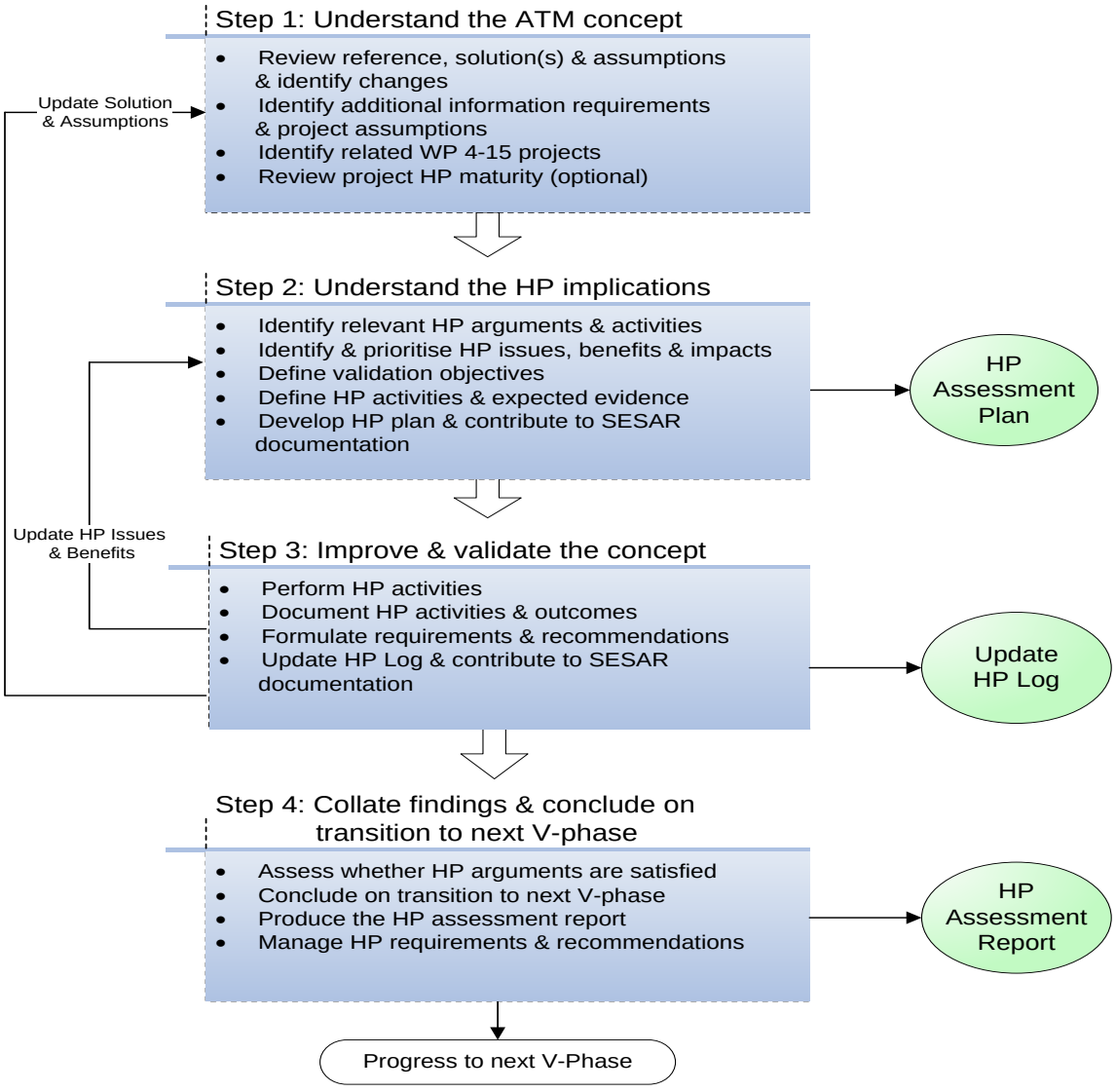

Figure 1: Steps of the HP assessment process

3 Human Performance Assessment

3.1 Step 1 Understand the ATM concept

3.1.1 Description of reference scenario

In today's practice there are several different alternatives for handling contingency situations where the local tower needs to be evacuated. The reference scenarios being used in the project are based on existing contingency plans at medium to high density airports (note that the remote contingency tower concept focus on low to medium density aerodromes). Currently there are three main reference scenarios for handling contingency situations in these environments, as described below.

Many (mainly smaller) aerodromes find contingency facilities or secondary Tower facilities not cost effective. In emergency situations the traffic is initially instructed to hold at nearby waypoints before being transferred to the neighbouring aerodrome approach control. This is the default and valid, contingency measure for the majority of airports worldwide.

There are also existing contingency solutions that permit the continued provision of ATS. At some aerodromes, this takes the form of a secondary local tower/control room that can be used in case of an emergency. It is normally located on the aerodrome, often in an old Tower or other building and the view for the controller is often impaired leading to increased spacing. Other airports use operations buildings where they have a dedicated workstation. During the transfer from the Tower to the secondary local tower/control room facility the air traffic movement rate is reduced and there is a transferal time until the contingency facility is operational.

At very large aerodromes where continued air traffic services are imperative, some have a "virtual" contingency facility using primarily only the A-SMGCS sensors (ground radar/multilateration), which replicates many of the operational and technical systems present in the local Tower, but without a full aerodrome view (which includes the manoeuvring areas and aerodrome vicinity). During the transfer from the Tower to the contingency facility the air traffic movement rate is reduced and there is a transferal time until the contingency facility is operational. When the contingency facility is operational the landing rate is normally decreased[1].

Table 1 provides a summarized overview of the three reference scenarios described above.

Table 1: Reference scenarios

REFERENCE SCENARIOS		
#	**SCENARIO**	**DESCRIPTION**
1	Divert traffic and terminate ATS provision	No contingency plan provided for ATS. The local tower will close. Traffic is instructed to hold at nearby waypoints before being transferred to the neighbouring aerodrome approach control.
2	Provide ATS via Secondary facility without A-SMGCS	The aerodrome contingency plan is formed around being able to provide ATS from a location remote to the local tower that provides some level of OTW view.[2]
3	Provide ATS via Secondary facility with A-SMGCS	The aerodrome contingency plan is formed around being able to provide ATS from a location remote to the local tower by means of using the A-SMGCS to provide a surveillance view of the aerodrome, without a visual presentation.

[1] A well-known example of this type of facility is at London Heathrow, where lack of OTW view leads to a 70% capacity restriction.

[2] This reference scenario is, technically speaking, similar to the solution scenario. However, this is a basic and non-standardized solution. Another difference is that the solution scenario makes use of A-SMGCS sensors.

3.1.2 Description of solution scenario

The objective of "Remotely Provided Air Traffic Service for Contingency Situations at Aerodromes" is to provide the ATS defined in ICAO Documents 4444 and 9426 for one aerodrome from a remote location (i.e. not from a Control Tower local to the aerodrome). The overall benefit mechanism proposed by the project is that the remote provision of ATS from a remote location during contingency situations provides a benefit compared to existing contingency plans/procedures used in current operations at aerodromes. The benefits will be achieved through technical features including visual presentations and advanced visual features for supporting ATCO situation awareness.

Table 2: Solution scenario

SOLUTION SCENARIO	DESCRIPTION
Provide ATS from a Remote Contingency Tower (RCT) during contingency situations.	The aerodrome will provide ATS during planned and unplanned contingency situations (where the Tower needs to be closed or evacuated) from an RCT that provides a visual presentation of the OTW view from a suitable position, and advanced visual features for supporting ATCO situation awareness. A-SMGCS could also be available in the RCT.

The Remote Provision of ATS for a Single Aerodrome during contingency is defined in such a way that it is appropriate and operable for a single aerodrome. However, it can ultimately be expanded and scaled to apply to more than one aerodrome. Remotely provided ATS during contingency will include visual presentation and/or other equipment/technology such as A-SMGCS. The visual presentation is a vital feature in the concept, enabling the RCT to gain a visual representation of the aerodrome and continue to provide ATS based on this ability. In addition, the concept will also include support for advanced visual features (AVF), which aims to provide enhanced situational awareness. The AVF are deemed especially useful for increased traffic levels (as highlighted under OI Step SDM-0201 provision of remote ATS to a single aerodrome).

3.1.3 Comparison of reference scenario and solution scenario

Table 3 provides a detailed comparison between the reference ATM system (i.e. provide ATS during contingencies from a secondary facility with limited OTW view with or without A-SMGCS) and the proposed ATM system (i.e. provide ATS from an RCT during contingencies). It lists the elements that will change, and describe how these elements are implemented in the two systems.

REFERENCE AND PROPOSED SYSTEM COMPARISON		
ELEMENT	**Reference ATM system**	**Proposed ATM system**
Tower evacuation contingency plan	Depending on the airport, the contingency plan will either be to (1) divert incoming traffic to neighbouring aerodromes, close the Tower, and stop all provision of ATS, or (2) to relocate controllers to a secondary tower facility and provide some level of ATS continuity.	The contingency plan will be to relocate controllers to a remote contingency tower (RCT) where they can continue to provide a high level of ATS continuity until the situation is under control and they can return to the main Tower building.
Location of the ATS contingency facility	As the reference solution is not standardized, the location of the contingency facility varies from case to case. In some cases ATS will be provided from a secondary facility normally located on the aerodrome. In other cases it will be provided from an operations building where they have a dedicated workstation. The OTW view for the controller is often impaired leading to increased spacing of aircrafts.	The RCT will be located in a "standard" building (i.e. not a tower building) that is not necessarily located within the aerodrome. The contingency RCT may be shared among multiple neighbouring aerodromes, depending on the distance between them.

Visual overview of the aerodrome and its traffic	The provided visual overview depends on the location of the secondary ATS contingency facility. Some facilities will provide an (often impaired) OTW view. One airport (to our knowledge), London Heathrow, provide A-SMGCS only. In some cases the facilities might have both OTW view and A-SMGCS, or they might only include the use of radio.	The RCT will provide a visual overview by means of a high resolution panoramic display. Video cameras located at various locations (one location may be sufficient for contingency RCT operations) in the aerodrome vicinity will be used to project a real time image of the aerodrome and traffic situation onto the panoramic display.
Transition of ambient sound from the airport	The transition of ambient sound from the airport will depend on the location of the secondary ATS contingency facility. In some cases the controllers will be able to hear sounds (e.g. jet engines) from the airport. In other cases the facilities will be sound protected, or too far away for noise to be heard.	The RCT will provide selectable options for reproducing real-time ambient noise from the aerodrome.
Identification and tracking of aircrafts	Aircraft and vehicles are identified visually using the outside view from the tower, in combination with information derived from the radar, flight progress strips (made of paper or electronic flight strips at some places) and associated radio communication.	Depending on the solution used and the airport, the RCT may (optionally) provide functionality to automatically identify and track the aircraft in the aerodrome vicinity. The aircraft and perhaps vehicles displayed on the panoramic display will be accompanied by labels automatically generated by the system displaying the necessary relevant information. In addition to this visual presentation, the RCT will also include the use of flight progress strips, radar and radio communication.
Video recording and playback	Currently there is no feature to continuously record and replay the visual chain of events (e.g. aircraft movements) on the ground or in the airspace visible from the TWR cabin.	The video system may potentially provide the possibility to record and replay traffic movements (this is not currently available but may be in future implementations).
Close-up viewing of objects and elements at the aerodrome	If the reference solution provides and OTW view, binoculars are used to enable ATCOs to get a close-up view of objects / elements in the aerodrome and in its vicinity. If there is no OTW view in the reference solution, close-up viewing of objects and elements is not poss ble.	A separate video camera installed at the aerodromes will have pan, tilt and zoom functions to enable ATCO to get a close-up view of target objects / elements in the aerodrome vicinity.
Setup of controller working position	In most current tower environments many separate pieces of equipment exist each having its own particular interface and control input / output devices with a minimum of standardisation between the different elements.	The CWP in the RTC will be integrated, as far as possible, to minimise the number of displays / menus / manoeuvres and associated HMIs present to allow as smooth and seamless operations as possible.

3.1.4 Consolidated list of assumptions

The following assumptions relate to OI Step SDM-0204 Remotely Provided ATS for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway:

- The ATS will be provided from a remote facility during contingency situations, referred to as a Remote Contingency Tower (RCT);
- The remote provision of ATS in contingency is targeted at Air Traffic Control (ATC).
- Visual presentation of the aerodrome view will be a key part of the solution. Other non-visual solutions are not included in the scope of this solution within this document;
- The target environment for whom the remote provision of ATS in contingency is suitable is envisaged to be low and medium density aerodromes;
- The RCT will be designed for both planned and unplanned contingency events but may also be used for other purposes such as training;
- The remote provision of ATS in contingency will include TWR ATC only. APP control is not considered within the scope of the solution;
- The aim of remote provision of ATS in contingency is to provide the full range of services

defined in ICAO Documents 4444 [5], 9426 [6];

- The aim of remote provision of ATS in contingency is to achieve as close to full operating capacity as possible (when compared to ATS provided from a local Tower);

3.1.5 List of related WP 4-15 projects to be considered in the HP assessment

The following projects are expected to be influenced by or have an impact on the HP assessment of the P06.09.03 - Remote Provision of ATS for Contingency Situations at Aerodromes concept:

P12.04.06 Remotely Operated Tower Technology Enablers

P12.04.07 Remotely Operated Tower Multiple Controlled Airports with Integrated Working Position

P12.04.08 Remotely Operated Tower technology used for contingency and enhanced local operations

P06.08.04 Coupled AMAN-DMAN (specifically the exercises related to contingency remote tower)

3.1.6 HP maturity of the project

The Remotely Provided ATS for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway concept is targeted to exit V3.

3.1.7 Identification of the nature of the change

Table 3: Description of the change

HP ARGUMENT BRANCH	CHANGE & AFFECTED ACTORS
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	The primary actors impacted by a remotely provided ATS during contingencies are the ATCOs. The overall roles and responsibilities of the ATCOs will not change, in so far as they will remain responsible for the provision of the required ATS. ATCOs working at aerodromes that cease to provide ATS during contingency situations will however experience changes as they will now need to provide ATS during contingency situations. Furthermore, the RCT layout/responsibilities may not be exactly the same as the local tower since the contingency events are rare and roles can be combined. Additionally, the ATCO may not have the ability to perform any tasks that are external to the control facility.

1.2 OPERATING METHODS	Instead of terminating the provision of ATS during contingency situations, or providing it from a secondary facility with limited OTW view (with or without A-SMGCS), ATS will be provided from a remote contingency tower (RCT). The RCT will provide a visual presentation of the OTW view, and advanced features for supporting situation awareness. This new technology might lead to ATCOs finding it more difficult to judge aircraft separation, and distance and depth in general, particularly as they will not make use of the visual OTW reproduction during normal day to day operations. The remote provision of ATS during contingency situations is targeted at ATCOs. The contingency procedures may also change in terms of how ATCOs are relocated and transferred to the RCT during planned and unplanned contingency situations. The aim of remote provision of ATS in contingency is to provide the full range of services defined ICAO Documents 4444, 9426. Other procedures may have to be developed or amended to ensure performance is optimised under RCT operations.
1.3 TASKS	ATCOs that currently work in aerodromes that cease to provide ATS when the local Tower is evacuated will (with the introduction of the RCT concept) need to provide ATS during contingency situations. The ATCOs will most likely not have the ability to perform any tasks that are external to the RCT. The aim is that that they primarily will focus on the pure ATS tasks and other tasks will be secondary and/or performed by personnel local to the aerodrome.
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	The RCT functions for automatic aircraft and vehicle identification, labelling and tracking at the aerodrome and in its vicinity should aid the ATCO in identifying and tracking objects at the aerodrome, and thus help enhance ATCO situation awareness during contingency situations.
2.2 PERFORMANCE OF TECHNICAL SYSTEM	Potential latency, picture quality and responsiveness of the visual presentation display are a very important factor that will impact ATCO situation awareness and acceptance of the remote contingency tower operations.
2.3 HUMAN – MACHINE INTERFACE	The concept will introduce new HMIs (e.g. the visual presentation system and the AVFs), and ATCOs must have considerable knowledge and training in using these HMIs. Consideration must be given to the design and layout of the HMIs in the RCT to ensure that ATCOs have all necessary information and equipment to support their tasks to ensure operations are optimised in terms of safety and efficiency.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change in team composition is foreseen within the RCT regarding ATCOs. The provision of ATS from the RCT can still be handled by the same number of ATCOs as in the local tower.
3.2 ALLOCATION OF TASKS	If the RCT is located quite far from the aerodrome, ATCOs might no longer be able to perform any additional tasks that require physical proximity to the aerodrome; such tasks will be allocated to other aerodrome personnel, for example snow removal personnel that are located on-site.
3.3 COMMUNICATION	No significant change in communication is foreseen for the RCT regarding ATCOs.

4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	ATCOs working at aerodromes which provide ATS during contingency situations from a secondary facility with no or limited OTW view may feel more confident in their ability to provide high-quality ATS when provided with a visual presentation of the OTW view as well as AVFs. This could lead to a higher job satisfaction and acceptance of the system. ATCOs working at aerodromes that terminate the provision of ATS during contingencies could get a higher job satisfaction as they will now be able to continue the provision of ATS during contingency situations. Furthermore, ATCOs must undergo new training programmes to acquire the skills and knowledge required to work in the RCT, which could impact acceptability and job satisfaction. The acceptance of the new concept is also highly dependent on the performance and reliability of the visual presentation and AVFs introduced in the concept.
4.2 COMPETENCE REQUIREMENTS	All ATCOs working in an RCT must be licensed (appropriate rating) and have the appropriate endorsement. Before ATCOs are allowed to work in a RCT during contingency situations they must be fully familiar with the system and its performance capabilities and limitations. They must also be familiar with the new contingency procedures regarding evacuation to the RCT. A training programme must be designed and developed to ensure that they are fully trained and rated to transfer to/from the local tower to the RCT, and to provide ATS from the RCT. All ATCOs that could be working in the RCT must be fully familiar and trained with the new equipment and working procedures for remote operations prior to implementation. Regular training must be conducted to ensure that ATCOs maintain an acceptable level of skills and knowledge about working in the RCT.
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	ATCOs might be panicked or traumatized by contingency events and it might therefore be better to call in a different ATCO to take over the shift in the RCT when an unplanned contingency situation occurs. If the aerodrome has a system of standby ATCOs in the normal TWR shifts, then those ATCOs can be called in. Otherwise off duty ATCOs could also be called in voluntarily in emergency/contingency cases. Furthermore, as the ATCOs are less familiar with the RCT tower than they are with the ordinary local tower, it might be necessary to work shorter shifts in the RCT.

3.2 Step 2 Understand the HP implications

3.2.1 Identification of relevant arguments

The HP arguments are 'claims that need to 'proven' by the HP assessment'. Therefore, the aim of HP assessment is to provide 'evidence' to show the HP arguments impacted have been considered and satisfied by the HP assessment process. From the changes that would result from the introduction of the remote provision of ATS during contingency situations concept, it was identified that ten V2 HP arguments need to be considered by the HP assessment. The arguments to be considered by the HP assessment process were:

- Argument 1.1 The roles and responsibilities of the human are clear & exhaustive
- Argument 1.2 The operating methods are clear, exhaustive and support human performance
- Argument 1.3 Human actors can achieve their tasks in normal, abnormal and degraded

modes of operation

- Argument 2.1 There is appropriate allocation of tasks between the human and the machine
- Argument 2.2 The performance of the technical system supports the human in carrying out their tasks
- Argument 2.3 The design of the HMI supports the human in carrying out their tasks
- Argument 3.2 The allocation on tasks between human actors support human performance
- Argument 4.1 The proposed solution is acceptable to the affected human actors
- Argument 4.2 Changes in competence requirements are identified
- Argument 4.3 Changes in staffing requirements and staffing levels are identified.

3.2.2 Identification of HP issues & benefits and HP activities

To identify potential HP issues, benefits & impacts relating to the remote tower concept for single aerodromes, two activities were performed:

- A literature review
- Interviews with subject-matter experts

3.2.2.1Literature review

A literature review was conducted in May and June 2014 to identify potential HP issues related to the remote provision of ATS during contingencies concept. The literature review included documents produced from previous work conducted by NORACON (LFV) and NATMIG (SAAB) [3] [4] [8] [9]. Other research considered relevant to the project was also identified and reviewed. The review also included the HP assessment reports from the remote provision of ATS for single aerodromes concept [7], which is very similar to the remote provision of ATS for contingency situations concept (i.e. the technology is the same, but it is being used in different contexts).

3.2.2.2 HP Issue, benefit & impact analysis

Interviews were conducted with subject matter experts to help identify potential HP issues and impacts that may result from the introduction of the remote provision of ATS during contingencies concept. The subject matter experts participating in these interviews consisted of two current tower ATCOs that had previous hands-on experience (from earlier trials) and knowledge about the concept.

The interviews were structured according to a predefined interview guide, with questions designed to identify potential issues for each of top-level HP argument. Audio from the interviews were recorded and later analysed to document the potential HP issues that were identified. In the first part of the interview, a presentation of the concept was provided to refresh the participants' understanding and (when necessary) clarify any misunderstandings.

Over 30 HP issues and benefits were identified from the literature review and HP issue and benefits interviews conducted. The HP issues/benefits identified are listed in Table 8 in Section 3.4.1 under the HP arguments to which the issue/ benefit corresponds. More information regarding the issues/benefits identified in terms of: 1) a description of the issue / benefit and the potential impact of the issue / benefit on human performance (and where appropriate the wider system; 2) the priority of the potential issue/benefit identified ; 3) a possible means for prevention or mitigation and/or a recommended action; 4) the HP / validation objective associated with the potential issue/benefit and; 5) recommended activity to further investigate the potential issue or the suggested mitigation, can be found in Annex A in the Issue and Benefits register.

It should be noted that the identified issues/ benefits listed in table 8 are not exhaustive or complete.

3.3 Step 3 Improve and validate the concept

3.3.1 Description of HP activities

This section describes the HP activities that were selected on the basis of the relevant arguments and HP issues & benefits. Table 4 contains an overview of the HP activities and their priority together with deadlines. The validation activities that contribute to the HP assessment for the remote provision of ATS during contingency situations concept have been conducted within SESAR P06.09.03.

The HP validation activities conducted to date includes EXE-06.09.03-VP-059 Live Shadow Passive Mode (PSM) trial and EXE-06.09.03-VP-062 Live PSM trial, both at Gothenburg Airport. The former trial was conducted before 16.06.05 representatives got involved in the HP assessment for the contingency concept. However as the results from this trial hold valuable input to the HP issues and benefits, they have been included in the HP assessment where appropriate. More detailed descriptions of the trials can be found in the validation reports for the trials (see the Contingency TWR Trial 1 Validation Report [5] and the Contingency TWR Trial 1 & 2 Validation Report [6]). Expert reviews/workshops were conducted in relation to the aforementioned trials. A detailed description of the abovementioned activities are given in the tables in the following pages. Outside of project 06.09.03 was EXE-06.08.04-VP-752, whose additional comments are also part of this report.

Table 4: Table of proposed HP activities and their priority

HP ACTIVITY	PRIORITY	BY WHEN
Live PSM trial (EXE-06.09.03-VP-059)	HIGH	OCTOBER 2013
Expert reviews/workshops	MEDIUM	MARCH 2015
Live PSM trial (EXE-06.09.03-VP-062)	HIGH	MARCH 2015
Live PSM trial (EXE-06.08.04-VP-752)	HIGH	NOVEMBER 2015

Table 5: Description of Activity 1

ACTIVITY 1	EXE-06.09.03-VP-059 Live PSM trial
DESCRIPTION	The overall aim of this exercise was to assess the technical and operational capability of an initial prototype at aerodromes during contingency situations as part of SDM-0204. A live PSM trial was chosen as the validation method in order to assess the impact of the remote contingency tower concept on ATCO human performance in terms of situational awareness, human error/performance, acceptability, trust and workload. The aim of shadow mode trials is to enable ATCOs to work in a realistic environment with real live traffic in order to assess the impact of the remote contingency tower concept of operations on human performance. Both subjective and objective data will be obtained to assess human performance. The main objective of the shadow trials is to assess the impact of the remote contingency tower concept on ATCO human performance in terms of situation awareness, human error / performance, acceptability, trust and workload. The trials will also be used to verify the impact of the remote contingency tower concept of operations on ATCOs tasks and activities.
RELATED ARGUMENTS & HP OBJECTIVES	Arg. 1.3.1: The potential for human error is reduced as far as possible. Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable. Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate. Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness. Arg. 1.3.6: Human performance satisfies the expected TA target levels. Arg. 2.1.6: The level of trust in automated functions is appropriate. Arg. 2.3.1: The type of information provided satisfies the information requirements of the human. Arg. 2.3.2: Input devices (e.g. keyboard, mouse, touch screen) correspond to HF principles. [V1: AIR only] Arg. 2.3.5: Workstations (e.g. cockpit layout and consoles) adhere to ergonomic principles. [V1: AIR only] Arg. 2.3.7: The user interface design reduces human error as far as possible. [V1: AIR only] Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only] Arg. 3.2.1: Changes to the task allocation between human actors do not lead to adverse effects on human tasks.
ISSUES ADDRESSED / FROM ISSUES NALYSIS	1.3.1.2, 1.3.3.1, 1.3.3.2, 1.3.4.1, 1.3.5.1, 1.3.6.1, 2.1.6.1, 2.1.6.2, 2.3.1.1, 2.3.2.1, 2.3.5.1, 2.3.7.1, 2.3.8.1, 3.2.1.1
TOOLS/METHODS SELECTED OUT OF THE HP REPOSITORY	Observation, End of Exercise Questionnaires, debriefs, and workshops were used to collect feedback from the ATCOs on the contingency tower concept. The list below provides additional details about the tools/methods that will be used: • The Controller Acceptance Rating Scale (CARS) was used to determine the ATCOs acceptance towards the concept. • The SHAPE measurement technique for Situational Awareness in ATM systems (SASHA) was used to measure ATCO situation awareness. • The SHAPE Automation Trust Index (SATI) was used to determine the ATCOs trust in the concept. • The NASA Task Load Index (NASA TLX) was used to measure ATCO work load during the trial.
SUMMARY OF THE HP ACTIVITY	For details please refer to Section 6.1 in [10]

Table 6: Description of Activity 2

ACTIVITY 2	Expert reviews/workshops (conducted in relation to trials)
DESCRIPTION	This activity involved a set of workshops to assess whether: • ATCOs tasks and responsibilities are clear and consistent • Operating methods cover degraded modes of operation • HF design principles are applied properly • Work stations are consistent with design standards and regulations • Job satisfaction is impacted by the concept • The solution impact ATCO licensing • The solution impact staff levels and/or shift organization The workshops were conducted in relation to EXE-06.09.03-VP-059 and EXE-06.09.03-VP-062.
RELATED ARGUMENTS & HP OBJECTIVES	Arg. 1.1.3: Roles and responsibilities are clear and consistent (in V1: non-contradictory). Arg. 1.2.3: Operating methods cover degraded modes of the ATM system. Arg. 2.3.2: Input devices (e.g. keyboard, mouse, touch screen) correspond to HF principles. [V1: AIR only] Arg. 2.3.5: Workstations (e.g. cockpit layout and consoles) adhere to ergonomic principles. [V1: AIR only] Arg. 4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered. Arg. 4.3.1: The impact on staff levels is identified. Arg. 4.3.2: The impact on shift organisation is identified.
ISSUES ADDRESSED / INVESTIGATED FROM ISSUES ANALYSIS	1.1.2.1, 1.1.3.1, 1.2.3.1, 1.2.3.2, 2.3.2.1, 2.3.5.1, 4.1.2.1, 4.3.1.1, 4.3.2.1
TOOLS/METHODS SELECTED OUT OF THE HP REPOSITORY	• Questionnaires • Interviews • Workshops
SUMMARY OF THE HP ACTIVITY	For details please refer to [11].

Table 7: Description of Activity 3

ACTIVITY 3	EXE-06.09.03-VP-062 Live PSM trial
DESCRIPTION	The overall aim of this exercise was to assess the technical and operational capability of an initial prototype at aerodromes during contingency situations as part of SDM-0204. A live PSM trial was chosen as the validation method in order to assess the impact of the remote contingency tower concept on ATCO human performance in terms of situational awareness, human error/performance, acceptability, trust and workload. The aim of shadow mode trials is to enable ATCOs to work in a realistic environment with real live traffic in order to assess the impact of the remote contingency tower concept of operations on human performance. Both subjective and objective data will be obtained to assess human performance. The main objective of the shadow trials is to assess the impact of the remote contingency tower concept on ATCO human performance in terms of situation awareness, human error / performance, acceptability, trust and workload. The trials will also be used to verify the impact of the remote contingency tower concept of operations on ATCOs tasks and activities.
RELATED ARGUMENTS & HP OBJECTIVES	Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner. Arg. 1.3.1: The potential for human error is reduced as far as possible. Arg. 1.3.2: Tasks can be achieved in a timely manner. Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable. Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate. Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness. Arg. 2.1.6: The level of trust in automated functions is appropriate. Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task. Arg. 2.3.1: The type of information provided satisfies the information requirements of the human. Arg. 2.3.7: The user interface design reduces human error as far as possible. [V1: AIR only] Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]
ISSUES ADDRESSED / INVESTIGATED FROM ISSUES ANALYSIS	1.2.5.1, 1.3.1.1, 1.3.1.2, 1.3.1.3, 1.3.2.1, 1.3.3.1, 1.3.3.2, 1.3.4.1, 1.3.5.1, 2.1.6.1, 2.1.6.2, 2.2.2.1, 2.3.1.1, 2.3.7.1, 2.3.8.1, 4.1.1.1, 4.2.1.1
TOOLS/METHODS SELECTED OUT OF THE HP REPOSITORY	Observation, End of Exercise Questionnaires, debriefs, and workshops were used to collect feedback from the ATCOs on the contingency tower concept. The list below provides additional details about the tools/methods that will be used: • The Controller Acceptance Rating Scale (CARS) was used to determine the ATCOs acceptance towards the concept. • The SHAPE measurement technique for Situational Awareness in ATM systems (SASHA) was used to measure ATCO situation awareness. • The SHAPE Automation Trust Index (SATI) was used to determine the ATCOs trust in the concept. • The NASA Task Load Index (NASA TLX) was used to measure ATCO work load during the trial.
SUMMARY OF THE HP ACTIVITY	For details please refer to Section 6.2 in [10]

Table 8: Description of Activity 4

ACTIVITY 4	EXE-06.08.04-VP-752 Live PSM trial
DESCRIPTION	The overall aim of this exercise was to assess the technical and operational capability of an initial prototype at aerodromes during contingency situations as part of SDM-0204. A live PSM trial was chosen as the validation method in order to assess the impact of the remote contingency tower concept on ATCO human performance in terms of situational awareness, human error/performance, acceptability, trust and workload. The aim of shadow mode trials is to enable ATCOs to work in a realistic environment with real live traffic in order to assess the impact of the remote contingency tower concept of operations on human performance. Both subjective and objective data will be obtained to assess human performance. The main objective of the shadow trials is to assess the impact of the remote contingency tower concept on ATCO human performance in terms of situation awareness, human error / performance, acceptability, trust and workload. The trials will also be used to verify the impact of the remote contingency tower concept of operations on ATCOs tasks and activities.
RELATED ARGUMENTS & HP OBJECTIVES	Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner. Arg. 1.3.1: The potential for human error is reduced as far as possible. Arg. 1.3.2: Tasks can be achieved in a timely manner. Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable. Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate. Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness. Arg. 2.1.6: The level of trust in automated functions is appropriate. Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task. Arg. 2.3.1: The type of information provided satisfies the information requirements of the human. Arg. 2.3.7: The user interface design reduces human error as far as possible. [V1: AIR only] Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]
ISSUES ADDRESSED / INVESTIGATED FROM ISSUES ANALYSIS	1.2.5.1, 1.3.1.1, 1.3.1.2, 1.3.1.3, 1.3.2.1, 1.3.3.1, 1.3.3.2, 1.3.4.1, 1.3.5.1, 2.1.6.1, 2.1.6.2, 2.2.2.1, 2.3.1.1, 2.3.7.1, 2.3.8.1, 4.1.1.1, 4.2.1.1
TOOLS/METHODS SELECTED OUT OF THE HP REPOSITORY	Observation, End of Exercise Questionnaires, and debriefs were used to collect feedback from the ATCOs on the contingency tower concept. The list below provides additional details about the tools/methods that will be used: • The Controller Acceptance Rating Scale (CARS) was used to determine the ATCOs acceptance towards the concept. • The SHAPE measurement technique for Situational Awareness in ATM systems (SASHA) was used to measure ATCO situation awareness. • The SHAPE Automation Trust Index (SATI) was used to determine the ATCOs trust in the concept. • The NASA Task Load Index (NASA TLX) was used to measure ATCO work load during the trial.
SUMMARY OF THE HP ACTIVITY	For details please refer to Section 4.1 in [12]

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

3.4.1 Summary of HP activities results & recommendations / requirements

Table 8 provides a summary of the main results / evidence, status of the HP issue and the HP recommendations / requirements for each of the HP issues/benefits identified from the activities conducted to date (i.e. shadow mode trials and interviews/workshops).

The recommendations resulting from the activities conducted are proposed as a potential means to mitigate the HP issues identified relating to the remote contingency tower concept. It should be noted that the recommendations requires additional analysis, that is, refinements and / or validation before they are mature enough to become a requirement.

The requirements are statements that specify the required characteristics of the solution from a HP point of view. HP requirements can be seen as relatively stable and either lead to a redefinition of the operational concept or the specification of the technical solution.

The HP recommendations and requirements fall into one of several classes, among others:

- Technical system and HMI design
- Operational concept and procedures
- Training of end user

In addition, HP recommendations can relate to test and validation activities that need to be conducted in later V phases in order to investigate issues/benefits and potential mitigation in more detail.

It should be noted that Table 8 is a means to check and track what issues have or have not been addressed by the HP activities conducted to date. The current status of the issue/benefit is either said to be:

- Closed: An issue is considered ‘closed’ when the issue had been sufficiently answered or no additional activities relating to that issue are foreseen as necessary
- On-going: An issue is considered as being ‘on-going’ when the issue has been either: partially addressed and more studies are needed or; the issue had been addressed by certain activities but as a result other related issues had arisen. On-going issues need to be further investigated in the future activities.
- Not addressed: An issue is considered as being ‘not addressed’ when no activities relating to the issue have been conducted**.**

Table 9: Summary of the HP results and recommendations/ requirements for each identified issue & related argument

ARG.	ISSUE ID	HP ISSUE / BENEFIT & IMPACT	ACTIVITY CONDUCTED PLUS RESULTS / EVIDENCE	ISSUE STATUS & RECOMMENDATIONS / REQUIREMENTS
Arg. 1.1.2: The description of roles & responsibilities cover all tasks to be performed by a human actor.				
1.1.2	1.1.2.1	ATCO roles and responsibilities under remote contingency operations might differ slightly from those used in regular towers; particularly if there will be no supervisor role in the RCT (the need for a supervisor role will most likely depend on the operational environment, and will probably only be needed in the transition phases). Hence, the description of roles and responsibilities might not cover all tasks to be performed in the RCT.	EXE-06.09.03-VP-059: During the workshop ATCOs agreed that there was no requirement for a supervisor position but ATCOs will require regular familiarisation/training before use. EXE-06.09.03-VP-062: Based on discussions with ATCOs the number of controllers providing services will not need to be increased once the contingency operations are established and no supervisor would be needed either, however support or someone to lead the transition may be required depending on the nature of transition in order to shorten the time required to transition into stable contingency operations.	*On-going* *Recommendations:* - Task analyses should be conducted to verify that the roles and responsibilities will remain the same as in the local tower when providing ATS from the RCT (this should preferably be done on a local level to accommodate the fact that the roles and responsibilities may differ slightly from aerodrome to aerodrome). - The responsibilities of a potential transition leader role which can be required to facilitate transition to and from the RCT should be defined and validated at a local level.
Arg. 1.1.3: Roles and responsibilities are clear and consistent (in V1: non-contradictory).				
1.1.3	1.1.3.1	The roles in the RCT may be combined in new ways (i.e. different than in the local tower), leading to inconsistency in task allocation and responsibilities. This inconsistency could lead to increased stress for ATCOs, and hence impact capacity and safety.	EXE-06.09.03-VP-059: Based on the feedback from the ATCOs during a workshop following the trial there does not seem to be an issue with inconsistency in task allocation. The ATCOs implied that roles and responsibilities will remain static. EXE-06.09.03-VP-062: Roles and responsibilities were found to be clear and consistent. During debrief sessions, all ATCOs that were asked felt that the roles and	*Closed*

ARG.	ISSUE ID	HP ISSUE / BENEFIT & IMPACT	ACTIVITY CONDUCTED PLUS RESULTS / EVIDENCE	ISSUE STATUS & RECOMMENDATIONS / REQUIREMENTS
			responsibilities would remain the same as they are in the local tower. The end-of-trial questionnaire showed that ATCOs found their tasks, roles and responsibilities in the RCT to be clear and acceptable. ATCOs felt that there would be no difference in task allocation when providing ATS remotely compared with local tower operations.	
1.2.2	1.2.1.1	Operating methods do not cover abnormal operating conditions.	EXE-06.09.03-VP-059: Feedback from the end-of-trial workshop showed that ATCOs felt that proficiency checklists and contingency handover procedures should be developed for use during contingency transition phases. These checklists will require fully validation and integration into existing standards and procedures with full regulatory approval. EXE-06.09.03-VP-062: Based on results from the workshop controllers decided that working methods for handling abnormal situations from local tower apply for a remote tower as well. However, airspace users concluded that they would need to be made aware of potential degradation in the RCT and hence the phraseology to be used to communicate that to the pilots will need consideration.	*On-going* *Recommendations:* - Checklists to aid in re-establishing operations in a RCT to the predefined capacity following a contingency event should be defined and validated at a local level, also depending on the technical solution implemented and the local conditions. - Procedures for notifying pilots about abnormal situations in the RCT affecting the flight operations should be defined and validated.
Arg. 1.2.3: Operating methods cover degraded modes of the ATM system.				
1.2.3	1.2.3.1	The defined operating methods may not cover scenarios where one or more functions in the RCT fails (e.g. communication link down, visual presentation unavailable, etc.). These scenarios should be accounted for in the operating methods definitions.	EXE-06.09.03-VP-062: Degraded modes where technical enablers in the RCT fail were discussed with ATCOs in debriefs and during a workshop following the trial. These discussions highlighted a need for additional procedures in case the visual presentation fails (i.e. dark screen procedures – possibly different procedures depending on which screen fails), if the air situation display fails, if MET information becomes unavailable, and possibly also if the PTZ fail. Airspace users concluded that they need to be made aware of the Low Visibility Procedures / dark screen procedures being applied at the Controller Working Position, and hence the phraseology to communicate the required information to pilots was considered. The majority of the ATCOs felt that phraseology should remain the same as	*On-going* *Recommendations:* - Procedures for handling technical degradation in the RCT (e.g. dark screen procedures) should be defined and validated at a local level, when the technical solution and the local conditions are known.

ARG.	ISSUE ID	HP ISSUE / BENEFIT & IMPACT	ACTIVITY CONDUCTED PLUS RESULTS / EVIDENCE	ISSUE STATUS & RECOMMENDATIONS / REQUIREMENTS
			in current operations, as far as possible. The ATCOs also felt that it was better to cease operations if degradations occurred in the RCT due to the nature of this solution/situation. EXE-06.08.04-VP-752. During one of the runs, a single fixed camera failed. one of the PTZ cameras was used to provide the view of the runway. More than one PTZ (VIS/IR) can provide backup for at least some fixed cameras (critical positions TBD locally). Automation may be required for replacing an OTW camera with an overlaid PTZ view + a need to define the degraded mode procedure.	
1.2.3	1.2.3.2	Operating methods may not cover scenarios where the RCT is already in use by another aerodrome (relevant when multiple aerodromes share the same RCT). These scenarios should be accounted for in the operating methods definitions.	Not investigated	*Not addressed*
Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner.				
1.2.5	1.2.5.1	The differences between the RCT and the local tower (e.g. use of visual presentation, AVFs) could have an impact on the timeliness, accuracy and efficiency with which ATCOs can follow operating methods. This could have a significant impact on capacity and safety.	EXE-06.09.03-VP-062: The findings from the trial indicate that ATCOs were able to effectively achieve their tasks when using the RCT. In the end-of-trial questionnaire all ATCOs agreed or strongly agreed that they could achieve their tasks in a timely and efficient manner when using the RCT. Six out of eight ATCOs responded that their human performance in the RCT in terms of providing ATS would be the same or be improved compared with their human performance in the local tower. Two ATCOs stated that their performance could be slightly reduced. One of these ATCOs emphasized that he was not sure yet in this assessment as he felt that he did not have enough experience with the system yet. In the end-of-trial workshop the ATCOs stated that capacity would be improved while using the OTW (although this would depend on the complexity of the aerodrome, resolution of the screens, meteorological conditions, traffic level and having or not having the 360 degree view). The ATCOs did not feel that the advanced configuration (tracking, overlays, sound, IR camera) increased capacity, and believed that they could maintain the traffic levels experienced in the trial using only the most basic system features. ATCOs felt that the RCT should be kept as simple as possible, and that it should be as similar as possible to the local tower. In light of this, it was suggested that the RCT might benefit from not including the tracking functions (at least initially). Regarding the PTZ camera the ATCOs emphasized that having only one	*On-going* *Recommendations:* - Procedures stating who have the control of the PTZ camera should be developed to ensure that the camera can be used in an efficient manner (this applies to cases where more than one ATCO needs to use the same PTZ camera), unless there are more than one PTZ.

ARG.	ISSUE ID	HP ISSUE / BENEFIT & IMPACT	ACTIVITY CONDUCTED PLUS RESULTS / EVIDENCE	ISSUE STATUS & RECOMMENDATIONS / REQUIREMENTS
			camera could be a challenge as it can only be used by one ATCO at a time. The participants were asked if there is a need for two PTZ cameras since there where two ATCOs working in parallel in the trial. Controllers felt that two PTZs would make their tasks easier, however if only one PTZ camera was provided then the RCT would need procedures to state which controller that have ultimate control of the PTZ (either one position or a supervisor). EXE-06.08.04-VP-752. The ATCOs commented that there would be a need for periodic refresher training since the tools used in the contingency tower differed significantly from those in the local tower.	
Arg. 1.3.1: The potential for human error is reduced as far as possible.				
1.3.1	1.3.1.1	The potential for human error may be increased as a result of ATCOs having to relocate to a different environment (the RCT) during contingencies. This could have a significant impact on safety.	Not investigated EXE-06.08.04-VP-752. Not investigated	*Not addressed* *Recommendations:* - The impact of relocating from the local tower to the RCT on potential for human error should be further investigated in future validation activities at a local level, when the technical solution and the local conditions are known.
1.3.1	1.3.1.2	The potential for human error may be increased as a result of ATCOs having to make use of different technical enablers than they use in the regular tower (e.g. use of advanced visual features, visual presentation, and work area). This could have a significant impact on safety.	EXE-06.09.03-VP-059: Results from the end-of-trial questionnaire showed that the ATCOs thought the OTW view increased safety, decreased their stress levels, made them prone to making less errors and they felt comfortable using the OTW view to provide ATS. However, the ATCOs thought that the AVFs increased stress levels and made the ATCO more prone to making errors. The slight negative responses could, in part, be due to the technical issues experienced during the trial. EXE-06.09.03-VP-062: In the end-of-trial questionnaire, five out of eight ATCOs agreed that the RCT would increase safety compared to ground surveillance-based contingency solutions (only one ATCO disagreed and the remaining two	*On-going* *Recommendations:* - The potential for human error when working in the RCT should be investigated with objective methods during future trials. - The impact of replicating the local tower CWP in the RCT on ATCO acceptance, trust and efficiency should be further investigated in

ARG.	ISSUE ID	HP ISSUE / BENEFIT & IMPACT	ACTIVITY CONDUCTED PLUS RESULTS / EVIDENCE	ISSUE STATUS & RECOMMENDATIONS / REQUIREMENTS
			were neutral). Similarly, results from the end-of-trial workshop showed that the ATCOs felt the tracking features and the OTW view (in comparison with the A-SMGCS only baseline) increased safety, capacity and flexibility and that it made it easier to foresee what is going to happen. However, ATCOs felt that the RCT should be kept as simple as possible, and that it should be as similar as possible to the local tower. In light of this, it was suggested that the RCT might benefit from not including the tracking functions (at least initially). The main risk contributors were found to be potential technical failures, insufficient video resolution, difficulties in seeing objects in darkness, and unfamiliarity with the CWP. EXE-06.08.04-VP-752. Not investigated	future validation activities at a local level, when the technical solution and the local conditions are known.
1.3.1	1.3.1.3	The potential for human error may be increased as a result of ATCOs having to continue to provide ATS after being relocated and potentially traumatized and/or stressed by the on-going contingency. This could have an impact on safety.	Not investigated	*Not addressed* *Recommendations:* - The impact of stress/trauma (after being relocated to the RCT following a contingency event) on potential for human error should be investigated in stakeholder workshop with critical incident stress management experts.
Arg. 1.3.2: Tasks can be achieved in a timely manner.				
1.3.2	1.3.2.1	The differences between the RCT and the local tower (e.g. use of visual presentation, AVFs) could have an impact on the time ATCOs require to achieve their tasks. The impact could be either positive or negative.	EXE-06.09.03-VP-062: The results showed that ATCOs were able to effectively achieve their tasks when using the RCT. However, these results cannot be used as a proper assessment due to the nature of PSM trials. ATCOs did however emphasize that having only one PTZ in the RCT could be a challenge as it can only be used by one ATCO at a time. EXE-06.08.04-VP-752. The results showed that ATCOs were able to effectively achieve their tasks when using the RCT. However, these results cannot be used as a proper assessment due to the nature of PSM trials.	*On-going* *Recommendations:* The question of whether tasks can be achieved in a timely manner in the RCT should be investigated in active shadow mode trials or RTS. - The RCT should ensure that each ATCO can make

ARG.	ISSUE ID	HP ISSUE / BENEFIT & IMPACT	ACTIVITY CONDUCTED PLUS RESULTS / EVIDENCE	ISSUE STATUS & RECOMMENDATIONS / REQUIREMENTS
				use of a PTZ when required (this may require that more PTZ cameras are available).
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.				
1.3.3	1.3.3.1	The possible combination of roles in the RCT could lead to additional task demands, and hence increase the workload of the ATCOs working in the RCT. This could also increase stress levels and have a negative impact on safety.	EXE-06.09.03-VP-059: Workload was rated very low. However, these results cannot be fully regarded as a proper assessment due to the nature of the PSM trial. Many ATCOs found it hard to rate workload as there were multiple extra tasks that the ATCO would have to do if working with real traffic such as speaking to the pilots, coordinating with adjacent sectors and activating movements in the manoeuvring area. However, these initial findings are promising, with workload peaking in the morning (much like during local operations when traffic loading is highest). EXE-06.09.03-VP-062: Workload was rated very low but these results cannot be used as a proper assessment due to the nature of the PSM trial. Also related to this is the results/evidence presented for issue 1.1.3.1 indicating that tasks will remain the same in the RCT. EXE-06.08.04-VP-752. Workload was rated as relatively high, but still within limits. This could have been due to the difficulty in viewing the VFR flights, or the problems with the tracking	*On-going* *Recommendations:* - Workload in the RCT should be assessed in active mode trials or RTS under high task load, normal operating conditions as well as abnormal & degraded modes of operation.
1.3.3	1.3.3.2	The fact that ATCOs have to use different systems in the RCT (e.g. use of visual presentation, AVFs) than they use in the local tower could increase both stress and workload levels as ATCOs are less familiar with the new systems. This could have a negative impact on capacity and safety.	EXE-06.09.03-VP-059: See results for issue 1.3.3.1. EXE-06.09.03-VP-062: Workload was rated very low but these results cannot be used as a proper assessment due to the nature of the PSM trial. ATCOs mentioned features that could have a negative impact on workload to be data delays, minor usability issues with the PTZ camera, and video tracking during darkness. The OTW view was said to contribute most to reduce workload during the passive shadow mode trial. To reduce workload further, ATCOs suggested that the CWP should be kept as similar as possible to the local tower CWP, and better SMGCS equipment.	*On-going* *Recommendations:* - Workload in the RCT should be assessed in active mode trials or RTS under high task load, normal operating conditions as well as abnormal & degraded modes of operation.
Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate.				

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1.3.4	1.3.4.1	Potential technical issues with the technical enablers in the RCT can lower the ATCOs trust in the RCT to an inappropriate level. This could negatively impact the ATCOs acceptability of the concept, and their job satisfaction.	EXE-06.09.03-VP-059: The results showed a high level of trust in the system. The prototype platform scored highest in it being useful. Robustness of the platform was given the lowest score of trust (medium) which may be due to the technical issues experienced throughout the two week trial and the problems with the PTZ HMI. EXE-06.09.03-VP-062: Trust was found to be at an acceptable level. In similarity with the results from the first trial, this trial also showed that the ATCOs had a high level of trust in the system. The platform scored highest in being understandable and in making the ATCOs feel confident. Accuracy and robustness were given the lowest scores, but the trust was also high for these dimensions. Despite the good results, several ATCOs highlighted trust as the greatest challenge for implementation of the concept. Sufficient hands-on training and CWP replication (i.e. make the CWP in the RCT as similar as possible to the RCT in the local tower) were suggested as means that can be used to further increase trust. EXE-06.08.04-VP-752. Trust was not very high apart from the above average trust in the controller's understanding. Scores relating to accuracy, faith, and familiarity received negative trust scores.	*On-going* *Recommendations:* - The impact of replicating the local tower CWP in the RCT on ATCO acceptance, trust and efficiency should be further investigated in future validation activities at a local level, when the technical solution and the local conditions are known.
Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.				
1.3.5	1.3.5.1	The situation awareness enhancement tools in the RCT (i.e. visual presentation in conjunction with the AVF) may improve the ATCO's situational awareness by providing them with enough, if not more, information compared to the local tower. This could positively impact safety and capacity.	EXE-06.09.03-VP-059: Overall, the results from the SASHA questionnaire were positive with an average score of between 4 and 5 equating to "more often" and "very often" being able to maintain sufficient situational awareness. The situational awareness between session one and session two was the same for most elements of situational awareness but improved over time in the "ability to plan and organise work" and "not having to search for an item of information". This suggests that with more exposure to the RCT with the AVF and visual presentation, the ATCOs could plan and organise their work easier and were getting used to the prototype in order to provide ATS remotely during contingency situations. EXE-06.09.03-VP-062: Again the overall results from the SASHA questionnaire were positive with an average score of between 5-6, equating to "very often" and	*On-going* *Recommendations:* - The potential need to use technical enablers during darkness to maintain a sufficient level of situation awareness should be further examined. - Further investigations should be performed to determine how switching of views in the visual presentation should be handled if there is more

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			"always" being able to maintain sufficient situation awareness. This shows a slight increase from the previous trial. Ability to anticipate events and not forgetting important information were given the highest scores. The visual presentation and video tracking were highlighted as the parts that contributed most to increase situation awareness. At the same time, participants highlighted insufficient resolution and other minor quality issues in the visual presentation as parts that contributed negatively to their situational awareness. During darkness controllers indicated that the RCT screens were not as good as the local tower view (if visual features were not provided). Controllers were unsure if the quality of screens during darkness would be sufficient without visual features. Results from the end-of-trial questionnaire showed that ATCOs generally found that the hotspot cameras, PTZ camera, IR camera, radar tracking, visual tracking, aerodrome overlays, and aerodrome sound features increased their situation awareness. However, the lack of a 360 degree view was seen by many of the ATCOs as a factor that reduced situation awareness. Improvements for the visual presentation to include a continuous 360 degree view were suggested as opposed to the switching/panning solution used during VP-062. This would help detecting VFR traffic in all directions and it was seen as important to detect and handle non-nominal situations. In conclusion the 360 degree view was seen as a part of a business case for individual contingency solutions. EXE-06.08.04-VP-752. The controllers somewhat agreed (50,6%) that the OTW view enabled sufficient situational awareness of the airport for operating in contingency mode. There was not a great difference noted in situational awareness between day and night operations	than one controller sharing the same CWP simultaneously. - The potential advantages of having a 360 degree view in the RCT as opposed to a switching/panning solution should be further investigated at a local level, when the technical solution and the local conditions are known.
Arg. 1.3.6: Human performance satisfies the expected TA target levels.				
1.3.6	1.3.6.1	Safety in terms of potential for human error should not increase compared to current operations in traditional control towers	EXE-06.09.03-VP-059: ATCOs reported that the concept was safe with eight out of eight considering it to be at least as safe as existing contingency solutions. ATCOs felt that the concept would be safe to apply at aerodromes of all sizes, given that capacity was reduced accordingly. Comments indicate that ATCOs correlated the level of safety possible to the level of traffic applied. Safety during unplanned contingency events scored the lowest, however this understandable as the nature of an unplanned emergency	*On-going* *Recommendations:* - The findings regarding safety when working in the RCT should be confirmed and verified by results from the safety analyses

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			has a higher potential for safety concerns to arise. The workshop revealed a recommendation that proficiency checklist be used during transition phases. Applying this measure may increase the opinion of the safety during unplanned events. Any increase in safety compared to closing the aerodrome has not been proven; although ATCOs agree safety has not reduced. EXE-06.09.03-VP-062: Results from the end-of-trial workshop showed that the ATCOs thought that the tracking features and the OTW view (in comparison with the A-SMGCS only baseline) increases safety, capacity and flexibility and that it makes it easy to foresee what is going to happen in a more realistic way. It also gives confidence on spacing and a sense of security to the controllers and the aerodrome operator. In the end-of-trial questionnaire seven out of eight ATCOs felt that the RCT solution was at least as safe as the ground surveillance based contingency solution. The main identified risk contributors were seen as unfamiliarity with the CWP and potential technical difficulties with the technical enablers. EXE-06.08.04-VP-752. The overall response for was conditionally favourable and the level of safety was deemed acceptable. In addition, the checklists for transitioning into and out of contingency were approved by the ATCOs as clear and complete, so these areas were deemed acceptable with regards to safety. The conclusion was that the simulated system was acceptably safe with the caveat that the flight tag information requires considerable improvement if it is to be used.	conducted in the safety assessment. - The findings should be liaised/consolidated with the safety assessment.
Arg. 2.1.6: The level of trust in automated functions is appropriate.				
2.1.6	2.1.6.1	If ATCOs trust in the automatic aircraft identification, tracking & labelling function is too high they may not notice errors, e.g. the system tracking non-a/c objects, this could reduce situation awareness and increase potential for error and may have safety implications.	See results/evidence from issue 1.3.4.1.	*On-going*
2.1.6	2.1.6.2	If ATCOs trust in the automatic a/c/ identification, tracking & labelling function is too low then ATCO may not benefit from the functionality & their SA will not be enhanced by the automation & efficiency could be impacted. This could impact the cost-effectiveness of the RCT solution.	See results/evidence from issue 1.3.4.1.	*On-going* *Recommendations:* See recommendations from issue 1.3.4.1.

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Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task.				
2.2.2	2.2.2.1	Technical latency in the visual presentation of the OTW or in the responsiveness of the advanced visual features will reduce the accuracy of the information that is presented in the RCT. This could hinder the ATCOs in carrying out their tasks in an efficient and safe manner.	EXE-06.09.03-VP-062: In the end-of-trial questionnaire some of the ATCOs mentioned minor issues with the technical performance of the visual presentation, including uneven picture updates (only sporadically), insufficient smoothness of picture, and minor delays. It was also emphasized that there was a need to better synchronize the data in the radar tracking and the video tracking. The panning function was positively received, with all participants finding the technical performance to be acceptable. Regarding responsiveness, ATCOs highlighted that the PTZ camera should have a faster zoom and tracking feature, that it sometimes had an uneven picture, and that the PTZ camera was too easy to start. EXE-06.08.04-VP-752. In the end-of-trial questionnaires the ATCOs mentioned minor issues with the technical performance of the visual presentation, stating that the system provided average usefulness scores and slightly below average ease of use scores. Comments were made regarding uneven picture updates (only sporadically), and insufficient smoothness of picture. It was also emphasized that there was a need to better synchronize the data in the radar tracking and the video tracking	*On-going* *Recommendations:* - The slew rate of the PTZ should be sufficient enough that ATCOs can locate targets with the PTZ in a timely manner. - The steps required to start the PTZ in the HMI should ensure that ATCOs do not start PTZ unintentionally.
Arg. 2.3.1: The type of information provided satisfies the information requirements of the human.				
2.3.1	2.3.1.1	The information presented on the HMI may not support the ATCO in his/her work. Specifically the visual presentation and the AVF may not provide a sufficient overview and details, particularly when used in poor visibility conditions such as darkness, fog, etc.	EXE-06.09.03-VP-062: The usability and acceptability of the technical enablers and the system as a whole was generally rated very high. Some minor issues were reported for the use of the PTZ camera, saying that it was clunky to use and too easy to start. Some difficulties with the visual presentation were also reported including difficulties to track/view objects during darkness, sporadic mismatch between the radar tracking and the video tracking, problems with sun reflection, shaking cameras (due to wind), and too low resolutions. Suggestions for additional information/capabilities that could be useful included ability to add markers or free text to the OTW, IR camera in both RWY ends via hot spot cameras, e-strips on screen, and having two cameras (one for each position). Further it was also suggested that the opacity of radar labels should change the closer they got to the aerodrome. ATCOs found that a 360 degree view of the aerodrome would be necessary.	*On-going* *Recommendations:* - Investigate the possibilities for providing functionality that allows ATCOs to make annotations to the visual presentation in the form of markers and/or free text. - Further investigations should be performed to determine how switching of views in the visual presentation should be handled if there is more than one controller

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			It was stated that the aerodrome view should be fixed/static in the RCT if there are more than one controller working on the same RCT. In the end-of-trial questionnaire all ATCOs agreed or strongly agreed that they could achieve their tasks in a timely and efficient manner when using the RCT. EXE-06.08.04-VP-752. The ATCO reported that they like the infrared camera view, and that it would be very helpful in LVC	sharing the same CWP simultaneously. - The system should to the extent possible minimize any misalignment of the radar tracking labels caused by inaccuracy in the radar. - Procedures for how to operationally use the tracking information in the visual presentation should be developed and validated. - The potential advantages of having a 360 degree view in the RCT as opposed to a switching/panning solution should be further investigated.
Arg. 2.3.2: Input devices (e.g. keyboard, mouse, touch screen) correspond to HF principles. [V1: AIR only]				
2.3.2	2.3.2.1	ATCOs may find it difficult to manoeuvre and use the new HMIs such as the visual presentation and the advanced visual features. This could have a negative impact on efficiency, workload, stress, and situation awareness, and could consequently also negatively impact safety and capacity.	EXE-06.09.03-VP-059: Due to technical issues the number of positive responses towards the AVFs was not high. The majority of ATCOs had a neutral opinion on the potential for the PTZ camera, IR camera and tracking labels to improve workload. ATCOs felt that the PTZ and IR camera were not responsive or easy to use, with poor image quality. The PTZ camera was deemed to be useful and improve situational awareness (on average). Importantly ATCOs felt the concept of the PTZ was a necessary feature. Opinion on the IR camera was neutral, with no strong opinions in either direction. ATCOs felt the IR camera would contribute during IMC. Some ATCOs questioned usefulness of such a tool with the presence of ground surface movement radar. IR zoom ability may improve acceptance. Tracking labels were deemed to aid hazard detection. However technical issues with labels not aligning to aircraft within 5nm were viewed as mandatory items to improve. Labels were seen as useful but concerns over overreliance in them were raised. In	*On-going* *Recommendations*: - The impact of replicating the local tower CWP in the RCT on ATCO acceptance, trust and efficiency should be further investigated in future validation activities at a local level, when the technical solution and the local conditions are known. - The steps required to start the PTZ in the HMI should ensure that ATCOs

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			their current form ATCOs did not feel the AVFs would reduce stress or make them less prone to error. Despite this result on average ATCO opinion was neutral regarding the AVFs. EXE-06.09.03-VP-062: The usability of the technical enablers was generally rated very high. Some minor issues were reported for the use of the PTZ camera, saying that it was clunky to use and too easy to start. Furthermore, ATCOs identified a need to provide two PTZ cameras so that each ATCO could make use of PTZ simultaneously when necessary. Furthermore results also showed that as ATCOs will be less familiar with the CWP in the RCT, they may find it more difficult to use.	do not start PTZ unintentionally. - The RCT should ensure that each ATCO can make use of the PTZ when required (this may require that more PTZ cameras are available). - HF design principles should be applied to ensure that the new input devices introduced in the RCT are consistent with design standards or regulations.
Arg. 2.3.5: Workstations (e.g. cockpit layout and consoles) adhere to ergonomic principles. [V1: AIR only]				
2.3.5	2.3.5.1	The fact that ATCOs have to change to a new work station during a contingency, which they are less familiar with, might impact the ATCOs performance and efficiency. This can consequently lead to a capacity reduction, particularly in the initial phase of switching to the RCT.	EXE-06.09.03-VP-062: The CWP layout used in the RCT during the PSM trial was considered as acceptable by six out of eight ATCOs. All ATCOs stated that they found the control devices in the CWP to be easy to use, and that the information presented in the CWP was easy to understand. Some ATCOs emphasized that the range of features in the CWP was insufficient (VCS, real AWOS, ATIS and information about aircraft gates were mentioned as missing features). During the end-of-trial workshop participants agreed that the switch from the local tower to the RCT should be as smooth as possible and that the CWP should be as similar to the CWP in the local tower as possible.	*On-going* *Recommendations:* - The impact of replicating the local tower CWP in the RCT on ATCO acceptance, trust and efficiency should be further investigated in future validation activities, at a local level, when the technical solution and the local conditions are known.
Arg. 2.3.7: The user interface design reduces human error as far as possible. [V1: AIR only]				
2.3.7	2.3.7.1	Potential technical issues and/or low usability in the new HMIs (i.e. visual presentation, AVFs) could reduce ATCO efficiency and increase the possibility of ATCOs making errors in their work. This could have a significant impact on capacity and safety.	EXE-06.09.03-VP-059: Results from the questionnaire showed that the ATCOs thought that the OTW view increased safety, decreased their stress levels, made them prone to making less errors and they felt comfortable using the OTW view to provide ATS. However, the ATCOs thought that the AVFs increased stress levels and made the ATCO more prone to making errors. The slight negative responses could, in part, be due to the technical issues experienced during the trial. Some technical issues occurred	*On-going* *Recommendations:* - The potential for human error when working in the RCT should be investigated with objective methods during future trials. - The system should to the

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			during the trial which increased the stress levels of the ATCOs. This was particularly seen in the AVF features, where the tracking labels were not coupled to the aircraft within 5Nm of the runway threshold properly which caused confusion and were a labelled a "risk factor". Technical issues with the PTZ might also have impacted the stress levels. Further investigations are needed. EXE-06.09.03-VP-062: In the end-of-trial questionnaire, five out of eight ATCOs agreed that the RCT would increase safety compared to ground surveillance-based contingency solutions (only one ATCO disagreed and the remaining two were neutral). Similarly, results from the end-of-trial workshop showed that the ATCOs felt the tracking features and the OTW view (in comparison with the A-SMGCS only baseline) increased safety, capacity and flexibility and that it made it easier to foresee what is going to happen. However, ATCOs felt that the RCT should be kept as simple as possible, and that it should be as similar as possible to the local tower. In light of this, it was suggested that the RCT might benefit from not including the tracking functions (at least initially). The main risk contributors were found to be potential technical failures, insufficient video resolution, difficulties in seeing objects in darkness, and unfamiliarity with the CWP. EXE-06.08.04-VP-752.	extent possible minimize any misalignment of the radar tracking labels caused by inaccuracy in the radar.
Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]				
2.3.8	2.3.8.1	The visual presentation system and advanced visual features in the RCT platform should lead to increased individual situation awareness for the ATCOs working in the RCT. This could have a positive impact on capacity and cost-efficiency.	See results/evidence in issue 1.3.5.1.	*On-going* *Recommendations:* See recommendation for issue 1.3.5.1.
Arg. 3.2.1: Changes to the task allocation between human actors do not lead to adverse effects on human tasks.				
3.2.1	3.2.1.1	The roles in the RCT can potentially be combined in new ways, leading to changes in task allocation between human actors. This may reduce the ATCOs ability to achieve their tasks, and could consequently impact capacity.	EXE-06.09.03-VP-062: ATCOs reported that the roles and responsibilities would remain static and hence changes in task allocation between human actors are not expected.	*On-going* *Recommendations:* - Task analyses should be conducted to verify that

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			EXE-06.08.04-VP-752. ATCOs reported that the roles and responsibilities would remain static and hence changes in task allocation between human actors are not expected.	the roles and responsibilities will remain the same as in the local tower when providing ATS from the RCT (this should preferably be done on a local level to accommodate the fact that the roles and responsibilities may differ slightly from aerodrome to aerodrome).
Arg. 4.1.1: Changes in roles and responsibilities are acceptable to the affected human actors.				
4.1.1	4.1.1.1	Any changes in roles and responsibilities introduced by the RCT solution might not be acceptable to the affected human actors.	EXE-06.09.03-VP-062: All participating ATCOs stated that the tasks, roles and responsibilities during the trial were acceptable.	*Closed*
Arg. 4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered.				
4.1.2	4.1.2.1	The introduction of the RCT might increase the ATCOs ability to perform quality ATS during contingencies which again may positively impact job satisfaction. However, there might also be negative impact due to having to learn a new system and undergo new training programs.	Not investigated	*Not addressed* *Recommendations:* Impact of changes on job satisfaction should be assessed in future workshops.
Arg. 4.2.1: Knowledge, skill and experience requirements for human actors have been identified.				
4.2.1	4.2.1.1	The RCT solution requires that ATCOs have in-depth knowledge, skills, experience and confidence with using the new technologies that are introduced in the solution (e.g. AVFs, visual presentation). The requirements towards knowledge, skill and experience might not be fully identified.	EXE-06.09.03-VP-062: Initial findings regarding roles and responsibilities indicate that the tasks of the ATCOs will not change significantly while working in the RCT. However, it is clear that the ATCOs will require skills and knowledge on how to perform their tasks using the technical enablers in the RCT. During the workshop ATCOs stated that they would require training to start the system on different levels of capacity. The participants were also asked if they could define training intervals for a contingency installation to Landvetter airport. Discussions considered that by providing services from the RCT during weekends or night shifts (in low traffic periods), performing live shadow mode activities or simulations from the RCT twice a year, proficiency could be maintained. The final conclusion was that it depends on a cost-efficiency business case,	*On-going* *Recommendations:* - A cognitive task analysis should be performed to identify skills, knowledge and experience requirements for working in the RCT. - Training programs for using the technical enablers in the RCT should be defined and validated

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			however regular training would be required in order to allow for a smooth transition.	(this work needs to be conducted on a local level to accommodate the fact that different aerodromes may use different RCT setups which require different training needs). - Training programs for transitioning into and out of contingency using the RCT should be developed and validated (this work needs to be conducted on a local level to accommodate the fact that different aerodromes may use different RCT setups and target different levels of capacity).
Arg. 4.2.2: The impact on operator licensing (as defined by the regulating bodies) has been identified.				
4.2.2	4.2.2.1	The RCT solution might impact ATCO licensing, as the ATCOs will need new competencies, knowledge and skills to work in the RCT.	Not investigated	*Not addressed*
Arg. 4.3.1: The impact on staff levels is identified.				
4.3.1	4.3.1.1	The RCT solution might impact staff levels as one might require stand-by ATCOs that can step in during unplanned contingencies if the current ATCOs are unfit for continuing their work after the contingency occurred. This impact on staff levels might not be fully identified.	EXE-06.09.03-VP-062: Not explicitly investigated. However discussions during the end-of-trial workshop indicated that there might be a need to use a new "watch"/shift of controllers to provide services in the case of worst case scenarios - e.g. bomb – and the possibility to provide services from another airport. It was concluded that the latter would imply multiple aerodromes licenses for the controllers.	*On-going*
Arg. 4.3.2: The impact on shift organisation is identified.				
4.3.2	4.3.2.1	As the ATCOs will have to work in a different environment that they are less familiar with than the local tower, there is a risk for increased fatigue. Due to this it might be necessary to apply shorter shifts. This impact of shift organisation might not be fully identified.	EXE-06.09.03-VP-062: Discussions during debriefs indicated that the RCT concept will not have a major impact on shift lengths (1.5 hours were suggested as a suitable shift length).	*On-going* *Recommendations:* - Conduct a fatigue study to determine the shift schedules and the recommended breaks /

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				rest periods for working in the RCT at a local level, when the technical solution and the local conditions are known.

3.4.2 Maturity of the project

The HP maturity criteria checklist for finalising the V3 assessment was used to determine the HP maturity of the remote contingency tower concept following the HP related activities conducted to date (see Table below). The checklist was completed based on the activities conducted and the evidence collected to date, as described in Table 9.

Table 10: Maturity criteria

Checklist for finalizing the V3 assessment		
ID	**Question**	**Answer and comments**
1	Have all relevant arguments been addressed and appropriately supported?	No. The relevant arguments have been addressed but some of the arguments have not been appropriately supported by the level of evidence required for finalizing V3. Further HP validation activities are required in order to conclude some of the arguments and such activities have been noted in this report.
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)?	No, some of the identified issues related to human performance and operability have not yet been sufficiently assessed on the level required for finalizing V3. In particular this is evident for issues relating to workload, timeliness, and potential for human error (see Table 8). These aspects of human performance should be assessed in active mode trials or RTS, and recommendations for such validation activities have been made.
3	Have all the parts of the solution/concept been considered?	Yes, all relevant parts of the solution/concept have been considered. Some parts of the solution, such as training, staffing needs, and transition phases to and from the RCT have only been discussed in workshops. However, some of these aspects will differ depending on the environment/aerodrome where the solution is to be used and the technical implementation of the RCT and are therefore difficult to generalize.
4	Have potential interactions with related projects/concepts been considered and addressed?	Yes, recommendations from the 06.09.03 assessment were fed into projects 12.04.08, and 06.08.04.
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes, the evidence collected to date indicates that the proposed solution is consistent with human capabilities in passive shadow mode trials. However, certain aspects of human performance are difficult to assess in this type of trial, and it is therefore recommended to perform active mode trials or RTS to gather more evidence on certain aspects of human performance.
6	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes, the proposed solution has been tested with end-users in three passive shadow mode trials. Abnormal and degraded conditions have been addressed thoroughly in workshops with end-users but not in trials. However, abnormal and degraded conditions were tested in trials in the Remote Provision of ATS to a Single Aerodrome (SDM-0201) concept, which used the same technical setup as the one used in the RCT trials.
7	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes, the OSED have been updated with the outcomes of the HP activities.

8	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	As explained in point 1 and 2, some of the HP issues/benefits requires more evidence in order to be satisfied.
9	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	The HP recommendations described in this report are the collected HP recommendations to be produced in the formal HP assessment process for SDM-0204 Remotely Provided Air Traffic Service for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway. Hence, as only the recommendations have been produced, future development efforts will need to take these recommendations into consideration.
10	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, the major factors that can impact the transition have been recorded. The service stays the same; the only change is the way that it's provided (i.e. from an RCT). Procedures for degradation cannot be defined on a general level as it will depend on the local implementation.
11	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. The findings indicate that there is a need for a new transition leader role that can help facilitate the transition to/from the RCT during contingencies; unit-specific routines/procedures for handling of technical degradation in the RCT; checklists for re-establishing operations in the RCT; and training programs for working in the RCT.
12	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes. Where appropriate recommended validation activities for the next V-phase have been identified (see Table 8 and Appendix A).

Considering the evidence gathered during the HP related validation activities, with respect to maturity criteria imposed to finalize the V3 assessment, we cannot yet fully conclude that the OI step SDM-0204 Remotely Provided Air Traffic Service for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway satisfies the criteria for finalizing V3. The reason for this is that some of the HP issues/benefits have not been appropriately supported by the level of evidence required for finalizing V3, as defined by the HP assessment reference material. Additional evidence is required in order to address these aspects. However, it should be emphasized that the evidence that has been collected to date is generally positive with regards to supporting the relevant HP arguments.

The validation exercises and activities conducted has helped mature the concept of Remotely Provided ATS for Contingency Situations at Small to Medium Aerodromes with a Single Main Runway (SDM-0204), moving it closer to V4. The issues and recommendations found during the HP assessment are highly relevant for other projects that are assessing SDM-0204, and needs to be taken into account during the planning and conduct of validation activities in these projects.

P06.08.04 took the results reported here in consideration in the exercise EXE-06.08.04-VP-0752 (it was received too late to be taken into consideration for EXE-06.08.04-VP-751), and when conducting the SDM-0204 V3-V4 maturity assessments. and used the issues and recommendations identified in this report when planning and conducting the validation exercises. As VP-752 was also a passive shadow mode exercise, the recommendations regarding potential for human error could not be included except in the form of post exercise questionnaires. However, workload, and timeliness were taken into consideration in accordance with the given recommendations.

4 References

[1] P06.09.03 Remotely Provided Air Traffic Service for Contingency Situations at Aerodromes Appendix F: HP Assessment Report, v00.01.01, 5/11/2015

[2] SESAR P16.04.01 D26 SESAR Human Performance Reference Material - Guidance v00.01.01, 03/09/2015.

[3] SESAR P16.06.05 D10-001 HP assessment process for projects in V1, V2 and V3. (ground based and airborne projects), 00.01.00, 19/05/2015

[4] SESAR (2011). P06.09.03 D05.1 Single Remote Tower Validation Plan – Appendix: Human Performance Assessment Plan.

[5] SESAR P06.08.04 D94 OSED Single Remote TWR Ph2 - Final Update. Edition 00.07.00. 30/05/2016.

[6] ICAO Document 4444 “Procedures For Air Navigation Services - Air Traffic Management”, 14th Edition, November 2005;

[7] ICAO Document 9426 “Air Traffic Services Planning Manual”, Edition 1, February 2006.

[8] SESAR P06.08.04 D109. HP Assessment Report for Single Remote TWR. Edition 00.02.00.

[9] SESAR (2013). P06.09.03 D09. Contingency TWR Trial 1 Validation Report. Edition 00.01.01.

[10] SESAR (2013). P06.09.03. Validation Plan (VALP) for Remote Provision of ATS during Contingency Situations. Edition 00.00.01.

[11] SESAR (2015). P06.09.03 D12. Contingency TWR Trial 1 & 2 Validation Report. Edition 00.02.01.

[12] SESAR (2015). P06.09.03 D05.3. Validation Plan for Remote Provision of ATS During Contingency Situations. Edition 00.02.01.

[13] SEASR (2016) P06.08.04 D107 Validation Report for Remote Provision of ATS During Contingency situations Edition 00.01.01

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Appendix A – HP Recommendations Register

HP Recommendations Register						
This table presents the list of HP recommendations gathered in the project. If a recommendation has been transformed into a requirement, this will be indicated in the last column. In this case, the recommendation can be closed and a reference to the SESAR document in which the requirement has been integrated has to be made. If additional columns are needed to document additional information identified as necessary please add.						
ID	**Source** *Reference of HP activity*	**Recommendation** *Describe the recommendation.*	**Rationale** *Describe the rationale of the recommendation.*	**Type** *Specify the type of the recommendation: Design, Procedure, Training or Validation activity*	**Status** *Specify the status of the recommendation: Open, Cancelled or Closed*	**Justification of Status** *If the status is cancelled or closed, a justification has to be provided. In case a recommendation is closed because it was transformed into an HF requirement, a reference to the document in which the requirement has been integrated has to be made.*
RCT_REC_01	EXE-06.09.03-VP-062 (Issue 4.2.1.1) EXE-06.08.04-VP-752	Training programs for using the technical enablers in the RCT should be defined and validated (this work needs to be conducted on a local level to accommodate the fact that different aerodromes may use different RCT setups which require different training needs).	The RCT concept introduces new technology and ATCOs will need training on how to use this technology.	Training	Open	Not applicable
RCT_REC_02	EXE-06.09.03-VP-062 (Issues 1.1.2.1, 3.2.1.1)	Task analyses should be conducted to verify that the roles and responsibilities will remain the same as in the local tower when providing ATS from the RCT (this should preferably be done on a local level to accommodate the fact that the roles and responsibilities may differ slightly from aerodrome to aerodrome).	Current findings regarding roles and responsibilities are based solely on discussions with ATCOs. A more objective and formal method is required to fully address this aspect.	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are referring to local issues.
RCT_REC_03	EXE-06.09.03-VP-062 (Issue 1.1.2.1)	The responsibilities of a potential transition leader role which can be required to facilitate transition to and from the RCT should be defined and validated.	The findings highlighted a potential need for a transition leader role for aiding the transition to and from the RCT. The responsibilities of the person taking on this role should be clearly	Procedure	Open	Not applicable

			defined.			
RCT_REC_04	EXE-06.09.03-VP-059, EXE-06.09.03-VP-062 (Issue 1.2.1.1) EXE-06.08.04-VP-752	Checklists to aid in re-establishing operations in a RCT to the predefined capacity following a contingency event should be defined and validated.	The findings showed that ATCOs would require procedures for re-establishing operations in the RCT following a contingency event. These checklists should be validated and integrated with existing standards and procedures.	Procedure	Open	Not applicable
RCT_REC_05	EXE-06.09.03-VP-062 (Issue 1.2.1.1) EXE-06.08.04-VP-752	Procedures for notifying pilots about abnormal situations in the RCT affecting the flight operations should be defined and validated.	Airspace users concluded that they would need to be made aware of potential degradation in the RCT and hence the phraseology to be used to communicate such matters to the pilots will need to be considered.	Procedure	Open	Not applicable
RCT_REC_06	EXE-06.09.03-VP-062 (Issue 1.2.3.1) EXE-06.08.04-VP-752	Procedures for handling technical degradation in the RCT (e.g. dark screen procedures) should be defined and validated. An example solution is the substitution of the PTZ camera for the failed OTV camera.	Findings showed that there is a need for additional procedures in case of technical degradation in the RCT (e.g. failure in the visual presentation).	Procedure	Open	Not applicable
RCT_REC_07	EXE-06.09.03-VP-062 (Issues 2.3.7.1, 1.3.1.2)	The potential for human error when working in the RCT should be investigated with objective methods during future trials.	The current findings regarding potential for human error in the RCT are based on subjective measures. Objective measures are required to gain a better understanding of this aspect.	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are referring to local issues regarding the specific implementation.
RCT_REC_08	EXE-06.09.03-VP-062 (Issue 1.2.5.1)	Procedures stating who have the control of the PTZ camera should be developed to ensure that the camera can be used in an efficient manner (this applies to cases where more than one ATCO needs to use the same PTZ camera).	ATCOs felt that if only one PTZ camera was provided then there would need to be procedures to state which controller that has the ultimate control of the PTZ (e.g. either one position or a supervisor) if there is more than one ATCO working in the RCT simultaneously.	Procedure	Open	Not applicable
RCT_REC_09	EXE-06.09.03-VP-062 (Issue 1.3.1.1) EXE-06.08.04-VP-752	The impact of relocating from the local tower to the RCT on potential for human error should be further investigated in future validation activities.	The potential for human error may be increased as a result of ATCOs having to relocate to a different environment (the RCT) during contingencies. Current results do not clarify how the potential for human error is impacted by this relocation and it should therefore be further investigated.	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are referring to local issues regarding the specific implementation.
RCT_REC_10	Issue 1.3.1.3 EXE-06.08.04-VP-752	The impact of stress/trauma (after being relocated to the RCT following a contingency event) on potential for human error should be investigated in stakeholder workshop with critical incident stress management experts.	The potential for human error may be increased as a result of ATCOs having to continue to provide ATS after being potentially traumatized and/or stressed by an on-going contingency. Current results do not clarify how the potential	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development.

			for human error is impacted by stress/trauma and it should therefore be further investigated.			
RCT_REC_11	EXE-06.09.03-VP-062 (Issue 1.3.2.1)	The question of whether tasks can be achieved in a timely manner in the RCT should be investigated in active shadow mode trials or RTS.	Passive shadow mode trials are not the best means to assess whether ATCO tasks can be achieved in a timely manner. This needs to be assessed in a setting where ATCOs can perform the tasks properly i.e. active mode trials or RTS.	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are greatly impacted by local issues regarding the specific implementation.
RCT_REC_12	EXE-06.09.03-VP-062 (Issue 1.3.2.1)	The RCT should ensure that each ATCO can make use of the PTZ when required (this may require that more PTZ cameras are available).	Having only one PTZ in the RCT could be a challenge as it can only be used by one ATCO at a time. ATCOs felt that having more than one PTZ camera would make their tasks easier.	Design	Open	Not applicable
RCT_REC_13	EXE-06.09.03-VP-062: (Issues 1.3.3.1, 1.3.3.2) EXE-06.08.04-VP-752	Workload in the RCT should be assessed in active mode trials or RTS under high task load, normal operating conditions as well as abnormal & degraded modes of operation.	Passive shadow mode trials are not suitable for assessing ATCO workload. This needs to be assessed in a setting where ATCOs can perform the tasks properly i.e. active mode trials or RTS.	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are greatly impacted by local issues regarding the specific implementation.
RCT_REC_14	EXE-06.09.03-VP-062 (Issue 4.2.1.1) EXE-06.08.04-VP-752	Training programs for transitioning into and out of contingency using the RCT should be developed and validated (this work needs to be conducted on a local level to accommodate the fact that different aerodromes may use different RCT setups and target different levels of capacity).	ATCOs need to develop skills, knowledge and trust in using the RCT during all phases of contingency situations. A training programme should be developed and validated to ensure this.	Training	Open	Not applicable
RCT_REC_15	EXE-06.09.03-VP-059 , EXE-06.09.03-VP-062 (Issue 1.3.5.1)	The potential need to use technical enablers during darkness to maintain a sufficient level of situation awareness should be further examined.	During darkness controllers indicated that the RCT screens were not as good as the local tower view (if visual features were not provided). Controllers were unsure if the quality of screens during darkness would be sufficient without visual features.	Design	Open	Not applicable
RCT_REC_16	EXE-06.09.03-VP-062 (Issues 1.3.5.1, 2.3.1.1) EXE-06.08.04-VP-752	The potential advantages of having a 360 degree view in the RCT as opposed to a switching/panning solution should be further investigated.	The lack of a 360 degree view in the RCT was seen by many of the ATCOs as a factor that reduced situation awareness. Improvements for the visual presentation to include a continuous 360 degree view were suggested as opposed to the switching/panning solution used during VP-062. This could help detecting VFR traffic in all directions and it was seen as important to detect and handle non-nominal	Design	Open	Not applicable

			situations.			
RCT_REC_17	EXE-06.09.03-VP-062 (Issue 1.3.5.1, 2.3.1.1)	Further investigations should be performed to determine how switching of views in the visual presentation should be handled if there is more than one controller sharing the same CWP simultaneously.	Findings showed that switching of views in the visual presentation can be a challenge when there is more than one controller sharing the same CWP simultaneously. The controllers might have different preferences/needs regarding which view to use.	Design	Open	Not applicable
RCT_REC_18	EXE-06.09.03-VP-062 (Issue 2.2.2.1) EXE-06.08.04-VP-752	The slew rate of the PTZ should be sufficient enough that ATCOs can locate targets with the PTZ in a timely manner.	It was highlighted by ATCOs that participated in the trial that speed of the zoom feature of the PTZ camera was too low, making it potentially difficult to locate targets in a timely manner.	Design	Open	Not applicable
RCT_REC_19	EXE-06.09.03-VP-059, EXE-06.09.03-VP-062 (Issue 1.3.6.1) EXE-06.08.04-VP-752	The findings regarding safety when working in the RCT should be confirmed and verified by results from the safety analyses conducted in the safety assessment.	Current results on safety in terms of potential for human error when working in the RCT are based on subjective opinions and should be verified by more detailed analyses conducted in the safety assessment.	Validation activity		These validation activities are recommended to be performed during the V4 stage of development since they are greatly impacted by local issues regarding the specific implementation.
RCT_REC_20	EXE-06.09.03-VP-062 (Issue 2.2.2.1)	The steps required to start the PTZ in the HMI should ensure that ATCOs do not start PTZ unintentionally.	ATCOs reported that starting/initiation of the PTZ camera was too easy, causing them to sometimes start the PTZ camera unintentionally. The HMI of the PTZ should be improved so that ATCOs do not start the PTZ camera unintentionally.	Design	Open	Not applicable
RCT_REC_21	EXE-06.09.03-VP-062 (Issue 2.3.1.1)	Investigate the possibilities for providing functionality that allows ATCOs to make annotations to the visual presentation in the form of markers and/or free text.	This recommendation is based on suggestions for additional functionality made by ATCOs. The ATCOs suggested that it could be useful to include the ability to add markers or annotations to the visual presentation in order to mark points or areas.	Design	Open	Not applicable
RCT_REC_22	EXE-06.09.03-VP-059 , EXE-06.09.03-VP-062 (Issue 2.3.2.1)	HF design principles should be applied to ensure that the new input devices introduced in the RCT are consistent with design standards or regulations.	The RCT concept introduces new HMIs. These HMIs should be assessed against HF design principles to ensure that they are designed in accordance with standards and regulations	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are greatly impacted by local issues regarding the specific implementation.
RCT_REC_23	EXE-06.09.03-VP-062 (Issues 1.3.4.1, 2.3.5.1, 2.3.2.1)	The impact of replicating the local tower CWP in the RCT on ATCO acceptance, trust and efficiency should be further investigated in future validation activities.	Differences between the CWP in the local tower and the RCT may have a negative impact on ATCOs acceptance, trust and efficiency when working in the RCT, and could also affect the time		Open	Not applicable

			required to re-establish operations from the RCT after an outage, as well as the number of AVF included in the system. (more features, more time for accommodation).			
RCT_REC_24	EXE-06.09.03-VP-062 (Issue 4.2.1.1)	A cognitive task analysis should be performed to identify skills, knowledge and experience requirements for working in the RCT.	A more thorough analysis is recommended to identify requirements towards skills, knowledge and experience for working in the RCT.	Training	Open	Not applicable
RCT_REC_25	EXE-06.09.03-VP-062 (Issue 4.3.2.1) EXE-06.08.04-VP-752	Conduct a fatigue study to determine the shift schedules and the recommended breaks / rest periods for working in the RCT.	Current findings regarding shift organization in the RCT are based on high-level discussions with ATCOs. In EXE-06.08.04-VP-752, ATCOs commented they would need shorter activity periods (break more often) as RCT HMI operation caused more visual fatigue that local tower. A more thorough study is required in order to determine suitable shift schedules and required breaks / rest periods.	Validation activity	Open	These validation activities are recommended to be performed during the V4 stage of development since they are greatly impacted by local issues regarding the specific implementation.
RCT_REC_26	EXE-06.09.03-VP-062 (Issue 2.3.1.1) EXE-06.08.04-VP-752	Procedures for how to operationally use the tracking information in the visual presentation should be developed and validated.	During trials ATCOs experienced issues with tracking labels in the visual presentation not aligning to aircraft within 5nm. This misalignment is caused by radar information intrinsic delay and granularity of C mode data. and is thus not something that can be resolved directly from a RCT point of view. However, as such misalignment can occur, it is crucial that visual and radar tracking should be presented to ATCOs in a way that they can clearly discriminate between visual tracking, radar tracking and aligned visual and radar tracking information. It is also crucial that they are given clear procedures that describe how the tracking information in the visual presentation should be used.	Procedure	Open	Not applicable
RCT_REC_27	EXE-06.09.03-VP-062 (Issues 2.3.1.1, 2.3.7.1) EXE-06.08.04-VP-752	The system should to the extent possible minimize any misalignment of the radar tracking labels caused by inaccuracy in the radar.	During trials ATCOs experienced issues with tracking labels in the visual presentation not aligning to aircraft within 5nm. This misalignment is caused by inaccuracy in the radar and is thus not something that can be	Design	Open	Not applicable

			resolved from a RCT point of view. However, the system should to the extent possible (given the limitations of the accuracy of the radar) minimize that such misalignments occur.			

Appendix B– HP Requirements Register

HP Requirements Register						
This table presents the list of HP requirements gathered in the project. If additional columns are needed to document additional information identified as necessary please add.						
ID	**Source** *Reference of HP activity*	**Requirement** *Describe the requirement.*	**Rationale** *Describe the rationale of the requirement*	**Type** *Specify the type of the requirement: Design, Procedure, Training, or Test*	**Status** *Specify the status of the requirement: Open, Cancelled or Closed*	**Justification of Status** *If the status is cancelled or closed, a justification has to be provided. For each HF requirement, a reference to the document in which the requirement has been integrated has to be made.*

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