P06.09.03 Validation Strategy

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Abstract

The 6.9.3 Validation Strategy is the deliverable of D05 of the 06.09.03 project in WP06.09. The document will follow the guidelines developed in the European Operational Concept Validation Methodology (E-OCVM), more specifically covering Step 0 (State Concept and Assumptions) and Step 1 (Set Validation Strategy) of the Stepped Evaluation View of the methodology. Identification of current and target maturity levels of the concept as well as outlining of the expected validation cases will be part of this document.

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Executive summary

This document describes the overall 6.9.3 project validation strategy, which will cover the entire series of validation activities. The 6.9.3 validation strategy is addressing the validation of concept elements developed for the 6.9.3 OSED concept documents for Single Remote Tower, Multiple Remote Tower and Contingency Tower. Primary stakeholders, Air Navigation Service Providers, Air Traffic Control and Aerodrome Flight Information Service Officers, Airport Operators, Industry, Regulatory bodies and Airspace Users will be involved at various degrees in the validation process. Their main validation expectations are related to cost-benefits, efficiency and safety. Guidance from WP16.6 will be provided during the validation process to make sure that the validation outcomes provide necessary elements to build the overall SESAR cases related to stakeholder's expectations. Validation exercises will be performed in shadow passive mode where the new system will be non-interfering and will not play an active part in the ATM system. Platforms for the trials will be delivered and verified by WP12.4.7 and 12 4 8.

1 Introduction

1.1 Purpose and scope of the document

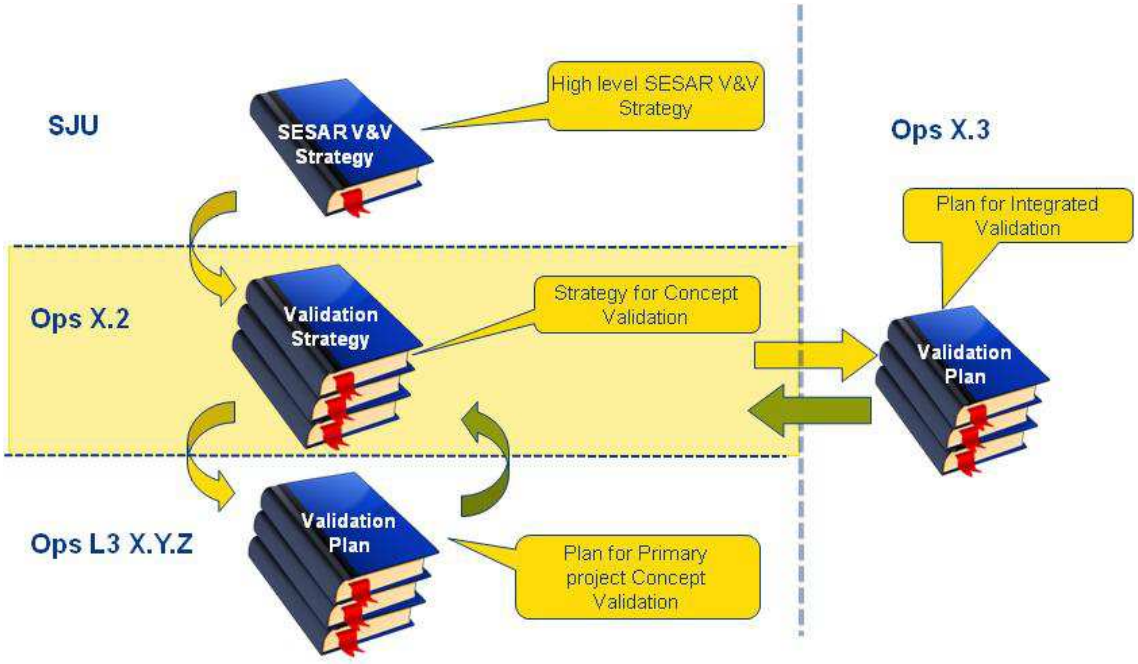


Figure 1: Overview of Validation strategies and plans responsibilities

This document describes the overall 6.9.3 project validation strategy, which will cover the entire series of validation activities. It is compliant with both the overall WP6 Validation Strategy [**5**] and the **E-OCVM [4]**. The objective is to identify and understand how the series of trials planned will address the validation of the overall project concept towards implementation maturity and this is covering the following topics:

- Stakeholders needs and involvement
- Concept maturity
- Expected Outcomes
- Validation Objectives
- Describes how project cases will be addressed during the validation activities
- Validation Requirements

The 6.9.3 validation strategy is addressing the concept elements that will be developed by the project. These concept elements cover the following domains:

- Single remote tower concept (ATS including AFIS) Remote Tower
- Multiple remote tower concept (ATS including AFIS)
- Contingency tower

1.2 Structure of the document

Section 1 Introduction: This section describes the purpose, scope and structure of the document and provides the acronyms and terminology definitions.

Section 2 Description of the Concept and Assumptions: This section describes the ATM problem the project is addressing as well as the proposed solution that is of interest for the validation activity.

Section 3 Validation Strategy: This section is the core of the document and includes the following sub-sections:

- Section 3.1 Stakeholders: This section identifies the stakeholders that will be concerned by the validation activities, their expectations and expected involvement in the activity.
- Section 3.2 Concept Maturity Level: This section provides background information on similar domain activities in order to justify and position the concept to be validated at a starting maturity level and identify the maturity level targeted by the project.
- Section 3.3 Expected Validation Outcomes: This section identifies the validation outcomes based on stakeholders' expectations. It also introduces the cases for which the validation activities shall bring concrete elements
- Section 3.4 Validation Objectives: This section indentifies the Key Performance Areas that the validation activities will address. High level objectives are listed per KPAs retained for the validations and low level objectives are derived.
- Section 3.5 Validation Plan: This section introduces the approach taken by the project for developing validation plans associated to planned trials.
- Section 3.6 Transversal Area: This section describes how the project will provide evidences requested by WP16.6 Transversal Area to build the project cases. For each case, approach from collecting information is described.
- Section 3.7 Validation Requirements: This section identifies the requirements in term of technical platform, operational realism, type of data etc… to conduct the validation exercises.
- Section 4 References: This section provides details on all documents referenced in the 6.9.3 Validation Strategy.

1.3 Acronyms and Terminology

Term	Definition
ACB	Assessment of Costs and Benefits
ANSP	Air Navigation Service Provider
AFIS	Aerodrome Flight Information Service
AFISO	Aerodrome Flight Information Service Officer
ATCEUC	Air Traffic Controllers European Unions Coordination
ATCO	Air Traffic Control Officer
ART	Advanced Remote Tower
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ATS	Air Traffic Service
CBA	Cost Benefit Analysis
CWP	Controller Working Positions

Term	Definition
EASA	European Aviation Safety Agency
ETF	European Transport Workers Federation
E-OCVM	European Operational Concept Validation Methodology
GA	General Aviation
HF	Human Factors
HMI	Human Machine Interface
HP	Human Performance
HR	Human Resources
ICAO	International Civil Aviation Organization
IFATCA	International Federation of Air Traffic Controllers Associations
NOTAM	Notice To Airmen
KPA	Key Performance Area
OFA	Operational Focus Area
OSED	Operational Services and Environment Definition
OTW	Out The Window
RTC	Remote Tower Centre
ROT	Remote Operated Tower
SEMP	System Engineering and Management Plans
SRM	Safety Reference Material

2 Description of Concept and Assumptions

2.1 ATM Problem Description

The range of ATS defined in ICAO Documents 4444, 9426 and EUROCONTROL's Manual for AFIS are provided by local ATCOs or AFISOs from local Tower building facilities. Remote operations as envisaged in the 693 concept do not exist.

The problems with today's operations are:

- Utilisation of various systems, equipments, operating methods and procedures according to aerodrome.
    - With lack of standardisation
        - impacting cost (equipment, systems) and
    - controller training (methods, equipment and procedures)
        - multi-aerodrome ratings are not as feasible
- Provision of services is not always cost efficient
    - Local facility sometimes having to remain open and staffed all day despite perhaps having only a few IFR flights in the morning and some in the afternoon/evening

2.2 Description of the Proposed Solution

The solution is focused on Cost reduction for providing ATS without reducing the level of safety. ATCO or AFISO will no longer be located at the aerodrome and will be re-located to Remote Tower facility or a Remote Tower Centre (RTC).

An RTC will be:

- Remotely connected to (at least) one airport
- Manned by one or several Controller Working Positions (CWP)
- Manned by one or several ATCO/AFISOs who will be able to perform all ATS tasks from this CWP

An RTC will have "Visual surveillance"

- reproducing the Out The Window (OTW) view, by using visual information capture and/or other sensors
- supported by the Introduction of technologies to enhance the visual reproduction in all visibility conditions

3 Validation Strategy

3.1 Stakeholders

3.1.1 Identification of Stakeholders

The Validation Strategy should consider the following primary stakeholders:

- Air Navigation Service Providers;
- ATC and AFIS Officers;
- Airport Operators;
- ATC Equipment manufacturers and providers ("Industry");
- Regulatory bodies e.g. ICAO, EASA, national regulatory authorities;
- Airspace Users e.g. airlines, pilots, GA;

The Validation Strategy should also consider the following secondary/project stakeholders:

- The SESAR Joint Undertaking;
- ATCO/AFIS Trade unions, ETF and ATCEUC
- Professional Staff Organisations e.g. IFATCA

3.1.2 Stakeholders Validation Expectations

Stakeholders' outcome or 'final product' from the 6.9.3 validation activity is represented by the table below:

Stakeholder	Validation Expectations
ANSP	ANSP will expect the validation process to provide evidence that the concept: • Is cost-effective and supports the findings of the business case in that it will reduce overall operating costs; • Provides levels of safety that are at least as good, if not better than current (local) operations; • Is acceptable to all operators and service users; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility.
ATC and AFIS Officers	ATC and AFIS Officers will expect the validation process to provide evidence that the concept: • Provides levels of safety that are at least as good, if not better than current (local) operations; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility; • Is usable and acceptable;
Airport operators	Airport operators will expect the validation process to provide evidence that the concept: • Lowers ATS costs as part of airport fees, as much as possible;

	• Will help them maintain and sustain future operations; • To maximise airport capacity under a variety of scenarios.
Industry	Industry will expect the validation process to: • Generate and assess requirements to help mature and prove the concepts; • Gather evidence to help them decide on continued investment and/or concept implementation; •Promote the benefits of the concept.
Regulatory Bodies	The Regulatory Bodies will expect the validation process to: • Assist in understanding the impact of the concept on current and future standards and regulations; • Provide evidence that the concept meets the required performance levels in terms of safety, capacity, access etc.
Airspace Users	Airspace Users will expect the validation process to provide evidence that the concept: • At least maintains, and hopefully improves, safety levels; • Lowers ATS costs as part of airport fees, as much as possible; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility;
SESAR Joint Undertaking	The SESAR JU will expect the validation process to: • Provide evidence that the concept will make a positive contribution to European ATM; • Be completed within timescales and budget.
ATC trade unions	The Trade Unions will expect the validation process to provide evidence that the concept: • Is acceptable to the operational users; • Does not lead to unwanted changes to procedure, roles or responsibilities for the operational staff;

3.1.3 Stakeholders Involvement

The co-operation and advice of stakeholders is vital to ensure that a good operational concept is brought into service. Thus, stakeholders must be consulted throughout the validation process and are expected to be involved in the validation in the following ways:

Stakeholder	Stakeholder Involvement
ANSP	Four ANSP from the NORACON consortium (LFV, AVINOR, FINAVIA, EANS) will directly contribute to the concept development, validation

	process and other areas of the concept development as required. These ANSP will provide the resources, operational experts and operational staff for the validation. Other ANSP are not directly involved but will have access to the validation results through open days and programme wide information sharing.
ATC and AFIS Officers	Operational staff (current and former ATCO/AFISO) from the project ANSP and other organisations will contribute to the concept development and validation activities. The validation exercises will be staffed by current operational staff from candidate airports. The opinion and feedback from these staff will directly influence the validation results and further concept development. Other ATCO/AFISO are not directly involved but will have access to the validation results through open days and programme wide information sharing.
Airport operators	Validation exercises will use candidate aerodromes. The airport operators of these aerodromes will therefore play a role in enabling and facilitating the validation exercises.
Industry	Industry will engineer and develop the concept to be used in the validation exercises. They will provide the platforms and systems on which the concept will be assessed. The NATMIG consortium will make direct contributions to the concept development through WP12.4.6-8. Other industrial partners will also develop systems which will not be included as part of the P06.09.03 operational assessments.
Regulatory Bodies	The Regulatory Bodies will be asked to give feedback on the concept and other areas of the project where their input will be required. This is most likely to be done via the national regulatory authorities where the trials will take place. They may have to give consent for live trials to take place in their areas of jurisdiction.
Airspace Users	If live trials are to take place, airspace users will be informed (via NOTAM or similar). Input from airspace users via the SESAR JU “Airspace Users” agreement has been requested but more for observation than for direct input.
SESAR Joint Undertaking	The SJU will be the overall body in charge of the project. They are expected to monitor project output and make demands from time to time for information and coordination with other SJU projects.
ATC trade unions	Two ATC trade Unions (ATCEUC and ETF) are directly involved in concept development.

3.2 Concept Maturity Level

3.2.1 Previous evaluations

Several projects are providing significant input elements to 6.9.3 project and hence putting already the concept at a quite high level of maturity.

1. **Remote Operated Tower (ROT) - LFV and SAAB**

The ROT project performed validation of TMA and aerodrome control services for Angel Holm airport

- The control services were performed remotely in Malmo using video camera and microphones, transmission of compressed data and reproduction of the visuals and audio

2. **Advanced Remote Tower (ART) - LFV and SAAB**

The ART project was based on ROT and addressed the feasibility of adding specific enhanced visual features on the panoramic display such as:

- digital image enhancing of the picture presented in the ROT
- tracking functions for moving objects
- label and met data

3.2.2 Concept Maturity level in 6.9.3 project

The Concept Maturity level in 6.9.3 for Single Remote Tower is V3 for Single basic concept and V2 for other less mature elements of the concept such as Visual enhancement features etc....

Preceding projects ROT and ART have addressed and solved a lot of issues related to Remote Tower Operations but nevertheless, the project team thinks that still work will have to be carried out in SESAR to ensure that operational procedures and requirements becomes stable.

Therefore the validation activities in the project will have to focus on the operability and operational acceptance

The aim of the project is to reach V3 maturity level for all domains (Single, Multiple and Contingency) addressed in the concept.

3.3 Outline of Case Structure

To address the stakeholder validation expectations the following cases will be produced. The validation process is expected to provide inputs to these cases:

- Human Performance Case – The HP Case will, for all the concept applications, identify the Human Performance Issues and Action plans. The initial HP case requirements will be derived from the initial concepts, fed into the validation plans, and then updated with results from the various trials
- Safety Case – The Safety Case will identify hazards, risks, fallbacks and mitigations. The initial safety case requirements will be derived from the initial concepts, fed into the validation plans, and then updated with results from the various trials. The Safety Case will also contribute to any Safety and Performance Requirements which may be required for Standards and Regulations. Therefore it shall also strive to establish a safety dialog with the appropriate NSA and/or EASA, to get them involved in the evolving process of these new concepts,
- Business Case – This Business Case activity will consist of an Assessment of Costs and Benefits (ACB) in line with SESAR P16.06.06 guidelines. P06.09.03 has not been instructed to perform a full CBA. The ACB will include details on the various costs and benefits using a range of implementation scenarios. Existing information from previously performed Cost Benefit studies in this area will be used as a starting point. Additional base fact finding studies will follow on this from this, e.g. resource allocation possibilities, applicability of the concept in different areas of interest, etc. The WP16.06.06 guidance material will drive

execution of this task. Considerable contributions are envisaged and expected from all project partners. External stakeholders i.e. Airspace users inputs are also foreseen;

The final cases will be built by the WP16. Nevertheless, guidance from WP16 is expected in order to identify the elements that the 6.9.3 should collect during its validation activity. More details on cases are provided in section 3.6.

3.4 Validation Objectives

3.4.1 Key Performance Areas

The ATM Key Performance Areas are critical to the projects success or failure. KPAs have been already defined by EUROCONTROL Performance Review Commission, the SESAR consortium or ICAO and more recently in the SESAR context by the project B41.

In the 6.9.3 OSED the following table identifies the KPAs addressed by the project.

		Expected Benefit	Main Constraint
Societal Outcome	Safety		X
	Security		
	Environmental Sustainability		
Operational Performance	Cost Effectiveness	X	
	Capacity		X
	Efficiency	X	
	Flexibility		X
	Predictability		
Performance Enablers	Access and Equity		X
	Participation		
	Interoperability		

The 6.9.3 concept is aimed at providing benefits in two main areas – Cost Effectiveness and Efficiency. In addition, it is necessary for the concept to maintain performance at least as good as current operations in other Key Performance Areas (KPA).

In addition to KPAs identified in the OSED, the 'Acceptability' criteria has been added in the validation strategy since it is an important part of the project assessment as indicated in the stakeholder section. Therefore a positive contribution is expected in:

- Cost Effectiveness – This is the main benefit delivered by the 6.9.3 concept. The benefit is expected through provision of air traffic services from remote facilities. For single aerodromes these facilities will be cheaper to maintain, able to operate for longer periods and enable lower staffing costs (through centralised training and resource pools). For multiple aerodrome additional cost effectiveness benefits can be achieved through the ability to control a greater number of aerodromes with fewer individual facilities and controllers. For contingency requirements, the aim of the 6.9.3 concept is to provide a solution that is cheaper to install

and maintain than A-SMGCS based solutions or can act as an improvement for an A-SMGS based solution.

- Efficiency – The 6.9.3 concept provides efficiency benefits in three main areas. The first is the cost effectiveness benefits described above, centred around using assets and resources more efficiently thus leading to a more cost effective service. The second is the ability to exploit the use of technology in the provision of the services. Digital enhancements can be used to maintain throughput in low visibility conditions, thus making a more efficient use of available capacity. Finally, the application of the 6.9.3 technology in a contingency environment should allow throughput to be maintained when the local control facility is out of service.

The following KPA must not be negatively impacted (and preferably improved) through the introduction of the 6.9.3 concept:

- Safety – Safety is the number one concern for air traffic. The provision of air traffic services (facilities and staff) from a remote location should provide the same, or greater if possible, levels of safety as if the services were provided locally. The use of the digital visual technologies used in the 6.9.3 concepts may provide some safety enhancements in low visibility.
- Capacity – Capacity should not be reduced through the removal of local facilities, or through the sharing of resources across multiple aerodromes. It may even be increased through the use of digital enhancements in low visibility.
- Flexibility – The implementation of the 6.9.3 concept, especially the Multiple Aerodrome applications must not affect the ability to provide a flexible service to the airspace users. It may even be increased through a greater possibility to extend opening hours when through remote operations.
- Acceptability – to assess the acceptability of the Remote and Virtual Tower concept to the operators and customers.
- Access and Equity – As above, the implementation of the 6.9.3 concept, and the Multiple Aerodrome applications in particular, must not affect the levels of access each type of airspace user has to the aerodrome.

3.4.2 High Level Validation Objectives

The high level validation objectives reflect the stakeholder needs and expectations. High level validation objectives that will be validated in the 6.9.3 project are described per KPA and with regards to the design and technical issues.

If there is no high level validation objective specified for a KPA that doesn't mean that there are no expectations of stakeholders concerning 6.9.3 for this KPA, but only that 6.9.3 will not look at it.

The High Level Validation Objectives are as follows:

- Safety – To assess the impact of the Remote and Virtual Tower concept on safety of ATS operations;
- Capacity – To assess the impact of the Remote and Virtual Tower concept on aerodrome capacity in all visibility conditions;
- Efficiency – To assess the impact of the Remote and Virtual Tower concept on efficiency of ATS service provision;
- Cost-effectiveness – To assess the impact of the Remote and Virtual Tower concept on the cost of providing ATS services compared to local provision;
- Flexibility – To assess the impact of the Remote and Virtual Tower concept on flexibility of ATS provision;
- Access and equity – To assess the impact of the Remote and Virtual Tower concept on airspace users' access to ATS

- Acceptability – To assess the acceptability of the Remote and Virtual Tower concept to the operators and customers

3.4.3 Low Level Validation Objectives

The high level objectives can be mapped to the three operational services (Single Tower, Multiple Tower, Contingency Tower), and concept maturity level. This will then allow low level objectives to be derived for the corresponding validation exercises.

	Operational Services					
	Single Tower		Multiple Tower		Contingency Tower	
	V2	V3	V2	V3	V2	V3
Safety	x	x	x	x	x	x
Capacity					x	x
Efficiency		x		x		x
Cost Effectiveness		x		x		x
Flexibility		x	x	x		
Acceptability	x	x	x	x	x	x
Access and Equity				x		x

V2 validation exercises will focus on safety and acceptability, after which the V3 exercises will focus on generating evidence for performance assessments.

3.5 Validation Plan

The overall approach for the project is to embark on a research and development process to develop and validate the 3 operational services using technical systems developed by WP12.4.6-8 (based on P06.09.03 operational requirements). The processes and methodologies will follow those outlined in the European Operational Concept Validation Methodology (E-OCVM) and the SESAR System Engineering and Management Plans (SEMP) Parts 1, 2 and 6 in particular.

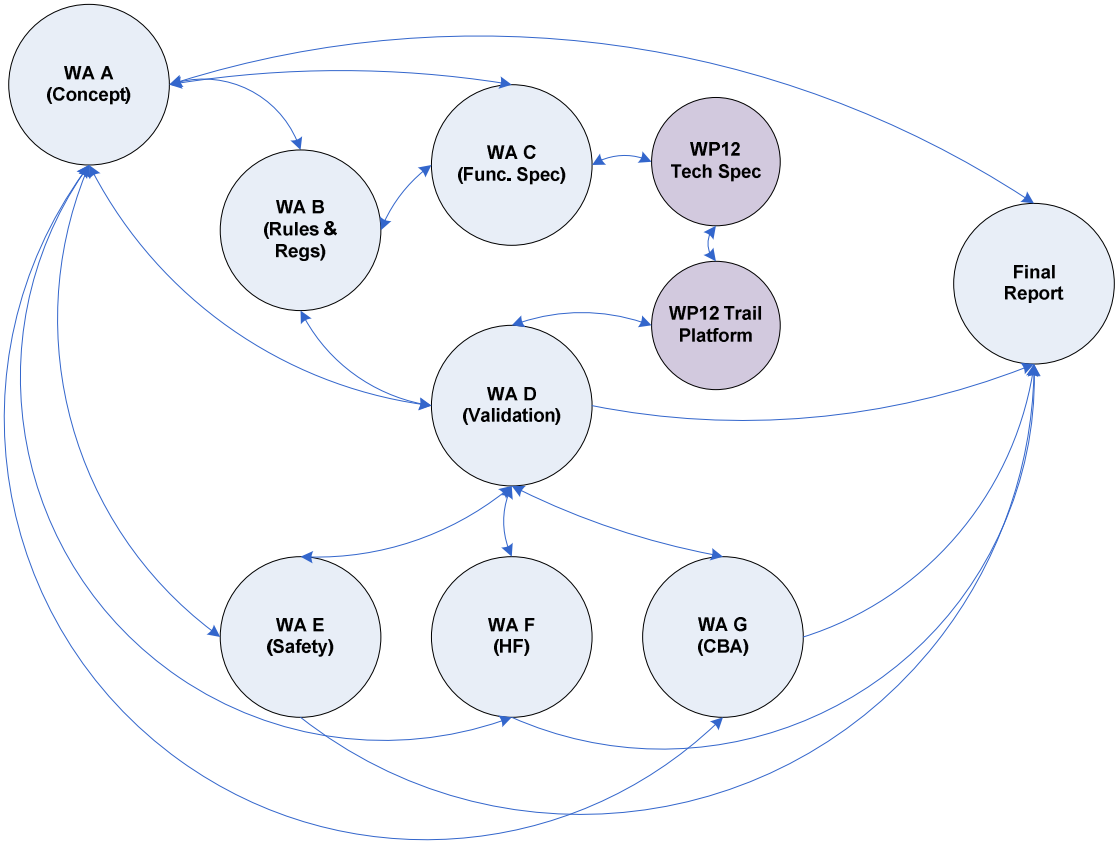
As defined in the OSED, the overall concept is divided into 3 different services:

- Single Remote Tower (ATS, including AFIS);
- Multiple Remote Tower (ATS, including AFIS);
- Contingency Tower.

At a project level and for each of the services, a similar development process will be used with the work carried out under the following subject areas:

The operational concept, functional specifications and validation strategy will be defined first at a project level to ensure coherency across the project and alignment with external influences. Then for each application, the distinct elements of the concept and specifications will be developed. A lower level validation plan will be developed to describe how the applications will be validated in a series of trials. The results then feedback first into the service level activities and then the project level.

Due to the amount of sharing across concept and technologies, the entire process will be linked and iterative, as illustrated below.



3.6 Transversal Areas

WP16.6 is responsible for building the SESAR cases which justify the deployment of the new operational concepts and enablers. The evidence needed for these cases is expected to come from validation assessments made by the 6.9.3 project. The validation assessments approach is described hereafter for every case identified for the project.

3.6.1 The Safety Case

Following (except if differently requested by the SJU or Regulatory Bodies) the safety approach to be applied in SESAR (see SESAR Safety Reference Material - SRM **[1]**), the Safety Case (PAC06) addressing the Remote Tower concept is to be developed in the frame of the safety transversal activity WP16.6.1. At the level of the corresponding Operational Focus Area – OFA (which encompasses WP6.9.3 and WP12.4.6, WP12.4.7 and WP12.4.8), a Safety Assessment is to be carried out, in order to provide necessary and sufficient evidences and information to support the production of this PAC06 Safety Case.

The aim of this safety assessment is to show that Remote Tower concept provides levels of safety that are at least as good, if not better than, current (local) operations. For that, evidences will be provided ensuring that the Remote Tower functional system[1] (for Single airport, Multiple airports and Contingency situations respectively):

- has sufficient safety functionality and performance

[1] 'Functional system' shall mean a combination of equipment, procedures and human resources organised to perform a function within the context of air navigation services (as per SRM definition).

- works properly under all normal conditions of the operational environment that it is likely to encounter,
- can safely continue to operate under any external abnormal condition that it may exceptionally encounter,
- can safely operate under, and recover from, all degraded modes of operations,
- and that the safety requirements specifying it (and ensuring precedent statements) are realistic, i.e. a system can be built to deliver them.

The safety assessment process to obtain this evidence is argument-driven. The safety assurance activities that constitute the process are driven entirely by the need for the activities to generate evidence (the ones mentioned above) with the right rigour. This safety assurance process is based on and applied as follows:

- *principles*, which are the essential foundations for capturing and demonstrating satisfaction of a complete and correct set of safety requirements for the corresponding functional system before bringing it into service and maintaining it through its operational life;
- *safety assurances objectives*, which state what has to be achieved in order to satisfy the related principles; and
- *safety assurance activities* which state how the safety assurance objectives will be satisfied – including the tools and techniques to be used.

The principles to be satisfied in the frame of Remote Tower OFA are the following ones:

P1. Define the scope, boundaries and interfaces of the functional system being considered, or other affected parts of the remainder air navigation services and underlying functional systems, its intended functions as well as the environment(s) of operations in which the change is intended to operate.

P2. Derive safety acceptance criteria specific for the change that are consistent with the overall criterion in terms of safety for SESAR and operational environment(s).

P3. Describe the service currently provided (i.e. the same as the one to be provided by the change) identifying its positive contribution to aviation safety and its contribution to the risk of an accident.

P5. Derive safety requirements for the design induced by the change in order to achieve the safety acceptance criteria.

P6. Show that, if the safety requirements are satisfied, then the safety acceptance criteria will be achieved.

P7. Show (through the construction and evaluation of pre-industrialization prototypes) that the safety requirements for the design are complete, correct and consistent.

The complete list of safety assurance activities to be performed to satisfy these principles is available in the Safety Plan **[2]** for Remote Tower OFA (for all Single, Multiple and Contingency applications). Detailed information on techniques and tools to be used in these activities is also provided.

Live trials and real time simulations are part of these techniques, in particular for activities related to principle P7. The results from these exercises will *a priori* provide evidence to show that Remote Tower system design operates correctly in a dynamic sense, under all normal and abnormal conditions, and that it can safely operate under, and recover from, all degraded modes of operations. Some evidence on the capability of safety requirements to be satisfied and tested is also expected from these activities.

Safety expectations for each particular live trial and real time simulation (in terms of safety validation objectives) are to be specified in each corresponding Exercise Validation Plan, to be developed prior to each exercise.

3.6.2 The Human Performance Case

A human performance assessment will be conducted for the Remote and Virtual Tower project in accordance with the SESAR Human Performance Reference Material **[3]**. The output of this human

performance assessment will feed into the overall Human Performance Case being developed by the human performance transversal activity WP16.06.05, for the operational package PAC06.

Human performance includes both Human Factors (HF) and Human Resources (HR). Human Factors considers all issues relating to roles and responsibilities, procedures and task design, teams and communications as well as human machine interface (HMI) design. Human resources consider all issues relating to training, selection, recruitment, staffing, planning, competency checking and licensing.

The HP assessment process provides a structural framework to identify, understand and manage human performance (HP) issues within a project and to ensure the required HP validation activities are performed at the appropriate time in the concept design, development and implementation process.

The overall aim of the HP assessment is to demonstrate that the remote tower concept for each of the three services, (i.e. remotely provided Air Traffic Services for a single remote aerodrome, multiple aerodromes and contingency situations) does not negatively impact, if not improves, human performance compared to current operations. Thus the remote tower concept for each service must adhere to two fundamental HP principles, that is:

- The role of the human actors in the system is consistent with human capabilities and characteristics
- The contribution of the human within the system supports the expected system performance and behaviour

It is currently foreseen that the pre-planned live trials and real time simulations (RTS) will be the main HP validation activities conducted to address the issues identified during the HP assessment process and to derive the necessary evidence to determine whether the two fundamental HP principles (described above) are achieved. However, other HP activities such as, task analysis, human error assessments, may also be necessary depending on the potential issues and impacts identified during the assessment process. The specific activities and tools required will be described in the HP Assessment Plan once the potential HP issues and impacts assessment has been conducted. A separate HP Assessment Plan will be developed for each of the three remote tower services.

3.6.3 The Business Case

P06.09.03 has not been tasked with performing a specific CBA or full business case by the SJU. However, since one of the main expected benefits is in cost effectiveness, an Assessment of Costs and Benefits (ACB) will be produced in line with SESAR P16.06.06 guidelines.

Working Area G of P06.09.03 will perform much of the ACB work and link directly to WP B, C and 16 and as such will have to provide information on:

- High-level description of Cost and Benefit mechanisms;
- Alternative/options analysis;
- Estimation of the Return on Investment per stakeholder group;
- Sensitivity analysis and risk profile analysis;
- Considerations for any varying deployment choices.

To support this activity, the validation exercises will have to validate the benefit mechanisms and provide performance information related to the expected benefits.

Earlier trials should assess the feasibility of the benefit mechanisms to make sure that the benefits can technically be achieved. In later trials the assessment should take a more quantifiable approach and generate performance data in the key performance areas of capacity, efficiency, predictability and flexibility (in line with WP guidelines).

3.7 Validation Needs

The *initial* validation needs are as follows:

- Validation Environment:
  - At least one real time simulation will be required to test the immature concept aspects in a non-live operational environment;
  - The remaining exercises should take place in a live environment using shadow-mode technique;

    According to E-OCVM, shadow mode technique is a validation technique in which the new system is given live feeds in the operational environment and runs in parallel to the operational system.

    There are 3 different types of shadow mode trials:

    Passive, Active and Advanced (sometimes called 'reverse' or 'hot' shadow mode).
    - In Passive Mode, the new system will be non-interfering and will not play an active part in the ATM system.
    - In Active Mode the new system can be provided to a user in parallel with the current system and thereby play a more active role in actual operations.
    - In Advanced Mode the new system will be put in active operation with the old system run in parallel as a fallback
  - The 693 project will mainly perform shadow mode passive exercises using live traffic.
  - The validation environment should include AFIS and ATC environments;
  - The validation environments should include a range of actual candidate/target aerodromes;
  - The validation environments should include aerodromes from different countries since the focus of services is different in different countries e.g. Sweden and ATC, Norway and AFIS;
- Validation Scenarios:
  - The normal day to day air traffic is the “normal scenario”.
  - All normal airport operations should be part of the validation e.g. normal IFR and VFR traffic arriving/departing/school flights, helicopters, airport vehicle movements;
  - Day and night operations;
  - All weather conditions that occur during the period.
- Others:
  - Participants – Trials should involve a number of validation participants over a period of time to generate maximum feedback;
  - Platform – For the first trial (part of “Release1”) the platform will need to be delivered and verified by WP12.4.6, 12 4 7 and 12.4.8;
  - Data - The mixture of Qualitative and Quantitative data will be required by stakeholders.

4 References

4.1 Reference Documents

[1] SESAR P16.6.1 Task T16.06.01-006, SESAR Safety Reference Material, Edition 00.01.00, 15th December 2010

[2] P6.9.3, Task 14 - Remote Tower Safety Plan, Edition 00.00.01, 14th February 2011

[3] SESAR Human Performance Reference Material – Guidance. Deliverable ID: 16:06:05 D06 1. Version 01:00

[4] European Operational Concept Validation Methodology (E-OCVM) - 2.0 [March 2007]

[5] WP 6.2 Validation Strategy

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