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SESAR Solution PJ01-06 SPR/INTEROP-OSED for V3 - Part IV - Human Performance Assessment Report

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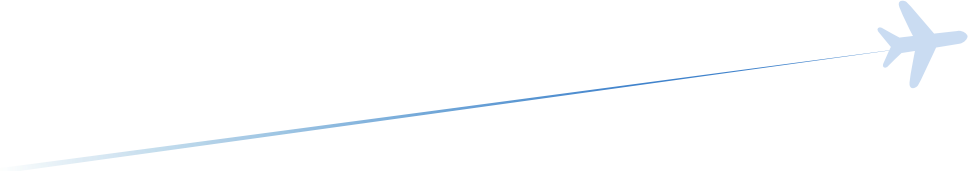

Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Thierry Ganille	Engineer	15/07/2019

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Ana Paz Goncalves Martins	Solution member	09/07/2019
Thomas Lueken	Solution Lead	18/07/19

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

Name/Beneficiary	Position/Title	Date
Thomas Lueken	Solution Lead	05/09/19

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date

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PJ.01 EAD

PJ01 EAD - ENHANCED ARRIVALS AND DEPARTURES

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Abstract

This document contains the Human Performance (HP) assessment report for the PJ.01-06 which consists of the HP assessment plan, the results of the HP activities conducted according to the HP assessment process, newly identified issues and the HP recommendations & requirements. It corresponds to the completion of the four steps of the Human Performance assessment process, namely: Step 1 – Understand the concept: Baseline, Solution and Assumptions, Step 2 – Understand the Human Performance Implications, Step 3 – Improve and Validate the concept and Step4 – Collate findings & conclude on transition to next V-phase.

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1 Executive Summary

This document contains the Human Performance (HP) assessment report that presents the results of the activities conducted according to the SESAR Human Performance (HP) assessment process applied on the advanced PinS procedures for rotorcraft solution worked within PJ 06.01. The solution is based on the use of an Helmet Mounted Display to manually fly as well as autopilot coupling to automatically fly PinS procedures with curved segments.

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.

Level of maturity of the concept at the start of the HP assessment is considered to be V3. As an on board technical solution, it has been stated that no changes on ATM actors or procedures would result from the introduction of the advanced PinS procedure concept. Five HP arguments that needed to be considered and satisfied in the HP assessment were identified in HP assessment plan.

Specific HP issues and benefits relating to the advanced PinS procedure concept for each of the relevant arguments have been identified by performing HP issue and benefit brainstorming sessions / interviews with relevant stakeholders including pilots, engineers, safety and HF experts.

Based on the HP arguments and issues / benefits identified, three HP activities were recommended and realised:

- Advanced PinS flight simulator trials (EXE-01.06-V3-VALP-001)
- Advanced PinS real flight trials (EXE-01.06-V3-VALP-002)
- Advanced PinS real flight trials (EXE-01.06-V3-VALP-003)

The results from these three exercises were satisfying for the HP assessment and allowed to obtained evidences relating to all the issues / benefits identified end to close it all.

Four recommendations and two requirements were derived from the HP assessment process.

2 Introduction

2.1 Purpose of the document

The purpose of this document is to describe the result of the activities conducted according to the Human Performance (HP) assessment process [2] in order to derive the HP assessment report for PJ.01-06 including requirements and recommendations.

2.2 Intended readership

The intended audience for this document are the other team members of the SESAR Solution PJ.01-06 under investigation.

HP practitioners at the level of the transversal areas and federating projects are also expected to have an interest in this document.

2.3 Scope of the document

The scope of the document is to present the result for Human Performance Assessment activities of the solution PJ.01-06.

2.4 Human performance work schedule within the Solution

The Human Performance Assessment for the PJ.01-06 was conducted according to the Validation Plan without any deviation.

2.5 Structure of the document

- §1 provides an executive summary
- §2 (this section) introduces the document
- §3 describes the objective and approach to the four stages of the SESAR Human Performance Assessment Process
- §4 describes the HP assessment by reminding the solution concept and deriving its HP implications
- §5 lists the documents referenced in this document
- Appendix A gives the additional HP activities conducted
- Appendix B gives the HP Recommendations Register
- Appendix C gives the HP Requirements Register
- Appendix D includes the HP log file

2.6 Acronyms and Terminology

Term	Description
Human Factors (HF)	HF is used to denote aspects that influence a human's capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, "Human Factors" can be considered as *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.
HP activity	An HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies.
HP argument	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.
HP assessment	An HP assessment is the documented result of applying the HP assessment process to the SESAR Solution-level. HP assessments provide the input for the HP case.
HP assessment process	The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. The development of this process constitutes the scope of Project 16.04.01. It covers the conduct of HP assessments on the Solution-level as well as the HP case building over larger clusters of Solutions.
HP benefit	An HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance.
HP case	An HP case is the documented result of combining HP assessments from Solutions into larger clusters (SESAR Projects, deployment packages) in SESAR.
HP issue	An HP issue relates to those aspects in the ATM concept that need to be resolved before the proposed change can deliver the intended positive effects on Human Performance.
HP impact	An HP impact relates to the effect of the proposed solution on the human operator. Impacts can be positive (i.e. leading to an increase in Human Performance) or negative (leading to a decrease in Human Performance).

HP recommendations	HP recommendations propose means for mitigating HP issues related to a specific operational or technical change. HF recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional analysis is performed, HF recommendations may be transformed into HF requirements.
HP requirements	HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable result of the HF contribution to the Solution, leading to a redefinition of the operational concept or the specification of the technical solution.

Table 1: Acronyms and terminology

3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in [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 that 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 Solution 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 updated and / or added to as the Solution progresses.

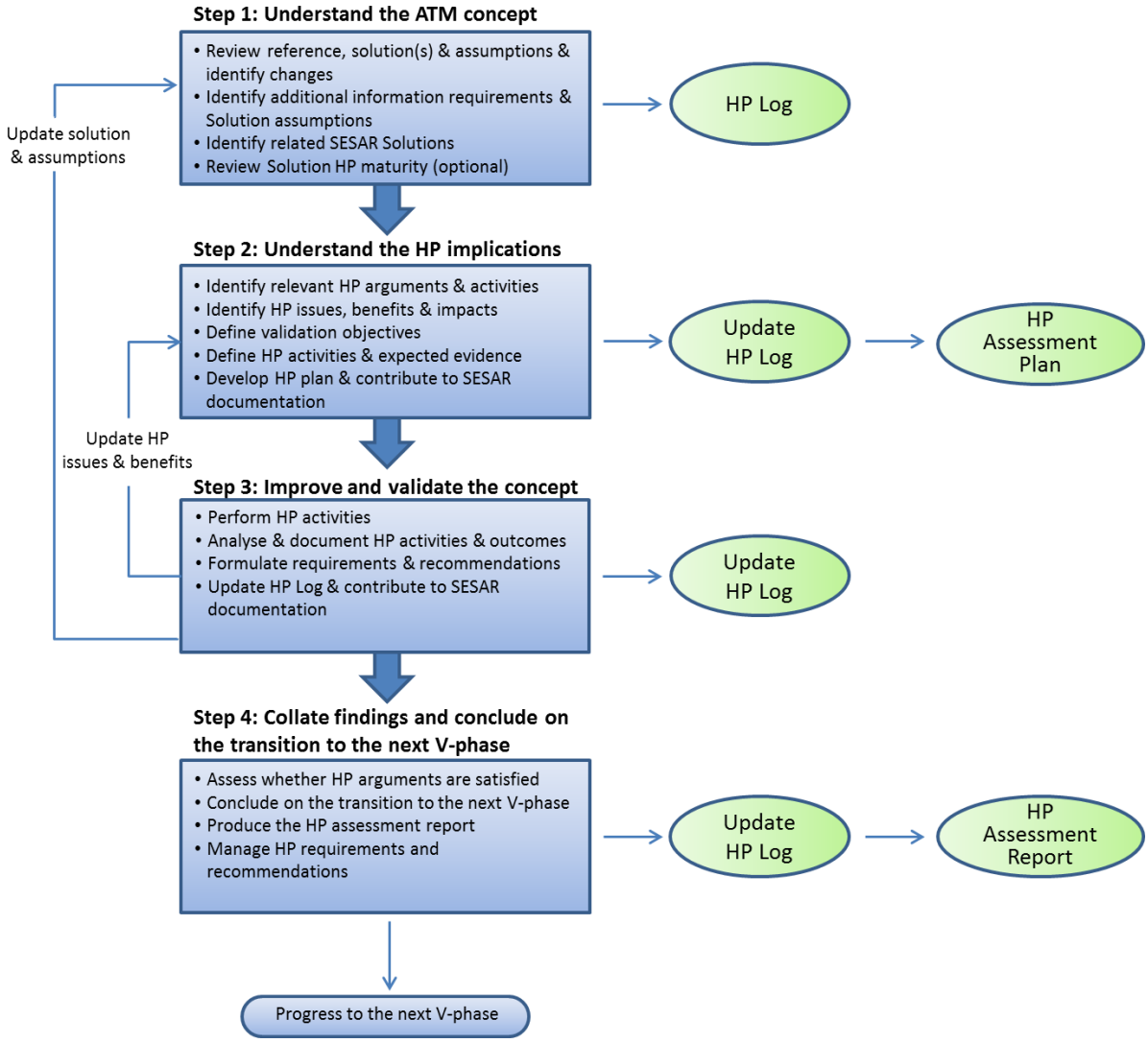

Figure 1: Steps of the HP assessment process

4 Human Performance Assessment

4.1 Step 1 Understand the ATM concept

4.1.1 Description of reference scenario

The reference scenario for project PJ01-06 is given in the SPR-INTEROP/OSED [6] section 3.3.1 and written again below:

Today, rotorcraft reach their best operational performances, when flying unconstrained in VFR flight rules, an operating mode really dependent upon weather conditions and visibility. During winter months this way to operate can be adversely affected, by foggy and cloudy weather conditions which can prevent rotorcraft to proceed VFR or make them subject to delays when operating to/from a controlled airspace (i.e: CTR) in a dense medium complexity ATM airspace

At present, there are many helicopters which are IFR certified and characterized by advanced avionic standards. Already today many helicopters are SBAS equipped and certified for RNP APCH operation down to LPV minima, which enables them to fly PinS LPV approaches. When these rotorcrafts are flying in IFR mode, due to the lack of rotorcraft specific procedures, they are used to fly the same instrument flight procedures designed for aircrafts.

Most of today procedures, being specifically designed for fixed-wing A/C, are constraining for rotorcraft implying important limitation on their operations as they have flight profiles which are not optimised for this category of operations. In particular rotorcraft categories have different needs and possibility in terms of descent rate and speed profile in order to optimise their performances.

Forcing them along the same SID/STAR (designed for fixed wing) can delay their operations to/from airports, and impact negatively the operations of commercial fixed-wing A/C, increasing also Air Traffic Controller workload.

In current operations arriving helicopters aiming for an instrument approach procedure are directed toward the instrument flight procedures available for runway (IFR landing location in an airport environment) often experiencing delay in order to avoid penalty to commercial IFR aircraft, since no tailored approach is available taking into account the different performances achievable by helicopters with respect to aircraft.

The current operating method offers the principle of the Point in Space (PinS) concept relying on the pilot's capability to perform an IFR approach toward a Point in Space and not directly to the FATO. Once the PinS has been reached, the pilot shall acquire visual references to proceed visually (or VFR) and land on the helipad (HP). If visual references cannot be acquired, a missed approach shall be executed. The main difference of PinS down to LNAV minima with direct CAT H criteria is the maximum glide path angle on the final IFR segment of the approach (from FAF to PinS), shall be up to 7.5° (13.2%) with a limitation of 90kt IAS on the initial and intermediate segment and 70 kt IAS on the final segment provided the course change at the FAF is less than or equal to 30°.With the new edition of PANS OPS from 2014, LPV final approaches for PinS procedures are allowed. To create the FAS datablock for PinS procedures, a fictitious heliport (FHP) is required. This FHP is located 800m from the PinS at the same height as the real heliport. All requirements for the FAS datablock are described in PANS OPS, 6th Edition of 2014, Volume 2, Section 2, Chapter 6

According PANS-OPS Pins LPV are currently allowed only when the intermediate segment is aligned with the final approach segment. Pins LPV can be designed with a glide path angle up to 6.3°

FAA AC20-138D defines the acceptable means to obtain airworthiness approval for RNP APCH down to LPV minima.

Availability of Low Level IFR routes and IFR access to helipads, thanks to Point-in-Space departure/approach procedures, should reduce VFR flights undertaken in marginal visibility conditions and make rotorcraft operations less dependent on the weather.

4.1.2 Description of solution scenario

The solution scenario for project PJ01-06 is given in the SPR-INTEROP/OSED [6] section 3.3.2 and written again below:

The rationale of the new operating Method is the coherent involvement in SESAR project of the need to properly consider all the possible air platform requirements in the development of the new ATM system allowing the correct integration of the rotorcraft element in the Single European Sky.

Tailored rotorcraft flightpath offers a vision of the benefits and challenges faced by European aviation community in meeting the future need of a sustainable mobility system. A future safe and efficient Air Traffic System (ATS) that respects the SESAR pillars of paramount importance in this field, allowing “smarter” flight operations than today: precise navigation and on-board systems not only will deliver benefits to commercial air transport, but also offer all-weather, 24/7 capacity to rotorcraft and aircraft capable of door-to-door operation with limited infrastructure. In this scenario, all types of rotorcraft are expected in the next future to perform simultaneous, non-interfering approach and departures to/from airports as part of international networks including VFR FATOs inside congested and densely populated areas but also secondary, remote infrastructure, complying with local noise regulations and operative constraints.

In the near future, satellite-based instrumental flight procedures will radically change the way Rotorcraft are operated, improving transportation inter-modality and both ATM and flight efficiency. The goal is a synchronised and predictable European ATM system, where partners and stakeholders are aware of the business and operational situations and collaborate to optimise the network. This first step initiates arrival time prioritisation together with wide use of data-link and the deployment of initial trajectory based operations, reflected in optimizing 2D/3D routes, moving then to 4D trajectory management.

The introduction of RNP will optimise route structures and automation. The Rotorcraft characteristic/needs and Airspace management needs can be matched by developing PBN based advanced PinS procedures and applying SNI concept at busy airports.

In this scenario the concept is addressing a new OI taking into consideration the existing rotorcraft needs in order to fulfil the SESAR gap into rotorcraft operations.

The incorporation of rotorcraft optimised 2D/3D routes (i.e: low level IFR routes) operations in a medium dense airspace reflected the necessity to insert a dedicated operational Improvement for the rotorcraft approaches procedures:

- Enhanced Rotorcraft Operations at VFR FATOs with specific Point-in-Space RNP procedures using satellite augmentation.

This rotorcraft operational improvement will facilitate the ability of the SESAR project to meet its stated aims like:

- To increase safety operational level
- To improve efficiency
- To reduce costs (due to more direct routing)
- To increase Airport/Heliport and Airspace capacity
- To improve access to Airport / Heliport
- To reduce the environmental impact of noise and pollution (i.e: reduce fuel burn, reducing flight and holding time)

A-RNP (also included in the new edition of PANS OPS from 2014) gives provisions for including RF legs in the initial and intermediate segments of an approach procedure. They are currently not specified for PinS-procedures specially tailored for helicopter operations. Their main advantage is a smoother transition onto the final segment where a turn at the FAF is needed which can be handy for obstacle avoidance and that they provide a non-varying segment length which facilitates continuous descent (thus smoother) approaches. They are defined by a radius to be flown and start and end points, thus unambiguously defining a turn, compared to a fly-by-turn at a single given waypoint.

4.1.3 Consolidated list of assumptions

The following assumptions relating to the Advanced PinS procedure solution for helicopters are listed below:

- SBAS service is mandatory to fly the Advanced PinS procedure
- Advanced PinS procedures have no impact on existing ATM procedures

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

The solution worked out in the PJ01-06 is an on board technical solution without impact on existing ATM procedures. So at this step of the project, no relation with other SESAR solutions has been considered in the HP assessment. The dependency with PJ.02-06 doesn't generate additional interactions concerning the HP assessment.

4.1.5 Identification of the nature of the change

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	

1.1 ROLES & RESPONSIBILITIES	No change
1.2 OPERATING METHODS	The new procedures allows the helicopter pilot to capture the localizer later, to capture localizer and glide slope at the same location and to have shorter approach and departure segment possible.
1.3 TASKS	No change
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	No change
2.2 PERFORMANCE OF TECHNICAL SYSTEM	No change
2.3 HUMAN – MACHINE INTERFACE	For manual flight of advanced PinS procedure, the use of an helmet mounted device is envisaged. Otherwise, the procedure should be flown with an automatic piloting system.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change
3.2 ALLOCATION OF TASKS	No change
3.3 COMMUNICATION	No change
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	No change
4.2 COMPETENCE REQUIREMENTS	No change
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	No change

Table 2: Description of the change

4.2 Step 2 Understand the HP implications

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

The HP activities were conducted according to the plan (see Table 3: HP Arguments, related HP issues and benefits, and proposed HP activity in the HP validation plan).

4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

HP activity	By when
Simulator flight trials	July 2018
Real flight trials	December 2018
Real flight trials	November 2018 and February 2019

Table 3: Table of proposed HP activities and their priority

ACTIVITY 1.	SIMULATOR FLIGHT TRIALS
Description	Simulator flight trials of two different specifically designed PinS procedures with curved segments
Arguments & issues to be addressed	Arg. 1.2.5 / A1.2.5-01.06-V3-HP(I)-001 Arg. 1.2.5 / A1.2.5-01.06-V3-HP(I)-003 Arg. 2.3.1 / A2.2.1-01.06-V3-HP(B)-004 Arg. 2.3.6 / A2.3.6-01.06-V3-HP(I)-006 Arg. 2.3.8 / A2.3.8-01.06-V3-HP(B)-007
HP objectives	HP-OBJ-01.06-V3-VALP004-HP(I)-003 HP-OBJ-01.06-V3-VALP002-HP(B)-004 HP-OBJ-01.06-V3-VALP005-HP(I)-006 HP-OBJ-01.06-V3-VALP006-HP(B)-007
Tools / Methods selected out of the hp repository	Situation Awareness Rating Technique (SART 10) NASA TLX questionnaire Debriefing questionnaire
Summary of the hp activity	The RTS ought to provide evidence of operability and feasibility of the advanced PinS processes and procedures by mainly collecting feedback of the flight crews in comparison with the flight technical error recorded. The results have to reflect the impact on the KPAs as well as show a feasible way

	for implementing the solution.

Table 4: Description of Activity 1- Simulator flight trials

ACTIVITY 2.	Real flight trials
Description	Real flight trials of a specifically designed PinS procedures with curved segments in EDVE
Arguments & issues to be addressed	Arg. 1.2.5 / A1.2.5-01.06-V3-HP(I)-001 Arg. 1.2.5 / A1.2.5-01.06-V3-HP(I)-003 Arg. 2.3.1 / A2.2.1-01.06-V3-HP(B)-004 Arg. 2.3.6 / A2.3.6-01.06-V3-HP(I)-006 Arg. 2.3.8 / A2.3.8-01.06-V3-HP(B)-007
HP objectives	HP-OBJ-01.06-V3-VALP001-HP(I)-001 HP-OBJ-01.06-V3-VALP004-HP(I)-003 HP-OBJ-01.06-V3-VALP002-HP(B)-004 HP-OBJ-01.06-V3-VALP005-HP(I)-006 HP-OBJ-01.06-V3-VALP006-HP(B)-007
Tools / Methods selected out of the hp repository	Situation Awareness Rating Technique (SART 10) NASA TLX questionnaire Debriefing questionnaire
Summary of the hp activity	The Operational Trial ought to provide evidence of operability and feasibility of the advanced PinS processes and procedures by mainly collecting feedback of the flight crews in comparison with the flight technical error recorded. The results have to reflect the impact on the KPAs as well as show a feasible way for implementing the solution.

Table 5: Description of Activity 2- Real flight trials

ACTIVITY 3.	Real flight trials

Description	Real flight trials of a specifically designed PinS procedures with curved segments in Donauwörth
Arguments & issues to be addressed	Arg. 1.2.5 / A1.2.5-01.06-V3-HP(I)-002 Arg. 2.3.1 / A2.3.1-01.06-V3-HP(I)005
HP objectives	HP-OBJ-01.06-V3-VALP001-HP(I)-002 HP-OBJ-01.06-V3-VALP003-HP(I)-005
Tools / Methods selected out of the hp repository	Situation Awareness Rating Technique (SART 10) NASA TLX questionnaire Debriefing questionnaire
Summary of the hp activity	The validation objectives include an assessment of operability, feasibility and pilot's perspective of advanced PinS procedures to VFR FATOs. The success criteria include flight technical error, pilot workload and situation awareness for the approach procedure.

Table 6: Description of Activity 3- Real flight trials

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

4.4.1 Summary of HP activities results & recommendations / requirements

Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	activity conducted	results / evidence	recommendations	requirements
Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner.							
A1.2.5-01.06-V3-HP(I)-001	An RF leg ending at the start of LPV combines the interception of localizer and glideslope at the same location. Departure and approach segment can be designed much shorter. For pilots this could introduce a higher workload and	Closed	HP-OBJ-01.06-V3-VALP001-HP(I)-001	Real Time Simulation, Operational Trial	Both Real Time Simulation and flight Operational trial have shown that the HMD advanced symbology allows the pilot to manually fly an advanced PinS procedure without introducing a higher workload neither a time pressure. See validation report PJ.01-06 D5.1.030.	It is recommended to implement an HWD guidance symbology to manually fly advanced PinS procedure with RF legs.	A guidance symbology shall be displayed on the HMD if any to allow manual flight of an advanced PinS procedure.

	time pressure, especially in manual flight						
A1.2.5-01.06-V3-HP(I)-002	An RF leg ending at the start of LPV combines the interception of localizer and glideslope at the same location. Departure and approach segment can be designed much shorter. For pilots this could introduce a higher workload and time pressure in automated flight	Closed	HP-OBJ-01.06-V3-VALP001-HP(I)-002	Operational Trial	Flight Operational trial at Donauwoerth has shown that the automatic pilot allows to fly an advanced PinS procedure without introducing a higher workload neither a time pressure. See validation report PJ.01-06 D5.1.030.	Eyes-out pilot assistance functions, together with autopilot coupling, during standard/advanced PinS procedures in uncontrolled airspaces should be explored in greater depth. It is recommended to investigate the flyability and human factors of approaches beyond PANS-OPS criteria with RF legs after the FAF and larger turns ending at FAF falling under RNPAR.	

A1.2.5-01.06-V3-HP(I)-003	Advanced PinS procedures introduce RF legs with a low position error margin, vertically as well as laterally. For pilots, this could introduce an high workload in manual flight.	Closed	HP-OBJ-01.06-V3-VALP004-HP(I)-003	Real Time Simulation, Operational Trial	Both Real Time Simulation and flight Operational trial have shown that the HMD advanced symbology allows the pilot to manually fly an advanced PinS procedure without introducing a higher workload. See validation report PJ.01-06 D5.1.030.	It is recommended to implement an HWD guidance symbology to manually fly advanced PinS procedure with RF legs.	A guidance symbology shall be displayed on the HMD if any to allow manual flight of an advanced PinS procedure.
Arg. 2.3.1: The type of information provided satisfies the information requirements of the human.							
A2.2.1-01.06-V3-HP(I)005	In manual flight with high precision needs pilot ought to plan thier actions accuratly. Advanced display	Closed	HP-OBJ-01.06-V3-VALP002-HP(B)-004	Real Time Simulation, Operational Trial	Both Real Time Simulation and flight Operational trial have shown that the HMD advanced symbology allows the pilot to manually fly an advanced PinS procedure under	It is recommended to implement an HWD guidance symbology to manually fly advanced PinS procedure with RF legs. Integration of other air traffic display on the	A guidance symbology shall be displayed on the HMD if any to allow manual flight of an advanced PinS procedure. Surounding air traffic shall be displayed on the HMD if any for pilot situation

	formats can assist this process and therefore serve as enable for manual flight.				multiple weather conditions. 2 different designs have been tested, an advanced flight director concept allowing an anticipation of the next change in the flight trajectory, and a conformal 3D display of the route to fly. A slight advantage has been shown in favour of the advanced flight director concept regarding the trajectory flight precision and the workload level. See validation report PJ.01-06 D5.1.030.	HMD is a strong recommendation for pilot situation awareness.	awareness.
A2.2.1-01.06-V3-HP(I)005	In automated flight with high precision needs, pilot ought to	Closed	HP-OBJ-01.06-V3-VALP003-HP(I)-005	Operational Trial	Flight Operational trial at Donauwoerth has shown that the automatic pilot allows to fly an advanced PinS	Eyes-out pilot assistance functions, together with autopilot coupling, during standard/advanced PinS	

	anticipate the systems actions ahead of time. The complexity of an advanced PinS procedure can interfere with the pilots ability to anticipate system reactions and impact situational awareness.				procedure without interfering with the pilots ability to anticipate system reactions and without impact situational awareness.. See validation report PJ.01-06 D5.1.030.	procedures in uncontrolled airspaces should be explored in greater depth. It is recommended to investigate the flyability and human factors of approaches beyond PANS-OPS criteria with RF legs after the FAF and larger turns ending at FAF falling under RNPAR.	
Arg. 2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable. [V1: AIR only]							
A2.3.6-01.06-V3-HP(I)-006	The Helmet Mounted Display might bring discomfort for the pilot after several	Closed	HP-OBJ-01.06-V3-VALP005-HP(I)-006	Real Time Simulation, Operational Trial	Questionnaire's results of the flight trial have shown that neither visual nor wearing discomfort was induced by the HMD. See validation report PJ.01-		

	minutes of use.				06 D5.1.030.		
Arg. 2.3.8: The user interface supports a sufficient level of individual situation awareness. [V1: AIR only]							
A2.3.8-01.06-V3-HP(B)-007	Piloting guidance using an HMD enhances the pilot's situational awareness particularly regarding aircraft position relatively to the vertical and horizontal offsets to the required trajectory.	Closed	HP-OBJ-01.06-V3-VALP006-HP(B)-007	Real Time Simulation, Operational Trial	SART results of the Real Time Simulation exercise show a huge improvement of the pilots' situation awareness with both HMD symbology compare with the head down CDI solution. See validation report PJ.01-06 D5.1.030.	It is recommended to implement an HWD guidance symbology to manually fly advanced PinS procedure with RF legs.	A guidance symbology shall be displayed on the HMD if any to allow manual flight of an advanced PinS procedure.

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

4.4.2 Maturity of the Solution

Maturity checklist for finalising the V3 assessment			
ID	**Question**	**Answer**	**Comments**
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	Yes	HP assessment report completed. All relevant arguments have been adressed. See HP assessment report §4.4.1.
2	Are the benefits and issues in terms of human performance and operability related to the proposed solution sufficiently assessed (i.e. on the level required for V3)?	Yes	2 different flight trial exercises have been successfully conducted in order to assess a V3 maturity level. HP assessment report §4.4.1. lists the arguments addressed and associated evidence, identified HP benefits and issues as well as outcomes of the validation exercises.
3	Have all the parts of the solution/concept been considered?	Yes	See HP assessment report §4.1.1, §4.1.2, §4.1.3 and §4.4.1 for: - Description of the solution/concept and related assumption - List of assumption that have a link with the HP issue/benefits - List of issues/benefits and associated validation objectives
4	Have potential interactions with related projects/concepts been considered and addressed?	Yes	The dependency with PJ.02-05 doesn't generate additional interactions concerning the HP assessment.
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	Both flight trials demonstrated that the level of hp needed is consistent with human capabilities. See validation report for detailed results.
6	Are the assessments results in line with what is targeted for that concept? If not, has the impact on the overall strategic performance objectives/targets been analysed?	Yes	Assessments results allowed to close all hp issues identified. See HP table "Issue-Objective-Outcome" tab.
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes	2 flight trials exercises were conducted, including some flights with degraded conditions. See validation report annexes for details.

8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	The 2 flight trials have confirmed this point. See validation report annexes for details.
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	HP table consistent with last version of OSED and SPR.
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	HP assessment activities outcomes allowed to close all identified HP issues. See HP table "Issue-Objective-Outcome" tab.
11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	The HMI design satisfies the HP recommendations and requirements.
12	Have the major factors that can influence the transition feasibility (e.g. changes in competence requirements, recruitment and selection, training needs, staffing requirements, and relocation of the workforce) been addressed? Are there any ideas on how to overcome any issues?	Yes	No transition feasibility issues identified.
13	Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine.	No	See HP table "Change&Argument Identification" tab.
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes	Recommendations for next phase have been written in VALR §5.2.

Table 8: Maturity checklist for finalising the V3 assessment

The solution's transition to the next V phase from an HP point of view is recommended.

5 References

Human Performance

[1] 16.06 Strawman Paper on Case Building in SESAR SWP 16.6

[2] 16.04.01 Evolution from the ATM HF case to a HP Case Methodology for SESAR, HP assessment process for projects in V1, V2 or V3. D10-001, 00.01.00

[3] 06.09.03 D05.1 Single Remote Tower Validation Plan – Appendix Human Performance Assessment Plan

[4] 16.06.05 D 27 HP Reference Material D27

[5] 16.04.02 D04 e-HP Repository - Release note

[6] D5.1.010 SESAR Solution PJ.01-06 SPR-INTEROP/OSED for V3 - Part I

Appendix A – Additional HP activities conducted

No additional HP activities have been conducted.

Appendix B – HP Recommendations Register

HP Recommendations Register									
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
Adv-PinS_Design-Recom_1	System design	It is recommended to implement an HWD guidance symbology to manually fly advanced PinS procedure with RF legs.	Classical Head Down solution displaying vertical and horizontal deviations did not allow to fly manually an advanced PinS procedure with RF legs within the RNP 0.3 limit while both HWD proposed guidance symbologies did.	Validation report PJ.01-06 D5.1.030	Airborne	Advanced Point in Space (A-PinS) procedures	Accepted		

Adv-PinS_Design-Recom_2	System design	Integration of other air traffic display on the HMD is a strong recommendation for pilot situation awareness.	Executing PinS approaches in uncontrolled airspace, where ATC may have very limited or no coverage, requires the flight crew to be vigilant and responsible for adequate separation to other VFR traffic encountered in VMC.	Validation report PJ.01-06 D5.1.030	Airborne	Advanced Point in Space (A-PinS) procedures	Accepted		
Adv-PinS_Design-Recom_3	System design	Eyes-out pilot assistance functions, together with autopilot coupling, during standard/advanced PinS procedures in uncontrolled airspaces should be explored in greater depth.	Many helicopters, and almost all EMS helicopters, operate in uncontrolled airspaces. During PinS procedures in VMC and even VMC-IMC borderline conditions, it is common to encounter other VFR traffic during precision approaches. With no ATC coverage in uncontrolled airspaces, maintaining adequate separations becomes the	Validation report PJ.01-06 D5.1.030	Airborne	Advanced Point in Space (A-PinS) procedures	Accepted		

			responsibility of the pilot, which leads to higher workload.						
Adv-PinS_OPS-Recom_4	OPS (operating methods / procedures)	It is recommended to investigate the flyability and human factors of approaches beyond PANS-OPS criteria with RF legs after the FAF and larger turns ending at FAF falling under RNPAR.	In mountainous terrain or small airspaces in the vicinity of busy airports, it may not always be possible to define PinS satisfying the PANS-OPS criteria. It may be necessary to reduce the lateral and vertical obstacle clearance zones and to allow greater flexibility in the approach procedures, such as large course changes ending at FAF, turns after the FAF, in order to avoid terrain or the glidepath of fixed wing traffic.	Validation report PJ.01-06 D5.1.030	Airborne	Advanced Point in Space (A-PinS) procedures	Accepted		

Table 9: HP recommendations

Appendix C – HP Requirements Register

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
Adv-PinS_Design-Req_1	System design	A guidance symbology shall be displayed on the HMD if any to allow manual flight of an advanced PinS procedure.	Executing PinS procedures with RF legs requires a flight precision that usual deviations display doesn't allow. An HMD solution allows to provide an efficient guidance while maintaining external	Validation report PJ.01-06 D5.1.030	Airborne	Advanced Point in Space (A-PinS) procedures	Accepted		

			surveillance.						
Adv-PinS_Design-Req_2	System design	Surounding air traffic shall be displayed on the HMD if any for pilot situation awareness.	Executing PinS approaches in uncontrolled airspace, where ATC may have very limited or no coverage, requires the flight crew to be vigilant and responsible for adequate separation to other VFR traffic encountered in VMC.	Validation report PJ.01-06 D5.1.030	Airborne	Advanced Point in Space (A-PinS) procedures	Accepted		

Table 10: HP Requirements

Appendix D – HP Log

HP Assessment Process for V1 to V3_

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