SESAR VLD1-W2 DREAMS Demo Report - Part III HPAR

DeliverableID	D1.4
Dissemination Level:	PU
ProjectAcronym	DREAMS
Grant:	874469
Call:	H2020-SESAR-2019-1
Topic:	SESAR-IR-VLD-WAVE2-14-2019 VLD.01 W2 GBAS/SBAS precision approaches including variable approach path
Consortium coordinator:	INDRA
Edition date:	09 December 2022
Edition:	00.01.02
Template Edition	02.00.05

Authoring & Approval

Authors of the document

Beneficiary	Date
DEEPBLUE on behalf of ENAV (ENAV LTP)	09/12/2022

Reviewers internal to the project

Beneficiary	Date
AIRBUS	04/10/2022
HONEYWEL	30/07/2022
DASSAULT	30/07/2022

Reviewers external to the project

Beneficiary	Date

Approved for submission to the S3JU By - Representatives of all beneficiaries involved in the project

Beneficiary	Date
AIRBUS	04/11/2022
DASSAULT	04/11/2022
DFS	04/11/2022
DLR	04/11/2022
ENAV	04/11/2022
EUROCONTROL	04/11/2022
HONEYWELL	04/11/2022
INDRA	04/11/2022
NLR	04/11/2022

Rejected By - Representatives of beneficiaries involved in the project

Beneficiary	Date

Document History

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Edition	Date	Status	Beneficiary	Justification
00.00.01	06/05/2022	Draft	DBL (ENAV LTP)	Initial Draft
00.00.02	14/06/2022	Draft	DBL (ENAV LTP)	Intermediate version internal review comments' integration
00.00.03	12/05/2022	Draft	DBL (ENAV LTP)	Updates and edits regarding section 4
00.00.04	14/06/2022	Draft	DBL (ENAV LTP)	Intermediate version internal review comments' integration
00.00.05	19/07/2022	Draft	DBL (ENAV LTP)	Integration of EXE3 and 4 results
00.00.06	02/08/2022	Draft	DBL (ENAV LTP)	Integration of SJU Comments
00.00.07	19/10/222	Draft	DBL (ENAV LTP)	Integration of SJU Comments & EXE2 results
00.01.00	02/11/2022	Final	DBL (ENAV LTP)	Final Version for formal approval
00.01.01	07/11/2022	Final	DBL (ENAV LTP)	Final Version approved for the submission to SJU
00.01.02	09/12/2022	Final	DBL (ENAV LTP)	Final Version integrating SJU's comments

Copyright Statement

DREAMS

VLD1 WAVE 2 DEMONSTRATION OF RUNWAY ENHANCED APPROACHES MADE WITH SATELLITE

This VLD DEMOR HPAR is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874469 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document contains the Human Performance (HP) assessment report for the DEMO 01 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.t

Table of Contents

List of Tables

EUROPEAN PARTNERSHIP
Co-funded by the European Union

List of Figures

EUROPEAN PARTNERSHIP

Co-funded by the European Union

THESE INSTRCUTIONS MUST BE REMOVED BEFORE THE SUBMISSION OF THE DELIVERABLE

EUROPEAN PARTNERSHIP

Co-funded by the European Union

1 Executive Summary

The HP Assessment report collects all HP results for the operational and technical development of the SESAR solutions on enhanced approach procedures supported by GBAS/SBAS addressed in the VLD1-W2 DREAMS and based on the SESAR HP Assessment Process methodology:

- PJ02-W2.14.2: Second Runway Aiming Point (SRAP) solution
- PJ02-W2.14.3: Increased Second Glide Slope (ISGS) solution
- PJ02-W2.14.5: Increased Glide Slope to a Second Runway Aiming Point (IGS-to-SRAP) solution

The HP Assessment report is built on the structure of the HP Arguments which are “HP claims that need to be proven”, according to the HP Reference Material. In a first step – the scoping and change assessment- the arguments that are relevant for the concept were identified. Following arguments were identified as being relevant for the concept:

Argument 1: The role of the human is considered consistent with human capabilities and limitations;

Argument 2: Technical systems support the human actors in performing their tasks;

Argument 3: Team structures and team communication support the human actors in performing their tasks;

Argument 4: Human Performance related transition factors are considered.

HP issues, HP objectives and HP activities meant to assess the feasibility of the concepts were identified and assessed in the performed demonstration activities

The VLD1 activities consisted in flight live trials at several European aerodrome platforms: Twente (EHTW), Frankfurt (EDDF) and Roma Ciampino (LIRA).

EUROPEAN PARTNERSHIP

Co-funded by the European Union

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 SESAR Human Performance (HP) assessment process in order to derive the HP assessment report for VLD01 DREAMS including requirements and recommendations]

2.2 Intended readership

The intended audience for this document are primarily all the partners involved in SESAR 2020 VLD1-W2 DREAMS.

Stakeholders are to be found among:

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

EUROPEAN PARTNERSHIP

Co-funded by the European Union

2.3 Structure of the document

The Document contains 5 Chapters.

- Chapter 1- contains an executive summary which gives information about the purpose, scope, and methods used, including a reference to results, conclusions, and recommendations.
- Chapter 2- describes the purpose, the intended readership and details the structure of the document. It entails a list of acronyms and terminology.
- Chapter 3- detailed the HP objectives and approach
- Chapter 4- in line with the HP reference material, it describes the 4steps out of the HP Assessment Process.
    - Step 1 Understand the ATM Concept
    - Step 2 Understand the HP Implications
    - Step 3 Improve and Validate the concept
    - Step 4 Collate Findings & Conclude on transition to next V-Phase
- Chapter 5- References

Appendix A to D have not been developed since all the HP results, HP issues, Requirements and Reccomendations have been reported in section 4. Furthermore, no HP-Log was developed in HPAP.

2.4 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.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

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

EUROPEAN PARTNERSHIP

Co-funded by the European Union

3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in the Human Performance Guidance document (see the latest version in Program Library) is to ensure that HP aspects related to SESAR Solution technical and operational developments are systematically identified and managed. The SESAR HP assessment process uses an 'argument' and 'evidence' approach. An HP argument is an 'HP claim that needs to be proven'. The aim of the HP assessment is to provide the necessary 'evidence' to show that the HP arguments impacted have been considered and satisfied by the HP assessment process. This includes the identification of HP requirements and recommendations to support the design and development of the concept.

The HP assessment process is a four-step process and the following figure 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).

EUROPEAN PARTNERSHIP

Co-funded by the European Union

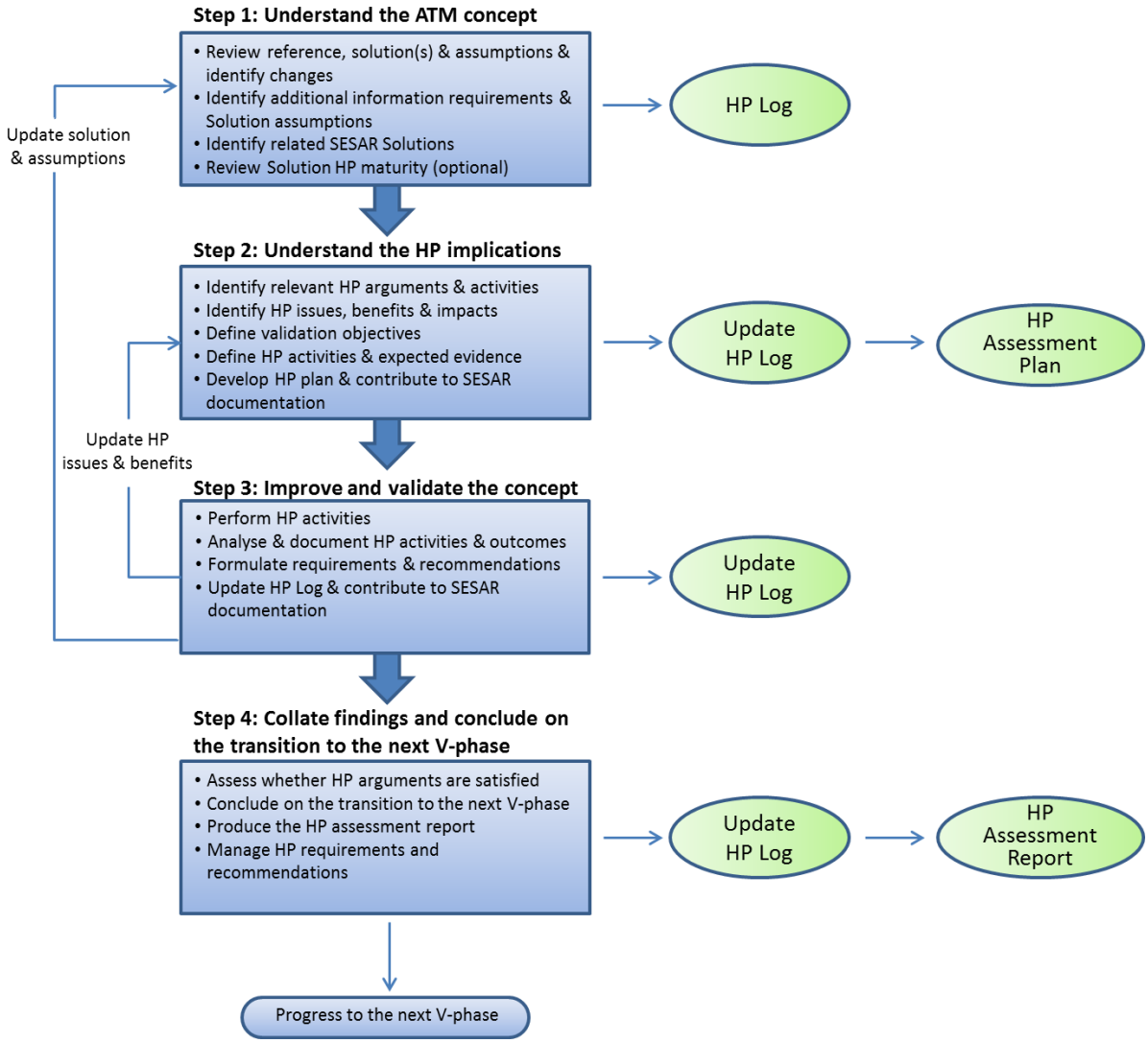

Figure 1: Steps of the HP assessment process

4 Human Performance Assessment

4.1 Step 1 Understand the ATM concept

4.1.1 Description of reference scenario

The **reference scenario** is represented by the current final approach operations conducted with a nominal (3°) and continuous glide path angle, with a conventional threshold, based on the various available navigation technologies for precision approach: Instrument Landing System (ILS), GBAS CAT I, Area Navigation (RNP) with vertical guidance (e.g. Satellite-Based Augmentation System -SBAS).

4.1.2 Description of solution scenario

4.1.2.1.1 Solutions descriptions

PJ02-W2.14.2 (AO-0319)	Enhanced Arrival Procedures using a Second Runway Aiming Point (SRAP)	Full
Enhanced arrival procedures using a Second Runway Aiming Point (SRAP) will allow inbound aircraft reducing noise footprint impact in the surrounding areas of the airport and possibly runway occupancy time and/or taxi-in time, while also allowing potential increased runway capacity (via optimized wake separations). The SRAP concept is a published approach procedure, enabling aircraft to land on a second further runway aiming point (with associated runway ground markers, lights and visual aids). The SRAP procedure is designed with a glide slope parallel to the nominal one operated for the first aiming point. Choosing a SRAP approach (over the conventional one) could be the result of the best compromise between available runway length, preferential runway exit use, noise, wake turbulence separation constraints, and the runway occupancy time.		

PJ02-W2.14.5 (AO – 0331)	Enhanced Arrival procedures using an Increased Glide Slope to a Second Runway Aiming Point (IGS-to-SRAP)	Full
This enhanced arrival procedure, applying an Increased Glide Slope (above the approach angle in use to the considered runway threshold and up to 4.49°) to an Aiming Point further down the runway threshold (as specified in the published chart), will enable inbound aircraft to reduce noise footprint (environmental benefit). Additionally a possible reduction of runway occupancy time and/or taxi-in		

EUROPEAN PARTNERSHIP

Co-funded by the European Union

time depending on local runway/taxiway layout is expected. Unlike the Increased Glide Slope concept (which applies to the runway physical threshold), increasing the glide slope on an additional (second) runway aiming point should prevent a potential reduction of airport capacity and potentially increasing it through optimization in wake turbulence separations.

Compared to benefits gained from the Second Runway Aiming Point concept (using the same glide path angle for both glide slopes), increasing the glide slope on the additional (second) runway aiming point allows a potential increase of airport capacity through optimization in wake turbulence separations with a limited / shorter displacement of the additional runway aiming point.

4.1.2.1.2 Reference Scenario(s)

Please refer to the DEMOP Part I, Chapter 5.1 on SRAP and IGS-to-SRAP demonstration at Twente

4.1.2.1.3 Solution Scenario(s)

Please refer to the DEMOP Part I, Chapter 5.1 on SRAP and IGS-to-SRAP demonstration at Twente

4.1.2.1.4 Limitations to the solution scenario

Please refer to the DEMOP Part I, Chapter 5.1 on SRAP and IGS-to-SRAP demonstration at Twente

4.1.2.2 ISGS Demonstrations at Rome Ciampino Airport (LIRA)

4.1.2.2.1 Solutions description

PJ02-W2.14.3 (AO-0320)	Enhanced Arrival Procedures using Increased Glide Slope (IGS)	Full
Enhanced arrival procedures using Increased Second Glide Slope (ISGS) will allow inbound aircraft to reduce noise footprint (environmental benefit). ISGS procedures are published approaches which feature a glide slope between the published one (commonly 3 degrees) and 4.49 degrees (limit above which steep approach concept applies), in order to provide a significant reduction in ground noise level (order of magnitude: -3 dBA in approach between 15 NM and 4 NM from runway threshold).		

4.1.2.2.2 Reference Scenario(s)

Please refer to the DEMOP Part I, Chapter 5.3 on ISGS Demonstration at Ciampino.

4.1.2.2.3 Solution Scenario(s)

Please refer to the DEMOP Part I, Chapter 5.3 on ISGS Demonstration at Ciampino.

4.1.2.2.4 Limitations to the solution scenario

Please refer to the DEMOP Part I, Chapter 5.3 on ISGS Demonstration at Ciampino.

4.1.2.3 ISGS Demonstrations at Frankfurt Airport (EDDF)

4.1.2.3.1 Solutions description

Please refer to the section 4.1.2.2.1.

4.1.2.3.2 Reference Scenario(s)

Please refer to the DEMOP Part I, Chapter 5.3 on ISGS Demonstration at Frankfurt

4.1.2.3.3 Solution Scenario(s)

Please refer to the DEMOP Part I, Chapter 5.3 on ISGS Demonstration at Frankfurt

4.1.2.3.4 Limitations to the solution scenario

Please refer to the DEMOP Part I, Chapter 5.3 on ISGS Demonstration at Frankfurt

4.1.3 Consolidated list of assumptions

Please refer to the DEMOP Part I, sections 5.1.5, 5.2.5 and 5.3.5.

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

The following solutions are considered for the HP Assessment :

- PJ.02-W2.14.2: Second Runway Aiming Point (SRAP) solution
- PJ.02-W2.14.3: Increased Second Glide Slope (ISGS) solution
- PJ.02-W2.14.5: Increased Glide Slope to a Second Runway Aiming Point (IGS-to-SRAP) solution

4.1.5 Identification of the nature of the change

The following table collects the changes on Human Performance Arguments areas (Roles and Responsibilities, Human and Systems, Teams & Communication, HP Related Transition Factors) introduced by SRAP and ISGS approach procedures under evaluation, as identified during the solution developed under PJ02 project.

Note: An iteration is foreseen for further consolidation with the contribution of the HP experts involved in the demonstrations

4.1.5.1 PJ.02-W2.14.2 SRAP

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	For both air & ground there are no role changes foreseen in the project. What could occur is a different task sharing between existing roles, with the same responsibilities
1.2 OPERATING METHODS	Operators and pilots intending to conduct any approach operations should fill the appropriate flight plan suffixes and the on board navigation data must be current and include the appropriate procedures, including the new SRAP (that must be selectable from a valid navigation database (NavDB) and not prohibited by a company instruction or Notice to Airmen (NOTAM)). Aircraft capability to fly the approach corresponding to the second runway aiming points shall be indicated in the flight plan so that the capability can be considered in the Demand Capacity Balancing (DCB) process. Note the SRAP procedure emphasizes the specificities regarding the landing distance. On a destination airport with multiple runways and/or multiple runway aiming points, the landing distance computation at dispatch may be performed on the longest landing runway with no wind. If the runway condition changes at landing (wind, dry/wet, contaminated etc.), the flight crew must perform a new landing distance computation. With SRAP, once informed by ATC of the intended approach procedure which defines the requested landing runway and runway aiming point, the flight crew may perform an in-flight landing performance assessment if the landing conditions changed compared with the landing computation at dispatch, or if they have not prepared the intended approach procedure at dispatch. For SRAP, the crew has to respect the Standard Operational Procedure defined for the corresponding SRAP flown if any (described in the Flight Crew Operating Manual FCOM). That concerns particularly the aircraft configurations deployment in order to be stabilized in speed and thrust level no later than

	1000ft. The crew must also comply with the ATC speed constraints if any. ATCO manages the landing sequence of the a/c flying a mix of different standard approach procedures and SRAP. ATC tools are enhanced to support ATCOs. TMA/APP ATCO through ATIS informs a/c about the SRAP in use; instructs a/c to fly STAR or they receive clearances by ATC to follow radar-vectoring instructions. In SRAP the descent profile should contain at least one fix, where pilots compare the actual crossing altitude with the required crossing altitude. With SRAP aircraft may commence its final descent when aircraft passes the new descent point (FAP).
1.3 TASKS	Before capturing the final approach segment, the flight crew must verify the correctness of the Enhanced Arrival data from the Navigation Database, crosschecking them with the approach chart. Moreover, the crew must verify that there is there is not any failure (e.g. faulty slats/flaps…) affecting the aircraft performance and especially impairing the aircraft deceleration capability. On most modern avionics, following ATC clearance to fly final approach, the crew arms the approach guidance modes on the Automatic Flight System Control Panel (AFS CP) and then the aircraft captures and flies the final approach path down to the runway. In addition to the standard info, the ATCO provides the a/c with the leading a/c precision approach segment; At TOD ATCO requests to fly SRAP. If refused by a/c – the standard ILS precision segment is instructed; In SRAP increased monitoring of the weather conditions and the GBAS (or other EAP enablers) equipment status are necessary. Ground controller needs to know where a SRAP flight is most likely to leave the runway in order to plan an optimised ground flow and avoid unforeseen conflicts on the taxiways (Check if there is a difference between the standard procedure and SRAP).

EUROPEAN PARTNERSHIP

Co-funded by the European Union

	The responsible ATCO can change the request before 15 NM to the airport.
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	The approach can be flown with various levels of automation: with Autopilot/flight director (AP/FD), with FD only and without AP/FD (using only the raw data). For the ATCO changes are foreseen in relation to the separation tool that is providing the ATCO with an indicator of the desired separation taking the approach and the wake category of the aircraft into account. The tool is available on the approach and tower positions. The target distance indicators will be displayed in order to help the ATCOs determine and achieve the required a/c spacing /separation. The ATC separation delivery support tool (like used for TBS-ORD) will provide the minimum distance to be maintained down to threshold (the final target distance indicator). In addition, the HMI will also present the compression effect to help ATCOs deliver the required minimum separation at threshold (the initial target distance indication). This means that the system, and not the ATCO, is now calculating the required spacing between different a/c pairs. The tool proposes not only the separation but also the optimal sequence, while the separation cannot be overwritten by the ATCO, the sequence can.
2.2 PERFORMANCE OF TECHNICAL SYSTEM	A/c trajectory, performance and status are shared between a/c and ground via the conformance monitoring tool; glide path monitor. On-board system may need to be improved in order to ensure safe approach and landing operations in automatic and manual mode. On the visual segment below the minima, additional flight deck aids may be provided to the pilot to achieve correctly the manual flare manoeuvre. However, tailwind conditions may have a negative impact on aircraft deceleration capabilities (impact is under study).

	Therefore, before performing a SRAP approach, flight crew would also need to check from ATIS reports or in coordination with ATC if the weather conditions on the arrival airport allow performing safe SRAP. Pilots need access to accurate information to be able to analyse it differently than today to ensure SRAP flyability. Generally, low visibility is a concern for GBAS SRAP.
2.3 HUMAN – MACHINE INTERFACE	The ATCO has the indication that the aircraft flies SRAP on the human machine interface. The tower controller has additionally also an indication of the location of the SRAP on his working position. There are additional options of flexibly highlighting the runway aiming point the landing aircraft is aiming at. For ISGS, energy management and flare assistance enablers will support the Pilots when the aircraft is equipped with these additional functions.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change
3.2 ALLOCATION OF TASKS	No change
3.3 COMMUNICATION	Aircraft that are approaching an aerodrome are informed about the SRAP in use, in addition to the standard final approach instrument procedure, through the automatic terminal information service (ATIS and NOTAM). The introduction of the SRAP functions could imply (e.g. in case of rejection, more information etc.) additional communications between flight crew and controllers.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	No changes foreseen but assessed
4.2 COMPETENCE REQUIREMENTS	An understanding of aircraft behaviour when following SRAP is needed and the controllers have to take this into account when setting up sequence and spacing. The controllers also need to understand the technology enablers used to fly SRAP (GBAS; RNAV/ SBAS) and how that differs from the well-known (for example ILS system).

EUROPEAN PARTNERSHIP

Co-funded by the European Union

4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	No changes
4.4. RECRUITMENT AND SELECTION	No changes
4.5. TRAINING NEEDS	The ATCO training shall include training of the ORD tool and the related changes in operating methods, procedures and the technology that enables SRAP. Training is needed on the aircraft behaviour when following SRAP and how SRAP shall be considered when setting up sequence and spacing

Table 2: Description of the SRAP change

4.1.5.2 PJ.02-W2.14.3 ISGS

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	For both air & ground there are no role changes foreseen in the project. What could occur is a different task sharing between existing roles, with the same responsibilities.
1.2 OPERATING METHODS	Operators and pilots intending to conduct any approach operations should fill the appropriate flight plan suffixes and the on board navigation data must be current and include the appropriate procedures, including the new ISGS (that must be selectable from a valid navigation database (NavDB) and not prohibited by a company instruction or Notice to Airmen (NOTAM)). Aircraft capability to fly glide slope increase shall be indicated in flight plan so that the capability can be considered in the Demand Capacity Balancing (DCB) process. The crew has to respect the Standard Operational Procedure defined for the corresponding ISGS flown if any (described in the Flight Crew Operating Manual FCOM). That concerns particularly the aircraft configurations deployment in order to be stabilized in speed and thrust level no later than 1000ft. The crew

EUROPEAN PARTNERSHIP

Co-funded by the European Union

	must also comply with the ATC speed constraints if any. ATCO manages the landing sequence of the a/c flying a mix of different standard approach procedures and ISGS. ATC tools are enhanced to support ATCOs. TMA/APP ATCO through ATIS informs a/c about the EAP in use; instructs a/c to fly STAR or they receive clearances by ATC to follow radar vectoring instructions . In ISGS the descent profile should contain at least one fix, where pilots compare the actual crossing altitude with the required crossing altitude . Lateral or vertical profile changes may impact aircraft deceleration capability and on-board energy management . That may require that pilots adapt the current operating procedure in order to ensure safe approach and landing operations. In addition, pilots will have to consider the impact of the conditions of the day (wind, temperature) to adapt the procedure.
1.3 TASKS	Before capturing the final approach segment, the flight crew must verify the correctness of the arrival data from the Navigation Database, crosschecking them with the approach chart. Moreover, the crew must verify that there is no any failure (e.g. faulty slats/flaps…) affecting the aircraft performance and especially impairing the aircraft deceleration capability. On most modern avionics, following ATC clearance to fly final approach, the crew arms the approach guidance modes on the Automatic Flight System Control Panel (AFS CP) and then the aircraft captures and flies the final approach path down to the runway. In addition to the standard info, the ATCO provides the a/c with the leading a/c precision approach segment; At TOD ATCO requests the flight crew to fly a published ISGS approach procedure. If refused by a/c – the standard approach procedure is instructed; Monitoring of the weather conditions and the GBAS (or other EAP enablers) equipment status are necessary. In ISGS increased monitoring of the a/c

EUROPEAN PARTNERSHIP

Co-funded by the European Union

	deceleration is expected by both the pilot and the ATCOs; Increasing the slope may challenge pilots' habit regarding approach procedure: new perception of the runway, new tasks to accomplish, which may be more mentally demanding than for conventional approaches leading therefore to potential additional workload. Additional actions/checks linked to these operations: An inadequate integration of tasks could raise issues regarding task accomplishments, situational awareness, workload management, etc. leading to potential difficulties to manage the approach. Potential impact on existing role and responsibilities sharing within the crew.
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	The approach can be flown with various levels of automation: with Autopilot/flight director (AP/FD), with FD only and without AP/FD (using only the raw data). The target distance indicators will be displayed in order to help the ATCOs determine and achieve the required a/c spacing /separation. The ORD support tool will provide the minimum distance to be maintained down to threshold (the final target distance indicator). In addition, the HMI will also present the compression effect to help ATCOs deliver the required minimum separation at threshold (the initial target distance indication). This means that the system, and not the ATCO, is now calculating the required spacing between different a/c pairs. Furthermore, an ATCO support tool monitoring the glide interception is foreseen. With the ISGS the aircraft flies a different glide slope and the ATCO needs support
2.2 PERFORMANCE OF TECHNICAL SYSTEM	A/c trajectory, performance and status are shared between a/c and ground via the conformance monitoring tool; glide path monitor.

EUROPEAN PARTNERSHIP

Co-funded by the European Union

	On-board system may need to be improved in order to ensure safe approach and landing operations in automatic and manual mode. On the visual segment below the minima, additional flight deck aids may be provided to the pilot to achieve correctly the manual flare manoeuvre. However, tailwind conditions may have a negative impact on aircraft deceleration capabilities (impact is under study). Therefore, before performing an ISGS approach, flight crew would also need to check from ATIS reports or in coordination with ATC if the weather condition on the arrival airport allows performing a safe ISGS approach. Pilots need access to accurate information to be able to analyse it differently than today to ensure ISGS flyability. Generally, low visibility is a concern for GBAS ISGS.
2.3 HUMAN – MACHINE INTERFACE	The ATCO should have the indication that the aircraft flies an ISGS on the human machine interface.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change
3.2 ALLOCATION OF TASKS	No change
3.3 COMMUNICATION	Aircraft that are approaching an aerodrome are informed about the ISGS in use, in addition to the standard final approach instrument procedure, through the automatic terminal information service (ATIS and NOTAM). The introduction of the ISGS functions could imply (e.g. in case of rejection, more information etc.) additional communications between flight crew and controllers and a change in the phraseology used.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	No changes foreseen but assessed
4.2 COMPETENCE REQUIREMENTS	An understanding of aircraft behaviour when following ISGS is needed and the controllers have to take this into account when setting up sequence and spacing. The controllers also need to understand the technology enablers used to fly ISGS (GBAS; RNAV/

	SBAS) and how that differs from the well-known (for example ILS system).
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	No changes
4.4. RECRUITMENT AND SELECTION	No changes
4.5. TRAINING NEEDS	The changes are expected to introduce new training needs such as the ORD tool and the related changes in operating methods, procedures, phraseology and the technology that enables ISGS. Training is needed on the aircraft behaviour when following ISGS and take this into account when setting up sequence and spacing.

Table 3: Description of the change

4.1.5.3 PJ.02-W2.14.5 IGS-to-SRAP

This combines the two previous change descriptions of ISGS and SRAP.

4.2 Step 2 Understand the HP implications

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

Arg.	Issue ID	HP issue / Benefit	HP/Valid. Obj. ID	HP Demonstration objective	recommended activity/ies
Arg.1.2	HPI Arg 1.2.1_SRAP02	SRAP procedures are not accepted by pilots	SRAP - HP-OBJ 02	***Assess the SRAP operational feasibility from the Crew perspective (in VMC)*** Assess acceptability of SRAP procedures by pilots	Flight trials (Twente)
Arg.1.2	HPI Arg 1.2.1_ISGS 02	ISGS procedures are not accepted by pilots		***Assess the ISGS operational feasibility from***	Flight trials (Frankfurt,

			ISGS-HP-OBJ 02	***the Crew perspective (in VMC)*** Assess acceptability of ISGS procedures by pilots	Ciampino, Twente)
Arg.1.2	HPI Arg 1.2.1_IGS to SRAP02	IGS to SRAP procedures are not accepted by pilots	IGS to SRAP - HP-OBJ 02	***Assess the IGS-to-SRAP operational feasibility from the Crew perspective (in VMC)*** Assess acceptability of IGS to SRAP procedures by pilots	Flight trials (Twente)
Arg.1.3	HPI Arg 1.3.1_SRAP02	The pilot confuses the thresholds	SRAP - HP-OBJ 09	***Assess the SRAP impact on Safety from the Crew perspective (in VMC)*** Specific visual aids (runway markings, PAPI and Approach lighting system (ALS) will be associated to the SRAP. The visuals aids for SRAP are based on ICAO / EASA standards, following the results of PJ02-W2 validation, however this duplication could be a source or confusion in itself	Flight trials (Twente)
Arg.1.3	HPI Arg 1.3.1_IGStoSRAP02	The pilot confuses the thresholds in the switching scenario	IGS to SRAP -	***Assess the IGS-to-SRAP impact on Safety from the Crew perspective (in VMC)***	Flight trials (Twente)

EUROPEAN PARTNERSHIP

Co-funded by the European Union

			HP-OBJ 12	Specific visual aids (runway markings, PAPI and Approach lighting system (ALS) will be associated to the SRAP. The visuals aids for SRAP are based on ICAO / EASA standards, following the results of PJ02-W2 validation, however this duplication could be a source or confusion in itself	
Arg.1.3	HPI Arg 1.3.1_SRAP03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach	SRAP - HP-OBJ 10a	***Assess the SRAP impact on Safety from the Crew perspective (in VMC)*** Assess the acceptability of the landing visual aid references	Flight trials (Twente)
Arg.1.3	HPI Arg 1.3.1_IGStoSRAP03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach	IGS to SRAP - HP-OBJ 14	***Assess the IGS-to-SRAP impact on Safety from the Crew perspective (in VMC)*** Assess the acceptability of the landing visual aid references	Flight trials (Twente)
Arg.1.3	HPI Arg 1.3.1_SRAP04	Flight Crew is disoriented by (virtual or physical?) the several available runway markers and lands on a SRAP different from the one cleared for.	SRAP - HP-OBJ 11	***Assess the SRAP impact on Safety from the Crew perspective (in VMC)*** *Assess usability and efficiency of runway markers*	Flight trials (Twente)

EUROPEAN PARTNERSHIP

Co-funded by the European Union

				and lighting indicators.	
	HPI Arg 1.3.1_IGStoSRAP04	Flight Crew is disoriented by (virtual or physical?) the several available runway markers and lighting indicators and lands on a RAP different from the one cleared for.	SRAP - HP-OBJ 15	***Assess the ISG-to-SRAP impact on Safety from the Crew perspective (in VMC)*** Assess usability and efficiency of runway markers and lighting indicators.	Flight trials (Twente)
Arg.1.3	HPI Arg 1.3.1_ISGS03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach		ISGS -HP-OBJ 11	Flight trials (Frankfurt, Twente)
Arg.2.3	HPI Arg 2.3.3_ISGS01	Flare assistance: Flare assitance is not alerting system, so it does not provide auditory nor visual alert/annunciation - it provides guidance information to pilot.	ISGS -HP-OBJ 18	***Assess the ISGS impact on Operational Feasibility from the Crew perspective*** ***Assess the impact on Crew Task performance*** Test the flare assistance indication in real conditions to make sure that they are easily noticed.	Flight trials (Ciampino)
Arg. 2.3.3	HPI Arg 2.3.3_ISGS02	Inadequate external visual aids may lead to difficulties to handle the function and to understand what actions pilots have to do to	ISGS -HP-OBJ 19	***Assess the ISGS impact on Crew Task performance*** Assess visual references	Flight trials (Twente)

EUROPEAN PARTNERSHIP

Co-funded by the European Union

		perform an ISGS approach.			
Arg 2.3.3.	HPI Arg 2.3.3_ISGS03	Energy Management Assistant function use is expected to help the pilots when the aircraft is from top of descent to final stabilization gate, providing them relevant information to support the management of the energy and to facilitate the choice of strategy to adopt. This in turn will bring a benefice in term of human performance	*ISGS -HP-OBJ 20*	***Assess the ISGS impact on Operational Feasibility from Crew perspective***	Flight trials (Ciampino)
Arg 2.3.3.	HPI Arg 2.3.3_ISGS04	Energy Management Assistant function use is expected to provide pilots an energy awareness in case of high workload during the approach phase giving relevant information that can help them to choose the appropriate strategy to adopt. This in turn will bring a benefice in term of human performance (other allocation of cognitive resources).	ISGS -HP-OBJ 21	***Assess the ISGS impact on Crew Task performance*** *(Optional issue not mandatory to achieve V3):* Assess the energy management assistant function (Does it provide the pilot with sufficient information to make a decision in any circumstances)	Flight trials (Ciampino)
Arg. 4.5	HPI Arg 4.5.1_SRAP01	Pilots are not sufficiently familiar with the novel SRAP operations and associated changes (e.g.	SRAP - HP-OBJ 26	***Assess the SRAP impact on Safety from the Crew perspective (in VMC)***	Flight trials (Twente)

EUROPEAN PARTNERSHIP

Co-funded by the European Union

		runway marking and lighting.		Assess training needs	
Arg.1.3: Human actors can achieve their tasks	New	The introduction of ISGS procedure may require to the FC additional tasks and monitoring leading with possible negative impact on workload, communication/ cooperation activity and potential for human error.	OBJ-02.02-V3-VALP-ISGS.0201	***Assess the ISGS impact on Crew Task performance***	Flight trials (Frankfurt, Ciampino)
Arg. 2.3: The design of the human-machine interface supports the human in carrying out their tasks.	New	The ISGS procedure may introduce new features and functionalities in the cockpit HMI that might have an impact on the FC task performance.	OBJ-02.02-V3-VALP-ISGS.0202	***Assess the ISGS impact on cockpit HMI***	Flight trials (Ciampino)
Arg. 1.2: Operating methods (procedures) are exhaustive and support human performance.	New	FC operating methods with the introduction of ISGS procedure are not clearly identified for normal, abnormal and degraded mode conditions, negatively affecting the task execution and the FC confidence in flying the procedure.	OBJ-02.02-V3-VALP-ISGS.0204	***Assess the ISGS operational feasibility from Flight Crew perspective***	Flight trials (Frankfurt, Ciampino)

4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

HP activity	By when
SRAP and ISG-to-SRAP Flight trial at Twente Airport (EHTW)	29 SEP – 08 OCT 2021

EUROPEAN PARTNERSHIP

Co-funded by the European Union

ISGS Flight trial at Frankfurt Airport (EDDF)	JAN 2022 – SEP 2022
ISGS Flight trial at Ciampino Airport (LIRA)	22-26 NOV- 2021 and MAR 2022
ISGS Flight trial at Twente Airport (EHTW)	14-18 FEB 2022 and 22-28JUN 2022
HP integration Post-Demo Workshops (ISGS and SRAP)	

Table 4: Table of proposed HP activities and their priority

ACTIVITY 1.	**SRAP and ISG-to-SRAP Flight trial at Twente Airport (EHTW)**
Description	The flight simulation is used to validate concept elements that relate to the airside, specifically the visual aid system.
Arguments & related issues addressed	• Arg.1.2 HPI Arg 1.2.1_SRAP02 • Arg.1.2 HPI Arg 1.2.1_ISGS 02 • Arg.1.2 HPI Arg 1.2.1_IGS to SRAP02 • Arg.1.2 HPI Arg 1.2.1_IGS to SRAP02 • Arg.1.3 HPI Arg 1.3.1_SRAP02 • Arg.1.3 HPI Arg 1.3.1_IGStoSRAP02 • Arg.1.3 HPI Arg 1.3.1_SRAP03 • Arg.1.3 HPI Arg 1.3.1_IGStoSRAP03 • Arg.1.3 HPI Arg 1.3.1_SRAP04 • Arg.1.3 HPI Arg 1.3.1_IGStoSRAP04 • Arg. 4.5 HPI Arg 4.5.1_SRAP01
HP objectives	• To confirm that the pilot task performance when flying a SRAP approach is not negatively impacted • To confirm that the Second Runway Aiming Point (SRAP) is operationally feasible from crew perspective • To confirm that there is no negative impact of SRAP on existing SOPs • To confirm that the phraseology used by Flight Crew for SRAP is clearly understandable
Tool selected out of the HP repository	No specific tool, open questions, questionnaires used
Summary of the HP activity	See Section 4

Table 5: Description of Activity 1

ACTIVITY 2	ISGS Flight trial at Frankfurt Airport (EDDF)
Description	The flight simulation is used to validate concept elements that relate to the airside, specifically transition procedure from normal to abnormal and degraded modes of operation and the runway lighting system and the visual aid system.
Arguments & related issues addressed	• Arg.1.2 HPI Arg 1.2.1_ISGS 02 • Arg.1.3 HPI Arg 1.3.1_ISGS03 • Arg.1.3 HPI Arg 1.3.1_VLD1_01 • Arg. 1.2 HPI Arg 1.2_VLD1_03
HP objectives	• To confirm that the pilot task performance when flying an ISGS approach is not negatively impacted • To confirm that cockpit HMI is usable and acceptable for ISGS operation • To confirm that the ISGS is operationally feasible from crew perspective • To confirm that there is no negative impact of ISGS on existing SOPs
Tool selected out of the HP repository	No specific tool, open question questionnaires used
Summary of the HP activity	See Section 4

Table 6: Description of Activity 2

ACTIVITY 3	ISGS Flight trial at Ciampino Airport (LIRA)

Description	• Designing, coding and validating of different ISGS (SBAS-based) approach procedures;
	• In-depth analysis on the ISGS approach procedure charts details:
	  ○ Evaluation of need to indicate into the procedure chart the approach path (e.g. angle) and related supporting navigation guidance;
	  ○ Specifically highlight of the glide path angle in case it's significantly different compared to the conventional one (e.g. more than 3.5°)

Arguments & related issues addressed	• Arg.1.2 HPI Arg 1.2.1_ISGS 02 • Arg.2.3 HPI Arg 2.3.3_ISGS01 • Arg 2.3.3 HPI Arg 2.3.3_ISGS03 • Arg 2.3.3. HPI Arg 2.3.3_ISGS04

EUROPEAN PARTNERSHIP

Co-funded by the European Union

	• Arg.1.3 HPI Arg 1.3.1_VLD1_01 • Arg. 2.3 HPI Arg 2.3_VLD1_02 • Arg. 1.2 HPI Arg 1.2_VLD1_03
HP objectives	• To confirm that the pilot task performance when flying a ISGS approach is not negatively impacted • To confirm that ISGS is operationally feasible from crew perspective • To confirm that there is no negative impact of ISGS on existing SOPs • To confirm ISGS impact on the flight crew HMI is acceptable
Tool selected out of the HP repository	• FC Workload: Tailored questionnaire, Bedford Workload Scale • FC Situational Awareness: tailored questionnaire • FC Acceptability/Trust: Tailored and/or standard questionnaire (CARS/SATI) • FC Usability: tailored questionnaire • FC Communication /cooperation: Tailored or standard questionnaire (STQ-s) • FC Safety: Tailored questionnaire Debriefings: Post flight Debriefing/Post FT campaign - Final Debriefing involving FC Expert observation on board (TBC)
Summary of the HP activity	See section 4

Table 7: Description of Activity 3

ACTIVITY 4	ISGS Flight trial at Twente Airport (EHTW)
Description	The flight simulation is used to validate concept elements that relate to the airside.
Arguments & related issues addressed	• Arg.1.2 HPI Arg 1.2.1_ISGS 02 • Arg.1.3 HPI Arg 1.3.1_ISGS03 • Arg.1.3 HPI Arg 1.3.1_VLD1_01 • Arg. 1.2 HPI Arg 1.2_VLD1_03

HP objectives	• To confirm that the pilot task performance when flying an ISGS approach is not negatively impacted • To confirm that cockpit HMI is usable and acceptable for ISGS operation • To confirm that the ISGS is operationally feasible from crew perspective • To confirm that there is no negative impact of ISGS on existing SOPs
Tool selected out of the HP repository	No specific tool, open question questionnaires used
Summary of the HP activity	See Section 4

Table 8: Description of Activity 3

ACTIVITY 4	HP integration Post-Demo Workshop (ISGS and SRAP)
Description	Workshop to integrate and consolidate HP demo results (remote)
HP objectives	Review and integration of HP demo results
Tool selected out of the HP repository	Focus group
Summary of the HP activity	Review of single exercise results and integration in Part I and Part III

Table 9: Description of Activity 4

EUROPEAN PARTNERSHIP

Co-funded by the European Union

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

4.4.1 Summary of HP activities results & recommendations / requirements

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.1.2	HPI Arg 1.2.1_SRAP02	SRAP procedures are not accepted by pilots	TBD	***Assess the SRAP operational feasibility from the Crew perspective (in VMC)*** Assess acceptability of SRAP procedures by pilots	Flight trials (Twente)	Despite the vast majority of responses were positive as above reported, some issues were mentioned by participating pilots in relation with the brightness of the portable PAPI affecting its visibility in the bright sunlight. The needs to provide adequate	The needs to provide adequate SRAP PAPI brightness (equal to the PAPI used for conventional threshold and aiming point) must further be reflected in the solution OSED / TS requirements. It is recommended to increase the minimum space between the end	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						SRAP PAPI brightness (equal to the PAPI used for conventional threshold and aiming point) must further be reflected in the solution OSED / TS requirements. Solution PJ.02-W2-14.2 has eventually been updated to have a minimum of 1100m between the two thresholds, which was slightly not the case in Twente (1020m) and led to a comment	of the last Touchdown zone marker (960m from first threshold) and the second threshold bar marking. it might be useful to have further guidance in addition to one distance marker after the touchdown point, and the threshold markings for the conventional runway aiming point might need to be better distinguished by the runway	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						from the Lufthansa Crew about the recommendations to increase the minimum space between the end of the last Touchdown zone marker (922.5 m from first threshold in the case of Twente) and the second Transverse stripe marking In Twente exercise zone markers were at 150, 300, 600, 750 and 900m and are 22.5 m in length; 2 sets in front and 3	markings of the first aiming point. Additional tests with the chequered option of the ICAO marking, for the second threshold, should be conducted,	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						sets behind the aiming markers. The outputs from PJ.02-W2-14.2 validation activities show that the best marking of the second threshold is a complete duplication of the ICAO marking, which was the case in Twente (except for the second threshold's transverse stripe which was dashed instead of solid). Runway length at Twente is 2406m,		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						remaining LDA from the SRAP at Twente was 1386m, therefore 3 pairs of touchdown zone markers were applied (ICAO Annex 14 section 5.2.6.3, runway length between 1200m and 1500m). On longer runways the marking scheme will include more than 3 touchdown zone markings. In TWENTE demo SRAP markings were based on ICAO standard		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						provision with white rectangular for the aiming point while in PJ.02-W2-14.2 a second design option with chequered shape was tested and also found acceptable by the participating test subjects (airline pilots). Additional tests with the chequered option of the ICAO marking, for the second threshold, should be conducted, even if from the flight simulations flown		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						in PJ.02-W2-14.2, there is no preference between the standard ICAO marking and the chequered one.		
Arg.1.2	HPI Arg 1.2.1_ISGS 02	ISGS procedures are not accepted by pilots		***Assess the ISGS operational feasibility from the Crew perspective (in VMC)*** Assess acceptability of ISGS procedures by pilots	Flight trials (Frankfurt, Ciampino, Twente)	The results show that the ISGS experimented operations at Frankfurt, Ciampino and Twente airports are operationally feasible. Energy management during the flare was acceptable.		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.1.2	HPI Arg 1.2.1_IGS to SRAP02	IGS to SRAP procedures are not accepted by pilots		***Assess the IGS-to-SRAP operational feasibility from the Crew perspective (in VMC)*** Assess acceptability of IGS to SRAP procedures by pilots	Flight trials (Twente)	Pilot succeeds to accomplish a 3.5 deg IGS-to-SRAP operation without any difficulty has been successfully met as positive responses were collected relevant for the criteria in the PR and PE questions Despite the majority of responses were positive as above reported, some issues were mentioned by participating pilots in relation with the visibility	Same as HPI Arg 1.2.1_SRAP02 Some sentences or a small paragraph may be required in company SOPs to highlight the importance of identifying the correct threshold	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						of the PAPI. Also, some improvements might be needed in relation with the runway markings based on the provided subjective feedback. Similar recommendations as noted for HPI Arg 1.2.1_SRAP02 about SRAP, are also applicable to IGS-to-SRAP. Finally, pilots confidence in flying IGS-to-SRAP operations in tailwind conditions was		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						not very high as IGS operations are very difficult to manage in such cases, even to a conventional threshold. The combination of the tailwind and the IGS left the crew subjectively feeling that the ground speed was too high for the aircraft weight. Confidence should be OK in headwind conditions.		
Arg.1.3	HPI Arg 1.3.1_SRAP02	The pilot confuses the thresholds		***Assess the SRAP impact on Safety from the Crew***	Flight trials (Twente)	Despite Criteria 3 - EX3-CRT-VLD-01-0203-001 there is evidence	Same as HPI Arg 1.2.1_SRAP02	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
				perspective (in VMC) Specific visual aids (runway markings, PAPI and Approach lighting system (ALS) will be associated to the SRAP. The visuals aids for SRAP are based on ICAO / EASA standards, following the results of PJ02-W2 validation, however this duplication could be a source or confusion in itself		that the additional SRAP runway markings are sufficient to not negatively impact SRAP procedures under VMC compared to the reference scenario, from the perspective of the crew from the collected answers, there are few issues as explained in issue HPI Arg 1.2.1_SRAP02		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.1.3	HPI Arg 1.3.1_IGStoSRAP02	The pilot confuses the thresholds in the switching scenario		***Assess the IGS-to-SRAP impact on Safety from the Crew perspective (in VMC)*** Specific visual aids (runway markings, PAPI and Approach lighting system (ALS) will be associated to the SRAP. The visuals aids for SRAP are based on ICAO / EASA standards, following the results of PJ02-W2 validation, however this duplication could be a source or confusion in itself	Flight trials (Twente)	Despite the Criteria 20 - EX3-CRT-VLD-01-0203-001 There is evidence that the additional SRAP runway markings are sufficient to not negatively impact IGS-to-SRAP procedures compared to the reference scenario, from the perspective of the crew according to the collected responses some issues were raised by pilots. See HPI Arg 1.2.1_IGS to SRAP02	Same as HPI Arg 1.2.1_IGS to SRAP02	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.1.3	HPI Arg 1.3.1_SRAP03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach		***Assess the SRAP impact on Safety from the Crew perspective (in VMC)*** Assess the acceptability of the landing visual aid references	Flight trials (Twente)	Same as HPI Arg 1.2.1_SRAP02 & HPI Arg 1.3.1_SRAP02	Same as HPI Arg 1.2.1_SRAP02 & HPI Arg 1.3.1_SRAP02	
Arg.1.3	HPI Arg 1.3.1_IGStoSRAP03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach		***Assess the IGS-to-SRAP impact on Safety from the Crew perspective (in VMC)*** Assess the acceptability of the landing visual aid references	Flight trials (Twente)	Same as HPI Arg 1.2.1_IGS to SRAP02 & HPI Arg 1.3.1_IGStoSRAP02	Same as HPI Arg 1.2.1_IGS to SRAP02 & HPI Arg 1.3.1_IGStoSRAP02	

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.1.3	HPI Arg 1.3.1_SRAP04	Flight Crew is disoriented by (virtual or physical?) the several available runway markers and lands on a SRAP different from the one cleared for.		***Assess the SRAP impact on Safety from the Crew perspective (in VMC)*** *Assess usability and efficiency of runway markers and lighting indicators.*	Flight trials (Twente)	Same as HPI Arg 1.2.1_SRAP02 & HPI Arg 1.3.1_SRAP02	Same as HPI Arg 1.2.1_SRAP02 & HPI Arg 1.3.1_SRAP02	
Arg.1.3	HPI Arg 1.3.1_IGStoSRAP04	Flight Crew is disoriented by (virtual or physical?) the several available runway markers and lighting indicators and lands on a RAP different from the one cleared for.		***Assess the ISG-to-SRAP impact on Safety from the Crew perspective (in VMC)*** Assess usability and efficiency of runway markers and lighting indicators.	Flight trials (Twente)	Same as HPI Arg 1.2.1_IGS to SRAP02 & HPI Arg 1.3.1_IGStoSRAP02	Same as HPI Arg 1.2.1_IGS to SRAP02 & HPI Arg 1.3.1_IGStoSRAP02	
Arg.1.3	HPI Arg 1.3.1_ISGS03	Flight crew is not supported by appropriate			Flight trials	PAPI indications did not generate	One recommendation	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
		landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach		ISGS -HP-OBJ 11	(Frankfurt, Twente)	issue in majority of cases of Ciampino trial conditions. PAPI indications did not generate issue in majority of cases of Twente trial conditions with preferences on specific color coding. No differnces for Frankfurt as only 3.2° approaches was experimented	relates to the PAPI information, which needs to be addressed and charted properly in the navigation approach charts so that flight crew can be briefed ahead of the approach and have a correct expectation what kind of visual information they see out-the window during steeper approach. The PAPI out-the window needs to be aligned with charts. It must be adjustable on the	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
							ground to reflect steeper approaches, or it needs to be clearly stated that pilots will experience inconsistency during steeper glide slope. In follow-up projects on this matter, the additional PAPI should be totally comparable with the existing, fixed PAPI, in terms of intensity and power supply (use of batteries is not recommended).	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
							The ISGS procedures with two active PAPI's should also be checked in IMC and poor light/visibility conditions. More specific example for further investigation: becoming visual at low altitude in IMC approach with deviation (above/below) from correct glide path. This may lead to confusion. During ISGS approaches with two active PAPI's,	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
							no last minute changes (e.g. by ATC) should be made. Consider the use of two totally different colours for the ISGS PAPI (e.g. magenta-green) so that it even better shows that the ISGS PAPI is totally different. An awareness call on which PAPI to use during approach may be helpful.	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.2.3	HPI Arg 2.3.3_ISGS01	Flare assistance: Flare assitance is not alerting system, so it does not provide auditory nor visual alert/annunciation - it provides guidance information to pilot.		***Assess the ISGS impact on Operational Feasibility from the Crew perspective*** ***Assess the impact on Crew Task performance*** Test the flare assistance indication in real conditions to make sure that they are easily noticed.	Flight trials (Ciampino)	The Flare Assistant was implemented on the Honeywell primary flight. However, due to safety reasons, pilots did not look at the primary flight display during the flare phase of flight. Therefore, the post evaluation video review was conducted with 2 pilots. Pilots were asked to observe 4 recorded ISGS approaches captured during the Rome trials, where primary	Flare assistance usability should be improved	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						display with the Flare Assistant is visible. Pilots feedback suggests that the Flare Assistant could be useful and could effectively support pilot during ISGS procedures, if usability of the system were improved and especially, if flare related cues were provided on the head-up instead of the head-down display.		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg. 2.3.3	HPI Arg 2.3.3_ISGS02	Inadequate external visual aids may lead to difficulties to handle the function and to understand what actions pilots have to do to perform an ISGS approach.		***Assess the ISGS impact on Crew Task performance*** Assess visual references	Flight trials (Twente)	PAPI indications did not generate issue in majority of cases of Twente trial conditions with preferences on specific color coding.	The PAPI out-the window needs to be aligned with charts. It must be adjustable on the ground to reflect steeper approaches, or it needs to be clearly stated that pilots will experience inconsistency during steeper glide slope. In follow-up projects on this matter, the additional PAPI should be totally comparable with the existing, fixed PAPI, in terms of	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
							intensity and power supply (use of batteries is not recommended). The ISGS procedures with two active PAPI's should also be checked in IMC and poor light/visibility conditions. More specific example for further investigation: becoming visual at low altitude in IMC approach with deviation (above/below) from correct glide	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
							path. This may lead to confusion. During ISGS approaches with two active PAPI's, no last minute changes (e.g. by ATC) should be made. Consider the use of two totally different colours for the ISGS PAPI (e.g. magenta-green) so that it even better shows that the ISGS PAPI is totally different. An awareness call on which PAPI to use during	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
							approach may be helpful.	
Arg 2.3.3.	HPI Arg 2.3.3_ISGS03	Energy Management Assistant function use is expected to help the pilots when the aircraft is from top of descent to final stabilization gate, providing them relevant information to support the management of the energy and to facilitate the choice of strategy to adopt. This in turn will bring a benefice in term of human performance		***Assess the ISGS impact on Operational Feasibility from Crew perspective***	Flight trials (Ciampino)	The Energy Management system has been tested only by the Honeywell flight crew during 23 approaches. It needs to be noted, that it is an experimental prototype with known limitation, which needs to be considered during the result interpretation. The Energy Management system seems to	Energy management prototype should be improved and further assessed	

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						be useful during ISGS procedure, especially during the approach to an unfamiliar airport in bad weather. However, current prototype needs to be refined to improve the level of usability and effectiveness, how it supports the crew during ISGS procedures.		
Arg 2.3.3.	HPI Arg 2.3.3_ISGS04	Energy Management Assistant function use is expected to provide pilots an energy awareness in		***Assess the ISGS impact on Crew Task performance*** *(Optional issue not mandatory to*	Flight trials (Ciampino)	The Energy Management system has been tested only by the Honeywell flight		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
		case of high workload during the approach phase giving relevant information that can help them to choose the appropriate strategy to adopt. This in turn will bring a benefice in term of human performance (other allocation of cognitive resources).		*achieve V3):* Assess the energy management assistant function (Does it provide the pilot with sufficient information to make a decision in any circumstances)		crew during 23 approaches. It needs to be noted, that it is an experimental prototype with known limitation, which needs to be considered during the result interpretation. The Energy Management system seems to be useful during ISGS procedure, especially during the approach to an unfamiliar airport in bad weather. However, current prototype needs		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
						to be refined to improve the level of usability and effectiveness, how it supports the crew during ISGS procedures. Workload and situation awareness were anyway maintained at acceptable levels		
Arg. 4.5	HPI Arg 4.5.1_SRAP01	Pilots are not sufficiently familiar with the novel SRAP operations and associated changes (e.g. runway marking and lighting.		***Assess the SRAP impact on Safety from the Crew perspective (in VMC)*** Assess training needs	Flight trials (Twente)	No issues were raised in relation to the lack of familiarities with SRAP operations and associated changes in addition to what identified for HPI Arg 1.2.1_SRAP02 & HPI Arg 1.3.1_SRAP02		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg.1.3	HPI Arg 1.3.1_VLD1_01	The introduction of ISGS procedure may require to the FC additional tasks and monitoring leading with possible negative impact on workload, communication/ cooperation activity and potential for human error.		***Assess the ISGS impact on Crew Task performance***	Flight trials (Frankfurt, Ciampino)	Workload and Situation Awareness were at acceptable levels		
Arg. 2.3	HPI Arg 2.3_VLD1_02	The ISGS procedure may introduce new features and functionalities in the cockpit HMI that might have an impact on the FC task performance.		***Assess the ISGS impact on cockpit HMI***	Flight trials (Ciampino)	Task performance were not affected.		

Arg.	Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP Demonstration objective	activity conducted	results / evidence	recommendations	requirements
Arg. 1.2	HPI Arg 1.2_VLD1_03	FC operating methods with the introduction of ISGS procedure are not clearly identified for normal, abnormal and degraded mode conditions, negatively affecting the task execution and the FC confidence in flying the procedure.		***Assess the ISGS operational feasibility from Flight Crew perspective***	Flight trials (Frankfurt, Ciampino)	No gaps identified in the operating methods. T		

Table 10: Summary of the HP results and recommendations/ requirements for each identified issue & related argument

4.4.2 Maturity of the DEMO

[…]

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Maturity checklist for finalising the V3 assessment			
ID	**Question**	**Answer** *Fill in 'yes' or 'no'.*	**Comments** *Please substantiate your answer.*
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	Yes	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
2	Are the benefits and issues in terms of human performance and operability related to the proposed demo sufficiently assessed (i.e. on the level required for V3)?	Yes	*See section 4.4.1*
3	Have all the parts of the demo/concept been considered?	Yes	*See section4.1 and 4.4.1*
4	Have potential interactions with related projects/concepts been considered and addressed?	NO	*PJ02.14.2, PJ02.14.3 and PJ02.14.5 addressing the V3 cycle of the proposed solution has been considered as input to the VLD1*
5	Is the level of human performance needed to achieve the desired system performance for the proposed demo consistent with human capabilities?	Yes	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
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	*- See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
7	Has the proposed demo been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*

8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	- *See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (SPR-INTEROP/OSED)?	Not Applicable	*Compare the HP table and last version of SPR-INTEROP/OSED*
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
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	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*
13	Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine.	Yes	*See section 4.4.1 and DEMOR part I Appendix E*
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes	*See section 4.4.1 and DEMOR part I Appendix A, B, C, D*

5 References

Content Development

[1] SESAR PJ02-02 D2.1.01 PJ02-02 OSED-SPR-Interop Part I, II, III, IV, V, Edition 00.01.00

[2] SESAR D1.3 DEMO Plan Part I – IV v 00.01.00

Human Performance

[3] SESAR Human Performance Assessment Process V1 to V3 v 00.03.02

Appendix A – Additional HP activities conducted

EUROPEAN PARTNERSHIP

Co-funded by the European Union

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
VLD1-Rec-1.	Visual Aid	The needs to provide adequate SRAP PAPI brightness (equal to the PAPI used for conventional threshold and aiming point) must further be reflected in the solution OSED / TS requirements.	See section 4.4.1	See section 4.4.1	Air / Ground	AO-0319	In Progress		
VLD1-Rec-2.	Procedure	Some sentences or a small paragraph may be required in company SOPs to highlight the	See section 4.4.1	See section 4.4.1	Air	AO-0319	In Progress		

		importance of identifying the correct threshold							
VLD1-Rec-3.	Visual Aid	The PAPI out-the window needs to be aligned with charts. It must be adjustable on the ground to reflect steeper approaches, or it needs to be clearly stated that pilots will experience inconsistency during steeper glide slope.	See section 4.4.1	See section 4.4.1	Air / Ground	AO-0319/AO-0320	In Progress		
VLD1-Rec-4.	Visual Aid	In follow-up projects on this matter, the additional PAPI should be totally comparable with the existing, fixed PAPI, in terms of intensity and	See section 4.4.1	See section 4.4.1	Air / Ground	AO-0319/AO-0320	In Progress		

		power supply (use of batteries is not recommended).							
VLD1-Rec-5.	System Design	Flare assistance usability should be improved	See section 4.4.1	See section 4.4.1	Air	AO-0320	In Progress		
VLD1-Rec-6.	System Design	Energy management prototype should be improved and further assessed	See section 4.4.1	See section 4.4.1	Air	AO-0320	In Progress		
VLD1-Rec-7.	Visual Aid	The ISGS procedures with two active PAPI's should also be checked in IMC and poor light/visibility conditions. More specific example for further investigation: becoming visual at low altitude in IMC approach with	See section 4.4.1	See section 4.4.1	Air / Ground	AO-0320	In Progress		

		deviation (above/below) from correct glide path. This may lead to confusion.							
VLD1-Rec-8.	Visual Aid	During ISGS approaches with two active PAPI's, no last minute changes (e.g. by ATC) should be made.	See section 4.4.1	See section 4.4.1	Air / Ground	AO-0320	In Progress		
VLD1-Rec-9.	Visual Aid	Consider the use of two totally different colours for the ISGS PAPI (e.g. magenta-green) so that it even better shows that the ISGS PAPI is totally different.	See section 4.4.1	See section 4.4.1	Air / Ground	AO-0320	In Progress		

VLD1-Rec-10.		An awareness call on which PAPI to use during approach may be helpful	See section 4.4.1	See section 4.4.1					

Table 11: HP recommendations

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Appendix C – HP Requirements Register

No New requirement identified respect to previous work in PJ02.14.2/3/5 solutions

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Appendix D – HP Log

No HP Log has been developed in the DEMOP

EUROPEAN PARTNERSHIP

Co-funded by the European Union

-END OF DOCUMENT-

EUROPEAN PARTNERSHIP

Co-funded by the European Union