

SESAR Solution PJ.02-W2-21.4 SPR-INTEROP/OSED V3 - Part IV - Human Performance Assessment Report

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AIRPORT AIRSIDE AND RUNWAY THROUGHPUT

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Abstract

This document contains the Human Performance (HP) assessment report for the PJ02.21.4 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 provides contains the Human Performance Assessment Report (HPAR) for PJ.02-W2-21.4 Full Guidance Assistance to mobiles using 'Follow the Greens' procedures based on Airfield Ground Lighting.

The document contains the Human Performance (HP) assessment report for the Solution PJ02.21.4 Full guidance FtG, 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. The report 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.

The complete list of identified benefits and issues and related objectives and success criteria as well as the derived Human Performance activities per partner are described in the attached HP Log





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 in order to derive the HP assessment report for PJ.02-W2-21.4 (V3) including the HP requirements and recommendations to inform the design and development of the concept explored in the validation activities and to ensure that it is mature enough to move on the next V-phase.

2.2 Intended readership

The intended audience of this VALR for the Solutions PJ.02-W2-21.4 are:

- the SESAR Projects developing Solutions related to High Performing Airport Operations
- the key stakeholders targeted by the Solution, i.e.
 - Air Navigation Service Providers who will benefit from the deployment of the Solution
 - o Airspace Users who will benefit from the deployment of the new operations
 - Airport operators who will benefit from the deployment of the solution concepts.





2.3 Structure of the document

This document is composed of 5 main chapters:

- Chapters 1 and 2 introduce the content of the document and its scope;
- Chapter 3 highlights the steps of the Human Performance Assessment process which are within the scope of this document;
- Chapter 4 details describes the four two steps of the Human Performance Assessment. In particular, it reports the main findings and the HP recommendations and requirements from the activities performed as part of the HP assessment process;
- Chapter 5 includes the list of reference documents;
- Appendix A reports the minutes of the 'Pilot and vehicle drivers';
- Appendix B provides the HP recommendations register which specifies the list of HP recommendations gathered in the project;
- Appendix C provides the HP requirements register which offers the list of HP requirements gathered in the project;
- Appendix D provides the HP Log in which all the data/information obtained from all HP activities conducted as part of the HP assessment (Step1 Step 4) have been documented. It specifies the list of HP requirements gathered in the project.

Term	Description
Human Factors (HF)	HF is used to denote aspects that influence a human's capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, "Human Factors" can be considered as <i>focussing on the variables that determine Human Performance</i> .
Human Performance (HP)	HP is used to denote the human capability to successfully accomplish tasks and meet job requirements. In this way, "Human Performance" can be considered <i>as</i> <i>focussing on the observable result of human activity in a work context</i> . Human Performance is a function of Human Factors (see above). It also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well as Social Factors and Change Management.
HP activity	An HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies.
HP argument	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.

2.4 Acronyms and Terminology





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 the HP Reference Material is to ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed. The SESAR HP assessment process uses an 'argument' and 'evidence' approach. An HP argument is an 'HP claim that needs to be proven'. The aim of the HP assessment is to provide the necessary 'evidence' to show that the HP arguments impacted have been considered and satisfied by the HP assessment process. This includes the identification of HP requirements and recommendations to support the design and development of the concept.

The HP assessment process is a four-step process. Figure 3-1 provides an overview of these four steps with the tasks to be carried out and the two main outputs (i.e. HP plan and HP assessment report). In addition, an 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 continuously updated and / or added to as the SESAR Solution progresses.



Figure 3-1: 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

Refer to the description in PJ02-W2.21.04 VALP Part I.

4.1.2 Description of solution scenario

Refer to the description in PJ02-W2.21.04 VALP Part I.

4.1.3 Consolidated list of assumptions

Refer to the description in PJ02-W2.21.04 VALP Part I.

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

Solution PJ03a-01 from Wave 1 that dealt with enhancement of A-SMGCS performance by means of digitalisation of the ATCO/vehicle driver communications based on airport-level datalink. In the present exercise datalink communication was out of scope.

SESAR Solution	OI Steps	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
PJ.02.21.4	AO-0222-B	V2 on-going	V3	SESAR Solution PJ03a-01 Data Pack

4.1.5 Identification of the nature of the change

HP argument branch

Change & affected actors

1. ROLES & RESPONSIBILITIES





1.1 ROLES & RESPONSIBILITIES	 TWR ATCO: The Tower Ground and Tower Runway Controllers are responsible for monitoring that all movements on the manoeuvring area comply with the clearances issued. Flight crew: Flight crews are responsible to follow the cleared taxi route indicated by the AGL and the A-SMGCS Guidance service, and shall provide reliable and intuitive information to the Flight Crew to support their navigation accordingly.
	Vehicle drivers: Responsible to follow the guidance information provided via AGL. They are also responsible for indicating any inability to act according to received AGL instructions. Airport operations service vehicles will only be guided via AGL in LVP and when intentionally and unavoidably (for their specific task) operating on the taxiway centre line. Fire service vehicles will only be guided via AGL in LVP and in complex traffic situations. Individual guidance via AGL may help the fire service to identify the shortest way to the incident area. The use of AGL for this purpose is subject to local procedures.
1.2 OPERATING METHODS	TWR ATCO: The Tower Controller will be able to control the AGL via clearances input into the ATC system. Following the Controllers input and clearance, the corresponding lamps will be activated in front of the mobile and the Tower Controller will monitor the compliance and intervene if necessary. For example, in case an aircraft deviates from the route indicated by the AGL, the Tower Controller has to inform the Flight Crew immediately by R/T communication as an additional safety net accompanying the reaction of the guidance network. Related information may also be provided to the other mobiles involved, if applicable. Depending on the automation of prioritisations at crossing or converging taxiway, the Tower Controller will have to enter and/or monitor guidance instructions with the ultimate possibility to intervene whenever needed. In case of AGL service degradation, the Tower Controller is responsible for taking appropriate action. Therefore, the contingency procedures would need to





	be updated, concerning all kinds of degraded modes (i.e. what to do if the TCLs/stop bars/only specific segments of AGL are not working). Flight Crew : They are responsible to follow the cleared taxi route indicated by the AGL and the A-SMGCS Guidance service shall provide reliable and intuitive information to the Flight Crew to support their navigation accordingly.	
1.3 TASKS	 Tower Controller: Tower ATCO will have to supervise the AGL, monitor its functionality. However, s/he can overwrite the automation's routing plans manually, restrict TCL or swap the priority of switched TCL between converging mobiles. Flight crew: The flight crew will have the task to follow 	
2. Human & System	the taxi guidance provided by AGL accurately.	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	Tower Controller : The question of human-machine interaction (i.e. level of automation) is especially relevant in this solution, as previous research showed a certain shift in planning, conflict detection and resolution to the automation. The ATCO can swap priorities or modify the route as s/he sees fit. Therefore, the main tasks of the Tower ATCO may shift more to monitoring and there will be a constant need to maintain the mental picture of the traffic (e.g. by hovering over the labels, cross-checking the system's performance). Trust in the system is of key importance.	
2.2 PERFORMANCE OF TECHNICAL SYSTEM	Tower Controller : The Guiding Service will interface the AGL System to trigger lighting commands. The Controller Working Position (CWP) via Electronic Controller Input (ECI) will enable the ATCO to input and/or cancel clearances for all mobiles operating within their area of responsibility to support the Guidance Service Automated Switching of AGL. In case a conflicting situation is predicted, the A-SMGCS Guidance service will give priority to one mobile over the other. The rules for giving priority to mobiles will	





	be configured off-line and may use criteria such as type of mobile, departure/arrival, TTOT, ground speed, airline. The correct configuration could have an impact on the Guidance service's usability. The Tower Controller will see the priority via the HMI but does not need to manually accept each of them as this would increase their workload. The Automated Switching of AGL (TCL+ Stop Bars)
	corresponds to a mobile's route allocated by the Tower Controller. The function will progressively switch TCL on in sequence in front of the mobile in order to guide the movement of a mobile along its cleared route based on the mobile's current position. The TCL are switched off behind the mobile as it progresses along its route.
	When the CMAC function detects a route deviation the Automated Switching of TCL function will switch off the TCL for that mobile until a revised route and clearance has been input.
2.3 HUMAN – MACHINE INTERFACE	Tower Controller : The integrated A-SMGCS will show the AGL on the HMI as the aircraft and mobile progresses. This is different from the current method (and the Reference scenario with the Routing Service) in which ATCOs use two separate system for the same task: input the (taxi) clearance to the main ATM system and control the AGL on another system. Route modification and priority swap are also accessible from the aircraft label on the HMI.
	The integrated A-SMGCS will also feature new safety nets (e.g. stand occupied, push vs push, deadlock alert).
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	N/A
3.2 ALLOCATION OF TASKS	N/A





3.3 COMMUNICATION	TWR ATCO & Flight crew : The solution is associated with a potential change (i.e. simplification) of the phraseology.
4. HP RELATED TRANSITION FACTORS	·
4.1 ACCEPTANCE & JOB SATISFACTION	Tower ATCO : The individual guidance via AGL may reduce Tower Controller workload, but on the expense of taking over some of the planning work from the Tower ATCO, resulting in rather supervisor role. This may have a significant impact on acceptability.
4.2 COMPETENCE REQUIREMENTS	Tower ATCO : Due to the increased automation, ATCOs competence to solve conflicting situations or react to abnormal operations and in degraded modes (e.g. system failures) might be impacted.
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	N/A
4.4. RECRUITMENT AND SELECTION	N/A
4.5. TRAINING NEEDS	Tower ATCO, flight crew and vehicle drivers : Both theoretical and practical hands-on training on the new functionality would be needed.

Table 2: Description of the change - PJ02-W2-21.4

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 validation objective	recommended activity/ies		
	Argument 1. Roles & Responsibilities, Operating methods, Tasks						
Arg. 1.2.1	1.2.1-21.4- 001-HP	Planned TWY closure or de-icing may be complicated with the automatic switching of AGL if the system is not prepared for such cases. This would lead to increased workload, annoyance and lack of acceptability.	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service.	Post Run Questionnaire Debriefing Observations		
Arg. 1.2.1	1.2.1-21.4- 002-HP	RWY direction change may be complicated with the automatic switching of AGL if the system is not prepared for such cases. This would lead to increased workload, annoyance and lack of acceptability.	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service.	Post Run Questionnaire Debriefing Observations		
Arg. 1.2.2	1.2.2-21.4- 001-HP	An unexpected situation (e.g. emergency or unplanned RWY/TWY closure) could have an impact on the ATCO's workload if the system is not well prepared for such cases.	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service.	Post Run Questionnaire Debriefing Observations		
Arg. 1.2.3	1.2.3-21.4- 001-HP	Due to equipment outage (i.e. Guidance Service failure), the ATCO will have to follow contingency operations. If those are not (thoroughly) defined, ATCOs might	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service.	Post Run Questionnaire Debriefing Observations		





Arg. 1.2.5	1.2.5-21.4- 001-HP	not be able to handle the situation efficiently. See the HP issues for 1.2.1, 1.2.2 and 1.2.3	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service.	Post Run Questionnaire Debriefing Observations
Argument 2-Usability and technical performance of the system					
Arg. 2.1.4	2.1.4 21.4-001- HP	If many important tasks are shifted to the system (i.e. conflict detection and resolution), it can decrease workload.	OBJ-02.21.4-V3- VALP-008	Assess Controllers' workload and situational awareness when providing ATS with the automated switching of AGL and A-SMGCS Routing Service.	Post Run Questionnaire Debriefing Observations
Arg. 2.1.6	2.1.6-21.4- 001-HP	The defined priority rules for conflict detection and resolution may not be in accordance with the ATCO's expectations (the logic of the algorithm). It could be a problem if e.g. an arrival is well ahead from time point of view but still the departure has the priority. This may lead to lack of trust in the system.	OBJ-02.21.4-V3- VALP-009	Assess the usability and effectiveness of the Controllers HMI	Post Run Questionnaire Debriefing Observations





Arg. 2.3.1	2.3.1-21.4- 001-HP	The HMI may include features or content which are not organised well or presented correctly. This could lead to increased time to find the relevant information .	OBJ-02.21.4-V3- VALP-009	Assess the usability and effectiveness of the Controllers HMI	Post Run Questionnaire Debriefing Observations
Arg. 2.3.6	2.3.6-21.4- 001-HP	It may be problematic if the interaction with some system features is difficult. For example, the modification of routes or RWY exit points may require too many clicks, swapping priorities or restricting an a/c route manually may not be straightforward, causing annoyance.	OBJ-02.21.4-V3- VALP-009	Assess the usability and effectiveness of the Controllers HMI	Post Run Questionnaire Debriefing Observations
Arg. 2.3.6	2.3.4-21.4- 002-HP	The presence of alerts (e.g. CATC and CMAC) may mitigate human error and increase situational awareness by highlighting non-conformance or conflicting ATC clearances.	OBJ-02.21.4-V3- VALP-009	Assess the usability and effectiveness of the Controllers HMI	Post Run Questionnaire Debriefing Observations
Arg. 2.3.6	2.3.3-21.4- 003-HP	If the HMI had a modern look and feel it could significantly enhance user experience. Simple and logical design with optimal colouring scheme could also add value to this experience.	OBJ-02.21.4-V3- VALP-009	Assess the usability and effectiveness of the Controllers HMI	Post Run Questionnaire Debriefing Observations





Arg. 2.3.8	2.1.2 21.4-004- HP	If too many important tasks are shifted to the system (i.e. conflict detection and resolution), it may decrease the workload at the expense of increasing the potential for overreliance , which could lead to the lack of sufficient mental picture of the traffic situation. This issue might be the most prominent in dense traffic situations, but its effect on normal traffic level is yet to be seen.	OBJ-02.21.4-V3- VALP-008	Assess Controllers' workload and situational awareness when providing ATS with the automated switching of AGL and A-SMGCS Routing Service	Post Run Questionnaire Debriefing Observations	
	Argument 3- Teams and communication					
Arg. 3.3.2	3.3.2-21.4- 011-HP	If the ATCO does not issue the full taxi clearance , s/he may not remember where the a/c are taxiing in dense traffic situation (i.e. the mental picture of the traffic situation may be impacted).	OBJ-02.21.4-V3- VALP-007	Assess the adequacy of the phraseology	Post Run Questionnaire Debriefing Observations	
	Argument 4- Transition factors					
Arg. 4.1.1	4.1.1-21.4- 001-HP	See 2.1.2-1.1 regarding acceptance of the changing tasks.	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service	Post Run Questionnaire Debriefing Observations	





Arg. 4.1.2	4.1.2-21.4- 001-HP	See 2.1.2-1.1 regarding overreliance and acceptance	OBJ-02.21.4-V3- VALP-006	Assess Controllers acceptance of operating methods when providing ATS with the automated switching of AGL and A- SMGCS Routing Service	Post Run Questionnaire Debriefing Observations
Arg. 4.1.2	4.1.2-21.4- 002-HP	In case the a/c has no foreseen conflicts, the TCL being lit in small blocks and not until the stop bars could make the optimal speed control for the flight crew difficult. It may result the flight crew following the TCL blindly, not knowing where it would lead.	OBJ-02.21.4-V3- VALP-HPAP-001	Assess the impact of the automatic switching of AGL and A-SMGCS Routing Service on the flight crew	Workshop
Arg. 4.1.2	4.1.2-21.4- 003-HP	Airport operations service vehicles will be guided via AGL in LVP and when intentionally and unavoidably (for their specific task) operating on the taxiway centre line. This is expected to increase their situational awareness and their efficient task execution. Similarly, Fire service vehicles will only be guided via AGL in LVP and in complex traffic situations. Individual guidance via AGL may help the fire service to identify the shortest way to the incident area.	OBJ-02.21.4-V3- VALP-HPAP-002	Assess the impact of the automatic switching of AGL and A-SMGCS Routing Service on the vehicle drivers	Workshop





Arg. 4.5	4.5-21.4- 001-HP	Adequate training that takes into account the required level of knowledge, skill and experience requirements (Arg. 4.2.1 in wave 1) can accelerate the learning of the new operating method.	OBJ-02.21.4-V3- VALP-HPAP-003	Assess the training needs for the affected actors	Debriefing Workshop	
Arg. 4.5	4.5-21.4- 002-HP	Adequate training of the flight crew can improve the acceptance of the new operating method and reduce workload.	OBJ-02.21.4-V3- VALP-HPAP-004	Assess the training needs for the affected actors	Workshop	
Arg. 4.5	4.5-21.4- 002-HP	Adequate training of the vehicle drivers can improve the acceptance of the new operating method and reduce workload.	OBJ-02.21.4-V3- VALP-HPAP-005	Assess the training needs for the affected actors	Workshop	
	Table 3: HP Arguments, related HP issues and benefits, and proposed HP activity - PJ02-W2-21.4					





4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

HP activity	By when
Real-Time Simulation	21-25th March 2022
Flight crew and vehicle drivers workshop	13 th June 2022
ATCOs final workshop	28 th June 2022

Table 4: Table of proposed HP activities and their priority - PJ02-W2-21.4

ACTIVITY 1.	Real-Time Simulation
Description	A Real time Simulation with a reduced capability is used to validate the AGL concept and the A-SMGCS Guidance Service with its HMI in a realistic simulated Air Traffic Management environment. The EXE will use the operational platform in simulator configuration with reduced capability, which is different from a usual simulation in the sense that the aircraft will taxi according to the script, and no deviation is possible. Pseudo pilots will act as pilots, however, will not be able to modify the routes and are only there to enable readbacks thus enhancing the ecological validity of the setting.
HP OBJECTIVES	OBJ-02.21.4-V3-VALP-006 - Assess Controllers acceptance of operating methods OBJ-02.21.4-V3-VALP-007 - Assess the adequacy of the phraseology OBJ-02.21.4-V3-VALP-008 - Assess Controllers' workload and situational awareness OBJ-02.21.4-V3-VALP-009 - Assess the usability and effectiveness of the Controllers HMI OBJ-02.21.4-V3-VALP-010 - Assess the efficiency and effectiveness of the manual route modification.
Tool selected out of the HP repository	Over the shoulder observations, questionnaires, debriefings.
Planning and Approach	 Validation planning, development of HP objectives and associated scenario and measurement recommendations. Definition of the required scenarios HP support during the RTS runs Post-exercise data analysis Reporting



timeline

21-25th March 2022

Table 5: Description of Activity 1- Real Time Simulation





Description	 The purpose of the workshop is to present full guidance FtG concept and assess the concept feasibility from pilots and airport drivers facilitating the discussion from their point of view on the following topics: Acceptance of the solution among flight crew and vehicle drivers. Flight crew and vehicle drivers side feedback on procedures, situation awareness and communication, namely phraseology. Transition factors related to acceptance and training needs. The workshop was hosted at HungaroControl (HC) premises in hybrid modality, partners outside HC connected online. The purpose was also to collect feedback and recommendations from the flight crew and vehicle drivers.
	participated in the workshop.
Related Arguments	
HP objectives	Assess the impact of the solution on transition factors (training and acceptability)
	Assess acceptance of the solution among the affected actors (flight crew and vehicle drivers)
Issues to be addressed / investigated from issues analysis	
Tools/Methods selected out of the HP repository	Interview and workshop
summary of the HP activity	The workshop was carried out the 13 th June 2022.

Activity 2. Flight crew and vehicle drivers workshop

Table 6: Description of Activity 2 – Description of Activity 2- Workshop with ATCOs and Flight Crew

Activity 3. ATCOs final workshop	
Description	The purpose of the workshop is to present the final RTS results to the ATCOs that participated in it and consolidate the final conclusions, recommendations and requirements.





	The recommendation / requirements discussions will focus on procedures, HMI, situation awareness and transition factors related to acceptance and training needs.
Related Arguments	OBJ-02.21.4-V3-VALP-009 - Assess the usability and effectiveness of the Controllers HMI
HP objectives	Discuss and consolidate the final recommendations and requirements for the solution.
	Assess the impact of the solution on transition factors (training and acceptability).
Issues to be addressed / investigated from issues analysis	
Tools/Methods selected out of the HP repository	Interview and workshop
summary of the HP activity	The workshop took place the 28th June 2022 as an online meeting.

Table 7: Description of Activity 3 - ATCOs final workshop





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

4.4.1 Summary of HP activities results & recommendations / requirements

The HP recommendations are split in the following categories:

- Procedural •
- Training
- System design and usability

Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	activity conducted	results / evidence	recommendations	requirements		
Arg. 1.2	Arg. 1.2.1: Operating methods cover operations in normal operating conditions.								
1.2.1- 21.4- 001- HP	Issue: Planned RWY closure or de-icing may be complicated with the automatic switching of AGL if the system is not prepared for such cases. This would lead to	Closed	OBJ- 02.21.4- V3-VALP- 006	Real time simulation	The RWY closure was well handled by ATCOs during the RTS. Their mean workload level (Bedford scale) in the runway closure run was not significantly higher compared to the other runs (2.6 in the RWY closure run vs 2 2 SOL run				





	increased				vs 2.8 REF run). It is	
	workload,				important to mention	
	annoyance and				that the amount of traffic	
	lack of				was not particularly high	
	acceptability.				or complex by ATCOs.	
					The full guidance FtG supported ATCOs in performing their tasks in a timely and efficient manner most of the times and was considered highly acceptable. The de-icing operations were not included in the scenarios during the RTS.	
1.2.1- 21.4- 002- HP	Issue: RWY direction change may be complicated with the automatic switching of AGL if the system is not prepared for such cases. This would lead to increased	Open	OBJ- 02.21.4- V3-VALP- 006	Real time simulation	RWY direction change was not addressed in the RTS.	





workload,			
annoyance and			
lack of			
acceptability.			

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

1.2.2-	Issue: An	Open	OBJ-	Real time	During the validation	
21.4-	unexpected		02.21.4-	simulation	exercise all ATCOs	
001-	situation (e.g.		V3-VALP-		reported that they had	
НД	emergency or		006		no problem in going back	
1 IT	unplanned		000		to the procedures	
	unplanned				without the FtG solution.	
	RWY/IWY				Their mean workload	
	closure) could				level (Bedford scale) in	
	have an impact				the runway closure run	
	on the ATCO's				was not significantly	
	workload if the				higher compared to the	
	system is not				other runs (2.6 in the	
	well prepared				RWY closure run vs 2.2	
	for such cases.				SOL run vs 2.8 REF run). It	
					is important to mention	
					that the amount of traffic	
					was not particularly high.	
					The de-icing operations	
					were not included in the	
					scenarios during the RTS.	
					However, a couple of	
					ATCOs commented that	
					in the degraded scenario	
					the traffic complexity was	





	too low to properly	
	evaluate the impact of	
	the system malfunction.	

Arg. 1.2.3: Operating methods cover degraded modes of the ATM system.

		_			
1.2.3-	Issue: Due to	Open	OBJ-	Real time	During the RTS all ATCOs
21.4-	equipment		02.21.4-	simulation	reported that they had
001-	outage, the		V3-VALP-		no problem in going back
HP	ATCO will have		006		to the procedures
	to follow		000		without the FtG solution.
					4/5 ATCOs agreed they
	contingency				were able to apply the
	operations. If				operating methods in an
	those are not				accurate, efficient and
	(thoroughly)				timely manner in the
	defined, ATCOs				equipment outage run.
	might not be				One of the ATCOS
	able to bandle				answered that he
					somewhat agreed
	efficiently.				ATCOs also mentioned
					that the transition to
					contingency operations
					could get complicated if
					the traffic complexity is
					high and if there are
					some conflicts (e.g.
					conflict with more than 2
					2/c) If the ATCO people to
					d/cj. II the Arco needs to
					regain the picture of
					everything without the

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th	This could greatly
in	increase the workload
ex	experienced but the fact
th	that the procedures in
pl	lace dictate that the a/c
w	vill not move once they
dd	on't have the TCL makes
th	the situation safe.

Arg. 1.2.5: Operating methods (procedures) can be followed in an accurate, efficient and timely manner.

1.2.5-	See the HP	Closed	OBJ-	Real time	ATCOS were able to	R-PROC-02. ATCOs should	REQ-02.W2.21.4-
21.4-	issues for 1.2.1,		02.21.4-	simulation	follow the operating	avoid doing sudden priority	SPRINTEROP-AL01.0050. The
001-	1.2.2 and 1.2.3.		V3-VALP-		methods in an accurate,	swaps between mobiles or	Tower Controller shall be
HP			006		efficient and timely	re-routings when they are	able to switch on/off any
					manner during the	too close to the converging	stop bar individually.
					exercise. One AICO	point.	REO-02 W2 21 /-
					mentioned that in the		SPRINTEROP-ALO1 0060 The
					stand area the FtG might		Tower Controller shall be
					give some false connict		able to activate and
					alerts II it is not		deactivate the Full Guidance
					this happens the ATCOs		Assistance to mobiles
					might feel tempted to		solution.
					use a workaround of		
					giving the FtG once the		REQ-02.W2.21.4-
					a/c leaves the stand area		SPRINTEROP-AL01.0190.
					to reduce their workload.		Spacing rules shall take into
					The procedures should		account if routes are merging
					state and specify how		or in-line, types of aircraft,
					. /		the weather conditions, and





		ATCOs should act in this specific case.	other conditions requiring different spacing.
			REQ-02.W2.21.4- SPRINTEROP-AL01.0090. Priority of mobiles in conflict situations shall be based on rules, and use data such as distance from intersection, departure/arrival, TTOT, or order of electronic flight strips.

Arg. 2.1.4: The level of workload (induced by the allocation of tasks between the human and the machine) is acceptable.

2.1.4	Benefit: If many	Closed	OBJ-	Real time	3/5 ATCOS reported to	
21.4-	important tasks		02.21.4-	simulation	have experienced less	
001-	are shifted to		V3-VALP-		workload working with	
HP	the system (i.e.		008		the full guidance FtG	
	conflict				compared to the	
	dotaction and				reference scenario with	
					FtG from SESAR1. The	
	resolution), it				medium value or	
	can decrease				workload (Bedford scale)	
	workload.				reported in both the	
					Solution runs (both	
					normal visibility and LVP)	
					were slightly better than	





	in the reference runs (2.2	
	Sol ; 3 Sol. LVP vs 2.8 Ref ;	
	3.2 Ref LVO).	
	Overall, ATCOs	
	considered that	
	compared with current	
	operations, the full	
	guidance FtG solution	
	greatly improved their	
	workload, the conflict	
	detection features were	
	highly appreciated and	
	they were the aspect that	
	mostly contributed to the	
	workload reduction.	

Arg. 2.1.6: The level of trust in automated functions is appropriate.

2.1.6-	The defined	Closed	OBJ-	Real time	All ATCOs reported that	R-SDU-08. Priority	
21.4-	priority rules		02.21.4-	simulation	they agreed that the	configurations and	
001-	for conflict		V3-VALP-		default conflict solving	separation distances should	
HP	detection and		009		priority parameters were	be based on the local	
	resolution may				adequate in the post-	airport rules and	
	not he in				simulation questionnaire.	procedures.	
	accordance				Overall, ATCOs		
	with the ATCO's				mentioned that they		
	with the ATCO'S				really appreciated the		
	expectations				conflict resolution logic.		
	(the logic of the				Finally ATCOs mentioned		
	algorithm). It				that some priority		
	could be a				configurations would		





problem if e.g.	need be fine-tuned
problem if e.g. an arrival is well ahead from time point of view but still the departure has the priority. This may lead to lack of trust in the system and increased workload.	need be fine-tuned according to Budapest airport and in some occasions they experienced vehicles being prioritised over an aircraft (platform limitation).

Arg. 2.3.1: The type of information provided satisfies the information requirements of the human.

2.3.1-	Issue: The HMI	Closed	OBJ-	Real time	All ATCOs agreed that the	R-SDU-01. When a conflict	
21.4-	may include too		02.21.4-	simulation	overall usability of the full	is detected, the HMI should	
002-	many features,		V3-VALP-		guidance FtG HMI was	clearly distinguish between	
HP	cluttering the		009		adequate. 3 ATCOs	the mobile with priority and	
	display which				agreed that the HMI	mobile being restricted.	
	cap load to				supported their SA and 2		
					ATCOs somewhat agreed		
	confusion and				that the HMI support		
	increased time				their SA.		
	to find the						
	relevant				ATCOs also agreed that		
	information.				the overall timeliness and		
					accuracy of the full		
					guidance FtG supported		
					their tasks. However,		
					they also mentioned		

_





		some specific aspects in which they would have liked to see improvements.	
		4/5 ATCOS reported that it was not immediate to understand the a/c who had priority from the label symbol.	

Arg. 2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable.





	not be straightforward.				highlights the a/c that does not have priority. ATCOs would have preferred a more conspicuous representation of the a/c with priority.		
2.3.6- 21.4- 002- HP	The presence of alerts (e.g. CATC and CMAC) may mitigate human error and increase situational awareness by highlighting non- conformance or conflicting ATC clearances.	Closed	OBJ- 02.21.4- V3-VALP- 009	Real time simulations	The alerts (CMAC no taxi (no FtG) and route deviation) were considered very useful and reduced the ATCOs' scanning load. All ATCOs agreed that the No taxi (no FtG) and the route deviation alert were triggered timely and accurately.	R-SDU-05. The CMAC no taxi (no FtG) and route deviation false alarms should be reduced to a minimum acceptable level because they can cause cry wolf effect and distract ATCOs from important situations/events.	REQ-02.W2.21.4- SPRINTEROP-AL01.0280. If the solution detects a route deviation, including lit TCL overrun, the TCL shall be switched off. REQ-02.W2.21.4- SPRINTEROP-AL01.0290. The Tower Controller shall receive an alert when an aircraft is moving on a taxiway without having received a TAXI instruction. This includes when it is being guided by a means such as activated TCL (Follow the Greens) and it overruns the activated TCL.





2.3.6- 21.4- 003- HP	The HMI's look and feel could entail the potential of being modern, which would enhance the user experience. Simple and logical design with optimal colouring scheme could also add value to this experience.	Closed	OBJ- 02.21.4- V3-VALP- 009	Real time simulation	All ATCOs agreed that the overall usability of the full guidance FtG HMI was adequate. The taxiway centre lights were correctly displayed in the HMI and the accuracy and timeliness of the information provided was adequate for to support the ATCO tasks. 3 ATCOs agree that the HMI supported their SA and 2 ATCOs somewhat agreed that the HMI support their SA.	R-SDU-02. When a conflict is detected, the HMI should highlight the aircraft with priority and make it more conspicuous.	REQ-02.W2.21.4- SPRINTEROP-AL01.0140. When a mobile's TCLs are being restricted in order to prioritise converging mobiles at intersections or to avoid a deadlock situation, the Controller shall be provided with information indicating the last lit TCL. REQ-02.W2.21.4- SPRINTEROP-AL01.0330. The Tower Controller shall be informed about the status of the solution and be alerted in case of a failure.

Arg. 2.3.8: The user interface design supports a sufficient level of individual situation awareness.

2.3.8-	Issue: If too	Open	OBJ-	Real time	The questionnaire results	R-SDU-03. Once a conflict is	REQ-02.W2.21.4-
21.4-	many important	-	02.21.4-	simulation	revealed that ATCOs	identified, the labels of the	SPRINTEROP-AL01.0040. The
001-	tasks are		V3-VALP-		workload (Bedford scale)	involved mobiles or flights	Tower Controller shall be
НР	shifted to the		008		was slightly lower using	shall display the priority	provided with the
	system (i.e.				the Solution FtG (2.2	order with numbering to	information on lit Taxiway
	system (i.e.				mean value between		
	connict				ATCOs vs 2.8 in the		








						mobiles at intersections or to avoid a deadlock situation, the Controller shall be provided with information indicating the last lit TCL.
Arg. 3.3.2: The phraseology	supports com	munication in	all operating condi	tions.	:	;
 3.3.2- Issue: If the 21.4- ATCO does not 001- issue the full HP taxi clearance, s/he may not remember where the a/c are taxiing in dense traffic situation (i.e. the mental picture of the traffic situation may be impacted). 	Open	OBJ- 02.21.4- V3-VALP- 007	Real time simulation	 When asked if the phraseology used was clear and did not cause any misunderstandings, all 5 ATCOs rated as Always or very often in the solution scenarios. Two ATCOs mentioned that in the degraded scenario they experienced an increase in communication between Ground and a/c which they were able to manage without much problem in that specific case. One ATCO pointed out that the information should be backed up with a specific came kind of endly 	R-PROC-01. Using additional traffic information and extending phraseology should be considered in situations of sudden priority swap between converging mobiles or re-routing.	





system to increase	
reliability and pilots	
confidence. This	
confidence and trust	
could expedite even	
more the taxy for pilo	ts
and avoid them slowi	1g
down or stopping in	·0
critical areas during ta	avi
Pilot and vehicle drive	yr
feedback	-
Sudden change of gre	en
lights at intersections	can
be confusing from the	
pilot's side and might	
need to be backed up	
with a specific proced	ure
and dedicated	
phraseology.	
In the current	
implementation, that	
does not take the spe	ed
of the aircraft in the	
guidance, it would be	
helpful if the ATCO	
phraseology can	
integrate some impor	tant
operational aspects li	<e contract="" of="" s<="" second="" td="" the=""></e>
the priority information	on





		in certain crossings (good	
		visibility operations) or	
		that the pilot is provided	
		with taxi speed advise	
		from the ATCO in order	
		to maintaining a good	
		flow of traffic.	

Arg. 4.1.1: Changes in roles and responsibilities are acceptable to the affected human actors.

4.1.1- 21.4- 001- HP	See 2.1.2-1.1 regarding acceptance of the changing tasks	Closed	OBJ- 02.21.4- V3-VALP- 006	Real time simulation	There were no changes in the roles and responsibilities of the human actors affected by the solution. The operating methods introduced by the full guidance FtG were well accepted and could be followed accurately, efficient and in a timely manner by ATCOs in all the operational conditions.		
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Arg. 4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered.

4.1.2-	See 1.2.1-21.4-	Closed	OBJ-	Real time	The operating methods
21.4-	001 regarding		02.21.4-	simulation	introduced by the full
					guidance FtG were well
					accepted and could be

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001- HP	overreliance and acceptance		V3-VALP- 006		followed accurately, efficient and in a timely manner by ATCOs in all the operational conditions. During the debriefing ATCOs considered that compared with current operations, the FtG solution greatly improved their workload level, the conflict detection features were highly appreciated and they were the aspect that mostly contributed to the workload reduction. The full guidance FtG reduce ATCOs effort to search for possible conflict because of the alerts in place.
4.1.2- 21.4- 002- HP	In case the a/c has no foreseen conflicts, the TCL being lit in small blocks and not until the stop bars	Open	OBJ- 02.21.4- V3-VALP- 006	RTS and ATCOs debriefing	The full guidance FtG concept that was tested during the RTS had no speed control functionality and the TCL lit in front of the aircraft varied in the sections of the airport. The TCL in





	could make the			front of the a/c reduced
	optimal speed			to separate two aircraft
	control for the flight crew difficult. It may			or approaching a conflict
				spot in order to regulate
				the priority between 2
	result the flight			mobiles (in the RTS case 2
	crew following			aircraft).
	the TCL blindly			The system in certain
	not knowing			cituation did not apply
	whore it would			
				good spacing. One ATCO
	ieau.			
				pleased that sometimes
				the second a/c was let
				too close to the one in
				front. In normal VMC
				condition scenario they
				went too close to each
				other. At the same
				situation and sometimes
				the system kept the same
				distance and the ATCO
				felt that the spacing was
				not a consistent.
112	Airport	Open	Pilot and vehicle	Vehicle drivers
4.1.2-	Anport	Open	drivers' workshop	mentioned that they
Z1.4-				would like to use EtG only
	service venicles			in Low visibility
	will be guided			





003-	via AGL in LVP	conditions, since now
HP	and when	they are not allowed to
	intentionally	taxi in LVP in Budapest
	and	airport. It should be
	unavoidably	considered that the
	(for their	participating vehicle
	specific task)	drivers were part of
	operating on	maintenance teams
	the taxiway	(engineers and
	constanting This	technicians) and they
	centre line. I nis	usually need to go to
	is expected to	specific locations that the
	increase their	AICUS don't know
	situational	request clearances to
	awareness and	request clearances to
	their efficient	the airport
	task execution.	
	Similarly, Fire	In case of emergency
	service vehicles	ATCOs might close
	will only be	certain part of the
	guided via AGL	taxiway or manoeuvring
	in LVP and in	area and fire brigades can
	complex traffic	easily be guided to
	situations	certain locations without
	Individual	the risk of causing a
	guidance via	conflict. Therefore, the
		FtG was also considered
	AGL may nep	and advantage for this
		type of operations.
	to identify the	
	shortest way to	





the incident			
area.			

Arg. 4.5: Training needs are identified for affected human actors.

4.5- 21.4- 001- HP	Benefit: Adequate training that takes into account the required level of knowledge, skill and experience requirements (Arg. 4.2.1 in wave 1) could accelerate the learning of the new operating method.	Closed		Pilot and vehicle drivers' workshop	ATCOs considered that adequate training and good knowledge on the tools functionalities and limitations is one most of the most important aspects to consider in terms of operational acceptability.	R-TRAINING-01. The operating methods and procedures while using the full guidance FtG should be clear to all the actors and therefore, included in training.	
4.5- 21.4- 002- HP	Adequate training of the flight crew can improve the acceptance of the new operating method and	Closed	OBJ- 02.21.4- V3-VALP- 012	Pilot and vehicle drivers' workshop	During the workshop discussions, pilots and vehicle drivers agreed that training and familiarization is the most important aspect to build trust in the system and, consequently, improving	R-TRAINING-02. The training content to be addressed during the FtG introduction should be based on common standardised material that will for all European ANSPs,	

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reduce		acceptance of the new	airspace users and airports	
workload		operating method	operators.	
Workload.		(procedures).		
		(p. c.c.a. c.).		
		Pilots mentioned the		
		familiarization with the		
		EtC should be done both		
		via sirling operators		
		training and via		
		information in the airport		
		briefing (AIP). The airline		
		training must be		
		mandatory and the		
		modality could be using		
		e-learning (online) or		
		computer-based training		
		(CBT).		
		()		
		The training should		
		mainly focus on the		
		competences below:		
		competences selom		
		- Theoretical knowledge		
		on FtG (rules airport		
		local operational		
		specificities good		
		practices, contact of use		
		practices, context of use,		
		Low visibility Operations,		
		limitations of the system		
		and failure modes)		
		- Regulatory framework		





					- Theoretical knowledge on the FtG procedures (including procedures to fallback in case of degraded operations).	
4.5- 21.4- 003- HP	Adequate training of the vehicle drivers can improve the acceptance of the new operating method and reduce workload.	Closed	OBJ- 02.21.4- V3-VALP- 013	Pilot and vehicle drivers' workshop	During the workshop discussions, pilots and vehicle drivers agreed that training and familiarization is the most important aspect to build trust in the system and consequently improving acceptance of the new operating method (procedures). Vehicle drivers found that FtG familiarization could be integrated as part of the aerodrome driver license training. The training should mainly focus on the competences below:	





- Theoretical knowledge
on FtG (rules, airport
local operational
specificities, good
practices, context of use,
Low Visibility Operations,
limitations of the system
and failure modes)
- Regulatory framework
- Theoretical knowledge
on the FtG procedures
(including procedures to
fallback in case of
degraded operations).

Table 8: Summary of the HP results and recommendations/ requirements for each identified issue & related argument





4.4.2 Maturity of the Solution





	Maturi	ty 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	The present report encloses the HP Assessment report. Relevant arguments, associated HP issues and HP VOs have been addressed in this document (section 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	All benefits and issues have been addressed and the associated evidence provided (section 4.4.1). The only argument 1.2.1-21.4-002-HP about RWY direction change was not addressed in the RTS since it was not included as part of the validated.
3	Have all the parts of the solution/concept been considered?	Yes	Most parts of the solution scope were assessed. The de-icing scenarios and RWY direction change were not addressed in the scenarios as initially previewed because they were considered more relevant scenarios to the routing service validation which was within the scope of PJ.02-W2-21.6 A RWY change could have created more conflicting situations to be handled by the solution. This scenario be included and addressed in more detail in the next phases and validated as part of the routing function. For this purpose, the routing and guidance services should be also validated in the same validation activities because their results in terms of Human Performance are hard to dissociate.During the RTS a couple of ATCOs commented that in the degraded scenario the traffic complexity was too low to properly evaluate the impact of a system malfunction in a high workload context. This should be further investigated in future steps.
4	Have potential interactions with related projects/concepts been considered and addressed?	Yes	The list of projects and links with other projects/concepts has been in the change request.





5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	Refer to results provided in the table in section 4.4.1.
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	Refer to results provided in the table in section 4.4.1.
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes	The proposed solution has been tested with 5 ATCOS in a RTS which covered good visibility, LVP and degraded FtG tool scenarios. The RTS was carried out in realistic conditions. The participation of more ATCOs in the RTS would have certainly improved the level of confidence in the results. But the opinions of the ATCOs were generally aligned and did not show much divergence. During the RTS the degraded scenario the traffic complexity considered was too low by ATCOs to properly evaluate the impact of a system malfunction. This should be further investigated.
8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	Validation results related to the interaction between the human and the system confirm that the concept is operationally feasible and consistent with human performance requirements. But also highly dependent on routing and not only in the guidance features of the system.
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	HP results have provided the input for the HP results in HPAR have been integrated in the OSED.





10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	The results do not show blocking point regarding human performance. The main improvements are related to ATCO HMI and usability of the tool and a better definition of procedures and phraseology.
			In the current implementation, that does not take the speed of the aircraft in the guidance, it would be helpful if the ATCO phraseology can integrate some important operational aspects like the priority information in certain crossings (good visibility operations) or that the pilot is provided with taxi speed advice from the ATCO in order to maintaining a good flow of traffic.
			Sudden change of green lights routing can be confusing from the pilot's side, sudden change might need to be backed up with a specific procedure and dedicated phraseology.





11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	Most HP recommendations were taken into consideration in the HMI design, procedures and training.
			The training of participants on the solution and platform should have been more detailed and maybe also done with a bit more advance respect to the RTS. This was due to travel and time constrains since HC ATCOs had to travel to Asker in Norway to INDRA premises. To mitigate this a online training was delivered the week before but some ATCOs understood some platform limitations as solution limitations, we tried to unpack these aspects during the debriefings and clarify.
			The following some HMI requirements were not fully implemented (REQ-02-W2.21.4 SPRINTEROP-AL01.0140) in the validated full guidance FtG prototype but during the debriefings it confirmed as relevant in order to improve ATCOs Situational Awareness.
			REQ-02-W2.21.4 SPRINTEROP-AL01.0140. When a mobile's TCLs are being restricted in order to prioritise converging mobiles at intersections or to avoid a deadlock situation, the Controller shall be provided with information indicating the last lit TCL.
			Others requirements were not implemented, mostly related the stop bars activation and switching off features (REQ-02.W2.21.4-SPRINTEROP-AL01.0270; REQ- 02.W2.21.4-SPRINTEROP-AL01.0050 and REQ-02.W2.21.4-SPRINTEROP-AL01.0210).
			However, even if no major blocking point points were found, some improvements should be carried out before an actual implementation of the concept. Those improvements are main requested were mainly related to the HMI:
			 <u>Alerting features:</u> The alerts were considered very useful and reduced the ATCOs' scanning load. All ATCOs agreed that the 'No taxi' and the 'route deviation alert' were triggered timely and accurately
			 <u>Conflict detection and resolution</u>: 4/5 ATCOS reported that it was not immediate to understand the a/c who had priority from the label symbol. ATCOs would have preferred a more conspicuous representation of the a/c with priority.





			 ATCOs would have liked to have the priority information more immediate and in a more intuitive way. Namely, seeing the priority number on the flight label or a colour coding in the label corresponding to the order of the flights and having the information without having to hoover with the mouse over the label/conflict. <u>Priority change feature:</u> ATCOs were unanimous in reporting that the changing priority feature should be improved. The fact that the change priority symbol remains always in the label it gave the idea to a couple of ATCOs that the conflict had not yet been resolved by the system.
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	The major transition aspects have been considered in the V3 exercises and in the reporting.





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	 No changes in roles and responsibilities regarding the one currently implemented will require regulations changes. Operating methods introduced by the automated switching of AGL function and A-SMGCS Routing Service could be followed accurately, efficient and in a timely manner by ATCOs in all the operational conditions. However, a couple of ATCOs commented that in the degraded scenario the traffic complexity was too low to properly evaluate the impact of a system malfunction. Refer to results provided in the table in the TS/IRS document on applicable Standards and Regulations. SERA (Standardised European Rules of the Air) (EU regulation 923/2012) – specifies taxi phraseology in: Appendix 1 to AMC1 SERA.14001 General with ATC PHRASEOLOGIES (1.4.7) May need amendment to include taxi procedure by A-SMGCS guidance service/FtG procedure SEARA also contain an appendix for Signals. Using light signals for taxi guidance may be need to be described here.
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes	Recommendations for future research concerning HP aspects have been identified and reported in the present document and in the VALR.

Table 9 PJ02 21.4 Full guidance follow the greens HP Maturity checklist for the V3 assessment.





5 References

Human Performance

- [1] 16.06.05 D27 Human Performance Assessment Process V1 to V3 including VLDs., 00.01.00
- [2] 16.04.02 D04 e-HP Repository Release note





Appendix A – Additional HP activities conducted





PILOTS AND VEHICLE DRIVERS FtG WORKSHOP minutes

Participants: Four participants participated in the workshop, two pilots and two vehicle drivers.

1. Main operational benefits this follow the greens implementation could have in your work:

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The main benefits that were mentioned by both pilots and vehicle drivers were improved situation awareness, less workload and less probability of taking the wrong taxiway due to poor communication (i.e. pronunciations or accent aspects). More expedite taxiing, more confidence in low visibility operations and reduction of communication with Tower ATC were also mentioned. The reduction of head down time was also considered an advantage for safety, if with two pilot flight crew only one must spend more head down time with navigation functions.

Vehicle drivers mentioned that they would like to use it only in Low visibility conditions, since now they are not allowed to taxi in LVP in Budapest airport. It should be considered that the participating vehicle drivers were part of maintenance teams (engineers and technicians) and they usually need to go to specific locations that the ATCOs don't know beforehand, they need request clearances to reach a specific part of the airport.

In case of emergency ATCOs might close certain part of the taxiway or maneuvering area and fire brigades can easily be guided to certain locations without the risk of causing a conflict. Therefore, the FtG was also considered and advantage for this type of operations.





Please rate your level of agreement towards the following operational benefits of the current FTG concept



Figure A-3. Results of the Mentimeter slide with some pre-selected FtG benefits (N. of answers: 3).

2. Acceptability towards the FtG implementation:

Both pilots and vehicle drivers would be happy to use the current FtG implementation in operations. The working methods were considered clear but the training plays an important role, pilots and vehicle drivers must be informed about them.

The most important aspect that associated to acceptability was trust in the system. One of the pilots mentioned that training and familiarization is the way to accept and trust the system.

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The reduced communication between ATC and aircraft could impact on the vehicle drivers SA. If they can't use radio communication to build their SA while then they require this information to be given to then by others means.

One of the pilots mentioned that one of the solutions could be having ATCOs providing information via FtG and enriching the information provided to them so they can build up an adequate picture of the manoeuvring area. But this can ultimately impact the ATCO workload because he needs to provide different information to a/c and to vehicle driver and we are creating different procedures for different stakeholders.

One pilot mentioned that he would like to have the length of TCL lit in front of them associated to the speed control, so they know if they should start slowing down of can accelerate more (this is not part of the current implementation).

The same pilot also mentioned that it could be interesting that length of TCL could be customized according to different type of aircraft. But during the discussion it was also mentioned that for standardization between airports and between concepts the distance for bigger aircraft could be the one used in order to be conservative with distances.

3. Situations where pilots or vehicle drivers would want guidance by TCL backed up with further instructions from the ATC:

If the FtG is stopping the a/c and the pilots can't see no other aircraft around then the pilots will call the ATCO asking the reason why he can't move. But this will also depend on training and briefing that pilots and vehicle drivers will attend.

In the current implementation, that does not take the speed of the aircraft in the guidance, it would be helpful if the ATCO phraseology can integrate some important operational aspects like the priority information in certain crossings (good visibility operations) or that the pilot is provided with taxi speed advise from the ATCO in order to maintaining a good flow of traffic.

4. Situation/scenario in which the FtG operations could be problematic:

Adverse weather situations where extensive parts of TCL segments are covered in snow will not enable FtG operations. When the pilot receives information that is not in line with the clearance it can be problematic and will impact the pilots and vehicle drivers' trust in the system. Any updates to assigned parking stand after receiving the initial taxi clearance need to be coordinated between ATC and flight crew.





In certain contexts it might be more complex to move around the airport and take more time with the FtG. For instance, if vehicle drivers need to quickly move from A to B in a small and familiar airport, they need to inform the ATCO about it and to FtG to that place it might take more time.

5. Aspects to improve trust in the FtG implementation (i.e. phraseology, procedures, communication tools, etc.):

The main aspect that will improve pilots' and vehicle drivers trust in the system is training, which was considered paramount. All stakeholders must understand how the systems works so that they can make their own decisions without pushing the boundaries of that system.

6. TRAINING. FtG familiarization format and suggestions for pilots:

The familiarization with the FtG should be done both at airline operators training and by including information in the airport briefing (AIP). The airline training must be mandatory and the modality could be using e-learning (online) or computer-based training (CBT).

It was mentioned that it would be good to have a standardized training so that airlines could adopt the same training and consider it as a type of license. It could be considered like LVP training, the core system are standard so that pilots are certified to fly LVP in all airports. All special features that can differ between different systems or providers would be addressed in a dedicated training or airport briefing, but the main core competences and contents could be stay the same.

If the FtG will be implemented in very few airports, then it should be treated like trainings that are done for special airports (i.e. Innsbruck).

7. TRAINING. FtG familiarization format and suggestions for vehicle drivers:

Vehicle drivers found that FtG familiarization could be included in the aerodrome driver license. At a certain point one driver mentioned the familiarization could be part of the LVP training module, but this opinion is related to the fact that they would like to use it in LVP.

8. TRAINING. Main training content and competences that should be addressed:

- Theoretical knowledge on FtG (rules, good practices, context of use, Low Visibility Operations, limitations of the system and failure modes)
- Regulatory framework and
- Theoretical knowledge on the FtG procedures (including procedures to fallback in case of degraded operations)

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Appendix B – HP Recommendations Register

			HP Recom	mendations	Register					
Reference	Type of recommendat ion	Recommendation	Rationale	Assessme nt source + Reference report	Scope (Air, Air/Ground, Ground)	Conce pt/ solutio n Involve d	Recommendation status	Rationale case rejection	in of	Comments
R-TRAINING- 01	Training	The operating methods and procedures while using the full guidance FtG should be clear to all the actors and therefore, included in training.	Both ATCOs and pilots recommend that procedures and operating methods of the full guidance FtG must be addressed in detail in training to make sure that they are clear. Training greatly contributes to improve trust and acceptability by all actors.	RTS 2022 Vehicle drivers and pilots workshop	Air/Ground	PJ02 21.4	Accepted			
R-TRAINING- 02	Training	The training content to be addressed during	The new competences will be introduced to	Vehicle drivers	Air/Ground	PJ02 21.4	Accepted			





		the FtG introduction should be based on common standardised material that will for all European ANSPs, airspace users and airports operators.	ANSPs, airspace user and airport operators should preferably be created by a unique European standard body or safety agency.	and pilots workshop				
R-PROC-01	Procedures /operating methods	Using additional traffic information and extending phraseology should be considered in situations of sudden priority swap between converging mobiles or re-routing.	ATCOs should provide additional information in these cases, using dedicated phraseology. If they do not do it, pilots might communicate to try to get more information because they might need to be reinsured.	Vehicle drivers and pilots workshop	Air/Ground	PJ02 21.4	Accepted	
R-PROC-02	Procedures /operating methods	ATCOs should avoid doing sudden priority swaps between mobiles or re-routings	Sudden change of green lights can be confusing from the pilots or vehicle drivers side The	Vehicle drivers and pilots workshop	Ground	PJ02 21.4	Accepted	





		when they are too close to the	procedures should specify what	ATCO workshop				
		converging point.	should be done if ATCO are forced to do late route changes at converging points and how they should do it (including phraseology specification to be used in the cases).					
R-SDU-01	System design and usability	When a conflict is detected, the HMI should clearly distinguish between the mobile with priority and mobile being restricted.	4/5 ATCOS reported that it was not immediate to understand the a/c who had priority from the label symbol.	RTS 2022	Ground	PJ02 21.4	Accepted	
R-SDU-02	System design and usability	When a conflict is detected, the HMI should highlight the aircraft with priority and make it more conspicuous.	ATCOs mentioned that in the current interface implementation the most conspicuous aircraft in a conflict was the one being	RTS 2022	Ground	PJ02 21.4	Accepted	





			restricted. Most of them mentioned they would prefer to seem the aircraft with priority highlighted (the highlight could be achieved by using a specific colour code, adding priority numbering or adding other visual features).					
R-SDU-03	System design and usability	Once a conflict is identified, the labels of the involved mobiles or flights shall display the priority order with numbering to support the ATCO's situation awareness.	ATCOs need to know the priority order of each aircraft involved in a detected conflict, the order lets them know the resolution provided by the system. The order should also be displayed for the aircraft conflict pairs in the priority window.	RTS 2022	Ground	PJ02 21.4	Accepted	





R-SDU-04	System design and usability	The ATCO should be able to easily visualise the point in which the mobile will be restricted when a conflict is identified.	Knowing the specific point where the mobile will be restricted supports the ATCO in checking what the system will do, this information supports his trust in the system.	RTS 2022	Ground	PJ02 21.4	Accepted	
R-SDU-05	System design and usability	The CMAC no taxi (no FtG) and route deviation false alarms should be reduced to a minimum acceptable level because they can cause cry wolf effect and distract ATCOs from important situations/events.	ATCOs mentioned that their SA could get especially if the conflict alerts are provided too much in advance and/or do not match actual conflicts. False alarms can induce cause cry wolf effect and distract ATCOs from important situations.	RTS 2022	Ground	PJ02 21.4	Accepted	
R-SDU-06	System design and usability	The priority change feature symbol should show when an action is	ATCOs mentioned that it was not easy to understand if the priority change symbol was a	RTS 2022	Ground	PJ02 21.4	Accepted	





		interactive).	lacked feedback when it had been pressed. It should be clear that is a button and when it is activated. When it is pressed it would be good if the involved mobiles are highlighted.					
R-SDU-07	System design and usability	The implementation window should include a clear visualization of the prioritized mobiles order (include numbering) and integrate a more straight forward interaction modality.	recommendation is relevant in case the implementation includes a priority change window: ATCOs mentioned that the lack of order (numbering) of the mobiles in the priority change window made difficult to understand the conflict resolution provided the system and to distinguish the	RTS 2022	Ground	PJ02 21.4	Accepted	





			prioritised mobiles within the pair.					
R-SDU-08	System design and usability	Priority configurations and separation distances should be based on the local airport rules and procedures.		RTS 2022	Ground	PJ02 21.4	Accepted	

Table 10: HP recommendations for PJ02 21.4 full guidance Follow the greens.





Appendix C – HP Requirements Register

HP Requirements Register									
Reference	Type of requiremen t	Requirement	Rationale	Assess ment source + Referen ce report if availabl e	Scope (Air, Air/Ground , Ground)	Concept / solution Involved	Requiremen t status	Rational e in case of rejection	Comment s
REQ- 02.W2.21.4- SPRINTEROP- AL01.0040	System design and usability	The Tower Controller shall be provided with the information on lit Taxiway Centreline Lights status on the solution HMI.	The Tower Controller need a detailed status of the individual TCL.	RTS 2022	Ground	PJ02 21.4	Accepted		
REQ- 02.W2.21.4- SPRINTEROP- AL01.0050	System design and usability	The Tower Controller shall be able to switch	Ultimately, the Controller should remain responsible for the activation	RTS 2022	Ground	PJ02 21.4	Accepted		





		on/off any stop bar individually.	or de- activation of stop bars and can override the system's decisions.					
REQ- 02.W2.21.4- SPRINTEROP- AL01.0060	System design and usability	The Tower Controller shall be able to activate and deactivate the Full Guidance Assistance to mobiles solution.	This requirement covers the situation where there is a need to override the solution due to a failure or whatever.	RTS 2022	Ground	PJ02 21.4	Accepted	
REQ- 02.W2.21.4- SPRINTEROP- AL01.0090	PROC	Priority of mobiles in conflict situations shall be based on rules, and use data such as distance from intersection, departure/arrival , TTOT, or order of electronic flight strips.	The aim of the Guidance Service is to take into account other traffic for spacing and guide mobiles as they progress along their assigned routes and allocates	RTS 2022	Ground	PJ02 21.4	Accepted	





			priority between mobiles based on local operating rules.					
REQ- 02.W2.21.4- SPRINTEROP- AL01.0140.	System design and usability	When a mobile's TCLs are being restricted in order to prioritise converging mobiles at intersections or to avoid a deadlock situation, the Controller shall be provided with information indicating the last lit TCL.	The ATCO needs to be informed of the system's restrictions on guidance by TCL. The indication could be a red mark or line at the end of the TCL indication.	RTS 2022	Ground	PJ02 21.4	Accepted	
REQ- 02.W2.21.4- SPRINTEROP- AL01.0150	System design and usability	The Tower controller shall be allowed to swap the priority between converging mobiles or	The ATCO needs to be able to change the system's resolution in case it does	RTS 2022	Ground	PJ02 21.4	Accepted	





		mobiles in a predicted deadlock situation.	not match his/her intent.					
REQ- 02.W2.21.4- SPRINTEROP- AL01.0190	PROC	Spacing rules shall take into account if routes are merging or in-line, the types of aircraft, the weather conditions, and other conditions requiring different spacing.	The solution control the movement of mobiles by switching the AGL on/off, taking into account spacing rules. Due to different types of aircraft, the presence of vehicles, the weather conditions, the day time, local and other restrictions the visualized spacing can change. This includes applying the spacing between the	RTS 2022	Ground	PJ02 21.4	Accepted	





			lit TCL of two mobiles in trail on the same route.					
REQ- 02.W2.21.4- SPRINTEROP- AL01.0290	System design and usability	The Tower Controller shall receive an Alert when an aircraft is moving on a taxiway without having received a TAXI instruction. This includes when it is being guided by a means such as activated TCL (Follow the Greens) and it overruns the activated TCL.	The Controller needs to know when aircraft are moving without authorisation.	RTS 2022	Ground	PJ02 21.4	Accepted	
REQ- 02.W2.21.4- SPRINTEROP- AL01.0310	System design and usability	The Stop bar status (on/off) shall be provided to the Tower	The Tower Controller should have the ability to get a detailed	RTS 2022	Ground	PJ02 21.4	Accepted	




		Controller on the A-SMGCS HMI.	status of the Stop Bars.					
REQ- 02.W2.21.4- SPRINTEROP- AL01.0330	System design and usability	The Tower Controller shall be informed about the status of the solution and be alerted in case of a failure.	Tower Controllers shall be aware of the status of the A- SMGCS Guidance service at every moment.	RTS 2022	Ground	PJ02 21.4	Accepted	
REQ- 02.W2.21.4- SPRINTEROP- AL01.0400	System design and usability	When the solution detects a conflicting situation, the Controller shall be provided with information that a conflict is detected, who has priority, and where the predicted conflict is, preferably without having to	The priority when a conflict is detected and the predicted location of the conflict should be readily available to the ATCO because these are critical information's that allow them to	RTS 2022	Ground	PJ02 21.4	Accepted	

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		make input to the system.	decide if they accept the proposed prioritisation or not.					
REQ- 02.W2.21.4- SPRINTEROP- AL01.0410	System design and usability	The HMI shall keep the ATCO informed once the guidance system is considering LVP separation distances in guidance.	It is important that the ATCO is aware if the system is considering the LVP separation once those procedure are applicable.	RTS 2022	Ground	PJ02 21.4	Accepted	

Table 11: HP Requirements





Appendix D – HP Log







-END OF DOCUMENT-









