

# SESAR 2020 PJ 07-W2-40 - SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report

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# OAUO

## INITIAL 4D MISSION TRAJECTORY DEVELOPMENT WITH INTEGRATED DMA TYPES 1 AND 2 SUPPORTED BY AUTOMATION AND DYNAMIC CIVIL-MILITARY CDM

This Human Performance Assessment Report is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874465 under European Union's Horizon 2020 research and innovation programme.



### Abstract

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This document contains the Human Performance (HP) assessment report for the PJ 07-W2-40, 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 Step 4 – Collate findings & conclude on transition to next V-phase.

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# 1 Executive Summary

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This document constitutes the Part IV of the OSED/SPR/INTEROP and collates the findings on **Human Performance assessment** activities performed in the SESAR Project Solution PJ07-W2-40 "Initial 4D mission trajectory development with integrated DMA types 1 and 2 supported by automation and dynamic civil-military CDM" at V3 maturity phase.

Solution PJ07-W2-40 validation builds upon the results delivered by SESAR 1 - P7.6.2 (Business and Mission Trajectory), P7.5.4 (Advanced Flexible Use of Airspace), SWP11.1 (WOC), and SESAR 2020 Wave1 - PJ.07-03/PJ.18-01a (Mission Trajectory Driven Processes), and PJ.08-01 (Management of Dynamic Airspace Configurations supporting DMAs type 1 and 2).

The following OI steps have been validated within the context of this solution:

- AUO-0216 — Shared Mission Trajectory Data
- AUO-0210 — Participation in CDM through iSMT and Target Time (TTO) negotiation
- AOM-0304-B — Integrated management of Mission Trajectory in trajectory based operations environment
- AOM-0208-B — Dynamic Mobile Areas (DMA) of types 1 and 2

The HP report presents the outcomes of the four Steps tasks completed for each OI covered by the solution and related to HP Assessment Process aiming at:

Step 1 – Understand the concept: Reference, Solution and Assumptions

Step 2 – Understand the Human Performance Implications

Step 3 - Improve and validate the concept

Step 4 - Collate findings and conclude on transition to next V-phase.

## 2 Introduction

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### 2.1 Purpose of the document

This document provides the Human Performance Assessment Report for PJ07-W2-40 for V3. It describes the results of assessment process defined in PJ07-W2-40 V3 Validation Plan and provides a set of relevant conclusions and recommendations.

### 2.2 Intended readership

The intended audience of this document consist of:

- PJ.07 Solutions; all solutions part of Project 07 should have a close collaboration to ensure a consolidated approach to their common validation threads
- PJ.09-W2-44, which is a complementary solution concerning the validation of DMA performance benefits, addressing the integration of DMA type 1 into Dynamic Airspace Configurations (DAC)
- PJ.19.02, in charge of the SESAR conceptual documents in Wave 2
- PJ.19.04, which will collect outputs of the validation exercises for consolidation and will perform the performance gap analysis
- Key stakeholders who will benefit from the deployment of the Solution:
  - Military and Civil Airspace Users
  - Air Navigation Service Providers, particularly Airspace Managers (AMCs) and Air Traffic Flow and Capacity Managers (FMPs)
  - Network Manager, indirectly from improved sub-regional/local processes



## 2.3 Structure of the document

This document consists of Part IV of the SPR-INTEROP/OSED for solution PJ07-W2-40.

SPR-INTEROP/OSED Part I provides the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), related to a SESAR Solution PJ07-W2-40, that have been validated during validation activities at a V3 level. They are presented in the context of the Operational Service and Environment Definition (OSED), which describes the environment, assumptions, etc. that are applicable to the SPR and INTEROP requirements. These requirements will cover safety, performance, operational aspects as well as the interoperability aspects (related to a specific technology to support the SESAR Solution).

The document is completed by appendices including:

- The Benefit and cost Mechanisms, showing how the SESAR Solution elements contribute (positively or negatively) to the delivery of performance benefits and the costs.
- Part II: The Safety Assessment Report describes the results of the safety assessment work for the SESAR Solution. Due to regulatory obligations, it should be expected that a Safety Assessment is required for any proposed change to the ATM system, although the depth of such an assessment will depend on the nature of the change (Select the appropriate template for the scope of the Solution);
- Part IV: The Human Performance Assessment Report (HPAR) describes the results of the Human Performance assessment work for the SESAR Solution;
- Part V: the Performance Assessment Report (PAR) that consolidates the performance results obtained in different validation activities at SESAR Solution level.

The present document is the Part IV of the SESAR Solution PJ07-W2-40 VALP document. It is structured as follows:

- Section 1 provides the Executive Summary.
- Section 2 is the Introduction section briefly introducing the document, the intended readership and the structure of the documents and terms and acronyms.
- Section 3 describes the objectives and the approach to the human performance assessment process.
- Section 4 describes four steps of the assessment; understanding of the ATM concept, implications on Human Performance in a form of benefits and issues, validation activities conducted and finally summary of the findings and conclusions
- Section 5 lists all applicable and reference documents.
- Appendix A contains the HP Log.

## 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 <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 as <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.
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

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The purpose of the HP assessment process described in detail in Human Performance Guidance [1] is to ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed.

The SESAR HP assessment process uses an ‘argument’ and ‘evidence’ approach. A HP argument is a ‘HP claim that needs to be proven’. The aim of the HP assessment is to provide the necessary ‘evidence’ to show that the HP arguments impacted have been considered and satisfied by the HP assessment process. This includes the identification of HP requirements and recommendations to support the design and development of the concept.

The HP assessment process is a four-step process that provides an overview of these four steps with the tasks to be carried out and the two main outputs (i.e. HP plan and HP assessment report). In addition, a HP Log is maintained throughout the lifecycle of the Solution in which all the data/ information obtained from all HP activities conducted as part of the HP assessment is documented. This HP Log is a living document and is updated and / or added to as the Solution progresses.

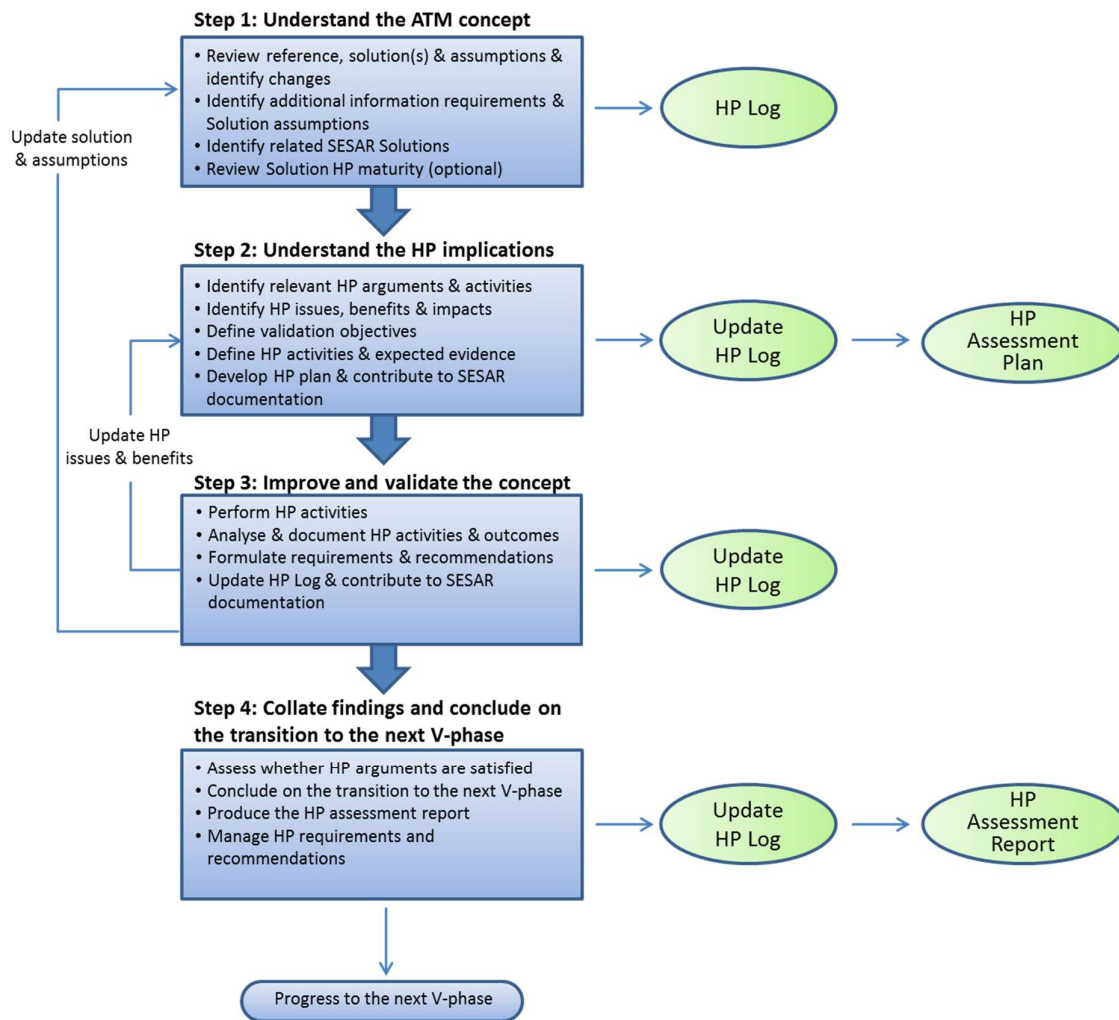


Figure 1: Steps of the HP assessment process

## 4 Human Performance Assessment

### 4.1 Step 1 Understand the ATM concept

#### 4.1.1 Description of reference scenario

The overall aim of reference scenario is to assess the impact of static ARES on local traffic demand and airspace configuration (DAC) and to provide a reference for comparing the performance benefits of the new operating methods.

For the military activities, the reference scenario simulates the previous operating method described by OSED with the usage of static and VPA design type of ARES and subsequent ASM and MT processes and procedures:

- Previous operating methods are mostly based on static airspace reservation. This is a 3D area plus safety buffer activated well in advance thus limiting civil aircraft operation opportunities to improve the FUA uptake.
- Integration of iSMT with static ARES into sub-regional/local traffic flow management with no target times

The VPA modules are configured and booked in accordance with mission requirements. The Figure 2 below provides a layout of the currently in use VPA modules available for configuration.

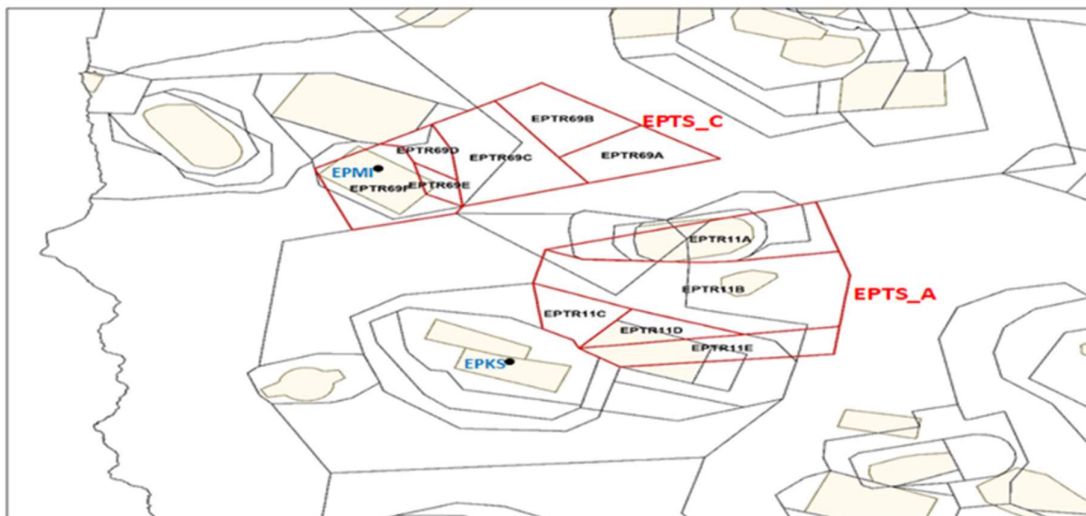


Figure 2 Current organization of VPA modules for ARES in Polish airspace

The military ATM demand expressed through mission trajectories is integrated into the ASM and ATFM processes of DAC as requested by the military airspace user, without alteration.

The Figure 3 describes the layout of ARES/VPA modules configuration for reference scenario, extended in order to fulfil training requirements.



Figure 3 Layout of ARES/VPA modules configuration for reference scenario

#### 4.1.2 Description of solution scenario

The solution scenario simulates the execution of civil and military aerial activities and ATM support of a day operations projected into 2035 (same as in the reference scenario), in accordance with the applicable SESAR target concept.

In the solution scenarios:

- The definition and management of the integrated military ATM demand composed of iMT 3D profile and DMA Type 1 and 2. The new ARES design principle (DMA) caters for better flexibility of the military AU and for increased dynamicity of the NM in balancing and managing all AU demand. It demonstrates the evolution of the detailed iMT concept and Advanced Airspace Management underpinned by validation results achieved in SESAR 2020 Wave 1
- iSMT with integrated DMA type 1 and type2 also participates in CDM for negotiation of TTO/iMT enabling optimization of sub-regional/local traffic flow management. In CDM, the local DAC function can propose a modification of ARES within the flexible parameters threshold or modification of trajectory applying the concept of Target Time.

The military scenario represents a daily military training activity, conducted by the Polish air force units by using assets, tactics and combat manoeuvres suited to 2035 timeline. The training activities are performed in ad-hoc defined areas – DMAs – managed as an integral part of MT definition and development, in accordance with the new operating methods described by OSED.

The solution scenario is also testing, without any validation purpose, the ability of actors and tool prototypes to define, to process and to integrate into the civil-military CDM process, ATM priorities for iMT with integrated DMA type 1 and type 2.

At this stage of SESAR, the definition of ATM priority for military ATM demand is based on the judgement of experts playing the role of mission planners in WOC.

The validation addresses military priorities for ATM purposes only (no military mission prioritization) exclusively related to regular training activities and provides non-exhaustive criteria and rules for R&D purposes. The aim is to trigger and support the way forward to easing the complexity of civil-military CDM by early provision of MT availability to changes and negotiation. The Solution seeks at an initial, simple operational-technical solution, which will be further developed and validated in next SESAR cycles.

The tool prototypes supporting the management of DMAs are able to describe and exchange the priority in the iMT with DMA type 1 and 2 data set, so that to support the operators to understand the meaning of priority as well as to integrate the priority into the impact assessment methods.

The services supported by the connectivity of tools ensure the information exchange on priorities amongst the actors throughout a suited solution.

Figure 4 below provides an overview and proposes a solution for the implementation of military ATM priority levels within the scope of solution 40 conceptual developments and validation activities.

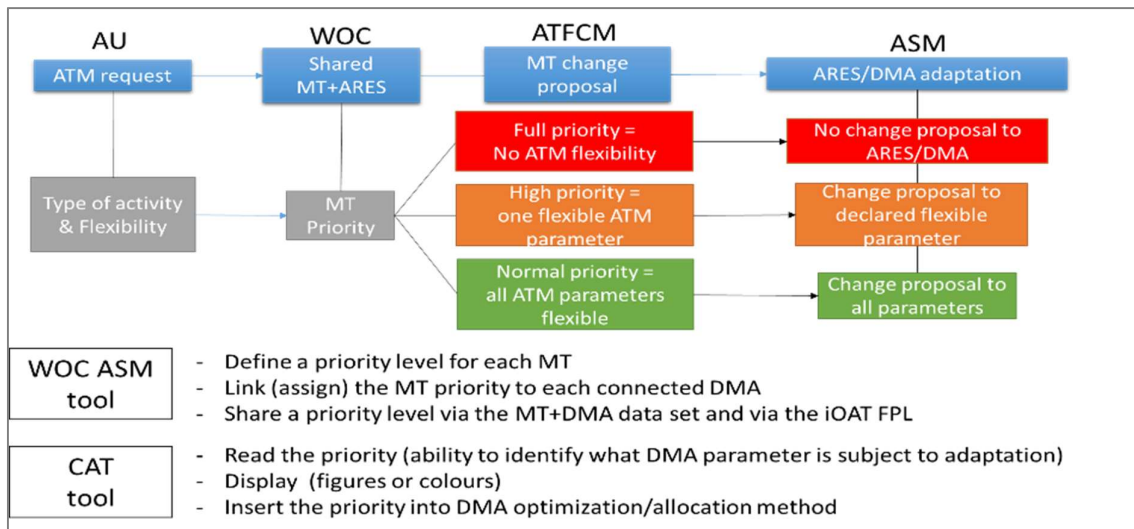


Figure 4 iMT with DMA type 1 and type 1 priority levels and rules

### 4.1.3 Consolidated list of assumptions



Table 2 presents consolidated list of assumptions for solution PJ07-W2-40.

Identifier	Title	Description	Justification	Impact on Assessment
ASS-PJ07-W2-40-001	V3 validation relevance	Validation remains relevant without addressing network level collaborative processes. However, key to the success of the validation is the acknowledgement and integration into the validation objectives and activities, as feasible as possible to national operational stakeholders, of the Network Manager's requirements so that the results of sub-regional/local processes to be compatible with the network management performance needs.	The network-level processes for consolidation of airspace configurations and trajectories optimization can only improve or at least not degrade the performance outcomes of the processes at sub-regional/local level. That key assumption needs to be considered in conjunction with the validation results achieved in the previous SESAR solutions upon which solution 40 builds.	Low
ASS-PJ07-W2-40-002	Reference operating environment for validation purposes	Reference operating environment is En-Route of very high, high and medium complexity levels with overall traffic and military airspace requirements set for 2035	For the integrated management of Mission Trajectory in TBO, FOC is 31.12.2035	Medium
ASS-PJ07-W2-40-003	Solution operating environment for validation purposes	Solution operating environment is En-Route of very high, high and medium complexity levels with overall traffic and military airspace requirements set for 2035		Medium
ASS-PJ07-W2-40-004	Traffic characteristics	Traffic samples used in scenarios are realistic enough to ensure relevance of assessment results	The simulation scenarios shall be as realistic as possible for producing meaningful validation results	High

ASS-PJ07-W2-40-005	Airspace layout	The solution is implemented into En-Route airspace of very high, high, and medium complexity level, with Free Route implemented.	By 2035, free route airspace and operations will be fully implemented in accordance with the current NM plans	Medium
ASS-PJ07-W2-40-006	Military airspace requirements	Fifth generation of fighter aircraft and RPAS operations require more flexibility and dynamicity for ARES definition and allocation	DMA type 1 and type 2 scenarios shall be as close as possible to the evolution of security and defence demand and relevant to identify their impact on ATM performance areas	Medium
ASS-PJ07-W2-40-007	Ground Tools / Technology	The tools enable an integrated definition and management of Mission Trajectory with DMA type 1 and type 2 and their dynamic revision,	The validation is dependent on the ability of tools to enable a dynamic exchange of information and impact assessments on a single Mission Trajectory with DMA type 1 and type 2 data set among the participating functions	High
ASS-PJ07-W2-40-008	Procedures in Place	The planning procedures associated to Trajectory management and Dynamic Airspace Configuration processes are in place	The validation of Mission Trajectory with integrated DMA type 1 and type 2 supports mainly the accomplishment of Trajectory Based Operations CONOPS	Medium
ASS-_J07-W2-40-009	Environmental constraints	Weather information is not taken into account	Validation considers nominal conditions for running the scenarios	Low
ASS-_J07-W2-40-010	Information exchange amongst validation actors	A SWIM like environment is not fully addressed in the validation exercise	NM validation platforms that enable the implementation of SWIM principles are not available	Low

Table 2 Consolidated list of assumptions.

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

Solutions PJ-07-W2-40 and PJ.09-W2-44 share the DMA common topic: PJ-07-W2-40 validates its integration into MT, while PJ.09-W2-44 addresses DMA integration into DAC. The solutions will use the same validation platform, but they will run separate validation activities. Therefore, the additional HP related performance impact related to the integration of DMA type 1 into Dynamic Airspace Configurations (DAC) will be obtained through the PJ.09-W2-44. PJ09-W2-44 will also provide inputs (simulation platform logs) related to the integration of the DMA type 1 into Dynamic Airspace Configuration at network level in both planning and execution phases.

#### 4.1.5 Identification of the nature of the change

The initial Human Performance assessment identified the impact of the changes as mostly technology driven focusing on the interoperability between the systems and flow of the information and processes between involved human actors.

The following table is used to help systematically identify and capture the nature of the change in terms of, the ATM actors impacted as well as the potential changes to their work.

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	<p>The following roles and high-level responsibilities can be identified:</p> <ul style="list-style-type: none"> <li>• AU Operations WOC: WOC operator - MT and DMA Type 1 and 2 planning and request; participation in CDM for DMA allocation; TTO proposal impact assessment and negotiation</li> <li>• ASM Sub-Regional/National operator: DMA Type 1 and 2 impact assessment, optimization, and allocation in DAC and associated negotiation in CDM;</li> <li>• ATFCM Sub-Regional/Local operator: MT with DMA impact assessment on local traffic and TTO proposal and negotiation</li> </ul>
1.2 OPERATING METHODS	<p>Current operations are limited with regard to the availability of iterative ASM/ATFCM negotiation processes and are largely based on semi-rigid procedures as agreed on ASM Level 1. In the new operating methods initial information is provided by the WOC for analysis by the ASM and ATFCM functions via enhanced CDM capabilities and facilities</p>

	<p>where the initial information undergoes an iterative enhancement process from Early Flight Intent to iSMT and is taken into consideration in the sub-regional / local ATFCM process.</p> <p>Furthermore, in the current operating methods the trajectory (MT) data is may be associated with static ARES or VPA booking request while in the new operating method the MT may be also associated with a DMA Type 1 or 2 booking request.</p>
<p>1.3 TASKS</p>	<p>Changes in WOC human actors' tasks are expected as they will participate in a CDM process with the sub-regional / local ASM / ATFCM processes by submitting initial MT/DMA requests and refining these as they mature and move closer to the time of operations.</p> <p>Changes in ASM human tasks are expected as they will consider the DMA request associated with the MT and participate in the DMA booking request refinement.</p> <p>Changes in ATFCM human task are expected as they will participate in the sub-regional / local MT impact assessment, associated DCB solution development, apply what-if capabilities for DMA location optimisation and submit change proposal to WOC.</p>
<p>2. HUMAN &amp; SYSTEM</p>	
<p>2.1 ALLOCATION OF TASKS (HUMAN &amp; SYSTEM)</p>	<p>The Solution is expected to be significantly supported by new technical tools and technology allowing for:</p> <ul style="list-style-type: none"> <li>• Integrated MT/DMA requests to be submitted by the WOC using interoperable systems;</li> <li>• Impact assessment of the MT/DMA request by the sub-regional / local ASM/ATFCM functions – including execution of what-if scenarios;</li> <li>• Trajectory and DMA optimisation as part of the sub-regional / local ASM and ATFCM processes taking into consideration complexity and demand;</li> <li>• System supported assignment of TTO to DMA;</li> </ul>

	<ul style="list-style-type: none"> <li>• Submission of revised MT / DMA proposals to the WOC, and;</li> <li>• Agreement through CDM of the final MT profile and DMA allocation by all concerned stakeholders.</li> </ul> <p>The allocation of tasks between the human and tools is expected to change due to:</p> <p>a) new tasks and changes to the operating methods being introduced by the solution.</p> <p>b) implementation of automation support to human decisions, supporting alleviation of current complexities and interdependencies in the overall MT/DMA impact assessments and negotiations.</p> <p>The dependencies involved in the impact assessment would place significant cognitive requirements on the human actors and are suitable processes for automation. Human actors will be required to resolve unforeseen situations and to make the final decision and therefore they need a good understanding of the processes, procedures and other stakeholders' needs and requirements.</p>
<p>2.2 PERFORMANCE OF TECHNICAL SYSTEM</p>	<p>Technical systems supporting delivery of the services developed by the Solution require a high level of interoperability across the civil – military boundary. Overall performance of the ATM system as well as the effectiveness of military mission are expected to improve as the MTs and DMAs are now fully integrated into the ASM and ATFCM sub-regional/local planning processes. Accuracy of demand and complexity information provided by the technical support should be improved by interoperable systems proposed by the Solution.</p>
<p>2.3 HUMAN – MACHINE INTERFACE</p>	<p>The Solution proposes a trilateral negotiation process where each stakeholder has the capability of assessing the impact of other stakeholders requests, issuing proposals and/or revisions to the MT/DMA planning. The associated HMI needs to support the responsibilities, requirements and privileges of each user role – including rules and restrictions – to ensure that the CDM process takes place as proposed by the Solution.</p>

3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No changes to the team composition. Increased ASM/ATFCM coordination may be envisaged but the internal ASM and ATFCM teams' composition should not be affected.
3.2 ALLOCATION OF TASKS	The Solution proposes enhanced CDM mechanisms to be applied between the identified roles and as such the task allocation needs to be defined in terms of the competencies, responsibilities, requirements, and privileges of each role.
3.3 COMMUNICATION	Current operating method based largely on semi-rigid ASM Level 1 rules and priorities requires little communication between the roles if and when the Level 1 requirements are followed. The new operating method increases and improves communication between the roles and stakeholders through improved system support ensuring all stakeholders are informed of the state and status of the negotiation process.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	Assuming sufficient level of technical support is available, the acceptance of new roles and responsibilities can be expected to be high and job satisfaction is expected to increase for the ASM and ATFCM human actors as they now have more timely and accurate information available for the execution of their tasks. Workload impact should be manageable.
4.2 COMPETENCE REQUIREMENTS	In nominal conditions the new operating methods should not impose any new competence requirements.
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	No changes in staffing requirements and levels are expected.
4.4. RECRUITMENT AND SELECTION	No changes in recruitment and selection are expected.
4.5. TRAINING NEEDS	All stakeholders / roles will require training prior to implementing the new operating methods.

Table 3: Description of the change

## 4.2 Step 2 Understand the HP implications

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



Arg.	Issue ID	HP issue / Benefit	HP SC ID	HP Success Criteria	recommended activity/ies
1.1.2	HPI-Arg.1.1-07-W2-40-001	The description of responsibilities and tasks has not been clearly established.	CRT-PJ07W2-40-V3-VALP-HP01-001	There is no negative impact of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 on operators' tasks and operating methods (HP argument 1).	Identify responsibilities and tasks changes in the new operating methods (solution scenario) against the current roles and their tasks and responsibilities.
1.2.4	HPI-Arg.1.2-07-W2-40-001	The operating methods have been considered as unclear and inconsistent by end users.	CRT-PJ07W2-40-V3-VALP-HP01-001	There is no negative impact of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 on operators' tasks and operating methods (HP argument 1).	Review operating methods with SMEs to ensure they are clear and consistent.
1.2.5	HPI-Arg.1.2-07-W2-40-002	Due to the introduction of new/additional tasks, the end users can not follow operating methods (procedures) in an accurate, efficient and timely manner.	CRT-PJ07W2-40-V3-VALP-HP01-001	There is no negative impact of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 on operators' tasks and operating methods (HP argument 1).	Identify likely errors by means of walkthrough.  Assess errors and their recovery means, timeliness of actions and workload in Real-Time Simulation.
1.3.4	HPI-Arg.1.3-07-W2-40-001	Level of trust in the new concept (and associated procedures) experienced as insufficient by the end user.	CRT-PJ07W2-40-V3-VALP-HP01-001	There is no negative impact of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 on operators' tasks and operating methods (HP argument 1).	Identify factors that will impact upon trust using focus groups with end users and identify preliminary mitigation.



					Assess trust in Real-Time Simulation.
1.3.5	HPI-Arg.1.3-07-W2-40-002	User is not able to perceive and interpret task relevant information and anticipate future events/actions.	CRT-PJ07W2-40-V3-VALP-HP01-001	There is no negative impact of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 on operators' tasks and operating methods (HP argument 1).	Identify factors that will impact upon situational awareness and assess it in the Real-Time Simulation.
2.1.4	HPB-Arg.2.1-07-W2-40-001	Although additional tasks are introduced, the end users are supported by automation in task performance and workload perceived remains within acceptable limits.	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess workload in Real-Time Simulation.
2.1.5	HPI-Arg.2.1-07-W2-40-001	Understanding of the technical system's behaviour is not consistent with the operator's task demands.	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess end users' understanding of the technical system's behaviour using think-aloud methods, questionnaires and debriefings in Real Time Simulations.
2.1.6	HPB-Arg.2.1-	Level of trust is increased due to the support of automated functions in task execution.	CRT-PJ07W2-40-V3-	There is no negative impact on task performance related to the implementation of technical systems supporting the	Assess trust in automated functions in Real-Time Simulation.

	07-W2-40-002		VALP-HP01-002	introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	
2.2.1	HPI-Arg.2.2-07-W2-40-001	The accuracy of information provided by the technical system is not adequate for carrying out the task.	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess information accuracy in Real-Time Simulation.
2.2.2	HPI-Arg.2.2-07-W2-40-002	The timeliness of information provided by the technical system is not adequate for carrying out the task	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess information timeliness in Real-Time Simulation.
2.3.1	HPI-Arg.2.3-07-W2-40-001	The type of information provided by the technical system does not satisfy the information requirements of the human.	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess Human Performance & Usability during Real-Time Simulation
2.3.6	HPI-Arg.2.3-	The usability of the user interface (input devices, visual	CRT-PJ07W2-	There is no negative impact on task performance related to the implementation	Assess the user interface in Real-Time Simulation.

	07-W2-40-002	displays/output devices, alarm& alerts) is not acceptable.	40-V3-VALP-HP01-002	of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	
2.3.7	HPI-Arg.2.3-07-W2-40-003	The user interface design does not reduce human error as far as possible.	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess error occurrence and error management in Real-Time Simulation.
2.3.8	HPI-Arg.2.3-07-W2-40-004	The user interface design does not support a sufficient level of end user situation awareness.	CRT-PJ07W2-40-V3-VALP-HP01-002	There is no negative impact on task performance related to the implementation of technical systems supporting the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 2).	Assess individual situational awareness in Real-Time Simulation.
3.2.1	HPI-Arg.3.2-07-W2-40-001	Changes to the task allocation between human actors lead to adverse effects on human tasks.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Identify changes to task allocation between human actors that could bring any potential adverse effects on cognitive/ task demands and potential for error

3.2.2	HPI-Arg.3.2-07-W2-40-002	The proposed task allocation between human actors is not supported by technical systems/the HMI.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Assess Usability in Real-Time Simulation.
3.2.3	HPI-Arg.3.2-07-W2-40-003	The potential for human error in team tasks is not reduced as far as possible.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Assess errors and recovery means in Real-Time Simulations.
3.2.4	HPI-Arg.3.2-07-W2-40-004	Team tasks can not be achieved in a timely and efficient manner.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Assess timeliness of individual/team actions in Real-Time Simulation.

3.3.1	HPI-Arg.3.3-07-W2-40-001	Intra-team and inter-team communication does not support the information requirements of team members.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Analyse intra-team/ inter-team communication in Real-Time Simulation.
3.3.3	HPI-Arg.3.3-07-W2-40-002	Changes in communication means & modalities are not identified and/or are not acceptable.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Assess usability of communications means and human performance in Real-Time Simulation.
3.3.5	HPI-Arg.3.3-07-W2-40-003	Team members can not maintain a sufficient level of shared situation awareness.	CRT-PJ07W2-40-V3-VALP-HP01-003	There is no negative impact on human performance related to the changes to the team tasks sharing and communication brought by the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 3).	Assess team situational awareness in Real-Time Simulation

4.1.1	HPI-Arg.4.1-07-W2-40-001	Changes in roles and responsibilities are not acceptable to the affected human actors.	CRT-PJ07W2-40-V3-VALP-HP01-004	There is no negative impact on human performance related to transition factors associated to the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 4).	Assess acceptability of the proposed changes in Real-Time Simulation.
4.1.2	HPI-Arg.4.1-07-W2-40-002	The impact of changes on the job satisfaction of affected human actors has not been considered.	CRT-PJ07W2-40-V3-VALP-HP01-004	There is no negative impact on human performance related to transition factors associated to the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 4).	Discuss proposed solution with end users & get feedback on potential impact on job satisfaction.
4.5.1	HPI-Arg.4.5-07-W2-40-001	The content of training for each actor group is not specified.	CRT-PJ07W2-40-V3-VALP-HP01-004	There is no negative impact on human performance related to transition factors associated to the introduction of sub-regional/local management of iMT with integrated DMAs of type 1 and 2 (HP argument 4).	Identify the content of the training with SMEs.

**Table 4 HP Arguments, related HP issues and benefits, and proposed HP activity**

## 4.3 Step 3 Improve and validate the concept

### 4.3.1 Description of HP activities conducted

Table 5 provides a summary of activities conducted within the solution development phase to clarify HP issues, benefits and impact. Following tables provide a structure and detailed description of activities conducted as part of the HP assessment process.

	HP activity	Dates
1	HP & SAF scope and change assessment workshop	February 2021
2	HP & SAF metrics and indicators workshop	November 2021
3	EXE-07-W2-40-V3-01 AIRBUS SAS	April 2022
4	HP results and requirements consolidation workshop	September 2022

**Table 5 Summary of HP activities conducted under PJ07-W2-40.**

<b>Activity 1. HP &amp; SAF scope and change assessment workshop</b>	
Description	The aim of the workshop was to discuss with partners the differences between the reference and the Solution's solution scenario, i.e. the changes introduced by the concept and the human actors impacted, plus assumptions and constraints and to examine the list of relevant HP arguments (identified earlier through solution documents review)
Arguments & related issues addressed	Arg. 1.1 Roles and responsibilities Arg. 1.2 Operating Methods Arg. 1.3 Tasks
HP objectives	OBJ PJ07W2-40-V3-VALP-HP-01
Tools / Methods selected out of the HP repository	Online workshop with SMEs and exercise' partners Structured Walkthrough
Summary of the HP activity	Online workshop on 14 of February 2021  The aim of the workshop was to identify the impact of the change brought by the concept on human performance and elicitation of the human performance issues and benefits. The following expertise was involved:  <ul style="list-style-type: none"> <li>- Concept developers; Project manager, OSED leader,</li> <li>- Military representatives</li> <li>- Civil ANSP representative.</li> <li>- Software developers (civil and military)</li> <li>- Safety expert</li> <li>- Human factor expert</li> </ul> The output of the workshop was an initial HPAP and HP log

**Table 6: Description of Activity 1- HP & SAF scope and change assessment workshop**

<b>ACTIVITY 2. HP &amp; SAF metrics and indicators workshop</b>	
Description	Based on the defined HP validation objectives and scope of the validation exercises, identification of appropriate metrics and indicators to obtain necessary evidence
Related Arguments	All
HP objectives	OBJ PJ07W2-40-V3-VALP-HP-01



Issues to be addressed / investigated from issues analysis	All
Tools/Methods selected out of the HP repository	Face to face meeting with SMEs and exercise partners Focus group discussion
Summary of the HP activity	<p>The face-to-face meeting with partners was conducted on 16 of November 2021 in EIH, France.</p> <p>The general approach to the human performance assessment was presented and discussed with the partners. The metrics and indicators and specific standardise tools for each HP success criteria were presented and discussed. Project partners were invited to contribute and provide their feedback.</p> <p>The following expertise was involved:</p> <ul style="list-style-type: none"> <li>- Concept developers; Project manager, OSED leader,</li> <li>- Military representatives</li> <li>- Civil ANSP representative (ASM, FMP)</li> <li>- Software developers (civil and military)</li> <li>- Safety expert</li> <li>- Human factor expert</li> </ul> <p>The output was recorded in the HPAP.</p>

**Table 7: Description of Activity 2 – Focus Group on Metrics and indicators**

<b>ACTIVITY 3. EXE-07-W2-40-V3-01</b>	
Description	<p>The exercise validates the processes and tool prototypes for:</p> <ul style="list-style-type: none"> <li>• Integrated definition and development of iMT with DMA type 1 and type 2 in sub-regional/local ATM planning phase</li> <li>• Participation of iSMT with DMA type 1 and type 2 to sub-regional/local level CDM for balancing capacity with demand with planning target times (TTO – target time over ARES entry/exit point).</li> </ul>
Related Arguments	All
HP objectives	OBJ PJ07W2-40-V3-VALP-HP-01
Issues to be addressed / investigated from issues analysis	All

Tools/Methods selected out of the HP repository	Objective data collection using RTS platform, R-NEST  Subjective data collection through questionnaires, briefings, interviews, observations
Summary of the HP activity	<p>The real-time, human in the loop simulation took place on 5-7 of April 2022 in EIH, France. The simulation was preceded with dry run trial and training session on 15-16 of March 2022. The simulation consisted of 4 exercise runs (4 solution runs) involving all necessary human actors: civil and military experts. During the simulation, the evidence was collected by the following means:</p> <ul style="list-style-type: none"> <li>- Observations</li> <li>- Interviews</li> <li>- Debriefing sessions</li> <li>- Standardised HP questionnaires: workload, Trust, situational awareness, usability, acceptance)</li> <li>- Customised questionnaire (HMI)</li> <li>- Data logs (objective data)</li> </ul> <p>The evidence was analysed and recorded in VALR.</p>

**Table 8 Description of Activity 3: Validation Exercise**

<b>ACTIVITY 4. HP results and requirements consolidation workshop</b>	
Description	Face to face workshop aiming at consolidation of HP and Safety requirements and recommendations
Related Arguments	All
HP objectives	OBJ PJ07W2-40-V3-VALP-HP-01
Issues to be addressed / investigated from issues analysis	All
Tools/Methods selected out of the HP repository	Analysis of the HP evidence obtained in the exercises and their consolidation to feed into HP validation objectives and associated Success criteria and identification of HP requirement.

Summary of the HP activity	September 2022  During the workshop the requirements and recommendations elicited from the HP and safety assessments were presented to the partners.  The feedback was collected.
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Table 9 Description of Activity 4 - HP results and requirements consolidation Workshop

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

### 4.4.1 Summary of HP activities results & recommendations / requirements

Issue ID	HP issue / Benefit	Status	Activity conducted	results / evidence	Recommendations & Requirements
Arg. 1.1.2: The description of roles & responsibilities covers all tasks to be performed by a human actor.					
HPI-Arg.1.1-07-W2-40-001	The description of responsibilities and tasks has not been clearly established.	Closed	Scope and change assessment workshop RTS Debriefings Interviews	<p>In current way of working there are no DMAs and within one country the coordination between WOC and AMS remains the same but the negotiation part with ATFCM is a new task. WOC users will have also new tasks related to the negotiation process and coordination with the aircrew. The new task is definition and sharing of iSMTs and further assessment the impact of proposals from civil partner.</p> <p>The evidence showed that the WOC responsibilities and tasks are clearly established.</p> <hr/> <p>Airspace manager tasks:</p> <ul style="list-style-type: none"> <li>-to collect the requests from WOC,</li> <li>-to deconflict and optimise the DMAs against the traffic volumes,</li> <li>-to review the timeline.</li> </ul> <p>Those tasks are organized in 3 phases: strategical/planning, pre-tactical and tactical phase.</p> <p>The area is validated in static manner based on the experience. Sometimes it is not needed to do the</p>	

analysis, i.e. for those static areas which are already published in AIP and for some static areas the general safety case that is applicable. For more complicated exercises more time is needed, traffic analysis, assessment with the NEST tool to perceive how it could impact the traffic and the network.

With the new concept, the tasks remain the same, but the timeframe is changed. Some of the tasks currently performed in the strategical phase are moved forward to the pre-tactical phase. In addition, closer coordination with the FMP is expected in order to identify optimal solution for the DMAs. The decision where the DMA will be positioned depends on the flows and how much impact it would have on traffic (e.g. avoiding rerouting of the approaching traffic, and opt for the area where it is easier to re-route the traffic or vector it by ATCO).

This coordination is then moved to the pre-tactical phase making the application of the DMAs more accurate than TSAs and ASM 2.

The evidence showed that the ASM responsibilities and tasks are clearly established.

The tasks of the FMP have not changed significantly. Currently the FMP is responsible for preparation and definition of the ATC volumes and verification of the impact of conflicts. The FMP also coordinates with AMS.

				<p>The main change brought by the CAT tool is that the data are more precise and more accurate.</p> <p>The evidence showed that the FMP responsibilities and tasks are clearly established.</p>	
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Arg. 1.2.4: The content of operating methods is clear and consistent

HPI-Arg.1.2-07-W2-40-001	The operating methods have been considered as unclear and inconsistent by end users.	Open	<p>Scope and change assessment workshop</p> <p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>The WOC's operating methods are considered clear and consistent.</p> <p>The operating methods will change due to the introduction of DMAs with respect to the current way of working with static ARES. The new coordination and negotiation tasks, as well as introduction of flexible parameters are impacting the changes in the operating methods.</p> <p>The ASM working methods in general remain the same, and therefore ASM working methods were considered as clear and consistent.</p> <p>The difference is that in the new concept, a new tool is used for combining information from different sources and simplifying the work of ASM. Additionally closer coordination is required at strategic level and FMP to jointly identify the optimal solution.</p>	<p>- To further investigate the applicability of DMAs for complex missions in different operational environments.</p> <p>-In next phase of concept development, for WOC users it is important to address the safety assessment of the DMAs as it might impact the concept implementation on the WOC side.</p>
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			<p>Moreover, in the new way of working there are also flexible parameters. With flexible parameters the process is more optimized, permitting them to understand better what is the intention (preferences) on the military side.</p> <p>Nevertheless, while flexible parameters are very much facilitating the work for ASM, more effort is expected on the military side to find the acceptable option – mission/DMA</p> <p>The FMP reported that operating methods are simplified compared to the current existing environment. The novelty of the concept is that FMP is now working with the tactical flow, whereas previously there was only strategic level. Thus, the information is more precise.</p> <p>Identification of the airspace volumes is a new task however based on the information that FMP is using already today.</p> <p>The operating methods were considered clear and consistent by the FMP.</p>	
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Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner.

<p>HPI-Arg.1.2-07-W2-40-002</p>	<p>Due to the introduction of new, additional tasks, the end users can not follow operating methods (procedures) in an accurate, efficient and timely manner.</p>	<p>Open</p>	<p>RTS Debriefings Interviews</p>	<p>WOC users were able to perform the tasks in timely manner in simulated environment. However, the WOC users recommended to further investigate the timeliness of negotiating process for complex missions, requiring extensive coordination with air crews. In addition, currently safety assessments are done for each static ARES in the strategic/planning phase while the safety assessment for DMAs is moved closer to the execution phase creating more workload on the WOC side</p> <hr/> <p>The ASM users were able to perform their tasks in efficient and timely manner. The ASM’s tasks have marginally changed (different kind of analysis) and therefore it is expected that workload might increase but remaining within acceptable limits.</p> <p>Potential for errors is comparable to the current way of working-as most of ASM work is based on the expert judgement where, the error is possible.</p> <hr/> <p>The evidence showed that FMP was able to perform the task accurately and in timely manner. The risk of human error was rated same as in the current operating environment</p>	<p>WOC users recommended to further investigate the timeliness and efficiency of the negotiation process in case of the complex mission that may require significant coordination with aircrew.</p>
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Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate.



HPI-Arg.1.3-07-W2-40-001	Level of trust in the new concept (and associated procedures) experienced as insufficient by the end user	Open	RTS	The WOC users assessed the trust as with the following ratings % out of 10 on the scales: robust, confident and easy to use, 6 out of 10 on the scales: accurate, understandable, reliable and 8 on the scale usefulness.	The WOC users found the tool acceptable, but some improvements are proposed:  - possibility of acceptance for specific elements only (currently the acceptance is for whole DMA counterproposal)  - possibility to visualise the delta of the change (the initial proposal versus counterproposal)
			Debriefings	The trust level was reported slightly lower due to maturity of the tool.	
			Interviews	The ASM reported high trust in the tool rating 8 out of 10 on the scales: useful and reliability, 9 out of 10 on the scale accurate and 10 on the scales: understandability, confident and easy to use.	
				The FMP reported very high trust in the concept and the CAT tool (rating maximum 10 score on all the scales: usefulness, reliability, accuracy, understandability, robustness, confident and easy to use). The FMP reported also the trust in the associated working methods and procedures.	

Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.

HPI-Arg.1.3-07-W2-40-002	User is not able to perceive and interpret task relevant information and anticipate	Open	RTS	WOC users had enough information to perform their tasks and to anticipate future actions. Their situational awareness remained at acceptable levels.	Further validation should be conducted based only on the information provided by the tool (e.g. the timeline and the nature of the mission) and not by the description of validation scenarios provided to the participants before the exercise.
			Debriefings	Nevertheless, WOC operators recommended to include additional information on the nature of the mission – what is simplified and explained briefly in the simulation	
			Interviews		

future events/actions			scenarios might take lots of time, analysis, preparation, and coordination with air crew. The information provided in the simulation scenario would not be provided so simply to the operators.	
			ASM's situational awareness is expected to increase taking into consideration new information available and the information presentation in the integrated tool, but also due to flexible parameters (i.e. military intentions) and closer coordination with the strategic/planning actors and with FMP.	
			<p>The evidence from the exercise showed that FMP was able to interpret the information provided by the tool.</p> <p>The exercise revealed that the information about the dependency between DMAs is not provided to FMP. Therefore, the modification proposed to DMA in some cases were not respecting the dependency.</p>	<p>Requirement:</p> <p>In case of the dependency of different DMAs, the information should be contained in the description of such DMAs (preferable as a graphical visualisation) in order to improve the efficiency of the negotiation process.</p>

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

HPI-Arg.2.1-07-W2-40-001	Although additional tasks are introduced, the end users are supported by automation	Closed	RTS Debriefings Interviews	The WOC ASM tool did not work as expected and subsequently additional workload was perceived by the users (e.g. when a mission is to be joined to the existing DMA missions to the DMAs, the WOC operators has to go through the same process already performed for other missions already within the DMA). Workload was	The WOC tool should provide automated support to pre-fill the initial information about the mission.
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<p>in task performance and workload perceived remains within acceptable limits.</p>			<p>assessed as moderate to high due to the lack of automated support.</p> <p>On the other hand, WOC operators using the MT tool were satisfied with the support provided by the tool and assessed workload as insignificant.</p> <p>The ASM reported that despite the expected increase of tasks brought by additional interactions, workload should be alleviated by support tool. The workload is assessed as acceptable.</p> <p>The FMP reported that workload induced by additional interactions with the tool and reviewing or analysing the traffic flows tasks was acceptable at all the times. The feedback gathered in post exercises questionnaire was rated as low.</p>		
<p>Arg. 2.1.5: Human actors can acquire an adequate mental model of the machine and its automated functions.</p>					
<p>HPI-Arg.2.1-07-W2-40-002</p>	<p>Understanding of the technical system's behaviour is not consistent with the operator's task demands.</p>	<p>Closed</p>	<p>RTS Debriefings Interviews</p>	<p>The WOC users reported good understanding of the technical system behaviour however some improvements were proposed for the WOC tools:</p> <ul style="list-style-type: none"> <li>- the automated support should be provided for the pre-filling the data based on initial inputs.</li> <li>- HMI support to identify the delta of changes in the initial proposal with respect to the counterproposal.</li> </ul>	<p>The WOC tool should provide automated support to pre-fill the initial information about the mission.</p> <ul style="list-style-type: none"> <li>- Possibility to visualise the delta of the change (the initial proposal versus counterproposal)</li> </ul>

				Visual support to identify the dependent DMAs	In case of the dependency of different DMAs, the information should be contained in the description of such DMAs (preferably as a graphical visualisation) in order to improve the efficiency of the negotiation process.
				The new system is appreciated by the ASM (the presentation of flows, AU areas, constraints etc.) and they hope that it would be used for all types of AU reservations.	
				The CAT tool is a new tool for the FMP position, as in current operation FMP uses mainly the CHMI NM tool. The FMP considered that CAT tool supported his task adequately, providing the required information. The logical model of the tool was considered appropriate.	The CAT tool should provide the support to identify/ pre-select optimal area for airspace volumes.

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

HPB- Arg.2.1- 07-W2- 40-003	Level of trust is increased due to the support of automated functions in task execution.	Closed	RTS  Debriefings  Interviews	<p>The level of trust was high for WOC MT with rating 8 out of 10 on the scale of accuracy, 9 out of 10 on the scales: usefulness, reliability and robustness, and 10 out of 10 on the scales: understandability, confident, and easy to use.</p> <p>The WOC ASM tool was assessed less positive with ratings of 8 and 4 out of 10 on usefulness, 2 and 6 out of 10 on scales of reliability and accuracy, 6 and 3 out of 10</p>	
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				<p>on understandability, 5 and 4 out of 10 on robustness and easy to use and 5 and 2 on confident.</p> <p>The new system is appreciated by the ASM (the presentation of flows, AU areas, constraints etc.) and they hope that it would be used for all types of AU reservations</p> <p>The FMP reported very high trust in the tool (rating 10 score maximum) on all the scales: usefulness, reliability, accuracy, understandability, robustness, confident and easy to use).</p>	
2.2.1: The accuracy and timeliness of information provided by the system is adequate for carrying out the task.					
HPI-Arg.2.2-07-W2-40-001	The accuracy of information provided by the technical system is not adequate for carrying out the task.	Open	<p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>The WOC users reported that the visualisation of the presentation of integrity of the mission and its flexible parameters should be improved.</p> <p>The ASM reported that the provided information is accurate, not overloading. The granularity of the information is acceptable</p> <p>The FMP reported that the information provided by the tool is accurate and appropriate for performing the tasks.</p> <p>The exercise revealed that the information about the dependency between DMAs is not provided to FMP.</p>	<p>In case of the dependency of different DMAs, the information should be contained in the description of such DMAs (preferably as a graphical visualisation) in order to improve the efficiency of the negotiation process.</p> <p>The WOC users should have possibility to visualise the delta of the change (the initial proposal versus counterproposal to easily identify for which DMA the change has been proposed).</p>

				<p>Therefore, the modification proposed to DMA in some cases were not respecting the dependency and in the later stage did not satisfy the WOC actor.</p> <p>The FPM when assessing the modification proposed by WOC does not receive the specific notification about the modification (time, position) and need to review/verify the complete response.</p>	
2.2.2: The timeliness of information provided by the system is adequate for carrying out the task.					
HPI-Arg.2.2-07-W2-40-002	The timeliness of information provided by the technical system is not adequate for carrying out the task	Closed	<p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>the WOC users reported that the timeliness of information provided was considered acceptable.</p> <p>The timeliness of the information is as expected by the ASM and therefore it does not affect negatively performance of the tasks.</p> <p>The FMP reported that the timeliness of provided information was adequate for performing his tasks</p>	
2.3.1: The type of information provided satisfies the information requirements of the human.					
HPI-Arg.2.3-07-W2-40-001	The type of information provided by the technical system does not satisfy	Open	<p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>Some improvements were identified in the technical system and the following recommendations were given by the WOC users:</p> <p>Proposal – one ARES request for more DMAs – the database should be revised to accommodate their</p>	The tool should provide the means (visual or other alerts) allowing the comparison of the final proposal with the initial one, including the parameters.

<p>the information requirements of the human.</p>			<p>needs. It could group the family of dependent DMAs and also facilitate the assessment on the civilian side</p> <ul style="list-style-type: none"> <li>• The tool should provide the means (visual or other alerts) allowing the comparison of the final proposal with the initial one, including the parameters.</li> <li>• The tool should provide the means to link multiple DMAs and share this constrain with the civil partner.</li> </ul>	<p>The tool should provide the means to link multiple DMAs and share this constrain with the civil partner.</p> <p>The WOC users should have possibility to visualise the delta of the change (the initial proposal versus counterproposal to easily identify for which DMA the change has been proposed).</p>
			<p>The information currently provided are sufficient to perform tasks. However, it would be useful to have also static data (published in AIP, navigation points) incorporated in the database just to take into consideration when doing the analysis, handier.</p> <p>Regarding the DMA type 2, it is suggested to also provide the information of the dependency of different DMAs (master DMA and co-dependent DMAs).</p> <p>It has been suggested, in order to increase situational awareness, to provide the comparison between the initial proposal by WOC, ASM proposal for changes and WOC's counterproposal.</p>	
			<p>The information provided by the system were considered sufficient from the FMP perspective.</p>	<p>The DAC when assessing the counterproposal proposed by WOC should receive the specific notification about the modification (time,</p>

				<p>However, the validation revealed that the information related to dependent DMAs are not transferred to the FMP. Therefore, the FMP is not aware of the constraints and can provide the DMAs adaptation that is not corresponding to the requirements of the WOC user. This could prevent the multiple coordination between WOC user and FMP.</p>	<p>position) and not requiring to review/verify the complete response.</p>
<p>2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm&amp; alerts) is acceptable.</p>					
HPI-Arg.2.3-07-W2-40-002	The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is not acceptable	Closed	RTS Debriefings Interviews	<p>The WOC ASM tool usability was assessed it with the rating 6 on a scale from 1 to 10 on a user acceptance scale (Moderately Objectionable Deficiencies. Considerable user compensation to achieve adequate performance).</p> <p>On the other hand, on the user acceptance scale WOC operators assessed very satisfactory the WOC MT tool (on a scale from 1 to 10 with the rating 9: System is acceptable, and compensation is not a factor to achieve desired performance)</p>	
				<p>The new tool is appreciated by the ASM. Usability of the interface was assessed as adequate for the accomplishment of the tasks</p>	
				<p>The FMP reported that the CAT tool is very easy to use. The acceptability of the tool was rated with 8 out of 10 (8 indicating Mildly unpleasant Deficiencies. System is</p>	



				acceptable and minimal compensation is needed to meet desired performance.) on the adapted CARS scale.	
2.3.7: The user interface design reduces human error as far as possible					
HPI-Arg.2.3-07-W2-40-003	The user interface design does not reduce human error as far as possible.	Closed	RTS Debriefings Interviews	<p>The WOC users declared that assessing modification of TTO should be supported by HMI visualisation of the changes in comparison to the original proposal.</p> <p>The ASM reported that since the airspace design is based on the expert judgement, same procedure would apply with the concept applied and therefore, no change in the risk as such could be identified. The only risk increase could be derived from time constraint –as the human actor would need to analyse information in the shorted time. It is however considered that the risk of increase of human error is acceptable.</p> <p>The FMP participating the in-validation exercise reported that the likelihood of human error is similar as in the current operating environment. The DMAs and the following modification are further reviewed by WOC user and additionally verified before the publications of (NOTAMS). Therefore, the possible error is expected to be detected</p> <p>Specific attention should be given to credible corrupted data based on the failure of connectivity and corrupted</p>	The HMI support should be provided allowing comparison of TTO proposal with the initial ones (i.e. recalculation and visualization of the new trajectory based on the new TTO).

				data – this type of error would be more difficult to detect – (to be further investigated by safety assessment)	
2.3.8: The user interface supports a sufficient level of individual situation awareness.					
HPI-Arg.2.3-07-W2-40-004	The user interface design does not support a sufficient level of end user situation awareness.	Closed	RTS Debriefings Interviews	<p>The situation awareness level was considered acceptable for WOC MT users with ratings of 7 out of 10 indicating My SA with respect to the task was not complete. I was able to perform the task, but not satisfactorily) and 9 out of 10 indicating My SA with respect to the task was very good. I was able to perform the task well all of the time.</p> <p>The level of situation awareness for WOC ASM was rated slight lower with ratings 5 out of 10 indicating “My SA with respect to the task was reduced. I was unaware of some of the important information required to perform the task effectively”, and rating 8 out of 10 indicating “My SA with respect to the task was good. I was able to perform the task well most of the time.”</p> <p>The WOC users recommended some improvements to the HMI that could further enhance the level of situational awareness: the HMI should allow to rotate the DMA in order to have more visibility of the changes</p>	The WOC tool HMI should allow to rotate the DMA in order to have more visibility of the changes. Currently the rotation is only available through modification of coordinates.

				<p>The ASM situational awareness is on a good level, nevertheless it has been suggested, in order to increase situational awareness, to provide the comparison between the initial proposal by WOC, ASM proposal for changes and WOC's counterproposal</p> <p>The FMP has reported very high level of situation awareness. In the post exercises questionnaire, the FMP reported level 8 - My SA with respect to the task was good. I was able to perform the task well most of the time, or 10- My SA with respect to the task was excellent. I was able to perform the task extremely well all of the time.) on 10 points China Lakes scale (1- low, 10 excellent).</p>
<p>3.2.1: Changes to the task allocation between human actors do not lead to adverse effects on human tasks.</p>				
HPI-Arg.3.2-07-W2-40-001	Changes to the task allocation between human actors lead to adverse effects on human tasks	Closed	<p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>No negative impact has been identified on the task allocation for WOC users.</p> <p>Static coordination doesn't require additional coordination with tactical side, while DMAs might need their input with regard to complexity DMAs might make on the ATC side (tactical side).</p> <p>Closer coordination with other actors involved in the process (strategic, ASM and FMP) requires changes in</p>

				<p>their coordination and communication, but it does not impact negatively human tasks.</p> <p>It has been identified that due to the shift in the tasks for strategic to tactical phase, two possible implementations could be foreseen:</p> <ul style="list-style-type: none"> <li>- The new/extended FMP position that needs the knowledge of airspace management</li> <li>- The combined position for FMP and ASM sharing the working position</li> </ul> <p>Both implementations were considered acceptable.</p>
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3.2.2: The proposed task allocation between human actors is supported by technical systems/the HMI.

HPI-Arg.3.2-07-W2-40-002	The proposed task allocation between human actors is not supported by technical systems/the HMI	Closed	<p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>No issues were reported on the task allocation between human actors and tools.</p> <p>The acceptance of the WOC ASM tool was rated 6 out of 10 indicating Moderately Objectionable Deficiencies. Considerable user compensation to achieve adequate performance.</p> <p>The acceptance of WOC MT Tool was rated 9 out of 10 Negligible Deficiencies. System is acceptable and compensation is not a factor to achieve desired performance.</p>
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				<p>Closer coordination with FMP would impose either for AMS and FMP to work together at the same position (elbow consultation) or in case that there are on a distance, they should be able to send some screenshots or working together on using shared screen or kind of shared platform with the chat and ghost model with reviewing the proposal.</p>	
				<p>The FMP reported that the tools supported his work appropriately. However, to facilitate the assessment of the modification of the DMA from WOC actor, there should be a visual.</p>	<p>The DAC when assessing the counterproposal proposed by WOC should receive the specific notification about the modification (time, position) and not requiring to review/verify the complete response.</p>

3.2.3: The potential for human error in team tasks is reduced as far as possible.

HPI-Arg.3.2-07-W2-40-003	The potential for human error in team tasks is not reduced as far as possible.	Closed	RTS	The potential for human error was identified comparable for any human performed task, however multiple verification of various actors at internal level consist the mitigation.	
			Debriefings		
			Interviews		
				The means of communications are not changed, if the CAT would have some more integration, that would be a plus.	
				The validation exercise showed that the likelihood of team human error is similar as in the current operating environment. The DMAs and the following modification are further reviewed by WOC user and additionally	

				verified before the publications of (NOTAMS). Therefore, the possible error is expected to be detected.	
3.2.4: Team tasks can be achieved in a timely and efficient manner.					
HPI-Arg.3.2-07-W2-40-004	Team tasks can not be achieved in a timely and efficient manner.	Closed	RTS Debriefings Interviews	The WOC users reported that internal coordination with different teams (e.g. air crews, defence unit air defence, air operation centre) might be a challenging when assessing the proposals of modification of DMAs coming from civil part.	
				The ASM reported that team was able to perform the tasks efficiently and in timely manner.	
				The FMP reported that team was able to perform the tasks efficiently and in timely manner.	
3.3.1: Intra-team and inter-team communication supports the information requirements of team members.					
HPI-Arg.3.3-07-W2-40-001	Intra-team and inter-team communication does not support the information requirements of team members.	Open	RTS Debriefings Interviews	The communication means & modalities between the teams are not changed however it is expected that the frequency of the coordination will increase due to the multiple assessments.	The changes in the intra-team communication and coordination should be further investigated.
				The static ARES doesn't require frequent coordination, while with the new concept more frequent coordination is expected, especially in the beginning. That the learning curve will make it easier, the repetitiveness will make the	

				<p>process easier and easier to operate, thus there will be less of coordination.</p> <p>Closer coordination with other actors involved in the process (strategic, ASM and FMP) requires changes in their coordination and communication means.</p>	
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3.3.3: Changes in communication means & modalities are identified and acceptable.

HPI-Arg.3.3-07-W2-40-002	Changes in communication means & modalities are not identified and/or are not acceptable	Open	RTS Debriefings Interviews	<p>The communication means &amp; modalities between the teams are not changed however it is expected that the frequency of the coordination will increase due to the multiple assessments. WOC users estimated that considering learning effect, the communication load and modalities are considered acceptable. They envisage that the DMA will increase intra-team communication.</p> <p>In the past the coordination would be done by telephone. With CAT functionalities the coordination is optimising the process (the free text is also available also today).</p> <p>The communication means and modalities are improved due to possibility of sharing the same view. The way of working is considered more interactive.</p>	The changes in the intra-team communication and coordination should be further investigated.
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3.3.5: Team members can maintain a sufficient level of shared situation awareness.

HPI-Arg.3.3-07-W2-40-003	Team members can not maintain a sufficient level of shared situation awareness.	Open	RTS	The maintain the sufficient level of situation awareness between the teams, the WOC users recommended to create the interface allowing to display the changes in the propositions of DMA to the air crews.	It should be further investigated how to ensure the information sharing among WOC actors impacted by the negotiation process.
			Debriefings		
			Interviews		
				The ASM reported that the team members were able to maintain the team situational awareness. Sharing the same view could also increase team situational awareness.	
				The FMP reported that the team members were able to maintain the team situational awareness. Sharing the same view could also increase team situational awareness.	

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

HPI-Arg.4.1-07-W2-40-001	Changes in roles and responsibilities are not acceptable to the affected human actors.	Closed	Scope and change assessment workshop	The changes in the roles and responsibilities were found acceptable by the WOC users.	
			RTS	Changes in roles and responsibilities are acceptable to the ASM, but they will increase the need for coordination with other actors in the process, increasing workload and requiring additional skills or usage of additional means of communication.	
			Debriefings		
			Interviews	The evidence showed the tool and working methods are acceptable.	



4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered.

HPI-Arg.4.1-07-W2-40-002	The impact of changes on the job satisfaction of affected human actors has not been considered.		RTS	No negative impact on job satisfaction was identified.
			Debriefings	Job satisfaction is expected to increase, as a new tool integrating all required information would also allow for the workload to decrease.
			Interviews	No negative impact on job satisfaction was identified.

4.5.1: The content of training for each actor group is specified.

HPI-Arg.4.5-07-W2-40-001	The content of training for each actor group is not specified.	Closed	<p>RTS</p> <p>Debriefings</p> <p>Interviews</p>	<p>It is expected that the WOC users will require to undergo a training on DMAs concept, together with the tools and related HMI and additional coordination procedures with civil partners.</p> <p>WOC users should also have the operational understanding of air crew missions in order to be accept or to refuse the modification in flexible parameters of the mission.</p> <p>Moreover, it is required that the WOC users will acquire some basic knowledge on NM operations, and functions.</p> <p>Additionally, the awareness of DMAs should be built in ATM community especially within VFR pilots.</p>
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			<p>Additional skills and training regarding the usage of the system but also related to the shift from the application of the pre-designed areas in the instantaneous context, while with the concept they will also have an opportunity to modify/adapt the proposed AU areas (as a part of the planning and DMA design process</p> <p>Specific training on the CAT tool is required as well as the training on the DMAs concept as such.</p>	
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**Table 10: Summary of the HP results and recommendations/ requirements for each identified issue & related argument**

#### 4.4.2 Maturity of the Solution

The maturity of the PJ07-W2-40 solution is assessed via the maturity checklist for finalising the assessment for V3. The details are presented in the Table 11.

Although only one validation exercise took place to validate the solution, the human performance relevant aspects of the concept have been adequately addressed and therefore the solution can be considered as reaching V3.

The validation activity revealed some potential developments to be implemented in order to allow gaining full benefits of the concept.

Maturity checklist for finalising the V3 assessment			
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	Yes	The human performance assessment report for solution PJ07-W2-40 was completed. The conducted assessment considered all relevant arguments for V3 phase. For more details, please refer to section 4.2.1 of this report.
2	Are the benefits and issues in terms of human performance and operability related to the proposed solution sufficiently assessed (i.e. on the level required for V3)?	Yes	The V3 relevant issues and benefits were assessed during real-time, human in the loop simulation that is considered as appropriate validation method for V3 phase.  It should be noted that the evidence was gathered only during one validation exercise, within single operational environment and limited number of participants.
3	Have all the parts of the solution/concept been considered?	Yes	The HP assessment considered the impact on human roles, responsibilities, tasks and operating methods (argument 1), technical support systems and Human-Machine Interface (argument 2), team structures and team communication (argument 3) and transition factors (argument 4).  Therefore, it is considered that all the parts of the concept have been considered.

4	Have potential interactions with related projects/concepts been considered and addressed?	Yes, partially	<p>The PJ07-W2-40 addressed the interaction between different actors performing the following tasks.</p> <ul style="list-style-type: none"> <li>• Develop early flight intent (EFI) for MT with DMA Type 1 and 2</li> <li>• Allocate ARES DMA Type 1 and 2</li> <li>• iSMT sharing</li> <li>• iSMT Management with planning ATM constraint (TTO)</li> </ul> <p>However, the further interaction in the tactical phase should be further validated.</p> <p>Additionally, the internal WOC part interaction considering the evaluation of the proposal were not simulated.</p>
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	<p>The evidence gathered during real – time simulation demonstrates that human performance needed to achieve the desired system performance for the proposed solution is consistent with human capabilities.</p> <p>Outcomes of the real time simulation showed that the workload, trust, human error and situational awareness were maintained at acceptable level. However, it should be noted that the identified technical improvements must be implemented to fully achieve the benefits for WOC.</p>
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	<p>Although solution PJ07-W2-40 does not have a HP target assigned, the results showed that the human performance was maintained at the acceptable level while achieving the targets for other KPA (CAP, FEF, ENV).</p>

7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes, partially	<p>Although the solution was tested with the participation of end users, some of the elements of the solution were excluded from the validation, due to limited scope of the simulation, therefore considered as not sufficiently realistic:</p> <p>Following limitations of the obtained results for solution PJ07-W2-40 were identified:</p> <ul style="list-style-type: none"> <li>• The tasks covered by the solution would take place in a period of few days. Therefore, the timeliness of the simulation does not reflect the reality of the timespan of the validated tasks.</li> <li>• The real time simulation exercises were based on a research prototype platform, including a rebuild of the operational ATM system and the integration of the system under test into this rebuild. These functionalities, although replicated the operational functions to a great extent, were not fully comparable with real operational ATM system. For example, sometimes the HMI was not well adapted for the use of all tools' functionalities. This affected the assessment of the potential tool benefits in some situations. In addition, the participants encountered technical limitations related to HMI usability.</li> <li>• All the information required for the WOC and DAC actors to perform their tasks in the simulation scenarios were provided to the simulation participants before the runs took place. This facilitated to the great extent the performance of the tasks in the simulation runs. Nevertheless, in real operational environment they would have to look into different sources in order to identify and analyse all the information required.</li> <li>• A limited sample of operational experts participated in the exercise. It cannot be assumed that the collected results will be valid for all WOC and DAC users. In addition, the results are also subject to the bias induced by the local training,</li> </ul>
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			local system, working approach, and specific cultural background and might not be fully attributable to different operating environment.
8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	The evidence gathered during the real time simulation demonstrated that the interactions between human and technology are operationally feasible. Additional recommendations were identified for the design of the HMI, that are registered in section 4.4.1.
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	The requirements and recommendations have been included into the project documentations.
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	Although solution PJ07-W2-40 does not have a HP target assigned, the results showed that the human performance was maintained at the acceptable level while achieving the targets for other KPA (CAP, FEFF, ENV).
11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	The recommendations and requirements have been considered in HMI design, Procedures, documentation and training.
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 transition factors under Argument 1: changes to the job responsibilities, job satisfaction and training were considered in the assessment. For more details, please refer to section 4.4.1



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	The impact of the solution on the regulation was revised. Additionally, the impact on the roles and responsibilities, competence requirements were also investigated.  The results are registered in the section 4.4.1 under Argument 1 and argument 4.
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes, partially	The HP issues and benefits elicited for the solution were investigated and evidence is provided. However, the validation activity was conducted in only one operational environment, therefore it is recommended to test the concept under various environment and with different users.

Table 11 Maturity assessment for finalising V3



## 5 References

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### Human Performance

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- [1] SESAR Human Performance Guidelines Materials



## Appendix A – HP Log



Copy of PJ07 W2  
Solution 40 HP LOG.

**-END OF DOCUMENT-**

