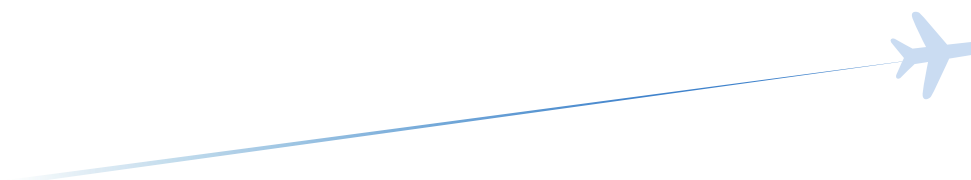




SESAR Solution PJ.10-01a SPR/INTEROP-OSED V2-V3 - Part IV - Human Performance Assessment Report

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Abstract

This document contains the final Human Performance (HP) assessment report for the PJ.10-01a. The report consists of:

- the HP assessment plan,
- the results of the HP activities conducted,
- newly identified issues and
- the HP recommendations & requirements.

The HP assessment has been driven by the SESAR Human Performance Assessment process, which notably covers four steps:

- 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.

The present reports present the outcome of this process.

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1 Executive Summary

This document provides the Human Performance Assessment Report (HPAR) for **Solution 10-01a: High Productivity Controller Team organization**

It contains the Human Performance (HP) assessment report for the Solution 10-01a, 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 Step 4 – Collate findings & conclude on transition to next V-phase.

The HP assessment comprises two PJ.10-01a validation exercises; one at V2 maturity level (EXE-10-01a-V2-VALP-001) and one at V3 level (EXE-10-01a-V3-VALP-001). They are both real time simulations which provided HP evidences and which are fully described in the section 5 of the VALP Part I [8].

Table 1 lists all HP arguments identified as being relevant for the V2/V3 phase of the Solution and the associated validation exercises that address these arguments:

HP argument		Associated EXE
A1.1.3	Roles and responsibilities are clear and consistent.	EXE-10-01a-V3-VALP-001
A1.2.5	Operating methods can be followed in an accurate, efficient and timely manner	EXE-10-01a-V3-VALP-001
A1.3.1	The potential for human error is reduced as far as possible.	EXE-10-01a-V3-VALP-001
A.1.3.3	The level of workload (induced by cognitive and/or physical task demands) is acceptable	EXE-10-01a-V3-VALP-001
A.1.3.5	Human actors can maintain a sufficient level of situation awareness.	EXE-10-01a-V3-VALP-001
A2.3.5	Workstations (e.g. cockpit layout and consoles) adhere to ergonomic principles	EXE-10-01a-V3-VALP-001
A2.3.6	The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable	EXE-10-01a-V3-VALP-001
A3.2.1	Changes to the task allocation between human actors do not lead to adverse effects on human task	EXE-10-01a-V3-VALP-001
A3.3.1	Intra-team and inter-team communication supports the information requirements of team members	EXE-10-01a-V3-VALP-001

HP argument		Associated EXE
A4.1.1	Changes in roles and responsibilities are acceptable to the affected human actors	EXE-10-01a-V3-VALP-001

Table 1 Relevant HP arguments and associated validation exercises

The complete list of identified ¹benefits 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 in Appendix D.

¹ In order to separate eTMA and En-Route Operational Environments scopes, the solution 10-01a has been split into two solutions :

- 10-01a1 : PJ.10-01a1 High Productivity Controller Team Organisation in eTMA
- 10-01a2 : PJ.10-01a2 High Productivity Controller Team Organisation in En Route

2 Introduction

2.1 Purpose of the document

The purpose of this document is to detail the Human Performance assessment results obtained from the validation exercises performed in the frame of the Solution 10-01A.

In addition to the results, this document presents the assumptions and mechanisms (how the validation exercises results have been consolidated) used to achieve these assessment results.

2.2 Intended readership

The intended audience for this document are the same ones declared in the SPR-INTEROP/OSED part I document i.e.:

- Team members of other SESAR Solutions as depicted in [5]:
 - PJ.10-01b: Flight Centred ATC
 - PJ.10-01c: Collaborative Control
 - PJ.10-02a: Improved Performance In The Provision Of Separation
 - PJ.10-02b: Advanced Separation Management
 - PJ.10-06: Generic' (non-geographical) Controller Validations
 - PJ.16-04: Workstation, Controller productivity
 - PJ.18-02: Integration of trajectory management processes in planning and execution
- Team members of transverse and federating projects:
 - PJ19.02: ATM Operation
 - PJ19.03: System & Services
 - PJ19.04: Performance Management

Other stakeholders that may be interested in this document are to be found among:

- Affected employee unions
- ANS providers
- Airport owners / providers
- Airspace users

2.3 Scope of the document

This document describes the Human Performance Assessment Report for the V2 and the V3 phases of Solution 10-01a which aims at validating the concept of Multi Sector planning role.

The introduction of this new role is studied in two environments:

- An En-route environment, for which a V2 exercise was planned.
- An Extended TMA environment, for which V3 maturity is expected to be reached.

The human performance assessment process reviews HP arguments that are relevant for the successful implementation of this new concept and covers roles and responsibilities, human and system, teams and communication, as well as HP related transition factors.

2.4 Human performance work schedule within the Solution

The Human Performance activities for this Solution 10.01a started in June 2018 and were conducted according to the Validation Plan [6].

For the actual dates of the two validation exercises, please refer to the validation plan [6].

2.5 Structure of the document

The present document is the Part IV of the SESAR Solution 10-01a SPR-INTEROP/OSED document.

It is structured as follows:

- **Section 1** is the Executive Summary.
- **Section 2** outlines the scope and intended readership as well as the schedule of the HP work.
- **Section 3** describes the objective and approach of the HP assessment process.
- **Section 4** describes the HP assessment of the concept elements under investigation including the nature of the change, the identification of argument and issues, the description of the planned HP activities, as well as a summary of the HP activities results and recommendations.
- **Section 5** contains the list of references.

2.6 Acronyms and Terminology²

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.

² Note that in this document ATCOs role defined as "Executive Controller" refers also to generic term "Tactical Controller"

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 constituted the scope of SESAR 1 Project 16.04.01. It covered 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. HP recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional analysis is performed, HP recommendations may be transformed into HP 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. HP requirements can be seen as the stable result of the HP contribution to the Solution, leading to a redefinition of the operational concept or the specification of the technical solution.

Table 2 Acronyms and terminology

3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in [2] is to ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed.

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

The HP assessment process is a four-step process. Figure 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, a HP Log is maintained throughout the lifecycle of the project 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 project progresses.

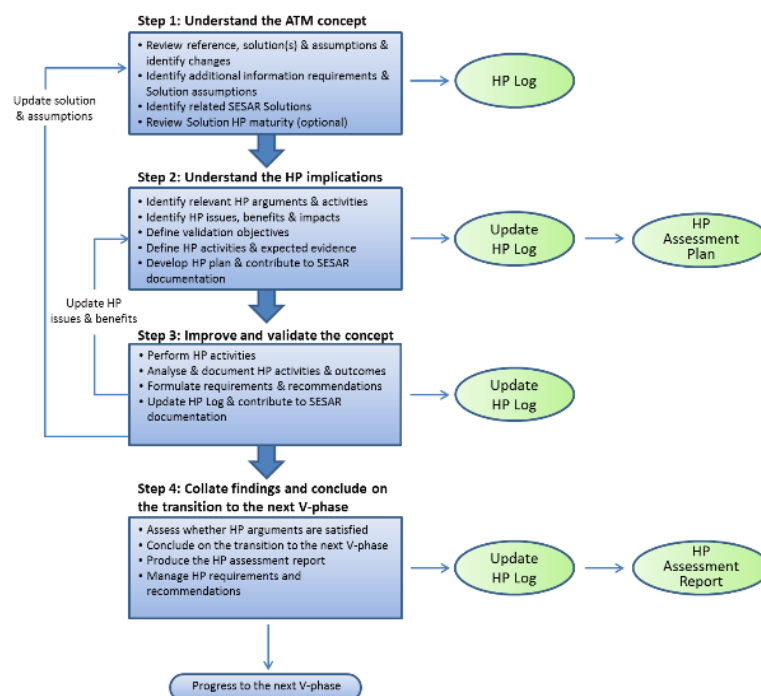


Figure 1: Steps of the HP assessment process

4 Human Performance Assessment

4.1 Step 1 Understand the ATM concept

4.1.1 Description of reference scenario

Please refer to the VALP Part I section 3.3 SESAR Solution 10-01a: Key R&D Needs, which describes the baseline of the Solution scope. For detailed description of the reference scenarios per validation exercise please refer to the VALP Part I sections 5.X.4.1.

4.1.2 Description of solution scenario

Please refer to the VALP Part I section 3.3 SESAR Solution 10.01a: Key R&D Needs, which describes the baseline of the Solution scope. For detailed description of the solution scenarios per validation exercise please refer to the VALP Part I sections 5.X.4.2

4.1.3 Consolidated list of assumptions

Please refer to the VALP Part I section 4.4 Validation Assumptions, which describes the validation assumptions that are applicable at Solution level. For a detailed description of the validation assumptions per validation exercise please refer to the VALP Part I sections 5.1.5 and 5.2.5.

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

The Solutions that have an impact on the HP assessment of the SESAR Solution 10-01a are the following:

- SESAR 1 solution #05 Extended Arrival Management (AMAN) horizon.
- SESAR 1 solution #06 Controlled Time of Arrival (CTA) in Medium density / medium complexity environment.

4.1.5 Identification of the nature of the change

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	Introduction of the role of the Multiple Sector Planner (MSP), i.e., one PC assisting two or more ECs over a larger area of responsibility, the Multi-Sector Area (MSA).

	<p>The MSP will retain today's PC's responsibilities. In addition to these, s/he will be responsible for the following:</p> <ul style="list-style-type: none"> • Co-ordinating entry and exit conditions at internal and external MSA boundaries. • Conduct pre-planning of aircraft horizontal and vertical trajectories (including overflights) through the MSA by checking the potential conflicts and airspace restrictions that may occur with coordinated entry/exit conditions at MSA external boundaries, and take action if necessary, coordinating with adjacent sectors (PC task) or with MSA EC. • Co-ordinating re-routing options with adjacent areas/sectors and with MSA EC if necessary. • Handling the internal boundary between the two (or more) sectors s/he is working with. The coordination and planning for the two (or more) EC will be a new task. • Mitigating traffic complexity and if necessary balance workload between ECs by applying constraints e.g. level capping, target times, levels or speeds, etc. An example of this is rerouting a west arrival from the south to the east (for the Skyguide use cases).
1.2 OPERATING METHODS	<p>The applicability of the MSP configuration is dependent on traffic and environmental conditions:</p> <p>it will replace the classic 1PC-1EC team configuration only during specific bandwidth of traffic load or complexity as a measure to maintain an acceptable workload (i.e. min. and max. occupancy). Therefore, the operating methods need to consider transitions across different team configurations, from MSP to 1PC-1EC and vice versa.</p> <p>Handover during the split MSP→1PC-1EC: The MSP concept introduces a new handover occurring during the transition (split) of the MPS team into two classic 1PC-1EC teams. In this case, a new ATCO will have to be integrated into the team as a PC and receive a handover from the MSP. This transition will occur during busy periods.</p>
1.3 TASKS	<p>Specific changes for the PC:</p> <ul style="list-style-type: none"> • The PC in the MSP configuration should have to listen to and integrate information coming from two or more ECs: S/he will have to build and maintain one mental picture of current

	<p>traffic and plan for each EC. This is a significant change compared to today where the PC has to integrate information from one EC only.</p> <ul style="list-style-type: none"> The PC will have to integrate information coming from a larger geographical area. In some areas this may mean that the PC will have to process up to 20/30% more traffic (as in the case of Skyguide).
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	No change compared to today. Same ATCO support tools (with same allocation of tasks) as in classical operations (advanced monitoring tools, conflict detection and resolution (CD/R) tools and E-coordination tools).
2.2 PERFORMANCE OF TECHNICAL SYSTEM	MSP operations will rely extensively on E-coordination functionalities, therefore this needs to work reliably so that ATCO can trust and use it.
2.3 HUMAN – MACHINE INTERFACE	<ul style="list-style-type: none"> E-Coordination tools will need to be modified to enable efficient coordination between the MSP, the PCs and the ECs. HMI adaptation may be needed to assist the MSP to distinguish traffic and conflicts for the different sectors (of the EC's) within the MSA (e.g. through colour coding or additional information in labels). Possible adaptations of head-set and/or speakers to enable the MSP to better segregate and therefore overhear the frequency communication of both EC's and pilots. Today CWP's are organised to accommodate the classic team made by 1PC and 1EC sitting next to each other. For SKYGUIDE, the MSP is planned to be located in between the two ECs, thus resulting in principle in a symmetrical seating plan. However, note that the MPS concept may also come with an asymmetric seating plan where only one EC will be seated next to the PC, all the others being far. CWP physical design needs to support quick handover from a MSP to a 1PC-1EC seating plan and vice versa. This may mean that the physical design of individual CWP may have to

	be adjustable depending on the role that will man the CWP and independently of other CWPs.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	<ul style="list-style-type: none"> Change in team composition: the team will change from a 1PC-1EC configuration to the MSP configuration (1MSP-2EC) depending on traffic levels. Single Person Operation (SPO) is not considered in the scope of the solution.
3.2 ALLOCATION OF TASKS	<ul style="list-style-type: none"> With the MSP concept, the task distribution may dynamically adapt between the MSP and EC. Depending on the situation, the MSP may take (part of) of one of the EC task to offload him/her and vice versa, while delegating more tasks to the other EC. Also, the opposite may be true, as the EC may take up some MSP tasks for his/her specific sector in order to assist the MSP. An example of such tasks is the change of exit conditions, which could be delegated to the EC and done electronically. This may be the case due to increased traffic demands, or to the occurrence of non-routine and/or emergency events.
3.3 COMMUNICATION	<ul style="list-style-type: none"> The MSP concept combines (at least) two classic 1PC-1EC teams into one team with only 1PC. In other words, the MSP concept combines two PCs into one person, therefore, this will reduce part of PC-to-PC communications in the control room. When operating in the MSP configuration, the PC will have to communicate with several, not one, ECs. Most of the communication will be supported by electronic coordination tools. This will be more relevant for Executives sitting far from the Planner. The change in the seating plan means that informal collaboration (e.g. discussing traffic while pointing at each other display) will not be possible as of today.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	The solution may make the work of the planner potentially more engaging compared to today.

4.2 COMPETENCE REQUIREMENTS	<p>No additional license is envisaged for the EC who will have to perform a role comparable to what is done today.</p> <p>No additional license is envisaged for the MSP (PC) who perform a role comparable to what is done today (only slightly modified tasks to operate geographical sector (MSA) they are already licensed for today).</p>
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	<p>The MSP may allow a more effective use of staff, as for medium traffic levels a team of three could be used instead of a team of four.</p>

Table 3: Description of the change

4.2 Step 2 Understand the HP implications

4.2.1 EXE-10-01a-V2-001_ENAV Relevant arguments, issues & benefits and HP activities (V2)

Most aspects related to HP activities were conducted according to the plan. The main deviations concerning to the VALP were that workload measurement was done using the Bedford scale metric instead of NASA-TLX and that the training sessions that were planned were not sufficient for the ATCOs to be fully confident with the tools. Overall the validated MSP concept was not considered fully feasible and operationally acceptable under the tested conditions.

Arg.	Issue ID	HP issue / Benefit	HP/Valid. Obj. ID	HP validation objective	Recommended activity/ies
A1.1.3	113-001	ISSUE: Possible confusion may occur due to, for instance, new or changed responsibilities, and/or to potential cross over in responsibilities between EC and MSP. Possible role confusion within or between teams or on neighboring sectors may occur.	OBJ-10-01a-V2-VALP-HPAP-113-001	Identify any consistency gap within existing roles and responsibilities in MSP operations.	Observations Debriefing
A1.2.1	121-001	ISSUE: In situations of high workload the MSP might start delegating tasks to less loaded EC(s). This might lead to bad situation awareness and excessive delegation (MSP→1EC) could eventually lead the EC as acting almost as single operator.	OBJ-10-01a-V2-VALP-HPAP-121-001	Assess if working methods for both MSP and ECs are operationally acceptable.	Observations Final questionnaire Debriefing
A1.2.2	122-001	ISSUE: In abnormal operational conditions the MSP experiencing higher cognitive workload could start using operating methods that were not covered before.	OBJ-10-01a-V2-VALP-HPAP-122-001	Assess if working methods for both MSP and ECs are operationally acceptable in abnormal conditions.	Observations Final questionnaire Debriefing



A1.2.3	123-001	ISSUE: In degrading operational modes the MSP experiencing higher cognitive workload could start using operating methods that were not covered before.	OBJ-10-01a-V2-VALP-HPAP-123-001	Assess if working methods for both MSP and ECs are operationally acceptable in degrading modes (e.g.	Observations Final questionnaire Debriefing
A1.2.5	125-001	ISSUE: The integration of a new ATCO, acting in a PC capacity, during the split MSP→1PC-1EC configuration. As this transition is expected to occur during busy periods, the MSP may be too busy to ensure an effective handover, meaning that the new PC may not receive all of the relevant information about traffic on the sector he is about to take in charge.	OBJ-10-01a-V2-VALP-HPAP-125-001	Assess if the team transitions (MSP>1PC-1EC) are possible to be performed in situations where controllers are busy and or have complex traffic situations in sectors.	Observations Post-run questionnaire Debriefing
A1.3.1	131-001	ISSUE: The fact that the MSP has to monitor a larger sector area while providing support to 3 ECs means that it be could be harder for him and to provide timely support to all the ECs.	OBJ-10-01a-V2-VALP-HPAP-131-001	Assess if the MSP considers acceptable to support 3 ECs.	Observations Final questionnaire Debriefing
A1.3.1	131-002	ISSUE: The coexistence between voice and e-coordination communication can create error-prone situations and inefficient communication between MSP and one EC (e.g. if MSP communicates something verbally and does not update that information on the e-coordination tool).	OBJ-10-01a-V2-VALP-HPAP-131-002	Assess if the number of errors that the MSP commits are not increased due to coexistence between voice and ecoordination communication compared to reference operations.	Observations Final questionnaire Debriefing



A1.3.1	131-003	The fact that the MSP has to monitor a larger sector area while providing support to 3 ECs means that it be could be harder for him stay ahead of traffic.	OBJ-10-01a-V2-VALP-HPAP-131-003	Assess if the number of errors that the MSP commits are not increased due to the fact that is not able to stay ahead of all incoming traffic.	Observations System logs Final questionnaire Debriefing
A1.3.2	1.3.2-001	ISSUE: The use of e-coordination might take more time than the voice coordination, this means that the MSP will be taking more time using the e-coordination tool.	OBJ-10-01a-V2-VALP-HPAP-132-001	Assess if the MSP is able to communicate and coordinate with the ECs in a timely manner.	Observations Final questionnaire Debriefing
A.1.3.3	1.3.3-001	BENEFIT: The MSP is responsible of supervising and balancing the workload between the ECs. He may decide to support the busy EC(s) while delegating tasks to the less busy EC(s). For the EC this may translate in a more acceptable distribution of the level of cognitive workload.	OBJ-10-01a-V2-VALP-HPAP-133-001	Assess the impact of MSP configuration on the EC cognitive workload.	Observations System logs Post-run questionnaires Debriefing
A.1.3.3	1.3.3-002	ISSUE: The MSP might experience high cognitive workload just to follow the communications and build an adequate Situation Awareness of the sectors assigned to him. (Multiple frequency related issue)	OBJ-10-01a-V2-VALP-HPAP-133-002	Assess if the MSP workload to follow communications and maintain an adequate SA is acceptable.	Observations System logs (Number and frequency occupancy and number of call x a/c, x sectors and x scenario) Post-run questionnaires



					Debriefing
A1.3.3	1.3.3-003	ISSUE: The MSP might experience high cognitive workload due to the fact that s/he will have to integrate traffic information from a larger geographical area. This problem may be particularly severe for a 3EC configuration, where the sectors combined are three.	OBJ-10-01a-V2-VALP-HPAP-133-003	Assess if the MSP cognitive workload to work on a larger sector is acceptable.	Observations Post-run questionnaires Debriefing
A1.3.5	1.3.5-001	ISSUE: The MSP might experience a reduced ability to stay ahead of the traffic and maintain a mental picture of more than one EC traffic and traffic plans. Especially In busy periods, s/he may be lagging behind.	OBJ-10-01a-V2-VALP-HPAP-135-001	Assess if the MSP is able to stay ahead of all incoming traffic and to provide timely information to all ECs.	Observations Post-run questionnaires (SASHA) Debriefing
A1.3.5	1.3.5-002	ISSUE: The MSP is responsible of supervising and balancing the workload between the ECs. He may decide to support the busy EC(s) while delegating tasks to the less busy EC(s). Currently the PC is able to make an estimation of the EC workload because he listening to the frequencies and communication. This will not be possible anymore in the current MSP configuration.	OBJ-10-01a-V2-VALP-HPAP-135-002	Assess if the MSP is provided with the information necessary to the make a suitable estimation of the EC cognitive workload.	Observations Post-run questionnaires Debriefing
A2.3.5	2.3.5-001	ISSUE: The CWP layout and seating position might not be flexible enough to accommodate quick team configuration transitions (split or aggregation).	OBJ-10-01a-V2-VALP-HPAP-235-001	Assess if CWP layout is flexible enough to allow smooth team and safe configuration transitions.	Observations Debriefing



A2.3.5	2.3.5-002	<p>ISSUE: The CWP layout for one MSP working with more than 2 ECS might create a situation in which the team awareness it is not the same for all elements. The MSP not seating physically close to the EC(s) he is supporting might impair him to anticipate certain peaks of workload.</p> <p>Additionally, MSP might also privilege communication or coordination with the ECs that are seating physically close to him.</p>	OBJ-10-01a-V2-VALP-HPAP-235-002	Assess if the MSP and EC coordination and communication is less efficient than the ones seating closer to the MSP.	<p>Observations</p> <p>System logs</p> <p>Final questionnaire</p> <p>Debriefing</p>
A2.3.7	2.3.7-001	<p>ISSUE: The MSP supporting more than one EC might confuse which flights are being managed by which EC. The HMI should support him in maintaining a good situation awareness on traffic on the responsibility of different EC.</p>	OBJ-10-01a-V2-VALP-HPAP-237-001	Assess if the system supports the MSP in maintaining a good situation awareness in terms of traffic assigned to the ECs that he is supporting.	<p>Observation</p> <p>Post-run questionnaire (SUS)</p> <p>Final questionnaire</p> <p>Debriefing</p>
A2.3.8	2.3.8-001	<p>ISSUE: The MSP might experience a reduced ability to stay ahead of the traffic and maintain a suitable mental picture of more than one EC. This can be true especially during busy periods, s/he may be lagging behind.</p> <p>Therefore, the enhanced interface and MSP tools must allow support both MSP and EC to maintain a good Situation Awareness.</p>	OBJ-10-01a-V2-VALP-HPAP-238-001	Assess the MSP concept tools and interface support the MSP and EC to maintain a good Situation Awareness.	<p>Observation</p> <p>Post-run questionnaire (SASHA)</p> <p>Debriefing</p>



A2.3.9	2.3.9-001	ISSUE: To make a correct estimation and balance of the workload of the ECs that he is supporting the MSP (without being overloaded himself) might need to be supported by the HMI. In prevalently silent coordination (not able to follow the voice frequency of some or all ECs) environment the MSP might not be able to judge the ECs workload. The fact that the MSP is not physically close to the EC(s) that he is supporting might aggravate this issue.	OBJ-10-01a-V2-VALP-HPAP-239-001	Assess if the usability of the e-coordination system supports the MSP in estimating the workload of the EC.	Observations Post-run questionnaire (STQ) Debriefing
A2.3.9	2.3.9-002	ISSUE: The team situational awareness might be impacted if all the team members don't have access to the same information in the same sector and if the MSP has difficulty to distinguish from which sector or EC the requests are coming from.	OBJ-10-01a-V2-VALP-HPAP-239-002	Assess if the usability of the e-coordination system supports the MSP in providing the same support to all ECs and to easily recognise the origin of the requests.	Observations Post-run questionnaire (STQ) Debriefing
A3.2.1	3.2.1-001	ISSUE: The MSP concept implies that the 2-pairs-of-eyes on the same sector might be compromised if the MSP is experiencing cognitive overload. This means that in a situation like this he can experience attention tunneling or start delegating more tasks to the ECs he is supervising.	OBJ-10-01a-V2-VALP-HPAP-321-001	Assess if the MSP is able to stay ahead of traffic and does not excessively delegate tasks to any of the ECs that he is supporting.	Observations Post-run questionnaire (SASHA) Debriefing
A3.2.2	3.2.2-001	BENEFIT: The MSP has an overview over a group of adjacent sectors to which he provides support and manages EC cognitive workload levels. The working method change and the fact that the MSP has to maintain a good situation awareness to supporting	OBJ-10-01a-V2-VALP-HPAP-322-001	Assess if the PC-EC teams perceived an improvement in the error rate between sectors in terms of coordination and agreements in the MSP concept.	Observations Post-run questionnaire (STQ short version)



		a team of ECs might also reduce the team coordination errors between all those sectors.			Debriefing
A3.2.3	3.2.3-001	ISSUE: The fact that MSP concept will affect the 2 pairs of eyes principle, considering the changes in the working methods (silent coordination), might mean that some errors might be detected with some delay.	OBJ-10-01a-V2-VALP-HPAP-323-001	Assess if the MSP and ECs consider that the detection of errors might be impacted by the loss of the 4 eye principle in operations.	Observations Debriefing
A3.3.1	3.3.1-001	ISSUE: Proximal collaboration strategies in use in the 1P-1E configuration will be affected: due to physical distance it will not be possible to talk directly to the EC while discussing (complex) traffic situations and potential trajectories while looking at the same screen, or to assess other's ATCOs workload just by glancing quickly at them or at their screen.	OBJ-10-01a-V2-VALP-HPAP-331-001	Assess if team members can maintain a sufficient level of shared situation awareness (MSP-ECs).	Observations Post-run questionnaire (STQ short version?) Final questionnaire Debriefing
A3.3.3	3.3.3-001	BENEFIT: The amount of communication between MSP and EC is expected to be reduced compared to the PC-EC units. The coordination between planners (PC-PC) is also eliminated. This can improve the communication means between teams using the e-coordination system.	OBJ-10-01a-V2-VALP-HPAP-333-001	Assess if changes in communication means & modalities between (MSP-ECs) and (MSP-PC) are acceptable.	Observations Final questionnaire Debriefing
A3.3.3	3.3.3-002	ISSUE: The MSP concept is based on the presence of electronic (or silent) coordination replacing most of verbal coordination — voice communication should be used as a “backup” for the former. This will bring major changes in the	OBJ-10-01a-V2-VALP-HPAP-333-002	Assess if changes in communication means & modalities between (MSP-ECs) and (MSP-PC) are acceptable.	Observations Final questionnaire



		communication between the EC-PC teams are communicating today and creating their shared situation awareness. The silent coordination could take more time compared to previous quick voice coordinations, especially when controllers are seating side-by-side and can point to each other screens.			Post-run questionnaire Debriefing
A3.3.5	3.3.5-001	ISSUE: The team situation awareness (MSP-3ECs) in high workload scenarios can be degraded. The fact that the MSP is not seating close to all the ECs and that he should be using the e-coordination system might mean that the HMI of the system might impact team situation awareness.	OBJ-10-01a-V2-VALP-HPAP-335-001	Assess if team members can maintain a sufficient level of shared situation awareness (MSP-ECs).	Observations Final questionnaire Debriefing
A4.1.2.	4.1.2-001	ISSUE: The MSP might experience higher cognitive workload to maintain a good SA and always be ahead of traffic and provide adequate support to more than one EC.	OBJ-10-01a-V2-VALP-HPAP-412-001	Assess whether there is a negative impact on PC job satisfaction considering MSP operations.	Post-run questionnaire Final questionnaire Debriefing
A4.1.2	4.1.2-002	ISSUE: An MSP supporting more than a single EC might mean that in a certain period of time the MSP might not be available to support right away. The feeling of uncertainty in the MSP support and the possibility of the lack of the 2 pair of eyes principle in operations might affect the EC acceptance and satisfaction towards MSP operations.	OBJ-10-01a-V2-VALP-HPAP-412-002	Assess whether there is a negative impact on EC job satisfaction considering MSP operations.	Post-run questionnaire Final questionnaire Debriefing

Table 4: HP Arguments, related HP issues and benefits, and proposed HP activity (EXE-10-01a-V2-001_ENAV)



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

HP activities were successfully conducted according to the plan. The only deviation was the fact that HP VO OBJ-10-01a-V3-VALP-HPAP-005 was not addressed, because external coordination, i.e., coordination with adjacent sectors outside of the MSP, was not simulated.

Arg.	Issue	HP issue / Benefit	HP/Valid. Obj. ID	HP validation objective	Recommended activity/ies
A1.1.3	01	There needs to be clarification that all actors understand the scope of their roles and responsibilities. Confusion may occur due to, for instance, new or changed responsibilities, and/or to potential cross over in responsibilities between EC and PC. Possible role confusion within or between teams or on neighboring sectors may occur.	OBJ-10-01a-V3-VALP-HPAP-001	Validate that roles and responsibilities are clearly defined.	Post Run Questionnaire Debriefing Observations
A1.2.5	02	MSP (1PC-2EC) concept may result in better overall sector efficiency, but may reduce planner efficiency. This may be the case in very high and complex situations, such as adverse weather situations or emergencies where PC workload is higher than in normal situations. This comes from NATS SESAR1 VALP.	OBJ-10-01a-V3-VALP-HPAP-002	Validate that the efficiency of the planner is operationally acceptable.	Post Run Questionnaire(s) Debriefing Observations ISA Workload ratings



A1.2.5	03	It needs to be validated that the working methods for MSP and ECs are operationally acceptable.	OBJ-10-01a-V3-VALP-HPAP-003	Validate that the working methods for the MSP and EC are operationally acceptable	Post Run Questionnaire Debriefing Observations
A1.2.5	04	The integration of a new ATCO acting in a PC capacity during the split MSP→1PC-1EC configuration. As this transition is expected to occur during busy periods, the MSP may be too busy to ensure an effective handover so that the new PC may not receive all of the relevant information about traffic on his sector.	OBJ-10-01a-V3-VALP-HPAP-004	Validate that the handover procedure allows the entering PC to form an adequate picture of the sector.	Post Run Questionnaire Debriefing Observations
A1.3.1	05	The MSP may be prompted to accept too quickly suggestions from electronic coordination without properly assessing the impact on both ECs (one solution that works for one EC may create a problem for the other EC).	OBJ-10-01a-V3-VALP-HPAP-005	Validate that the new working methods for coordination with other units (verbal coordination and e-coordination) are acceptable and do not lead to mistakes.	Post Run Questionnaire Debriefing Observations
A1.3.1	06	Misunderstandings between EC and MSP during team communication may occur. MSP may give information to the wrong EC or EC misinterprets that response of MSP is for him/her.	OBJ-10-01a-V3-VALP-HPAP-006	Validate that communications procedures are clearly defined (e.g. by using read back phraseology or defining clearly who should be the receiver of the message) and that the number of communication related issues is acceptable for safe operations	Post Run Questionnaire Debriefing Observations



A.1.3.3	07	The MSP might experience a reduced ability to stay ahead of the traffic and maintain a mental picture of both ECs traffic and traffic plans. Especially in busy periods, s/he may be lagging behind. This may result in delayed or missed detection of incoming a/c, something that may be frustrating for the EC. Note that already today the PC tend to miss some calls from incoming a/c.	OBJ-10-01a-V3-VALP-HPAP-007 ³	Validate that MSP's ability to build and maintain situational awareness (i.e. "the mental picture" of the traffic and the needs of both EC's of both sectors) is acceptable.	Post Run Questionnaire(s) Debriefing
A1.3.3	08	The MSP might experience high cognitive workload due to the fact that s/he will have to process up to 20/30% more traffic (as in the case of Skyguide), and will need to follow communication on the frequency of both sectors at the same time. This problem may be particularly severe for a 3EC configuration where the three sectors are combined. This problem may also affect the EC(s). If the MSP is too busy, ECs may need to dynamically take over tasks from the ² MSP, may need to engage in more explicit communication to voice request,	OBJ-10-01a-V3-VALP-HPAP-008	Validate that the workload needed for the MSP to manage the traffic with medium/high traffic levels is acceptable.	Post Run Questionnaire Debriefing Observations

³ OBJ-10-01a-V3-VALP-HPAP-007 has been reformulated and combined with OBJ-10-01a-V3-VALP-HPAP-009, since both VOs were SA related. This latter objective OBJ-10-01a-V3-VALP-HPAP-009 has been removed because obsolete.



		etc., traffic solutions may be coordinated later than preferred, etc.			
A.1.3.5	10	Having to work with two or more ECs, the MSP has to readily know which a/c is in contact with which frequency. This is important especially in situation where the association may not be obvious, e.g. weather, a/c on boundaries. This will ensure that the MSP will get in touch with the right EC.	OBJ-10-01a-V3- VALP-HPAP-010	Validate that the MPS can readily identify which flight is associated to which sector.	Post Run Questionnaire End of Day questionnaire Debriefing Observations
A.2.3.5	11	CWP physical design needs to be flexible enough to accommodate various team configurations, and, most importantly, to allow quick transition between them during handover (split or aggregation). One relevant transition is the split from MSP to classic PC-EC configuration (use case #5) as this will occur during busy periods, and it is important that people does not get distracted by the practicalities of moving, changing their physical settings. Current skyguide operational layout do not necessarily accommodate for this due to the presence of a third back up CWP.	OBJ-10-01a-V3- VALP-HPAP-011	Validate that the CWP support physical movements of ATCOs during splits and groupings of sectors.	Post Run Questionnaire Debriefing Observations



A.2.3.6	12	The MPS concept comes with new functionalities to support the MSP configuration (e.g. solutions to visually segregate the traffic and e-coordination tools adaptation to support MSP coordination for both ECs). The usability/acceptability of these functionalities needs to be evaluated.	OBJ-10-01a-V3-VALP-HPAP-012	Validate that the new functionalities to support the MSP configuration are usable/acceptable for the ATCOs.	Post Run Questionnaire Debriefing Observations
A.3.2.1	13	Roles and responsibilities between EC and MSP may change more dynamically during the shift depending on the workload of the MSP and/or the urgency of needs of the EC. This may entail the MSP delegating more to one EC in order to offer more support to another.	OBJ-10-01a-V3-VALP-HPAP-014	Validate that dynamic change in task allocation are acceptable from an operational perspective.	Post Run Questionnaire(s) Debriefing Observations
A3.2.1	14	Loss of the 4-eyes/4-ears principle: The MSP implies that the 2-pairs-of-eyes/ears on the same sector is now fully lost. This is a safety issue whose consequences need to be investigated. Also, this issue may be relevant for the regulators.	OBJ-10-01a-V3-VALP-HPAP-015	Validate that the loss of the 4-eye principle on the same sector does not decrease safety.	Post Run Questionnaire Debriefing Observations
A3.3.1	15	Proximal collaboration strategies in use in the 1PC-1EC configuration will be affected: due to physical distance it will not be possible to talk directly to the EC while discussing (complex) traffic	OBJ-10-01a-V3-VALP-HPAP-013	Validate that ATCOs are able to assess: <ul style="list-style-type: none"> the workload of their colleagues at a glance; 	Post Run Questionnaire(s) Debriefing Observations



		situations and potential trajectories while looking at the same screen, or to assess other ATCOs workload just by glancing quickly at them or at their screen.		<ul style="list-style-type: none"> ATCOs can discuss complex traffic situations. 	
A4.1.1	16	The MSP introduced relevant changes in roles and responsibilities. This may encounter some resistance from an ATCO's perspective.	OBJ-10-01a-V3-VALP-HPAP-016	Validate that the changes in roles and responsibilities are acceptable to both the MSP and the EC.	Post Run Questionnaire(s) Debriefing Observations

Table 5: 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

This section provides a summary of activities conducted within the current V-phase to identify HP issues, benefits and impacts. The description of the activities conducted as part of the HP assessment process is presented in the tables below. There is one table for each activity conducted.

ACTIVITY 1.

Description	A workshop with operational experts to perform an assessment of the change from a human performance and safety perspectives, to derive relevant human performance issues.
Arguments & issues to be addressed	1.1.3 A1.2.5 A1.3.1 A.1.3.3 A.1.3.5 A2.3.5 A2.3.6 A3.3.1 A.3.2.1 A4.1.1
HP Objectives	The workshop identified the relevant HP issues applicable for the MSP. This activity allowed the derivation of the relevant Validation Objectives (already presented in section 4.2.2).
Required Evidence	ATCO's feedback
Tool selected out of the HP repository	ATCO's feedback
Planning and Approach	Group discussions, moderated by two HP experts and guided by a pre-planned template that was filled together with the meeting participants.
Resources	<ul style="list-style-type: none"> - 2 Senior HP experts - 1 Junior HP expert - 1 Junior Safety Expert - 2 Operational experts

Timeline	<ul style="list-style-type: none"> Workshop preparation: 2-10 July 2018 Workshop Execution: 11/12 July 2018 Analysis of results and reporting: 13-20 July 2018
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Table 6: Description of Activity 1

Activity 2. EXE-10-01a-V2-VALP-001 ENAV RTS	
Description	A real time simulation study to investigate the feasibility of the Multi Sector Planner concept when implemented by means of 1PC and 3 ECs in En Route upper airspace. The exercise was conducted at ENAV facilities.
Arguments & related issues addressed	A1.1.3; A1.2.1; A1.2.2; A1.2.5; A1.3.1; A1.3.2; A1.3.3; A1.3.5; A2.3.5; A2.3.7; A2.3.8; A2.3.9; A3.2.2; A3.2.3; A3.3.1; A3.3.3; A3.3.5 and A4.1.2.
HP objectives	OBJ-10-01a-V2-VALP-HPAP-113 OBJ-10-01a-V2-VALP-HPAP-121 OBJ-10-01a-V2-VALP-HPAP-122 OBJ-10-01a-V2-VALP-HPAP-123 OBJ-10-01a-V2-VALP-HPAP-125 OBJ-10-01a-V2-VALP-HPAP-131 OBJ-10-01a-V2-VALP-HPAP-132 OBJ-10-01a-V2-VALP-HPAP-133 OBJ-10-01a-V2-VALP-HPAP-135 OBJ-10-01a-V2-VALP-HPAP-235 OBJ-10-01a-V2-VALP-HPAP-237 OBJ-10-01a-V2-VALP-HPAP-238 OBJ-10-01a-V2-VALP-HPAP-239 OBJ-10-01a-V2-VALP-HPAP-322 OBJ-10-01a-V2-VALP-HPAP-322 OBJ-10-01a-V2-VALP-HPAP-323 OBJ-10-01a-V2-VALP-HPAP-331 OBJ-10-01a-V2-VALP-HPAP-333 OBJ-10-01a-V2-VALP-HPAP-335 OBJ-10-01a-V2-VALP-HPAP-412
Tools / Methods selected out of the HP repository	ATCO's feedback. Expert HP observations of ATCOS during the simulation.

	Standard questionnaires (e.g. EUROCONTROL Shape). ISA measurements.
Summary of the HP activity	<p>The validation exercise was conducted during the 13th and 14th May of 2019 as a Real Time Simulation with the aim to validate the MSP concept providing supporting 3 ECs both in En route and free route operational environment.</p> <p>During two days of simulation the following runs were carried out:</p> <p>Run 1. Reference 1(2 PCs-3ECs);</p> <p>Run 2. Nominal 1 (1MSP-3EC; vocal + e-coordination);</p> <p>Run 3. Configuration transition (1MSP-3EC to 2PC-3EC; vocal + e-coordination);</p> <p>Run 4. Nominal 2 (1MSP-3EC; e-coordination);</p> <p>Run 5. MTCD failure SCN (1MSP-3EC; vocal + e-coordination);</p> <p>Run 6. MIL Airspace activation SCN (1MSP-3EC; vocal + e-coordination);</p> <p>A combination of both qualitative and quantitative data collection techniques will be used prior and post the validation exercise.</p> <ul style="list-style-type: none"> Quantitative data will be obtained from system data logs recorded during each run and questionnaires. Qualitative data will be collected from the actors taking part in each run by different methods. <p>The following techniques were used:</p> <ul style="list-style-type: none"> Over the shoulder observations. During the sessions, the activities of actors will be observed in order to collect insights about their performance, strategies they use to perform the task and difficulties experienced. In order to better understand the reasoning and the way that provided information is used, operators might be asked to “think-aloud” while performing their tasks. Questionnaires (Post-run questionnaire and Post-simulation questionnaire). specific questionnaires will be developed to obtain a feedback from the actors involved in the study on the concept, their performance, the scenarios and exercises performed Debriefings. Structured debriefings will be performed at the end of each simulation day. The difficulties on the exercise

will be discussed among all the participants (operational, validation and technical staffs) and they will be asked to discuss reason about their performed activity based on the information provided by the system.

Table 7: Description of Activity 2

ACTIVITY 3. EXE-10-01a-V3-VALP-001	
Description	A real time simulation study to investigate the feasibility of the Multi Sector Planner concept when implemented by means of 1PC and two EC in extended TMA (lower en Route sectors above TMA). The exercise was conducted at Skyguide facilities.
Related Arguments	A1.1.3, A1.2.5, A1.3.1, A1.3.3, A.1.3.5, A2.3.5, A2.3.6, A3.3.1, A.3.2.1, A4.1.1.
HP objectives	OBJ-10-01a-V2-VALP-001 Operational feasibility OBJ-10-01a-V2-VALP-002 Human performance OBJ-10-01a-V2-VALP-003 Safety OBJ-10-01a-V2-VALP-004 Cost Efficiency
Issues to be addressed/ investigated from issues analysis	16 issues were addressed. They are described in section 4.4.1.
Tools/Methods selected out of the HP repository	Instantaneous Self-Assessment of workload (ISA) Post Run Questionnaires: NASA TLX, EUROCONTROL SASHA questionnaire, CARS, EUROCONTROL STQ. Debriefing Observations
Summary of the HP activity	The Human Performance activities consisted of the following: <ul style="list-style-type: none"> Assist in the production of the Validation Plan and validation material (i.e. briefing presentation, run plan, seating plan, questionnaires, and observers' guidance).



	<ul style="list-style-type: none"> • Collect HP data during the exercise, through observations, interviews, debriefings and questionnaire administration. Perform HP data analysis. • Assist in the production of the Validation Report.
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Table 8: Description of Activity 3

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



4.4.1 Summary of HP activities results & recommendations / requirements at V2 level

The HP recommendations and requirements fall into one of several categories:

- System design
- OPS (operating methods / procedures)
- Open issue

Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
Arg. 1.1.3: Roles and responsibilities are clear and consistent (in V1: non-contradictory).							
113-001	ISSUE: Possible confusion may occur due to, for instance, new or changed responsibilities, and/or to potential cross over in responsibilities between EC and MSP. Possible role confusion within or between teams or on neighboring sectors may occur.	Open	OBJ-10-01a-V2-VALP-HPAP-113-001	RTS	One MSP supporting 3 ECs brought up many questions in terms of roles and responsibilities, especially applied to the conflict resolution tasks and decision making. ATCOs considered that there is still a need to clearly define the boundaries in the MSP and	<ul style="list-style-type: none"> • OPS_Recom_01- Roles and responsibilities must be clarified between the MSP and EC, especially for conflict detection and resolution. • System_Design_Recom_01. The conflict 	<ul style="list-style-type: none"> • REQ-10-01a-V2-01- The roles and responsibilities shall be clear and complete for all human ATC actors involved.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
					<p>EC roles and responsibilities in the Multi sector area.</p> <p>In the questionnaire Executive controllers rated the roles and responsibilities as more adequate, this might have been due to the fact that they felt that they are performing their tasks as before, only with less support from the PC side.</p>	<p>detection and resolution tools to be used by the different roles should be calibrated based on the different needs (MSP- Strategic and EC- Tactical).</p>	
Arg. 1.2.1: Operating methods (procedures) cover operations in normal operating conditions.							
121-001	ISSUE: In situations of high workload the MSP might start delegating tasks to less loaded EC(s). This might lead to bad situation awareness and excessive delegation (MSP→1EC)	Open	OBJ-10-01a-V2-VALP-HPAP-121-001	RTS	The overall cognitive workload ratings show that the MSP has experienced reduced spare capacity to very high workload in 3 of the 5 MSP solution runs,	<ul style="list-style-type: none"> OPS_Recom_02- The working methods for conflict detection and resolution on the borders of the MSA and internally 	<ul style="list-style-type: none"> REQ-10-01a-V2-02- The operating methods and conflict detection resolution procedures



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
	could eventually lead the EC as acting almost as single operator.				<p>particularly in run 2 and in run3.</p> <p>The MSP also experienced a lack of situation awareness of what the ECs were doing inside the sectors, motivated by the lack of HMI adequacy and the fact that it was not possible to listen to the frequencies between EC and the pilots.</p> <p>The EC perceived to be working without the support of the MSP.</p>	<p>to the MSA should be further specified.</p> <ul style="list-style-type: none"> System_Design_Recom_02-MSP should be able to “delegate” the conflicts notification and resolution to the ECs and the MTCD tool should be able to support the MSP in this task. Open_Issue_Recom_01- The MSP concept should be further investigated with one MSP supporting 2 ECs. The investigated concept with one 	<p>(including handovers) procedures shall be clear to all actors inside the MSA and on borders.</p>



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
						MSP providing support to 3 ECs was considered too demanding and not operationally acceptable.	
Arg. 1.2.2: Operating methods (procedures) cover operations in abnormal operating conditions.							
122-001	ISSUE: In abnormal operational conditions the MSP experiencing higher cognitive workload could start using operating methods that were not covered before.	Open	OBJ-10-01a-V2-VALP-HPAP-122-001	RTS	During the RTS run 6 addressed an Unexpected MIL airspace activation, meaning that the activation not planned in the daily log. The duty supervisor in this case warned controllers (EXEs and MSP) of the involved sectors not later than 10 minutes before the effective activation. The MSP experienced reduced	<ul style="list-style-type: none"> Open_Issue_Recom_02-Future MSP concept research steps should further explore the impact of abnormal operating conditions on human performance. 	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
					spare capacity according to Bedford scale but MSPs reported higher workload levels in other runs (run 2 and 3).		
Arg. 1.2.3: Operating methods (procedures) cover degraded modes of the ATM system.							
123-001	ISSUE: In degrading operational modes the MSP experiencing higher cognitive workload could start using operating methods that were not covered before.	Open	OBJ-10-01a-V2-VALP-HPAP-123-001	RTS	During the run 5, in which there was an MTCD failure, ATCOs did not experience high workload. ATCOs also did not notice there was a failure in the MTCD and did not apply working methods that were not covered before during this run.	<ul style="list-style-type: none"> System_Design_Rec om_03- MTCD HMI should provide a “status” indicator to allow ATCO to immediately detect failure. 	<ul style="list-style-type: none"> REQ-10-01a-SPRINTEROP-MSP02.0046- In case of total loss of MTCD functionalities, a visible and permanent notification shall be displayed to all MSP and PLN CWP, with no need for the ATCO to autonomously



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
							check whether the MTCD is working or not in a dedicated diagnostic window.
Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner.							
125-001	ISSUE: The integration of a new ATCO, acting in a PC capacity, during the split MSP→1PC-1EC configuration. As this transition is expected to occur during busy periods, the MSP may be too busy to ensure an effective handover, meaning that the new PC may not receive all of the relevant information about traffic on the sector he is about to take in charge.	Open	OBJ-10-01a-V2-VALP-HPAP-125-001	RTS	Run 3 addressed the team configuration transition from 1MSP-3EC to MSP-2EC 1PC-1EC The configuration transition was operationally and technically feasible without any perceived degradation in the ATC service. No particular problems were detected during the team transition run but this aspect should be further investigated in future steps.	<ul style="list-style-type: none"> Open_Issue_Recom_03-Further validation activities should investigate the impact of team configuration transitions in the operating methods. 	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
					Initial result (limited only to run3) suggest that this configuration is more acceptable compared to the MSP+3EC configuration.		
Arg. 1.3.1: The potential for human error is reduced to a tolerable level							
131-001	ISSUE: The fact that the MSP has to monitor a larger sector area while providing support to 3 ECs means that it be could be harder for him and to provide timely support to all the ECs.	Open	OBJ-10-01a-V2-VALP-HPAP-131-001	RTS	During the debriefing MSPs mentioned that they did not had enough information in order to build an adequate SA of the MSA for most of the runs. The size of the MSA, the amount of traffic in the sectors and the lack of possibility to listen to the frequencies were some of the factors that impacted human performance.	None	None



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131-002	ISSUE: The coexistence between voice and e-coordination communication can create error-prone situations and inefficient communication between MSP and one EC (e.g. if MSP communicates something verbally and does not update that information on the e-coordination tool).	Open	OBJ-10-01a-V2-VALP-HPAP-131-002	RTS	The support provided by the e-coordination tool was not considered acceptable by ATCOs. As a consequence, the ATCOs were frequently required to revert to verbal communication in order to clarify reciprocal intentions and make sure that the choices made at a strategical level by the different ECs of the same MSA where not inconsistent among them. This communication mechanism was considered too complex, time consuming and possibly error-prone, especially if one takes into account that a real operating room would	<ul style="list-style-type: none"> System_Design_Recom_04-The MSP concept shall be supported by an efficient e-coordination tool. Open_Issue_Recom_04- Further validation activities should be performed to better investigate voice and e-coordination comparison with an improved e-coordination tool HMI. 	<ul style="list-style-type: none"> REQ-10-01a-V2-03- The MSP concept shall be supported by an efficient e-coordination tool.



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					<p>normally include much more ATCOs than just on 1MSP-3ECs or 1MSP-2PCs and 1PC-1EC, as it was the case in the simulation setting. However, no particular error-prone situation was detected from the coexistence of both e-coordination and voice communication.</p> <p>The voice coordination was deemed extremely important in general and ATCOs preferred that it would not be removed.</p>		
131-003	ISSUE: The fact that the MSP has to monitor a larger sector area while providing support to 3 ECs	Open	OBJ-10-01a-V2-VALP-	RTS	During the debriefing MSPs mentioned that they did not had enough information in order to build an adequate	None	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
	means that it be could be harder for him stay ahead of traffic.		HPAP-131-003		SA of the MSA for most of the runs. The size of the MSA, the amount of traffic in the sectors and the lack of possibility to listen to the frequencies were some of the factors that impacted human performance.		
Arg. 1.3.2: Tasks can be achieved in a timely manner.							
1.3.2-001	ISSUE: The use of e-coordination might take more time than the voice coordination, this means that the MSP will be taking more time using the e-coordination tool.	Open	OBJ-10-01a-V2-VALP-HPAP-132-001	RTS	The support provided by the e-coordination tool was not considered acceptable by ATCOs. As a consequence, the ATCOs were frequently required to revert to verbal communication in order to clarify reciprocal intentions and make sure that the choices made at a strategical level by the	None	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
					different ECs of the same MSA where not inconsistent among them. This communication mechanism was considered too complex and more time consuming.		
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.							
1.3.3-001	BENEFIT: The MSP is responsible of supervising and balancing the workload between the ECs. He may decide to support the busy EC(s) while delegating tasks to the less busy EC(s). For the EC this may translate in a more acceptable distribution of the level of cognitive workload.	Open	OBJ-10-01a-V2-VALP-HPAP-133-001	RTS	The overall MSP cognitive workload ratings showed that they experienced reduced spare capacity to very high workload in 3 of the 5 MSP solution runs and experienced lack of Situation Awareness of the sector and on what tasks ECs were carrying out. The MSP was not able to supervise and balance the work of 3 ECs in the present	<ul style="list-style-type: none"> System_Design_Rec om_05-The tools supporting the MSP concept (e-coordination and conflict detection and resolution tools) shall not increase the operator workload. 	<ul style="list-style-type: none"> REQ-10-01a-V2-04-The tools supporting the MSP concept shall not increase the operator workload.



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					operational configuration. This benefit was not confirmed for the ECs supported by the MSP.		
1.3.3-002	ISSUE: The MSP might experience high cognitive workload just to follow the communications and build an adequate Situation Awareness of the sectors assigned to him. (Multiple frequency related issue).	Open	OBJ-10-01a-V2-VALP-HPAP-133-002	RTS	<p>The load associated to following R/T communications was considered high.</p> <p>All the 71.4% of the respondents, percentage that had the opportunity to try the MSP role, strongly agreed that they missed the possibility to listen to the communication between the EC and pilots in order to build good Situation Awareness.</p>	None	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
1.3.3-003	ISSUE: The MSP might experience high cognitive workload due to the fact that s/he will have to integrate traffic information from a larger geographical area. This problem may be particularly severe for a 3EC configuration, where the sectors combined are three.	Open	OBJ-10-01a-V2-VALP-HPAP-133-003	RTS	<p>The overall MSP cognitive workload ratings showed that they experienced reduced spare capacity to very high workload in 3 of the 5 MSP solution runs and experienced lack of Situation Awareness of the sector and on what tasks ECs were carrying out.</p> <p>The size of the MSA and the amount of traffic in the sectors impacted the perceived workload.</p>	<ul style="list-style-type: none"> OPS_Recom_03-The MSA configuration implementation should take into consideration the compatibility of sectors to be merged (e.g. size, traffic flows evolution, shape). 	None
Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.							
1.3.5-001	ISSUE: The MSP might experience a reduced ability to stay ahead of the traffic and maintain a mental picture of	Open	OBJ-10-01a-V2-VALP-	RTS	The MSP experienced a reduced ability to stay	<ul style="list-style-type: none"> System_Design_Recom_06- Tools and the CWP HMI The interface should 	REQ-10-01a-SPRINTEROP-MSP02.0005- The MSP consolidated situation



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	more than one EC traffic and traffic plans. Especially In busy periods, s/he may be lagging behind.		HPAP-135-001		<p>ahead of traffic and low situation awareness.</p> <p>During the debriefings the MSPs mentioned that they had no SA of what his ECs are doing and of what was being done internally to each sector, especially because they are not able to listen to three (even two) frequencies at the same time. The size of the MSA and the high amount of traffic also contributed to the MSP's lack of SA.</p>	highlight and display all information and data exchange between team members' actions on the flights of the MSA to improve the overall SA.	display shall display all relevant information and data exchange pertinent to all Executive sectors within the Multi-Sector Area
1.3.5-002	ISSUE: The MSP is responsible of supervising and balancing the workload between the ECs. He may decide to support the busy EC(s) while delegating tasks to	Open	OBJ-10-01a-V2-VALP-	RTS	The overall MSP cognitive workload ratings showed that they experienced reduced spare capacity to very high workload in 3 of	<ul style="list-style-type: none"> OPS_Recom_04-The MSP should be provided with means to monitor the workload of the 	REQ-10-01a-SPRINTEROP-MSP02.0033- The MSP shall be able to monitor



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	the less busy EC(s). Currently the PC is able to make an estimation of the EC workload because he listening to the frequencies and communication. This will not be possible anymore in the current MSP configuration.		HPAP-135-002		the 5 MSP solution runs and experienced lack of Situation Awareness of the sector and on what tasks ECs were carrying out. The MSP was not able to monitor and balance the work of 3 ECs in the present operational configuration.	<p>MSP team members, even if he is not able to follow two different frequencies at the same time.</p> <ul style="list-style-type: none"> Open_Issue_Recom_05-The workload of the MSP providing support to 3ECs was not compatible with the role of workload monitoring, this should be further explored in future activities and considered in the clarification of the MSP role. 	the workload the ECs he is supervising.

Arg. 2.3.5: Workstations (e.g. cockpit layout and consoles) adhere to ergonomic principles.



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2.3.5-001	ISSUE: The CWP layout and seating position might not be flexible enough to accommodate quick team configuration transitions (split or aggregation).	Open	OBJ-10-01a-V2-VALP-HPAP-235-001	RTS	The CWP layout and sitting position allowed to accommodate team configuration transitions and was dealt with like a sector opening or closing.	None	<ul style="list-style-type: none"> REQ-10-01a-V2-05- The CWP layout and seating position shall accommodate team configuration transitions without affecting operations.
2.3.5-002	ISSUE: The CWP layout for one MSP working with more than 2 ECs might create a situation in which the team awareness it is not the same for all elements. The MSP not seating physically close to the EC(s) he is supporting might impair him to anticipate certain peaks of workload.	Open	OBJ-10-01a-V2-VALP-HPAP-235-002	RTS	Most ATCOs did not feel supported by the team members (run 3, 4, 5 and 6). Questionnaire results showed that the seating position layout impacted the way the MSP-EC team cooperated. The TS sector, which was the sector where the EC was working far away from the MSP, was the sector that reported a more negative impact of the	<ul style="list-style-type: none"> System_Design_Recom_07-ATCOS suggested that a shared frequency could support an improvement in their SA. OPS_Recom_05-ATCOs suggested that a proper seating layout (that maximize the 	<ul style="list-style-type: none"> REQ-10-01a-SPRINTEROP-MSP02.0023- The e-coordination tool shall make visible electronic coordination to all members of the MSP team (all-in-the-loop philosophy).



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	Additionally, MSP might also privilege communication or coordination with the ECs that are seating physically close to him.				seating layout, together with the MSP. During debriefings ATCOs reported that the impact of the seating position layout would have been felt less if the coordinating tool worked in a better way.	proximity between the SMP and EC) could support an improvement in their SA.	<ul style="list-style-type: none"> REQ-10-01a-SPRINTEROP-MSP02.0025- MSP and its ECs SHALL seat sufficiently close so that verbal communication is possible, and that the MSP can see ECs' screen and vice versa.
Arg. 2.3.7: The user interface design reduces human error as far as possible.							
2.3.7-001	ISSUE: The MSP supporting more than one EC might confuse which flights are being managed by which EC. The HMI should support him in maintaining a good situation awareness on	Open	OBJ-10-01a-V2-VALP-HPAP-237-001	RTS	During the debriefings MSPs mentioned could not really coordinate or delegate tasks in a clear way via HMI. With 3 ECs the MSP felt like he was not able to provide support to any of them. The voice coordination was	<ul style="list-style-type: none"> System_Design_Recom_08- The CWP interface of the MSP should clearly indicate which is the EC responsible each of the flights. 	<ul style="list-style-type: none"> REQ-10-01a-SPRINTEROP-MSP02.0013- The CWP display shall support the MSP role in identifying which flight belong



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	traffic on the responsibility of different EC.				deemed extremely important in general and can't really be removed.	<ul style="list-style-type: none"> System_Design_Recom_09-The MSP/EC shall be able to immediately determine via a clear HMI indication who is the controller originator of the proposal. 	to which sectors of the MSA.
Arg. 2.3.8: The user interface design supports a sufficient level of individual situation awareness.							
2.3.8-001	ISSUE: The MSP might experience a reduced ability to stay ahead of the traffic and maintain a suitable mental picture of more than one EC. This can be true especially during busy periods, s/he may be lagging behind.	Open	OBJ-10-01a-V2-VALP-HPAP-238-001	RTS	<p>The MSP experienced a reduced ability to stay ahead of traffic and low situation awareness.</p> <p>During the debriefings the MSPs mentioned that they had no SA of what his ECs are doing and of what was being done internally to</p>	See Arg. 1.3.5.	See Arg. 1.3.5.



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	Therefore, the enhanced interface and MSP tools must allow support both MSP and EC to maintain a good Situation Awareness.				each sector, especially because they are not able to listen to three (even two) frequencies at the same time. The size of the MSA and the high amount of traffic also contributed to the MSP's lack of SA.		
Arg. 2.3.9 The user Interface design supports a sufficient level of team situational awareness.							
2.3.9-001	ISSUE: To make a correct estimation and balance of the workload of the ECs that he is supporting the MSP (without being overloaded himself) might need to be supported by the HMI. In prevalently silent coordination (not able to follow the voice frequency of some or all ECs) environment the MSP might not be able to judge the	Open	OBJ-10-01a-V2-VALP-HPAP-239-001	RTS	<p>The current user interface design did not support ATCOs team coordination and awareness on the tasks performed by the actors in the team.</p> <p>The overall perception of ATCOs was that the tools supporting the MSP operational concept were</p>	<p>The recommendations that were collected on improvements for the e-coordination were the following:</p> <ul style="list-style-type: none"> System_Design_Recom_10-Coordination status and details visible directly from the flight label; 	<ul style="list-style-type: none"> REQ-10-01a-SPRINTEROP-MSP02.0043- When receiving a coordination proposal via the E-Coordination tool, the PLN or MSP shall receive on the HMI a visible notification that the



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	ECs workload. The fact that the MSP is not physically close to the EC(s) that he is supporting might aggravate this issue.				not adequate enough because they required many steps, they were not immediate and user-friendly enough.	<ul style="list-style-type: none"> System_Design_Rec om_11-Minimizing the time and the number of steps to complete the coordination task; System_Design_Rec om_12-More conspicuous notifications on the flight label that in case when there is a pending coordination request. <p>The recommendations that were collected on improvements for the MTCD were the following:</p>	<p>proposal has arrived, as close as possible to the affected flight (e.g. in the track label) in order to minimize the risk that the proposal will go unnoticed.</p> <ul style="list-style-type: none"> REQ-10-01a-SPRINTEROP-MSP02.0044- When receiving a coordination proposal via the E-Coordination tool, the EC shall receive on the HMI a visible notification that the proposal has arrived, as close as



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						<ul style="list-style-type: none"> System_Design_Recom_13- ATCOs suggested that 'M' tag in the label should be visible ONLY if the a/c involved in the conflict is in the sector of interest and only if is a 'real' conflict (namely loss of separation in both Vertical and Lateral). System_Design_Recom_14-ATCOs would have liked to be able to acknowledge conflicts that have already been considered by them, 	possible to the affected flight (e.g. in the track label) in order to minimize the risk that the proposal will go unnoticed.



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						<p>to 'tick them of' the conflict list.</p> <ul style="list-style-type: none"> • System_Design_Recom_15-ATCOs mention they would like to see a more dynamic MTCD. For instance that when they would open the vertical level window they would see the conflicting levels directly from the list. • System_Design_Recom_16-The MSP should be able to delegate to his ECs the conflict resolution that he can act on (visually 	



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						<p>highlighted and the reason why should be clearly elicited). This way the MSP can anticipate an action to facilitate the EC work before a TCT alert.</p> <ul style="list-style-type: none"> System_Design_Recom_17-The MSP considered that it would be useful to have a MTCD panel with the conflict alerts provided by importance and/or by temporal order. This would support MSP in prioritizing tasks accordingly. 	



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2.3.9-002	ISSUE: The team situational awareness might be impacted if all the team members don't have access to the same information in the same sector and if the MSP has difficulty to distinguish from which sector or EC the requests are coming from.	Open	OBJ-10-01a-V2-VALP-HPAP-239-002	RTS	<p>Coordination log. ATCO consider that there is a lack of traceability of the coordination and outcome of the request. ATCOs should be able to retrace the coordination history associated to a flight;</p> <p>Feedback. No feedback or notification is provided to ATCOs informing that there is a coordination request pending. The lack of an alert on pending coordination requests has a negative impact in the overall team task flow and timing.</p> <p>Coordination log. It is not clear for the team which actions were carried out by</p>	<ul style="list-style-type: none"> System_Design_Recom_18-The e-coordination tool should be improved in order to work in a similar way to CPDLC. 	None



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					which actors. In some occasions the MSP made a 'direct to' but the EC SU was not aware that the MSP had done it (the list of coord out did not open).		
Arg. 3.2.1: Changes to the task allocation between human actors do not lead to adverse effects on human tasks.							
3.2.1-001	ISSUE: The MSP concept implies that the 2-pairs-of-eyes on the same sector might be compromised if the MSP is experiencing cognitive overload. This means that in a situation like this he can experience attention tunneling or start delegating more tasks to the ECs he is supervising.	Open	OBJ-10-01a-V2-VALP-HPAP-321-001	RTS	<p>A total of 85.7% of the ATCOs considered that they felt uncomfortable for not having the extra pair of eyes on their sector, the remaining 14.3% did not agree nor disagreed.</p> <p>During the debriefings MSPs mentioned they could not really coordinate or delegate tasks in a clear way via HMI. With 3 ECs the MSP</p>	<ul style="list-style-type: none"> System_Design_Recom_19-The CWP display and tools shall support the MSP in delegating and/or highlighting tasks to ECs, including conflict management tasks. Open_Issue_Recom_06- Further validation activities 	<ul style="list-style-type: none"> REQ-10-01a-V2-06- The CWP display and tools shall support the MSP in delegating and/or highlighting tasks to ECs, including conflict management tasks.



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					felt like he was not able to provide support to any of them. The voice coordination was deemed extremely important in general and can't really be removed.	should be carried out in order to investigate how the human redundancy can be support in other ways or using tools.	
Arg. 3.2.2: The proposed task allocation between human actors is supported by technical systems/the HMI.							
3.2.2-001	BENEFIT: The MSP has an overview over a group of adjacent sectors to which he provides support and manages EC cognitive workload levels. The working method change and the fact that the MSP has to maintain a good situation awareness in order to support a team of ECs might also reduce	Open	OBJ-10-01a-V2-VALP-HPAP-322-001	RTS	The MSP cognitive workload level and the limited situation on what was going on inside the MSA did not allow him to perform the task of balancing the workload levels of the ECs he was supporting. During the debriefings MSPs mentioned they could not	None	None



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	the team coordination errors between all those sectors.				really coordinate or delegate tasks in a clear way via HMI. With 3 ECs the MSP felt like he was not able to provide support to any of them.		
Arg. 3.2.3: The potential for human error in team tasks is reduced as far as possible.							
3.2.3-001	ISSUE: The fact that MSP concept will affect the 2 pairs of eyes principle, considering the changes in the working methods (silent coordination), might mean that some errors might be detected with some delay.	Open	OBJ-10-01a-V2-VALP-HPAP-323-001	RTS	ATCOs were not satisfied of the support offered by the e-coordination tool to in compensating the missed possibility to listen the communication between EC and pilots to build a good situation awareness. This communication mechanism was considered too complex, time consuming and could lead to an increase number of errors	None	None



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					but this was not supported by quantitative data.		
Arg. 3.3.1: Intra-team and inter-team communication supports the information requirements of team members.							
3.3.1-001	ISSUE: Proximal collaboration strategies in use in the 1P-1E configuration will be affected: due to physical distance it will not be possible to talk directly to the EC while discussing (complex) traffic situations and potential trajectories while looking at the same screen, or to assess other's ATCOs workload just by glancing quickly at them or at their screen.	Open	OBJ-10-01a-V2-VALP-HPAP-331-001	RTS	Some ATCOs considered the seating position impacted the communication means. In the debriefings it was mentioned that the impact of the seating position layout could be less relevant if the coordinating tool was improved in a way that they can distribute and communicate information to their team members more clearly. The TS sector, which was the sector where the EC was working far away from the	See A1.3.5-001.	See A1.3.5-001.



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					<p>MSP, was the sector that reported a more negative impact of the seating layout, together with the MSP.</p> <p>Even if at the level of perception the sitting configuration of the MSP was not satisfactory for the ATCOs the sitting configuration per se did not cause a higher number of conflicts.</p>		
Arg. 3.3.3: Changes in communication means & modalities are identified and acceptable.							
3.3.3-001	BENEFIT: The amount of communication between MSP and EC is expected to be reduced compared to the PC-EC units. The coordination between planners (PC-PC) is also	Open	OBJ-10-01a-V2-VALP-HPAP-333-001	RTS	ATCOs (ECs, PCs and MSP) felt that the e-coordination tool did not support them communicating with team members and did not support the information	<ul style="list-style-type: none"> Open_Issue_Recom_07- External coordination should be investigated future simulations (MSP-PC 	None



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	eliminated. This can improve the communication means between teams using the e-coordination system.				<p>sharing. Therefore the advantages of using the e-coordination system were not possible to observe with the current tool implementation.</p> <p>In the chosen simulation setting there were only one MSP position and 3 EC positions, plus the non-measured Feeder sector. In such configurations there was no additional PC the MSP could have coordinated with by phone. The phone coordination between the MSP and the single feeder sector were mostly related to responding to a technical need of the simulation and not to a working method</p>	coordination). The impact of external coordination on MSP's workload should be further explored in future validation activities.	



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					that would be used in a real operating environment.		
3.3.3-002	ISSUE: The MSP concept is based on the presence of electronic (or silent) coordination replacing most of verbal coordination — voice communication should be used as a “backup” for the former. This will bring major changes in the communication between the EC-PC teams are communicating today and creating their shared situation awareness. The silent coordination could take more time compared to previous quick voice coordination, especially when controllers are seating side-by-side and can point to each other screens.	Open	OBJ-10-01a-V2-VALP-HPAP-333-002	RTS	ATCOs (ECs, PCs and MSP) felt that the e-coordination tool did not support them communicating with team members and did not support the information sharing. Therefore the advantages of using the e-coordination system were not possible to observe with the current tool implementation.	<ul style="list-style-type: none"> OPS_Recom_06- Voice coordination was deemed extremely important in general and should not be really be removed from the concept 	None



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Arg. 3.3.5: Team members can maintain a sufficient level of shared situation awareness.							
3.3.5-001	ISSUE: The team situation awareness (MSP-3ECs) in high workload scenarios can be degraded. The fact that the MSP is not seating close to all the ECs and that he should be using the e-coordination system might mean that the HMI of the system might impact team situation awareness.	Open	OBJ-10-01a-V2-VALP-HPAP-335-001	RTS	<p>The team situation awareness in MSP-3ECs configuration was inexistent or close to inexistent. ATCOs (ECs, PCs and MSP) felt that the available tools did not support them in working as a team and did not support the information sharing.</p> <p>The fact that the platform in with the RTS was performed was not the actual operational platform that they use in operations played a role in these results, even in the reference scenario the feedback was not more</p>	See Arg. 2.3.9.	See Arg. 2.3.9.



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					positive in comparison with the other runs.		
Arg. 4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered.							
4.1.2-001	ISSUE: The MSP might experience higher cognitive workload to maintain a good SA and always be ahead of traffic and provide adequate support to more than one EC.	Open	OBJ-10-01a-V2-VALP-HPAP-412-001	RTS	<p>The MSP experienced very high workload supporting 3 ECS at the same time.</p> <p>During the debriefing of the transition scenario (run 3) the MSP mentioned that it was more much acceptable to support only 2 ECs (SU and ES sectors). The acceptability was connected to the following main 3 reasons: (1) the MSA was smaller in this case, (2) in current operations the two sectors already work with one PC when the traffic is</p>	None	None



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					very low, and finally, (3) the MSP that working physically closer to his ECs has better chances of sustaining a good SA from those two sectors (facilitated communication, faster coordination and possibly to follow 2 frequencies). The EC from the TS sector mentioned that he preferred to work with a dedicated Planner.		
4.1.2-002	ISSUE: An MSP supporting more than a single EC might mean that in a certain period of time the MSP might not be available to support right away. The feeling of uncertainty in the MSP support and the possibility of the lack of the 2 pair of eyes principle in operations might	Open	OBJ-10-01a-V2-VALP-HPAP-412-002	RTS	<p>The MSP experienced very high workload supporting 3 ECS at the same time.</p> <p>The ECs considered that the MSP concept operational acceptability was not very good. Some Both MSP and ECs mentioned that they felt</p>	None	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Recommendations	Requirements
	affect the EC acceptance and satisfaction towards MSP operations.				<p>like the roles and responsibilities were not clear enough and did not feel confident working in this configuration.</p> <p>During the debriefing of the transition scenario (run 3) the MSP mentioned that it was more much acceptable to support only 2 ECs (SU and ES sectors).</p>		

Table 9. ENAV V2 RTS Human Performance Results



4.4.2 Maturity of the Solution (V2)

The validation allowed to assess the MSP concept in the configuration of one MSP supporting 3 ECs, as defined in the OSED. The validated concept was not considered fully feasible and operationally acceptable under the tested conditions. The lack of acceptability was connected to the following main 3 reasons: (1) the MSA was considered too large, (2) the tools supporting the MSP concept were not mature enough. The tools supporting the MSP concept should be improved according to recommendations. (3) the roles and responsibilities and working methods require further clarification, especially in terms of conflict resolution tasks inside the MSA and on the sectors boundaries.

On the other hand, the configuration of one MSP supporting 2 ECs (transition scenario-run 3) was considered much more acceptable. This was highlighted by the slightly more positive results on the working methods adequacy in run 3 (transition).

To conclude, the outcomes of the operational implementation of one MSP supporting 3 ECs in En route (Free Route Environment) was not considered sufficiently mature in order to advance to the next V-phase (V3). Future steps must focus on the technical and operational implementation of the concept focusing on MSP supporting 2 ECs. However, further studies are needed to confirm this initial result which is based on one run only.

Maturity checklist for finalising the V2 assessment

ID	Question	Answer	Comments
1	Have relevant arguments for V2 been addressed and appropriately supported?	Yes	The main outcomes and evidences related to the HP issues, benefits and Validation Objectives are reported in 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 V2)?	Yes	The main benefits and issues in terms of human performance have been addressed and evidence reported in reported in section 4.4.1.

3	Have potential interactions with related projects/concepts started to be considered?	Yes	The interaction with related projects have been considered. An important enabler to the MSP solution comes from PJ10.02a, as improved Separation Management solutions can improve planning and work distribution between the different roles (PC, MSP and ECs) and improved safety levels.
4	In case of different options of the proposed solution, is the decision for a specific option(s) based on the consideration of HP benefits and issues?	No	In the proposed solution no alternative options addressed.
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	No	<p>The MSA operations with one MSP supporting 3 ECs were not considered fully feasible and operationally acceptable under the validated conditions. The concept needs further clarification in terms of roles and responsibilities and operating methods, especially in terms of conflict resolution tasks inside the MSA on the sectors boundaries. The tools supporting the MSP concept should be improved according to recommendations.</p> <p>On the other hand, the configuration of one MSP supporting 2 ECs (transition scenario-run 3) was considered much more acceptable. However, further studies are needed to confirm this initial result (which is based on one run only).</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	No	The results did not achieved the target set for this concept. The impact has been analysed and reported.

	objectives/targets been analysed?		
7	Has the proposed solution been tested with end-users and started to be tested under sufficiently realistic conditions, including certain abnormal and degraded conditions?	Yes	<p>The proposed solution has been tested with end-users and sufficiently realistic conditions. Degraded conditions have also been addressed.</p> <p>The impact of external coordination on MSP's workload should be further explored in future validation activities. In the chosen simulation setting there were only one MSP position and 3 EC positions, plus the non-measured Feeder sector.</p>
8	Are the outcomes based on the solution assessment mature enough to start V3?	No	<p>The outcomes based on the 1MSP-3ECs configuration solution assessment were considered too ambitious and not mature enough to start V3.</p> <p>The MSA operations with one MSP supporting 3 ECs were not considered fully feasible and operationally acceptable under the tested conditions.</p> <p>On the other hand, the configuration of one MSP supporting 2 ECs (transition scenario-run 3) was considered much more acceptable. However, further studies are needed to confirm this initial result (which is based on one run only).</p>
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	HP results have provided the inputs for the HPAR have been integrated in the OSED.

10	Have the major factors that can influence the transition feasibility (e.g. changes in automation level, changes in staff requirements, such as competence, staffing levels) been considered? Are there any ideas on how to overcome any such issues?	Yes	Initial feedback on transition aspects has been collected in the V2 RTS and but these aspects haven't been addressed in detail.
11	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 potential impact on regulatory aspects of ATM has been considered. The main novelty is the role and responsibilities of the MSP role, however there is no impact on regulatory aspect as the tasks of the MSP are already defined in the planner and executive roles
12	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	No	Recommendations for future research concerning HP aspects have been identified.



4.4.3 Summary of HP activities results & recommendations / requirements at V3 level

Table 4 provides an excerpt of the HP Log following the completion of the recommended HP activities.

Table 4 provides a summary of the HP argument and related issues/benefits along with the HP activity(ies) conducted. It reports on the outcomes of HP issues that were included into the HP assessment plan. For each HP argument and issue, the results/evidence obtained from the activities conducted are briefly described along with the recommendations and/or requirements generated.

The status of each HP issue is also given. The status of an issue / benefit can either be 'closed', 'open', 'cancelled': An issue is considered 'closed' when the issue had been sufficiently answered or no additional activities relating to that issue are foreseen as necessary. An issue is considered as being 'open' when the issue has been either: partially addressed and more studies are needed or; the issue had been addressed by certain activities but as a result other related issues had arisen or; when no activity has been performed to date to address a specific issue. An issue is considered as being 'cancelled' when the activities conducted have shown the issue to be not relevant to the given concept under investigation.

The HP recommendations and requirements fall into one of several categories:

- System design
- OPS (operating methods / procedures)
- OBJ (New objective)
- Training
- Other

In addition, HP recommendations can relate to evaluation activities to be conducted in the deployment phase in order to confirm issues/benefits and their potential mitigation in more detail.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
Arg. 1.1.3: Roles and responsibilities are clear and consistent (in V1: non-contradictory).							
01	There needs to be clarification that all actors understand the scope of their roles and responsibilities. Confusion may occur due to, for instance, new or changed responsibilities, and/or to potential cross over in responsibilities between EC and PC. Possible role confusion within or between teams or on neighbouring sectors may occur.	Open	OBJ-10-01a-V3-VALP-HPAP-001	RTS Post Run Questionnaire(s) Debriefing Observations	Questionnaire results indicate that roles and responsibilities were relatively clear for this concept. During the simulations, the MSPs reported some uncertainty about his role, as during the simulation some coordination were done directly between ECs, some others involved the MSP. For conflict across two boundaries, sometimes the MSP hesitated to intervene, as s/he was unsure about whether it was up to him/her to initiate the coordination. Note these gaps were due to the novelty of the concept rather than issues of feasibility, that they can be addressed in further concept evolution.	It should be clear to the MSP that s/he has to exploit his/her global view (of the two sectors combined) to streamline the work for both ECs. The MSP should remain responsible for external coordination by phone. EC could still do external coordination via e-coordination (still to be considered in the next validation phase). The MSP role should not be responsible for monitoring both frequencies, as this is not feasible for the MSP (see the problem of listening to the split	Evaluation activities prior to the deployment phase to consolidate the following issues: It remains to be specifically defined which are team tasks, i.e. tasks that can be done by either the MSP or the EC, vs specific tasks, i.e. tasks that are associated to one specific role. Examples of team tasks (which could be done by the EC or MSP) include delegation of XFL to the EC, sequencing, coordination with external units, CPDLC tasks, etc. It has to be further specified the best way to deal with Coordination of conflicts near



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
						frequency (see issue #07). (However, this aspect should be mitigated to ensure that safety is maintained.)	<p>to the boundary. For now we see two extremes:</p> <ul style="list-style-type: none"> • Coordination directly between ECs, while keeping the MSP in the loop through verbal coordination • Coordination between the two ECs via the MSP.
Arg. 1.2.5: Operating methods can be followed in an accurate, efficient and timely manner.							
02	MSP (1PC-2EC) concept may result in better overall sector efficiency, but may reduce planner efficiency. This may be the case in very high and complex situations, such as adverse	Open	OBJ-10-01a-V3-VALP-HPAP-002	RTS Post Run Questionnaire(s) Debriefing Observations	The MSP was observed to be less proactive compared to today's Planner, due to the inability to follow two frequencies at the same time (see issue #07). However, note that the MSP was still able to act on a planning capacity, thanks to the global traffic picture that he could acquire from the radar display.	None	Evaluation activities prior to the deployment phase in order to investigate the full MSP concept simulated together with the potential solutions that could further increase the ability of the



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
	weather situations or emergencies, where PC workload is higher than in normal situations. This comes from NATS SESAR1 VALP.			ISA workload ratings	<p>(Covering all sectors of the MSP areas, this picture is not available to the ECs, who maintains a local view of own sector.) Overall, this was a positive result as it was anticipated that the decreased efficiency (as a result of too high workload) of the MSP could be a blocking aspect.</p> <p>This was confirmed by the Post Run Questionnaire Workload for the MSP. The results indicated that the workload for the MSP for EC/MSP Communication and Coordination tasks was higher for the MSP compared to the EC (which is reverse compared to the Reference scenario), however, overall workload for the MSP was similar to EC for the MSP use cases.</p>		planner to stay ahead of traffic.
03	It needs to be validated that the working	Closed	OBJ-10-01a-V3-	RTS	Ratings from items Q1 and Q2 of the End-of-the-Day questionnaire	The MSP should be relieved from the obligation to	Evaluation activities prior to the deployment phase in



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
	methods for MSP and ECs are operationally acceptable.		VALP-HPAP-003	Post Run Questionnaire(s) Debriefing Observations	<p>addressed the acceptability of working methods for the MSP and EC, and they respectively suggest the concept was overall well received.</p> <p>However, the following points should be considered to further mature the MSP working methods:</p> <p>During the debriefing, it was reported that it was not always clear for the MSP which information to relay to which executive. However, it was noted that this can be a challenging aspect also on today's system.</p>	monitor the frequency. (However, this aspect should be mitigated to ensure that safety is maintained.)	<p>order to investigate the following issues:</p> <p>Mitigation means to the fact that the MSP will not be able to monitor both frequencies.</p> <p>Definition of team tasks vs role-specific tasks (already mentioned in VO1).</p> <p>The MSP will have to support two different ECs that may have two very different working methods. For instance, an EC may require a lot of coordination. For the MSP having two of these EC may make things more complicated (two executive may give a hard time). This challenge was not observed/explored in the simulation; however, during debrief the ATCOs considered</p>



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
							it feasible for the MSP to adapt to the needs/working style of different ECs.
04	The integration of a new ATCO, acting in a PC capacity, during the split MSP->1PC-1EC configuration. As this transition is expected to occur during busy periods, the MPS may be too busy to ensure an effective handover, so that the new PC may not receive all the relevant information about traffic on his sector.	Closed	OBJ-10-01a-V3-VALP-HPAP-004	RTS Post Run Questionnaire(s) Debriefing Observations	<p>Transition possibilities were:</p> <ul style="list-style-type: none"> 2 PC-EC teams to 1 MSP team. MSP to 2 PC-EC teams (this was the condition simulated). 1 combined sectors to MSP, 1 EC is added. <p>Transition for the MSP and EC was found never challenging.</p> <p>The mental switching from the MSP mode to the PC mode was not reported to be a relevant issue. It seems unlikely that an actor may retain the MSP perspective while working as a PC and vice-versa. However, this point should be</p>	System functionalities should be developed to support handover (providing, e.g. info on a/c on the frequency, pending coordination).	<p>In principle, this problem should be mitigated by the fact that new sector configurations (regardless from MSP) should be planned by the SPVR in advance and with respect to the traffic. This means it should be done in low traffic situations before the peak starts.</p> <p>OPS: the definition of transition point (timing/closing of sector) is essential, also from a safety perspective—trespassing this point is an operational safety hazard.</p>



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					rechecked after the roles and responsibilities become clearer. The most critical issue is to avoid losing the opportunity window to split the sector in time; after this point, there will be no opportunity for the ATCOs to do the handover due to the high workload. This is also a safety issue and points to the importance of clearly defining maximum traffic threshold beyond which workload would be intolerable. Qualitative feedback confirmed that the MSP may provide an intermediate staffing level between a team of two (1PC-1EC) and a team of four (two teams of 1PC-1EC each). So, instead of adding two ATCOs right away as the traffic increases, a solution that may not be desirable for intermediate traffic, the supervisor would also have the possibility of adding just one ATCO.		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
Arg. 1.3.1: The potential for human error is reduced as far as possible.							
05	The MSP may be prompted to accept too quickly suggestions from electronic coordination without properly assessing the impact on both ECs (one solution that works for one EC; may create a problem for the other EC).	<i>Not Investigated</i>	OBJ-10-01a-V3-VALP-HPAP-005	RTS Post Run Questionnaire Debriefing Observations	This VO was not addressed in the validation as external coordination was not simulated. However, it is anticipated that no significant changes in methods and/or procedures regarding external coordination with adjacent units are expected at this stage for the MSP. What seems desirable is to have the possibility for the EC to do e-coordination.	E-coordination tools should allow the EC to do e-coordination. (see the team task-specialized task on the roles and resp. results).	New validation activities in order to investigate e-coordination in particular with external sectors.
06	Misunderstandings between EC and MSP during, within, and between team communication may occur. The MSP may give information to the wrong EC or EC misinterprets that	Open	OBJ-10-01a-V3-VALP-HPAP-006	RTS Post Run Questionnaire Debriefing Observations	It was not always clear for the MSP which information was to be passed to which executive. The occurrence of miscommunication, i.e. situations where one EC picked one MSP communication directed to the other EC, was an anticipated safety relevant issue prior to the exercise.	Working methods should define what communications the MSP should pass to the EC.	Evaluation activities prior to the deployment phase in order to: <ul style="list-style-type: none"> further monitor the potential for erroneous miscommunications; investigate and further consolidate



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
	response of MSP is for him/her.				<p>In fact, only one instance of this behaviour was detected (due to an asymmetrical seating plan placing one EC closer to the MSP than the other). This issue should be further monitored in future evaluations.</p> <p>The simulation unveiled a general requirement for “flexible” and “all-in-the-loop” communications in e-coordination. The need for flexibility arises especially from the fact that the MSP involves multi-party communications in which, for instance, either the EC or the MSP can trigger a communication exchange, and in which communications may occur between ECs without MSP involvement. In all cases, it was important that every member of the MSP team was kept in the loop regarding ongoing communication</p>	<p>The e-coordination communication exchanges should:</p> <ul style="list-style-type: none"> Clarify the status of the communication, e.g. coordination request vs coordination proposal. Clarify to the involved actors the communication perspective, i.e. communication done from a MSP vs an EC perspective. Clarify who is the initiator vs who is the recipient of the communication. 	<p>communication requirements associated with the solution, especially those that have to be supported by e-coordination. In particular, the notion of “communicational perspective” and the extent to which it can be embedded in e-coordination should be clarified;</p> <ul style="list-style-type: none"> Further assess the potential for EC to pick up communications directed to the other EC.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					exchanges (all-in-the-loop-philosophy).	<ul style="list-style-type: none"> Be visible to all members of the MSP team (all-in-the-loop philosophy). 	
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.							
07	The MSP might experience high cognitive workload just to follow the communications and build an adequate SA of the sectors assigned to him. (Multiple frequency issue.)	Open	OBJ-10-01a-V3-VALP-HPAP-007	RTS Post Run Questionnaire Debriefing	<p>Impact on the 4-eyes-principle: The planner controller needs to follow the tactical traffic to understand the plans of the EC. However, the planner controller may be unable to do so due to divided attention. Also, this may result in a decrease of safety, as the planner may miss input, clearances and alerts triggered by the system. Note, however, that this issue may be dependent on the sectors that are going to be combined for the MSP concepts, and their traffic load.</p> <p>Impact on the 4-ears principle: The planner controller is not able to</p>	<p>The decrease of SA for the MSP should be considered as part of the Safety Assessment, either as an hazard or as a precursor to an hazard; and adequate mitigations should be defined.</p> <p>MSP should be released of the task to monitor both frequencies. However, this aspect should be mitigated to ensure that safety is maintained.</p>	



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					<p>monitor two (or more) non-coupled frequencies at the same time. This results in a reduction of situation awareness for the planner, a multi-sector planner. The PC may be less aware of both sectors' traffic requests due to divided attention. The EC(s) may have to wait for actions to be taken by the PC. The safety consequences of this are that the planner controller may overhear or miss transmissions, false read-backs or pilot's requests.</p> <p>The results indicated above are supported by the evidence from the two MSP-specific questionnaires administered during the exercise. These indicate that the MSP SA decreases as traffic level increases, and that information acquisition, stage-1 of SA was difficult.</p> <p>Note that already in today's operational environment both the</p>		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					<p>4-eye and the 4-ear principles are not fully ensured through the shift: as soon as distracted by telephone calls or coordination, the planner loses already the picture today in a team of two.</p> <p>This was confirmed by the Post Run Questionnaire for SA of the MSP. The results indicated that the MSP had increasing lack of awareness what the EC's were doing (especially to UC4 for high traffic).</p>		
08	The MSP might experience high cognitive workload due to the fact that s/he will have to process up to 20/30% more traffic (as in the case of Skyguide), and need to follow the frequency of both sectors at the same time (which is a	Open	OBJ-10-01a-V3-VALP-HPAP-008	<p>RTS</p> <p>Post Run Questionnaire(s)</p> <p>Debriefing</p> <p>Observations</p>	<p>Workload Questionnaire results show that the workload increased with increased traffic levels. The frequency monitoring and scanning traffic were the main source of workload for the MSP, as the MSP had twice the traffic to monitor compared to the EC. Radio communication was the main source of workload for the EC.</p>	Further evaluations should take into consideration the contribution of e-coordination to overall workload for the MSP.	Evaluation activities prior to the deployment phase in order to simulate MSP external coordination. The actual workload for the MSP can be higher when implementing the concept.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
	<p>challenge due to overlap AND more traffic). This problem may be particularly severe for a 3EC configuration, where the sectors combined are three. This problem may also affect the EC(s).</p> <p>If the MSP is too busy, ECs may need to dynamically take over tasks from MSP, may need to engage in more explicit communication to voice request, etc., traffic solutions may be coordinated later than preferred etc.</p>				<p>ATCO's feedback suggest that workload was relatively low for the MSP during the first three use cases, despite the significant traffic increase compared to today. Workload in UC4 was considered unacceptably high for normal operations.</p>		

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



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
10	Having to work with two or more ECs, the MSP has to readily know which a/c is in contact with which frequency. This is important especially in situation where the association may not be obvious, e.g. weather, a/c on boundaries. This will ensure that the MSP will get in touch with the right EC.	Closed	OBJ-10-01a-V3-VALP-HPAP-010	RTS Post Run Questionnaire(s), End of Day Questionnaire(s) Debriefing Observation	Colour coding of traffic and conflicts was not preferred by the ATCOs due to interference with the current meaning of the colour code used but also it was not perceived as a useful solution as it would only be a solution for the traffic in conflict and not the rest of the traffic. The solution preferred was a Sector indication permanently added in the flight label to each flight in the format of a letter, i.e. "N" for sector North. This solution addressed satisfactorily the identification need of the ATCO (which was confirmed in the End-of Day Questionnaire).	None	Evaluation activities prior to the deployment phase in order to further investigate/confirm this issue.
Arg. 2.3.5: Workstations (e.g. cockpit layout and consoles) adhere to ergonomic principles.							
11	CWP physical design needs to be flexible enough to	Closed	OBJ-10-01a-V3-	RTS	No physical impediments to the movements of the ATCOs when splitting from the MSP to the classic	None	None



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
	accommodate various team configurations, and, most importantly, to allow quick transition between them during handover (split or aggregation). One relevant transition is the split from MSP to classic PC-EC configuration (use case #5) as this will occur during busy periods, and it is important that people does not get distracted by the practicalities of moving, changing their physical settings. Current SKGD operational layout do not necessarily accommodate for this due to the presence of a third back up display.		VALP-HPAP-011	Post Run Questionnaire(s) Debriefing Observations	configuration was neither observed nor reported.		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
Arg. 2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable.							
12	The MPS concept comes with new functionalities to support the MSP configuration (e.g. solutions to visually segregate the traffic and e-coordination tools adaptation to support MSP tools coordinating for both EC's. The usability/acceptability of these functionalities needs to be evaluated.	Open	OBJ-10-01a-V3-VALP-HPAP-012	RTS Post Run Questionnaire(s) End of Day Questionnaire(s) Debriefing Observations	Split-frequency headset. Overall, the results of the Post Run Questionnaire showed that the split frequency enjoyed a limited acceptability, which decreased as traffic levels increased. For low traffic most ATCOs did not used it, while two ATCOs found it usable. For high traffic the split frequency was found unusable by all ATCOs. The willingness to use the tool seems to stop when communications start to overlap as traffic increases. Overlapping communication from multiple frequencies can make the task of extracting information unacceptably difficult even when the frequencies are split to different channels (ears). At least		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					<p>one ATCO explained that with the two frequencies the ATCO find it very difficult to discriminate between background and foreground information (i.e. the potential communications of interests), in other words, he cannot focus his own attention as desired. Initial mitigations for this problem were discussed, and included tools for recording and replay of message. However, this technology is not sufficiently mature to date, as retrieving the right message to reply is currently too time confusing.</p> <p>Conflict management tools.</p> <p>The following were observed for conflicts management functionality:</p> <ul style="list-style-type: none"> Conflicts should not be colour coded depending on the sectors they belong to. The 		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					<p>solution evaluated showed conflicts in blue for one sector and orange for the other. This was considered undesirable. It was preferred to have sector indications.</p> <ul style="list-style-type: none"> Conflict detection tools shall visualize all the conflicts that appear on the MSP area of responsibility. This issue was mentioned because system set up may filter conflicts depending on the sector. The MSP maintains a global view and hence conflict visualisation should reflect this. <p>E-coordination.</p> <p>The e-coordination functionality was overall well received by ATCOs</p>		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					and some improvements were proposed (see previous VOs).		
Arg. 3.2.1: Changes to the task allocation between human actors do not lead to adverse effects on human tasks.							
13	Roles and responsibilities between EC and MSP may change more dynamically during the shift depending on the workload of the MSP and or urgency of needs of EC. This may entail the MSP delegating more to one EC in order to offer more support to another.	Open	OBJ-10-01a-V3-VALP-HPAP-014	RTS	This VO was partly validated. ATCOs accepted the static task allocation between MSP and ECs, and in principle they are open to dynamic task allocation as a balancing workload strategy in the MSP team. Note, however, that the full appreciation of this dynamic requires the availability of more mature technological support, (e-coordination in particular), and more operational practice. This can be achieved during the deployment phase.		Evaluation activities prior to/during the deployment phase to further confirm this aspect.
14	Loss of the 4-eyes/4-ears principle: The MSP implies that the 2-pairs-of-eyes/ears on the	Open	OBJ-10-01a-V3-	RTS	When analysing the impact on safety, it is in fact important to distinguish between the 4-Eyes and 4-Ears principles and consider how	The loss of the 4-ear principle and the degraded 4-eye principle should be	Evaluation activities prior to the deployment phase in order to investigate the important question of how



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
	same sector is now fully lost. This is a safety issue whose consequences need to be investigated. Also, this issue may be relevant for the regulators.		VALP-HPAP-015	Post Run Questionnaire(s) Debriefing Observations	<p>they are both affected by the MSP concept. As discussed earlier the MSP concept leads to a loss of the 4-Ears principle and a decrease of the 4-Eyes principle (see OBJ-10-01a-V3-VALP-HPAP-007).</p> <p>In principle, this means that a layer of redundancy is removed from the system. However, this observation should be mitigated by the fact that already today, the 4-Eyes principle is not fully realized throughout the duration of the shift: for instance, it suffices that the PC deals with two consecutive telephone calls that s/he is already behind traffic.</p> <p>Also, note that the impact on safety may be more operationally relevant for those ANSPs used to the “classic” 1PC-1EC configuration, rather than those that already today rely on the Single Person</p>	considered in the safety assessment.	the system can be improved so that it can take up the redundancy that cannot be provided by the human. Note that already today there is an effective redundancy layer as provided by advanced tools for conflict detection, analysis, and monitoring (conformance management). The redundancy layer also benefits from tools aimed at workload reduction. The safety assessment has to further validate whether these measures provide an efficient/reliable redundancy layer, and if not, what are the gaps, and what additional tools are needed.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					Operations configuration as part of their normal operations.		
Arg. 3.3.1: Intra-team and inter-team communication supports the information requirements of team members.							
15	Proximal collaboration strategies in use in the 1PC-1EC configuration will be affected: due to physical distance. It will not be possible to talk directly to the EC while discussing (complex) traffic situations and potential trajectories while looking at the same screen, or to assess other ATCOs workload just by glancing quickly at them or at their screen.	Open	OBJ-10-01a-V3-VALP-HPAP-013	RTS Post Run Questionnaire(s) Debriefing Observations	Proximity, visual contact and verbal communication are considered important: <ul style="list-style-type: none"> To understand at a glance what colleagues, i.e. the MSP and/or the ECs, are doing or how busy they are. For instance, by knowing EC load the MSP can decide whether or not passing a relatively challenging request to the EC. To quickly collaborate during relatively busy situations. If the EC is busy, the MSP can just point at a given aircraft and suggest the needed action. This will save the EC 	The MSP coordination needs to be very precise: it needs to be very clear to which EC the MSP is speaking to. The EC is to be aware of the coordination made by the MSP.	Evaluation activities prior to the deployment phase in order to further investigate these aspects.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					<p>the time and effort needed to scan the visual display in order to identify the specific a/c mentioned by the MSP.</p> <ul style="list-style-type: none"> To ensure that MSP communications can be effectively passed to both Executives. In the simulation, some seating configuration were asymmetric with one EC sitting closer to the MSP than the other. This meant that the more distant EC could not receive all the relevant information. At least one case of miscommunication was detected. <p>EC expectations about MSP support. The EC would naturally expect some support from the MSP; however, the fact that the MSP serves two ECs at the same time means that there is some uncertain</p>		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					<p>for the EC about the support s/he can actually get from the MSP. Thus, it is important that appropriate visual cues are provided so that the EC can quickly assess whether the MSP is working for her/him or not. Direct visual contact serves well this end (seeing a busy MSP is a source of worry because the EC can readily know s/he will not have any support if needed). Also, a useful cue addressing this need is an indication about which sector the MSP is calling. Note that an EC false assumption about whether the MSP is working for him/her is the worst situation.</p> <p>In the worst situation, EC may expect that the MSP is following/supporting him/her while in fact this is not the case. At least</p>		



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					one case of miscommunication was detected.		
Arg. 4.1.1: Changes in roles and responsibilities are acceptable to the affected human actors.							
16	The MSP introduced relevant changes in roles and responsibilities. These may encounter some resistance from an ATCO's perspective	Closed	OBJ-10-01a-V3-VALP-HPAP-016	RTS Post Run Questionnaire(s) Debriefing Observations	<p>ATCOs' feedback suggest that the concept was relatively clear from an operational perspective, as the MSP does not introduce radical changes compared to today.</p> <p>Operational acceptability regarding the operating methods for the EC and the MSP were generally high, whereas the operational acceptability of the task allocation for the EC and MSP was medium to high.</p> <p>Furthermore, no blocking points emerged/were identified, nor can be envisaged at this point. Acceptance is expected to increase</p>	None	Evaluation activities prior to the deployment phase in order to further assess the acceptance of the concept.



Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	Activity conducted	Results / evidence	Requirements	Recommendations
					as the tasks for the MSP and EC will be further defined.		

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

4.4.4 Maturity of the Solution (V3)

The validation permitted to validate from a Human Performance point of view the overall MSP concept as defined in the OSED. While the concept itself is considered as acceptable from an operational point of view, the following need to be considered:

- the introduction of an MSP configuration affects several fundamental operational processes notably team, collaboration and communication dynamics.

This means that some specific HP issues remain to be further investigated during the deployment phase. The table below reports some descriptive statistics as a result of this assessment. Note that most of these issues require only further corroboration, i.e., they are not blocking points, and addressing them will lead to further maturation of the concept.

	Closed HP issues	Open HP issues	Cancelled HP issues	Recommendations	Requirements
n.	5	9	1	15	15

Table 11. Closed, open, cancelled issues, recommendations and requirement from the V3 HP assessment.

Taking into account the mitigations and tools improvement that will come from further analysis before technical and operational implementation, the concept of MSP in medium to high complexity extended TMA from a Human Performance point of view is sufficiently mature to advance to the next V-phase.

Maturity checklist for finalizing 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?	Y	The present report constitutes the HP Assessment report. Relevant arguments, associated HP issues and VOs, the related results, recommendations and requirements for V3 are reported in section 4.4.3.
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)?	Y	Relevant arguments, associated HP issues and VOs, the related results, recommendations and requirements for V3 are reported in section 4.4.3.
3	Have all the parts of the solution/concept been considered?	Y	The solutions has been considered in its entirety during the normal operations simulated in V3 simulation EXE. The only limitation was the lack of simulation of external coordination, which can be addressed in further stages of the MSP lifecycle.

4	Have potential interactions with related projects/concepts been considered and addressed?	Y	The list of projects the solution relates to is reported in section 2.2. An important enhancer to the MSP solution comes from PJ10.02a, as improve MTCD solutions allows better planning capabilities for the MSP.
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Y	Refer to results in section 4.4.3
6	Are the assessment results in line with what is targeted for that concept? If not, has the impact on the overall strategic performance objectives/targets been analysed?	Y	Yes, results are in line with performance expectations: essentially the MSP is a productivity-oriented change that necessitates a verification that human performance aspects are not negatively impacted despite the change in team composition. The present assessment confirms this, provided that the recommendations developed are satisfied—including the recommendations related to the 4-Eye/4Hears principle.
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Y	The solution has been tested in normal operation scenarios in sufficiently realistic conditions (more details on this aspect are available in the VALR). Abnormal and degraded scenarios have been considered as part of the SAR, and it is recommended that they be further addressed in future evaluations.
8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Y	Validation results related to the interaction between the human and the system confirm that the concept is operationally feasible.
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Y	HP results have provided the input for the Safety Assessment Report. Subsequently, the outcome of both assessments has been cross-checked and integrated into the OSED Part I.
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Y	The results do not show blocking point points regarding human performance. Human Performance aspects of the concept contribute to the expected KPA provided that the impact on the 4-Eyes-4-Hears principles is duly considered.

11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Not applicable.	The concept is at V3; therefore, it has developed the output, i.e., recommendations and requirements that have to be 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?	Y	Transition aspects have been duly considered while preparing the V3 EXE, and in defining the relevant results. No blocking issues have been identified.
13	Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine.	Y	The potential impacts on regulatory aspects of ATM has been considered. The main novelty is the role and responsibilities definition for the MSP role, however there is no impact on regulatory aspect as the tasks of the MSP are already defined in the planner and executive roles
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Y	List of open questions and recommendations for further studies have been clearly identified in the table in section 4.4.3. This will provide effective input for the next V-phase.

Table 12. Maturity checklist for the V3 assessment.

5 References

Human Performance

- [1] 16.04.01 Evolution from the ATM HF case to a HP Case Methodology for SESAR, HP assessment process for projects in V1, V2 or V3. D10-001, 00.01.00
- [2] PJ19- Content Integration – HP Assessment Process for V1 to V3- including VLDs. Ed. 0.02.00
- [3] 16.06.05 D 27 HP Reference Material D27
- [4] 16.04.02 D04 e-HP Repository - Release note

Solution PJ10-01a Documents

- [5] PJ10-D1.1.005-SESAR Solution 10.01a SPR_INTEROP_OSED_V3_Part-I
- [6] PJ10-D1.1.005-SESAR Solution 10.01a SPR_INTEROP_OSED_V3_Part-II
- [7] PJ10-D1.1.005-SESAR Solution 10.01a SPR_INTEROP_OSED_V3_Part-V
- [8] PJ10-D1.1.030-SESAR Solution 10-01a VALP
- [9] PJ.10-D1.1.050-SESAR Solution 10-01a VALR (eTMA V3 & En route)



Appendix A – Additional HP activities conducted

No additional HP activities were conducted.



Appendix B – HP Recommendations Register

All V2 recommendations appear under section 4.4.1 of this document and the HPLOG (V2).

All V3 recommendations appear under section 4.4.3 of this document and the HPLOG (V3).



Appendix C – HP Requirements Register

All V2 requirements appear under section 4.4.1 of this document and HPLOG (V2).

All V3 requirements appear under section 4.4.3 of this document and the HPLOG (V3).

Appendix D – HP Log (V2 and V3)



D1.1.010 - PJ.10-01a
- SPR INTEROP OSED



D1.1.010 - PJ.10-01a
- SPR INTEROP OSED



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