SESAR Solution 10.02a SPR/INTEROP-OSED for V3 - Part IV - Human Performance Assessment Report

DeliverableID	D4.2.010
Dissemination Level:	PU
ProjectAcronym	PJ10 PROSA
Grant:	734143
Call:	[H2020-SESAR-2015-2]
Topic:	Separation Management En-Route and TMA
Consortium coordinator:	DFS
Edition date:	16 September 2019
Edition:	00.01.03
Template Edition	02.00.02

PJ10 PROSA

PJ10 PROSA

Abstract

This document contains the Human Performance (HP) assessment report for the PJ10-Solution 02a "Improved performance in the provision of separation". It consists of the HP assessment Plan, the results of the HP activities conducted according to the HP assessment process, newly identified issues and the HP recommendations & requirements. It corresponds to the completion of the four steps of the Human Performance assessment process, namely: Step 1 – Understand the concept: Baseline, Solution and Assumptions, Step 2 – Understand the Human Performance Implications, Step 3 – Improve and Validate the concept and Step4 – Collate findings & conclude on transition to next V-phase.

Founding Members

List of Tables

List of Figures

Founding Members

1 Executive Summary

This Human Performance Assessment Report (HPAR) belongs to Solution 10-02a *"Improved performance in the provision of separation"* and presents Part IV of the PJ.10-02a V3 SPR/INTEROP-OSED. It describes the results of the activities conducted according to the SESAR Human Performance (HP) assessment process applied on the solution.

The SESAR HP assessment process provides a framework to help ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed in the concept design, development and validation process. The HP assessment comprises all seven PJ.10-02a V3 validation exercises which are fully described in the section 5 of the VALP Part I. Level of maturity of the concept at the start of the HP assessment was considered to be **V3 for five of the validation exercises** that are:

- EXE-10.02a-V3-VALP-001 performed by DSNA: En-Route

- EXE-10.02a-V3-VALP-002b performed by COOPANS and Thales: TMA

- EXE-10.02a-V3-VALP-003 performed by ENAV: En-Route

- EXE-10.02a-V3-VALP-004 performed by Skyguide: En-Route

- EXE-10.02a-V3-VALP-005 performed by ECTL, ANS-CR, Thales: En-Route

And V2 for two validation exercises dealing with EPP:

- EXE-10.02a-V3-VALP-006 performed by PANSA and INDRA: En-Route

- EXE-10.02a-V3-VALP-007 performed by Airbus D&S and BULATSA: TMA and transition to En-Route

Therefore the argument structure for V3 and V2 were applied on the project respectively. From the changes that would result from the improved performance in the provision of separation, it is concluded that ten of the twelve V3 second level HP arguments needed to be considered and satisfied in the HP assessment.

Based on the HP arguments and issues/benefits identified, several HP activities are recommended. The HP related validation activities conducted to date include: (1) interviews through WebEx with operational experts, (2) Joint HP & Safety Workshop with all the HF and safety experts involved in the validation exercises, (3) Real Time Simulation including observations during the validation exercises as well as dedicated brainstorming sessions with relevant stakeholders (e.g. ATCOs involved in the RTS, engineers, system developers, operational experts and so on).

The output or 'evidence' collected from each of these activities that are relevant to the HP assessment are summarised in this report together with recommendations and/or requirements that have been proposed to help prevent or mitigate each of the potential HP issues identified. The HP recommendations and/ or requirements relate to each HP argument that had to be considered in the HP assessment for the operational concept under validation. These recommendations and requirements relate to: the operational concept, the technical system, HMI and the training of the end user. In addition, HP recommendations for future validation activities that need to be conducted in the next V-phase(s) in order to investigate the HP issues and benefits in more detail, as well as, potential

mitigation are also provided. The registers of the identified requirements and recommendations as well as the maturity assessments for each validation exercise are described in the attached HP Log.

From the completion of the HP maturity criteria checklist for transition from initial V3 to full V3 which is based on the 'evidence' obtained from the HP related validation activities conducted within SESAR PJ.10.02a, it can be concluded that the operational concept tested in the five validation exercises:

- EXE-10.02a-V3-VALP-001 performed by DSNA: En-Route

- EXE-10.02a-V3-VALP-002b performed by COOPANS and Thales: TMA

- EXE-10.02a-V3-VALP-003 performed by ENAV: En-Route

- EXE-10.02a-V3-VALP-004 performed by Skyguide: En-Route

- EXE-10.02a-V3-VALP-005 performed by ECTL, ANS-CR, Thales: En-Route

has reached the V3 level of HP maturity and **satisfies the V3 transition criteria to start the full V3 validation.**

For what concerns the V2 validation exercises dealing with EPP:

- EXE-10.02a-V3-VALP-006 performed by PANSA and INDRA: En-Route

- EXE-10.02a-V3-VALP-007 performed by Airbus D&S and BULATSA: TMA and transition to En-Route

from the completion of the HP maturity criteria checklist for transition from V2 to V3 which is based on the 'evidence' obtained from the HP related validation activities conducted within PJ.10.02a, it can be concluded that the operational concept tested in the validation exercises has reached the V2 level of HP maturity and **satisfies the V2 transition criteria to start V3 validation**.

2 Introduction

2.1 Purpose of the document

The purpose of this document is to describe the result of the activities conducted according to the Human Performance (HP) assessment process in order to derive the HP assessment report for SESAR Solution PJ10.02a for the next V-phase including the HP requirements and recommendations to inform the design and development of the concept explored in the validation activities and to ensure that it is mature enough to move on the next V-phase.

2.2 Intended readership

The intended audience for this document are the other members of the Solution 10-02a including all exercise contributors and industry partners providing the technical systems and / or platforms: DSNA, COOPANS, THALES, ENAV, Leonardo, Skyguide, Eurocontrol, ANS-CR, PANSA, INDRA, BULATSA, and AIRBUS.

At the level of the transversal areas and federating projects, SESAR 2020 PJ.19 is also expected to have an interest in this document.

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

The HP Assessment Report describes the performed HP activities for all the validation exercises and their preparation and the needed requirements and recommendations for moving to the next V-phase. Indeed, it comprises the five planned V3 and the two planned V2 validation exercises which aim to assess different separation management supporting tools and functionalities including also the aspect of improved trajectory prediction within different En-Route and TMA airspaces with medium high and/or very high density/complexity. It namely includes:

- CD/R aid to TC basing on tactical trajectory (TCT, What-if / What-else probing), [CM-0206];

- CD/R aid to PC basing on planning trajectory (MTCD, What-if / What-else probing),[CM-0209, CM-0209b, CM-0211];

- Conformance monitoring system basing on tactical or planning trajectory, [CM-0208-A, CM-0210, CM-0210b];

- Improved trajectory prediction due to new data (subtle navigational factors, EPP, weather), [CM-0206, CM-0208-A, CM-0209, CM-0209b, CM-0210, CM-0210b, CM-0211].

In the description of the changes and the definition of the HP issues and benefits and objectives these different aspects are summarized in the wording "tool/functionality".

The human performance assessment process reviews HP arguments that are relevant for the successful implementation of these new tools 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 10-02a started in November 2018 and are expected to finish in August 2019 with the delivery of the Validation Report (VALR).

2.5 Structure of the document

The structure of this document is derived from the SJU SESAR 2020 Human Performance Report template:

- Section 1 provides an executive summary of this document;

- Section 2 is the introduction of the document providing high level information related to the purpose, the audience, the scope, a glossary of terms and a list of acronyms and terminology;

- Section 3 describes the Human Performance Assessment Process detailing the objective and the approach;

- Section 4 describes the four two steps of the Human Performance Assessment. In particular, it reports the main findings and the HP recommendations and requirements from the activities performed as part of the HP assessment process;

- Section 5 gives the list of reference documents;

- Appendix A provides the HP recommendations register which specifies the list of HP recommendations gathered in the project;

- Appendix B provides the HP requirements register which offers the list of HP requirements gathered in the project;

- Appendix C provides the HP Log in which all the data/information obtained from all HP activities conducted as part of the HP assessment (Step1 – Step 4) have been documented. It specifies the list of HP requirements gathered in the project

2.6 Acronyms and Terminology

Term	Description
Human Factors (HF)	HF is used to denote aspects that influence a human's capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, "Human Factors" can be considered as *focussing on the variables that determine Human Performance*.
Human Performance (HP)	HP is used to denote the human capability to successfully accomplish tasks and meet job requirements. In this way, "Human Performance" can be considered *as focussing on the observable result of human activity in a work context*. Human Performance is a function of Human Factors (see above). It also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well as Social Factors and Change Management.
HP activity	An HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies.
HP argument	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.
HP assessment	An HP assessment is the documented result of applying the HP assessment process to the SESAR Solution-level. HP assessments provide the input for the HP case.
HP assessment process	The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. The development of this process constituted the scope of 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. HF recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional

	analysis is performed, HF recommendations may be transformed into HF requirements.
HP requirements	HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable result of the HF contribution to the Solution, leading to a redefinition of the operational concept or the specification of the technical solution.

Table 1: Acronyms and terminology

3 The Human Performance Assessment Process: Objective and Approach

The 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, an HP Log is maintained throughout the lifecycle of the Solution in which all the data/ information obtained from all HP activities conducted as part of the HP assessment is documented. This HP Log is a living document and is continuously updated and / or added to as the SESAR Solution progresses.

Step 1: Understand the ATM concept
- Review reference, solution(s) & assumptions & identify changes
- Identify additional information requirements & Solution assumptions
- Identify related SESAR Solutions
- Review Solution HP maturity (optional)

→ HP Log

Update solution & assumptions

Step 2: Understand the HP implications
- Identify relevant HP arguments & activities
- Identify HP issues, benefits & impacts
- Define validation objectives
- Define HP activities & expected evidence
- Develop HP plan & contribute to SESAR documentation

→ Update HP Log → HP Assessment Plan

Update HP issues & benefits

Step 3: Improve and validate the concept
- Perform HP activities
- Analyse & document HP activities & outcomes
- Formulate requirements & recommendations
- Update HP Log & contribute to SESAR documentation

→ Update HP Log

Step 4: Collate findings and conclude on the transition to the next V-phase
- Assess whether HP arguments are satisfied
- Conclude on the transition to the next V-phase
- Produce the HP assessment report
- Manage HP requirements and recommendations

→ Update HP Log → HP Assessment Report

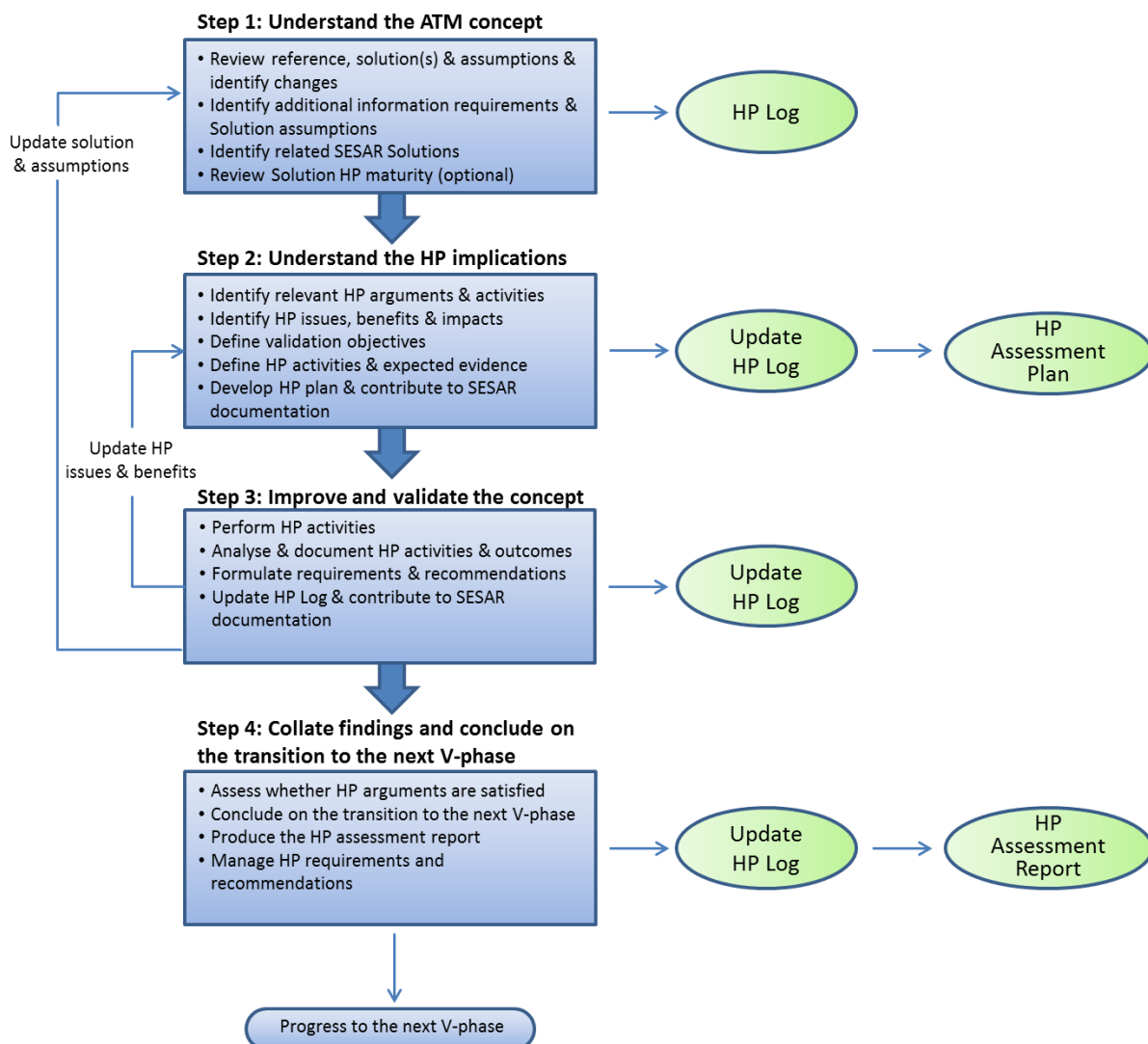Progress to the next V-phase

Figure 1: Steps of the HP assessment process

The SESAR HP assessment process provides a framework to help ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed in the concept design, development and validation process**Error! Reference source not found.**. The SESAR

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

Level of maturity of the concept at the start of the HP assessment was considered to be V2 for two exercises and V3 for five exercises. Therefore the argument structure for V2 and V3 was applied on the project respectively. From the changes that would result from the improved performance in the provision of separation, it is concluded that ten of the twelve V3 second level HP arguments needed to be considered and satisfied in the HP assessment, namely:

1. **Roles & Responsibilities**

   o *Argument 1.2:* The operating methods are clear, exhaustive and support human performance

   o *Argument 1.3*: Human actors can achieve their tasks in normal, abnormal and degraded modes of operation

2. **Human & System**

   o *Argument 2.1*: There is appropriate allocation of tasks between the human and the machine

   o *Argument 2.2:* The performance of the technical system supports the human in carrying out their tasks

   o *Argument 2.3*: The design of the HMI supports the human in carrying out their tasks

3. **Teams & Communication**

   o *Argument 3.2*: The allocation on tasks between human actors support human performance

   o *Argument 3.3*: The communication between team members supports human performance

4. **HP related transition factors**

   o *Argument 4.1*: Acceptance and job satisfaction

   o *Argument 4.2*: Changes in competence requirements are analysed

   o *Argument 4.5*: Training needs are identified for affected human actors

Specific HP issues and benefits relating to the improved performance in the provision of separation through these tools for each of the relevant arguments are identified by performing a review of existing literature as well as conducting a series of HP issue and benefit brainstorming sessions/interviews with relevant stakeholders including ATCOs, engineers, manufacturers, ANSP, safety and HF experts, and Real-Time Simulations. Over 41 potential HP issues/benefits are identified in total.

Based on the HP arguments and issues/benefits identified, several HP activities are recommended. The HP related validation activities conducted to date include:

- Interviews through WebEx with operational experts

- Dedicated F2F meetings with operational experts and relevant stakeholders

- Brainstorming sessions with relevant stakeholders

- Observations during the validation exercises

- 7 Real Time Simulations, one per exercise

- Joint HP and Safety Assessment Workshop with relevant stakeholders.

The output or 'evidence' collected from each of these activities that are relevant to the HP assessment are summarised in this report together with recommendations and/or requirements that have been proposed to help prevent or mitigate each of the potential HP issues identified. The HP recommendations and/ or requirements relate to each HP argument that had to be considered in the HP assessment for the operational concept under validation. These recommendations and requirements relate to: the operational concept, the technical system, HMI and the training of the end user. In addition, HP recommendations for future validation activities that need to be conducted in the next V-phase in order to investigate the HP issues and benefits in more detail, as well as, potential mitigation are also provided.

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 10-02a: 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 10-02a: 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

The assumptions on Solution level can be found in the VALP Part I section 4.4. The assumptions on exercise level can be found in the VALP Part I sections 5.X.5

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

All identified relationships and dependencies with/on other projects/solutions are listed in the PMP section 6.1. For the HP assessment the following aspects are important:

- **PJ.10-02b progressing the work of PJ.10-02a:** the outcome of Solution 10-02a HP assessment will be the baseline for the further HP work in the subsequent Solution.
- **PJ.18-06 providing an Extended Projected Profile (EPP) emulator:** the use of EPP data was considered during the Human Performance assessment and issues/benefits stored in the HP Log but only for two V2 validation exercises.

Furthermore, there is a Solution dependency to **PJ.06-01 providing Free Routing operational procedures** as defined in the applicable version of EATMA (Dataset 19 Draft - EATMA V12.0 Draft - see https://www.eatmportal.eu/working)

4.1.5 Identification of the nature of the change

Table 2 summarizes the main changes that have been identified per addressed HP argument. It covers all seven planned V3 and V2 validation exercises.

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	NO CHANGE IN ROLES OR GENERAL CONTROLLER

Founding Members

	RESPONSIBILITIES
1.2 OPERATING METHODS	CONFLICTS AND DEVIATION OF AIRCRAFT CAN BE DETECTED EARLIER THAN TODAY, RESOLUTION ADVICE IS PROVIDED -> AFFECTS SITUATIONAL AWARENESS AND CLEARANCES TO AIRCRAFT; COVERAGE OF TOOLS/FUNCTIONALITIES BY OPERATING METHODS NEEDS TO BE ENSURED
1.3 TASKS	GENERAL CONTROLLER TASKS IN TERMS OF RESPONSIBILITIES REMAIN THE SAME. NEW FUNCTIONALITIES WILL NOT INTRODUCE ANY ADDITIONAL RESPONSIBILITIES NOR WILL CHANGE THE CLASSIC ATCO TEAM ROLES AND GENERAL TASKS.
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	PART OF CONTROLLER TASKS ARE PERFORMED BY THE SUPPORTING TOOLS/FUNCTIONALITIES PROVIDING A HIGHER DEGREE OF AUTOMATION -> IMPACT ON WORKLOAD; CONTROLLER NEEDS RIGHT LEVEL OF TRUST INTO THE TOOLS/FUNCTIONALITIES AND UNDERSTAND THE WAY THEY OPERATE (ALGORITHM) CONTROLLER SKILLS DECREASE IF RELIANCE IS TOO STRONG
2.2 PERFORMANCE OF TECHNICAL SYSTEM	CONTROLLER NEEDS TO BE AWARE OF THE CURRENT "MODUS OPERANDI" AND THE ACCURACY LEVEL (E.G. DETECT FAILURE OR DEGRADED MODES) CONTROLLER NEEDS TO BE AWARE OF LATENCIES (RELIABILITY)
2.3 HUMAN – MACHINE INTERFACE	CONTROLLER NEEDS TO OBTAIN AND INTERPRET ADDITIONAL ALERTS AND TRAFFIC INFORMATION. THIS AFFECTS ALSO SITUATIONAL AWARENESS CONTROLLER NEEDS TO INTERACT WITH THE TOOLS/FUNCTIONALITIES (INPUT DATA), INFORMATION PRESENTATION AND INTEGRATION OF INFORMATION AFFECT SITUATIONAL AWARENESS
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	NO CHANGE IN TEAM COMPOSITION
3.2 ALLOCATION OF TASKS	TASKS ARE RE-DISTRIBUTED BETWEEN THE CONTROLLERS. THE PLANNER MAY HAVE MORE INVOLVEMENT IN TASKS RELATED TO THE RESOLUTION OF "IN-SECTOR CONFLICTS", WHICH ARE MORE

	TRADITIONALLY CONSIDERED AS EXECUTIVE CONTROLLER TASKS –> IMPACT ON WORKLOAD
3.3 COMMUNICATION	COMMON SHARED INFORMATION FOR BOTH TACTICAL AND PLANNING CONTROLLER IMPACTS TEAM COMMUNICATION AND SHARED SITUATIONAL AWARENESS
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	RELIABLE TOOL/FUNCTIONALITY SUPPORT CHANGES THE WAY HOW CONTROLLER PERFORM THEIR TASKS
4.2 COMPETENCE REQUIREMENTS	CONTROLLER CORE SKILLS NEED TO BE MAINTAINED AND WARNING AND ALERTS NEED TO BE CORRECTLY UNDERSTOOD
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	NO CHANGE
4.4: THE IMPACT ON RECRUITMENT & SELECTION PROCESSES HAS BEEN CONSIDERED	NO CHANGE
4.5: TRAINING NEEDS ARE IDENTIFIED FOR AFFECTED HUMAN ACTORS	THE TRAINING NEEDS RESULTING FROM THE PROPOSED CHANGES TO THE HUMAN ACTORS' ROLES AND TASKS HAVE BEEN PRELIMINARY IDENTIFIED -> FAMILIARISATION WITH NEW INSTRUCTION AND POSSIBLY NEW INTERFACE (DATALINK INSTRUCTIONS FOR PLC)

Table 2: Description of the change

4.2 Step 2 Understand the HP implications

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

The HP arguments are "claims" that need to "proven" by the HP assessment. Therefore, the aim of HP assessment is to provide "evidence" to show the HP arguments impacted have been considered and satisfied by the HP assessment process. From the changes that would result from the introduction of the operational concept, it is identified that ten out of the twelve V3/V2 level two HP arguments need to be considered by the HP assessment. Hence the arguments to be considered by the HP assessment process are:

- Argument 1.2: The operating methods are clear, exhaustive and support human performance

- Argument 1.3: Human actors can achieve their tasks (in normal & abnormal conditions of the operational environment and degraded modes of operation).

- Argument 2.1 There is appropriate allocation of tasks between the human and the machine

- Argument 2.2 The performance of the technical system supports the human in carrying out their tasks

- Argument 2.3 The design of the HMI supports the human in carrying out their tasks

- Argument 3.2 The allocation on tasks between human actors support human performance

- Argument 3.3 The communication between team members supports human performance

- Argument 4.1 Acceptance and job satisfaction

- Argument 4.2 Changes in competence requirements are identified

- Argument 4.5 Training needs are identified for affected human actors.

The table below describes these HP arguments. It also lists the Solution-specific HP issues and benefits that have been identified related to an HP argument. For each issue and / or benefit the impact on human performance as well as system performance (in terms of KPAs) is described. From this, the HP validation objectives can be defined. On the basis of the general guidance on the satisfaction of HP arguments as well as the HP issues

and benefits identified for the PJ.10-02a Solution, the proposed HP activity/ies are described. In order to provide a more detailed description of the recommended activities as well as the benefits/issues, for each exercise a HP Log has been created and added as Annex[1].

Arg.	Issue ID	HP issue / Benefit	HP/Valid. Obj. ID	HP validation objective	Recommended activity/ies
	121-001	ISSUE: Operating methods could provide insufficient coverage of the new tool/functionality.	OBJ-ARG1.2.1-10.02a-V3/V2-001	Identify any gap between existing operating methods and the operating methods associated with the use of the tool.	Identify/update situations that constitute normal operating conditions in cooperation with the safety and operational specialists & check against the scope of the operating methods. Liaise with procedure team (operational experts) to define operating methods for normal operating conditions if necessary
1.2.5	125-001	ISSUE: Resolving potential conflicts early is likely to have an overall negative effect on flight efficiency, as some of the resolutions would have been unnecessary.	OBJ-ARG1.2.5-10.02a-V3-001	Assess the relationship between workload, flight efficiency and TP accuracy and quantify the potential benefit to controller workload.	Assess errors and recovery means in RTS: -objective methods: observations, data recordings -subjective methods: interviews, debriefings. & analyse operational impact of errors with safety specialists

[1] All the HP activities were conducted according to the HP Assessment Plan.

1.3.2	132-001	BENEFIT: Aircraft have different capabilities with regards to air/ground data exchanges, hence, a different handling of the input parameters used by the CD&R tools is required for finding solutions. The use of the EPP data increases the confidence of the ATCO in the conflict detection and resolution tasks. This is expected to provide more reliable information on aircraft intention and more time for achieving the tasks.	OBJ-ARG1.3.2-10.02a-V3/V2-001	Assess whether the EPP data integrated in the CD&R tool leads to more reliable information on aircraft intention and more time for achieving the controller tasks.	Assess EPP data in RTS: -objective methods: data recordings -subjective methods: ISA, questionnaires and debriefings.
	132-002	BENEFIT: Introducing Planner Controller using the same CD&R TCT in the EXE 07 is expected to reduce the workload of the Executive controller (EC) by resolving conflicts in advance with appropriate coordination with adjacent sectors. Meaning that the EC will have more time for other tasks.	OBJ-ARG1.3.2-10.02a-V3-001	Assess whether including the PC working position in EXE007 positively impacts TC workload in terms to have more time for other tasks.	Perform a PC working position assessment in the RTS to identify the impact on TC workload by PSQ.
1.3.3	133-001	BENEFIT: By having advanced CD&R based on downlinked flight trajectory and corresponding flight intention (EPP data) ATCO is expected to achieve more cognitive resources, consequently decrease the workload of the controller.	OBJ-ARG1.3.3-10.02a-V3/V2-001	Assess the controller's workload level using the EPP data in the solution scenario by comparison to the reference scenario.	Compare reference (without EPP equipped ACFT) and solution scenarios (with EPP equipped ACFT) and compare ATCOs workload
1.3.4	134-001	ISSUE: If there're many false/missed alerts, neither new TCT nor CD&Rs can guarantee the acceptable level of trust.	OBJ-ARG1.3.4-10.02a-V3/V2-001	Assess whether the higher degree of automation and possible false/missed indications and alerts negatively impacts trust in the tool/functionalities.	Assess the number of false/missed alerts in RTS with: -objective methods: observations, data recordings

					-subjective methods: debriefings&analyse operational impact with safety specialists
1.3.5	135-001	BENEFIT: The information provided by TCT tool will enhance the ATCO/ATCOs individual/team situational awareness of upcoming conflicts and possible resolution advisories if it works correctly and can be easily perceived. TCT supports SA by ensuring indication of all conflicts in a pre-defined time frame supporting the ATCOs to establish a resolving plan, which is crucial to maintain SA at good level and avoid improvisation.	OBJ-ARG1.3.5-10.02a-V3/V2-001	Assess whether a TCT tool enhance situational awareness.	Assess the ATCO's SA in RTS with:

-subjective methods: questionnaires and debriefings. |
| | 135-002 | ISSUE: In case of many false/missed alerts or inappropriate HMI (too much colours and alerts indicating not relevant info) the TCT can only confuse ATCO and disturb the decision-making process. Thus, limiting the time for conflict planning and as a result will worsen SA. | OBJ-ARG1.3.5-10.02a-V3/V2-001 | Assess the influence of false/missed alerts (if any) on ATCO's tasks. | Assess the tool interface in RTS with receiving ATCO's view by:

-subjective methods: questionnaires and debriefings. |
| 2.1.2 | 212-001 | ISSUE: The higher degree of automation might lead to deterioration of controllers' conflict detection (core) skills. | OBJ-ARG2.1.2-10.02a-V3/V2-001 | Assess whether the higher degree of automation associated with the supporting tool/functionality leads to deterioration of controllers' conflict detection (core) skills. | Perform or update Cognitive Task Analysis to identify cognitive demands, potential error, and recovery means

Compare reference and solution scenarios and compare KPI/KPA |
| | 212-002 | BENEFIT: With the higher degree of automation, the tool/functionality assists controllers in their monitoring tasks by freeing up cognitive resources. This leads to an increase in controller efficiency. Also flight efficiency and planning stability can be improved. | OBJ-ARG2.1.2-10.02a-V3/V2-002 | Assess whether the increase in automation level positively impacts controller efficiency, flight efficiency and planning stability. | |

2.1.3	213-001	ISSUE: The tool/functionality without any warning fails to detect a conflict, fails to provide an adequate conflict resolution assistance, fails to provide an accurate conformance monitoring May lead to a missed alert or false alert.	OBJ-ARG2.1.3-10.02a-V3-001	Assess whether a failure without warning negatively impacts the controller performance such that the result is unacceptable for operations.	Assess timeliness and accuracy of transition actions in Real-Time Simulation with: -objective methods: observations, data recordings -subjective methods: interviews, debriefings. & analyse operational impact with safety specialists
	213-002	ISSUE: If the tool/functionality is suddenly not available anymore, the controller needs to be able to switch to "manual" mode. This impact should be even worse the more the controller relies on / trusts the tool.	OBJ-ARG2.1.3-10.02a-V3-002	Assess whether a sudden (failure induced) switch to the separation management task ("manual mode") negatively impacts the controller performance.	
	213-003	ISSUE: In case of a human-intended transition from automatic to manual modes and vice versa the controller needs to be able to switch to "manual" mode without having the tool input and vice versa.	OBJ-ARG2.1.3-10.02a-V3-003	Assess whether a human-intended transition to manual modes and vice versa negatively impacts the controller performance.	
2.1.4	214-001	ISSUE: The user interface of the tool is designed such that required inputs from the operator increase workload too much. Specific issue in TMA where many inputs are required in short amount of time.	OBJ-ARG2.1.4-10.02a-V3/V2-001	Assess whether the user interface design and required inputs negatively impact the controller workload.	Assess workload and underlying factors in Real-Time Simulation with: -subjective methods: questionnaires -objective methods: data recordings.
	214-002	BENEFIT: Better and quicker detection of conflicts, especially during flight integration task. The controller's workload is decreased and smoothed while the situation awareness is at least maintained. There is a better controller's resilience and SA.	OBJ-ARG2.1.4-10.02a-V3/V2-002	Assess the controller's workload reduction and smoothing in comparison to the reference scenario.	

2.1.5	215-001	ISSUE: New information with different level of certainty is added to existing information. The controller must understand the calculation for obtaining a clear mental model.	OBJ-ARG2.1.5-10.02a-V3/V2-001	Assess whether the addition of new information to trajectory calculation negatively impacts the controller's mental model.	Assess end users' understanding of the technical system's behaviour using think-aloud methods, questionnaires and debriefings in Real Time Simulations
	215-002	ISSUE: The establishment of the controller's mental model could be negatively affected by the higher degree of automation.	OBJ-ARG2.1.5-10.02a-V3/V2-002	Assess the impact of the higher degree of automation on the controller's establishment of a mental model.	
2.1.6	216-001	ISSUE: Trust in the tool/functionality must be adequate.	OBJ-ARG2.1.6-10-02a-V3/V2-001	Assess the level of trust into the tool/functionality and the positive impact for the controller's tasks.	Assess trust in automated functions in Real-Time Simulation using data recordings and observations
	216-002	ISSUE: The controller does not cross-check the quality of the output due to an over-reliance. This may lead to complacency. This could be even worse in situations of decreased TP accuracy and reliability (e.g. adverse weather situations.).	OBJ-ARG2.1.6-10-02a-V3-002	Assess the level of reliability into the tool/functionality and the potential impact on the controller's performance.	
2.2.1	221-001	ISSUE: In non-nominal situations (e.g. strong jetstream, adverse weather) a degradation of TP could lead to a silent reduction of the accuracy and reliability. This might lead to more human errors due to false and/or missed alerts.	OBJ-ARG2.2.1-10.02a-V3-001	Assess whether a data quality induced tool/functionality degradation leads to a reduced level of trust and more human errors, resulting in higher workload.	Assess information accuracy in Real-Time Simulation with: -objective methods: observations -subjective methods: questionnaires, debriefings Perform or update Cognitive Task Analysis comparing system provided information with information requirements of the human
	221-002	ISSUE: The accuracy of information provided in situations with a lot of vectoring clearances might not be sufficient.	OBJ-ARG2.2.1-10.02a-V3/V2-002	Assess whether the accuracy of information provided is sufficient in situations with many vectoring clearances.	

2.2.2	~~222~~-001	ISSUE: The timeliness of the information is not adequate for controllers to carry out their tasks, e.g. calculation results appear with delay, no update in opened interface display.	OBJ-ARG2.2.2-10.02-V3/V2-001	Assess that the impact of the information timeliness on the controller performance is within acceptable limits.	Assess timeliness of information Real-Time Simulation with: -objective methods: observations -subjective methods: questionnaires, debriefings
2.3.1	231-001	ISSUE: Additional, but non-essential information is being provided to the controller leading to ambiguous understanding and cluttering effects. This might result in a bad usability.	OBJ-ARG2.3.1-10.02a-V3/V2-001	Identify if non-essential information is provided to the controller leading to ambiguous understanding and cluttering effects.	Assess Human Performance & Usability during Real-Time Simulation with: -subjective methods: questionnaire, debriefings & interviews (feedback on system support) -objective methods: data recordings, observations (task performance).
2.3.4	234-001	ISSUE: The introduction of additional alarms (to the ones in the legacy systems) will provide an increasing operational complexity.	OBJ-ARG2.3.4-10.02a-V3-001	Assess whether the additional alarms increase the operational complexity within acceptable limits as defined by design standards and regulations.	Apply HF design principles: FAA HF Design Standards Chap. 7, ISO 9241-400:2007, Eurocontrol Style Guide CS 25 - Certification Specification for Large Aeroplanes
2.3.6	236-001	ISSUE: The HMI has to be clear and unambiguous.	OBJ-ARG2.3.6-10.02a-V3/V2-001	Assess the usability of the integrated tool/functionality interface.	Assess usability in Real-Time Simulation with: -objective methods: observations, data recording -subjective methods: questionnaires, debriefings.

2.3.8	238-001	BENEFIT: The displayed information increases individual SA.	OBJ-ARG2.3.8-10.02a-V3/V2-001	Assess the increase in individual SA.	Assess individual situational awareness in Real-Time Simulation: - objective methods: observations -subjective methods: questionnaires, debriefings.
2.3.9	239-001	BENEFIT: The displayed information increases team SA.	OBJ-ARG2.3.8-10.02a-V3/V2-001	Assess the increase in team SA.	Assess team situational awareness in Real-Time Simulation: - objective methods: observations -subjective methods: questionnaires, debriefings.
3.2.1	321-001	ISSUE: Changes to the task allocation between controllers may lead to adverse effects on their tasks	OBJ-ARG3.2.1-10.02a-V3-001	Assess if the task allocation between controllers is clearly defined	Assess controllers' task allocation in RTS: -objective methods: observations, data recordings -subjective methods: interviews, debriefings.
3.2.2	322-001	BENEFIT: The proposed task allocation between human actors is supported by technical systems/the HMI	OBJ-ARG3.2.2-10.02a-V3-001	Assess if the proposed task allocation between human actors is supported by technical systems/the HMI	Assess Usability in Real-Time Simulation: -subjective methods: questionnaire, debriefings &interviews (feedback on system support) -objective methods: data recordings, observations

3.2.3	323-001	BENEFIT: The potential for human error in team tasks is reduced as far as possible.	OBJ-ARG3.2.3-10.02a-V3-001	Assess if the potential for human error in team tasks is reduced as far as possible.	Assess errors and recovery means in Real-Time Simulations with -objective methods: observations, data recordings -subjective methods: interviews, debriefings & Analyse operational impact of errors with safety specialists
3.2.4	324-001	ISSUE: Team tasks cannot be achieved in a timely and efficient manner	OBJ-ARG3.2.4-10.02a-V3-001	Assess if team tasks can be achieved in a timely and efficient manner	Assess timeliness of individual/team actions in Real-Time Simulations with: -objective methods: observations, data recordings -subjective methods: interviews, debriefings
3.3.1	331-001	ISSUE: Intra-team and inter-team communication doesn't support the information requirements of team members	OBJ-ARG3.3.1-10.02a-V3-001	Assess if the intra-team and inter-team communication supports the information requirements of team members.	Analyse intra-team/ inter-team communication in Real-Time Simulation: -objective methods: observation, data recordings (R/T, HMI interaction) -subjective methods: interviews, questionnaires & debriefings
3.3.4	334-001	BENEFIT: The communication load can be reduced.	OBJ-ARG3.3.4-10.02a-V3-001	Assess whether there is a notable reduction in communication load.	Assess communication load in Real-Time Simulation (covering normal, abnormal conditions and degraded modes of operations):

					-subjective methods: questionnaires -objective methods: data recordings
3.3.5	335-001	BENEFIT: Team members can maintain a sufficient level of shared situation awareness	OBJ-ARG3.3.5-10.02a-V3/V2-001	Assess whether team members can maintain a sufficient level of shared situation awareness	Assess team situational awareness in Real-Time Simulation: -subjective methods: questionnaires -objective methods: probe methods
4.1.1	411-001	ISSUE: Changes in roles and responsibilities are not acceptable to the involved controllers	OBJ-ARG4.1.1-10.02a-V3-001	Assess whether changes in roles and responsibilities are acceptable to the involved controllers	Discuss description of roles and responsibilities with end users & get feedback on acceptability of the proposed changes.
4.1.2	412-001	ISSUE: Redo a task already done by a system can lead to a feeling a wasting time.	OBJ-ARG4.1.2-10.02a-V3/V2-001	Assess whether there is any negative impact of the higher degree of automation on job satisfaction.	Discuss proposed solution with end users & get feedback on potential impact on job satisfaction.
4.2.1	421-001	ISSUE: Controllers must have the necessary knowledge and skills to interpret warnings/ alarms.	OBJ-ARG4.2.1-10.02a-V3/V2-001	Assess whether controllers have the necessary knowledge and skills to interpret warnings/alarms correctly and to achieve a sufficiently high job performance.	Perform/update Cognitive Task Analysis to identify knowledge, skill and experience requirements. Integrate the tools/functionalities in controllers training. It is essential to present them as tools/functionalities that support the solution finding
	421-002	ISSUE: Controllers must have the necessary skills to detect and solve conflicts without tool/functionality support.	OBJ-ARG4.2.1-10.02a-V3-002	Assess whether controllers have the necessary skills to detect and solve conflicts without tool support.	

					Regular Training and Briefing
4.5.1	451-001	ISSUE: The content of training for each actor group isn't well specified.	OBJ-ARG4.5.1-10.02a-V3-001	Assess whether the content of training for each actor group is specified.	Identify training content using the good practice material from 16.4.3 Training And Competence Analysis Tool (TACAT) for Air Traffic Controllers (ATC), Air Traffic Safety Electronic Personnel (ATSEP) and Pilots or other relevant material
4.5.2	452-001	ISSUE: The duration of training for each actor group is not specified	OBJ-ARG4.5.2-10.02a-V3-001	Assess whether the duration of training for each actor group is specified	Identify required training duration using the good practice material from 16.4.3 Training And Competence Analysis Tool (TACAT) for Air Traffic Controllers (ATC), Air Traffic Safety Electronic Personnel (ATSEP) and Pilots or other relevant material
4.5.3	453-001	ISSUE: The required types of training (i.e. classroom, simulator, on-the job training) are not properly identified	OBJ-ARG4.5.3-10.02a-V3-001	Assess whether the required types of training are identified.	Identify required training needs using the good practice material from 16.4.3 Training And Competence Analysis Tool (TACAT) for Air Traffic Controllers (ATC), Air Traffic Safety Electronic Personnel (ATSEP) and Pilots or other relevant material.

Table 3: 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

To identify potential HP issues, benefits & impacts relating to the SESAR PJ10.02a solution, two preliminary activities were performed: (i) dedicated WebExes and (ii) a Joint HP & Safety Workshop. A series of dedicated WebExes were conducted in November and December 2018 as initial coordination for being aligned and share information on how to carry out both HP and also Safety assessments for all validation exercises. Guidance materials and SESAR documentation have been distributed too. Furthermore a Joint HP & Safety Workshop with HP experts, safety experts and actors/end users was organised in Rome at the end of February in order to perform both the HP and also the Safety assessment. Indeed, these aspects are very closely linked and the WS offered the opportunity explore some synergies. It also gave the opportunity to discuss the HP issues/benefit and to envisage suitable recommendations and requirements at the solution level. For any further detail on these activities please refer to "Appendix C - VALP Part IV: Human Performance Assessment Plan" in D4.2.030 - SESAR Solution 10-02a: Validation Plan (VALP) for V3.

In addition to these preliminary activities, Table 4 contains an overview of Real Time Simulations.

Activity 1.	
Description	Real Time Simulations
Arguments & related issues addressed	All arguments will be addressed.
HP objectives	Refer to HP Log, column L "Objectives" in "HP/ validation objectives" (see Appendix D)
Tools / Methods selected out of the HP repository	Refer to VALP Part I, sections 5.X.8
Summary of the HP activity	Refer to HP Log, column U "Actual evidence" as well as Recommendations/Requirements Register sheets.

Table 4: Description of Activity 1 - Real Time Simulations

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

4.4.1 Summary of HP activities results & recommendations/requirements

The tables in Appendix B and Appendix C provide a summary of the main results/evidence, status of the HP issue and the HP recommendations / requirements for each of the HP issues/benefits identified from the activities conducted to date, i.e. the focus groups, workshops and validation exercises. These are arranged according to the V-phase of the exercises as well as the HP Logs in Appendix D.

The recommendations resulting from the activities conducted are proposed as a potential means to mitigate the HP issues identified relating to the operational concept. It should be noted that the recommendations required additional analysis, that is, refinements and / or validation before they are mature enough to become a requirement.

The requirements are statements that specify the required characteristics of the solution from a HP point of view. HP requirements can be seen as relatively stable and either lead to a redefinition of the operational concept or the specification of the technical solution.

The HP recommendations and requirements fall into one of several classes, among others:

- Technical system and HMI design

- Training of end user

In addition, HP recommendations can relate to test and validation activities that need to be conducted in later V phases in order to investigate issues/benefits and potential mitigation in more detail.

4.4.2 Maturity of the Solution

The HP maturity criteria checklists for transition from V2 to V3 and from initial V3 to full V3 were used to determine the HP maturity of the operational concept following the HP related activities conducted to date. The checklist was completed for each validation exercise and based on the activities conducted and the evidence collected during the Real Time Simulations.

From the completion of the HP maturity criteria checklists for transition from initial V3 to full V3 which is based on the 'evidence' obtained from the HP related validation activities conducted within SESAR PJ.10.02a, it can be concluded that the operational concept tested in the five validation exercises:

- EXE-10.02a-V3-VALP-001 performed by DSNA: En-Route

- EXE-10.02a-V3-VALP-002b performed by COOPANS and Thales: TMA

- EXE-10.02a-V3-VALP-003 performed by ENAV: En-Route

- EXE-10.02a-V3-VALP-004 performed by Skyguide: En-Route

- EXE-10.02a-V3-VALP-005 performed by ECTL, ANS-CR, Thales: En-Route

has reached the V3 level of HP maturity and **satisfies the V3 transition criteria to start the full V3 validation** (for further details, see Appendix D - D.1.1 V3 exercises)**.**

For what concerns the V2 validation exercises dealing with EPP:

- EXE-10.02a-V3-VALP-006 performed by PANSA and INDRA: En-Route

- EXE-10.02a-V3-VALP-007 performed by Airbus D&S and BULATSA: TMA and transition to En-Route

from the completion of the HP maturity criteria checklists for transition from V2 to V3 which is based on the 'evidence' obtained from the HP related validation activities conducted within PJ.10.02a, it can be concluded that the operational concept tested in the validation exercises has reached the V2 level of HP maturity and **satisfies the V2 transition criteria to start V3 validation** (for further details, see Appendix D - D.1.2 V2 exercises)**.**

5 References

Human Performance

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

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

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

[4] 16.06.05 D 27 HP Reference Material D27

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

Appendix A   – Additional HP activities conducted

N/A

Appendix B – HP Recommendations Register

B.1.1 V3 exercises

HP Recommendations Register									
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
RECOM_10-02a-001_ 1	Training	Appropriate training time should be provided to the controllers with the MTCD and What-if, according to their current level of familiarity with automated tools	Disparities amongst controllers in Europe regarding familiarity with automated tools	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		
RECOM_10-02a-00_ 2	System design	The What-if should allow the evaluation of multiple clearances (e.g. direct point + CFL) on a single aircraft.	Relatively high frequency of multiple clearances ; should be possible to evaluate those with the what-if	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		
RECOM_10-02a-00_ 3	System design	The HMI should display conflicts on the PC interface first for a given sector, and allow the PC to share the	TC timeframe of conflict resolution is much shorter ; leave the possibility	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI	Ground	CM-0211: Improved	Accepted		

		conflict with his TC manually.	to manually share conflict if needed	CM-0211: Improved MTCD & What-if)		MTCD & What-if			
RECOM_10-02a-00_4	System design	The HMI should transfer automatically unresolved conflicts to the TC when they fall into a (customizable) time-frame.	by default, to avoid unseen conflicts, the TC should see the conflict occurring in a near future (inside in time horizon of work)	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		
RECOM_10-02a-00_5	New objective	Further studies on the concept of clearance proposition functions should be conducted.	Several participants were interested in automatic resolution tools which would propose resolution strategies	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		
RECOM_10-02a-00_6	OPS (operating methods / procedures)	The electronic environment including the MTCD should present a function so the controller can feed the system with an intermediate trajectory between the aircraft current position when on heading and its planned trajectory	This is important especially in case of bad weather; without this function the MTCD is non-functional when several aircraft are on heading. This was also an output from V2.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		

Table 5: HP recommendations - EXE-10.02a-V3-VALP-001

				HP Recommendations Register					
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
ATCO_Changes to the task allocation_Recom_1	System design	It is recommended to define appropriate periodic training of controllers conducted for retaining conflict detection skills.	BENEFIT: With the higher degree of automation, the tool/functionality will assist controllers in their monitoring tasks by freeing up cognitive resources which leads to an increase in human performance in terms of controller efficiency in all traffic situations. In addition also flight efficiency and planning stability can be improved.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted		
ATCO_The level of workload_Recom_2	System design	It is recommended to change or exclude unnecessary warnings for certain sectors, e.g. warnings where traffic had	BENEFIT: Better and quicker detection of conflicts, especially during flight integration task. The controller's workload is	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection	Air/Ground	PJ10.02a	Accepted		

		entered the TMA for S8.	decreased and smoothed while the situation awareness is at least maintained. There is a better controller's resilience and SA.	log Post-simulation questionnaire					
ATCO_Mental model for human actors_Recom_3	System design	It is recommended to that the same HP/issue should be used to analyse further the effect of the effect of low confidence in WEP tool regarding: "If it was tuned in correctly, it will be a good support for my mental model."	ISSUE: The establishment of the controller's mental model could be negatively affected by the higher degree of automation.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted		
ATCO_Level of trust_Recom_4	System design	It is recommended to that the same HP/issue should be used to analyse further the trust in tool functionality.	ISSUE: Trust in the tool/functionality must be adequate.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted		
ATCO_ The accuracy of information _Recom_5	System design	It is recommended to see into possibility into of	ISSUE: The accuracy of information provided in situations with a lot	Real Time simulation (May, 20-24 2019) Post-run	Air/Ground	PJ10.02a	Accepted		

		improving TCT CD tool function.	of vectoring clearances might not be sufficient.	questionnaire Observation data collection log Post-simulation questionnaire				
ATCO_The timeliness of information _Recom_6	System design	It is recommended to that the controller should have a strong understanding of the inputs and processes used by the tool support in order to work efficiently with it.	ISSUE: The timeliness of the information is not adequate for controllers to carry out their tasks, e.g. calculation results appear with delay, no update in opened interface display.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted	
ATCO_Type of information_Recom_7	System design	It is recommended to make the parameters used in predicting conflicts in the WEP function need to be tightened in order to only display the ones with great likelihood of occurring.	ISSUE: Additional, but non-essential information is being provided to the controller leading to ambiguous	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted	
ATCO_Alarms and alerts_Recom_8	System design	It is recommended to Information provision should be in line with	ISSUE: The introduction of additional alarms (to the ones in the legacy systems) will provide an	Real Time simulation (May, 20-24 2019) Post-run questionnaire	Air/Ground	PJ10.02a	Accepted	

		existing supporting tools.	increasing operational complexity.	Observation data collection log Post-simulation questionnaire					
ATCO_Usability of interface_Recom_9	System design	It is recommended to that the colour coding for the WEP option should be in line with the colour coding used in the operational ATM system.	ISSUE: The HMI has to be clear and unambiguous.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted		
ATCO_Interface_Recom_10	System design	It is recommended to improve the accuracy of the WEP information, in order to deliver a situational awareness improvement.	BENEFIT: The displayed information increases individual/team SA.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	Air/Ground	PJ10.02a	Accepted		

Table 6: HP recommendations - EXE-10.02a-V3-VALP-002b

HP Recommendations Register									
Reference	Type of recommendation	Recommendation	Rationale	Assessment source +	Scope	Concept/ solution	Recommendation status	Rationale in case of	Comments

Founding Members

				Reference report	(Air, Air/Ground, Ground)	Involved		rejection
ATCO_Workload_Recom_1	System design	It is recommended to define an appropriate training before the integration of the CD/R tools. This will allow the ATCOs to perform their tasks in a quicker and smoother manner and reduce the needed interactions with the interface as well as the workload.	ISSUE: The user interface of the tool is designed such that required inputs from the operator increase workload too much.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted	
ATCO_Workload_Recom_2	System design	It is recommended to define an appropriate training before the integration of the CD/R tools. The quantitative and qualitative results show that there isn't a significant reduction of workload induced by the use of the improved separation management supporting tools/functionalities. ATCOs report a limited support of the tools in managing traffic in the tested environment	BENEFIT: Better and quicker detection of conflicts, especially during flight integration task. The controller's workload is decreased and smoothed while the situation awareness is at least maintained. There is a better controller's resilience and SA.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted	

ATCO_Mental Model_Recom_3	System design	It is recommended to support the ATCOs in maintaining a clear mental model of the CD/R tools status by optimising the TCT, MTCD & What-if services (see Requirements Register)	ISSUE: New information with different level of certainty is added to existing information. The controller must understand the calculation for obtaining a clear mental model.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
ATCO_Mental Model_Recom_4	System design	It is recommended to support the ATCOs in maintaining a clear mental model of the CD/R tools status by optimising the TCT, MTCD & What-if services (see Requirements Register)	ISSUE: The establishment of the controller's mental model could be negatively affected by the higher degree of automation.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
ATCO_Trust_Recom_5	System design	It is recommended to fine-tuning the the improved TCT, MTCD & What-if services for increasing ATCOs system trust and acceptability (see Requirements Register)	ISSUE: Trust in the tool/functionality must be adequate.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	To be analysed		
ATCO_Trust_Recom_6	System design	It is recommended to fine-tuning the the improved TCT, MTCD & What-if services for increasing ATCOs system trust and	ISSUE: The controller does not cross-check the quality of the output due to an over-reliance. This	Real Time Simulation (May, 15-17 2019) Post-run debriefings	Air/Ground	PJ10.02a	To be analysed		

		acceptability (see Requirements Register)	may lead to complacency. This could be even worse in situations of decreased TP accuracy and reliability (e.g. adverse weather situations.).	Final Debriefing				
ATCO_ Intra/inter-team communication_Recom_7	System design	It is recommended to fine-tuning the the improved TCT, MTCD & What-if services for supporting ATCOs Intra-team and inter-team communication (see Requirements Register)	ISSUE: Intra-team and inter-team communication doesn't support the information requirements of team members	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	To be analysed	
ATCO_ Communication Load_Recom_8	System design	It is recommended to fine-tuning the the improved TCT, MTCD & What-if services for decreasing ATCOs communication load (see Requirements Register).	BENEFIT: The communication load can be reduced.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	To be analysed	
ATCO_ Team SA_Recom_9	System design	It is recommended to fine-tuning the the improved TCT, MTCD & What-if services for increasing ATCOs SA (see Requirements Register)	BENEFIT: Team members can maintain a sufficient level of shared situation awareness	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	To be analysed	

ATCO_ Job satisfaction_Recom_10	Training	It is recommended to define an adequate training before the implementation of the improved separation management supporting tools/functionalities in order to ensure job satisfaction.	ISSUE: Redo a task already done by a system can lead to a feeling a wasting time.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
ATCO_Knowledge and skills_Recom_11	Training	It is recommended to define an adequate training before the implementation of the improved separation management supporting tools/functionalities in order to ensure the necessary knowledge and skills to interpret warnings/ alarms	ISSUE: Controllers must have the necessary knowledge and skills to interpret warnings/ alarms.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
ATCO_ Knowledge and skills_Recom_12	Training	It is recommended to define an adequate training before the implementation of the improved separation management supporting tools/functionalities in order to ensure the necessary knowledge and skills to detect and solve conflicts without tool/functionality support.	ISSUE: Controllers must have the necessary skills to detect and solve conflicts without tool/functionality support.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		

Founding Members

ATCO_ Training_Recom_13	Training	It is recommended to properly define the content of the training for each group of actors before the integration of the CD/R tools. This will allow the ATCOs to perform their tasks in a quicker and smoother manner	ISSUE: The content of training for each actor group isn't well specified	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
ATCO_ Training Duration_Recom_14	Training	It is recommended to properly define the duration of the training for each group of actors before the integration of the CD/R tools. This will allow the ATCOs to perform their tasks in a quicker and smoother manner	ISSUE: The duration of training for each actor group is not specified	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
ATCO_ Types of Training_Recom_15	Training	It is recommended to properly define the types of the training for each group of actors before the integration of the CD/R tools. This will allow the ATCOs to perform their tasks in a quicker and smoother manner	ISSUE: The required types of training (i.e. classroom, simulator, on-the job training) are not properly identified	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		

Table 7: HP recommendations - EXE-10.02a-V3-VALP-003

HP Recommendations Register									
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
FRA_Design_Recom1		Deliver Operating methods for Exit CDT.			Ground	PJ10.02a	To be analysed		
FRA_Design_Recom2		Further HF analysis or study assessing the impact of loss of skills over time as a regular study to understand the degradation of skills over time for higher levels of automation. Validation during next VAL EXE in PJ06.01 (VAL EXE to validate tools in PJ10.02a).			Ground	PJ10.02a	To be analysed		
FRA_Design_Recom3		Further improve the tools (see requirements).			Ground	PJ10.02a	To be analysed		
FRA_Design_Recom4		Define training requirements for Exit CDT as it is currently not yet in operations.			Ground	PJ10.02a	To be analysed		

Table 8: HP recommendations - EXE-10.02a-V3-VALP-004

HP Recommendations Register

Founding Members

EUROPEAN UNION   EUROCONTROL

Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
EXE-10.02aVALR-006_Recom-01	OPS (operating methods / procedures)	The use of CD&R shall be extended according to the recommendations provided in EXE-10.02a-V2-VALR-006 and apply the same HP/Validation Objective to cover PC tasks.	Subject for further studies covering the extension of the time horizon to PC.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	To be analysed		
EXE-10.02aVALR-006_Recom-02	Training	Periodic information dissemination shall be conducted to ATCOs assisting to retain this core skill. [info bulletin (1) about the risk (2) best radar scanning practices].	Results indicate that the issue that the higher degree of automation associated with the supporting tool/functionality might lead to deterioration of controllers' conflict detection (core) skills is a valid one and mitigation measures should be taken.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted		

EXE-10.02aVALR-006_Recom-03	Training	Periodic training shall be conducted for retaining conflict detection skills including training for CD&R malfunction.	Results indicate that the issue that the higher degree of automation associated with the supporting tool/functionality might lead to deterioration of controllers' conflict detection (core) skills is a valid one and mitigation measures should be taken.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted			
EXE-10.02aVALR-006_Recom-04	OPS (operating methods / procedures)	Introduction of local procedures for disabling this functionality in low-traffic periods shall be considered.	Results indicate that the issue that the higher degree of automation associated with the supporting tool/functionality might lead to deterioration of controllers' conflict detection (core) skills is a valid one and mitigation measures should be taken.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted			
EXE-10.02aVALR-006_Recom-05	New objective	The operational scenario shall be included in V3 to capture more detailed results on cognitive ATCO resources in classic ATCO team (TC/PC) organisation.	This is a validation objective for V3; more research is needed	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated	Accepted			

Founding Members

				Ground Based Flight Conformance Monitoring in Step 1		
EXE-10.02aVALR-006_Recom-06	System design	Recommendations for system improvement that are provided in EX006-CRT-10.02a-V2-VALP-004-006 shall be implemented in V3.	n.a.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	To be analysed
EXE-10.02aVALR-006_Recom-07	New objective	"Tool failure" scenario(s) shall be introduced in V3 which should allow for analysis of operational transition to "manual mode"	This is a validation objective for V3; more research is needed	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted

EXE-10.02aVALR-006_Recom-08	New objective	"Intended transition" scenario(s) shall be introduced which should allow for analysis of human-induced transition.	This is a validation objective for V3; more research is needed	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted	
EXE-10.02aVALR-006_Recom-09	New objective	Use the same HP/benefit to analyse the effect on classic team organisation (PC/TC).	This is related to the HP assessment as a method. Not related to assessment results of workload or situational awareness	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted	
EXE-10.02aVALR-006_Recom-10	Other	The recommendations related to the HMI provided in EX006-CRT-10.02a-V2-VALP-004-006 should be implemented and followed-up.	n.a.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated	To be analysed	

Founding Members

					Ground Based Flight Conformance Monitoring in Step 1			
EXE-10.02aVALR-006_Recom-11	New objective	The same HP/ISSUE should be used to analyse further the effect with "tool failure", "intended transition" scenarios in V3.	This is a validation objective for follow-up validations; more research is needed	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted	
EXE-10.02aVALR-006_Recom-12	New objective	The same HP/ISSUE should be used to analyse further the trust in tool functionality after the V2 recommendations in EX006-CRT-10.02a-V2-VALP-004-006 are implemented. In addition, analyse further the level of trust into the system with classic ATCO team organisation (TC/PC).	This is a validation objective for V3; more research is needed	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted	
EXE-10.02aVALR-	New objective	The recommendations in EX006-CRT-10.02a-V2-	To replicate the effects of complacency the	PJ10.02a-V2-VALR	Ground	CM-0206 Conflict	Accepted	

006_Recom-13		VALP-004-006 should be implemented and the level of trust into the system should be analysed with the classic ATCO team organisation (TC/PC).	controllers will need to have a significant level of trust into the system. For this the controllers need more exposure to the new functionalities. This is a validation objective for V3; more research is needed	related to EXE-10.02a-V2-VALR-006		Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1		
EXE-10.02aVALR-006_Recom-14	System design	All conflict resolution solutions including the automated conflict detection function should to be stabilised in order to present to ATCOs not so rapidly changing information about potential conflicts and solutions.	exercise revealed rapidly changing information about potential conflicts and solutions	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1	Accepted	
EXE-10.02aVALR-006_Recom-15	New objective	The same benefit should be introduced for classic ATCO team organisation 2.3.9 (TC/PC) to assess the ATCO Team situational awareness with CD/R and enhanced conformance monitoring functionalities tailored to PC.	This is a validation objective for V3; more research is needed	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-006	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight	Accepted	

					Conformance Monitoring in Step 1			
	......							

Table 9: HP recommendations - EXE-10.02a-V3-VALP-005

B.1.2 V2 exercises

HP Recommendations Register									
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
PC-Aid-001	Training	It is recommended to make more tests with the tool in a realistic environment.	As the system used during this validation (as well as the MTCD tool itself) was new for ATCOs, the time spent validating MTCD enhanced by EPP was not sufficient for ATCOs to check the accuracy of the tool in most common or any abnormal situations. The accuracy of the MTCD enhanced by EPP tool needs to be analysed in a realistic-as-possible environment, e.g. exercises using Shadow Mode, where all factors like realistic weight and weather conditions could be used to show if the tool generates any situations in which conflicts		Air/Ground		To be analysed		

Reference	Type of recommendation	Recommendation	Rationale						
							cannot be detected by the system using the tool.		
PC-Aid-002	OPS (operating methods / procedures)	It is recommended to conduct research on situations where MTCD enhanced by EPP could miss a conflict.	As the MTCD enhanced by EPP changes the way conflicts are calculated, which has an impact on the scope of conflict demonstration, there is a need of researching if ATCOs' skill degradation could bring about any threat of missing a conflict in an operational situation. The research could be made with the knowledge of Operational Experts by using the tool, e.g. in Shadow Mode.						
PC-Aid-003	Training	It is recommended to clearly explain to ATCOs that automation of some tasks can relieve some resources for other challenging activities.	As air traffic is projected to increase year upon year, automation of some tasks can possibly relieve some ATCOs resources potentially useful for other tasks related to controlling of air traffic. There is a chance that the subjective feeling of challenge will remain at the same level.						

Table 10: HP recommendations - EXE-10.02a-V2-OSED-006

HP Recommendations Register									
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air,	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments

					Air/Ground, Ground)				
EXE-10.02a-VALR-007_Recom-01	System design	Fine tuning of the CD&R algorithm and its parameters in order to reduce (even eliminate) the number of missed/false alerts. It should be considered to introduce an altitude filtering Set-up for TMA environment in order to avoid false conflict indication and resolutions on intermediate and final track legs. The false/missed alerts and not relevant solutions shall be avoided and only "good" solutions shall be indicated based on the ATCO mental model considering the original positions and flight directions of the conflicting aircraft and approved pre-defined conflict resolution concept.			Ground				
EXE-10.02a-VALR-007_Recom-02	System design	"Periodic information dissemination shall be conducted to ATCOs assisting to retain this core skill.			Ground				
EXE-10.02a-VALR-007_Recom-03	Training	Periodic training for the ATCOs to maintain the core skills regarding the conformance monitoring of the issued instructions and clearances.			Ground				
EXE-10.02a-VALR-007_Recom-04	System design	HMI recommendations from the ATCOs to be considered for the next version of the tool. The full integration of electronic coordination between ATC sectors into the User Interface should be further developed.			Ground				

EXE-10.02a-VALR-007_Recom-05	Training	Periodic trainings for the ATCOs to maintain their conflict detection and resolution core skills.			Ground				
EXE-10.02a-VALR-007_Recom-06	OPS (operating methods / procedures)	Fine tuning of the CD&R algorithm and its parameters in order to reduce (even eliminate) the number of delayed alerts.			Ground				
EXE-10.02a-VALR-007_Recom-07	Training	More extensive training for the ATCOs with more focus on the EPP related part of the CD&R algorithms. New procedures should be designed, in order to prepare the ATCOs to cope the situations which include EPP capable traffic in different modes.			Ground				

Table 11: HP recommendations - EXE-10.02a-V2-OSED-007

Appendix C – HP Requirements Register

C.1.1 V3 exercises

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
REQ_10-02a-001_1	OPS (operating methods / procedures)	The What-if shall be available when implementing Free-Route airspace	FRA implies unusual conflicts for controllers used to the previous RTS airspace. The what-if will support this transition for the clearance validation task	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_2	OPS (operating methods / procedures)	The MTCD shall be available when implementing Free-Route airspace	FRA implies unusual conflicts for controllers used to the previous RTS airspace. The MTCD will support this transition by ensuring conflicts detection	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_3	System design	The MTCD shall detect aircraft-aircraft interferences on stable	V2 and V3 showed that this philosophy avoids detecting too many false positive; this way the	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001	Ground	CM-0211: Improved	To be analysed		

		segments of the aircrafts trajectories only	MTCD detects mostly relevant conflicts. This requirement is only valid if the requirement REQ_10-02a-001_ 5 is implemented.	(OI CM-0211: Improved MTCD & What-if)			MTCD & What-if		
REQ_10-02a-001_ 4	OPS (operating methods / procedures)	The working method shall specify that cases of conflicts during climb or descent are covered by the What-if service	The design philosophy here considers that conflicts on climbing or descending trajectories are covered before giving the clearance when the controllers checks it with the What-if.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_ 5	OPS (operating methods / procedures)	Considering their complementary operational scopes, the What-if and MTCD should be both available at the same time if put into operations	In order to respect the What-if+MTCD design philosophy (see REQ_10-02a-001_ 3 and REQ_10-02a-001_ 4)	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_ 6	System design	The upper lateral detection threshold of the "What-if" shall be the same as the one of the MTCD in order to ensure consistency.	In order to ensure the tools complementarity and consistency, since they shall work together (see REQ_10-02a-001_ 3 and REQ_10-02a-001_ 4)	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_ 7	System design	The What-if results display shall include the horizontal minimal	Participants gave only positive feedback about this feature. It allows	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211:	Ground	CM-0211: Improved MTCD & What-if	To be analysed		

		distance with conflicting aircrafts	evaluating the severity of potential conflict rapidly.	Improved MTCD & What-if)					
REQ_10-02a-001_8	System design	The What-if results display shall highlight every conflicting aircraft along with their trajectories	This is a core feature of the what-if, which overall acceptability and usability was rated as good.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_9	System design	The MTCD shall implement the concept of flight leg embellishment	Flight Leg Embelishment support controllers mental representation of conflict and their analysis. This is also confirmed by V2 results	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_10	System design	The detection criteria of the MTCD shall be transparent to the user and displayed on the interface as much as possible without impairing usability	The acceptability of a system is conditioned by the extent to the which users understand it.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		
REQ_10-02a-001_11	Training	Controllers training shall include uses cases explaining the MTCD detection algorithm scope and limits	The acceptability of a system is conditioned by the extent to which users understand it. It is important to emphasize the limits of the system,	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved	Ground	CM-0211: Improved MTCD & What-if	To be analysed		

			what it does and what it does not.	MTCD & What-if)				
REQ_10-02a-001_12	System design	The system shall release an alert when it has partial or degraded data input regarding the trajectory of one of the flights involved in a conflict	This supports proper human-machine cooperation and helps avoiding mistakes. Also confirmed by V2 results.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed	
REQ_10-02a-001_13	System design	The MTCD shall display the conflicts severity, type (entry / exit) and temporality using visual metaphors on the HMI	Those features encountered only positive feedback. They support a quick analysis of conflicts. This is reflected in the high usability scores. Also confirmed by V2.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed	
REQ_10-02a-001_14	System design	The MTCD shall allow each pair of CWP to select his own detection threshold from a list of predefined values.	"Threshold shall be the same for both controllers in order to avoid inconsistent data between positions.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed	
REQ_10-02a-001_15	System design	The MTCD detection scope shall not overlap with the safety nets upper thresholds.	Our prototype MTCD was designed by taking into consideration the existing safety nets on our platform.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed	

REQ_10-02a-001_16	System design	The What-if detection algorithm shall be based on the TCT algorithm in order to ensure tools complementarity and to cover a spectrum of possible interferences as large as possible, including aircraft on heading.	The what-if is a tactical tool and shall use the same detection criteria as the TCT (Tactical) safety net.	PJ10.02a-V3-VALR related to EXE-10.02a-V3-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	To be analysed		

Table 12: HP Requirements - EXE-10.02a-V3-VALP-001

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
TCT/WEP tool_Changes to the task allocation_Req_1	System design	The improved TCT tool and WEP training shall be provided in such way to give controllers clear understanding of different traffic situations	BENEFIT: With the higher degree of automation, the tool/functionality will assist controllers in their monitoring tasks by freeing up cognitive resources which leads to an increase in human performance in terms of controller efficiency in all traffic	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**		

			when using the tool. Limitations of the tool shall be clearly shown.	situations. In addition also flight efficiency and planning stability can be improved.					
TCT/WEP tool_The level of workload_Req_2	System design	The improved TCT tool and WEP shall introduce more Exe examples for the more dense traffic.	BENEFIT: Better and quicker detection of conflicts, especially during flight integration task. The controller's workload is decreased and smoothed while the situation awareness is at least maintained. There is a better controller's resilience and SA.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**		
TCT/WEP tool_Mental model for human actors_Req_3	System design	The improved TCT tool and WEP tool shall be improved in such way to display correct information for the controller in order to give controller ability to anticipate (develop and maintain mental model) evolving situations.	ISSUE: The establishment of the controller's mental model could be negatively affected by the higher degree of automation.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**		

Founding Members

TCT/WEP tool_Level of trust_Req_4	System design	The improved TCT tool and WEP tool parameters shall be adjusted and further training on the system is required to give proper opportunity for controllers' trust to develop.	ISSUE: Trust in the tool/functionality must be adequate.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**		
TCT/WEP tool_The accuracy of information_Req_5	System design	n/a	ISSUE: The accuracy of information provided in situations with a lot of vectoring clearances might not be sufficient.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**		
TCT/WEP tool_The timeliness of information_Req_6	System design	Tool should be adjusted in such way to avoid cluttering.	ISSUE: The timeliness of the information is not adequate for controllers to carry out their tasks, e.g. calculation results appear with delay, no update in opened interface display.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**		

TCT/WEP tool_Type of information_Req_7	System design	n/a	ISSUE: Additional, but non-essential information is being provided to the controller leading to ambiguous	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**			
TCT/WEP tool_Alarms and alerts_Req_8	System design	n/a	ISSUE: The introduction of additional alarms (to the ones in the legacy systems) will provide an increasing operational complexity.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**			
TCT/WEP tool_Usability of interface_Req_9	System design	n/a	ISSUE: The HMI has to be clear and unambiguous.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation data collection log Post-simulation questionnaire	*Air/Ground*	PJ10.02a	**Accepted**			
TCT/WEP tool_Interface_Req_10	System design	The WEP tool should give the controller and the team "heads up" of situations,	BENEFIT: The displayed information increases individual/team SA.	Real Time simulation (May, 20-24 2019) Post-run questionnaire Observation	*Air/Ground*	PJ10.02a	**Accepted**			

		therefore WEP tool must always be indicating correct information.		data collection log Post-simulation questionnaire					

Table 13: HP Requirements - EXE-10.02a-V3-VALP-002b

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
CD/R aids_Accuracy and timeliness_Req_1	System design	The improved TCT, MTCD & What-if services shall support the ATCOs in dealing with non-nominal situations (e.g. No-go Area) by providing accurate and timeliness information	ISSUE: In non-nominal situations (e.g. strong jetstream, adverse weather) a degradation of TP could lead to a silent reduction of the accuracy and reliability. This might lead to more human errors due to false and/or missed alerts.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		

CD/R aids_Accuracy and timeliness_Req_2	System design	The improved TCT, MTCD & What-if services shall support the ATCOs in carrying out their tasks by providing adequate and essential information	ISSUE: The accuracy of information provided in situations with a lot of vectoring clearances might not be sufficient.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
CD/R aids_Timeliness_Req_3	System design	The improved TCT, MTCD & What-if services shall support the ATCOs in dealing with nominal situations by providing adequate and essential information	ISSUE: The timeliness of the information is not adequate for controllers to carry out their tasks, e.g. calculation results appear with delay, no update in opened interface display.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		
CD/R aids_Type of Information_Req_4	System design	The improved TCT, MTCD & What-if services shall support the ATCOs in dealing with nominal situations by providing adequate and essential information	ISSUE: Additional, but non-essential information is being provided to the controller leading to ambiguous understanding and cluttering effects. This might result in a bad usability.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	To be analysed		
CD/R aids_Usability_Req_5	System design	The ATCOs shall be familiar with the HMI and the new features of the improved TCT, MTCD &	ISSUE: The HMI has to be clear	Real Time Simulation (May, 15-17 2019)	Air/Ground	PJ10.02a	To be analysed		

		What-If services. Indeed during the RTS, the ATCOs experienced some criticalities due to the lack of familiarization with the new CWP (out of the scope of the RTS, but impacting on the ATCOs performance) combined with new features of the TCT, MTCD and What if services (that were under investigation). In order to mitigate these aspects some adjustments were applied (e.g. revised look-head of both MTCD and also TCT). (see also Recommendations Register)	and unambiguous.	Post-run debriefings Final Debriefing					
CD/R aids_Interface ATCO SA_Req_6	System design	The ATCOs shall be familiar with the HMI and the new features of the improved TCT, MTCD & What-If services. Indeed during the RTS, the ATCOs experienced some criticalities due to the lack of familiarization with the new CWP (out of the scope of the RTS, but impacting on the ATCOs performance) combined with new features of the TCT, MTCD and What if services (that were under investigation). In order to	BENEFIT: The displayed information increases individual SA.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted		

		mitigate these aspects some adjustments were applied (e.g. revised look-head of both MTCD and also TCT). (see also Recommendations Register)						
CD/R aids_Interface Team SA_Req_7	System design	The ATCOs shall be familiar with the HMI and the new features of the improved TCT, MTCD & What-If services. Indeed during the RTS, the ATCOs experienced some criticalities due to the lack of familiarization with the new CWP (out of the scope of the RTS, but impacting on the ATCOs performance) combined with new features of the TCT, MTCD and What if services (that were under investigation). In order to mitigate these aspects some adjustments were applied (e.g. revised look-head of both MTCD and also TCT). (see also Recommendations Register)	BENEFIT: The displayed information increases team SA.	Real Time Simulation (May, 15-17 2019) Post-run debriefings Final Debriefing	Air/Ground	PJ10.02a	Accepted	

Table 14: HP Requirements - EXE-10.02a-V3-VALP-003

HP Requirements Register

Founding Members

Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
Advanced_Tools_Design_Req_1		When assessing the operational impact of loss of functions in automation (in case of a degraded mode situation), the loss of human skills over time should be considered when defining the level of operational degradation (e.g. traffic capacity limit in degraded mode). Regular measurement concerning the human skill is necessary.			Ground	PJ10.02a	To be analysed		
Advanced_Tools_Design_Req_2		Improvements for Trajectory Editor Improve options to display waypoints and trajectory information.			Ground	PJ10.02a	To be analysed		
Advanced_Tools_Design_Req_3		Improvements for Crossing Tool Crossing Tool to be developed also on Route Mode. Crossing tool currently works on			Ground	PJ10.02a	To be analysed		

		current heading only) also to be developed on Route Mode (to consider actual cleared route).						
Advanced_Tools_Design_Req_4		Improvements for CDT Improve CDT in the future by downlinking 4D trajectory (improved predictability and Situational Awareness).			Ground	PJ10.02a	To be analysed	
Advanced_Tools_Design_Req_5		Improvement for Exit CDT Exit CDT should work on Gate Concept, although this was already implemented some Exit COPS were missing in Exit Windows. Create new Exit Window (for gate GVA->ZRH and GVA ->ZRH) and define LoA			Ground	PJ10.02a	To be analysed	
Advanced_Tools_Design_Req_6		XFL in the track label for flights between GVA and ZRH should indicate XFL of own centre.			Ground	PJ10.02a	To be analysed	

Table 15: HP Requirements - EXE-10.02a-V3-VALP-004

HP Requirements Register

Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
EXE-10.02aVALR-001_Req-02	System design	The MTCD detection parameters shall at least ensure the detection of ACFT-ACFT interferences crossing in time horizon above of the TCT time horizon.	Continuum of separation management supporting tools	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		
EXE-10.02aVALR-001_Req-09	System design	The MTCD shall detect ACFT-ACFT interference along stable flight legs, at least for a first stage.	in order to avoid all the not relevant ACFT-ACFT interferences which are qualified as being "in-sector" conflicts and under the TC responsibility and supported by the associated ATC tools such as TCT and/or What-if Clearance.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted		
EXE-10.02aVALR-001_Req-11	System design	The MTCD shall classify the detected ACFT-ACFT interferences according to the associated operational impacts	Adequacy of mental-model between ATCO and System	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved	Ground	CM-0211: Improved MTCD & What-if	Accepted		

		and the probability of occurrences.		MTCD & What-if)			
EXE-10.02aVALR-001_Req-12	System design	The MTCD shall perform the detection of potential ACFT-ACFT interferences at least only along the stable segments of flight legs	in order to align the MTCD support with PC role and responsibility. The need to support TC detection task could be covered thanks to other ATC Tools such as TCT and/or What-if.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted
EXE-10.02aVALR-001_Req-14	System design	The MTCD severity thresholds shall be customizable in line with ATCO operational needs.	Filter the interference to focus on the most critical in busy period => For instance, it could have only one value such as between 0 and 8NM or three levels of severity: [0; 6[; [6;8[and [8;15NM[.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted
EXE-10.02aVALR-001_Req-15	System design	The MTCD service shall provide ATCO with a concept of Flight Leg Embellishment displaying MTCD information along the flight legs of each aircraft involved in an ACFT-ACFT interference.	in order to improve ATCO task and activity (e.g. flight integration, conflict analysis and resolution).	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted
EXE-10.02aVALR-001_Req-16	System design	The MTCD service should allow ATCO to display all of the available Flight Leg	in order to provide ATCO with an overall view about the MTCD	PJ10.02a-V2-VALR related to EXE-10.02a-V2-	Ground	CM-0211: Improved MTCD & What-if	Accepted

		Embellishments for a given aircraft at the same.	information concerning a flight.	VALR-001 (OI CM-0211: Improved MTCD & What-if)						
EXE-10.02aVALR-001_Req-19	System design	The conflict detection algorithm of What-if shall be design in line with ATCO expectation and mental-model, especially about climbing and descending aircraft.	as it could be counter-productive to have a too accurate detection leading to downgrade the level of operational acceptability and/or ATCO's trust in automation.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted			
EXE-10.02aVALR-001_Req-21	System design	The MTCD information should be display on CWP HMI with the concept of Agenda and datablock in order to represent detected ACFT-ACFT interference.	as it is a good vector of communication between TC/PC and allow an access to other feature such as cross-highlight, warning, extrapolation, SEP tools to support ATCO's integration and analysis of aircraft.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-001 (OI CM-0211: Improved MTCD & What-if)	Ground	CM-0211: Improved MTCD & What-if	Accepted			
EXE-10.02aVALR-004_Req-01	Training	Training shall be provided to the controllers to clearly understand what can be expected from the tools in different traffic situations (use cases) and what the	This is in order to ensure know the strengths and weaknesses of the tool in different situations and to achieve a satisfying level of job satisfaction and performance. For using TCT this level of understanding needs to be achieved as well in	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-004	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance	Accepted			

		limitations of the tools are.	order to integrate it as an additional tool for the tactical time horizon.			Monitoring in Step 1 CM-0209 Conflict Detection and Resolution in En-Route using aircraft data in Predefined and User Preferred Routes environments; CM-0210 Ground Based Flight Conformance Monitoring in En-Route using aircraft Data		
EXE-10.02aVALR-004_Req-02	System design	Tool parameters shall be adjusted when bringing the tools to a new target operational environment.	The airspace and route structure complexity of the traffic flows highly effect look ahead time and buffers of the tools. The need to be adjusted in order to ensure optimal impact of the tools and sufficient level of trust and acceptability	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-004	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1 CM-0209 Conflict Detection and Resolution in En-Route using aircraft data in	Accepted	

					Predefined and User Preferred Routes environments; CM-0210 Ground Based Flight Conformance Monitoring in En-Route using aircraft Data			
EXE-10.02aVALR-004_Req-03	System design	The look-ahead times and information provision of TCT shall be in line with existing supporting tools (e.g. MTCD) when bringing the tools to a new target operational environment	in order to enable a merged alarm chain of conflict detection and resolution aid. Contradictory or double conflict indications have to be avoided. This also ensures a better understanding of new functionalities within a given and used operational environment among the controllers.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-004	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1 CM-0209 Conflict Detection and Resolution in En-Route using aircraft data in Predefined and User Preferred Routes environments; CM-0210 Ground Based Flight	Accepted	

						Conformance Monitoring in En-Route using aircraft Data		
EXE-10.02aVALR-004_Req-04	System design	A trajectory update shall be provided on information display directly after every clearance input.	ATCOs would prefer to have a trajectory update directly after every input, not with every radar update.	PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-004	Ground	CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1 CM-0209 Conflict Detection and Resolution in En-Route using aircraft data in Predefined and User Preferred Routes environments; CM-0210 Ground Based Flight Conformance Monitoring in En-Route using aircraft Data	Accepted	

| EXE-10.02aVALR-004_Req-05 | System design | With a resolution advisory tool providing information about combined lateral and vertical conflict free clearances there shall be an adequate multiple touch input device to allow multiple clearances. | In a stripless environment there is a need of an input device for multiple (lateral and vertical) clearances, as the Danish controllers often give such combined clearances. (See also SESAR 1 P4.7.2 VP 175 HP recommendation: R 2.3.2-1-Input_Device) | PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-004 | Ground | CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1 CM-0209 Conflict Detection and Resolution in En-Route using aircraft data in Predefined and User Preferred Routes environments; CM-0210 Ground Based Flight Conformance Monitoring in En-Route using aircraft Data PJ.10-02b | Rejected | | |
| EXE-10.02aVALR-004_Req-06 | System design | The colour coding shall be brought in line with the colour coding philosophy used in the | in order to ensure HMI integration with an appropriate level of acceptability and usability. | PJ10.02a-V2-VALR related to EXE-10.02a-V2-VALR-004 | Ground | CM-0206 Conflict Detection and Resolution in the TMA using trajectory data; | Accepted | | |

		operational ATM system.				CM-0208-A Automated Ground Based Flight Conformance Monitoring in Step 1 CM-0209 Conflict Detection and Resolution in En-Route using aircraft data in Predefined and User Preferred Routes environments; CM-0210 Ground Based Flight Conformance Monitoring in En-Route using aircraft Data			
EXE-10.02aVALR-005-Req-01	System Design	The SNF information shall be integrated with existing User Interface.	integration with existing separation tools necessary to minimize cognitive load, enabling for active usage of additional information in the high traffic intensity regime.	EXE-10.02a-V2-VALP-005 held in March 2018 in Warsaw	Ground	CM-0211: Improved MTCD & What-if	Accepted		
EXE-10.02aVALR-V3-005-Req-01	System Design	When composing a RTE VIA clearance, the system should assist the controller in selecting inserted	Before committing a route clearance the ATCO needs to make sure it is conflict-free. Varying levels of	EXE-10.02a-V3-VALP-005 held in April	Ground	CM-0209			

		point[s] that resolve the conflict in the most efficient manner.	automation can be envisaged: • At a most basic level, the ATCO may benefit from the system displaying the flight legs of the aircraft involved in the conflict and indicating the conflicting legs and point of closest approach; • A more automated tool might give a continuous feedback of the predicted minimum separation as the controller moves the inserted point[s]; • The system might automatically propose inserted point[s] on one or both tracks that solve the conflict with a given probability. A routing proposed by the system should avoid turns greater than those normally used when vectoring (e.g. 10-15 degrees). Aircraft may have different RNP values along their trajectories, and/or may have a different RNP value when cleared towards a non-published waypoint. Turns at	2019 in Prague					

			waypoints may also be performed differently – in a ""fly-by" or "fly-over" manner. All this needs to be taken into account by the probe tool. When system support is used to propose automatically a VIA point for conflict resolution, the above difference in RNP values and types of turns shall be taken into account to adjust separation buffers.							
EXE-10.02aVALR-V3-005-Req-02	System Design	When either the PC or EC has given a RTE VIA instruction to an aircraft, a clear indication shall be provided at both work positions.	For situational awareness to both ATCOs, the system indicates that the aircraft is flying towards a "VIA" point of the new route preferably through an indication in the label of the aircraft.	EXE-10.02a-V3-VALP-005 held in April 2019 in Prague	Ground	CM-0209				
EXE-10.02aVALR-V3-005-Req-03	Procedures, Training	When issuing a RTE VIA clearance to solve a conflict, it should be given a sufficient time before the conflict.	Several factors contribute to the delay in issuing a route modification: - Input by the ATCO in the system (may include several probe inputs); - Upstream sector workload and assessment of a proposed clearance;	EXE-10.02a-V3-VALP-005 held in April 2019 in Prague	Ground	CM-0209				

			- Flight crew assessment, input of route clearance in the FMS and WILCO; Due to this delay, ATCOs should use it only when sufficient time is available..				
EXE-10.02aVALR-V3-005-Req-04	Procedures, Training	There should be a procedure between EC and PC before input of a RTE VIA into the system.	PC and EC may attempt to make a RTE VIA input on the same aircraft, or may start resolving a conflict between two aircraft while making opposing inputs. This may delay the resolution of a conflict, or result in no improvement of the situation or even its deterioration. Therefore, there should be a local procedure for the input of a RTE VIA. This may involve prior communication between PC and EC before any input, and/or an indication on the screen by the PC or EC that a certain conflict is under resolution. In the case when the PC is resolving a conflict without prior communication, they should aim to do so	EXE-10.02a-V3-VALP-005 held in April 2019 in Prague	Ground	CM-0209	

			before the aircraft are in the AoI of the EC. That would minimize the chance that the EC is attempting to resolve it.					
EXE-10.02aVALR-V3-005-Req-05	System Design	The downstream sector should be aware through the system if any incoming aircraft are subject to a RTE VIA when the VIA point is close to the sector boundary or when the change of the trajectory is outside of LoA conditions.	As with existing waypoints (REV highlight?) it should be obvious to the downstream sector that a RTE VIA is performed, so that they can anticipate any turns at the VIA point close to the boundary (parameter subject to local system tuning). In case the VIA point is further out in the upstream sector, but takes the trajectory outside of entry conditions as per LoA (parameter subject to local system tuning) this should also be obvious. In both cases this may be done through e.g. displaying the VIA point in the normal label, or highlighting it if it is already displayed.	EXE-10.02a-V3-VALP-005 held in April 2019 in Prague	Ground	CM-0209		

Table 16: HP Requirements - EXE-10.02a-V3-VALP-005

C.1.2 V2 exercises

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 17: HP Requirements - EXE-10.02a-V2-OSED-006

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
EXE-10.02a-VALR-007_Req-01	System design	The CD/R tool detection parameters shall cover both TMA and en-route sectors with required different	Continuum of separation management supporting tools		Ground				

		parameter settings and time horizons.									
EXE-10.02a-VALR-007_Req-02	OPS (operating methods / procedures)	The CD/R tool shall perform the CD/R only along the stable segments of flight legs (to exclude considering intermediate and final segments)	In order to avoid all the false alerts in the TMA sector		Ground						
EXE-10.02a-VALR-007_Req-03	System design	The CD/R tool shall take into account sequencing of landing ACFT in TMA when suggesting solutions.	To ensure an adequacy of mental-model between ATCO and System - two tasks in the same time: sequencing and separation		Ground						
EXE-10.02a-VALR-007_Req-04	New objective	The CD/R tool shall consider MRVA(Minimum Radar Vectoring Altitude) in TMA when suggesting solutions for CFL	To ensure the compatibility with operating methods		Ground						
EXE-10.02a-VALR-007_Req-05	Training	Training shall be provided to the controllers to clearly understand what can be expected from the tool in different traffic situations (use cases) and what the limitations of the tool is.	"This is in order to ensure know the strengths and weaknesses of the tool in different situations and to achieve a satisfying level of job satisfaction and performance.								
"		Ground									

EXE-10.02a-VALR-007_Req-06	System design	The colour coding shall be brought in line with the colour coding philosophy used in the operational ATM system.	To ensure HMI integration with an appropriate level of accuracy, acceptability and usability.		Ground					
EXE-10.02a-VALR-007_Req-07	System design	The tool should work properly without any missed/delayed/false alerts.	To ensure HMI integration with an appropriate level of accuracy, acceptability and usability.		Ground					
EXE-10.02a-VALR-007_Req-08	System design	The EPP information shall be integrated with existing HMI, e.g. into the label.	Will enable fast and productive usage of additional information when needed.		Air/ Ground					

Table 18: HP Requirements - EXE-10.02a-V2-OSED-007

Appendix D   – HP Log

D.1.1 V3 exercises

EXE-10.02a-V3-OSE
D-001 rev.xlsx

EXE-10.02a-V3-OSE
D-002b.xlsx

EXE-10.02a-V3-OSE
D-003 rev.xlsx

EXE-10.02a-V3-OSE
D-004.xlsx

EXE-10.02a-V3-OSE
D-005 rev.xlsx

D.1.2 V2 exercises

EXE-10.02a-V2-OSE
D-006.xlsx

EXE-10.02a-V2-OSE
D-007.xlsx

-END OF DOCUMENT-