V3 Validation Report

Document information	
Project Title	Implementation of the Dynamic Capacity Management in a high density area
Project Number	04.07.07
Project Manager	AENA
Deliverable Name	V3 Validation Report
Deliverable ID	D24
Edition	01.00.00
Template Version	03.00.00
Task contributors	
AENA	

Please complete the advanced properties of the document

Abstract

This Validation Report covers the EXE-04.07.07-VP-006 which is focused on the analysis of the use of a supporting tool for Operations Supervisor to evaluate the most suitable ACC En-Route sector configuration during the day of operations in terms of capacity to match forecast demand. This exercise was performed by AENA in October 2012 by means of Shadow-Mode Validation Technique for the v3 phase. The document describes the relevant aspects of the exercise VP-006 and provides an exhaustive result analysis.

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
[redacted] AENA	[redacted]	06/11/2012
[redacted] AENA		06/11/2012

Reviewed By - *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
[redacted] SELEX	[redacted]	15/01/2013
[redacted] AENA		09/01/2013

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
[redacted] EUROCONTROL	[redacted]	12/02/2013
[redacted] DSNA		01/02/2013
[redacted] EUROCONTROL		01/02/2013
[redacted] DFS		29/04/2013

Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
[redacted] AENA	[redacted]	12/01/2013
[redacted] NATS		08/01/2013
[redacted] SELEX ES, UK		15/01/2013

Rejected By - *Representatives of the company involved in the project.*		
None.		

Rational for rejection
None.

Document History

Edition	Date	Status	Author	Justification
00.00.01	06/11/2012	Draft	AENA	New Document
00.01.00	16/01/2013	Revised Draft	AENA	Update with comments from SELEX
00.01.01	12/02/2013	Revised Draft	AENA	Update with comments from the external review
00.01.02	12/02/2013	Revised Draft	AENA	Version for R2 SE#3
00.02.00	29/04/2013	Revised Draft	AENA	Update with comments from the SJU assessment
01.00.00	16/09/2013	Approved	[redacted]	Approved by SJU

Intellectual Property Rights (foreground)

The foreground of this deliverable is owned by the SJU..

Table of Contents

TABLE OF CONTENTS **3**
LIST OF TABLES **4**
LIST OF FIGURES **4**
EXECUTIVE SUMMARY **6**
1 INTRODUCTION **7**
1.1 PURPOSE OF THE DOCUMENT 7
1.2 INTENDED READERSHIP 7
1.3 STRUCTURE OF THE DOCUMENT 7
1.4 GLOSSARY OF TERMS 7
1.5 ACRONYMS AND TERMINOLOGY 8
2 CONTEXT OF THE VALIDATION **11**
2.1 CONCEPT OVERVIEW 11
2.2 SUMMARY OF VALIDATION EXERCISE/S 12
2.2.1 Summary of Expected Exercise/s outcomes *12*
2.2.2 Benefit mechanisms investigated *14*
2.2.3 Summary of Validation Objectives and success criteria *15*
2.2.4 Summary of Validation Scenarios *17*
2.2.5 Summary of Assumptions *17*
2.2.6 Choice of methods and techniques *19*
2.2.7 Validation Exercises List and dependencies *19*
3 CONDUCT OF VALIDATION EXERCISES **21**
3.1 EXERCISES PREPARATION 21
3.1.1 Demand Forecast Sources *21*
3.1.2 Platform Configuration *22*
3.1.3 Training *24*
3.2 EXERCISES EXECUTION 24
3.3 DEVIATIONS FROM THE PLANNED ACTIVITIES 25
3.3.1 Deviations with respect to the Validation Strategy *25*
3.3.2 Deviations with respect to the Validation Plan *25*
4 EXERCISES RESULTS **26**
4.1 SUMMARY OF EXERCISES RESULTS 26
4.1.1 Results on concept clarification *27*
4.1.2 Results per KPA *31*
4.1.3 Results impacting regulation and standardisation initiatives *41*
4.2 ANALYSIS OF EXERCISES RESULTS 42
4.2.1 Unexpected Behaviours/Results *44*
4.3 CONFIDENCE IN RESULTS OF VALIDATION EXERCISES 45
4.3.1 Quality of Validation Exercises Results *45*
4.3.2 Significance of Validation Exercises Results *45*
5 CONCLUSIONS AND RECOMMENDATIONS **46**
5.1 CONCLUSIONS 46
5.2 RECOMMENDATIONS 46
6 REFERENCES **47**
6.1 APPLICABLE DOCUMENTS 47
6.2 REFERENCE DOCUMENTS 47
APPENDIX A KPA TEMPLATES **49**
APPENDIX B VALIDATION EXERCISE QUESTIONNAIRES **50**

List of tables

Table 1: Concept Overview 12
Table 2: EXE-04.07.07-VP-006 OIs, KPAs and Validation Expectations 13
Table 3: Benefit Mechanisms 14
Table 4: Metrics and indicators for EXE-04.07.07-VP-006 16
Table 5: Validation Scenarios Summary 17
Table 6: Validation Assumptions 18
Table 7: Methods and Techniques 19
Table 8: Activities for exercise preparation 21
Table 9: Demand sources vs prototype interfaces and CHMI position 23
Table 10: Exercises execution/analysis dates 24
Table 11: Schedule for exercise execution 24
Table 12: Summary of Validation Exercises Results 27
Table 13: KPIs for Efficiency 38
Table 14: Summary of Validation Exercises Results 43
Table 15: Summary of Performance Indicators 44

List of figures

Figure 1: Benefit Mechanisms 15
Figure 2: Links to other validation activities 19
Figure 3: PIV-L Interface 22
Figure 4: PERSEO Interface 23
Figure 5: Demand forecast accuracy for the ATCos' morning shift (nominal conditions) 28
Figure 6: Demand forecast accuracy for the ATCos' afternoon shift (nominal conditions) 29
Figure 7: Demand forecast accuracy for the ATCos' night shift (nominal conditions) 29
Figure 8: Demand forecast accuracy for the ATCos' morning shift (non-nominal conditions) 30
Figure 9: Demand forecast accuracy for the ATCos' afternoon shift (non-nominal conditions) 30
Figure 10: Demand forecast accuracy for the ATCos' night shift (non-nominal conditions) 31
Figure 11: Proposed Airspace Configurations for the ATCos' Morning Shift 32
Figure 12: Number of saturation periods in the ATCos' Morning Shift (nominal conditions) 32
Figure 13: Number of flights able to enter airspace volume in the ATCos' Morning Shift (nominal conditions) 32
Figure 14: Proposed Airspace Configurations for the ATCos' Afternoon Shifts 33
Figure 15: Number of saturation periods in the ATCos' Afternoon Shift (nominal conditions) 33
Figure 16: Number of flights able to enter airspace volume in the ATCos' Afternoon Shift (nominal conditions) 33
Figure 17: Proposed Airspace Configurations for the ATCos' Night Shifts 34
Figure 18: Number of saturation periods in the ATCos' Night Shift (nominal conditions) 34
Figure 19: Number of flights able to enter airspace volume in the ATCos' Night Shift (nominal conditions) 34
Figure 20: Proposed Airspace Configurations for the ATCos' Morning Shift 35
Figure 21: Number of saturation periods in the ATCos' Morning Shift (non-nominal conditions) 35
Figure 22: Number of flights able to enter airspace volume in the ATCos' Morning Shift (non-nominal conditions) 35
Figure 23: Proposed Airspace Configurations for the ATCos' Afternoon Shift 36
Figure 24: Number of saturation periods in the ATCos' Afternoon Shift (non-nominal conditions) 36
Figure 25: Number of flights able to enter airspace volume in the ATCos' Afternoon Shift (non-nominal conditions) 36
Figure 26: Proposed Airspace Configurations for the ATCos' Night Shift 37
Figure 27: Number of saturation periods in the ATCos' Night Shift (non-nominal conditions) 37
Figure 28: Number of flights able to enter airspace volume in the ATCos' Night Shift (non-nominal conditions) 37
Figure 29: IRCO in the ATCos' Morning shift (nominal conditions) 39
Figure 30: IRCO in the ATCos' Afternoon shift (nominal conditions) 39
Figure 31: IRCO in the ATCos' Night shift (nominal conditions) 40
Figure 32: IRCO in the ATCos' Morning shift (non-nominal conditions) 40

Figure 33: IRCO in the ATCos' Afternoon shift (non-nominal conditions) 41
Figure 34: IRCO in the ATCos' Night shift (non-nominal conditions)..... 41
Figure 35: Feeling about the validation activity and the supporting tool 45

Executive summary

This document describes the results of the **EXE-04.07.07-VP-006** defined in P04.07.07 D23 – V3 Validation Plan [10] and how it has been conducted. This exercise assessed the use of a supporting tool in a high density area to evaluate the most suitable ACC En-Route sector configuration during the day of operations in terms of capacity to match forecast demand approximately eight hours before the operation, taking into account:

- the continuous refinement of the planning with the demand data and how the demand evolution has a direct impact on the capacity management;
- the local constraints such as the number of available controllers;
- the 'what-if' scenarios designed at local level (e.g. impact in the capacity due to bad weather conditions, change of operational circumstances in associated airports...).

EXE-04.07.07-VP-006 which is allocated to Step1 Operational Focus Area (OFA) **05.03.04 'Enhanced ATFCM Processes'**[1] within **Release 2** was conducted by means of **Shadow-Mode Validation Technique** in the **AENA Barcelona ACC** where the prototype developed by the P13.02.03 has been integrated. It has taken as the starting point the P04.07.07 D20 – Preliminary OSED [8] and D22 – Preliminary SPR [9] where the operational procedures and scenarios were defined.

All the relevant validation objectives have been covered by means of the Shadow-Mode Validation Technique, although additional analytical modelling runs have been performed to complement this assessment as planned in P04.07.07 D23 – V3 Validation Plan [10].

The main conclusions of this exercise are stated next:

- The functionalities included in the proposed supporting tool for the OPS Supervisor have been demonstrated to be ready for industrialization with full operational capability in any ACC, although some minor modifications should be implemented before its industrialization;
- The What-if functionality was considered as very useful to support the OPS Supervisor in the selection of the most suitable airspace configuration, improving the situational awareness;
- The accuracy of the mixed demand forecast was considered the most adequate to perform the planning of the next ATCOs' shifts in nominal conditions. However, in non-nominal conditions the most appropriate demand source would be the CHMI data;
- In nominal conditions, the optimisation of the airspace configuration supported by a tool and taking into account the number of available human resources allows increasing the number of flights handled by each sector as well as reducing, or, at least, maintaining the number of saturation periods (demand over capacity declared per sector).

The following recommendations are provided:

- The selection of the most appropriate **validation technique** for each validation exercise should be based not only on the v-phase of the maturity level but also on the indicators to be measured;
- The **accuracy of the demand forecast** should be improved in the case of **non-nominal conditions;**
- The following topics should be taken into account to **improve the usability of the supporting tool** for the OPS Supervisor before its industrialization:
  - Inclusion of the occupancy counts;
  - Display of the saturation periods in the proposed airspace configurations, if any;
  - Advisory about the most suitable demand source at the moment of the request;
  - Allowing the modification of the declared capacity.

[1] As stated in P04.07.07 D23 – V3 Validation Plan, this exercise belonged to the OFA 05.02.01 'Complexity Assessment and Resolution' which was integrated into OFA 05.03.04 'Enhanced ATFCM Processes' according to the last OFA structure approved by SJU [6].

1 Introduction

1.1 Purpose of the document

This document provides the Validation Report for **EXE-04.07.07-VP-006** executed by AENA within the P04.07.07 'Implementation of Dynamic Capacity Management in a High Density Area' which is allocated to Step1 Operational Focus Area (OFA) **05.03.04 'Enhanced ATFCM Processes'**[2]. It describes the results of validation exercise defined in P04.07.07 D23 – V3 Validation Plan [10] and how it has been conducted.

This exercise was conducted by AENA in October 2012 by means of Shadow-Mode Validation Technique within **Release 2**. Its main objective was to analyse the use of a supporting tool to evaluate the most suitable Area Control Centre (ACC) En-route sector configuration during the day of operations in terms of capacity to match forecast demand for the **V3 phase**.

1.2 Intended readership

Intended audience of the document are:

- Partners within the project P04.07.07 (AENA, NATS, SELEX);
- Projects members of the same OFAs (P04.03, P07.06.05, P04.07.01, P07.03.02, P10.08.01, P13.02.03);
- Project Members of the associated technical project P13.02.03;
- Projects that will collect the results for consolidation tasks (sWPs 04.2 & 07.02, P16.06.0X)

1.3 Structure of the document

The document is structured essentially in two parts. The first part (§2 & 3) is related to the validation context and approach and provides a coherent overview of the exercise that has been performed. The second part (§4) addresses the details of the validation exercise.

1.4 Glossary of terms

Term	Definition
Dynamic Capacity Management	Concept proposed by P04.07.07 to adapt the capacity to the traffic load by grouping and de-grouping sectors and managing the staff resources.
PERSEO tool	Web-based Local Tool where the forecast demand is based on the processing of massive historical data obtained from multiple sources of information or a mix of real traffic data and these historical data. This tool includes an optimization algorithm to provide the most suitable airspace configuration.

[2] As stated in P04.07.07 D23 – V3 Validation Plan, this exercise belonged to the OFA05.02.01 'Complexity Assessment and Resolution' which was integrated into OFA05.03.04 'Enhanced ATFCM Processes' according to the last OFA structure approved by SJU [6].

1.5 Acronyms and Terminology

Term	Definition
ABNA	Airspace Bottlenecks Analyser
ACC	Area Control Centre
ADD	Architecture Definition Document
AMAN	Arrival Manager
ATC	Air Traffic Control
ATCo	Air Traffic Controller
ATFCM	Air Traffic Flow Control Management
ATM	Air Traffic Management
CHMI	Controller Human Machine Interface
CWP	Controller Working Position
DCB	Demand Capacity Balancing
DCM	Dynamic Capacity Management
DMEAN	Dynamic Management of the European Airspace Network
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
E-OCVM	European Operational Concept Validation Methodology
EXE	Exercise
FAB	Functional Airspace Block
FMP	Flow Management Position
FOC	Final Operating Capability
FP	Flight Plan
GIPV	Flight Plans Integrated Manager
GSI	Recording Subsystem
GTA	Air Traffic Generator
HMI	Human Machine Interface

Term	Definition
IBP	Industrial Based Platform
IFR	Instrument Flight Rules
IRCO	Operational Configuration Quality Indicator
IRS	Interface Requirements Specification
INTEROP	Interoperability Requirements
IOC	Initial Operating Capability
KPA	Key Performance Area
KPI	Key Performance Indicator
NAT	North Atlantic
OI	Operational Improvement
OFA	Operational Focus Areas
OPS	Operations/Operational
OSED	Operational Service and Environment Definition
PERSEO	Sector Configuration Optimization Platform
PIVL	Local Flight Information Position
PSI	Control and Monitoring Position
PSSO	Operational Room Supervisor Position
RBT	Reference Business Trajectory
SACTA	Spanish ATM System
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
STAM	Short-Term ATFCM Measures
SUT	System Under Test

Term	Definition
TAD	Technical Architecture Description
TLPV	Flight Data Processing Subsystem
TMA	Terminal Control
TS	Technical Specification
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VP	Verification Plan
VR	Verification Report
VS	Verification Strategy

2 Context of the Validation

Unused latent capacity can occur in all Flow Management Positions during peak traffic times every day. Currently, the tools to assist the FMPs have improved detection of the overload but do not offer better options to deal with it. The solution proposed by the P04.07.07 to resolve this problem is to adapt the capacity to the traffic load by grouping and de-grouping sectors and managing the staff resources using supporting tools.

In this context, the main objective of the **EXE-04.07.07-VP-006** is to validate the use of supporting tools in a high density area to evaluate the most suitable ACC sector configuration during the day of operations in terms of capacity to match forecast demand approximately eight hours before the operation, taking into account:

- the continuous refinement of the planning with the demand data along the planning phases (i.e. weeks, days and hours before the execution) and how the demand evolution has a direct impact on the capacity management;
- the local constraints such as the number of available controllers;
- the "what-if" scenarios designed at local level (e.g. impact in the capacity due to bad weather conditions, change of operational circumstanced in associated airports...).

This exercise has been performed by means of **Shadow-Mode Validation Technique** in the **AENA Barcelona ACC** where the prototype developed by the P13.02.03 has been integrated. It has taken as the starting point the P04.07.07 D20 - Preliminary OSED [8] and D22 - Preliminary SPR [9] where the operational procedures and scenarios were defined.

Finally, it is important to note that the P04.07.07 was initially allocated to the **OFA 05.02.01 "Complexity Assessment and Resolution"** that has been integrated into **OFA 05.03.04 "Enhanced ATFCM Processes"**. However, the sWP04.02 and 07.02, which are the coordinating federating projects of these OFAs respectively, have not updated their Step1 Validation Strategies to reflect this change yet. Therefore, this exercise is based on the guidelines provided by sWP04.02 D59 – Step1 Validation Strategy [11] instead of sWP07.02 one.

2.1 Concept Overview

The following table summarizes the main details of the exercise under the scope of this Validation Report.

Validation Exercise ID and Title	EXE-04.07.07-VP-006: Implementation of Dynamic Capacity Management in a high density area
Leading organization	AENA
Validation exercise objectives	***OBJ-04.07.07-VALP-0006.0001:*** To validate the operational applicability of the supporting tools functionalities for the OPS Supervisor, from the operational and technical point of view, in order to balance the demand and capacity optimising the use of the human resources. ***OBJ-04.07.07-VALP-0006.0002:*** To identify the appropriate demand sources (real time data, historical data or mixed data) and the quality of the information at each planning phase to improve the optimisation of the sector configurations and, as a consequence, the planning. ***OBJ-04.07.07-VALP-0006.0003:*** To provide evidence on the improvement in the capacity and the Quality of Service due to the selection of the most suitable sector configuration in terms of traffic load and sector load balance. ***OBJ-04.07.07-VALP-0006.0004:*** To provide evidence on the improvement in the situational awareness and, thus in safety, due to the

Validation Exercise ID and Title	EXE-04.07.07-VP-006: Implementation of Dynamic Capacity Management in a high density area
	use of 'what-if' capabilities to check different sector configurations. ***OBJ-04.07.07-VALP-0006.0005:*** To demonstrate that the supporting tool is acceptable for deployment from a business perspective.
Rationale	**Pre-operationally validation (v3 phase)** of operational applicability of the supporting tools functionalities for the Operations (OPS) Supervisor, in order to balance the demand and capacity optimising the use of the human resources.
Supporting DOD / Operational Scenario / Use Case	N/A. The Operational Scenarios described within the sWP04.02 DoD [12] only concern the execution phase of the flight.
OFA addressed	***OFA 05.03.04:*** 'Enhanced ATFCM Processes'
OI steps addressed	***CM-0102-A:*** 'Automated Support for Dynamic Sectorisation and Dynamic Constraint Management'.
Enablers addressed	***ER APP ATC 15:*** Flight Data Processing: support for Dynamic Sectorisation and Dynamic Constraint Management. ***PRO-220a:*** ATC Procedures related to Detection and Resolution of Complexity, Density and Traffic Flow Problems.
Applicable Operational Context	En-Route
Expected results per KPA	***Safety:*** increase safety levels due to early management of the constraints. ***Capacity:*** increase capacity due to better use of available resources, both human and airspace. ***Efficiency:*** improvement of efficiency by reducing delays and adjusting ATC sectors to traffic flows ***Cost-Effectiveness:*** improvement of cost-effectiveness due to better usage of available resources adapting them to demand forecast in advance.
Validation Technique	This exercise has been performed by AENA in the operational environment at the Barcelona Air Traffic Control Centre (ACC) by means of the **shadow-mode validation technique**.
Dependent Validation Exercises	N/A

Table 1: Concept Overview

2.2 Summary of Validation Exercise/s

2.2.1 Summary of Expected Exercise/s outcomes

Table 2 describes the Operational Improvement Step (OIs) and the Key Performance Areas (KPAs) that have been addressed by the EXE-04.07.07-VP-006 and summarises the expectations per stakeholder group from this validation exercise.

Priority Business Need	Operational Sub-Package	Operational Focus Area (OFA)	OI Step	Affected KPAs in the exercise	Stakeholders	Validation Expectations
Network Collaborative Management and Dynamic Capacity Balancing	Demand and Capacity Balancing En-Route	OFA 05.03.04: Enhanced ATFCM Processes	CM-0102-A: Automated Support for Dynamic Sectorisation and Dynamic Constraint Management	Safety Capacity Efficiency Cost-Effectiveness	ANSP	To have evidence of safety improvement due to early management of constraints. This allows a pre-deconfliction and more effective application of separation provision. To have evidence of cost-effectiveness improvement due to better use of available resources, both human and airspace. To have evidence of capacity increase due to better usage of available resources which are adapted to demand in advance. To have evidence of the efficiency increase by reducing delays.
					Airspace Users	To have evidence of efficiency improvement (more optimal flight profiles) through adjusting ATC sectors to traffic flows.
					Ground Industry	To obtain a clear and unambiguous set of operational requirements, ensuring that the concept is technologically feasible.
					SESAR JU	To obtain evidence to support decision making of whether the SESAR concept will be able to achieve the assigned objectives.

Table 2: EXE-04.07.07-VP-006 OIs, KPAs and Validation Expectations

2.2.2 Benefit mechanisms investigated

The following table summarize the benefit mechanisms (BMs) identified for the concept aspects that have been addressed by this exercise. More details about them can be found in the §3.5 and Appendix F of the P04.07.07 D23 – V3 Validation Plan [10].

KPA	Benefit Mechanisms
Safety	The assessment of the optimum sector configurations adapted to the forecast demand based on predefined scenarios will enable an increase in the controllers' situational awareness and thus increase Safety (+). In addition, the optimisation of sector configurations will contribute to the improvement of safety by avoiding or, at least, minimising controllers' overload.
Security	No direct benefit mechanism has been identified for the Security KPA.
Environmental Sustainability	No direct benefit mechanism has been identified for the Environmental Sustainability KPA.
Cost Effectiveness	The optimisation of sector configurations to adapt the capacity to the traffic load taking into account the available number of human resources will lead to an optimisation of Human Resources Allocation thus enabling an improvement in cost-effectiveness (+).
Capacity	The optimisation of the sector configurations usage will avoid unused latent capacity, thus potentially releasing Capacity (++) and/or enabling available capacity to be used more effectively, to avoid or, at least, minimise controllers' overload.
Efficiency	The adaptation of the capacity to the forecast traffic load will allow balancing the demand and capacity and thus reducing the regulations (+).
Flexibility	No direct benefit mechanism has been identified for the Flexibility KPA.
Predictability	No direct benefit mechanism has been identified for the Predictability KPA.
Access & Equity	No direct benefit mechanism has been identified for the Access & Equity KPA.
Participation	No direct benefit mechanism has been identified for the Participation KPA.
Interoperability	No direct benefit mechanism has been identified for the Interoperability KPA.

Table 3: Benefit Mechanisms

The following figure shows the BMs diagram that was developed according to the P16.06.06 Guidelines for Producing Benefit and Impact Mechanisms [7].

Feature Description (OIs CM-0102-A): Optimisation of sector configurations by means of supporting tools for OPS Supervisor to adapt the capacity to the traffic load by grouping and de-grouping sectors and managing the staff resources.

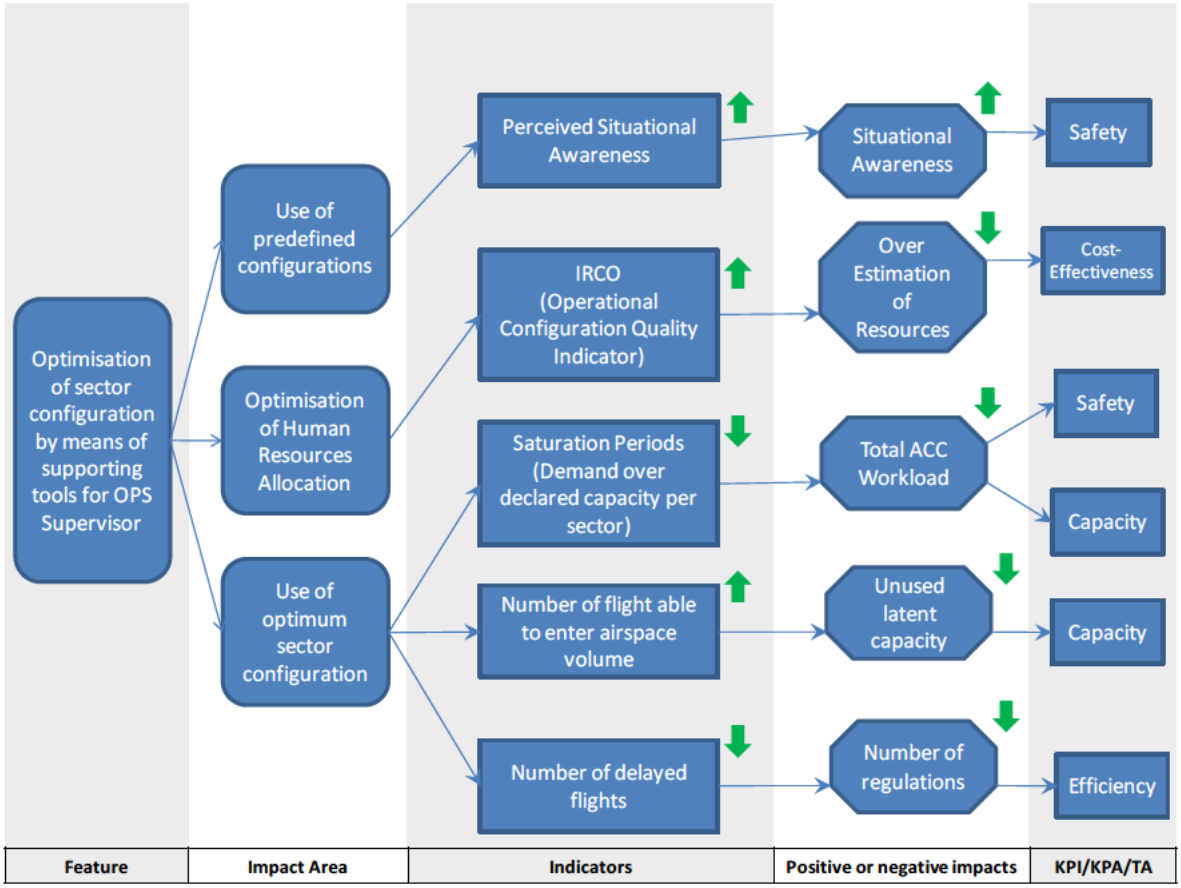

Figure 1: Benefit Mechanisms

2.2.3 Summary of Validation Objectives and success criteria

This section gathers the validation objectives that have been covered by this exercise, including their traceability to ATM and V&V SUT requirements and high level objectives defined by sWP04.02 D59 – Validation Strategy for Concept Step1 [11].

Identifier	OBJ-04.07.07-VALP-0006.0001
Objective	To validate the operational applicability of the supporting tools functionalities for the OPS Supervisor, from the operational and technical point of view, in order to balance the demand and capacity optimising the use of the human resources.

Identifier	Success Criterion
CRT-04.07.07-VALP-0006.0101	A qualitative assessment demonstrates that the functionalities of the OPS Supervisor supporting tool are accepted by them.

Identifier	OBJ-04.07.07-VALP-0006.0002
Objective	To identify the appropriate demand sources (real time data, historical data or mixed data) and the quality of the information at each time of the planning phase to improve the optimisation of the sector configurations and, as a consequence, the planning.

Identifier	Success Criterion
CRT-04.07.07-VALP-0006.0201	The most appropriate demand source at each time of the planning phase (from eight to two hours before the operations) is identified and accepted by

	the OPS Supervisor.

Identifier	OBJ-04.07.07-VALP-0006.0003
Objective	To provide evidence on the improvement in the capacity and the Quality of Service due to the selection of the most suitable configuration in terms of traffic load and sector load balance.

Identifier	Success Criterion
CRT-04.07.07-VALP-0006.0301	Reduction in the Saturation Periods (10%).
CRT-04.07.07-VALP-0006.0302	Increase in the number of flights able to enter airspace volume (10%).
CRT-04.07.07-VALP-0006.0303	Reduction in the number of delayed flights (5%).

Identifier	OBJ-04.07.07-VALP-0006.0004
Objective	To provide evidence on the improvement in the situational awareness, and, thus, in safety, due to the use of 'what-if' capabilities to check different sector configurations.

Identifier	Success Criterion
CRT-04.07.07-VALP-0006.0401	Situational Awareness is improved.

Within the P04.07.07 D23 – V3 Validation Plan [10], an additional validation objective was identified to be covered by this validation exercise, i.e. the elaboration of a Cost-Benefit Analysis (OBJ-04.07.07-VALP-0006.0005). This analysis is on-going and will be included in an isolated deliverable, P04.07.07 – D27 Cost Benefit Analysis, expected to be delivered at the end of February 2013.

2.2.3.1 Choice of metrics and indicators

The table below shows the metrics and indicators selected to be covered by EXE-04.07.07-VP-006 taking as a reference the B4.1 D12 "Initial Baseline Performance Framework" [13].

KPA	Area	Metrics/Indicators	Related Validation Objectives/Hypothesis
Safety	ATM-related Safety Outcome	Perceived Situational Awareness	OBJ-04.07.07-VALP-0006.0004 (↑)
Capacity	Local Airspace Capacity	Saturation Periods (Demand over declared capacity per sector)	OBJ-04.07.07-VALP-0006.0003 (↓)
		Number of flights able to enter airspace volume	OBJ-04.07.07-VALP-0006.0003 (↑)
QoS (Efficiency)	Departure Punctuality	Number of delayed flights	OBJ-04.07.07-VALP-0006.0003 (↓)
Cost Effectiveness	ATM Cost Effectiveness	IRCO (Operational Configuration Quality Indicator)	OBJ-04.07.07-VALP-0006.0002 (↑) OBJ-04.07.07-VALP-0006.0005 (≈ or ↑)

Table 4: Metrics and indicators for EXE-04.07.07-VP-006

The **Operational Configuration Quality Indicator (IRCO)** currently used by AENA assesses the percentage of similarity between the configuration applied in the Operational Room and the optimum

one, taking into account only the number of sectors. The Optimum Configuration would be that which could be implemented with the minimum number of controllers to handle the traffic in a safe manner. Although this indicator will be used to perform the Cost Benefit Analysis, a preliminary analysis of the IRCO indicator has been included in this document (see §4.1.2).

2.2.4 Summary of Validation Scenarios

The table bellow summarises the validation scenarios related to EXE-04.07.07-VP-006 which were defined in the P04.07.07 D23 – V3 Validation Plan [10], where they are deeply described in §3.7, including their traceability with the validation objectives.

These Validation Scenarios have been focused on the planning of airspace configuration between 8 and 2 hours before the beginning of the Air Traffic Controllers (ATCos) shift, but, the supporting tool was additionally used:

- to monitor in real time the suitability of the selected airspace configuration with the actual traffic;
- to evaluate new airspace configurations at short time due to unexpected events (e.g. storms, unavailability of controllers...).

Validation Scenario	Name	Description
SCN-04.07.07-VALP-0006.0001	OPS Supervisor Day Shift	During the day shift, the OPS Supervisor will be responsible for the Barcelona ACC sector configuration planning for the Air Traffic Controllers (ATCos) afternoon and night shifts and the monitoring of the morning and afternoon ones.
SCN-04.07.07-VALP-0006.0002	OPS Supervisor Night Shift	During the night shift, the OPS Supervisor will be responsible for the Barcelona ACC and TMA sector configuration planning for the ATCos morning shift and the monitoring of the night one.

Table 5: Validation Scenarios Summary

2.2.5 Summary of Assumptions

The table below provides the validation assumptions applicable to the EXE-04.07.07-VP-006.

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-04.07.07-VP006-S1-001	Assessment based on predefined Sector Configurations	Airspace Layout	The assessment of the the most suitable ACC sector configuration is based on the current predefined ACC sector configurations.	N/A	Planning Phase	Safety	04.07.07 OSED	N/A	04.07.07	Medium
ASS-04.07.07-VP006-S1-002	C-HMI Availability	Ground Tools/Technology	The C-HMI is available to compare the information provided by the supporting tools.	N/A	Planning Phase	N/A	04.07.07 VALP	N/A	04.07.07	High
ASS-04.07.07-VP006-S1-003	Exercise Execution under nominal and non-nominal conditions	Environment Constraints and Characteristics	The exercise execution has been performed under the conditions presented during the shadow-mode sessions (nominal conditions and capacity shortfall due to weather conditions).	N/A	Planning Phase	N/A	04.07.07 VALP	N/A	04.07.07	High
ASS-04.07.07-VP006-S1-004	IP1 Operational Improvement Step considered as an assumption		The OI step CM-0101 is considered to be implemented.	N/A	Planning Phase	N/A	ATM Master Plan	N/A	04.07.07	High

Table 6: Validation Assumptions

2.2.6 Choice of methods and techniques

The table below shows the method and techniques used in this validation exercise to obtain the different metric and indicators (further information for the data collection method can be found in §4.1.3.1 of the P04.07.07 D23 – V3 Validation Plan [10]).

Supported Metric / Indicator	Platform / Tool	Method or Technique
Operational applicability of the supporting tools functionalities for the OPS Supervisor.	N/A	Questionnaires Debriefing Sessions Individual Interviews
Situational Awareness	N/A	Questionnaires Debriefing Sessions Individual Interviews
Accuracy of the demand forecast at each time of the planning phase (from eight to two hours in advance)	Data Post-Processing and Analysis Tool (Off-line tool)	Questionnaires Debriefing Sessions Individual Interviews
IRCO	Data Post-Processing and Analysis Tool (Off-line tool)	N/A
Number of Saturation Periods	Data Post-Processing and Analysis Tool (Off-line tool)	N/A
Number of flights able to enter airspace volume	Data Post-Processing and Analysis Tool (Off-line tool)	N/A
Number of delayed flights	Analytical modelling	N/A

Table 7: Methods and Techniques

2.2.7 Validation Exercises List and dependencies

Within the **OFA 05.03.04 "Enhanced ATFCM Processes"**, several projects share the operational complexity assessment to balance demand and capacity. However, no gaps and overlaps are detected since they are covering different planning time horizons and environmental scope (local/network), as it shows in the following figure.

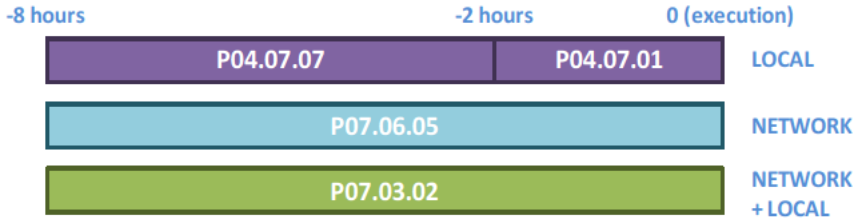

Figure 2: Links to other validation activities

The Enhanced ATFCM Processes should be looked upon as continuum without overlaps. In this context, the Dynamic Capacity Management defined in P04.07.07 should be considered as a part of the Local Network Management function.

In addition, it is important to highlight that although the process should be continuous, complexity indicators must be adapted to the planning horizon due to available accuracy of the traffic demand. From 8 to 2 hours in advance, the accuracy of traffic demand does not seem to be enough to provide exhaustive complexity indicators, but as a first attempt, the complexity could be assessed through the

entries at the sector (EXE-04.07.07-VP-006 framework). From 2 hours before the operations, this initial indicator will be refined with more information and new complexity indicators could be used. These indicators are being developed within the P04.07.01 framework.

3 Conduct of Validation Exercises

3.1 Exercises Preparation

This section summarises the activities undertaken to prepare the execution of the validation exercise according to its design described in the Validation Plan (P04.07.07 D23 – V3 Validation Plan [10]).

The exercise preparation required the involvement of different staff with specific skills and responsibilities. The main activities carried out during the preparation phase are collected in the following table including the staffs/actors in charge of performing them.

Staffs	Actors	Activities
Simulation Staff	Exercise Operational Coordinator	• Manages and monitors all the activities included in the preparation process in order to ensure the execution of the exercise in line with the validation objectives and timeline; • Coordinates the selection of the Operational Staff to guarantee the OPS Supervisors' availability; • Defines a detailed exercise planning; • Coordinates the preparation of the training material and sessions; • Coordinates with the WP03 the development of the IBP.
Simulation Staff	• Experts at the concept under analysis; • Simulation Experts (Shadow-mode validation technique and data analysis).	• Prepare the simulation scenarios; • Prepare the training material; • Define the material needed to collect validation results such as questionnaires and outlines of the individual interviews and debriefing sessions.
Technical Staff	• Platform experts.	• Coordinates with the industry the provision of the prototype and its integration in the IBP according to the project requirements and schedule; • Perform the Technical Tests of the platform.
Operations Staff	• 5 OPS Supervisor with wide experience[3].	• Support the preparation of the simulation scenarios; • Support the definition of how use the supporting tool for OPS Supervisor; • Perform the Operations Tests of the platform.

Table 8: Activities for exercise preparation

The following sections describe in detail the results of the activities undertaken to prepare the validation environment.

3.1.1 Demand Forecast Sources

Different demand sources have been used by the OPS Supervisor supporting tool to evaluate the most suitable sector configuration, in particular:

[3] All of them carry out the role and responsibilities of the OPS Supervisor in the Barcelona ACC and have been selected from a total number of seven.

- **Historical demand**, which is compound of the flown traffic seven days ago (i.e. on the same day of the previous week);

- **Actual demand**, which is compound of the FPs available in real time in the Spanish ATM system;

- **Mixed demand**, which is a combination of the previous ones. It is based on the actual demand enhanced with historical data. This historical data are added according to several parameters defined by means of ad-hoc analysis for the Spanish ATM system.

At the same time, the OPS Supervisor could consult the information available in the CHMI position.

3.1.2 Platform Configuration

The Barcelona ACC IBP used to perform this exercise is based on the Spanish ATM System (SACTA) and is described in detail in the §4.1.1.11 of the P04.07.07 D23 – V3 Validation Plan [10].

P13.02.03 was responsible for developing a prototype according to the operational requirements defined by P04.07.07 (further information in P04.07.07 D20 – Preliminary OSED [8]). This prototype acts as a decision-making tool and allows OPS Supervisor to detect and assess traffic imbalances on the day of operation from eight to two hours in advance.

An optimization algorithm provides the necessary output for the decision-making process to select the most suitable sector configurations throughout the day of operation in order to optimise the number and distribution of human resources by means of two different interfaces:

- A first one (**PIV-L**) where the demand forecast is based on actual traffic data. This interface was installed in a PC inside the Control Room.

  This position is a component of the Spanish ATM system that has been improved to add the optimisation algorithm;

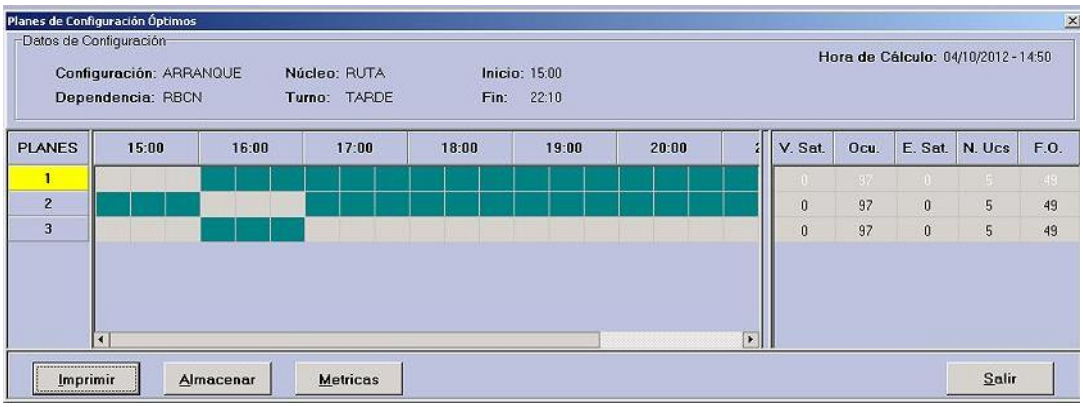

Figure 3: PIV-L Interface

- A second one (**PERSEO**) where the demand forecast is based on actual or historical data and a combination of both. This interface was installed in a PC inside the FMP room close to the CHMI position.

  This position is a web-based Local Tool connected to the Flight Plans Integrated Manager (GIPV) module of the Spanish ATM system that has the same optimisation algorithm included in the PIV-L mentioned above, thereby providing the same solution if the optimization is performed with the actual demand forecast.

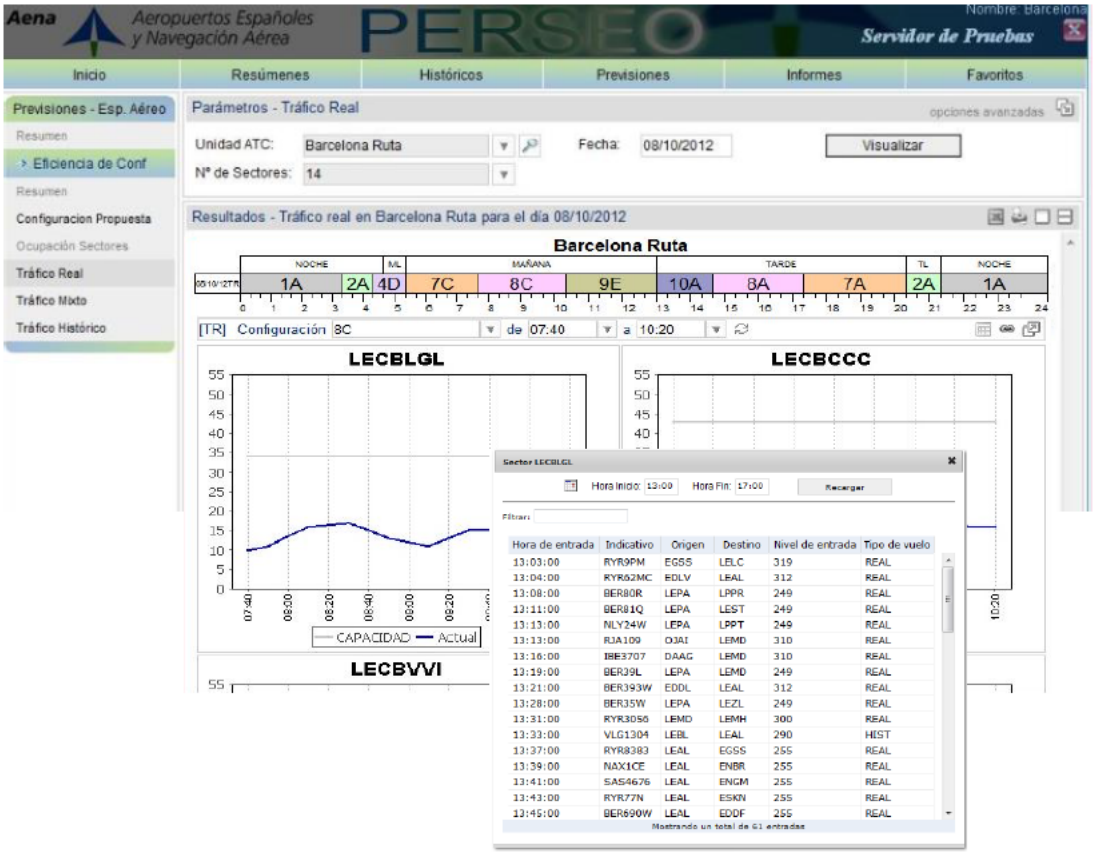

Figure 4: PERSEO Interface

The table below summaries the demand sources of each interface of the prototype and the CHMI position.

	Historical demand	Actual demand	Mixed Demand	CHMI demand
CHMI				✔
PERSEO	✔	✔	✔	
PIV-L		✔		

Table 9: Demand sources vs prototype interfaces and CHMI position

Finally, it is important to note that the optimisation algorithm is only based on traffic load and the capacity of each sector and its main objective is to propose the most suitable airspace configuration with the less number of operative sectors but avoiding their saturation. However, the proposal could include some saturated sector if the maximum number of sectors is constrained by the available human resources (i.e. ATCos) and there is not solution without saturation.

3.1.2.1 Platform for Analytical Modelling Runs

As stated in §4.1.1.5.5 of the Validation Plan (P04.07.07 D23 – V3 Validation Plan [10]), analytical modelling runs were performed to complement the results on the OBJ-04.07.074-VALP-0006.0003.

The platform used to perform these runs combined RAMS and ABNA tools which are well-known and have been used in numerous ATM-related validation programmes and studies carried out by AENA. Next, these tools are briefly described:

- **RAMS** is a comprehensive high-fidelity gate-to-gate ATM/Airport fast-time simulation tool applied in the design, analysis and planning of ATM systems. It simulates traffic from a macro-to-micro level (gate-to-gate movements), where a single scenario can contain as many flights, sectors and airports as needed, from a local to global level, to provide insights into the ATM system being studied.

- **ABNA** (Airspace Bottlenecks Analyser) is a Simulation Engine developed by AENA and based upon WITNESS for analysing gate-to-gate systems (Airports-Airspace). It complements the fast-time simulation tools, in this case RAMS.

3.1.3 Training

The day before beginning of the execution exercise (9th October 2012) was fixed for OPS Supervisor training which included the following modules:

- ATM concepts addressed by the EXE-04.07.07-VP-006;
- Brief description of the exercise, including validation objectives and technique;
- Description of the new functionalities of the supporting tools (PERSEO and PIV-L) and their HMI.

3.2 Exercises Execution

This table summarises the main milestones associated to the execution and results analysis of the EXE-04.07.07-VP-006.

Exercise ID	Exercise Title	Actual Exercise execution start date	Actual Exercise execution end date	Actual Exercise start analysis date	Actual Exercise end date
EXE-04.07.07-VP-006	Implementation of Dynamic Capacity Management in a high density area.	12/10/2012	25/10/2012	26/10/2012	18/12/2012

Table 10: Exercises execution/analysis dates

Table below details the simulation execution schedule followed for the execution phase of the exercise which fulfils the exit criterion ('completion of at least the 90% of the planned simulation runs') defined in §4.1.19 of the P04.07.07.07 D23 – V3 Validation Plan [10].

	09/10/2012	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Planning of Morning Shift			SCN-0006.0001 Session #3		SCN-0006.0001 Session #7	SCN-0006.0001 Session #10	SCN-0006.0001 Session #13
Planning of Afternnon Shift		SCN-0006.0001 Session #1	SCN-0006.0001 Session #4	SCN-0006.0001 Session #5	SCN-0006.0001 Session #8	SCN-0006.0001 Session #11	SCN-0006.0001 Session #14
Planning of Night Shift		SCN-0006.0002 Session #2		SCN-0006.0002 Session #6	SCN-0006.0002 Session #9	SCN-0006.0002 Session #12	

Table 11: Schedule for exercise execution

During all these sessions, several data as demand forecast from each source (i.e. historical, actual and mixed traffic as well as CHMI) and the associated proposal for the most suitable airspace configuration were recorded each hour from eight hours before the beginning of the ATCOs shifts. All this data has been post-processed to measure the indicators described in §2.2.3.1.

Finally, it is important to note that a strike was carried out in the French airspace on 23rd October 2013. The data from this day has been analysed as non-nominal conditions in §4.

3.3 Deviations from the planned activities

3.3.1 Deviations with respect to the Validation Strategy

According to the last allocation of projects to OFAs, the P04.07.07 belongs to OFA 05.03.04 "Enhanced ATFCM Processes" whose coordinating federating project is sWP07.02. However, the Validation Strategy for Step1 from sWP07.02 has not been updated yet to reflect this change and, therefore, both Validation Plan and Report documents for EXE-04.07.07-VP-006 follow the guidelines provided by sWP04.02 within its Validation Strategy for Step1 [11].

In particular, this exercise has covered partially one High Level Validation Objective defined by sWP04.02 within the VALS:

- **OBJ-04.02-VALS-0001.0190:** To validate the performances and benefits provided by the implementation of a Dynamic Capacity Management in high density area. To demonstrate in particular that the concept dealing with enhanced complexity assessment and detection contributes at OFA level to the following targets:
    - The increase in airspace capacity by at least 1.20%;
    - The reduction of ANS cost per flight by at least 0.63%;
    - The reduction of fuel burn per flight by at least 0.11%, and;
    - The reduction in variability of the deviation between the actual flown i4D trajectory and the RBT by at least 0.05%

  compared to IP1 baseline.

In this context, as stated in §2.1 of P04.07.07 D23 – V3 Validation Plan [10], complexity indicators must be adapted to the planning time horizon due to the available accuracy of the traffic demand forecast. From 8 to 2 hours in advance (EXE-04.07.07-VP-006 framework), the accuracy of traffic demand forecast doesn't seem to be enough to provide exhaustive complexity indicators, but as a first attempt, the complexity could be assessed through the '*Hourly Entry Rate*'. From 2 hours before the operations (P04.07.01 framework), this initial indicator should be refined and new complexity ones could be used. Then, to guarantee that this High Level Validation Objective has been covered fully, additional activities in P04.07.01 should be taken into account.

3.3.2 Deviations with respect to the Validation Plan

There were no deviations with respect to the P04.07.07 D23 – V3 Validation Plan [10].

However, it should be noted that during the Release2 Review#2, one issue related to this exercise was maintained with severity 2: "Incomplete VALP – The exercise, as a shadow mode trial, does not actually – consider non-nominal situations and does not address the security KPA". Next the final status of this issue is described:

- As stated in §3.2, during the exercise execution a strike was carried out in the French airspace and therefore, non-nominal situations has been analysed in §4;

- The Security KPA has not been addressed because the introduction of the supporting tool for OPS Supervisor covered by this exercise doesn't lead any change on the operational procedures. They could perform their tasks without restrictions if the new supporting tool didn't work properly.

4 Exercises Results

4.1 Summary of Exercises Results

The following table summarises the results from the EXE-04.07.07-VP-006 and their link with the success criteria associated to each Validation Objective:

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results
EXE-04.07.07-VP-006	OBJ-04.07.07-VALP-0006.0001	Validation of supporting tools functionalities	CRT-04.07.07-VALP-0006.0101	A qualitative assessment demonstrates that the functionalities of the OPS Supervisor Supporting tool are accepted by them.	The usability of the OPS Supervisor supporting tool was highlighted by all participants and the information provided by it was considered as very useful.
	OBJ-04.07.07-VALP-0006.0002	Identification of the most appropriate source	CRT-04.07.07-VALP-0006.0201	The most appropriate demand source at each time of the planning phase (from eight to two hours before the operations) is identified and accepted by OPS Supervisor.	To plan the ATCos morning and afternoon shifts, the most appropriate demand source is the mixed one from eight to four hours before the operations. At this time, all demand sources including CHMI converge. To plan the ATCos night shift, the most appropriate demand source is the historical one. These results were confirmed by the OPS Supervisors during the debriefing sessions.
	OBJ-04.07.07-VALP-0006.0003	Capacity and Quality of Service Improvement	CRT-04.07.07-VALP-0006.0301	Reduction in the Saturation Periods (10%).	In the case of the proposed airspace configurations with mixed and historical demand, the number of saturation periods is reduced in the ATCos' morning and night shifts or, at least, maintained in the afternoon one.
			CRT-04.07.07-VALP-0006.0302	Increase in the number of flights able to enter airspace volume (10%).	This increase of 10% has been confirmed with the results for mixed and historical demand.
			CRT-04.07.07-VALP-0006.0303	Reduction in the number of delayed flights (5%).	During the ATCOs' afternoon shift, the number of delayed flights is reduced. However during the

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results
					ATCos' morning shift, it's increased, but, the average delay per flights is within admissible values (less than one minutes) and the number of sectors is reduced. This indicator has been measured by means of analytical modelling runs.
	OBJ-04.07.07-VALP-0006.0004	Situational Awareness improvement	CRT-04.07.07-VALP-0006.0004	Situational Awareness is improved.	The use of the what-if functionality allowed identifying airspace configurations without saturation periods and avoiding the controllers' overload, at least, at early planning. The use of predefined airspace configurations known by OPS Supervisor made easier this selection.

Table 12: Summary of Validation Exercises Results

4.1.1 Results on concept clarification

4.1.1.1 Acceptability of the Supporting Tools Functionalities

The prototype developed to perform this exercise included two different positions, PIV-L and PERSEO as stated in §3.1.2, with the following functionalities:

- Selection of parameters such as demand forecast source, day and maximum number of sectors taking into account the available human resources;
- Proposal of the most suitable sector configuration (one per each demand forecast source);
- Display of the traffic load for each sector of the proposed sector configuration (only available in the PERSEO position);
- Display of the flights entering a selected sector of the proposed sector configuration ;
- What-if functionalities: the two previous data can be displayed related to alternative sector configurations to the proposed one as well as other time intervals (only available in the PERSEO position);
- Comparison of all information between two different demand forecast sources (only available in the PERSEO position).

The OPS Supervisor feedback about these functionalities as well as the presentation and utility of the information were gathered by means of the questionnaires and discussed during the debriefing sessions, obtaining very positive results (see Appendix B).

Finally, all five of the OPS Supervisors involved in the exercise execution stated that the usability, reliability and precision of the prototype used as a supporting tool are adequate to deploy it with full operational capability in any ACC. However, some minor improvements were recommended to enhance this supporting tool before its industrialization (e.g. the inclusion of occupancy counts: further information can be found in §5.2).

4.1.1.2 Identification of the most appropriate demand source

One of the most important aspects to ensure an adequate optimization of sector configuration is the accuracy of the demand forecast. Therefore, a validation objective (OBJ-04.07.07-VALP-0006.0002) was defined to identify the most appropriate demand source at each time of the planning phase (from eight to two hours before the operations). To perform this analysis all the data of the demand forecast recorded during the exercise execution (see §3.2) have been compared with the actual flown traffic.

Figures below show the results obtained in the analysis of the demand forecast available from eight hours to the beginning of each ATCos' shift.

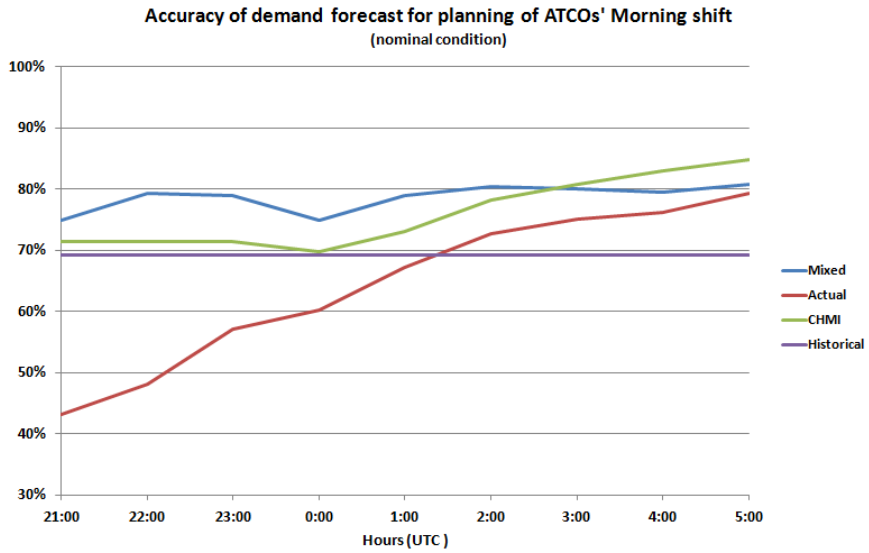

Figure 5: Demand forecast accuracy for the ATCos' morning shift (nominal conditions)

The planning of the airspace configuration for the ATCos' morning shift is performed between 21:00 and 00:00 UTC depending on the OPS Supervisor preferences. During all this period, the most suitable demand forecast source is the mixed demand described in §3.1.1. This situation is approximately maintained until two hours before the beginning of the shift when the CHMI data provides a more reliable demand forecast thanks to the availability of the Flight Plans (FPs) updates for those flights in the beginning of the shift that are already flown within the ECAC area (the prototype only receives the updates within the Spanish airspace).

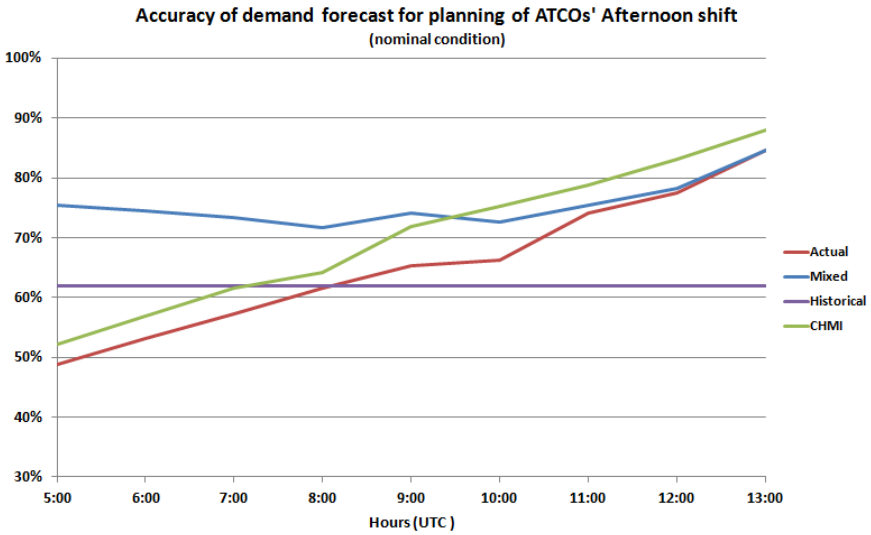

Figure 6: Demand forecast accuracy for the ATCos' afternoon shift (nominal conditions)

The planning of the airspace configuration for the ATCos' afternoon shift is performed between 08:30 and 09:00 UTC and, at this time, the most suitable demand forecast source is again the mixed demand. However, in the case of the afternoon shift, the slight improvement of the CHMI data occurs before, around three hours and a half before the beginning of the shift. This can be explained because during the afternoon shift there are more long haul flights flown within the ECAC area which is within the demand forecast at the beginning of the shift.

Moreover, it is important to note that the historical data is reliable during all the analysed period to plan the airspace configuration for both the ATCOs' morning (69%) and afternoon (62%) shifts. In both cases, the actual data are not enough reliable until approximately four hours before the beginning of the shift.

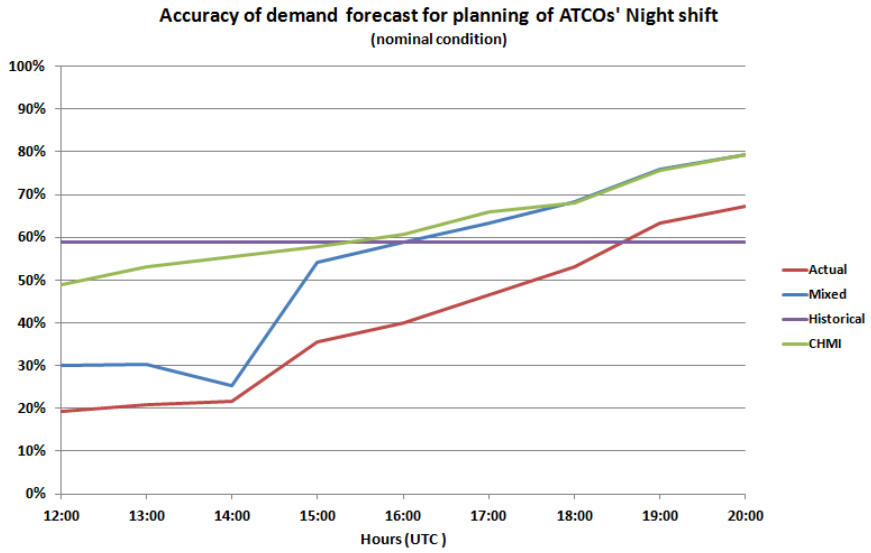

Figure 7: Demand forecast accuracy for the ATCos' night shift (nominal conditions)[4]

The planning of the airspace configuration for the ATCos' night shift is performed close to the beginning of the shift, around two hours in advance (18:00 UTC), given that during the night the traffic level decreases significantly and the airspace configuration always follows the same pattern unless

[4] It is important to note that all previous figures are an average of the data recorded in nominal conditions.

unexpected events occur. At this time, the most suitable demand forecast source is the mixed demand or CHMI data given that both sources provide the same accuracy.

The graph above shows a low reliability of the mixed and actual data at the beginning of the analysis period (around 30% and 20% respectively). This situation can be due to the late upload of the FPs of the night shift.

As stated in §3.2, on 23rd October 2012 there was a strike in the French airspace which had a great impact in the operations of the Barcelona ACC. The following figures show the results of the demand forecast analysis of this day.

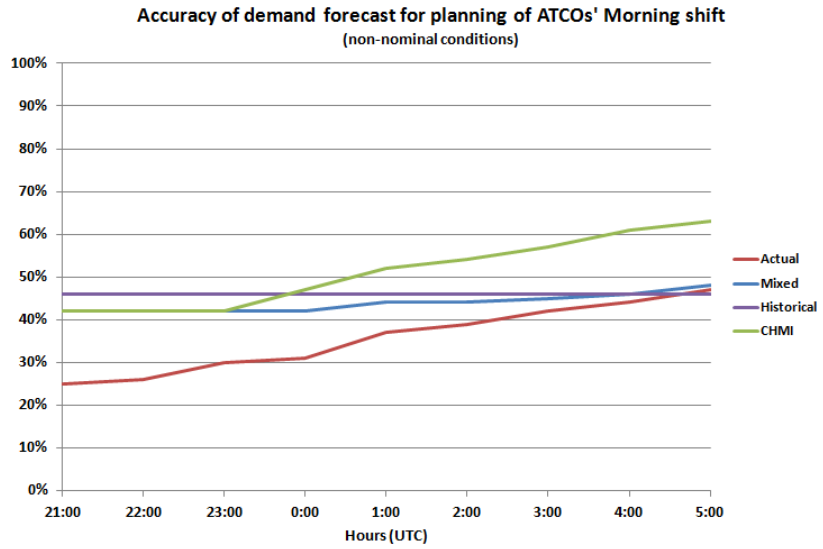

Figure 8: Demand forecast accuracy for the ATCos' morning shift (non-nominal conditions)

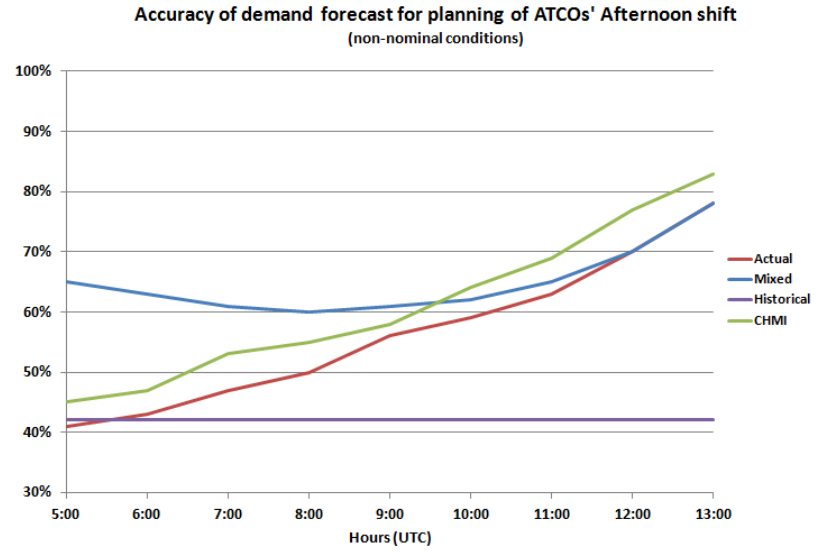

Figure 9: Demand forecast accuracy for the ATCos' afternoon shift (non-nominal conditions)

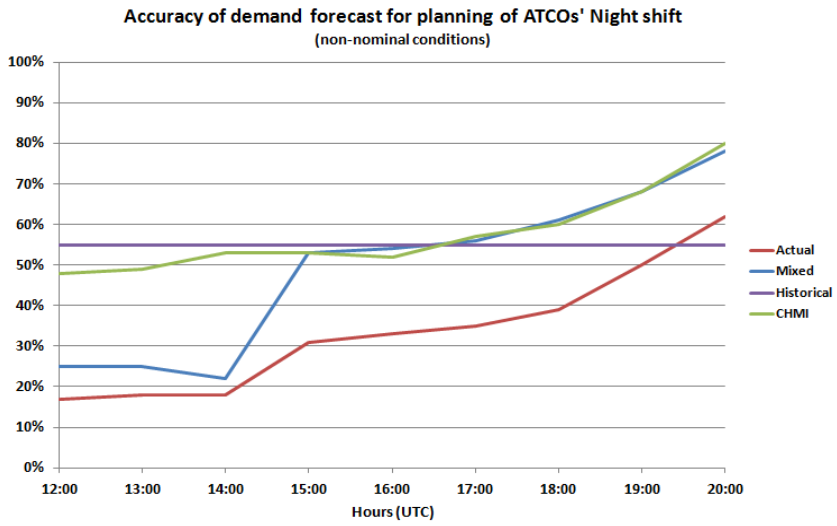

Figure 10: Demand forecast accuracy for the ATCOs' night shift (non-nominal conditions)

As it was expected the accuracy of the demand forecast in non-nominal conditions is lower than in nominal one for all the demand sources, including the CHMI, although the improvement of this data at the end of the analysed period with respect to the mixed demand[5] is higher due to the effect of the FPs updates for all ECAC area. Therefore, it should be noted that the most suitable demand source in non-nominal conditions when the planning of the airspace configuration is performed is the CHMI data.

4.1.2 Results per KPA

4.1.2.1 Safety

Perceived Situational Awareness:

According to the OPS Supervisors' feedback obtained by means of the questionnaires and during the debriefing sessions, it can be stated that the use of the supporting tool (in particular, the what-if functionality) provides a better situational awareness to plan the airspace configuration, avoiding demand and capacity imbalances in advance and subsequent situations in the execution phase that could lead to safety issues.

4.1.2.2 Capacity

Saturation Periods and Number of flights able to enter airspace volume:

A post-processing of the data recorded during the exercise execution has been carried out to obtain these indicators which have been analysed jointly due to the relationships between them.

It is important to note that this analysis have been performed with the actual flown traffic for the airspace configurations proposed by the supporting tool or planned based on the CHMI data at the time of the planning. These airspace configurations are shown in the tables below. Moreover, the saturation periods (20 minutes) and the number of flights able to enter airspace volume indicators are presented in the figures below as an average of the available sessions per ATCOs' shift.

On the other hand, the actual demand forecast source has been disregarded in this analysis because at the planning time its accuracy is insufficient, as can be observed in §4.1.1.2, and all the participants

[5] Due to the low number of flights during the night shift, in this case this difference is not significant.

in the validation avoided its use. In addition, the number of available FPs was low and so the airspace configurations proposed by the supporting tool with this source were always non-realistic and led to excessive saturation periods due to their low number of sectors.

Next the results obtained during the post-processing of the recorded data are presented.

		5:20	5:40	6:00	6:20	6:40	7:00	7:20	7:40	8:00	8:20	8:40	9:00	9:20	9:40	10:00	10:20	10:40	11:00	11:20	11:40	12:00	12:20	12:40
Mix	day 1	9G										10A					9E							
	day 2	7A							9D														9A	
	day 3	8K										10A					8I							
Historical	day 1	8B											9D				10C							
	day 2	7A										8C							8D					
	day 3	6D					8A								8I									
CHMI	day 1	11A																						
	day 2	9D																						
	day 3	10A																						

Figure 11: Proposed Airspace Configurations for the ATCos' Morning Shift

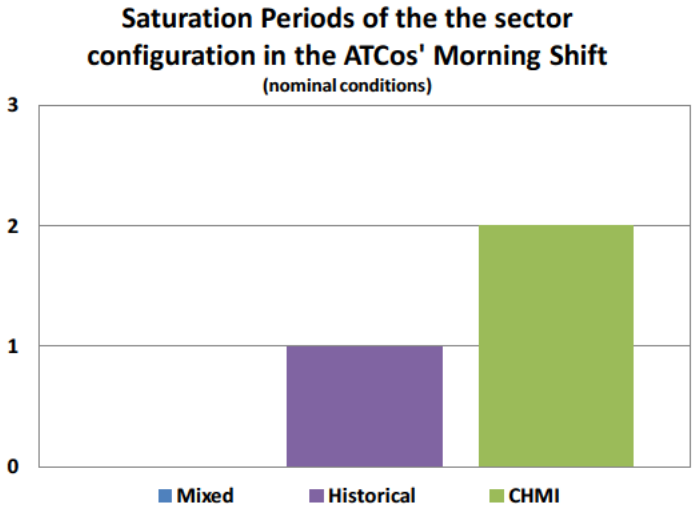

Figure 12: Number of saturation periods in the ATCos' Morning Shift (nominal conditions)

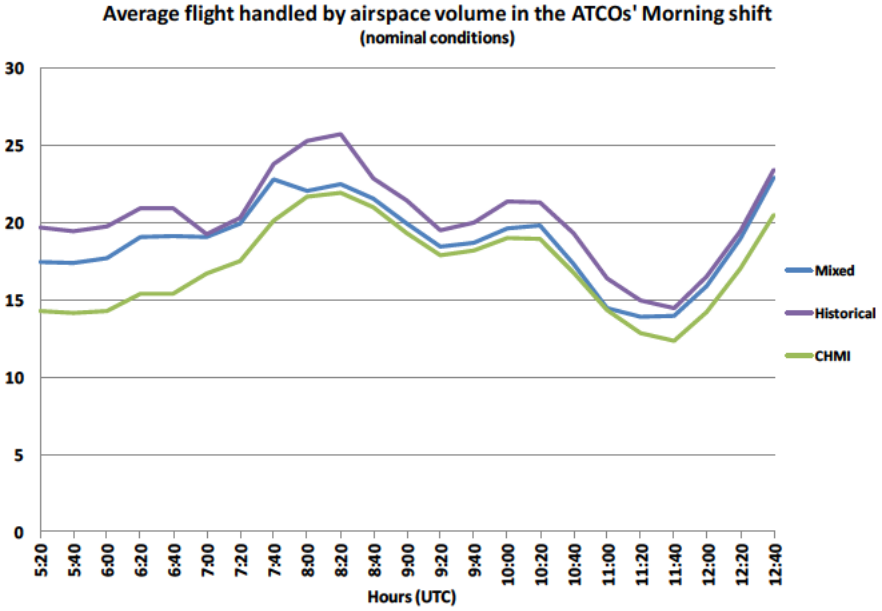

Figure 13: Number of flights able to enter airspace volume in the ATCos' Morning Shift (nominal conditions)

		13:00	13:20	13:40	14:00	14:20	14:40	15:00	15:20	15:40	16:00	16:20	16:40	17:00	17:20	17:40	18:00	18:20	18:40	19:00	19:20	19:40	20:00	20:20
Mix	day 1	5C									7A								5E					
	day 2	6C				5F					7D													
	day 3	6C											6G				6C							
	day 4	7H			6A						6C													
	day 5	5E									7D								5C					
Historical	day 1	6C									7A				5C									
	day 2	7A														5H			4B					
	day 3	8D						7H											5C					
	day 4	8D							6B										7A					
	day 5	7A								5B					6C									
CHMI	day 1	8D																						
	day 2	7A																						
	day 3	8D																						
	day 4	7A																						
	day 5	7A																						

Figure 14: Proposed Airspace Configurations for the ATCos' Afternoon Shifts

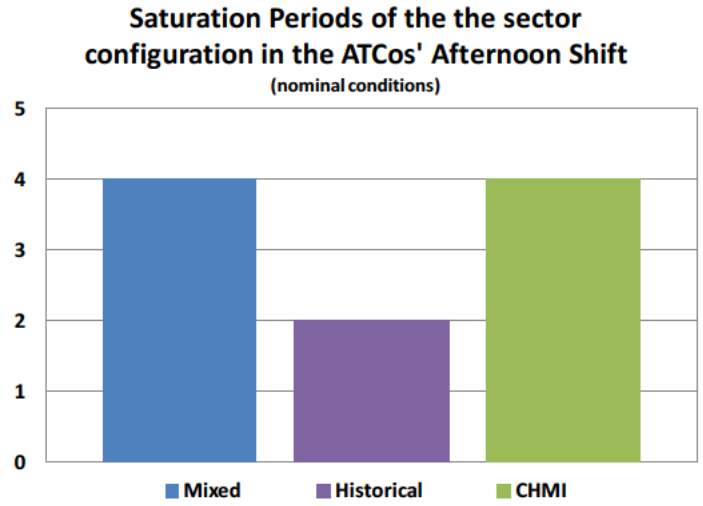

Figure 15: Number of saturation periods in the ATCos' Afternoon Shift (nominal conditions)

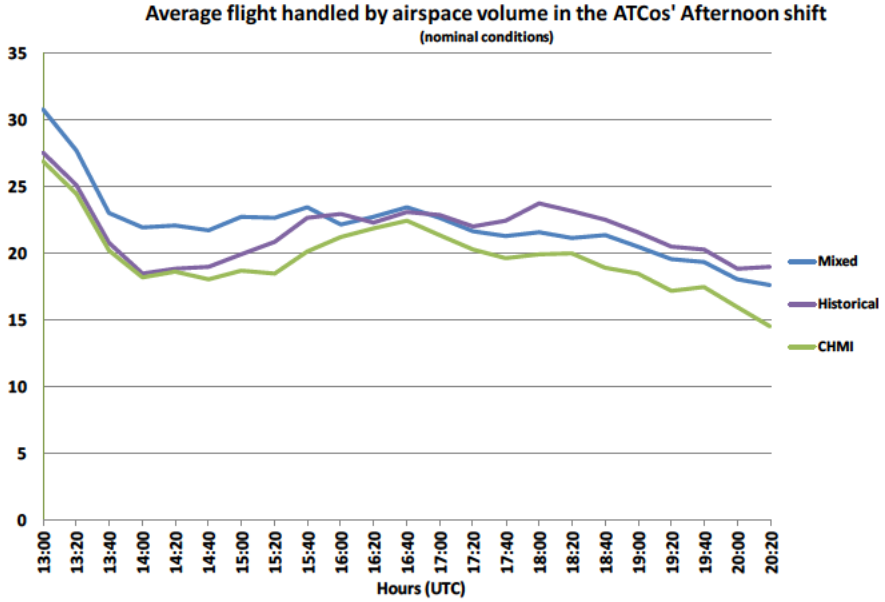

Figure 16: Number of flights able to enter airspace volume in the ATCos' Afternoon Shift (nominal conditions)

		20:20	20:40	21:00	21:20	21:40	22:00	22:20	22:40	23:00	23:20	23:40	0:00	0:20	0:40	1:00	1:20	1:40	2:00	2:20	2:40	3:00	3:20	3:40	4:00	4:20	4:40	5:00	5:20
Mix	day 1	3A			1A									1A									2A			5G			
	day 2	3A			1A									1A									2A			5G			
	day 3	3A			1A									1A									2A			5G			
Historical	day 1	2A			1A									1A									2A			4C			
	day 2	3A			1A									1A									2A			4B			
	day 3	3A			1A									1A									2A			4C			
CHMI	day 1	3A												4B														5F	
	day 2	4B			3A									3A														4B	
	day 3	4B			3A									3A														5F	

Figure 17: Proposed Airspace Configurations for the ATCos' Night Shifts

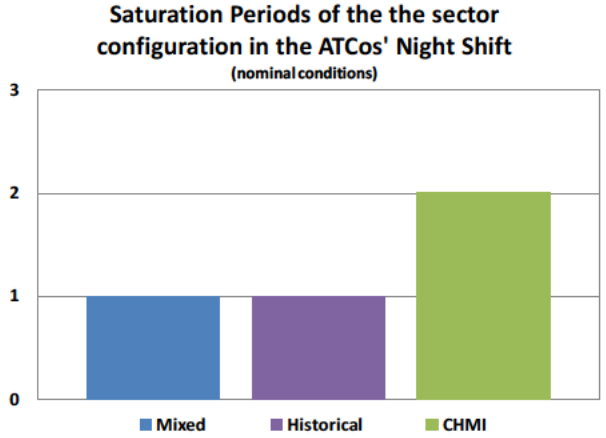

Figure 18: Number of saturation periods in the ATCos' Night Shift (nominal conditions)

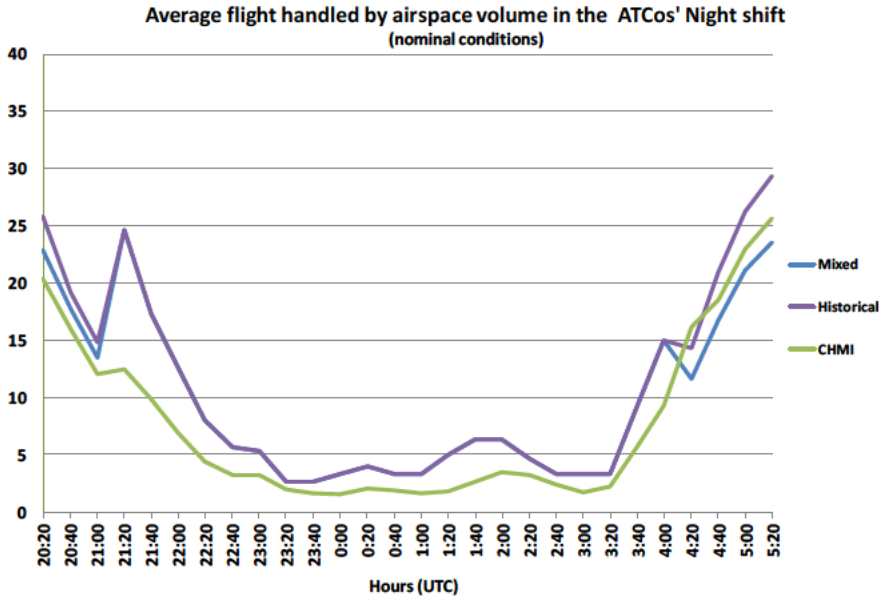

Figure 19: Number of flights able to enter airspace volume in the ATCos' Night Shift (nominal conditions)

In nominal conditions, the optimisation of the airspace configuration by means of a supporting tool and taking into account the number of available human resources allows increasing the number of flights handled by each sector as well as reducing, or, at least, maintaining the number of saturation periods (demand over capacity declared per sector).[6]

[6] It is important to note that all previous figures are an average of the data recorded in nominal conditions.

In particular, in the ATCos' afternoon shift, the number of saturation periods for the proposed airspace configurations with the actual demand forecast is the same as the planned ones with the CHMI data. This situation can be justified because in the planning time (around 09:00 UTC), the accuracy of both demand sources is very similar as can be observed in §4.1.1.2.

Figures below show the results associated to the 23rd October (non-nominal conditions).

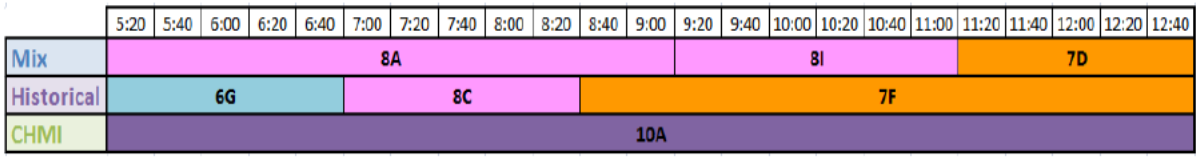

Figure 20: Proposed Airspace Configurations for the ATCos' Morning Shift

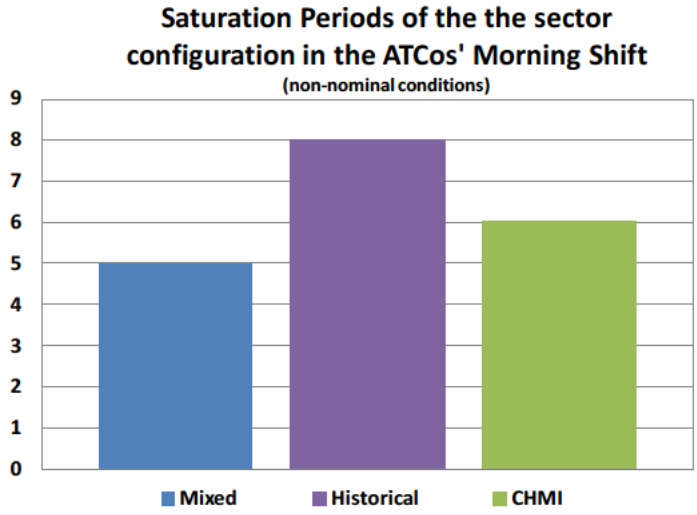

Figure 21: Number of saturation periods in the ATCos' Morning Shift (non-nominal conditions)

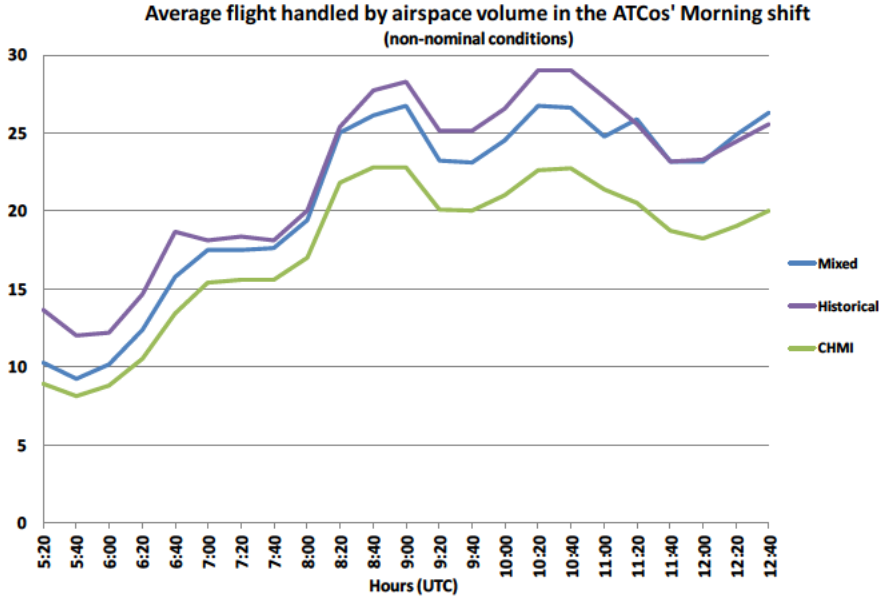

Figure 22: Number of flights able to enter airspace volume in the ATCos' Morning Shift (non-nominal conditions)

	13:00	13:20	13:40	14:00	14:20	14:40	15:00	15:20	15:40	16:00	16:20	16:40	17:00	17:20	17:40	18:00	18:20	18:40	19:00	19:20	19:40	20:00	20:20
Mix	5C										7A		5E										
Historical	6C			6B			6C																
CHMI	7A						6C																

Figure 23: Proposed Airspace Configurations for the ATCos' Afternoon Shift

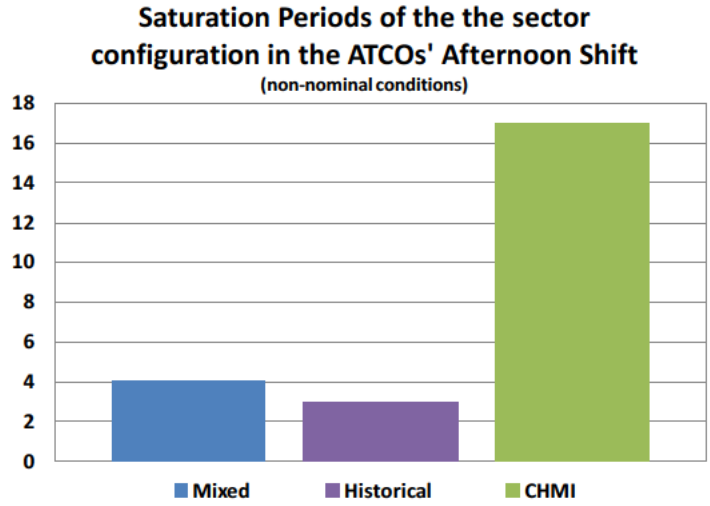

Figure 24: Number of saturation periods in the ATCos' Afternoon Shift (non-nominal conditions)

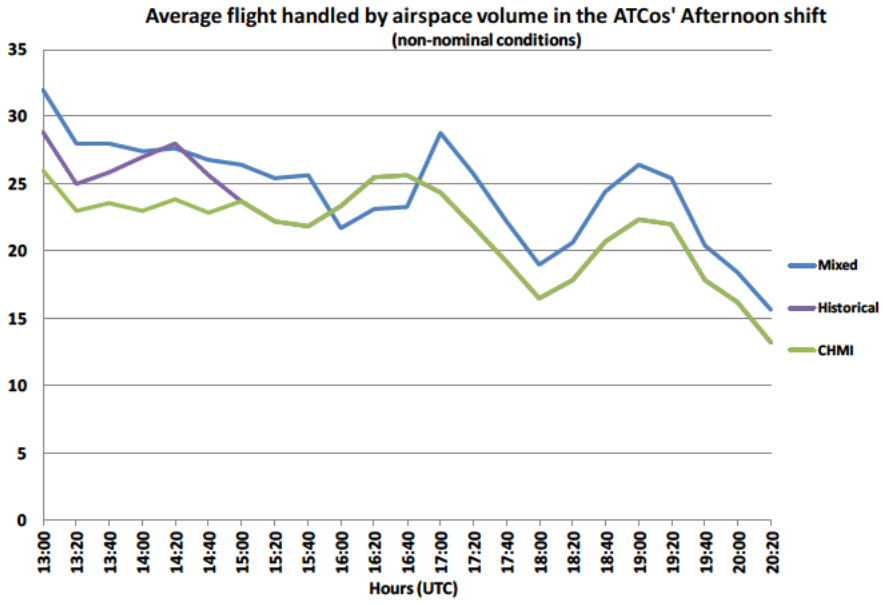

Figure 25: Number of flights able to enter airspace volume in the ATCos' Afternoon Shift (non-nominal conditions)

	20:20	20:40	21:00	21:20	21:40	22:00	22:20	22:40	23:00	23:20	23:40	0:00	0:20	0:40	1:00	1:20	1:40	2:00	2:20	2:40	3:00	3:20	3:40	4:00	4:20	4:40	5:00	5:20
Mix	3A			2A			1A						1A									2A			5E			
Historical	2A			1A									1A									2A			5G			
CHMI	4B			3A									3A												5F			

Figure 26: Proposed Airspace Configurations for the ATCos' Night Shift

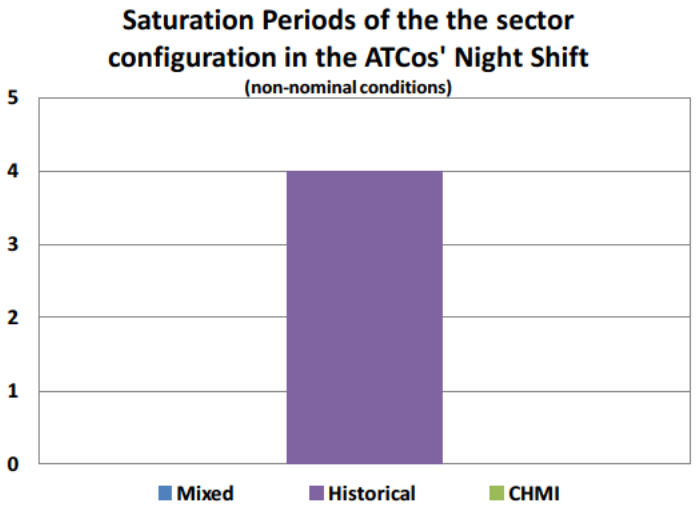

Figure 27: Number of saturation periods in the ATCos' Night Shift (non-nominal conditions)

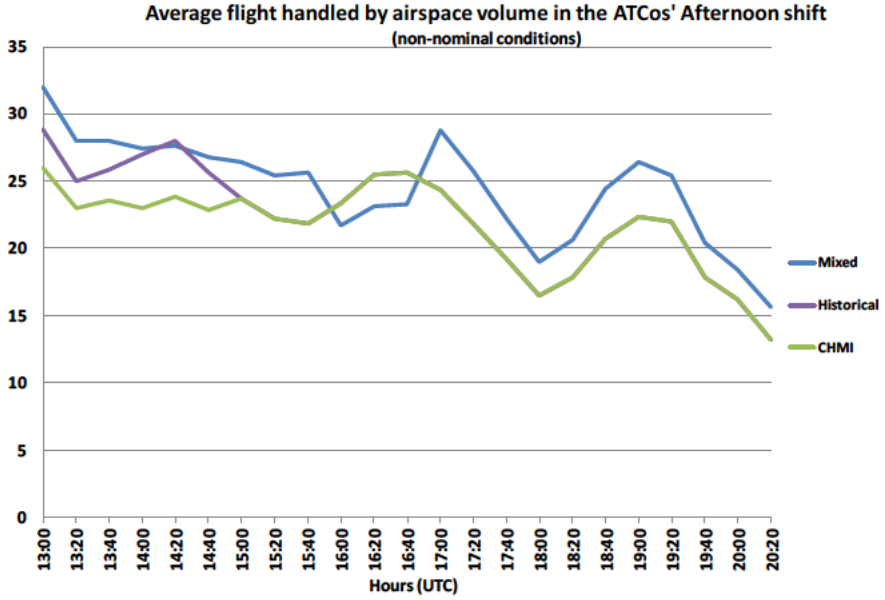

Figure 28: Number of flights able to enter airspace volume in the ATCos' Night Shift (non-nominal conditions)

These figures show that the airspace configurations proposed by the supporting tool with mixed forecast demand led to reduce, or at least maintain, the saturation periods and handle more flights per sector even in non-nominal conditions. However, the optimisation with the historical forecast demand provides more saturation periods because the behaviour of the traffic under non-nominal conditions is very different compared to the usual one (i.e. traffic flown in previous week). In fact, during the debriefing sessions, all the participants in the validation pointed out that it is necessary to find behaviour patterns for non-nominal traffic (e.g. Christmas, Eastern, sport events, strikes...) that should be incorporated to the prototype.

4.1.2.3 Efficiency

Number of delayed flights:

This indicator cannot be measured by means of the Shadow-Mode Validation Technique. Therefore, further analytical modelling runs have been performed to cover it as planned in §4.1.1.5.5 of the P04.07.07 D23 – V3 Validation Plan [10]. The results of this activity are included next.

As in the case of KPIs for Capacity, this analysis have been carried out with the actual flown traffic for the airspace configurations proposed by the supporting tool and ones planned based on the CHMI data at the time of the planning. These airspace configurations are shown in §**Error! Reference source not found.**. Moreover, the 'percentage of delayed flights' and 'Average of delay per flight' indicators are presented in the figures bellow as an average of the available sessions of both ATCo's morning and afternoon shifts in nominal conditions. The ATCo's night shifts have been excluded from this analysis due to the low level of traffic during them.

Finally, it's important to note that the airspace configurations proposed by the supporting tool are based on the mixed demand forecast source given that it has been demonstrated as the most appropriate to evaluate the airspace configurations at the planning time of the next ATCo's shift.

	Average of Delay per flight		% Delayed Fligths	
ATCo's Shift	CHMI data	Supporting Tool	CHMI data	Supporting Tool
Morning	0:00:37	0:00:50	4,86%	5,63%
Afternoon	0:00:20	0:00:18	1,32%	1,25%

Table 13: KPIs for Efficiency

It is appreciated that with the airspace configurations proposed by the supporting tool during the afternoon shift, the number of delayed flights and the average delay per flight are reduced. When the level of traffic increases (morning shift) the delays and delayed flights are increased but the average delay value per flight stays within the admissible values (less than 1 minute). This reinforces the added value of reducing sectors without a negative impact on the quality of service.

4.1.2.4 Cost-Effectiveness

IRCO:

IRCO (Operational Configuration Quality Indicator) provides the similarity between a proposed sector configuration and the optimum one which is calculated after the end of the shift based on the flown traffic.

The following figures show the values of IRCO from eight hours before the beginning of the shift comparing the sector configurations which are proposed by the prototype per each demand forecast source or planned with the available information from the CHMI.

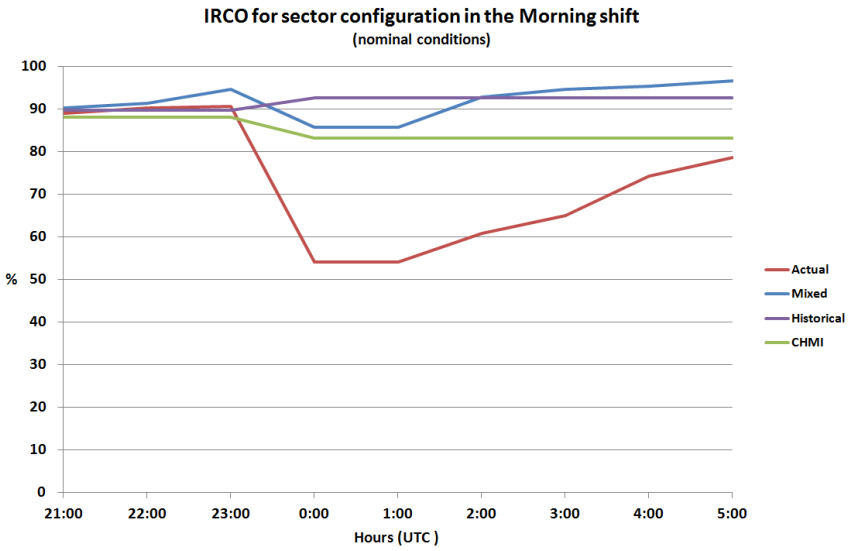

Figure 29: IRCO in the ATCos' Morning shift (nominal conditions)

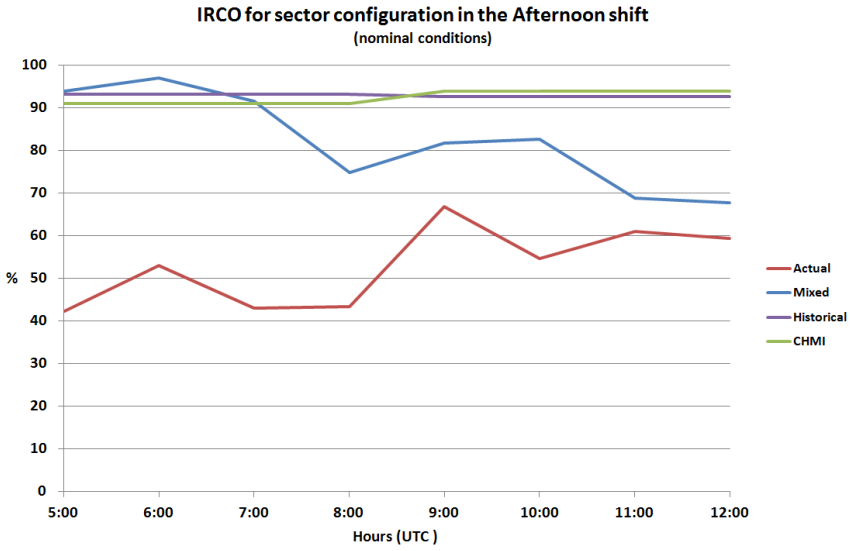

Figure 30: IRCO in the ATCos' Afternoon shift (nominal conditions)

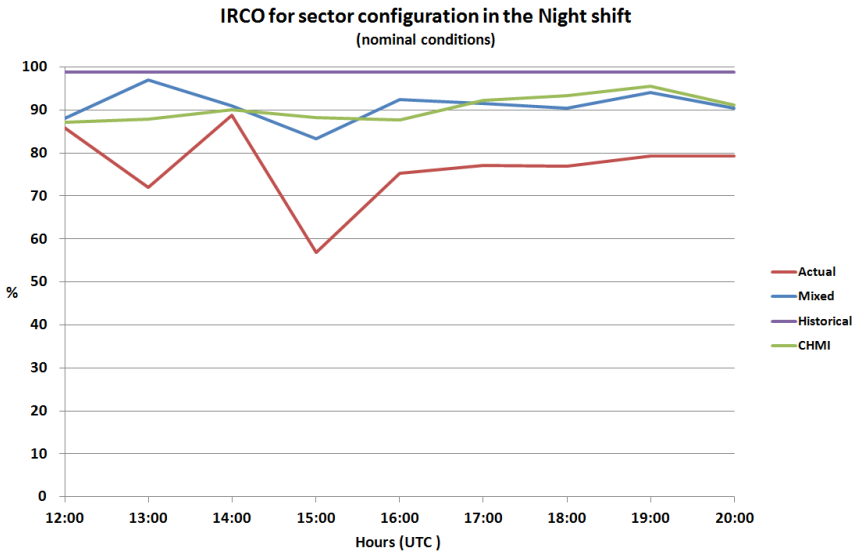

Figure 31: IRCO in the ATCos' Night shift (nominal conditions)

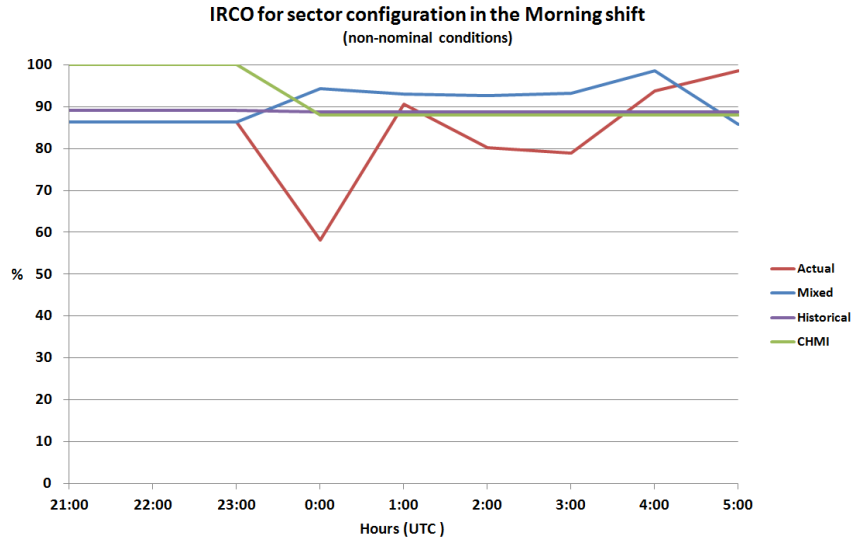

Figure 32: IRCO in the ATCos' Morning shift (non-nominal conditions)

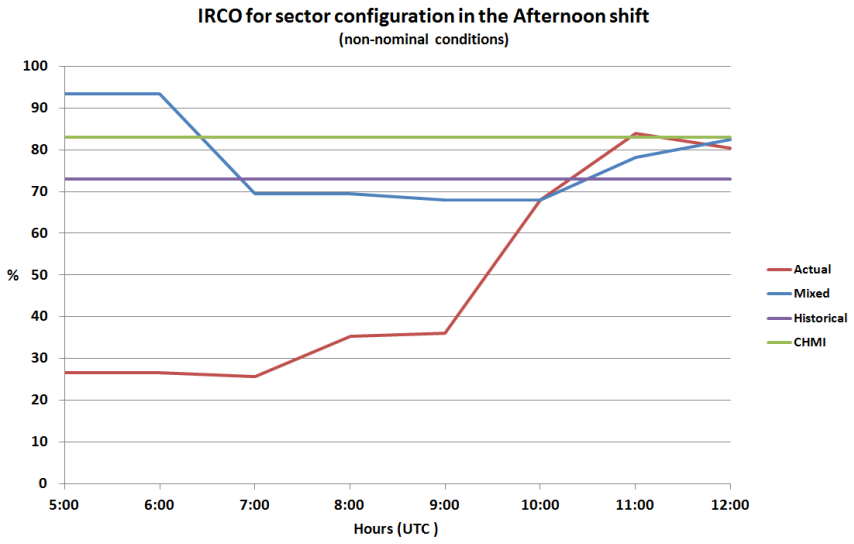

Figure 33: IRCO in the ATCos' Afternoon shift (non-nominal conditions)

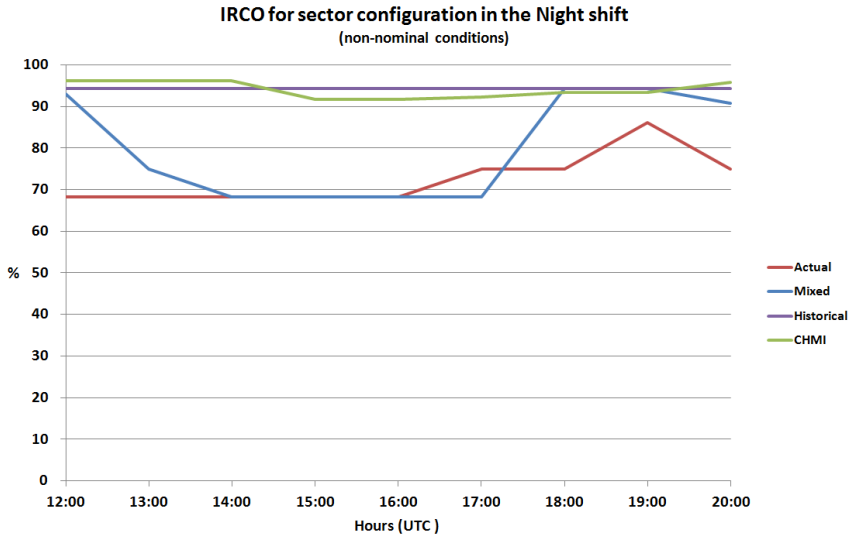

Figure 34: IRCO in the ATCos' Night shift (non-nominal conditions)

This indicator has been calculated to be used as an input for the Cost Benefit Analysis (P04.07.07 D27 - Cost Benefit Analysis), expected to be delivered at the end of February 2013.

4.1.3 Results impacting regulation and standardisation initiatives

Not applicable as this exercise has no impact on Regulation and Standardisation activities.

4.2 Analysis of Exercises Results

This section provides the level of achievement of all validation objectives including the analysis of the associated results. The assessment of the results against the validation objective is stated according to the following status:

- **OK:** validation objective achieves the expectations (exercise results achieve success criteria);
- **NOK:** validation objective does not achieve the expectations (exercise results do not achieve success criteria).

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status	Global Validation Objective Status
EXE-04.07.07-VP-006	OBJ-04.07.07-VALP-0006.0001	Validation of supporting tools functionalities	CRT-04.07.07-VALP-0006.0101	A qualitative assessment: demonstrate that the functionalities of the OPS Supervisor Supporting tool are accepted by them.	The usability of the OPS Supervisor supporting tool was highlighted by all participants and the information provided by it was considered as very useful.	OK	OK
	OBJ-04.07.07-VALP-0006.0002	Identification of the most appropriate source	CRT-04.07.07-VALP-0006.0201	The most appropriate demand source at each time of the planning phase (from eight to two hours before the operations) is identified and accepted by OPS Supervisor.	In the case of nominal conditions, to plan the ATCos morning and afternoon shifts, the most appropriate demand source is the mixed one from eight to four hours before the operations. At this time, all demand sources including CHMI converge. To plan the ATCos night shift, the most appropriate demand source is the historical one. These results were confirmed by the OPS Supervisors during the debriefing sessions.	OK	OK
	OBJ-04.07.07-VALP-0006.0003	Capacity and Quality of Service Improvement	CRT-04.07.07-VALP-0006.0301	Reduction in the Saturation Periods (10%).	In nominal conditions, the proposed airspace configurations with mixed and historical demand would reduce the number of saturation periods.	OK	OK
			CRT-04.07.07-VALP-	Increase in the number of flights able to enter	In the case of the proposed airspace configurations with	OK	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status	Global Validation Objective Status
			0006.0302	airspace volume (10%).	mixed and historical demand, the number of saturation periods is reduced (10%) in the ATCos' morning and night shifts and, at least, maintained in the afternoon one.		
			CRT-04.07.07-VALP-0006.0303	Reduction in the number of delayed flights (5%).	This indicator cannot be measured by means of the Shadow-Mode Validation Technique. Therefore, analytical modelling runs have been performed to cover it. During the ATCOs' afternoon shift, the number of delayed flights is reduced a 5%. However during the ATCos' morning shift, it's increased (16%), but, the average delay per flights is within admissible values (less than one minutes) and the number of sectors is reduced.	NOK	
	OBJ-04.07.07-VALP-0006.0004	Situational Awareness improvement	CRT-04.07.07-VALP-0006.0004	Situational Awareness is improved.	The use of the what-if functionality allowed identifying airspace configurations without saturation periods and avoiding the controllers' overload, at least, at early planning. The use of predefined airspace configurations known by OPS Supervisor made easier this selection.	OK	OK

Table 14: Summary of Validation Exercises Results

The table below details the values for the Performance Indicators (the figures are related to average values in nominal conditions), per validation objective and scenario:

Exercise ID	Objective ID	Scenario ID	Scenario Title	PI ID	Measure Value
EXE-04.07.07-VP-006	OBJ-04.07.07-VALP-0006.0001	SCN-04.07.07-VALP-0006.0001	OPS Supervisor Day Shift	Usability of the OPS Supervisor Supporting tool	Accepted
		SCN-04.07.07-VALP-0006.0002	OPS Supervisor Night Shift	Usability of the OPS Supervisor Supporting tool	Accepted
	OBJ-04.07.07-VALP-0006.0002	SCN-04.07.07-VALP-0006.0001	OPS Supervisor Day Shift	Appropriate demand source	Accepted
		SCN-04.07.07-VALP-0006.0002	OPS Supervisor Night Shift	Appropriate demand source	Accepted
	OBJ-04.07.07-VALP-0006.0003	SCN-04.07.07-VALP-0006.0001	OPS Supervisor Day Shift	Reduction in the number of Saturation Periods	-10%
				Increase in the number of flights able to enter airspace volume	+10%
				Reduction in the number of delayed flights	+16%/-5%
		SCN-04.07.07-VALP-0006.0002	OPS Supervisor Night Shift	Reduction in the number of Saturation Periods	-10%
				Increase in the number of flights able to enter airspace volume	+10%
				Reduction in the number of delayed flights	N/A
	OBJ-04.07.07-VALP-0006.0004	SCN-04.07.07-VALP-0006.0001	OPS Supervisor Day Shift	Situational Awareness	Improved
		SCN-04.07.07-VALP-0006.0002	OPS Supervisor Night Shift	Situational Awareness	Improved

Table 15: Summary of Performance Indicators

4.2.1 Unexpected Behaviours/Results

Not applicable as no ‘showstoppers’ were found and the exercise was performed as planned.

4.3 Confidence in Results of Validation Exercises

4.3.1 Quality of Validation Exercises Results

Taking into account the level of maturity of the validated concept, i.e. V3, as well as the validation objectives, the Shadow-Mode validation technique used to perform this exercise is adequate. The quality level of the overall exercise can be considered as appropriate given that it has assessed all relevant objectives. The overall goal of the exercise has been achieved although one of the validation objectives has not been fully covered. Qualitative and quantitative results have been provided. To fully cover the OBJ-04.07.07-VALP-0006.0003, in particular the number of delayed flights indicator, analytical modelling runs have been performed.

In terms of confidence, this exercise has provided a great degree of quality since OPS Supervisors involved in its execution had a wide proven experience and the supporting tool was used in a real operational environment.

4.3.2 Significance of Validation Exercises Results

To attain a certain degree of confidence that both the qualitative and quantitative results are representative, several sessions were carried out (see §3.2) and five OPS Supervisors were involved in the exercise execution.

In the questionnaires the OPS Supervisors were required to provide their opinion about the operational realism of the exercise and their confidence in the supporting tool concept. In all cases the confidence level was considered high as can be observed in the figures below (see Appendix B).

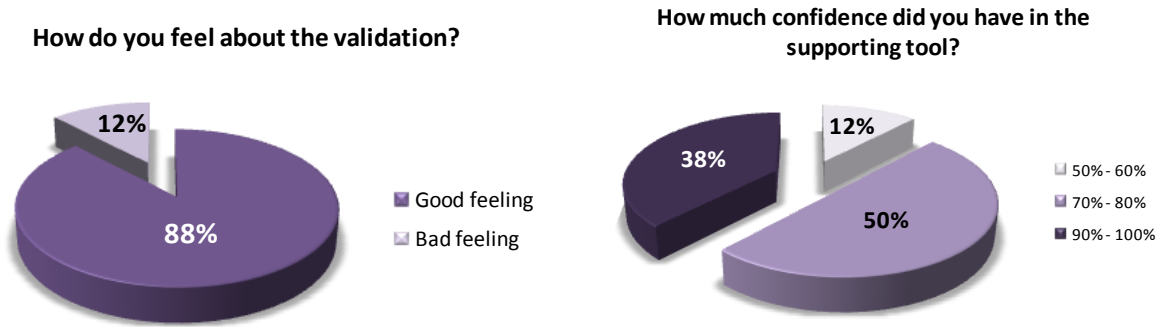

Figure 35: Feeling about the validation activity and the supporting tool

5 Conclusions and recommendations

5.1 Conclusions

After the analysis of the results the following conclusions have been stated:

- The functionalities included in the proposed supporting tool for the OPS Supervisor have been demonstrated to be ready for industrialization with full operational capability in any ACC, although some minor modifications should be implemented before its industrialization;
- The What-if functionality was considered as very useful to support the OPS Supervisor in the selection of the most suitable airspace configuration, improving the situational awareness;
- The accuracy of the mixed demand forecast was considered the most adequate to perform the planning of the next ATCOs' shifts in nominal conditions. However, in non-nominal conditions the most appropriate demand source would be the CHMI data;
- In nominal conditions, the optimisation of the airspace configuration supported by a tool and taking into account the number of available human resources allows increasing the number of flights handled by each sector as well as reducing, or, at least, maintaining the number of saturation periods (demand over capacity declared per sector).

5.2 Recommendations

The following recommendations are provided taking into account the activities performed during all the exercises phases:

- **Validation Technique:**

  The selection of the most appropriate validation technique for each validation exercise should be based not only on the v-phase of the maturity level but also on the indicators identified when the benefits mechanisms and validation objectives are developed. This will ensure that all the relevant benefits mechanisms will be covered by means of the qualitative and quantitative assessment of all the indicators. Therefore, one validation activity could be performed by means of a sequence of different validation techniques which allows all the defined validation objectives to be covered;

- **Demand forecast in non-nominal conditions:**

  The accuracy of the demand forecast should be improved in the case of non-nominal conditions. Statistical analysis, e.g. data mining, is needed to find traffic patterns associated to special circumstances (i.e. Christmas, Eastern, sport events, strikes...) which allows a reliable demand profile to be constructed.

- **Improvements of the supporting tool:**

  In order to improve the usability of the supporting tool for the OPS Supervisor before its industrialization, some recommendations were provided by the participants during the exercise execution:

  - Inclusion of the occupancy counts;
  - Display of the saturation periods in the proposed airspace configurations, if any;
  - Advisory about the most suitable demand source at the moment of the request;
  - Allowing the modification of the declared capacity.

6 References

6.1 Applicable Documents

[1] Template Toolbox 03.00.00
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Template%20Toolbox.dot

[2] Requirements and V&V Guidelines 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Requirements%20and%20VV%20Guidelines.doc

[3] Templates and Toolbox User Manual 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Templates%20and%20Toolbox%20User%20Manual.doc

[4] European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

[5] EUROCONTROL ATM Lexicon
https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR

[6] Operational Focus Area, 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Operational%20Focus%20Area.doc

[7] Guidance for Producing Benefit and Impact Mechanisms, 00.01.02
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Guidelines%20for%20Producing%20Benefit%20and%20Impact%20Mechanisms.doc

6.2 Reference Documents

The following documents provide input/guidance/further information/other:

[8] **P04.07.07** D20 - Preliminary OSED, 00.01.00
https://extranet.sesarju.eu/WP_04/Project_04.07.07/Project%20Plan/04.07.07-D20-Preliminary%20OSED-00%2001%2000.doc

[9] **P04.07.07** D22 – Preliminary SPR, 00.01.00
https://extranet.sesarju.eu/WP_04/Project_04.07.07/Project%20Plan/04.07.07-D22-Preliminary%20SPR-00%2001%2000.doc

[10] **P04.07.07** D23 – V3 Validation Plan, 00.02.00
https://extranet.sesarju.eu/WP_04/Project_04.07.07/Project%20Plan/04.07.07-D23-%20V3%20Validation%20Plan.docx

[11] **sWP04.02** D59 En-Route Concept Validation Strategy document Step1, 00.03.00
https://extranet.sesarju.eu/WP_04/Project_04.02/Project%20Plan/04.02%20D59%20Validation%20Strategy%2000.03.00.doc

[12] **sWP04.02** D07 Detailed Operational Description (DoD) Step1, 00.05.00
https://extranet.sesarju.eu/WP_04/Project_04.02/Project%20Plan/04%2002-D07-WP4%20detailed%20operational%20description%20Step%201-00.05.00_final.doc

[13] **B04.01** D12 Initial Baseline Performance Framework, Ed.0, [January 2010]
https://extranet.sesarju.eu/WP_B/Project_B.04.01/Project%20Management/Annex%202_SESAR%20Performance%20Framework%20Baseline%20(Edition%200)%20January%202010.pdf

[14]SESAR Business Case Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[15]SESAR Safety Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[16]SESAR Security Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[17]SESAR Environment Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[18]SESAR Human Performance Reference Material
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[19]D07 Guidance on list of KPIs for Step 1 Performance Assessment Ed1
https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

Remark: *if help is needed, the* **WP16 Front-Office** *can be contacted by e-mail. Do not hesitate to send an e-mail to* extranet@sesarju.eu*. Please start the subject line with Front-Office and use relevant keywords e.g. Safety, ATM Security, etc., or 16.06.01, 16.06.02 ..."*

[20]ATM Master Plan
https://www.atmmasterplan.eu

Appendix A KPA Templates

N/A

Appendix B Validation Exercise Questionnaires

Date		Shift	
	10-12	Day	Night

➔About the validation

Based on today's sessions…

1. How do you feel about the validation? (Please mark with an X)

Good	OK	Bad

2. How much confidence did you have in the supporting tool for the planning of the configuration of the sectors that have been used in the validation? Please mark with an X.

None	OK	Complete
0%	50%	100%

Please explain your reasons. If your level of confidence has changed since the beginning of the validations please explain why.

[If you need to make more comments please do so at the end of the questionnaire]

➔Situational Awareness

Please answer to each question by marking the correct box with an X.

3. Did you feel like you were able to plan and organize your work as you wanted?

3.1. Never	3.2. Almost Never	3.3. Often	3.4. Almost Always	3.5. Always

If never or almost never: Why?

[If you need to make more comments please do so at the end of the questionnaire]

4. Do you feel like the support tool will provide useful information?

4.1. Never	4.2. Almost Never	4.3. Often	4.4. Almost Always	4.5. Always

If never or almost never: Why?

[If you need to make more comments please do so at the end of the questionnaire]

5. Do you feel like the support tool has helped you to have a better understanding of the situation?

5.1. Never	5.2. Almost Never	5.3. Often	5.4. Almost Always	5.5. Always

If never or almost never: Why?

[If you need to make more comments please do so at the end of the questionnaire]

6. Rate your overall situational awareness during this validation exercise.

6.1. Poor	6.2. Fairly Poor	6.3. Adequate	6.4. Fairly Good	6.5. Very Good

If poor or fairly poor then why?

[If you need to make more comments please do so at the end of the questionnaire]

7. Please evaluate the OPS Supervisor supporting tool according to the following factors by marking with an X.

Name of the tool: **OPS Supervisor Supporting Tool**

1. IS THE TOOL USEFUL?

☹ *Not useful* -5 0 +5 *Very useful* ☺

2. IS IT RELIABLE?

☹ *Not reliable* -5 0 +5 *Very reliable* ☺

3. IS IT ACCURATE?

☹ *Not accurate* -5 0 +5 *Very accurate* ☺

4. DO YOU UNDERSTAND HOW IT WORKS?

☹ *Not at all* -5 0 +5 *Completely* ☺

5. DO YOU LIKE IT?

☹ *Not at all* -5 0 +5 *A lot* ☺

6. DO YOU FIND IT EASY TO USE?

☹ *Hard* -5 0 +5 *Easy* ☺

Please indicate the reason if you feel it is necessary.

[If you need to make more comments please do so at the end of the questionnaire]

8. Please rank the following factors in terms of their importance to you. One for the least important and six for the most important noting that each value should only be assigned once.

OPS Supervisor Supporting Tool	
Utility	*Range:*
Reliability	*Range:*
Accuracy	*Range:*
Understanding	*Range:*
Personal Taste	*Range:*
Ease of Use	*Range:*

9. Please evaluate the **method of presentation** of information in the following windows of the supporting tool for the OPS Supervisor, understanding the presentation as format, colours, and fonts of each screen as well as the ease of identifying information. (Please mark with an X)

	9.1 Not Useful	9.2	9.3 Useful	9.4	9.5 Very Useful	I don't know
A. Parameter selection screen						
B. Results window: Proposed configuration						
C. Results window: Graphs/Tables demand by sector.						
D. Results window: List of flights by sector						
E. Results window: What-if Option						
F. Parameter selection screen: Advanced (comparative)						
G. Results window: Comparison of Proposed configuration						
H. Results window: Comparison of Graphics/ Tables of demand by sector						
I. Results window: Comparison of flight lists by sector						
J. Results window: What if in comparisons						
Comments:						

10. Please evaluate the utility of the information presented by the OPS Supervisor supporting tool. The information will be useful as long as it can be easily understood and applied. (Please mark with an X)

	10.1 Not useful	10.2	10.3 Useful	10.4	10.5 Very Useful	I don´t know
A. Parameter selection screen						
B. Results window: Proposed configuration						
C. Results window: Graphs/Tables demand by sector.						
D. Results window: List of flights by sector						
E. Results window: What-if Option						
F. Parameter selection screen: Advanced (comparative)						
G. Results window: Comparison of Proposed configuration						
H. Results window: Comparison of Graphics/ Tables of demand by sector						
I. Results window: Comparison of flight lists by sector						
J. Results window: What if in comparisons						
Comments:						

11. Please evaluate the **method of procedure** with the supporting tool for OPS Supervisor taking into account the stability of the information, the ease of use and understanding of the information. (Please mark with an X)

	11.1 Inadequate	11.2	11.3	11.4	11.5 Very adequate
A. The presentation in periods of 20 minutes					
B. The graphics/tables of traffic demand by sectors					

	11.1 Inadequate	11.2	11.3	11.4	11.5 Very adequate
C. The procedure for analyzing sections that have not been proposed					
D. The procedure for performing comparisons					
Comments:					

12. Do you consider that the reliability of the solution proposed by the supporting tool for the OPS Supervisor is influenced by the source used to obtain traffic demand (historical, real or mixed)?

12.1. **YES**	12.2. **NO**	12.3. **I DON'T KNOW**

12.1.1. If the answer is **yes** please indicate which source of demand you consider to be the most adequate:

12.1.1. **Real**	12.2. **Historic**	12.3. **Mixed**

Comments:

13. Finally, do you feel that the support tool for planning configurations of sectors has helped you to do your job safely and effectively?

13.1. **YES**	13.2. **NO**	13.3. **I don't know**

If the response is not positive please let us know what changes need to be made to the atomization of the calculation of configurations in order to increase your trust and confidence in the tool.

[if you wish to make more comments make them at the end of the questionnaire]

Other Comments

A.1 Answers to the Questionnaire

Q1	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
100% (Good)	1	2	2	1	3	2
90%						
80%						
70%						
60%						
50% (OK)	1			1		
40%						
30%				1		
20%						
10% (Bad)						

Q2	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
100% (Complete)						
90%			1	1	2	2
80%		2	1		1	
70%				2		
60%	2					
50% (OK)						
40%						
30%						
20%						
10% (None)						

Q3	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Never						
Almost Never	1					
Often				2		
Almost Always		1	1		1	
Always	1	1	1	1	2	2

Q4	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Never						
Almost Never						
Often						
Almost Always	1	2	2	2	1	
Always	1			1	2	2

Q5	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Never	1					
Almost Never						
Often				2		
Almost Always	1	2	1		1	
Always			1	1	2	2

Q6	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Poor						
Fairly Poor	1					
Adequate				3	1	
Fairly Good		2	2		2	2
Very Good	1					

Q7_a	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Is the tool useful?	+3/+3	+4/+4	+4/+3	+3/+4/+4	+4/+4/+4	+4/+4
Is it reliable?	+4/+2	+3/+3	+4/+3	+3/+3/+4	+4/+4/+4	+4/+4
Is it accurate?	+1/+3	+2/+3	+4/+3	+2/+3/+4	+4/+4/+4	+4/+4
Do you understand how it works?	+4/+5	+4/+4	+4/+4	+3/+3/+4	+4/+4/+4	+4/+4
Do you like it?	+4/+3	+3/+4	+4/+4	+2/+3/+4	+4/+4/+4	+4/+4
Do you find it easy to use?	+4/+3	+4/+4	+4/+5	+3/+4/+4	+4/+4/+5	+4/+4

Q7_b	10/10/2012	11/10/2012	22/10/2012	23/10/2012	24/10/2012	25/10/2012
Utility	2/1	1/3	1/1	3/2/2	1/3/3	2/1
Reliability	3/4	3/2	4/4	2/3/3	4/2/2	4/4
Accuracy	1/3	2/1	2/3	1/1/1	2/1/1	1/2
Understanding	6/2	4/4	6/2	4/5/4	3/5/6	5/3
Personal Taste	5/6	5/6	5/5	6/6/6	6/6/4	6/6
Ease of Use	4/5	6/5	3/6	5/4/5	5/4/5	3/5

Appendix C Maturity Assessment

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Processes & procedures	[V3.C3.1]	Is the selected concept option confirmed to be operationally feasible when integrated into the end system, (showing that all interaction between people is viable based on prototyping of a realistic environment?	Validation	VAL.3.1	Do validation results confirm the quantitative and qualitative evidence on the operability and technical feasibility obtained in previous V phases?	VALR	X.02	N/A	No previous V2 validation activities
				VAL.3.2	Were the V3 Validation exercises executed in an operational environment representative of the target deployment scenario?			✓	Barcelona ACC
				VAL.3.3	Were the V3 Validation activities executed using a validation technique suitable for that maturity level e.g. shadow mode and / or live trials?			✓	Shadow-mode
				VAL.3.4	Are Reference, Solution scenarios and most relevant non-nominal situations considered in the validation?			✓	Strike in French airspace (non-nominal situations)
	[V3.C3.2]	Following its integration into the end system, do we have a stable and validated definition of business processes, operational procedures, roles and responsibilities of actors, their tasks, and human performance elements required to implement (and if so intended to regulate) this concept option?	Operations	OPS.3.1	Is the operational concept refined and further detailed after V3 activities and documented? (the description of the operational concept includes roles, working methods, training needs, etc. following OSED template)	OSED	X.02	✓	See D25 – Final OSED §3.
			Operations	OPS.3.2	Are the OI steps fully described and documented e.g. IOC-dates estimated and confirmed, validation results reflected in modified description and dates...?			✓	DS08
			Operations	OPS.3.3	Are the Operational and Performance Requirements (OSED & SPR) stable and updated after V3 validation activities?	OSED, SPR	X.02, 16.06	✓	D25 Final OSED D26 Final SPR

Table 16: Maturity Assessment Criteria related to processes and procedures

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Human–technology integration	[V3.C4.1]	Have the relationships and interactions between human and machine been defined and validated in an operationally realistic environment using a pre-industrial prototype?	Performance	PER.3.1	Has a Human Performance Assessment Report been completed and provide evidence that all relevant Human Performance aspects have been assessed? Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	VALR	16.06	N/A ✓	No Human Performance Assessment has been produced given that the operational procedures have not been modified. The only change has been the introduction of a new supporting tool.
	[V3.C4.2]	Have the relationships and interactions between people and technology been confirmed to be operationally feasible, and consistent with agreed human performance requirements?							

Table 17: Maturity Assessment Criteria related to Human-Technology Integration

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Technical enabler	[V3.C5.1]	Do we have a validated system architecture, HMI design, & technical specification ready to be used for industrialisation (and for standardisation if so intended)?	System	SYS.3.1	Are the enablers fully described and documented e.g. IOC-dates estimated and confirmed...	TS/IRS	X.01.07	✓	DS08
				SYS.3.2	Are the System Requirements (TS/IRS) verified on a verification platform, stable and updated after V3? Verification of the integrated prototype, HMI, system architecture, underlying algorithms and technology is successful.	TS/IRS Availability Note	X.01.07, 16.06	✓	D02 P13.02.03 DCB/ASM Scenario Step1 System Definition Final (TS)
			Validation	VAL.3.6	Has the IBP platform been successfully verified and accepted prior to the validation activity?	VR	WP03	✓	M6 (26/09/2012) M7 (01/10/2012)
Technical enabler	[V3.C5.2]	Are the interoperability requirements, the refined technical performance requirements, and the refined CNS requirements validated on a pre-industrial prototype and platform integrating all relevant target system elements?	System	SYS.3.3	Are the Interoperability requirements (INTEROP) updated after V3 activities?	INTEROP	X.02	N/A	No INTEROP deliverable in the project
				SYS.3.4	Are the requirements on underlying technology e.g. CNS documented?	TS/IRS	X.01.07	✓	D02 P103.02.03 – TS
	[V3.C5.3]	Is the technical enabler shown to be feasible (i.e. working preindustrial prototype showing that interoperability and performance requirements can be met)?	Covered by SYS.3.1 and platform integrating all relevant target system elements?on the "target" end system?						

Table 18: Maturity Assessment Criteria related to Technical enabler

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Integration	[V3.C8.1]	Are the related concepts considered in the validations?	Programme	PRG.3.1	Are there evidences that other related OI steps & enablers are at the expected level of maturity? (the target maturity can only be achieved if the related concept elements have achieved the same level of maturity) Are there proofs/evidences that the other related OI steps & enablers are feasible/operable/beneficial?	OSED	X.02	N/A	No related OI steps identified by this exercise
			Operations	OPS.3.4	Have all the related concepts been integrated and validated together, and shown that they work coherently? *This criterion is focused on those concepts that are identified at Validation Strategy level as the scope of the integration activities to be performed by X.03s.*	X.03 VALR	X.02	N/A	Integrated validation is not necessary

Table 19: Maturity Assessment Criteria related to Integration

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Assessments	[V3.C9.1]	Are the benefits and risk assessments refined (i.e. by a quantitative analysis and considering the impact of all related concepts to each other) for all relevant KPAs and for all contexts of applications? Is the trade-off analysis extended accordingly?	Covered by PER.3.2 to PER.3.6						
	[V3.C9.2]	What are the results? Are the major issues found during these assessments (e.g. assessments showing less then expected benefits, major safety hazards, etc.) adequately addressed in further concept elaboration, integration and validation activities? In case the targeted benefits are shown to be unfeasible, what is the impact on the overall (i.e. IP/Service level) strategic performance objectives/targets?	Performance	PER.3.2	Do validation results confirm the qualitative and quantitative evidences obtained in previous V phases about impact on Capacity, Quality of Service KPAs (Efficiency, Predictability and Flexibility) and Cost-effectiveness?	VALR	B05	✓	No previous V2 validation activities
				PER.3.3	Has an environmental Assessment Report been completed? Do validation results confirm the qualitative and quantitative evidences obtained in previous V phases about impact on environmental sustainability?	VALR	16.06	N/A	No impacto n Environmental Sustainability
				PER.3.4	Has a Safety Assessment Report been completed? Do validation results confirm the qualitative and quantitative evidences obtained in previous V phases about impact on safety?	VALR	16.06	N/A	No change in the operational procedures.
				PER.3.5	Has a Security Assessment Report been completed? Do validation results confirm the qualitative and quantitative evidences obtained in previous V phases about impact on security?	VALR	16.06	N/A	No change in the operational procedures.

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
				PER.3.6	Are the assessments results in line with what is targeted for that concept? In case of deviation, Has been the impact on the overall strategic performance objectives/targets analysed?	VALR	B05, 16.06	✓	D24 VALR - §4.2

Table 20: Maturity Assessment Criteria related to Assessments

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Business Case	[V3.C10.1]	Is the Business Cases refined for representative stakeholder groups?			Supported by evidences associated to PER3.2, PER.3.3, PER.3.4, PER.3.5, PER.3.6 and PER.3.7 **The initial E-OCVM criteria will be assessed as part of the 16.06 business cases activities (that may include various OI steps/enablers). These criteria require inputs that are beyond the scope of the maturity assessment**				
	[V3.C10.2]	Is the Business Case refined using the results of more detailed benefit and risk assessments as well as trade-off analysis between all relevant KPAs?			Supported by evidences associated to PER3.2, PER.3.3, PER.3.4, PER.3.5, PER.3.6 and PER.3.7 **The initial E-OCVM criteria will be assessed as part of the 16.06 business cases activities (that may include various OI steps/enablers). These criteria require inputs that are beyond the scope of the maturity assessment**				
	[V3.C10.3]	Does the Business Case provide a complete comparison for all alternative operational concepts and supporting enablers across all criteria and representative stakeholder groups?			Supported by evidences associated to PER3.2, PER.3.3, PER.3.4, PER.3.5, PER.3.6 and PER.3.7 **The initial E-OCVM criteria will be assessed as part of the 16.06 business cases activities (that may include various OI steps/enablers). These criteria require inputs that are beyond the scope of the maturity assessment**				
	[V3.C10.4]	Is the Business Case for the operational concept and supporting enabler(s) confirmed in an integrated and realistic environment?			Supported by evidences associated to PER3.2, PER.3.3, PER.3.4, PER.3.5, PER.3.6 and PER.3.7 **The initial E-OCVM criteria will be assessed as part of the 16.06 business cases activities (that may include various OI steps/enablers). These criteria require inputs that are beyond the scope of the maturity assessment**				
	[V3.C10.5]	Is the affordability analysis refined and confirmed taking into account the benefit and cost refinements for representative stakeholder groups?	Performance	PER.3.7	Has the V2 cost estimation associated to the OI steps and associated enablers been updated and refined per deployment scenario and stakeholder after Validation activities in V3?	VALR	16.06	N/A	No previous V2 validation activities

Table 21: Maturity Assessment Criteria related to Business Case

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Work plan	[V3.C11.1]	Does the work plan for V4 adequately cover all relevant activities (industrial product developments, standardisation, regulation, certification, further development of case material for specific local deployment contexts and individual stakeholders, if so required).	N/A						
	[V3.C11.2]	Are the time and potential risks for the completion of the next phase activities adequately identified?	N/A						
			Stand. & Reg.	S&R.3.1	Is the material produced sufficiently developed and mature to support the development or update of operational and technical standards in V4?	VALR	C03	N/A	
			Stand. & Reg.	S&R.3.2	Is the material produced sufficiently developed and mature to support the regulation process in V4?	VALR	C03	N/A	
			Validation	VAL.3.5	Do the validation objectives addressed in VALPs & VALRs coherent with the VALS and with the expectations in V3?	VALP, VALR	X.02	✓	D23 VALP D24 VALR

Table 22: Maturity Assessment Criteria related to Work Plan

E-OCVM	E-OCVM Criteria ID	E-OCVM Criteria	Thread	ID	Criteria	Where?	Who?	Answer	Evidences
Transition	V3.C6.1]	Are there any impacts on the transition steps and supporting activities identified in the previous phase coming from operational and technical refinements made during this phase? Is the transition analysis refined accordingly?	Transition	TRA.3.1	Has the transition analysis been refined by taking into account evolution of the operational concept and supporting enablers during V3 phase?	VALR	X.02	N/A	No impact on the transition steps
	[V3.C6.2]	Is the transition confirmed to be feasible?							
				TRA.3.2	Are there recommendations proposed for V4?	VALR	X.02	✓	D24 VALR §5.2

Table 23: Maturity Assessment Criteria related to Transition

-END OF DOCUMENT-