EPISODE 3

Single European Sky Implementation support through Validation

Document information	
Programme	Sixth framework programme Priority 1.4 Aeronautics and Space
Project title	Episode 3
Project N°	037106
Project Coordinator	EUROCONTROL Experimental Centre
Deliverable Name	Collaborative Network Planning Expert Group Report
Deliverable ID	D3.3.1-02
Version	1.00
Owner	
Alfredo Gómez de Segura	AENA
Contributing partners	
EUROCONTROL, ISDEFE, INECO	

- This page is intentionally blank -

DOCUMENT CONTROL

Approval

Role	Organisation	Name
Document owner	AENA	Alfredo Gómez de Segura
Technical approver	AENA	Pablo Sanchez-Escalonilla
Quality approver	EUROCONTROL	Catherine Palazo
Project coordinator	EUROCONTROL	Philippe Leplae

Version history

Version	Date	Status	Author(s)	Justification - Could be a reference to a review form or a comment sheet
1.00	14/12/2009	Approved	Alfredo Gómez de Segura	Approved by the Episode 3 consortium

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

EP3 WP3.1.1 Collaborative Network Planning Expert Group allowed gaining greater understanding of the SESAR Concept at the airspace and network levels during the medium/short term planning phase. This information was captured in detailed Operational Scenarios that describe the SESAR ConOps into a format suited to validation. In particular, the Collaborative Network Expert Group elaborated the operational scenarios concerning the military collaboration in the medium/short-term planning and the resolution of Non-Severe (No User Driven Prioritisation Process - UDPP) capacity Shortfall impacting arrivals in the Short Term.

The work covering concept clarification but also requirements development and assumptions definition was the main focus of this expert group. This information is described in the present document and is used as starting point for the development of the following validation activities: EP3 WP3.3.2 Business Trajectory Management and Dynamic Demand and Capacity Balancing - DCB, EP3 WP3.3.3 Airspace Organization and Management and EP3 WP3.3.5 Global Performances at network-wide Level.

Some “hot topics” with no experts’ consensus should be further refined in SESAR. Most of these issues are related to the User Driven Prioritisation Process - UDPP concept. The experts agreed that the UDPP process could be initiated by Airline Operators - AOs or by Air Traffic Management - ATM. However this approach does not comply with the SESAR concept where UDPP could be initiated by the Airline Operators - AOs, by the Airport Operations Control Center - APOC acting as a focal point but it could only be triggered by the Regional Network Manager

Other “hot topic” was the limit between Demand and Capacity Balancing - DCB Queue management and the Arrival Manager - AMAN. The experts were asked whether the AMAN and dynamic DCB Processes can be managed by a unique system, i.e. Extended AMAN, or by two distinct systems. All the experts agreed to have both functionalities i.e. arrival management and dynamic DCB considering two separated tools. However this architecture is not compliant with the SESAR ConOps.

At the end of the validation process, the experts also supported the refinement of the operational scenarios based on the exercises’ outcomes, and the analysis of the Expert Group as validation technique.

One of the main suggestions was the active participation of the airspace users in those DCB processes where the decisions affect their business trajectories.

As validation technique, the Expert Group-Based was identified as a very effective support to the first steps of the validation process. By Expert Groups it is in fact possible to perform an initial assessment on operational process feasibility, detailing the concept in its early maturity stages by identifying alternatives, pointing out possible areas of concern or uncertainty and providing early clarifications about the foreseen roles and responsibilities.

1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

The goal of this document is to report the results of the activities of EP3 Network Expert Group (WP3.3.1) regarding Medium and Short-Term Network Planning and Collaborative Network Planning.

The information provided by EP3 Network Expert Group contributes to:

- Provide guidance on SESAR Collaborative Planning Processes procedures;
- Support the definition of EP3 WP3 validation exercises, providing inputs for the refinement of their Experimental Plans and their validation scenarios;
- Refine the Detailed Operational Descriptions (DOD's) and the relevant Operational Scenarios;
- Consolidate and analyse the main results and outcome provided by EP3 WP3 validation activities on Medium and Short-Term Network Planning;
- Provide feedback on Expert Group as a validation technique.

This Final EP3 WP3.3.1 Collaborative Network Planning Expert Group Report updates and completes the Interim EP3 WP3.3.1 Collaborative Network Planning Expert Group Report delivered in March 2009.

This document is aligned with the E-OCVM [1] validation approach.

1.2 INTENDED AUDIENCE

The main audience of the work done within EP3 Network Expert Group (WP3.3.1) are the validation exercises EP3 WP3.3.2, WP3.3.3 and WP3.3.5 validation exercises. The Expert Group sessions were organised for providing support to these validation exercises during their whole life-cycle, from the definition of their experimental plans to the consolidation of the final results.

This report is also delivered to EP3 WP2 team for refining the Detailed Operational Descriptions and ensuring the consistency between the different assumptions provided by all the Expert Groups within Episode 3.

Later on, this report will contribute to the EP3 WP3 report (D3.4-01) and EP3 Final Report (D2.5-01).

The intended audience includes:

- EP3 WP3 participants:
  - EP3 WP3 Leader;
  - EP3 WP3.3.2, EP3 WP3.3.3 & EP3 WP3.3.5 exercise leaders;
  - EP3 WP3.2 Validation strategy, support and operational concept refinement.
- Other Episode 3 partners;
- SJU Project Managers.

1.3 DOCUMENT STRUCTURE

This introduction shows the document purpose, structure and provides general background and supportive information.

Section 2 gives information about the scope, objectives and expected outputs of the Expert Group.

Section 3 gives information about the operational details and Operational Scenarios related to the Collaborative Planning.

Sections 4, 5 and 6 describe the feedback given by the Expert Group for the refinement of the DOD's and operational scenarios addressed by EP3 WP3 validation exercises; a brief

summary of the different exercises and information about the assumptions given by the Experts and their contribution to the definition and execution of EP3 WP3 validation exercises is shown in the document. As said before, these sections also include the feedback provided by the experts on the exercises outcomes and results.

Section 7 explains the final conclusions and recommendations based on the results from the EP3 Collaborative Network Planning Expert Group activities, paying special attention to the feedback obtained on the applicability of Expert Groups as a validation technique.

Section 8 lists references and applicable documents.

Annex 9 contains the questionnaires used during the Collaborative Network Planning Expert Group Sessions. The answers to these questions have been consolidated through the main body of this document.

Annex 10 provides the list of experts contributing to the activities of EP3 Collaborative Network Planning Expert Group and the planning of these activities.

1.4 BACKGROUND

With a view to supporting SESAR Development Phase activities whilst ensuring preparation for partners SESAR JU activities, Episode 3 will focus on providing:

- Detail on key concept elements in SESAR;
- Initial operability through focussed prototyping exercises and performance assessment of those key concepts, i.e. operability and performance studies;
- Initial support for identifying technical needs and initial technical impact assessment;
- Analysis of the available tools and gaps for SESAR concept validation;
- Reporting on the validation methodology used in assessing the concept.

Validation exercises should produce evidence - preferably measured - about the ability of some aspect of the concept to meet the target performances. In order to prepare the Validation Exercises, there is a need for preliminary work covering concept clarification and requirements development.

The Expert Groups deal with the preliminary work to clarify concept. The Expert Groups take place before any validation exercise and generate input such as detailed and documented understanding of how the future concept needs to operate as well as hot topics requiring specific evaluation.

Part of this necessary preliminary work deals with the understanding of the SESAR Collaborative Layered Planning and concretely, Collaborative Network Planning, taking into consideration the SESAR ConOps [2].

The Medium and Short-Term Network Planning Expert Group is part of the Episode 3 WP 3.3, which validates the main aspects of the Mid & Short Term ATM planning in the SESAR ConOps [2]. This WP is mainly focused on providing evidence that the SESAR Planning Processes meet the target of performances. It benefits from the activities already carried out as part of EP3 WP3.3.1.1.1, for which a first Expert Group meeting had been organised before the suspension of Episode 3.

1.5 GLOSSARY OF TERMS

Term	Definition
ACARE	Advisory Council for Aeronautics Research in Europe
A-CDM	Airport Collaborative Decision Making
AENA	Aeropuertos Españoles y Navegación Aérea
A-FUA	Advance Flexible Use of Airspace
AIBT	Actual In Block Time

Term	Definition
AIR EUROPA	AIR EUROPA Airline
ALDT	Actual Landing Time
AMAN	Arrival Manager
AMC	Airspace Management Cell
ANSP	Air Navigation Service Provider
AO	Airline Operator
AOBT	Actual Off Block Time
AOC	Airline Operations Center
AOP	Airport Operations Plan
APOC	Airport Operations Control Centre
ASM	Airspace Management
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATS	Air Traffic Service
CAST	Comprehensive Airport Simulation Tool
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
ConOps	Concept of Operations
CSA	Common Situational Awareness
CT	Check-in Time
CTA	Controlled Time of Arrival
CTO	Controlled times of Over-fly
DCB	Demand and Capacity Balancing
DCMAC	Directorate of Civil-Military ATM Coordination
DOD	Detailed Operational Description
DT	Displacement time
Dynamic DCB	Dynamic Demand and Capacity Balancing
EASY JET	Easy Jet Airline
EC	European Commission
ECAC	European Civil Aviation Conference
EG	Expert Group
EIBT	Estimated In Block Time
ELDT	Estimated Landing Time
EOBT	Estimated Off Block Time
E-OCVM	European Operational Concept Validation Methodology

Term	Definition
EP3	Episode 3
ETA	Estimated Time of Arrival
ETFMS	Enhanced tactical Flow Management System
ETOT	Estimated Take Off Time
EUROCONTROL	European Organization for the Safety Air Navigation
FAB	Functional Airspace Block
FAF	Final Approach Fix
FMS	Flight Management System
GAT	General Air Traffic
HIL	Human In the Loop
IAF	Initial Approach Fix
IATA	International Air Transport Association
IBERIA	IBERIA Airlines
ICARO	Spanish Flight Plan System
INECO	Ingeniería y ECOnomía del Transporte
ISDEFE	Ingeniería de Sistemas para la DEFEnsa de España
KPA	Key Performance Area
KPI	Key Performance Indicator
MET	METeorology
MIL	MILitary
MVPA	Military Variable Profile Area
MVT	Aircraft Movement Message
NM	Nautical Miles
NOP	Network Operation Plan
NOPLA	Network Operation Planner
OAT	Operational Air Traffic
OI	Operational Improvement
OS	Operational Scenario
PF	Performance Framework
PMI	Palma de Mallorca Airport
PT	Passport time
QRA	Quick Alert Response
RBT	Reference Business Trajectory
RTA	Requested Time of Arrival
SACTA	Automated System of Air Traffic Control
SBT	Shared Business Trajectory
SCENA	Base de datos Centralizada y Asignación de Medios

Term	Definition
SESAR	Single European Sky ATM Research and Development Programme
SESAR JU	SESAR Joint Undertaking
ST	Security Time
SWIM	System-Wide Information Management
TAM	Total Airport Management
TIS	Traffic Information System
TTA	Target Time of Arrival
TTO	Target Time Over
UDPP	User Driven Prioritisation Process
UPT	User Preference Trajectories
VGA	Variable Geometry Area
WP	Work Package

Table 1: Glossary of Terms

2 EXERCISE SCOPE AND JUSTIFICATION

2.1 STAKEHOLDERS

There are two groups of stakeholders: external to Episode 3 and EP3 partners.

Integrating external stakeholders from the air transport industry in the preparation and conducting of the Expert Group secures a realistic operational feedback and evaluation of the results. Table 2 shows the main external stakeholders and their role in this expert group:

Stakeholder		Role
airspace users	General Aviation	• Responsible for providing a safe and efficient flight in respect of the agreed plan with ATC, DCB and Airport.
	AOCC "Airline Operation Control Centre"	• Responsible for planning and managing the fleet. They are in charge of flight schedules implementation, crew rotation, security, hub management.
	Military	• User of the airspace, in charge of performing military exercises. • Airspace Manager: the Airspace Management Cell AMC is a joint civil/military body.
air navigation service providers	In General and Management of ATCC	• Responsible for providing a safe and efficient service in the ATM in terminal and en-route. • In particular, ATCC management is responsible for the operational management of controller personnel including training.
	Airspace manager	• Responsible for implementing airspace design and modes of operation.

Table 2: External stakeholder's roles

The list below shows the internal stakeholders, which are the EP3 WP3 validation exercises receiving inputs from the Collaborative Network Planning Expert Group. Therefore, internal EP3 stakeholders are:

- EP3 WP3.3.2 Business Trajectory Management and Dynamic DCB, led by EUROCONTROL;
- EP3 WP3.3.3 Airspace Organization and Management, led by AENA;
- EP3 WP3.3.5 Global Performance at Network Wide Level, led by ISDEFE.

These validation exercises provided feedback to EP3 Collaborative Network Planning Expert Group about the execution of the exercises and about the results obtained though their activities.

The feedback obtained from EP3 WP3.3.1 feeds EP3 WP3.4 Collaborative Planning Results and Consolidation, that supports the consolidation of conclusions and recommendations addressed in EP3 WP3.3.1.

2.2 DESCRIPTION OF ATM CONCEPT BEING ADDRESSED

In Episode 3, the complete detailed description of the mode of operations is composed of a collection of documents according to the main phases defined by SESAR. These documents are the Episode 3 Detail Operational Descriptions (DODs) that provide the central reference describing the concept with the required level of detail as a starting point for the validation activities.

Among these, DOD M2 - Medium-Short Term Network Planning document [9] provided the description of the Collaborative Network Planning concept and the work done within EP3 WP3.3.1 Network Expert Group.

The ATM planning process in SESAR is a process of maturation, possibly starting many years in advance, to end with execution on the day of operations. In-between, network operations are planned in two phases, the Long Term Planning Phase and the Medium/Short Term Planning Phase. Planning activities do not change radically from one phase to the other. It is a work of continuous refinement relying on a number of core principles. However those processes are managed quite differently in the two phases:

- They do not obey the same operating principles;
- They do not exactly involve the same actors or there are roles and responsibilities specific to each phase;
- They are not driven by the same events or the same kind of information.

Medium Term Planning revises the long term plans on the basis of declared flight intentions, initially known at seasonal level SBT publication. Identified situations of imbalance are collaboratively worked out to make sure that the execution phase is sustainable for the whole network.

Short Term Planning starts on the day of operation when the information is available with a high level of quality and accuracy, possibly three hours before departure for each flight more than 95% of the SBTs shall be available. Short Term Planning works on a mixed picture: on the one hand, a part of the demand is still missing while on the other hand some flights are already in execution i.e. RBT is available at around the departure clearance.

The SESAR Operational Concept envisions the reorganisation of the current ATM planning process into a trajectory based collaborative layered planning. This reorganisation together with the particular emphasis put on trajectory based operations and on collaborative planning has led to the adoption of the following requisites for the ATM medium/short term planning process of SESAR.

In the medium/short term, the demand is planned, meaning that the flight intentions for the day of operation are progressively shared by the Airspace Users and gathered by the Regional Network Manager.

Because a part of the demand is unknown till the day of operation, declared flight intentions are complemented by virtual but probable flight intentions inferred from archived data. In the process, the Regional Network Manager builds a Reference Traffic Demand, regarded as a picture of the situation to come and the reference used for capacity planning and demand and capacity balancing. The picture is incrementally corrected “i.e. as new data become available” and progressively approaches reality. These data are available to Sub-Regional Network Managers, to Airspace Users, to AMC or Airspace Management Cell and to all other concerned actors, through the NOP i.e. Network Operation Plan. During the execution phase the NOP will continue to reflect updated information, including data from aircraft, ensuring access to the most up to date situation.

In the meantime, the AMC or Airspace Management Cell collects Airspace Requirements from Civil and Military Airspace Users and implements the appropriate Airspace Reservations, in close cooperation with the Sub-Regional Network Manager. Although airspace requirements may be known at short notice, the sooner the better in order to:

- Plan capacity consistently through the definition of a relevant Airspace Resource Available Capacity Plan;
- Implement suitable DCB Solutions in case of imbalance.

Airspace requirements will be thereby adjusted to allow military Airspace Users to operate in flexible airspace regions minimizing as much as possible the impact on civil Airspace Users.

Capacity planning and DCB are performed by the Sub-Regional Network Managers, working hand in hand with the AMC or Airspace Management Cell. Medium term DCB Solutions try to optimise capacity as much as possible. In the near short-term and in the short-term, DCB

Solutions not only will proceed with capacity adjustments but also with demand adjustments in the event of last minute imbalances, possibly resulting from an influx of intentions.

When the demand must be constrained, Airspace Users decide on how to meet the constraint e.g. through trajectory modifications in time and/or in space. The Airspace Users also decide on who meets the constraint i.e. through the User Driven Prioritisation Process (UDPP) in case of severe capacity shortfall. That is, the Airspace Users are the only ones able to assign their flights a priority based on each flight's marginal cost.

In addition, Medium/Short Term Network Planning, overseen by the network management function, will be founded on a number of key improvements:

- Collaborative Decision Making (CDM), enabled by common information sharing, will be enlarged throughout the planning phase;
- Shared Business Trajectories (SBTs) will be the focus of decision-making during the whole planning phase. They will contain high-quality data and more information than the current flight plan;
- SBTs will be managed uniquely through a common operational object, the Network Operations Plan, accessible to all ATM Stakeholders via SWIM.

NOP is the cornerstone of network planning activities. The NOP provides visibility of the demand and capacity situation, the agreements reached, detailed business / mission trajectory information, resource planning information as well as access to simulation tools for scenario modelling. It draws on the latest available information being shared in the system. It includes scenarios to assist in managing diverse events that may threaten the network in order to restore stability of operations as quickly as possible. In SESAR the NOP is a dynamic rolling plan for continuous operations rather than a series of discrete daily plans.

Stakeholders will use the Network Operations Plan as the single portal for access to ATM information. To interface with the NOP, all ATM Stakeholders will use the Network Operations Planner i.e. NOPLA. The NOPLA is the set of interactive and collaborative applications providing access to the NOP. The NOP is continually accessible to ATM partners and evolves during the planning and execution phases through iterative and collaborative processes.

If after all possible demand / capacity balancing measures have been taken, there is still an excess of demand, Network Management will work in close collaboration with individual Airspace Users, Airports and ANSPs to decide if the potential level of delay is acceptable or if and how the demand and the capacity shortfall will be managed (UDPP).

During the execution phase the NOP will continue to reflect updated information, including data from aircraft, ensuring access to the most up to date situation.

Network planning works on the following high-level processes:

- **A2.1: Plan Traffic and Airspace Requirements;**
- **A2.2: Refine ATM Resources;**
- **A2.3: Balance Planned Demand and Capacity.**

A synopsis of Medium/Short Term Network Planning is summarised as follows:

- Airspace Users declare their flight intentions and optimise their trajectory through SBTs, in accordance with their business model. Military users declare their airspace requirements. The NOP is visible to all of them at all times;
- The airspace is organised so as to respect their preferences and provide enough capacity, taking into account airspace requirements;
- The planned traffic and airspace demand and the planned capacity are evaluated by the Network Management function, so as to detect potential imbalances;
- In case of imbalance, a DCB Solution is selected in the Catalogue or elaborated with possible network impact assessment;
- The solution is then applied, resulting in capacity adjustments and possibly demand adjustments if advisories are notified or constraints are necessary. Airspace

reservations are also optimised accordingly, if possible. UDPP is exceptionally triggered to prioritise flights;

- The foreseen ATM picture is reassessed after implementation of the DCB Solution;
- The DCB loop runs iteratively during the medium and short term planning phases so that demand and capacity are balanced when SBTs become stable: the execution of RBTs can start, being served by the optimal Capacity Plan and the optimal Airspace Use Plan.

2.3 Exercise Objectives

The objectives of Episode 3 WP3.3.1 are:

- To obtain the operational details related to the ATM Collaborative Planning: available information along the phases coming from the different **civil and military actors** – e.g. users, airports, service providers - granularity of the information, the actors involved in every phase of the planning, the main milestones that could change the plan;
- To refine the operational scenarios and the relevant DOD's;
- To provide feedback on the technical approach and the validation scenarios to be simulated in other EP3 WP3 activities;
- To analyse the consistency of the validation results in other EP3 WP3 activities;
- To provide feedback on Expert Group as a validation technique.

In particular, this Collaborative Network Planning Expert Group is focussed on the activities related to Medium and Short-Term Planning process, addressing specifically the end of the medium term i.e. 1 day before the day of operation and the short term i.e. some hours before the operation.

2.4 Expected Output

The expert group was expected to produce the following results:

- Support to refinement of the current DOD's;
- Operational details related to the Collaborative Planning at Network Level:
  - Planning Phases and available information;
  - Granularity of the information;
  - Actors, roles and responsibilities involved in every phase of the planning;
- Refinement of the Operational Scenarios related to EP3 WP3.3.2, EP3 WP3.3.3 and EP3 WP3.3.5 validation exercises;
- Refinement of the experimental approach and validation scenarios to be simulated;
- Analysis of the consistency of the validation results;
- Feedback on Expert Group as a validation technique.

2.5 Tools, Techniques and Methodologies

This Experts Group has been supported by the use of statistical analysis with data and information of the current situation along all the medium & short-term planning ATM phases. Collection and compilation of information from the Experts Group were driven by the use of questionnaires and by regular meetings. The questionnaires were specifically designed to capture the knowledge of the actors identified for this Experts Group, and were orientated to support the EP3 WP3.3.2, EP3 WP3.3.3 and WP3.3.5 validation exercises. The results were then analysed and presented to the group and EP3 WP3.3 validation exercise leaders during the meetings. These public discussions facilitated the consolidation of the information.

This Expert Group has consisted of a continuous task along the project. As mentioned before, EP3 WP3 validation activities received support by EP3 WP3.3.1 Collaborative Network Planning Expert Group during the whole exercises' life-cycle, from the definition of the

operational details of the ATM planning process and the correspondent experimental plans to the final consolidation and analysis of their validation results.

2.6 Interactions, Relationships or Dependencies

EP3 Collaborative Network Planning Expert Group provides feedback and support to three EP3 WP3 validation exercises:

- EP3 WP3.3.2 analyses the collaborative processes to adjust the demand to the available capacity in the short-term planning and execution phases;
- EP3 WP3.3.3 is focused on Airspace Organization and Management;
- EP3 WP 3.3.5 deals with Global Performance at Network Wide Level.

EP3 Collaborative Network Planning Expert Group is not a one-off activity, but more of a long-term support activity during the whole duration of the programme.

Figure 1 depicts the relationships between the EP3 WP3.3.1 Collaborative Network Planning Expert Group and EP3 WP3.3.X validation exercises as well as the different steps of the work done:

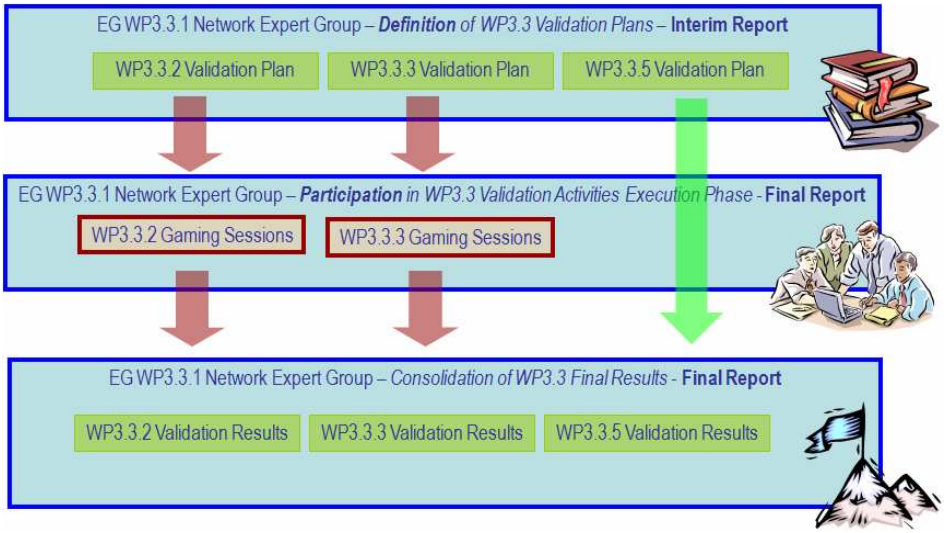

Figure 1: Sequence of validation activities in EP3 WP3

To gain greater understanding of the concept, Collaborative Network Planning Expert Group in EP3 WP3 clarifies the SESAR concept elements related to the Planning Process supported by analytical modelling, gaming and exercises. These descriptions are captured in the associated Detailed Operational Documents that consolidate operational scenarios and use cases used in assessment activity, linked to the SESAR Concept documents. Figure 2 illustrates these flows of information.

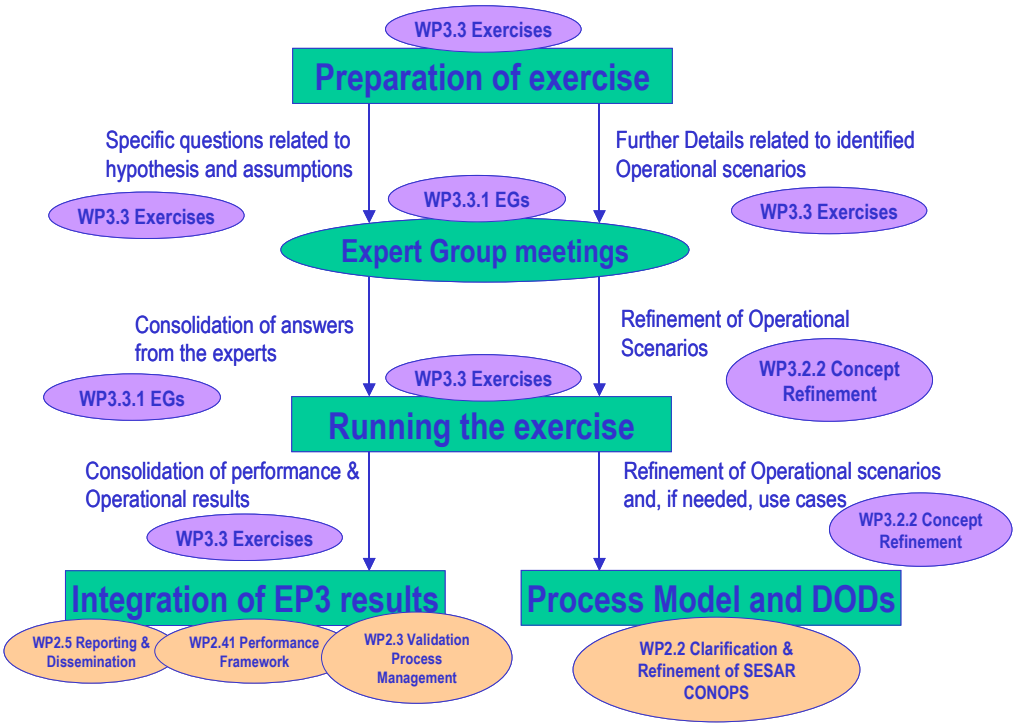

Figure 2: EP3 WP3.3.1 Relations with EP3 WP3 Validation Exercises

The consolidated results and conclusions of EP3 WP3.3.1 Collaborative Network Planning Expert Group feed to the EP3 WP3.4 Collaborative Planning Results and Consolidation.

2.7 ASSUMPTIONS

Before the starting date of the EP3 WP3.3.1 Collaborative Network Planning Expert Group, only an interim release of the following SESAR Detailed Operational Descriptions were issued:

- General Purpose [5];
- Medium/Short Term Planning Phases [9] – i.e. one of the main work documents for the Experts participating in the discussion.

Besides, only preliminary operational scenarios related to each EP3 WP3 exercise were available.

3 OPERATIONAL DETAILS RELATED TO THE CONCEPT BEING ADDRESSED

3.1 General Operational Details

The aim of EPISODE 3 is to conduct validation exercises with the objective of developing a better understanding of the SESAR Concept. To support these exercises, EPISODE 3 needs to refine and clarify the high level SESAR ConOps concept description.

A set of Detailed Operational Description (DOD) documents have therefore been produced to provide a central reference describing the concept with the required level of detail. The ATM Process Model, developed for EPISODE 3, provides a process breakdown of the SESAR ConOps and has been used to structure the list of Detailed Operational Description documents according to the main phases defined by SESAR.

This section is dedicated to the description of the links between EP3 WP3.3.1 Collaborative Network Planning Expert Group activities and the relevant sections for Network Operations contained in:

- Detailed Operational Descriptions (DOD's);
- The SESAR ConOps[2];
- The relevant Operational Improvements i.e. OIs for ATM Collaborative Planning.

This section, consolidated by the EP3 WP3.3.x validation exercise leaders as well as EP3 WP3.2.2, compiles the results from the EP3 WP3.3.1 Expert Group Meetings, and the various questionnaires released by EP3 WP3.3.1, related to the refinement of the DOD's and SESAR ConOps[2].

The Expert Group activity is a structured process that aims at obtaining the views of operational experts on the proposed concept in a set of operational scenarios.

An operational scenario describes a typical ATM situation and a set of events that triggers the application of control actions i.e. DCB measures during the short-term and during the execution phases for this EG.

Operational scenarios shall be clear; parameters precisely defined and concerned ATM functions described with precision, in order to:

- Reduce the number of validation scenarios;
- Provide an early qualitative view of performance when possible.

The EG and the validation exercise leaders reviewed the Operational scenarios before simulation scenarios were detailed.

Coherency with the other EGs has been as far as possible resulted in assumptions cross-check, particularly with EP3 WP4's Complexity Management.

The main foreseen achievements of EP3 WP3.3.1 Collaborative Network Planning Expert Group are summarised in the following points:

- EP3 WP3.3.1 was designed to support the refinement of the following DODs:
  - G – General Purpose;
  - M2 – Medium/Short Term Network Planning;
  - E4 – Network Management in the Execution Phase.
- The Collaborative Network Planning Expert Group contributed to refine two Operational Scenarios:
  - OS-11 – Non-Severe (No UDPP) capacity Shortfall impacting arrivals in the Short Term;
  - OS-34 – Military Collaboration in Medium and Short Term.

DOD M2 [9] focuses on the operating principles relevant to the Medium/Short Term Planning Phase for:

- Network management;
- Airspace management;
- Airspace user operations, when interacting with the network management function.

This DOD addresses on sequence the Medium Term, and then the Short Term Planning Phase:

- Medium Term Planning starts some six months in advance and revises the long term plans on the basis of declared flight intentions, initially known at seasonal level. Identified situations of imbalance are collaboratively worked out - e.g. selection, modification, elaboration of predefined DCB solutions - so as to prepare the short term planning phase;
- Short Term Planning starts on the day of operation: the information is almost fully available with a high level of quality and accuracy, i.e. a few hours - 2, 3 or 4 - before departure for each flight i.e. when a SBT is available with the required quality and accuracy level. Short Term Planning works on a mixed picture: on the one hand, a part of the traffic demand is still missing while on the other hand some flights are already in execution. It is worth noting that the short term planning and the execution phases are interlaced.

DOD E4 [6] addresses the execution phase:

- The Planning phase ends with the publication of the RBT – which the user agrees to fly and the ANSP and Airports agree to facilitate;
- Until aircraft are airborne, available data retains a level of uncertainty that limits their use for purposes other than planning. Once aircraft are airborne or close to, trajectories attain high precision in the time dimension. This data is shared and is available via the NOP or other appropriate means;
- Sub-Regional Network Management takes most of the initiative in this phase assuring the most efficient operation. Regional Network Management assures stability of the whole network. The objective will be to deal with the majority of events with pre-defined solutions agreed during the planning phase;
- Strategic de-confliction1 of individual flights i.e. 2D and 3D route allocation for departures and arrivals, enhanced ATC planning should reduce the need for tactical intervention on individual aircraft. Sectorisation may be dynamically adapted to changing traffic patterns to make best use of the available ANSP resources. Close co-operation with military authorities assures the smooth transition to/from periods of airspace reservation with as much prior notice as possible so that any opportunities for efficiencies can be fully exploited. During this phase, network management seeks to ensure the users business outcomes for individual flights and to maximise overall network performance.

Figure 3 shows the layered ATM process and the Business Trajectory lifecycle as described within SESAR ConOps.

1 The term Strategic De-confliction is used in this context to mean actions taken when the take-off time is known with sufficient accuracy after push-back or even after the flight is airborne i.e. 15 min, 40 min for ATC planning conflict management and 40 min and more for complexity management and dynamic DCB, before entry in high-density areas. The related DCB measures exclude tactical instructions and clearances that need an immediate response, but include activities such as dynamic route allocation.

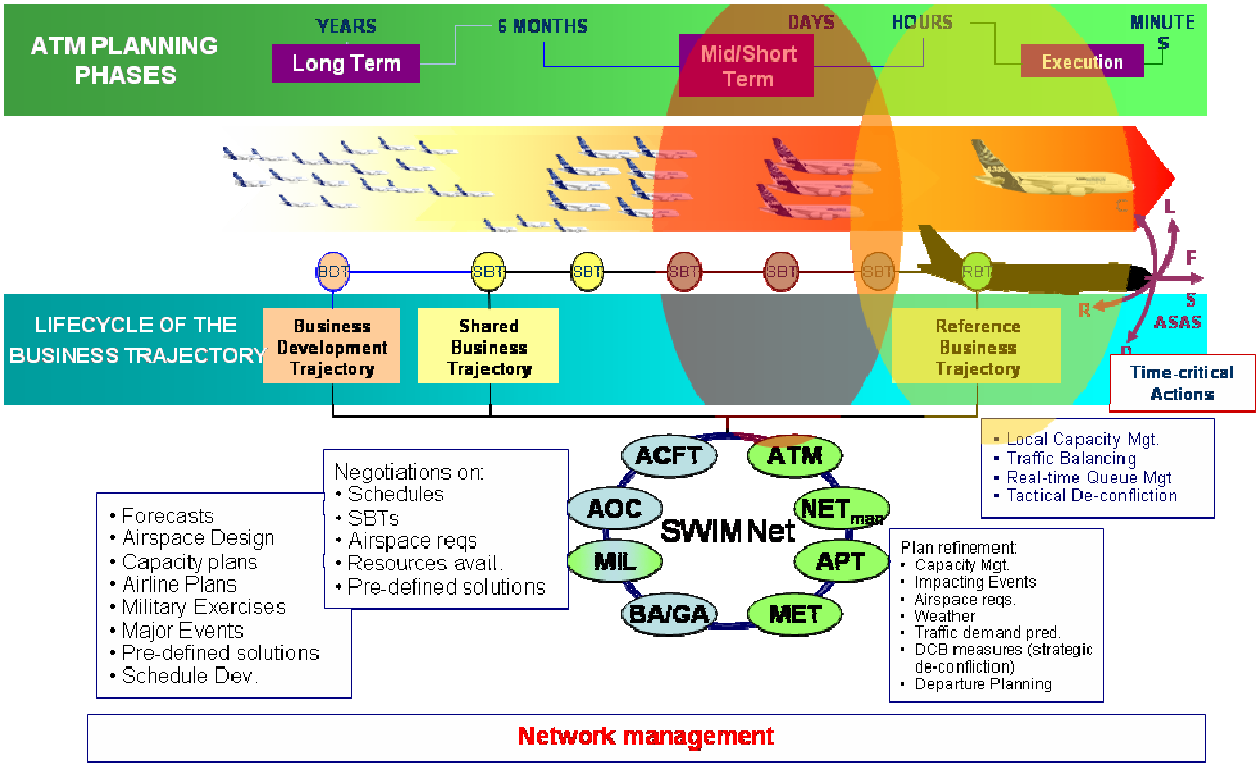

Figure 3: Layered ATM process and the Business Trajectory lifecycle.

The red oval of Figure 3 represents the medium-term/short-term phase while the yellow one highlights the execution phase.

The applicable DOD for the EP3 WP3.3.3 "Airspace Organization and Management" is **M2 Medium/Short Term Network Planning** [9].

The applicable DOD for the EP3 WP3.3.2 "Business Trajectory Management and Dynamic DCB" is **M2 Medium/Short Term Network Planning** [9]**Erreur ! Source du renvoi introuvable.**.

Details on business trajectory management and dynamic DCB can also be found in:

- E4 DOD on Network Management in the Execution Phase [6];
- Operational Scenario OS-11 – Non-severe capacity shortfall impacting arrivals in the short term [11].

It has to be emphasised that the exercise only partly covered the related processes as only one type of DCB solution was addressed.

Table 3 shows a summary of the aforementioned link between the EP3 WP3 validation exercises, the DODs and the Operational Scenarios.

Validation Exercise	DOD	Operational Scenario
EP3 WP3.3.2	M2 – Medium – Short Term Network Planning	OS-11 – Non Severe (no UDPP) capacity shortfall impacting arrivals in the Short-Term
	E4 – DOD on Network Management in the Execution Phase	N/A
EP3 WP3.3.3	M2 – Medium – Short Term Network Planning	OS-34 – Military Collaboration in the Medium and Short-Term

Table 3: Link between EP3 Validation Exercises, DoDs and Operational Scenarios

Although no specific DOD has been identified for EP3 WP3.3.5 Macro model validation exercise, the EP3 WP3.3.1 Collaborative Network Planning Expert Group has also provided feedback to the exercise, identifying validation scenarios and assumptions.

The details provided by EP3 WP3.3.2, EP3 WP3.3.3 and EP3 WP3.3.5 validation exercises can be found in sections 4.3.2, 5.3.2 and 6.3.2 respectively.

3.2 REFINEMENT OF THE OPERATIONAL SCENARIOS

As contribution for the ConOps detailing process, Episode 3 validation activities have refined a set of Operational Scenarios which represent a step further respect to the DOD level of detail. This section details the operational scenarios to which the EP3 WP3.3.1 Expert Group has contributed to.

EP3.WP3.3.1 Collaborative Network Planning Expert Group activities provide feedback to the following operational scenarios:

Operational Scenario	Validation Exercise
OS-11 – Non-severe (no UDPP) capacity shortfall impacting arrivals in the short term	EP3 WP3.3.2
OS-34 – Military collaboration in the medium and short term	EP3 WP3.3.3

Table 4: List of Operational Scenarios

The Operational Scenario linked to EP3 WP3.3.2 “Business Trajectory Management and Dynamic DCB” is OS-11 – Non-severe capacity shortfall impacting arrivals in the short term [11]. The operational scenario describes the resolution of a local imbalance facing a European airport in 2020 on the day of operations i.e. during the short-term planning phase and execution phase. The imbalance is subsequent to a capacity shortfall resulting from sudden adverse weather conditions. The imbalance, albeit non-critical, is identified at short notice and occurs during a busy time period. Therefore, actions have to be taken to rebalance the situation at the airport and in the vicinity i.e. terminal airspace.

The Operational Scenario linked to EP3 WP3.3.3 “Airspace Organization and Management” is the OS-34 Military Collaboration in the Medium and Short-Term [12]. In the corresponding exercise, some validation scenarios i.e. defined from the previous document are tested to get the expected results. The operational scenario describes the processes that are triggered when the military request an airspace reservation during the Medium and Short Term Phases in the light of the SESAR ConOps i.e. Advance Flexible Use of Airspace.

3.2.1 Non-Severe (no UDPP[2]) Capacity Shortfall Impacting Arrivals in Short-Term

Operational Scenario OS-11 treats Non-Severe (No UDPP) Capacity Shortfalls impacting Arrivals in the Short-Term planning phase and extended to the execution phase.

The operational scenario describes the resolution of a local imbalance facing a European airport in 2020 on the day of operations i.e. during the short-term planning phase and execution phase. The imbalance is subsequent to a capacity shortfall resulting from sudden adverse weather conditions. The imbalance, albeit non-critical, is identified at short notice and occurs during a busy time period. Therefore, actions have to be taken to rebalance the situation at the airport and in the vicinity i.e. terminal airspace. Those actions result from the application of a predefined DCB Solution, primarily impacting arrivals and taking the form of a DCB queue management process. Those actions are described together with the operational events they respond to. The processes relevant to it are addressed in the Detailed Operational Descriptions related to network management on the day of operations.

[2] UDPP: User Driven Prioritisation Process

Non-severe (or non-significant) capacity shortfalls can be solved without UDPP use, contrary to severe (significant) capacity shortfalls. Severity can be defined as a maximal capacity overload e.g. 20% or as a maximal overload during a time period e.g. 3 hours in a row with a 10% capacity overload, or as a maximal admissible delay per flight, or in some other way.

The identified questions, listed in Annex 9, can be can be grouped into three classes:

- Concept definition for example UDPP;
- Technical questions dealing for example with getting into details with the dynamic DCB process;
- Parameterisation like the assumption on ATM level 3 capability.

The following sections provide the questions and the answers provided by the experts (agreed or not).

3.2.1.1 Questions dealing with concept definition

The differences between the two following processes of the ATM process model, 2.3.2 “Propose a DCB solution” and 3.1.3 “Propose a Dynamic DCB solution”, needed clarification, in particular the conditions and the time of activation of each of these processes, as well as the frontier between the short term processes and the execution process.

Experts provide the following stand points:

- A DCB measure applies up to the initial RBT while a dynamic DCB measure applies to the actual RBT;
- Process “Propose a DCB solution” can be applied 2 hours before the constraint while “Propose a Dynamic DCB solution” can be applied from 2 hours to 40 minutes before the constraint;
- A dynamic DCB solution is implemented for a short time execution, for instance with half an hour to 4 hours time horizon; it is an additional constraint or relaxation to the DCB plan. Therefore, it is a temporary change of a constraint described in the DCB plan.

Most of the Experts agree that a DCB solution is defined / applied from several hours to 60 minutes in advance during the planning phase while a dynamic DCB solution applies between 2 hours and 40 minutes during the execution phase.

Both processes must be seen as continuous processes even if the planning phase ends with the publication of the RBT the user agrees to fly and the ANSP and Airports agree to facilitate.

It is necessary to analyse the differences between the sub-processes of the ATM process model 3.1.3.1.2 “S/R/E a Dynamic DCB solution at Airspace Level” and 3.1.3.2.2 “Apply the Dynamic DCB solution”. According to the Operational Scenario, it is needed further clarification of:

- Which one performs the DCB queues TTAs calculations in what-if mode?
- Which one updates these TTAs in the NOP?
- Who is responsible for updating the new EOBT agreed between AOCs and APOCs (SBT case)?

The Expert Group agrees on the following answers:

- It is the role of the regional / sub-regional / network manager or Civil-military airspace manager or AOC/APOC staff to propose a dynamic DCB solution;
- To assess network impact of a dynamic DCB solution is dedicated to the regional network manager;
- “Apply the DCB solution” is the role of the sub-regional network manager, or the APOC staff by “sending a GO for implementation concerning solutions that have been activated in the NOP”;
- Concerning TTA update:

  - The System will (re)-calculate all the concerned TTAs in case of a DCB solution is implemented;
  - It will be the role of the AOCs to propose a different TTA depending on their operational requirements;
  - In this case, the System will validate the corresponding SBT/RBTs including the TTA;
- Concerning the EOBT update:
  - After validation of the SBT/RBT by the system, the new SBR/RBT is published in the NOP;
  - Since AOs have not a global stand point, it is the responsibility of the APOC to make sure that the updated EOBTs have been transmitted.

Regarding the initiation and triggering of the UDPP process, the Expert Group provides the following answers:

- UDPP would be triggered in case of sudden capacity reduction due to e.g. weather, accidents that can be defined as crisis-like situations. This means that UDPP should only be used when DCB cannot cope with the ATM situation;
- A single AO should not be able to initiate a UDPP. However, several AOs could. The minimal number of required AOs or the parameters needed to work it out has not been defined by the EG;
- UDPP process can be initiated by AOs (or their representatives) or by ATM;

  HOT TOPIC: the EG approach on UDPP does not comply with the SESAR concept where UDPP could be initiated by the AOs, by the APOC acting as a focal point but it could only be triggered by the Regional Network Manager;
- When a UDPP process is triggered by ATM i.e. the regional network manager, the indicators could be:
  - Capacity decrease if there is no solution without heavy constraints;
  - Capacity decrease, having several equivalent solutions;
  - Several requests coming from different AOs and concerning traffic flying in the same airspace or going to the same airport;
  - Level of delay is also mentioned. In this case it is required a what-if tool.

CONSENSUS has not been reached by all the Experts. Nevertheless, regarding the content of the validation exercise, it is not critical to agree on the definition of what "initiate" and "trigger" mean in the context of UDPP. On the other hand, the definition of the trigger is of a major importance. The different interesting possibilities are defined in the frame of the validation exercise scenarios.

Regarding the time horizon when the UDPP is applicable the Experts provide the following answers, each of them raising a hot topic since the obtained feedback is not compliant with the SESAR ConOps:

- UDPP can deal with whatever known BT, even with RBT

  HOT TOPIC: The concept supposes that UDPP will not be applied to airborne flights (a too difficult CDM process to put in place).

  First HOT TOPIC could be tested and taken on-board as a specific validation scenario;
- UDPP should not only be applied during the short term planning phase. A UDPP process can be triggered when a downgraded situation is expected in several hours e.g. - 24 hours or days.

  HOT TOPIC: The concept supposes that if a capacity drop could be predicted sufficiently in advance, standard DCB processes should be applied first,(in fact, this is not an unpredicted and sudden situation). According to concept, -4h / -3h seems acceptable. Consensus must be reached and time horizons tested (possible feed-back to DOD's).

A CONSENSUS has been reached regarding the second HOT TOPIC: the validation scenario will apply UDPP during the day of operation only.

Finally, the experts are asked to provide their opinion on whether the pre-definition of the list of high priority flights is relevant or not in case of application of UDPP.

The idea is for AOCs to pre-define a list of flights according to individual flight priority but also with reference to AOC's business model. The challenge is to provide a robust list made of flights that have, as far as possible, stable marginal cost. For this reason, a possibility for modifying the list is mentioned.

Although there are remarks expressing that if the users are responsible for defining the rules to work out a flight list in case of UDPP application, it is not necessary to have a flight pre-list a consensus has been reached. A flight pre-list is worth being defined. This should be part of the validation scenarios and re-injected in the DOD's L [7], M1 [8], M2 [9]& E4 [10] depending on simulation results.

Asked about whether Slot Swapping, flight cancellation, negotiation of TTA, etc. are part of the standard process or they must be dedicated to UDPP, the Experts have different views:

- The UDPP processes and details belong to the users. It is their responsibility to define and implement these processes. The ATM services are just informed of the results of UDPP, and it is necessary to define how the requests and the answers from users and service providers have to be managed;
- Even for standard procedures:
  - Who can make a request?
  - Who is the ATM correspondent?
  - Who is the correspondent of the ATM representative: one AO or a representative of AOs in charge of the process?
  - What is the delay for a negotiation?
  - When does a SBT become a RBT?
  - In case of disagreement, who has the final decision?

There was no final agreement within the Expert Group. Therefore, roles, responsibilities and CDM processes, including UDPP and more standard procedures like flight cancellation or slot swapping, have to be defined accurately. This could be achieved through gaming exercises. Results might trigger modification in almost all the DOD's.

3.2.1.2 Technical questions – Parameterisation

Regarding the DCB Queue Management active time horizon, the goal of this technical analysis is to state which option seems to be the most appropriate between:

- Option 1: The limit for starting sending a TTA could be defined by a fixed time parameter before the ETA or else;
- Option 2: The limit for starting sending a TTA could be defined by a time parameter that would depend on the severity of the congestion (i.e. the level of calculated delays).

The expert group prefers Option 1. The DCB active time horizon should be a fixed time parameter. Nevertheless, delay monitoring should be possible before the DCB active time horizon.

Experts fear an increased number of SBT changes due to an improved monitoring and to the extended use of what if tools. For this reason, they suggest that it is essential to set working methods as simple and constant as possible.

Concerning the Boundaries between Dynamic DCB and AMAN the experts agreed that between 40 to 50 minutes seems to be reasonable.

A gap between the end of the dynamic DCB active horizon i.e. 50 minutes and the beginning of the AMAN active horizon i.e. 40 minutes has been defined and presented in the operational scenario OS-11.The aim of this gap is to stabilize the RBT by avoiding any late request

coming from the dynamic DCB process that would be discarded by the AMAN almost immediately. That means that by having them, they inhibit the emission of a TTA almost when entering the active AMAN horizon. In addition, like any measure, there is a minimal duration for implementation estimated to 10 minutes. Experts think that this feature was too microscopic compared to the magnitude of other envisaged parameters and therefore they consider that it is not essential to implement it.

The Experts also highlight that the interface between dynamic DCB and AMAN would naturally be done through RBT updates published in NOP/SWIM.

HOT TOPIC: AOs insisted on the importance of taking into account their operational requirements regarding fuel forecast due to en route variations i.e. dynamic DCB.

The experts were asked whether the AMAN and dynamic DCB Processes can be managed by a unique system i.e. Extended AMAN or by two distinct systems.

All the Experts agree to have both functionalities i.e. arrival management and dynamic DCB considering two separated tools i.e. an AMAN and dynamic DCB since:

- Not all flights are subject to DCB and/or AMAN estimates;
- Capacity problems are along the entire route and the AMAN is focused on the last part of the arrival.

Other considerations provided by the Expert Group:

- Extending the AMAN would imply that several AMANs overlap or are adjacent to each other. This is going to increase complexity as each AMAN tries to optimise the traffic for its own airport;
- In addition, the more the Arrival Manager is extended outwards from an airport, the more it becomes a network function.

Complementary Concerns are expressed:

- Both processes must have compatible outputs (in particular TTA/CTA);
- A mono system can be envisaged but, if one system is out of order the other one must still work.

HOT TOPIC: Nevertheless, this architecture being not compliant with the ConOps, it could be recommended defining two different validation scenarios:

- AMAN + dynamic DCB;
- AMAN + extended Arrival Manager.

In case there is a unique extended AMAN, the experts were asked to provide their opinion about the “ownership” of the system knowing that there might be a network impact. Also, at which level i.e. local, sub-regional or regional the operational requirements of the system and associated operational procedures should be defined.

Mainly 2 stand points are expressed:

- The owner should be the Network Manager;
- But, if the area for which the AMAN is working is a FIR or a TMA or the approach sector, this will be the owner.

Regarding the set of criteria/factors that influence the determination of the temporal planning horizon for both the AMAN and the Dynamic DCB process, the Expert Group provides the following answers:

- For the AMAN
  - TMA extension;
  - Type of approach.
- For Dynamic DCB
  - Time needed to perform analysis e.g. type/importance of congestion, evaluate/analyse changes and ways to avoid ASM/DCB measures;

    - Time required for understanding the general overview of the network and regulations.
- For both:
    - Meteorological information;
    - Military activity;
    - network complexity;
    - Busy/complex aerodrome;
    - Have the definitive constraint with a sufficient delay enabling to manage the flights in a normal way e.g. no excessive speed change, no complex and urgent actions on the traffic.

Concerning the TTAs, the first question the first question to the expert group tried to clarify about on which point of the 4D trajectory the DCB constraints should be applied regarding the TTA: the IAF or the FAF or at the transition between the DCB queue and the AMAN horizon. It is also needed to know if the application point of the DCB measures is the same than for the AMAN.

Based on Expert's feedback, DCB and AMAN constraints should be compatible and thus on the same point i.e. the IAF. Other DCB constraints should be far from the IAF so that the pilot could adjust the RBT: the compatibility between the TTA and the CTA, and between any TTO and the CTA has to be checked during validation exercises.

When a TTA is issued, which measure must be applied in case of no reply from the AOC? What to do if the returned business trajectory does not cope with the proposed TTA and does not solve the imbalance through application of a later TTA proposed by the AO?

Here follow most of the Experts' answers:

- Without timely answer, the proposed TTA will be effective;
- The system asks the AOC how to manage the delay associated to the actual TTA. The AOC should, at the same time, confirm the compliance with the TTA, and also its intention of dealing with the delay;
- If a TTA cannot be accomplished by any means, there must be a later TTA no matter how long afterwards so that the AO can be able to cope with, and at the same time, solves the imbalance;
- Remove aircraft from sequence;
- Is it a regulatory issue that EP3 WP3.3.2 does not have to test as a standard situation?

Concerning TTA update, the feedback from the expert is listed below:

- It could be the role of the AOC to update the TTA according to the operational requirements of the company;
- After validation of the SBT/RBT (including the TTA) by the System, the new SBR/RBT is published in the NOP;
- As soon as an ASM/DCB solution has been agreed and implemented, the System calculates all the corresponding TTAs that are automatically transmitted to the relevant actors and systems through the NOP.

In the case of a TTA is assigned to an airborne-flight, the experts were asked to select, between the following actors, which one should make the initial proposal to achieve it:

- The executive controller looking only at the airspace under his responsibility?
- The sub-regional Manager looking at the whole airspace until the AMAN Active horizon and advising the executive controller?
- The flight crew?

The Experts' proposals are the following:

- The sub-regional manager;

- The flight crew;
- The flight crew for ATM service level 3 capable a/c, AOC and ATC for the others.

The first TTA, and all the updates of this TTA, will be sent automatically to all the concerned stakeholders through NOP/SWIM: there is no need for the executive controller or any regional manager to inform the crew:

- When a TTA is proposed to a flight, it is sent at the same time to all the concerned actors in charge of accepting or not this TTA: the crew and the AOC staff;
- When accepting this TTA, the crew, with the agreement of the AOC Staff, will issue a new RBT, if necessary; this revised RBT will be the active one and will be delivered via NOP/SWIM to the ATM actors and the AOC;
- If this TTA is rejected, another process is set up i.e. negotiation.

The flight crew for ATM service level 3 capable a/c, AOC and ATC for the others, will suggest the initial proposal to achieve a new TTA when airborne.

The experts were asked about the necessity of implementing a ground trajectory tool aiming at:

- Checking compliance of S-R/BT with ATM constraints;
- Validating that the proposed S-R/BT does not create adverse effect on the NOP;
- Providing assistance to SBT elaboration.

Expert's answers are grouped into two classes:

1. If the SBT is good enough, there is NO need of a Ground Trajectory Tool. The SBT has to follow the ATM constraints.

2. YES! It is mandatory because:

- Rules are more and more numerous and are likely to change frequently;
- AOs will try more and more to optimise their S/RBT, a SESAR key concept element.

The Expert group agrees with answer #2.

DOD's M2 and E4 could be impacted by these validation exercise results:

- Through M2's process Validate SBT (A2.1.2.3);
- Through E4's process Validate RBT Changes (A3.5.1.2).

Validating a "changed" S/RBT aims at:

- Checking that the declared 4D trajectory is consistent with the aircraft type, 3D profile and with any other parameter that may characterize the S/RBT;
- Verifying that the 4D profile is compatible with the airspace resources to be activated at the moment the flight will be using it;
- Making sure the "new" S/RBT has no adverse impact on the network.

The experts were also asked about the degrees of freedom for AOC to re-plan a BT. The different Experts' views are the following:

- If there is only a TTA, accordingly with the actual state of the art, the flight will be passing through a lot of conflicting points and since flight's trajectory is calculated from departure, so it must depart at calculated time;
- In a perfect world, the process will be: let actors ask what they want based on the assumption that everybody is honest and play the game. But since this is not a perfect world and there is a possibility of trying to bypass and maybe play tricks, rules to ensure equity have to be defined;
- More generally, AOs need total freedom to re-plan;
- Re-planning / modification of variables like the taxi-time should be part of a specific CDM process e.g. airport CDM.

The Experts concluded that the example given above i.e. taxi time variation does not appear as a positive solution, or at least for some AOC it may not be worth performing. The answers provided are spread, making possible validation scenarios difficult to define.

Concerning the priority between several flights having the same TTA the Expert Group was asked to discuss if the following statements are true or not:

- Airborne fights have priority over the flights having a RBT but still on ground;
- Flights having a RBT have priority over those having a SBT?

Three different options have been mentioned by the Experts; therefore consensus has not been reached:

- If two flights have the same ETA, then they have the same rights. The solution can be UDPP;
- Poor arrival management if 2 flights have the same RTA: true but in our case, this is about ETA;
- Majority of people give airborne flights priority over a/c still on the ground. Reasons given are safety and cost effectiveness.

The expert group agreed on the actions that a standard CDM process should manage. These are the actions:

- the sub-regional manager is informed about the lack of capacity;
- DCB queue solution is selected;
- Network Function calculates TTAs;
- flight crews and AOCs are informed;
- AOCs vs APOCs negotiations;
- Flight crew vs Executive Controller negotiations;
- all flights agree with their TTAs and the way to achieve them.

The question is whether 10 minutes are enough or not to manage the standard CDM process described above. According to the Expert Group, there are two options:

- Too much negotiation or not enough time i.e. at least 30 minutes;
- It depends on the number of flights concerned. In addition what has been or can be negotiated has to be revisited and therefore, the related time needed for negotiation recalculated.

The Expert group concludes that specific CDM sessions should be organised e.g. like the EUROCONTROLs' CAMES project to address the potential CDM session duration problem.

These are the main conclusions related to the Network Effect object of discussion within the Expert Group Sessions:

- There is a need to manage the network effect;
- The identified actors are the AOC, APOC, ATC and sub-regional network manager;
- There is a need of means to perform CDM. Access to the NOP mentioned once;
- If a CDM process has to be used e.g. cases where the normal coordination process is not sufficient it is the role of the sub regional manager to cope with the situation and to coordinate with the relevant actors;
- Current tools to perform monitoring of traffic and capacity and what-if tools to calculate delay are sufficient.

As a conclusion, this shows that network effect assessment should be continuously performed at least at a sub-regional level since the regional / central level that would check the whole network stability has not been mentioned.

3.2.1.3 Questions dealing with parameterization

About the ATM Service Level Required, the full question is what seems to be the most realistic scenario in 2020:

- Option 1: 100% of aircraft will be ATM service level 3 operations capable;
- Option 2: Only 75% of aircraft will be ATM service level 3 operations capable.

In case Option 2 is the most realistic one, then the experts are asked to provide feedback about what needs to be considered for the remaining 25% of aircraft.

Option #2 seems to be the most consensual option amongst the Experts. Of course, the level of equipage depends on equipment prices, regulatory aspects and service provided by ANPS according to capability.

The remaining 25% of aircraft should be considered as equipped with:

- ADS-B and datalink;
- Conflict detection with surrounding aircraft.

Restrictions and lower priority will be applied to non-equipped aircraft.

The Expert Group agrees that a sensitivity analysis on the percentage of equipped aircraft is recommendable e.g. 100% of aircraft equipped.

Experts are asked to provide their opinion about the most realistic value for the percentage of aircraft connected to the Network via SWIM in 2020.

There is high variety of answers:

- From the most pessimistic: at most 50% of flights;
- To the most optimistic: almost 100% of flights.

As final conclusion, Experts assume that 75% of flights are connected to SWIM in 2020. In a second step, a sensitivity analysis will be performed by considering that 100% of flights are connected to SWIM.

3.2.1.4 Operational improvements considered

Table 5 provides a summary of the conclusions per OI or group or OIs:

OI ref	OI label	Description	Feedback
DCB-0103	SWIM enabled NOP	The NOP provides a relational image of the state of the ATM environment for past, present and future. The user, via the appropriate applications, is able to view this image, moving the window along the timeline and focusing on any particular aspect or aspects he or she is interested in. The plan itself is the result of the complex interactions between the trajectories shared into the system, the capacity being offered, the actual and forecast MET conditions, resource availability, etc. and the automatic and manual negotiations that have been carried out.	Provided operational scenario OS-11, connectivity to SWIM enabled NOP has been discussed according to ATM service level and system capabilities. The discussions focused on the proportion of traffic that could be connected to could and able to receive control actions dealing with A-FUA and dynamic DCB. No detailed investigation on the NOP content has been performed.
AUO-0101	ATFM Slot Swapping	Aircraft Operators' tactical priorities are introduced in a cooperative process with the CFMU through ATFM slot exchanges Such slot exchange could be for instance between flights within a single company or within a strategic alliance of companies.	Some experts consider slot swapping as part of UDPP

OI ref	OI label	Description	Feedback
AUO-0102 DCB-0305	User Driven Prioritisation Process (UDPP). Network Management Function In Support of UDPP	This process will be needed in case of disruptions of the network and at congested airports. This process leaves room for airspace users to trade slots if they individually agree to do so based on agreements and rules that are transparent to the other actors but that respect sets of rules agreed by all parties. The process is permanently monitored by the Network Management function in order to make sure that an acceptable solution is available in due time and that all concerned parties are aware of any adverse network wide effects that may develop.	Diverging opinions on when UDPP should apply e.g. normal congested situation versus crisis situations occurring during the medium term or the short term planning or/and execution phases. Diverging opinions on who should trigger the UDPP process? And on who should monitor and manage the UDPP process? Some experts e.g. airspaces users suggested that a pre-list of high-priority flights could be defined in advance during the medium-term planning phase and refined once UDPP is defined. .
AUO-0203, AUO-0204	Collaborative planning of SBTs and of RBTs	Airspace Users can participate to SBT/RBT trajectories optimisation	Changes to RBTs in order to optimise airspace use, coming from network management and airspace management, should be limited to the minimum due to aircraft management policy. The possibility offered to airspace users to optimise freely the SBT/RBT given a TTA at the arrival is considered as of limited interest for some airspace users.
DCB-0208	Dynamic ATFCM	Use of 4D trajectory updates in the ATFCM process in order to optimise the network usage.	The notion of arrival congestion management can be seen as a pure AMAN process complemented with an upstream process that can be either an extended AMAN or dynamic DCB process. At this stage of the maturity of the concept, the experts have the feeling that can't express a consistent opinion on this topic. The interface between queue management and dynamic DCB need to be clarified.
TS-0303 TS-0305 TS-01-06	Arrival Management into Multiple Airports Arrival Management Extended to En Route Airspace Multiple Controlled times of Over-fly (CTOs) through use of data link	Ois related to arrival queue management.	See conclusions on OI DCB-0208 (dynamic ATFCM)

Table 5: EP3 WP3.3.2 List of OIs and feedback from Experts

3.2.2 Military Collaboration in the Medium and Short-Term

The questionnaire in Annex 9[3], launched to the EP3 WP3.3.1 Collaborative Network Planning Expert Group, gathers the set of questions discussed during the Expert Group sessions about the Operational Scenario OS-34 Military Collaboration during Medium/Short Term Planning [12].

The outcome of the Expert Group related to OS-34 Military Collaboration during Medium/Short Term Planning [12] is listed below:

3.2.2.1 Airspace Reservation

The experts were asked to provide general information about the military activities nowadays. They are basically classified in:

- **Major/Special Exercises**: The yearly plan contains the planned exercises in terms of airspace impact e.g. international, national, and regional, altitude, and managed and/or unmanaged airspace. This plan is defined through CDM sessions between civilians and MIL. Some weeks before the Day of Operation, the location, size and timeframe of these military activities are refined;
- **Day to day Exercises**: These activities are planned the day before the Day of Operation or even the same day. Airspace needs for the exercise are coordinated in the medium term planning phase, and day-to-day operations of the military exercises are conducted accordingly. Only tactical changes to the agreed airspace are subject to CDM process.

Regarding these different military activities, the experts agreed on the following statements:

1. The airspace requirements in the day to day operations or exercises, which are the majority, are not known two days before the operation but one day before or even the same day of operation;
2. The critical issue is that the future concept will provide more dynamicity of than the current system and would allow the airspace reservations to be requested as late as possible, when necessary. Then, there is no added value determining/identifying the percentage of known airspace requirements 2 days before the operation. So, any reference to the percentage should be removed from the operational scenario.

3.2.2.2 Airspace Configuration

Regarding the size and shape of the VGA for military exercise, the OS-34 says that "*ALPHA VGA is made of a core region which is a CBA of approximately 100NM diameter: Two additional lobes are now required to facilitate long distance air-to-air fighting".*

EP3 WP3.3.3 needed further details on the shape of the VGA and on the length of the lobes.

Experts agreed on saying that the size of the core region is dependent on the military requirements that are, in turn, dependant on the mission typology e.g. number of aircrafts, mission. For instance, for Eurofighter-Typhoon missions, 100 NM seems reasonable. For flight detections in radar environment (flight identifications, separation assurance, etc.) 50-70 NM is a suitable size.

A basic assumption for EP3 WP3.3.3 validation exercise was that the airspace solutions wouldn't affect the network. The size of the military area will therefore be chosen accordingly. However, In the future it is likely that there will be less military aircraft, but due to the specific operational requirements of the new generation military aircraft, they need increased volumes of airspace to train enhanced operational capabilities. To summarize: less missions flown, but with bigger portions of airspace required.

The dynamic mobile areas are not considered in the timeframe of the exercise i.e. 2015/2020 as they are planned for 2025+.

[3] The answers to these questions have been consolidated through the different subsections.

Regarding the length of the lobes a 20% of the core area is agreed.

3.2.2.3 Scenario

Regarding what OS-34 says about military airspace reservation process, the experts agreed that, potentially, an airspace reservation release may imply capacity gains/opportunities as described in OS-34 [12]. However, the impact may be very variable even not always positive and in any case this impact should be assessed at the regional and sub-regional network level. This impact has to be concisely studied by the Sub-regional and Regional Network Managers e.g. using what-if tools and it can depend on:

- Time before the operation. In this sense, the sooner the airspace release in known the better for taking advantage of it;
- Duration of the release of the Reserved Area;
- Airspace which becomes available.

In any case, an airspace release can be useless in case it induces a negative impact upon the network.

There was a long discussion about the need of maintaining in the system the initial preferences of the users. So, if there is a cancellation of the exercise, all users that were affected taking into account the initial SBT should be notified.

Expert Group provided clarification about the DCB process between military and civil:

There is a significant difference between the planning cycle for day-to-day military operations and special exercises/activities.

- Day-to-day military operations are executed in airspace that is defined e.g. dimensions and conditions for use at strategic level between civil and military authorities; the negotiation for the required airspace, in this case, is conducted at pre-tactical or tactical level, the day before operation or even the day of operation;
- Special exercises/activities are those subject to the planning and coordination cycle that is described in the operational scenario, but the main objective of the negotiation is, in accordance with established priorities, to allow both civil and military airspace users, to conduct simultaneously the respective operations with the minimum possible constraints.

The priority for the military reservations must be ranged taking into account both sides of the problem: the impact in the traffic of passengers and the national defence interest. There will be exceptions, e.g. OPS missions, that may be considered as priority one by the State policies but the SESAR goal is that the airspace has to be shared taking in account the needs of each user i.e. considering Military flights as airspace users with their own specificity.

This military reservation will be the trigger of the negotiation between civil and military:

- 45-60 days before the Day of Operation, the location is negotiated between civil and military;
- 1 week before the Day of Operation, the final snapshot will be tuned. This could be performed even 1 day before, but the involved actors in the negotiation could be different.

Therefore, the main negotiation process is made normally 45-60 days before the day of operation. This is the process that should be considered in the medium term. The users are not involved, but the AMC i.e. the civil part should know the user intentions in terms of SBTs.

The main objective of this negotiation is to maintain the traffic demand without changes or with slight changes, which means, to achieve the necessary capacity without changing the demand i.e. trajectories. However, it might be that a State considers the military ops of highest priority. That is the case of the QRA i.e. Quick Alert Response, a particular mission not mentioned in the ConOps that requires the highest priority without negotiation. In this case this assumption is wrong.

The SESAR philosophy is to involve the users at the last moment when there is no solution without changing the traffic demand. Then, if there is any change on the SBTs, the users will

update their SBTs in the NOP, although the initial information is recorded to come back to it if possible.

When a new DCB solution is applied e. g. a corridor in the military airspace reservation the sub-regional manager will apply a CDM process to agree with the "corridor" solution. The actors involved will be the Exercise Director, as part of Military ASM, and Civil ASM.

All the aeronautical information e.g. AIP, NOTAM according to ICAO should be available in the NOP, but this could collapse. All users will have the necessary information on time, although not all data will be available in the NOP – e.g. the NOP is not updated until the agreement is reached -.

The AMC or Airspace Management Cell is responsible for the final decision on the airspace configuration in coordination with the sub-regional manager.

The Experts were also asked about what may happen if no agreement is reached and which is the timeframe limit to agree a solution.

The expert group agreed that the timeframe limit is not a fix value and should be dependant on the magnitude of the trajectory changes and the time horizon of the operation.

For instance:

- For a release of constraints: 30 minutes would be enough;
- For including new constraints: 30 minutes seems to be not enough.

In case an agreement is not reached, a set of priorities should be identified as a backup to be applied.

Finally, the list below shows other changes on the airspace reservation that are interesting to be analysed according to the prioritisation given by the expert group:

The following suggestions and prioritisation were given for additional scenarios that could be developed:

- Problem of resectorisation with civil and military airspace e.g. airspace, areas, sectors, routes, military areas design: How to take into account resectorisation and the relation with military airspace reservation? ⇒ 11 votes;
- Negotiation failure and finding a remedy: What happens if no agreement is reached? ⇒ 8 votes;
- Responsibility of aircraft during RBT: Analyse the transfer between OAT and military control ⇒ 2 votes. It is also stated that this option is out of scope of the exercise which is focused on planning.

3.2.2.4 Roles and Responsibilities

The expert group was asked to provide feedback on the actors involved in this operational scenario and their responsibilities. Although some specific information related to the validation exercise is provided in section 5.2, these are the actors and their responsibilities as agreed by the Expert group:

The Civil Users i.e. AOC Staff: convey the business intentions of the civil airspace users. As trajectory owners, they hold all the information related to their trajectories and contained in the NOP.

- They always give their consent before any demand adjustment;
- They drive all the user-centric processes, triggered in reaction to imbalance events;
- They will adapt their intentions according to their strategies.

The Exercise Director is the focal point for all MIL Actors, responsible for scheduling the military needs in terms of airspace reservation and time slot at any time.

With respect to **AMC or Airspace Management Cell** and the **Sub-regional Managers,** the Experts agree that **at FAB level** it doesn't make sense to separate both functions. Both functions will be considered inside the same role. At FAB level it is expected that both ASM and ATFCM functions will be integrated in the Sub-Regional Network Manager. It is possible that a Sub-Regional AMC will be established at FAB level, if concerned States agree so.

For the sake of this exercise, the Sub-Regional AMC coordinates airspace requirements with all Approved Agencies and, when such requirements are consolidated, starts the coordination with the ATFCM within the Sub-Regional Network Manager to identify the most suitable solution to allow operations within airspace volumes with the minimum impact for the traffic flows.

At national level, the Expert Group suggests that both roles should be maintained for institutional reasons. The AMC should coordinate with civil and military the airspace needs, and convey this info to the Sub regional Manager that would check that the solution is the most suitable possible option without negative effect at FAB level. If there will be a Sub-Regional AMC at FAB level, to which participant States delegate the responsibility for ASM, there will not be national AMCs.

As this exercise is at FAB level, the detailed tasks of the Sub-Regional AMC integrated in the Sub-Regional Network Manager would be to contribute to the following:

Coordinate airspace requirements (location, type of airspace, size, time) with the appropriate agencies (military, FMPs) and adjacent sub-regional managers;

- Organise and manage the airspace to accommodate predicted traffic with the demands and determine optimum airspace configurations;
- Provide optimum airspace availability in his area of responsibility;
- Initiate CDM process to adjust the demand to the available capacity;
- Co ordinate the decisions with the regional network manager
- Publish airspace allocation.

The sub-regional Manager detects a demand/capacity imbalance based on traffic complexity considering that airspace capacity is a function of traffic complexity.

Regional Manager who monitors, co-ordinates, and maintains the NOP, is not going to be considered as an actor in the validation scenarios because the assumption about solutions have no network impact. For this reason, this actor of the Operational Scenario is not going to participate in the exercise.

In the same way, **Complexity Manager** who balances the controller workload, maximizes the capacity of the ATM system and optimizes air traffic, is not going to be considered as an actor in the exercise because he is not inside the timeframe of the exercise i.e. the complexity manager look-ahead time horizon is - 40 minutes.

As it is said in the operational scenario, the sub-regional network manager will have an advanced tool for determining the less penalizing orientations of the VGA lobes.

Regarding the text about the advanced tools in OS-34, it is necessary some clarification to get, in an efficient way, the kind of solutions that those tools will provide in the future. Criteria to calculate the cost of these possible solutions have been identified by the Experts to obtain from “the what-if tool” the possible orientations of the lobes and the airspace configuration.

At the end, it was agreed that the sub-regional manager provides the constraints over the network and a ranked list of the best three solutions compromising network impact and costs.

The cost of the solution is a combination of indicators that can be ranked according to:

1. Number of affected business and mission trajectories;
2. Respect Initial SBT;
3. Delays;
4. Extra Flight Time;
5. Reduce Complexity;
6. Extra Fuel Consumption;
7. Maintain Demand and Capacity Management.

This issue is further detailed in section 5.2 when the assumptions related to the “what-if tool” analysed in the validation exercise EP3 WP3.3.3 is explained.

When the ASM/AMC and the Sub-regional Manager agree the possible orientations for the lobes, these are sent to the AOCs who evaluate the solutions and the associated air traffic demand i.e. SBTs and RBTs:

- Only flights affected by the trigger i.e. activation of a restricted area should be informed. If the final solution implies another trigger in another area, the flights affected by the new trigger should be notified;
- There was a long discussion in the Expert Group about the need of maintaining in the system the initial preferences of the users. So, if there is a cancellation of the exercise, all users that were affected taking into account the initial SBT should be notified;
- Those users that did not provide their SBTs will not be involved in the process. For instance, General Aviation and Business Aviation will not participate. This role could be done by the Sub-Regional Network Manager. He will also analyse the Network effect;
- All decisions will be communicated to the Regional Network Manager to ensure the consistency. Some experts consider a weakness in the exercise definition not involving the Regional Network Manager. Anyway, if there is no effect at other FABs, the coordination with the Regional Network Manager is not necessary.

3.2.2.5 Operational improvements considered

Table 6 provides a summary of the conclusions per OI or group or OIs.

OI Title	OI Step Id	OI Step Title	OI Step Description	Feedback
[L02-03] From FUA to Advanced FUA	AOM-0202	Enhanced Real-time Civil-Military Coordination of Airspace Utilisation	Real-time coordination is further enhanced through what-if functionalities and automated support to airspace booking and airspace management e.g. integrated toolset allowing AMC and other parties to design, allocate, open and close military airspace structures on the day of operations.	Experts gave information to configure and prototype the what-if prototyping tool. This tool is going to be used in the exercises defined for this EP3 WP 3.3.3. They provided information about the possible DCB solutions to include in the tool, and they selected the indicators used to calculate the cost of solution to rank the possible configurations to choose the best airspace configuration that what-if tool will have to provide. Also, Experts gave feedback about the operating of the DCB negotiation processes and roles and their responsibilities in the previous process.
	AOM-0206	Flexible Military Airspace Structures	The possibility for ad-hoc structure delineation at short notice is offered to respond to short-term airspace users' requirements not covered by pre-defined structures and/or scenarios. Changes in the airspace status are uplinked to the pilot by the system.	Experts provided feedback about VGA (Variable Geometry Area) that it is going to be implemented in the exercise. They defined the appropriate size of the CBA and the size of the lobes.
[L03-03] Planning the Shared Business Trajectory (SBT)	AUO-0204	Agreed Reference Business / Mission Trajectory (RBT) through Collaborative Flight Planning	Airspace users can refine the Shared Business / Mission Trajectory (SBT) in a number of iterations taking into account constraints arising from new and more accurate information. They access an up-to-date picture of the traffic situation with the level of detail required for planning (incl. Historical data, forecasted data, already known intentions, MET forecast, current traffic, ASM situation). The collaborative planning process terminates when the Reference Business / Mission Trajectory (RBT) is published.	Experts informed about the process of trajectory negotiation when these trajectories are affected by a military airspace reservation. They provided input about the negotiation process and identified that only affected users had to be informed about the changes in the trajectory. They defined the time limit to the negotiation to adapt trajectories to the airspace configuration. This time limit should be dependant on the magnitude of the trajectory changes and the time horizon of the operation.

Table 6: EP3 WP3.3.3 List of OIs and feedback from Experts

4 FEEDBACK TO EP3 WP3.3.2

4.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

Exercise EP3 WP3.3.2 addresses the management of **arrival traffic congestion situations** –mainly at large or medium size airports- in the short-term planning and execution phases.

Several prospective predict a huge increase in the number of saturated airports operating at full capacity for most of the day. This emphasises the need for highly dynamic and adaptive processes to efficiently manage all short notice events that impact arrival capacity.

In current operations, two main layers – local AMANs and ATFCM - allow the regulation of arrival traffic on the day of operations, respectively in the execution and short term planning phases.

The SESAR ConOps introduces the following set of concept elements that will have a deep impact on the way arrival traffic will be adapted to the available airport capacity:

- **Queue management** will allow a significant extension of the geographical and temporal scope for arrival congestion management in the execution phase;
- **Business trajectory management** both in the short-term planning (SBT) and the execution phases (RBT);
- **Dynamic DCB**;
- **UDPP (User Driven Prioritisation Process).**

The combined application of these concepts should provide highly flexible and efficient arrival congestion management through DCB/queuing measures. These will be dynamically adapted to the magnitude of the congestion and the accuracy of the situation while integrating airspace users' business constraints and preferences.

Still a large number of high level open issues remain that prevent stakeholders from having a clear and commonly agreed picture of the ATM processes. The following questions are addressed by this exercise:

- How will airspace user business trajectory management interact with DCB / queuing?
- The SESAR concept assumes that a centralised CFMU slot allocation process will no longer. However, ground delays will remain the most safe and efficient means to resolve significant arrival demand/capacity imbalances. Which CDM processes and functions will cover this aspect of DCB in the short term planning phase? And how will UDPP be triggered in this context and to which situations should it apply?
- The extension of the geographical range of an arrival queuing process in the execution phase will fundamentally shift the nature of the process from a local to a network scale. This raises many issues requiring further investigations related to:
  - The involvement of network management actors in the process and induced share of responsibilities;
  - The frontier/interfaces between DCB and en-route queuing;
  - The interactions between arrival regulation and en-route complexity management.

Considering the current maturity of the concept related to the aforementioned topics, the initial emphasis is on concept clarification activities. The exercise proposes to combine two complementary validation techniques: **gaming and fast time process simulation.**

Gaming has been chosen as an appropriate method to allow multiple stakeholders to take part in the proposed process. The roles include Sub-Regional Network managers for the functional airspace blocks (FABs), a Regional Network Manager with a view of the entire ECAC area, the APOC at the constrained airport and one airline involved in implementing the dynamic DCB solutions.

A simulation platform called DARTIS will be used. The validation scenarios will focus on medium severity arrival congestion situations following a sudden - or anticipated with short

notice - airport capacity shortfall. The two selected airports are Rome Fiumicino and Madrid Barajas whereas network monitoring will cover a significant part of the ECAC area.

Processes simulations using PROMAS will allow the designed processes to be modelled and incrementally refined through the identification of gaps. The benefit of using this automated processes simulator PROMAS, in complement to the Gaming, is to test the designed processes in a wider area, modelling a greater number of actors, roles, DCB problems, DCB solutions and network effects. In this way, problems that may not have been detected in the Gaming could arise at this stage of the validation activity e.g. bottlenecks, loops-without-end, cut flows.

Both Gaming and Process Simulation exercise will address in detail the operational scenario OS-11 Non-severe capacity shortfall impacting arrivals in the short term.

Validation exercise EP3 WP3.3.2 focuses on the short-term planning phase extended to the execution phase.

The applicable DOD for the EP3 WP3.3.2 “Business Trajectory Management and Dynamic DCB” is **M2 Medium/Short Term Network Planning** [9].

Details on business trajectory management and dynamic DCB can also be found in:

- E4 DOD on Network Management in the Execution Phase [6];
- Operational Scenario OS-11 – Non-severe capacity shortfall impacting arrivals in the short term [11]**Erreur ! Source du renvoi introuvable.**.

It has to be emphasised that the exercise only partly covers the related processes as only one type of DCB solution is addressed.

Although no specific DOD has been identified for EP3 WP3.3.5 Macro model validation exercise, the EP3 WP3.3.1 Collaborative Network Planning Expert Group has also provided feedback to the exercise, identifying validation scenarios and assumptions.

The details provided by EP3 WP3.3.2, EP3 WP3.3.3 and EP3 WP3.3.5 validation exercises can be found in sections 4.3.2, 5.3.2 and 6.3.2 respectively.

4.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

4.2.1 Assumptions

This section lists the main assumptions of the exercise and provides the feedback from the experts related to each of these assumptions. Feedback is from answers to questionnaires and from informal discussions during the sessions.

The list below shows the actors involved in EP3 WP3.3.2 validation exercise:

- ATS Supervisor (TWR);
- APOC Staff;
- Executive Controller (Arrival TMA);
- Regional Network Manager;
- Sub-Regional Network Manager;
- Flight Crew;
- AOC Staff;
- Executive Controller (ACC).

Assumption 1: most of anticipated / recurrent airport traffic demand /capacity imbalances will be handled in the long and medium term planning phases through the layered planning process. Nevertheless, in order to ensure an optimal utilisation of airport resources, a margin will be considered, leaving a significant proportion of medium/ low severity imbalances to be managed on the day of operations when the traffic/capacity picture is better known. Moreover,

due to the reduction of troughs in the daily traffic demand at major airports; the negative impact of unanticipated capacity shortfalls will be significantly increased if not treated adequately by DCB in the short-term planning phase

Feedback/conclusion: the expert group did not raise any contradictory opinion against this assumption. Experts consider that in nominal conditions, significant and anticipated congested situations should be tackled mostly in the short term planning phase rather than in execution phase. Therefore, arrival queue management in execution phase should manage no more than few minutes' delays in nominal conditions. However, experts agree that the likely increase in the number of saturated airports operating at full capacity for most of the day can potentially induce a significant increase of arrival delays in execution phase.

Assumption 2: In SESAR IP2 context, no centralised ATFCM multi-constraints ground slot allocation process will operate in the short term planning phase.

Feedback/conclusion: the expert group does not fully adhere to this assumption. Some experts emphasise that ground delays will remain the safest and most efficient way to manage a congested situation at least for predictable and significant airport arrival traffic demand capacity imbalances. Consequently, there is a need for a ground delay allocation process. Whether this process is centralised or not and should tackle both airport an en-route imbalances has not be discussed in detail.

Considering experts judgement, the exercise should reconsider this assumption as a hypothesis. However due to technical constraints, only a decentralised DCB queuing process will be evaluated in the exercise.

Assumption 3: The implementation of the SESAR concept will not necessarily induce a stable NOP / traffic picture in the short term planning and execution phases.

Feedback/conclusion: this assumption was mentioned during the presentation of the exercise. No negative opinion was expressed.

Consequently this remains an assumption of the exercise. Simulating the continuous evolution of traffic demand e.g. late filers, BT changes, BT cancellations, is a key requirement of the gaming exercise to demonstrate the flexibility of the designed processes and their ability to adapt efficiently to changing situations. Therefore, traffic samples with be based on real recorded situations including all traffic demand alterations that occurred in the short-term planning phase.

Assumption 4: The required technical enabler of SWIM enabled NOP is in place; Airlines must have Business Trajectory management for most of their flights to see benefits from dynamic DCB solutions;

Feedback/conclusion: the expert group considers this assumption as sensible. The open question is about the proportion of traffic fully connected to SWIM. As opinions vary from 50 % to 100 % of traffic connected to SWIM, a proportion of 75 % has been chosen in the exercise.

The exercise does not make the distinction between flights connected to SWIM and flights of ATM capability level 3 or more and the capability of AOC systems to manage 4D business trajectories. The exercise will consider that 25 % of the traffic is of ATM capability level 0/1 and is not connected to SWIM. For those flights, the 4D trajectory will be issued by ATM and based on flight plans.

Assumption 5: Airlines must have Business Trajectory management for most of their flights to see benefits from dynamic DCB solutions

Feedback/conclusion: see conclusion for assumption 4

Assumption 6: FABs will be in place and sub-regional management will be done at the level of FABs.

Feedback/conclusion: the expert group didn't raise any objection. Some experts highlighted that the sub-regional network manager must be viewed as an organisation/function rather than as a human actor. A human flow management actor within this sub-regional network management organisation will not have necessary the responsibility of the whole sub-region. In the gaming sessions, human actors playing the role of sub-regional managers should be in charge of only part of a FAB.

Assumption 7: In nominal conditions i.e. UDPP not triggered, flights can only be exempted from meeting DCB solution constraints e.g. refuse TTA with a justified reason; emergency on-board, insufficient fuel to meet constraints;

Feedback/conclusion: all experts insisted that the 4D business trajectories sent by airspace users must comply with DCB constraints i.e. TTAs in the frame of this exercise. Negotiation is limited to exceptional cases

Assumption 8: Dynamic DCB solutions to can only be applied to flights inside of ECAC for airborne flights.

Feedback/conclusion: this assumption was briefly mentioned during the presentation of the exercise but not discussed. Since no objection was raised, the assumption is maintained.

Assumption 9: Departure airports can accommodate all requests for on-ground delays i.e. there are no constraints on how many aircraft can be delayed on the ground and for how long.

Feedback/conclusion: the expert group considers that this point requires further investigation in the context of airport CDM studies. Some experts express their doubt about issuing DCB/queuing constraints to non-airborne flights shortly before departure e.g. in the taxiing phase. They suggest implementing in the SESAR DCB process mechanisms/parameters similar to those in use in current ATFCM operations i.e. TIS/TRS parameters in ETFMS to prevent that. Nevertheless, they agree to consider that, in the context of SESAR IP2, this is an open issue.

Due to the tight planning of Episode 3, assumption 9 is maintained and can be viewed as a limitation of the exercise.

Assumption 10: In situations that require the triggering of the UDPP process, the DCB queuing process will provide the default delay allocation as a basis for negotiation between airspace users and the default measure in case of no agreement.

Feedback/conclusion: this was briefly discussed during the expert group sessions. No objection from experts. This remain an assumption of the exercise

4.2.2 Hypothesis

Hypothesis: in execution phase, there are two distinct processes/layers addressing arrival queue management:

- The AMAN process working at a local/sub-regional level;
- The dynamic DCB process applied to flights in execution phase and working at network level in anticipation of an AMAN.

Feedback/Conclusions: as mentioned in section 4.2.1, no consensus was achieved on this point. Therefore this remains a hypothesis of the simulation. This hypothesis will be verified / falsified by considering in different simulation sessions two distinct time parameters values for the AMAN active planning horizon, delineating the frontier between AMAN and the DCB processes i.e. independent variables.

4.2.3 Validation scenarios and parameterisation

Selection airports of interest for arrival congestion management

The expert group selected two airports of interest for the simulation of arrival congestion situation.

- Madrid-Barajas airport LEMD;
- Rome-Fiumicino airport LIRF. It was recommended to include Rome-Ciampino airport LIRA in the scope of the simulation as there are significant interactions with LIRF.

In addition, experts expressed their opinion that any other congested airport can be selected as the proposed processes and operational scenarios have potentially an ECAC-wide application.

Area of responsibilities of network actors and AMAN operations.

During the expert group session held on the 23rd of January 2009, the following map was proposed as an initial basis for discussion.

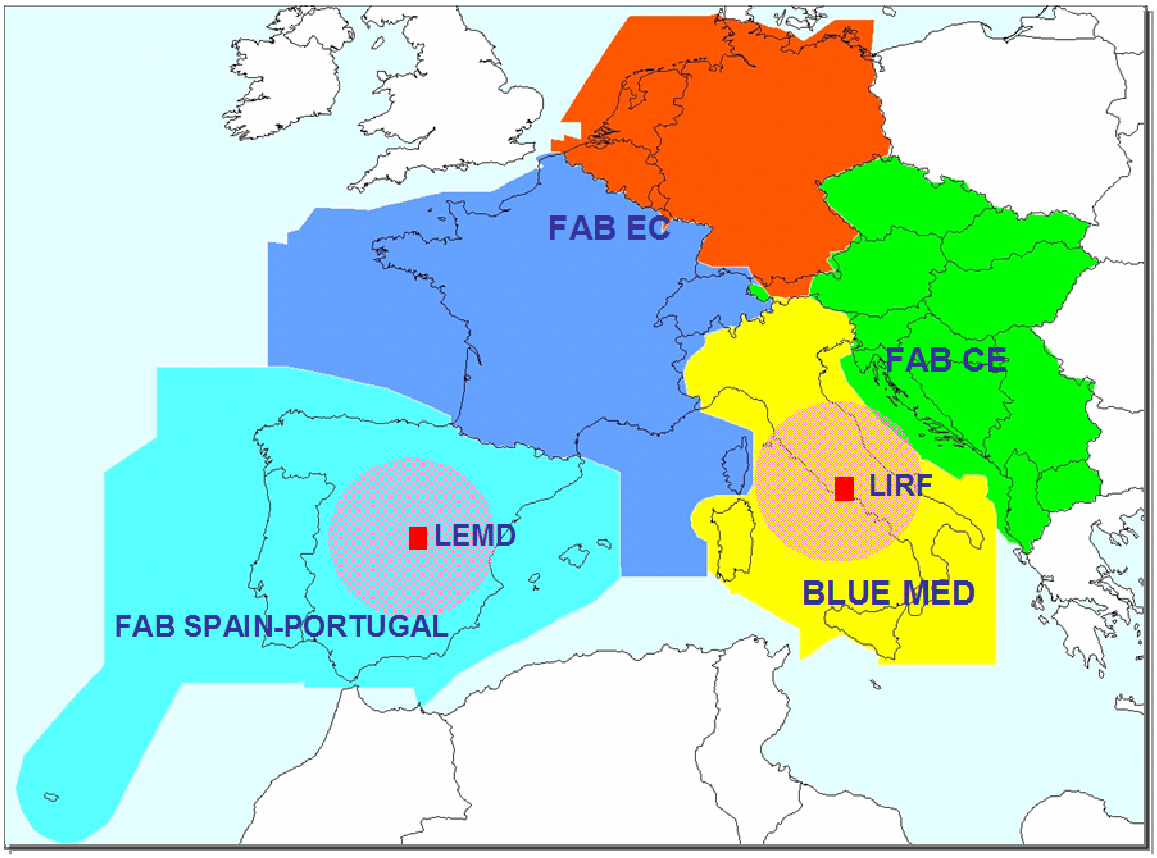

Figure 4: Operational context of gaming session

The map provides:

- the area of responsibility of AMAN operations for LIRF and LEMD;
- the area of responsibility of the human sub-regional network management actors;
- the area of responsibility of the human regional network manager actor.

No objection was raised related to the area of responsibility of gaming network actors.

About areas of responsibility of AMAN the following comments were raised:

- the Madrid (LEMD) AMAN should be extended north into French airspace;

- the Rome (LIRF) AMAN should extend north towards Florence and Pisa.

Scenarios

The three main situations to be simulated in both the gaming and the process simulations are:

1. **Sudden loss of capacity**: a non anticipated and immediate runway closure which impacts both AMAN and DCB – e.g. a 50% reduction in runway capacity;
2. **Short term loss of capacity**: a short notice prediction of LVP conditions that impacts only DCB – e.g. a 30% reduction in runway capacity placed at 08:00 for the period 09:30 to 11:00;
3. **Recovery from a loss of capacity**: a short notice modification of the LVP period – e.g. from a 30% capacity reduction to 100% available runway capacity where the original end time of 11:00, that is TTA's issued, changes to 09:00.

Situations 1 and 2 will be combined with situation 3 in the simulation runs to give an overview of the implementation and recovery of the entire dynamic DCB process.

Experts provided the following feedback on those scenarios:

- The selecting cases are relevant;
- Focusing on medium severity congested situations is particularly relevant;
- Addressing similar situations for en-route congestion would be also very interesting.

Experts expressed their interest in playing sessions combining dependant arrival and en-route congestion situations.

The gaming exercise will investigate the possibility to include such scenario in the simulations.

Along one PROMAS simulation, there will be only one capacity shortfall and one capacity recovery.

Operational parameters

AMAN active advisory horizon: two time values must be selected corresponding to the two options mentioned before. Experts are not in a position to propose definite values for the two options. 40 minutes for the lower value seems reasonable.

Those parameter values will be refined before the simulations by analysing arrival traffic flows at the selected airports.

DCB queue planning horizon

Experts expressed diverging views on this topic. Some of them consider that it should be defined through a fixed time parameter whereas others express the opinion that the horizon should be adapted to the level of congestion.

Currently it is foreseen to consider a fixed time horizon ahead of two hours. This means that TTAs are issued no more than 2 hours before arrival. This value will be refined during the pre-simulations.

More generally, the following diagram presents all time horizon parameters introduced in both gaming and process simulation. No particular objection was raised from experts.

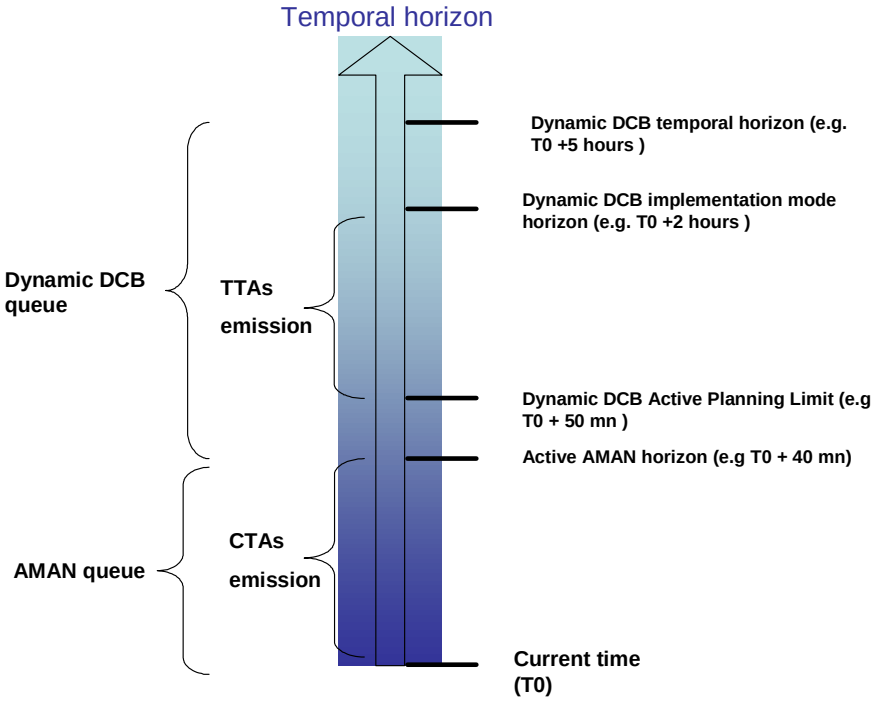

Figure 5: Temporal Horizon of AMAN and dynamic DCB

Deadline for BT replanning.

Following the issuance of a TTA, the concerned AOC is supposed to send back a BT coping with the TTA or several TTAs when any. A deadline time parameter is introduced to be used in case of no reply from the airspace user. In no reply is received, a new BT is recalculated by ATM. This parameter value is set to 5 minutes.

No objection has been raised by experts on this principle and parameter value.

RBT publication

The exercise simulates that an SBT turns to RBT 10 minutes before off-block, approximately at the pre-departure clearance.

Experts agreed on this parameter value

Additional parameters specific to the PROMAS simulation:

- The acceptable limit of ground delay is 15 minutes;
- For a flight already in air, it should be better not to increase neither decrease the remaining flight time more than 3%.

Hypothesis: the triggering of DCB solutions i.e. TTAs in the case of this exercise will be based on human decisions

Feedback/Conclusions: no consensus on this point. Some experts consider that through the implementation of SWIM based NOP, much more reliable information e.g. traffic, capacity, will be shared in real time allowing real-time automated decisions based on criteria and conditions agreed in long/medium term planning phases. An alternative opinion is that human decision will still prevail as predefining conditions is feasible only for a limited subset of occurring problems.

In the gaming session, two options will be tested:

- Automatic implementation mode: DCB solutions i.e. issuing TTAs are triggered automatically based on a delay threshold agreed by the actors in the long/medium term planning phase;
- Manual mode: in that case, the decision to send TTAs is triggered by human actors.

Hypothesis: the share of responsibilities between regional, sub-regional and local actors related to the definition and implementation of DCB solutions e.g. TTAs, will evolve in the context of SESAR.

Feedback/Conclusions: related to the decision to trigger a DCB solution e.g. issuance of TTAs, the expert group consider that the sub-regional manager is probably the more appropriate actor to take the final decision following possibly a CDM process involving the concerned actors.

In the gaming simulations, either the regional, sub-regional or APOC actors will have the option to trigger DCB solutions.

Hypothesis: different DCB queuing strategies may be implemented in SESAR context related to the mixed management of airborne and not airborne flights in DCB queues as well as the mixed management of SBTs and RBTs.

There is a consensus on the fact that airborne flights have priority against not airborne flights in most of the situations. However some alternative strategies can be envisaged in specific situations allowing the insertion of short haul flights in the sequence of airborne flights provided that the impact on airborne flights must be limited e.g. induce no additional stacking.

In the gaming exercise, only the default DCB queuing strategy will be implemented as the evaluation of queuing algorithms and strategies is not considered as a key objective of the simulation.

The process simulation (PROMAS) will evaluate 3 different strategies:

- First planned / first served;
- Flights-in-air have more priority than flights-on-ground;
- Flights-in-air: Absolute priority.

Hypothesis: an airspace user as owner of the 4D business trajectory has a total freedom when planning/re-planning an SBT as far as the permanent/structural restrictions and DCB/ASM constraint(s) are respected.

Feedback/Conclusions: some experts believe that this freedom is more theoretical than real. ATM actors such as (departure) airport actors (APOC) and network actors must be provided with the means to assess and possibly control the impact of SBTs /RBTs submitted by airspace users.

In the gaming simulation, airspace users will have limited freedom due to the technical limitations of the simulation platform. They can only “play” on the times in the business trajectories, including off-block and departure times.

In the simulation, no explicit validation of SBTs / RBTs by network managers, sub-regional or regional, is required before publication of the BTs in the NOP by airlines. Once published, ATM actors have then different mean to evaluate the published STBs/RBT and to limit their negative impact – when necessary - by adding/removing constraints i.e. TTAs on the business trajectories.

Hypothesis: the triggering of UDPP will be based on human decisions

Feedback/Conclusions: the scope of UDPP is still unclear. There is no consensus about the definition of criteria that could characterise situations requiring the activation of the UDPP process. The expert group considers in general that UDPP triggering decision will be based on real-time information following a set of pre-agreed rules defined in the long-term planning phase.

In the gaming simulation, human actors will have the possibility to trigger / stop the UDPP mode. Note that those actions are “fake” actions having no impact on the simulation. Those actions will be recorded providing some elements in support to the refinement of the scope of UDPP.

Hypothesis: The roles and responsibilities related to UDPP triggering have to be defined.

Feedback/Conclusions: Here again, no consensus is achieved. Some experts estimate that an airlines representative could take the decision, where as the majority feels that this action is under the responsibility of network managers.

In the gaming simulation, all actors will have the option to trigger the UDPP mode. Moreover, as all actors will be located in the same location, verbal discussions between actors will allow capturing needs for specific CDM functions in support to UDPP process triggering.

4.3 FEEDBACK ON THE EXERCISE RESULTS

4.3.1 Feedback on the Validation Methodology

The analysis of the dynamic DCB concept was performed through two parallel experiments using different techniques:

- **Platform-based gaming** (using a tool called **DARTIS**); DARTIS is a platform that is used as the means for people (game players) to deploy dynamic DCB measures against simulated imbalances and adapt business trajectories in consequences. Several games are played, with each game consisting of a different scenario and/or a different configuration of the dynamic DCB process. The games provide qualitative and quantitative information for scrutiny by analysts and operational experts;
- **Process Simulation**. Process simulations are particularly useful at revealing hidden incoherencies arising from the relations between actors involved and their responsibilities. PROMAS was developed to assess dynamic DCB measures and BT management against different scenarios (traffic samples, events, dynamic DCB strategies…). The outputs are principally quantitative but also qualitative.

Feedback from experts is essentially on the gaming technique as support to expert group brainstorming sessions. Some quantitative elements were produced both by DARTIS and PROMAS platforms but those results were not presented in details to the experts as the validation team did not consider those results as sufficiently reliable to be exploited from an operational point of view.

Concerning the use of gaming technique, the exercise revealed at this stage of maturity of the concept (lifecycle phase V1 in the E-OCVM) that it is inadequate to address all elements in the experiment uniquely through real-time simulation. Detailed procedures are not yet precisely defined and the platform obviously cannot include mature models of SESAR IP2 systems or planning working positions. Therefore, running real-time sessions provides limited outcomes in terms of concept clarification or operability. Real-time sessions are however interesting to capture the temporal aspects of the designed processes such as:

- The duration of CDM processes;
- The continuous refinement of the network operation plans and real-time network monitoring tasks;
- The study of the temporal transition between DCB and AMAN processes;

The organisation of WP3.3.2 gaming sessions revealed that a good approach at this stage was to mix two types of sessions:

- Interactive brainstorming sessions using the simulator as a concrete support to discuss the different steps of an operational scenario;
- “Pseudo” real-time simulations to capture the temporal aspects.

The experts involved in the Gaming experiment considered that the exercise was very useful for concept clarification and refinement, and for the identification of concrete issues related to concept implementation. The experiment also allowed the identification of some issues related to the use of the technique for the purpose of low maturity concept refinement:

- The designed processes and procedures are very far from the current ones. Therefore, a significant training period is required for the gaming actors to understand fully the impact of those new procedures and concept elements;
- Gaming participants tend to reproduce current practices through different processes and procedures;
- Gaming participants tend to focus on detailed system requirements (e.g., queuing algorithms, graphical representations) rather than on general concept refinement;

4.3.2 Feedback on DODs and Scenarios

As mentioned in the EP3 WP3.3.2 report, the objective of the exercise was not to provide definite statements at this stage. So, the feedback presented in this section must be viewed as initial trends. **Further investigation is required before the conclusions can be truly accepted as valid.**

The exercise mainly confirmed the assumptions included in the DODs (mainly M2 and E4) and the operational scenario OS-11 related to business trajectory management and dynamic DCB in the context of arrival traffic management. It also allowed producing justifications related to some of those assumptions, to define some roles and responsibilities and to refine some operational parameters.

More precisely, the topics on which the exercise provides some refinement are described hereafter:

Scope of Dynamic DCB, AMAN and their Interface

Main sections of the DODs concerned:

- E4 A3.1.3.1.3- Select/Refine/Elaborate a Dynamic DCB Solution at Network Level ;
- E4 A3.1.3.2.2 - Apply the Dynamic DCB Solution.
- E4 A3.5.1. - Revise RBT
- M2 A2.1.2.2 – Optimise SBT
- E5 A.3.2.3 - Arrival Queue Management

The DOD E4 as well the Operational Scenario-11 both identify at least two ATM processes that can contribute to the management of arrival congestion when an imbalance is detected at relatively short notice. These processes are:

- A continuous AMAN process working mainly on airborne flights within a limited look-ahead time horizon. This AMAN process manages accurate arrival sequences and issues CTAs that are managed on the airborne side by RTAs;
- An upstream Dynamic DCB process. This process pre-sequences flights (only when a significant imbalance is detected) through the dynamic allocation/re-allocation of TTAs and the consequent adaptation of business trajectories by airspace users. The TTAs can be allocated/re-allocated to flights in the short-term planning and execution phases before they are subject to the AMAN process (mainly long/medium haul flights).

The gaming participants considered that this breakdown was relevant for the following reasons:

- It allows the definition of a clear boundary between network and local/tactical processes and the clarification of roles and responsibilities;
- It allows the design of a seamless arrival management process covering both the short-term planning and execution phases, whilst allowing the type of measure/time constraint to be adapted to the level of the congestion and the accuracy of the traffic picture;

- By coherently managing flights in the short-term planning and execution phases, it allows time-based measures to be dynamically adapted to achieve an optimum balance between ground and airborne delays.

The two processes were viewed by most of the experts as two constituent elements of the queue management concept mentioned in the ConOps. No definitive statement was produced related to the system support needed for these processes. Some of the experts considered that a unique tool (an AMAN tool) could provide support to both processes. In that case, operational requirements, pre-defined rules and parameters related to the "dynamic DCB function" implemented in the tool must be agreed at network level.

The experts were asked a set of questions about the interaction between the AMAN and a dynamic DCB process. The consensus was that having two separate processes to address arrival queue management was acceptable. The following list provides some of the most important points:

- The area of responsibility of the AMAN process was defined by a temporal parameter expressing a time before landing. This time parameter was an airport-dependant value defined such that most of the flights managed in the AMAN horizon are airborne. In the Gaming experiment, this parameter value was set to 35 minutes for Fiumicino and 40 minutes for Madrid, based on the proportion of very short haul flights in the arrival traffic. An extended horizon of 60 minutes was also tested with these airports to see the impact;
- In normal conditions (i.e. no sudden capacity shortfalls), the AMAN process should be able to manage very limited delays thanks to better upstream planning. Most of the experts considered that the delays managed by the AMAN should not exceed a few minutes. This delay threshold parameter determines the triggering conditions and the objectives of the dynamic DCB process as well as the margins and time tolerance windows that have to be considered when issuing arrival time constraints (TTAs);
- The transition between the dynamic DCB TTA allocation process and the AMAN sequence optimisation process was done uniquely through business trajectories. This means that the AMAN process was not aware of the TTAs allocated by the upstream DCB. The TTAs were implicitly taken into account as they were embedded in the business trajectories.

The exercise also highlighted that the split between short-term planning processes (DOD M2/M3) and network operations in execution phase (DOD E4) is not fully obvious. Dynamic DCB processes (applied either to arrival or en-route congested situations) must manage in a coordinated way flights in short-term planning and execution phase to be fully efficient.

Roles and Responsibilities (DOD M2/ & E4 and OS-11)

Main sections of the DODs concerned:

- E4 A3.1.3.1.3- Select/Refine/Elaborate a Dynamic DCB Solution at Network Level ;
- E4 A3.1.3.2.1 - Assess Network Impact of the Dynamic DCB Solution ;
- E4 A3.1.3.2.2 - Apply the Dynamic DCB Solution.
- E4 A3.5.1. - Revise RBT
- M2 A2.1.2.2 – Optimise SBT
- E5 A.3.2.3 - Arrival Queue Management

The conclusions that can be drawn about roles and responsibilities are as follows:

- The AMAN sequence (even considering an increased horizon) is under the responsibility of the APOC/TMA manager. Network managers are not directly involved in the process;
- The actor triggering and managing the dynamic DCB TTA allocation process should be the Sub-Regional Network Manager of the sub-region that has the congested airport. The decision to trigger the dynamic DCB solution must be coordinated with the APOC and the Regional Network Manager;

- Airspace users are owners of their business trajectories are in charge of re-planning the business trajectories to take into account the DCB time-based constraints. Only the flight crew is involved in the management of constraints issued by the AMAN process. However, the management of time-based constraints issued by the dynamic DCB process (TTAs) would be primarily under the responsibility of the AOC. For flights in execution phase, the AOC must work in close cooperation with the flight crew. This represents the most likely situation, but it may vary between airspace users depending on their organisation;

Interactions between Business Trajectory Management and Dynamic DCB

Main sections of the DODs concerned:

- E4 A3.1.3.1.3- Select/Refine/Elaborate a Dynamic DCB Solution at Network Level ;
- E4 A3.1.3.2.1 - Assess Network Impact of the Dynamic DCB Solution ;
- E4 A3.1.3.2.2 - Apply the Dynamic DCB Solution.
- E4 A3.5.1. - Revise RBT
- M2 A2.1.2.2 – Optimise SBT
- M2 A2.1.2.3 - Validate SBT

- The procedures implemented in the simulations allowed the airspace users to decide how to absorb arrival delays through 4D business trajectory re-planning. The procedures were judged as globally acceptable from an airspace user point of view. However, some operational parameters need to be refined, in particular, the maximum response time allowed following the reception of a TTA (five minutes was played in the Gaming). It was also identified that in case of a capacity shortfall anticipated at short notice, the AOC staff of the main airline operating at a congested airport would probably be overloaded and could only focus on a limited number of flights (the most critical ones from a business point of view).
- The network managers expressed their disagreement about the business trajectory management procedures implemented in the gaming platform. Their opinion is that, in order to increase efficiency of the overall process and reduce risk of increased complexity in terminal airspace, business trajectories respecting TTAs should first be determined by ATM taking into account network constraints and then proposed to airspace users who could then make counter-proposals.
- Following the conclusions of an ad-hoc expert group meeting, the exercise considered the assumption that the SBT becomes an RBT at the Start-Up Approval Time (so approximately five minutes before Target-Off Block Time referring to airport collaborative decision making concept milestones). The airspace users involved in the simulations considered that this transition should be as seamless as possible towards ATM. The implications of this in the simulated scenarios were:
  - In normal conditions, the initial RBT is the same as the last SBT and there is no need for the initial RBT to be validated by the network;
  - The defined procedures relating to the interactions between dynamic DCB and BT management were the same whatever the flight phase (i.e., planning or execution). The only differences reside in the use of different values for some operational parameters.
- All participants agreed on the necessity to consider two additional key aspects that were not addressed in the Gaming experiment (due to platform limitations) to get a more complete view of the feasibility of the overall process:
  - The interaction with departure airports' planning processes;
  - The management of business trajectories in 2D/3D dimensions.

Real-Time Network Monitoring Function and Support Tools

Main sections of the DODs concerned:

- E4 A3.1.3.1.3 : Select/Refine/Elaborate a Dynamic DCB Solution at Network Level ;
- E4 A3.1.3.2.1 : Assess Network Impact of the Dynamic DCB Solution ;

- The need to define advanced tools/applications i.e NOPLA applications in support of the network/traffic monitoring tasks and the collaborative management of business trajectories was clearly identified. The Gaming platform included network monitoring functions that were close to functions available in current CFMU systems (e.g., CHMI). Those functions did not allow network managers/APOCs to assess easily in real-time the combined impact of the dynamic DCB and business trajectory management processes. Some high-level requirements for advanced functions in support of the future network monitoring tasks were identified including:
  - Advanced what-if functions allowing the impact of DCB measures and airspace users' replies to be assessed;
  - Advanced traffic monitoring indicators including complexity and performance factors, both for en-route and TMAs;
  - Context-oriented alerts highlighting network changes and analysing accurately the impact of business trajectories modifications.
- The question of the automation of the real-time network management function was also partly addressed as the gaming platform allowed simulating different options in terms of automation of DCB solutions implementation. The experts consider that full automation is not desirable even if most of the decisions related to dynamic DCB (or UDPP) should be based on pre-defined rules and parameters agreed at network level. Their opinion is that whatever the advanced SWIM-based applications available, final decisions should remain, in a significant proportion of cases, under the responsibility of humans to maintain some flexibility, for example, to go beyond pre-agreed "contracts" implemented in systems under certain circumstances. The resulting effect of full automation may be a loss of network capacity.

UDPP Scope and Triggering Conditions

Main sections of the DODs concerned: • M2 A2.1.3 - Start UDPP on SBTs

- As the nature of UDPP is not yet clarified, experts could not determine to any level of detail in which conditions it should be triggered;
- What can be concluded from the exercise is that, at least in the situations simulated (i.e., medium severity imbalances, no delays exceeding 20 minutes, no need to cancel flights), the airspace users did not see the potential gain of triggering an "overall negotiation process". The possibility to decide individually for each flight how to manage the arrival delay combined with the availability of a slot-swap function (usable at the level of an alliance, for example) and applied to a default TTA allocation process provided by ATM seemed to respond to airspace users' business needs;
- Therefore, UDPP application should be reserved for severe situations. No consensus was reached about who should initiate the UDPP process. Most of the experts think that the initiator of the process would depend on the type of situation.

4.3.3 KPI's / KPA's

Some quantitative assessment related to efficiency, predictability and equity KPAs were produced But due to the low maturity of the models implemented those results can not yet provide reliable information in terms of performance assessment.

5 FEEDBACK TO EP3 WP3.3.3

5.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

EP3 WP3.3.3 aims at clarifying the SESAR concept in terms of collaborative planning focused on short term phase and partially medium term phase i.e. from one day to some hours before the day of operation.

It will analyse if the DCB Negotiation Processes at local/sub regional level i.e. FAB level among Civil Airspace Users, Military Users, AMC or Airspace Management Cell and the Sub-regional Manager are operationally feasible when a change of airspace reservation by military is produced.

Airspace Manager and Sub-regional Manager activities will be supported by what-if tools that will provide the most suitable airspace configuration to meet predicted demand with the minimum distortions to the business/mission trajectories.

The main objectives of EP3 WP 3.3.3 are the following:

- **Clarification of the concept** in terms of collaborative planning focused at short term phase and partially medium term phase i.e. from one day to some hours before the day of operation.

The applicable DOD for the EP3 WP3.3.3 “Airspace Organization and Management” is **M2 Medium/Short Term Network Planning** [9]. Validation exercise EP3 WP3.3.3 focuses on the medium-term planning phase extended to the short-term phase.

EP3 WP3.3.3 is focused on the description of A2.3 Balance Planned Demand and Capacity process defined in the section 2.3 of the document. Details on these aspects can be found also on the operational scenario OS-34 Military Collaboration during Medium/Short Term Planning [12], further detailed based on the feedback from EP3 WP3.3.1 Expert Group.

Initially, the exercise is not focused on validation of the concept. The concept is not mature enough and as a consequence the main outcome is a qualitative assessment, and if possible, a preliminary quantitative assessment, of two main aspects of the concept: the Flexible Use of Airspace and the Agreement of the Business / Mission Trajectories through collaborative flight planning when military changes its airspace reservation. These aspects of the concept cover IP1 and IP2;

- **Assessment of process feasibility** when Airspace Reservations change by military users when considering the dynamic diverse airspace use i.e. AFUA concept.

  The different processes involved when military changes the location or timescale of a reserved area will be analyzed. The users will have the opportunities to change trajectories to best fit their preferences. The Civil/ Military Airspace Manager along with the Sub-regional Manager will have to provide the most suitable airspace configuration considering civil and military needs;

- **Exploration** the **techniques and supporting tools** needed to achieve an airspace organization and management efficiently adapted to changing demand considering civilian and military requests.

  The exercise will analyse and identify the potential functionalities of the what-if tools for airspace organization and management which will support the decisions of Airspace Managers and Sub-regional Managers. A what-if prototype tool with some of these functionalities will be developed to support the gaming sessions by providing the most suitable airspace configurations;

- Assessment of **alternative validation techniques** suited to these early stages of concept validation.

  Gaming techniques are an innovative method for ATM Operational Concept Validation. Mostly used for military strategy purposes, they have been adopted and

enhanced for validation of operational feasibility of processes. In this exercise, a gaming platform will be plugged with a what-if prototype tool for supporting the decision processes.

Two alternatives of gaming technique were used:

- Gaming based on papers (the only material used in the design and the trial of the game is paper);
- Gaming on a dedicated software platform called CHILL and plugged with a what-if tool for supporting the decision processes. CHILL allows simulating the pre-designed situations in a more realistic way and so, the behaviour of the players/roles, communications between the actors and the operation with the tools would be near to the reality.

The exercise will consist of a set of gaming sessions supported by the what-if prototype tool that will provide the most suitable airspace configurations to meet predicted demand with the minimum distortions to the business/mission trajectories. These Airspace Management (ASM) solutions will reproduce the outputs of the what-if tools which the Airspace Managers and the Sub-Regional Managers will use to perform their roles/responsibilities.

Two validation scenarios are defined in Experimental Plan document [5] to make several sessions of gaming. Schedule for these gaming sessions is defined in the Experimental Plan on Airspace configuration and Management Document [3].

5.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

Feedback regarding different assumptions in the exercise defined for EP3 WP3.3.3 was given from the Collaborative Network Planning Expert Group.

5.2.1 Traffic Demand

The Expert Group agreed that EP3 WP3.3.3 should use 2020 traffic. But the exercise has to ensure that these traffic samples consider not only the total forecasts but also the application of the right assumptions to reproduce the SESAR ConOps aspects for 2020 - e.g. the Users Preference Trajectories (UPT) without route structure, equipment or direct routing. It is necessary to highlight the assumptions under which 2020 traffic samples have been generated so as to identify any weaknesses that would impact the exercise results.

Also, it was agreed that in the timeframe from 1 day to 1 hour before the operation, the percentage of **unknown trajectory** intentions **does not affect** the processes.

Anyway, information about the known traffic depending on the timeframe was obtained:

- 1 hour in advance, the 99.9% of the traffic will be known;
- 2 hours before the 99% of the traffic will be known;
- 1 day before the day of operation, 90% of the traffic is known.

When traffic based on statistics evolves into SBTs, there could be an increase on the expected number of flights. This could imply a capacity imbalance to be evaluated in the exercises.

The assumption about “Military traffic can be considered as OAT” must be modified:

OAT should be removed and substituted for Mission Trajectories. As far as capacity is concerned, the mission trajectories should be considered as if they were business trajectories and affect the workload of the controller when they fly from their airbase to/from the airspace reservation.

Therefore, the degree of workload affection will be dependent on:

- The distance between the airbase and the airspace reservation;
- The civil traffic density during this aforementioned transition;
- The number of military flights flying to/from the airspace reservation.

Other assumptions regarding the traffic demand or trajectories that are going to be implemented in the exercise are the following:

- The timeframe of the Exercise is medium term close to short term i.e. from one day to two hours before the operation. All trajectories will mainly be SBTs or RBTs just in the case that the origin is really far from the area;
- The mission trajectories should be considered as if they were business trajectories and affect the workload of the controller when they fly from their airbase to the airspace reservation. The degree of workload affection will be dependent on:
  - The distance between the airbase and the airspace reservation;
  - The civil traffic density during this aforementioned transition;
  - The number of military flights flying to the airspace reservation.

5.2.2 Airspace Reservation

Regarding the location of the military airspace reservation, it is influenced by the exercise objectives. For the operational scenario described, the most interesting area are the following:

- Close to the military bases **Location 1: Gulf of Cadiz**;
- High complexity zones in order to squeeze the interactions among users when complex situations **Location 2: Madrid TMA**.

Exercise intends to reproduce particular situations of the operational scenario. Two validation scenarios were identified:

- Validation Scenario Example#1: MVPA/VGA planning;
- Validation Scenario Example#2: Release a MVPA/VGA area.

Finally, it was agreed to reproduce an additional situation in the Validation Scenario Example #1: *Negotiation Failure and finding a remedy*. *What happens if no agreement is reached?*. It is necessary to identify a timeframe limit to agree a solution when a negotiation failure is performed or triggered as result of the exercise.

5.2.3 Airspace Configuration – What-if prototype Tool

Regarding advance tools mentioned within the OS-34, in this case the what-if prototype tool the experts were asked about the potential capabilities of such a tool. Questions about how to get the airspace solutions i.e. DCB solutions and which are the possible solutions were launched to the Experts. Also, they gave feedback about criteria to calculate the cost of the possible solutions.

Firstly, Expert gave information about the functionalities of what-if prototype tool:

- It will support the decisions of Civil and Military Airspace Manager and Sub-regional Manager during the gaming sessions;
- It will provide the most suitable airspace configurations by:
  - considering the users choices;
  - ranking them according to a cost of solution;
  - ensuring the demand/capacity balance;
  - Assessing the impact at FAB Level.

In order to build and configure the what-if prototype tool, experts gave information about the different points described in the previous paragraph.

To assure the demand/capacity balance, Experts configured a list of solutions that could be taken to correct demand and capacity imbalance i.e. DCB solutions.

EUROCONTROL proposed to take into account the time to apply each pre-defined solution. It is important to highlight that the time to apply a pre-defined solution is associated with the event of the imbalance, but not with the operation (RBT). For instance, it would be one hour before the imbalance but not one hour before the operation.

For this reason, solutions were distributed in terms of the degree of imbalance implied i.e. from low to high and the timescale they operated on i.e. from 1 day to 1 hour.

Here is showed the list of solutions depending on the kind of measures that can be considered:

If only Airspace organisation mid-short term measures can be considered, the list of solutions is:

- Temporary route structure;
- Change of sectorisation with variable number of activated sectors.

But if DCB measures, meaning trajectories management measures, can be applied, the possible solutions are:

- Level capping;
- A slight modification of the trajectories;
- Advisory Routing;
- UDPP and queue management, excluded by the exercise for validation plan consideration.

Other important de-confliction measures are taken into account in SESAR but they are out of the present exercise scope.

To considering the users choices, the what-if prototype tool shall have simplified models to emulate the airlines behaviours depending on the kind of airline. In the opinion of the Experts, all the kind of airlines should be included in the gamming exercise, but taking into account that their strategies are different. The kind of airlines to be simulated in the gaming is: Commercial Airline, Low Cost Airline and Business Aviation Airlines. The Gaming exercise will also consider General Aviation as another airspace user.

In order to know the preferences of the AOCs about their routes, the experts firstly identified the factors that could affect aircraft operating decisions and afterwards, according to the kind of AOCs i.e. commercial, low cost, business and general aviation.

The following step was to reduce, consolidate and simplify the previous collection on factors to be introduced in the tool to emulate the airlines behaviours. The factors were prioritised between 1 (highest priority) and 3 (lowest priority) for each type of AOC. Table 7 shows the final result:

Factors		Commercial	Low Cost	Business	General Aviation
Passenger quality	Delay at departure	1	2	1	3
Operating Cost	Extra Flight time	2	3	2	2
	Extra Fuel Consumption	3	1	3	1

Table 7: Passenger quality and Operating cost factors

At least two DCB alternatives, in terms of constraints, are sent to the users by the sub-regional manager. The users will analyse how to meet those constraints according to their interest. Therefore, several alternatives should be provided by an advanced tool and the responsibility about the final decision should be taken by an operator. These alternatives are **ranked according to a cost of solution**. The experts gave feedback to calculate this cost:

The cost of the solution is a combination of indicators and they were listed in the previous section 3.2.2.4. These factors that could affect aircraft operating decisions were collected in the Expert Group meetings. Firstly, the experts prioritised a list of themes, listed in order of importance: Users' choices, Traffic complexity, Flight efficiency, Mission Typology, Simplicity, Safety, Mission effectiveness, Environment, and Miscellaneous. Then, indicators linked to the

themes were identified and finally, they selected the list of indicators to calculate the cost of each solution:

1. Airspace Users Acceptability ⇒ 25 points;
2. Respect Initial SBT ⇒ 14 votes;
3. Lesser impact on Flight Program ⇒ 9 votes;
4. Reduce Complexity ⇒ 9 votes;
5. Cost ⇒ 8 votes;
6. Maintain Demand and Capacity Balancing ⇒ 7 votes.

Other assumptions regarding the DCB solutions were agreed by the experts:

- The methodology to detect imbalances is based on traffic complexity measurement i.e. ATC Workload when the maximum admissible values are reached;
- The Airspace configurations will maintain the same number of sectors;
- Only Managed airspace is considered;
- The best airspace configurations are based on the traffic complexity expected for the day of operations and the users intentions;
- The Airspace Organization would consist of predefined solutions:
  - Temporary Route Structures;
  - Change of sectorizations.

5.2.4 Roles and Responsibilities

When the actors are defined for the validation exercises, information about the data that they would need to take decisions was asked to the Experts. The following table shows the information per actor.

Actor	Data to be decided on	Votes
Sub-regional Manager	Traffic Demand e.g. SBTs and/or RBTs, traffic flow data, users main flows	3
	User priority rules and Preferences	2
	Influence of his decisions at network level	2
	Sectorisation	2
	Imbalances on capacity	2
	All relevant ATM information impacting network operations	2
Civil Airspace User	Alternative routes	3
	Airspace restrictions	2
	Corridors	2
	SBT constraints	2
	Cost impact	2
Military/Exercise Director	Alternatives to minimize impact on the military exercise	4
	Civil Airspace Constraints	3
	Same info as sub-regional manager	2
	Airspace management alternatives	2
	ASM decision on airspace allocation, for the exercise	2
AMC or Airspace Management Cell	Same info as sub-regional manager	4
	Military Airspace Requirements	4

Actor	Data to be decided on	Votes
	Airspace allocation alternatives, information shared with the sub-regional manager	3
	Impact on civil traffic	3
	ATFCM information	2
	Up-to-date ATM events information	2
	What-if indicators to analyse before updating the NOP	2
	What-if alternatives for the airspace design	2
	Cost of solution evaluated by each actor	2

Table 8: Information per actor

5.2.5 Capabilities

These are the assumptions related to the capabilities of associated tools during the validation exercise:

- Equipment: no systems failures and consequently no emergencies have been considered;
- The non-SWIM-enable NOP aircraft will be out of the negotiation and they will be penalised: The will have to accept any solution;
- It was suggested to consider within the EP3 WP3.3.3 simulation scenarios, if possible, the alternative of considering that SWIM-enabled NOP is operational 100%.

5.2.6 General assumptions

Finally, these are the general assumptions applicable to the validation exercise:

- Weather conditions: weather constraints e.g. bad weather conditions, storms, were not be considered;
- Airport usage rules will not be considered.

5.3 Feedback on the Exercise Results

5.3.1 Feedback on the Validation Methodology

Before starting the gaming sessions and after the session using cards and using the dedicated platform, some questioners were delivered to experts so that they could express their thoughts about the technique. This section gathers the experts' feelings regarding confidence on the technique and the obtained results by using it, i.e., subjective aspects of the technique.

At these stages of the concept maturity, the use of gaming techniques to support Expert Judgement was unanimously found extremely positive. The conclusions obtained from an expert group are more solid if the process is played than if they are only based on discussions and theoretical ideas. For example, gaming sessions allow simulation of the discussions practically by exploiting concepts.

In this way, the Expert Judgement provides more fruitful conclusions for concept clarification. Furthermore, the performance of actors' interactions in a pseudo real environment makes possible the process feasibility assessment and the detection of supporting tools capabilities.

The following charts show some questions and answers obtained after analysing the questioners.

Figure 6 shows the experts opinions means on the confidence that they had in the gaming technique. The answers have been compared in three situations: before starting any game

sessions (pre-gaming questionnaire) and after game sessions using cards (post-gaming with papers) and after game sessions using CHILL (post-gaming with CHILL).

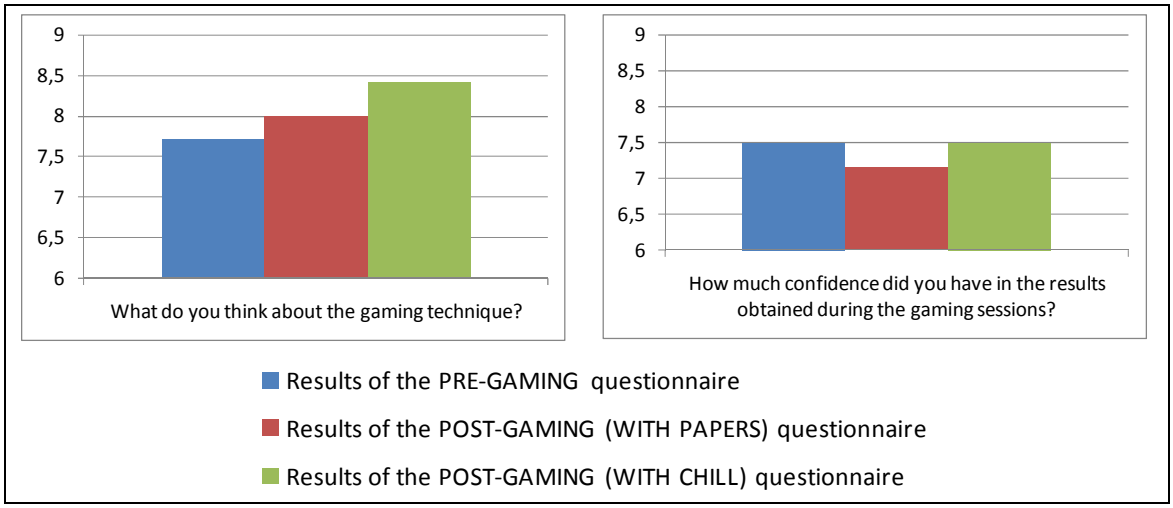

Figure 6: Confidence in the Gaming Technique

The gaming technique was really well valuated and it can be appreciated how the feeling on the technique improved along the sessions. Just one of the experts had participated once in a gaming session, so in general the participants didn't have any experience on the technique but high expectations. The confidence on the results is higher when using a dedicated platform than when using just cards that was a repeated conclusion during the last sessions.

In addition, the questioners also investigated about their opinions on particular aspects of the technique such as: usability, reliability, accuracy, understandable, likeliness and ease to play (Figure 7).

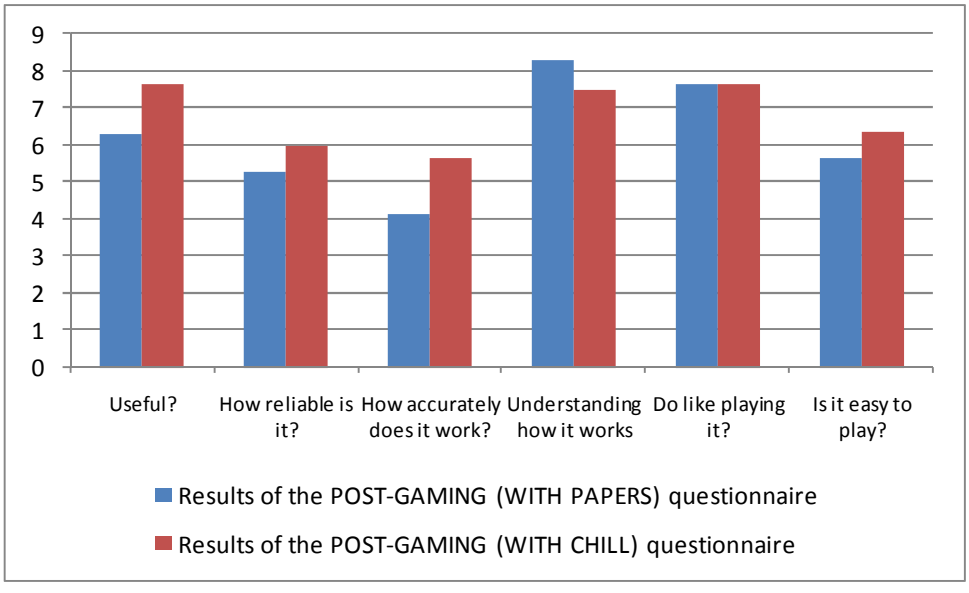

Figure 7: Usefulness of the Gaming Technique

The experts enjoyed playing the games and understood quickly the dynamicity of the technique. But also they detected some weaknesses of the technique already included in the previous section: the results can have variability that impacts on the reliability on the results and their accuracy. This variability is very sensitive to aspects like: different ways of interpreting the same roles, not having clear understanding of the game scope or a poor training.

Finally, going to more details on the gaming technique confidence, the experts were asked if the use of this technique had covered the high level objectives planned for the exercise. Confidence on the results in the accomplishment of the objectives was really positive and highly valuated. Special mention is done about the usefulness of the technique to explore tools capabilities (Figure 8).

Regarding the use of different supporting means, after having used CHILL the opinion about confidence on results just using papers decreased, what means that using a dedicated platforms enhance the results confidence.

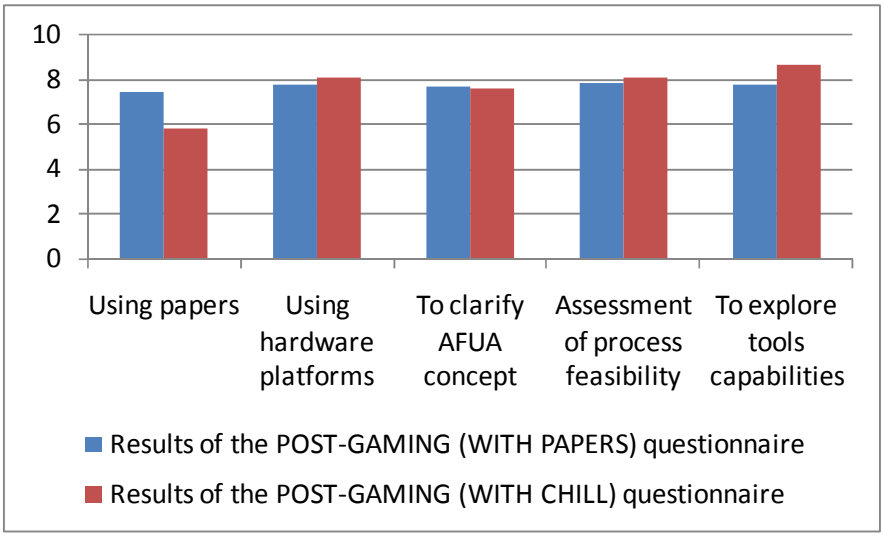

Figure 8: High level objectives vs. gaming technique

During the gaming sessions, some issues were detected, and as a consequence enhancements were implemented. In this section, some recommendations and good practices are gathered to make a good exploitation of the technique:

- Training of the actors/players on the gaming technique and tools is essential before starting the sessions in order to use the available time more efficiently. The training would consist of toy games that are simple games to clearly understand the rules, dynamicity of the serious games and to get familiar with the platform capabilities (in case a dedicated platform is used).
- Involving the actors in the preparation of scenarios of the exercises previously to the sessions running is positive for ensuring their main needs are covered;
- Ensuring that actors have the right understanding of their predefined roles and responsibilities at these stages of the concept is also of outmost importance. Making use of operational experts participation combined with the future concept application, the results of the game may inspire changes or additions to the predefined roles functions;
- Actors should be operational experts that are aware of the current problems and therefore, their judgement is relevant to know if the application of the future concept “elements” are beneficial in terms of performances and process feasibility;
- Repeating the same games with different groups of actors is positive in order to check the suitability of the different interpretations of roles/responsibilities within the group and to fully exploit the technique applicability;
- Exchanging the roles among experts participants is strongly recommended since allows covering different points of view;
- Spending enough time and effort in the definition of the session scope is mandatory. This technique is not useful to explore a full concept but delimited concept “pieces”. It is necessary to stress on the objectives that are intended to be covered and the possible issues of the game;

5.3.2 Feedback on DOD's and Scenarios

5.3.2.1 Recommendations on supporting DODs

The Interim DOD D2.2.-033 Medium/Short Term Network Planning-M2 has been considered as reference and where the EP3 WP3.3.3 results can be integrated. The high level description is consistent with the EP3 WP3.3.3 findings in terms of concept clarification but for low level detailed processes scoped by M2, EP3 WP3.3.3 provides more clarification, additions and even corrections when military users require airspace reservation at short notice. The analysed process have been focused between the end of medium term phase and short term phase (from one day to some hours before the operation), and therefore the recommendations for DOD changes are fitted to this time frame.

The key recommendations on supporting DODs are listed in Table 9 and linked with the low-level processes as they are in the ATM Process Model SADT diagrams. For more information, references to the content of this exercise report are also included in the mentioned table.

Code[4]	ATM Process	DOD Description	WP3.3.3 Contribution
A2.1.1	Refine/Define Airspace Reservation Demand	This process allows the long-term airspace requirements to be refined with more detailed requests, e.g. military reservations. But it also allows defining new airspace reservation demand during the medium/short term planning phase.	Civil users are also involved in this process. The dimension and location of a military airspace reservation is a process where not only the Exercise Director and the Airspace Managers are the involved actors but also the civilian part are a key active part by providing their preferences. In turn, the Exercise Director will intervene during all the process, willing to offer greater flexibility, if necessary, to impact civil users to a minimum.
A2.1.2.2	Optimise SBT	Through this process, SBTs are filed/refined and optimised to the best outcome for the user. This process is mainly a short term process.	For the SBT optimization process, the civil users will refine their preferred trajectories according to an Operational Quality Indicator. This indicator is a combination of Passenger Quality Indicator and an Operating Cost indicator. For those users who cannot afford to invest on tools, an access via SWIM to a standard supporting tool could be enabled so they could tune it according to their business model. This standard supporting tool for civil airspace users need to be agreed developed and made available to the ATM community. The supporting tool needs to be configurable, so each civil airspace user could customize it depending on its business model.

[4] This refers to the code associated to the process in the ATM Process Model SADT diagrams.

Code[4]	ATM Process	DOD Description	WP3.3.3 Contribution
A2.1.2.3	Validate SBT	SBT Validation is the latest process before integration of the updated SBT inside the NOP.	No major contribution
A2.1.3	Start UDPP on SBTs	This is an AOC process dealing with activities related specifically to UDPP process. However, SBT revisions are still effectively processed through "Optimise SBT" while UDPP Results should usually consist of a prioritised flight list.	No contribution
A2.1.4	Build/Refine Reference Traffic Demand	The Reference Traffic Demand is elaborated and used during the Medium Term Planning Phase. The reference planned traffic demand, built in a first step with only some SBTs in medium term, is continuously refined as soon as more SBTs are available or optimised.	No contribution
A2.2.1.2	Refine Airspace Usage Rules	In this process, airspace volume (including military areas) and route (route crossing military areas, SIDs, STARs, routes that can be activated in high density areas …) usage rules are refined if required.	The rules related to the definition of military areas should involve not only the Airspace Mangers/SBR, and the Exercise Director but also the civil airspace users by providing the airspace reservation dimension along with their preferred distorted trajectories. The criteria to allocate a VGA should take into consideration Equity Indicators to analyse the access to share airspace between civil and military users. Furthermore, to ensure the VGA location/dimension impact civil air traffic to a minimum several indicators have been accepted and consolidated: Minimum Number of affected SBTs, historic information at FAB Level, Operational Quality Indicator, and Cost of Solution.
A2.2.1.3	Refine Network Usage Rules	This process produces network usage rules as a consistent check of refined Airspace Usage Rules and refined Airport Usage Rules.	No contribution

Code[4]	ATM Process	DOD Description	WP3.3.3 Contribution
A2.2.2.2	Refine Possible Airspace Configurations	The possible airspace configurations refinement process aims at refining the possible configurations established in the long term planning phase. For each airspace resource, times of use are specified, e.g. per day type - i.e. week day, week-end, holiday, special event day.	For the refinement of the possible airspace configurations when military requests airspace needs at short notice, the AMC/SBR selects the most suitable airspace organization associated to each possible VGA by: - considering the user preferences and military airspace reservations; - ranking them according to a cost of solution; - ensuring the demand/capacity balance based on both number of movements and traffic complexity (ATC Workload) measurement; - assessing the impact at FAB level. The 'Cost of Solution' Indicator is a combination of Equitable Criteria, Demand and Capacity balance among sectors, Workload Saturation Indicator of the most suitable airspace organization, Workload Balance Indicator among sectors of the most suitable airspace organization, Total Workload Indicator of the most suitable airspace organization.
A2.2.3.2	Refine Airspace Resource Available Capacity Plan	Airspace Available Resource Capacity Planning gathers for each Airspace Configuration the available capacity, taking into account human resources plans, enhancement plans, etc.	No contribution
A2.3.1.2	Detect Airspace Demand Capacity Imbalance	This process aims at balancing demand and capacity for each Airspace Volume. For each day of operation, flights are scheduled overtime periods according to scheduled available capacity. Then, resources scheduling are consolidated in order to detect demand capacity imbalance.	The detection of demand and capacity imbalance is done at short term based also on traffic complexity. The agreed method for complexity assessment is the ATC workload assessment.

Code[4]	ATM Process	DOD Description	WP3.3.3 Contribution
A2.3.2.1.2	Select/Refine/Elaborate a DCB Solution at Network Level	This process allows the selection/refinement/elaboration of a DCB Solution at the Airspace level. Taking into account the detected Demand/Capacity Imbalance, the resulting Airspace DCB Solution is provided with an associated cost. Note: Solution acceptance depends on the related KPIs that are part of the target performance objectives defined and agreed by all Actors during the long-term planning phase.	The selection/refinement/elaboration of a DCB solution should always consider equity indicators as shared use is conflicting with other performance expectations, in this capacity. The indicator Cost of Solution should include indicators to ensure the equity between users such as historical reasons (Number of times that same civil users have been affected, Historical distortions degrees, flight priorities or SBT/RBT status).
A2.3.2.2.1	Assess Network Impact of the DCB Solution	This process describes respectively how the Sub-Regional and Regional Network Manager assesses the local/network impact of a DCB solution (possibly made of several DCB measures). Network impact assessment must be performed the more as DCB solutions will be defined most of the time at local level. Distant network impact cannot be detected at sub-regional/local level.	No contribution

Code[4]	ATM Process	DOD Description	WP3.3.3 Contribution
A2.3.2.2.2	Apply the DCB Solution	This process describes how the Sub-Regional Network Manager or APOC Staff may send a GO for implementation concerning the DCB solutions that have been activated in the NOP locally and require Network Impact assessment. Not all DCB solutions will require Network Impact assessment: those having sub-regional/local impact only (this being determined during the long-term planning phase) will not need network impact assessment in order to be published in the NOP (default GO for implementation).	No major contributions

Table 9: Recommendations on Supporting DODs

It also recommended updating section on **Roles and Responsibilities** related to Airspace Managers, Sub Regional Manager and Airspace Users with the EP3 WP3.3.3 results. The three main points to be refined are:

- Identification of a new role/function named Airline Coordinator to represent the civil airspace users' interests into the ATM System and deal with their problems. The role/function would work jointly with the Airspace Manager and Sub-Regional Manager to ensure the transparency of process for users and that the users' preferences are taken into consideration. The new role/function only intervenes in the process flow if the problem cannot be solved through direct negotiation between the civil airspace users and the Sub-Regional Manager and the Airspace Management Cell (e.g. a considerable number of users are affected);
- The AMC closely cooperates with the Sub-Regional network manager for the most efficient use of airspace and at FAB level, the Airspace Manager and the Sub-Regional Manager can be merged in only one role performing all the related functions;
- The AOC Staff along with the Airline Coordinator functions also intervene in the processes referred to Table 9, A2.1.1 Refine/Define Airspace Reservation Demand and A2.2.1.2 Refine Airspace Usage Rules. They provide their preferences on the military airspace reservation location and the associated trajectories.

5.3.2.2 Recommendations on supporting Operational Scenarios

EP3 WP3.3.3 Airspace Organization and Management has used the Operational Scenario *OS-34- Military Collaboration in the Medium-Short term* [12] as the initial reference. The existing Operational Scenario focuses on military special exercises starting with the medium planning of a MIL exercise, going on with the implementation of a corridor and the application of a temporary route structure, negotiation due to adverse weather conditions resulting in the

adjustment of a pre-planned VGA and finally cancelling the exercise, providing civilians with spare airspace resources.

Military activities can be classified in:

- Major/Special Exercises (addressed in the OS-34):
  - The yearly plan contains the planned exercises in terms of airspace impact;
  - It is established through CDM sessions between civilians and MIL several months in advance;
  - Some weeks before the operations the final snapshot of the activity is refined (location, size and time);
  - Generally, the re-negotiation in time or space of these exercises is difficult once the requirements have been agreed.
- Day to day exercises (not addressed in the existing OS-34 and analysed in the EP3 WP3.3.3 in the form of the negotiation/coordination of an ad-hoc structure to respond to short-term airspace military requirements, a VGA, and going on with the negotiation/CDM with civil users for the best location and dimension of a VGA in order to keep the impact on civil air traffic to a minimum:
  - Military activities are planned the day before the operations or even the same day;
  - Airspace needs are coordinated at the end of the medium term planning phase;
  - Tactical changes are established through CDM sessions.

The recommendation is to complete the existing operational scenario OS-34 with military day to day exercises or even to create a new scenario in case the scope of the mentioned scenario becomes too broad.

5.3.3 KPI's / KPA's

Although the exercise main objective is focused on the assessment of the processes feasibility, in the experimental plan of the exercise was foreseen, if possible, a preliminary assessment of performances. Finally this assessment has not been complied.

6 FEEDBACK TO EP3 WP3.3.5

6.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

The objective of this validation activity is to:

- Assess the impact during the short-term planning and the execution phases of some Operational Improvements (OIs) on ECAC-ATM performances of the application and,
- Extend the results of previous exercises EP3 WP3.3.2, EP3 WP3.3.3 and EP3 WP3.3.4 to the ECAC wide level.

The approach for this task is a macroscopic mathematical model with a low level of detail, using main results from Complex Graphs and combining deterministic equations with random variables.

Using the local levels of performance obtained in previous exercises and taking in consideration the ATM planning processes and SESAR performance solutions at network level, the Macromodel will extend the local conclusions to a network level in order to obtain metrics and indicators related to operational KPAs at ECAC wide level.

High level objectives of EP3 WP 3.3.5 exercise are:

1. Characterise the **macroscopic behaviour** of the ATM Network at ECAC level, studying how global imbalances are linked to local occurrences and how local instabilities diffuse across the network;
2. Study how **local OIs impact ECAC wide** performances and behaviour;
3. **Extend/ Analyse/ Refine** the conclusions obtained at local level in previous WP3 exercises to the network ECAC level;
4. Expand the different **cost-effective validation and clarification techniques** suited to the early stages of ATM operational concept development.

The operational context of EP3 WP3.3.5 Validation Scenario is:

- ECAC wide;
- Mixed picture (**short-term planning phase**):
  - some flights are in the planning phase (SBTs);
  - and some flights are already in execution (RBTs).

EP3 WP3.3.5 exercise takes place in the short-term planning phase, i.e. some hours before operation starts. The validation scenario starts with a **balanced situation** between planned **demand** (traffic sample/forecast plus airspace reservations) and **capacity** (including airports and airspace capacity increases).

Traffic demand is balanced in a static way, i.e. if no unexpected events occur, the uncertainty of the demand is zero, and there is no uncertainty associated with airports operations, then the network capacity (airports and airspace) is able to handle the planned demand without delays. The reason of this assumption is that the focus of the exercise is to study the benefits of the implementation of certain OIs when facing a **specific imbalance**, controlled in size and nature.

This static DCB situation is reflected in the short-term planning NOP. EP3 WP3.3.5 studies **ECAC wide ATM performances** and **behaviour** associated with the **execution of the short-term planning (day before Ops.) NOP**.

EP3 WP3.3.5 Validation Scenario allows exploring the **benefits of planning** by taking into consideration the **application of OIs** (DCB-0103, DCB-0208 and DCB-0305) **during the short-term planning phase**. Besides, EP3 WP3.3.5 Validation Scenario contemplates the application of operational procedures and **OIs** (DCB-0208) **related to the execution phase**, and the validation of their benefits at ECAC wide level.

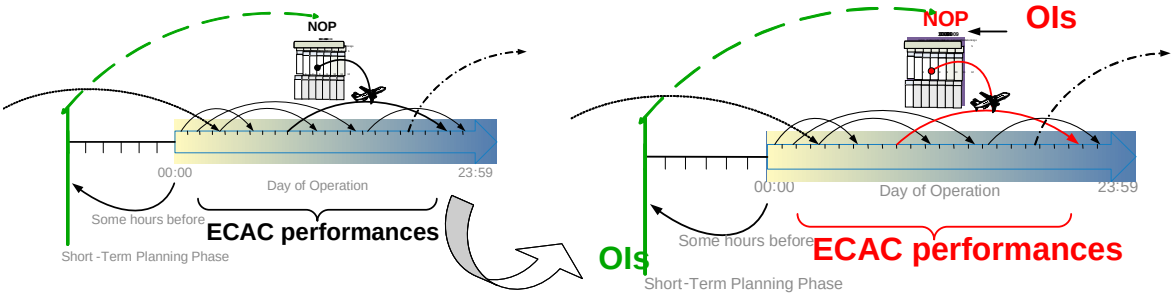

Figure 9: Application of OIs related to Short-Term Planning and Execution Phases.

6.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

All the information requested to the Experts was obtained during the expert group sessions and it was mainly focused in the scenarios generation and definition.

Below, there is an example of the issues configuring the scenarios, implemented in the tool. The Sx.x items represent the different scenarios to be used in the simulations.

			Simulation Scenario 1				Simulation Scenario 2	
	Configuration		S1.1	S1.2	S1.4	S1.3	S2.1	S2.2
Airports	Real Capacity	Shortfall 1		X		X		
		Shortfall 2						
		Shortfall 3						
	Increased capacity in hub airports	Palma						
		Airport 2						
		Airport 3						
	Prioritisation of flights							
Airspace	Real Capacity	Event 1					X	X
		Event 2						
		Event 3						
	Uncertainty of Demand	Scenario 1	X	X	X	X		
		Scenario 2					X	X
OIs	DCB-0208 Dynamic ATFCM using RBT				X	X		
	OI step 1							X
	OI step 2							
	OI step 3							
Integrated results	WP3.3.2	Rules			X	X		
		Parameters			X	X		
	WP3.3.3	Assumptions						X
		Parameters						X
	WP3.3.4	Assumptions						
		Rules						

Figure 10: Definition of the scenarios for WP3.3.5 exercise

Specific questions and the results obtained from the Experts are summarised below:

QUESTION 1: What are/would be the more suitable/interesting variables/features/properties that characterise the European ATM Network from a macroscopic point of view?

This question addresses the simulation measures to be taken into account in the study of the behaviour of the Network at ECAC level.

The outputs obtained from the experts and taken into account for the performance of the exercise were the following, classified by themes:

Themes	Simulation Measures
Flight/Time Efficiency Plan	• Flights Efficiency • Network Delays • Network Efficiency • Distribution of the delays actually generated • Reactionary delays
NOP/Capacity	• Capacity • Network Capacity Variables • Number of overloads (capacity shortfall) • Number of underloads (capacity room)
NOP/Demand	• What is the theoretical demand limit • Demand accuracy • Demand situation awareness • Number of congested nodes
Cost/Benefits	• Quantified benefits of all OIs
FAB Issues	• Passenger Citizen

Table 10: Answers to the Question 1

Some of the answers or issues obtained could not be implemented in the exercise due to time constraints and the proper limitations of the tool. Some examples are the environmental issues such as environmental constraints and environmental impact measurement (emissions).

QUESTION 2: Which are the current criteria/rules for prioritisation of flights in case of severe capacity shortfall (implying long delays or cancellations)? Which changes could be brought to these criteria/rules to benefit airspace users, airport operations, network performances, etc? What are/would be the more suitable/interesting variables/features/properties that characterise the European ATM Network from a macroscopic point of view?

These are the answers obtained about the current criteria taken into account for prioritisation:

- Depends slightly on the type of flight (State/Hospital/S&R vs Non-State)
- Does not depend on Number of passengers nor distance travelled
- Airborne flights have priority
- Emergency
- Co-ordination with Military
- Security
- First come-First Served
- Out of Area Flights
- OAT
- Slot Swapping

- Proportional Reduction (Equity)
- Easiest to Change
- Choice of Alternative Routes
- Limited choice to airlines
- Initial form of Negotiations
- Contingency RAD + NERS

Table 11 shows the ideas of the experts regarding the future changes necessary to improve the current operations, which were obtained during a brainstorming session:

Themes	Prioritisation issues

UDPP	• Future UDPP (to be defined)
	• Create a table to determine the efficiency of a flight (option less expensive)
	• Most token-first served. (Tokens must be created and sold or distributed)
	• For each flight use half and half:
	  o Objective priority tokens
	  o Subjective priority tokens
	• Same treatment for all aircraft (not depending upon equipment)
	• AOs notified about constraints (SWIM) and they make alternative choice
	• Equity in terms of company, passenger numbers, and aircraft.

CDM	• Commercial Airport Slots subject to CDM • Perform a CDM process
Civil/Military	• State aircraft flights' priority to be decided by States (current practice) • Military ATM to be fully integrated in SWIM to enable prioritization coordination when required • Define a Civil – Military airspace users' prioritization process • Cross Border Civil military coordination • Effective-Efficient civil-military coordination at all levels enabling flexibility in decision making
Safety/ATC criteria	• De-conflicted trajectories • Consider impact on the network: de-conflicted trajectories, minimise complexity • Flow: De-conflicting RAD • Reduced Flight uncertainty (plan for) • Exclude ATC from prioritisation process • Prioritisation Problem has to be solved before take-off of flights • Strengthen link between plan and execution

Themes	Prioritisation issues
Aircraft Operations	• Flight Distance • Length of flight remaining (longer flights greater priority) • Curfew • Crew activity limits • Airspace users well informed of expected congested modes • Take into account the previous constraints given to the AO • Number of Passengers • Passengers in transit • Aircraft type • Increase slot window tolerance • Removal of national restrictions (NER'S/RAD)
Other issues to take into account	• Total Awareness of Network Ability to perform • Future ops/enablers Interaction between airlines-ATC-Airport-Network for decision Making (CDM-NOP-SWIM) • CFMU What-If function • Identify the problem and the most important threat to solve • Continually available optimum profiles • Infinitely variable capacity • Flexibility – Ready to make a compromise • In the Future: Airlines to decide according to Network and ATC constraints.

Table 11: Answers to the Question 2

QUESTION 3: Which kind of demand changes can be expected in the short-term planning phase? How could the different demand changes be associated to the demand (duration of the flight, type of airline, etc)? What would be a good estimation of the uncertainty (% subject to changes) associated to each type of demand in the short-term planning phase?

This question addressed the uncertainty parameter to be included in the definition of the simulation scenarios of the exercise. The outputs from the Experts are summarised in Table 12:

Demand Changes		Type of Demand	Uncertainty
Military Area	Size	Airspace Management Coordination Civil-Military	1%
	Slot Time		1%
	Cancel		20%
	New request		1%
Flight cancel		AUO	10%

Demand Changes	Type of Demand	Uncertainty
New Flights (including special)		20%
EOBT changes		10%
Flight Plan changes		100% (approach)
Trajectory Modification	Civil-Military Coordination	0-100%
Airport Capacity Constraints	Airport Operations	
ACC Capacity Constraints	ATC Operations	
ATFM Capacity Constraints	Network operations	
Airspace Configuration Modification	Airspace Management	

Table 12: Answers to the Question 3

QUESTION 4: ***Which type of triggers of demand-capacity imbalances are likely to occur across the network? Which is the typical duration of the different triggers? What would be a good estimation of the probability of occurrence of different triggers and combinations of them?***

In the same way than in previous questions, this one is focused on the clarification of the shortfalls to be implemented in the scenarios and all the issues requested will be included as parameters in the different simulations.

The probability measure is quantified following this scale of values:

1= Very low, 2=Low, 3=Medium, 4=High, 5= Very high

Triggers	Duration	Probability
Airline Operation Closure	Days/Hours	0/1
System Failure	Days/Hours	1
Natural Catastrophe	Weeks/Days	1
Terrorist Attack	Days/Hours	1
Aircraft Accident	Days/Hours	1
False Threat	Hours	1
Support Airport Service Failure	Days/Hours	1
Networks System Support Collapse	Days/Hours	1
Nuclear Catastrophe	Years/Months	1
Pandemic Disease	Weeks/Days	1
Political Crisis	Years/ Months	1
Closure of a Hub	Day/ Hours	1
Political Airport Closure (Security)	Days/Hours	1
Airport Closure	Days/Hours	1
ACC in Contingency	Hours/ Minutes	2
Large Political Meeting	Days/Hours	2
Runway Closures	Days/Hours	2
Migration to New ATC System	Weeks/Days	2
Industrial Action	Days/Hours	3

Triggers	Duration	Probability
Large Scale Military Exercise	Week/ Days	3
Sport and other Events	Weeks/Days	3
Shortage of ATC Staff	Months/Days/Hours	3
Adverse Weather	Days/Hours	4
Tourist Migration (summer/ winter/other)	Days/ Hours	4
Airport Capacity	Months/Days	4
Mil. Training	Hours/Minutes	5

Table 13: Answers to the Question 4

QUESTION 5: How could be prioritised SESAR Operational Improvements in accordance with their expected impact at ECAC wide level? For top five OIs, what is the qualitative characterisation of the impact at ECAC wide level? Which trade-offs between OIs can be expected or would be interesting for case-studies?

This question was made to clarify the selection of operational improvements to be assessed in the different simulation scenarios. The experts selected five Operational Improvements (OIs) from the complete list of OIs defined in Episode 3 project and, afterwards, they assigned a priority to the Operational Improvements which they considered most important at ECAC level.

The prioritization was made using the following scale:

1=Very important, 2=important, 3=less important

These are the results extracted from the feedback of the Experts. Only the first five Operational improvements have assigned a qualitative characterisation. No trade-offs between OIs were identified:

Operational Improvement	Priority	Qualitative Characterisation
AOM-0206	1	Better Accommodation of Civil Military Airspace user Requirements Bunching of Aircraft, Trajectory Efficiency
AUO-0203	1	Planning preferred flight vs. network Demand/Capacity Known situation.
AUO-0204	1	Optimal, agreed trajectory of a flight I.A.W The latest airspace user needs and network situation
AOM-0501	1	Trajectory Efficiency& Cost Effectiveness Added complexity for ATC? (or disbursed conflicts?) Improved Nav Capabilities
DCB-0103	1	Increase Situational Awareness 4D trajectory information sharing Network Information Sharing Support CDM processes
AOM-0403	1/2	
AOM-0503	1/2	
DCB-0208	1/2	
AOM-0103	1/2	
AOM-0304	2	
AOM-0102	2/3	
AOM-0502	3	
AUO-0102	3	

Table 14: Answers to the Question 5

6.3 Feedback on the Exercise Results

Feedback from the experts was limited, since the simulations were still not finished before the last Collaborative Network Planning Expert Group meeting. The results presented were based on exercises with low numbers of simulations. Therefore, feedback on the results is focused on the assessment of the type of results obtained, but not on the significance or confidence on the results themselves.

6.3.1 Feedback on the Validation Methodology

As mentioned above, the Experts' feedback from the results was limited. This caused low confidence on the results obtained so far. Some issues extracted from the comments and questions provided by the experts were:

- To ensure the understanding of the results provided by a tool of this kind, it is important to dispose of more information about the basic rules implemented, the interpretation, and abstraction of the Operational Improvements simulated and the way the tool calculates and obtains the results. More data about the operation and configuration of the tool to perform the validation exercise will be included in the

report (not available at the moment of the meeting with the experts) (see section 06.3 Feedback on the Exercise Results above);

- More involvement of the Experts is needed in the configuration of the scenarios;
- The exercise could not achieve the predefined objectives due to the lack of quantitative results coming from other exercises in EP3 WP3;
- Maturity of the concepts has a decisive influence in the achievement of the objectives of the exercise: the level of maturity of the concepts being low, the results of the simulations are very dependent on a high number of assumptions, so the results are seen as possible trends related to the implementation of the OIs than validation of them;
- Good technique to provide performance assessments if quantitative information is provided and the level of maturity of the concept is high. It is the only technique fully oriented to the procurement of quantitative results and performance assessment;
- Suitable to provide results at ECAC level: the configuration and design of the tool is oriented to provide results at global level;
- Need for good planning for exercises of this type, aiming at integrating previous validation results: It is necessary to make a big effort in the design of the plan and schedule due to the dependence on the other exercises or results;
- Explanation of the results requires a high degree of detail and analysis to make them understandable for the Experts: Graphics must have text attached explaining their interpretation;
- Integration of the results from other exercises must be carefully studied and concisely detailed to be able to extrapolate the results at ECAC level.

6.3.2 Feedback on DOD's and Scenarios

The information provided by the experts about the influence of the results in the DODs or scenarios is focused on the Operational Improvements to be assessed in the simulations.

Experts participated in the selection of the Operational Improvements to be implemented in the different simulations and some results about this implementation were presented.

The results were provided from the statement of the hypothesis based on the specification of the Operational Improvement. As it happened with the presentation of other results, experts requested more details about the hypothesis and OIs definition, because different interpretations of the results were possible otherwise.

Some issues and recommendations were identified to be implemented in the creation of the Exercise Report document:

- Hypothesis definition was not clear for the experts: More detail is needed on the statement of the hypothesis together with the OIs linked to it;
- To increase the understanding about the hypothesis and OIs, it was recommended more involvement of the experts in the hypothesis definition;
- Likewise, the interpretation of the results must be better detailed to avoid misunderstandings;
- A high knowledge about the KPIs and KPAs is necessary to understand the results.
- When results show the improvement of an indicator (KPI), it is necessary to explain the baseline situation/scenario used to compare the results with and without the OI implementation.

Feedback on DODs and scenarios was also foreseen from the extrapolation of local results from other exercises. Only results from the EP3 WP3.3.2 could be integrated in the exercise but no clear results were obtained due to the lack of quantitative results from this exercise. Anyway, the integration was performed and some feedback was obtained from it:

- Integration of the local results must be deeply detailed to get a consensus in the results extrapolated at network level;

- Full integration needs quantitative results obtained at local level.

6.3.3 KPI's / KPA's

The exercise will provide quantitative results. The tool and the different simulations will give the values for the KPIs defined into the performance framework activities. Results are not deterministic because the model incorporates uncertainty associated to ATM complexity. Then, the results are provided by means of graphics and the numerical results have probabilistic character.

As explained before (see section 6.3 Feedback on the Exercise Results), feedback from the experts was limited. Some results were, nevertheless, presented to the Expert Group, and this is the feedback obtained:

- No clear understanding about the definition of the KPIs: More information and detail about KPIs was requested, though the KPIs used in the exercise were extracted directly from the EP3 WP2.4.1 Performance Framework;
- KPIs were not considered by the experts as the best quantitative measure to provide the expected results;
- More involvement of the experts in the definition of the measures to take in the simulations can provide benefits on the understanding of the KPIs.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 EP3 WP3.3.1 MAIN ACHIEVEMENTS

The main achievements of EP3 WP3.3.1 Collaborative Network Planning Expert Group are summarised in the following points:

- EP3 WP3.3.1 has effectively supported the refinement of the following DODs:
  - G – General Purpose;
  - M2 – Medium/Short Term Network Planning;
  - E4 – Network Management in the Execution Phase.
- The Collaborative Network Planning Expert Group contributed to refine two Operational Scenarios:
  - OS-11 – Non-Severe (No UDPP) capacity Shortfall impacting arrivals in the Short Term;
  - OS-34 – Military Collaboration in Medium and Short Term.
- The expert group sessions provided the necessary support to the Episode 3 WP3.3 Validation Exercises during their definition, execution and post-analysis phases through the direct participation of the group of experts. The EG has contributed during their discussions and through the direct participation during the Gaming Sessions (EP3 WP3.3.2 and EP3 WP3.3.3) to identify and detail the CDM Processes that are triggered when:
  - **Dynamic DCB measures** are applied for solving a **non-severe capacity shortfall** (no UDPP);
  - There is a **military airspace reservation** by the military at **short notice** (AFUA concept).
- The Expert Group participants also provided feedback on the explored validation techniques: Expert Group, Gaming and Macro-Modelling.

7.1.1 Main conclusions

These are the main conclusions derived from the Expert Group Sessions:

- A DCB solution is defined / applied from several hours to 60 minutes in advance during the planning phase while a dynamic DCB solution applies between 2 hours and 40 minutes during the execution phase. Both processes must be seen as continuous processes even if the planning phase ends with the publication of the RBT the user agrees to fly and the ANSP and Airports agree to facilitate;
- It is the role of the regional / sub-regional / network manager or Civil-military airspace manager or AOC/APOC staff to propose a dynamic DCB solution;
- To assess network impact of a dynamic DCB solution is dedicated to the regional network manager;
- “Apply the DCB solution” is the role of the sub-regional network manager, or the APOC staff by “sending a GO for implementation concerning solutions that have been activated in the NOP”;
- UDPP would be triggered in case of sudden capacity reduction due to e.g. weather, accidents that can be defined as crisis-like situations. This means that UDPP should only be used when DCB cannot cope with the ATM situation;
- The DCB active time horizon should be a fixed time parameter;
- Concerning the Boundaries between Dynamic DCB and AMAN the experts agreed that between 40 to 50 minutes seems to be reasonable;
- There is a need to manage the network effect by means of CDM processes by the following actors AOC, APOC, ATC and sub-regional network manager;

- During the CDM Process for identifying the best possible location of a VGA, the timeframe limit for achieving an agreement is not a fix value and should be dependent on the magnitude of the trajectory changes and the time horizon of the operation. In case an agreement is not reached, a set of priorities should be identified as a backup to be applied;
- With respect to **AMC or Airspace Management Cell** and the **Sub-regional Managers,** the Experts agree that **at FAB level** it doesn't make sense to separate both functions;
- The sub-regional network manager will have an advanced tool for determining the less penalizing location, size and timeslot of the VGA;

7.1.2 Hot topics

The section provides a list of hot topics identified during the Expert Group Sessions. These hot topics are basically conclusions agreed by the experts which are not compliant with the SESAR ConOps.

Most of the hot topics are related to the concept of UDPP and the limits between DCB Queue management and the AMAN.

Regarding the concept of UDPP, these are the identified hot topics:

- The EG agreed that the UDPP process can be initiated by AOs (or their representatives) or by ATM. However this approach on UDPP does not comply with the SESAR concept where UDPP could be initiated by the AOs, by the APOC acting as a focal point but it could only be triggered by the Regional Network Manager;
- According to the Experts opinion, UDPP can deal with whatever known BT, even with RBT. However the concept supposes that UDPP will not be applied to airborne flights (a too difficult CDM process to put in place);
- The EG agreed that UDPP should not only be applied during the short term planning phase. A UDPP process can be triggered when a downgraded situation is expected in several hours e.g. - 24 hours or days. However, the concept supposes that if a capacity drop could be predicted sufficiently in advance, standard DCB processes should be applied first,(in fact, this is not an unpredicted and sudden situation). According to concept, -4h / -3h seems acceptable;
- There was no final agreement within the Expert Group about roles, responsibilities and CDM processes, including UDPP and more standard procedures like flight cancellation or slot swapping. They have to be defined accurately e.g. through gaming exercises.

Regarding the relationship between DCB Queue Management and AMAN:

- The experts were asked whether the AMAN and dynamic DCB Processes can be managed by a unique system i.e. Extended AMAN or by two distinct systems. All the Experts agree to have both functionalities i.e. arrival management and dynamic DCB considering two separated tools. However this architecture is not compliant with the ConOps.

7.2 EP3 WP3.3.1 FEEDBACK ON VALIDATION TECHNIQUE

This section is focused on the conclusions and recommendations about the Expert Group as validation technique.

The list below provides the main conclusions about the use of Expert Groups as an innovative validation technique:

- It is difficult to think on the Expert Group as a validation technique, when considering it as a standalone technique. However, once the Expert Group is combined with other validation techniques e.g. Gaming Technique, it can be considered as an "Enabler" / "Supporter" for these other techniques;

- Keeping the Experts participants in the loop during the different steps of the concept life-cycle is positive since it:
  - increases the confidence in the results obtained;
  - Alerts on potential deviations from the initial expectations.

- The support of the Expert Group to Validation Exercises executed on other validation techniques and the experts' participation on them, through all the project phases (from the definition of the Exercise to the consolidation of the final results) has been proven as positive since:
  - Increases the buy-in and confidence of the validation exercises results from the stakeholders;
  - Provides wider audience and contributes to disseminate results including all stakeholders' views and feedback.

Figure 11 represents the activities where the expert groups provide major benefits in combination with HIL (Human In the Loop) techniques e.g. gaming:

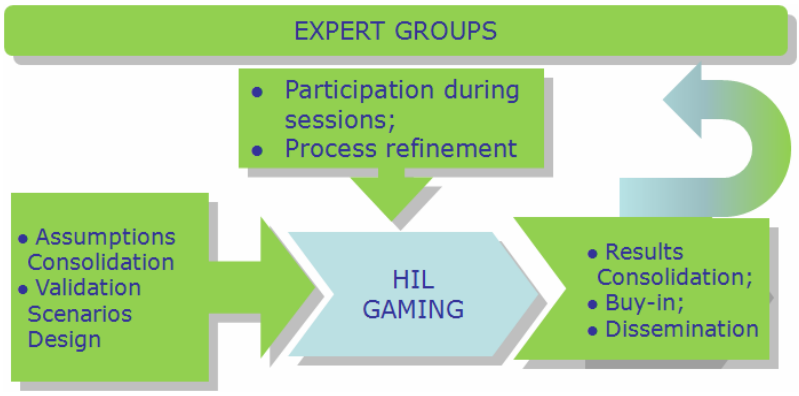

Figure 11: Expert Group applicability

The Expert Groups are good for:

- **Clarifying the Concept** at different stages of maturity since the expert groups help to:
  - Identify alternatives within the concept;
  - Clarify roles and responsibilities;
  - Identify Potential process bottlenecks;
  - Provide evidence of different stakeholder's views and business outcomes;
  - Disseminate results.
- **Performing an initial assessment on Operational Process Feasibility** and as a support to other HIL validation techniques e.g. gaming;
- **Performing a Qualitative Performance Assessment**;
- **Identifying areas of concern**, influences between OIs, potential trade-offs between KPAs or areas of uncertainty;
- Supporting the **initial** steps of a **top-down validation approach**.

The Expert Groups are not foreseen for:

- **Performing a quantitative Performance Assessment:**
  - It is always based on a limited number of inputs;
  - It is difficult to set a common list of assumptions and understanding on the area being analysed between the expert group participants.

Finally, these are the main recommendations and lessons learnt identified through EP3 WP3.3.1 Collaborative Network Planning Expert Group sessions that will be applicable in the future when organizing and managing an expert group for concept clarification:

- All relevant stakeholders should participate in the Expert Group, including the different existing sub-categories within each major stakeholder group e.g. different representatives of Airspace Users such as low cost airlines, commercial airlines, GA, etc;
- The Expert Group should combine expertise on the new concept with operational expertise: operational experts tend to interpret the proposed validation exercises and questions based on their own day-to-day knowledge;
- The Expert Group composition should consist of a permanent core group of experts which will organize regularly planned meetings with a bigger group of stakeholders' representatives in order to increase the dissemination of the results and their buy-in;
- As support for the validation exercises executed on other validation techniques, the expert group should participate during the different steps of each project life-cycle, from the definition to the final consolidation of results;
- It is recommendable to use a facilitator or facilitating techniques during the expert group discussions to guarantee that the meetings are dedicated to the designated objectives and all the issues are conveniently covered. It has been proven that the usual scheme of a general presentation followed by a general discussion does not work since it is not flexible enough for getting us much experts' feedback as possible;
- Dedicate enough time to identify and record the initial expectations of the experts at the beginning of each step in the validation exercises;
- The expert group participants should work in small teams focusing in different aspects of the problem and later on put the conclusions in common and, if possible, one of the experts being the speaker. The composition of these small teams should be periodically modified for guaranteeing that all experts contribute and all voices are properly attended;
- The expert group sessions should be carefully prepared in advance, clearly identifying the scope and objectives of each session, providing in advance adequate material to the experts on the issues to be discussed. The validation exercise leaders should be adequately guided in order to align their presentations with the scope of the meetings;
- The use of questionnaires as supporting material for the experts is recommendable since they guarantee the trace ability of:
    - the feedback provided by the EG;
    - the decisions taken during the meetings and agreements / disagreements;
    - the link between the expert group and the Validation Exercises.
- It is recommendable to provide a forum via Web for interchanging information: something more dynamic than a report to refer to;
- Organise Intermediate EG meetings between the definition of the exercise and the final results consolidation:
    - During the execution of the simulation trials only a limited number of experts can participate;
    - At these intermediate meetings, the experts participating in the simulation trials may present their findings to the rest of the group;
    - Use interim results to provide information to the expert before running the final simulation trials.

8 REFERENCES AND APPLICABLE DOCUMENTS

[1] **E-OCVM** European Operational Concept Validation Methodology, Version 2.0

[2] **SESAR** Concept of Operations DLT-0612-222-01-00

[3] **Episode 3** Experimental Plan on Airspace Organization and Management D3.3.3-01

[4] **Episode 3** **DoW** – Description Of Work V3.1, July 2009

[5] **Episode 3** **SESAR DOD G** – General Detailed Operational Description- D2.2-040

[6] **Episode 3** **SESAR DOD E4** - Network Management in the Execution Phase Detailed Operational Description - D2.2-046

[7] **Episode 3** **SESAR DOD L** - Long Term Network Planning Detailed Operational Description - D2.2-041

[8] **Episode 3** **SESAR DOD M1** - Collaborative Airport Planning Detailed Operational Description - D2.2-042

[9] **Episode 3** **SESAR DOD M2** - Medium-Short Term Network Planning, D2.2-043

[10] **Episode 3** **SESAR DOD E4** - Network Management in the Execution Phase Detailed Operational Description - D2.2-046

[11] **Episode 3** **OS-11** – Non-severe capacity shortfall impacting arrivals in the short term - part of Annex to SESAR DOD G – Operational Scenarios D2.2-050

[12] **Episode 3** **OS-34** Military Collaboration during Medium/Short Term Planning – part of Annex to SESAR DOD G – Operational Scenarios D2.2-050

9 ANNEX A: QUESTIONNAIRES

This annex lists the questionnaires distributed to the experts in order to support the exercises EP3 WP3.3.2 and EP3 WP3.3.3.

9.1 QUESTIONNAIRE EP3 WP3.3.2

9.1.1 Questions related to the Operational Scenario

QUESTION #1.1

In 2020, what seems to you to be the most realistic scenario?

- Option 1: 100% of aircraft will be ATM service level 3 operations capable;
- Option 2: Only 75% of aircraft will be ATM service level 3 operations capable.

If Option 2 is the most realistic one, what needs to be considered for the remaining 25% aircraft?

ATM Service Level3 is characterized by:

- Achieving advanced automation in a shared trajectory environment;
- Dynamic TMAs and Flexible Military structures;
- Dynamic DCB using RBT;
- Management Revision of RBT using Datalink;
- Full set of Advanced Controller tools using RBT/SBT;
- ASEP-ITP;
- 2D-PTC on User Preferred Trajectories.

QUESTION #1.2

In 2020 a given percentage of aircraft should be connected to the network via SWIM. According to you, what's the most realistic value for x? 100%? Less?

QUESTION #1.3

The DCB Queue Management process only provides a TTA if the flight has reached a time horizon of 2 hours before ETA because the ATM System capacity may vary between the time the DCB queue is activated and the time the flight reaches the point where the Queue is managed. This parameter is called DCB Queue active horizon.

Please state which option seems to be the most appropriate:

- Option 1: The limit for starting sending a TTA could be defined by a fixed time parameter before the ETA or else;
- Option 2: The limit for starting sending a TTA could be defined by a time parameter that would depend on the severity of the congestion i.e. the level of calculated delays.

If option 1 is selected, do you think 2 h is an acceptable limit?

In the same way, flights can be submitted to a DCB Queue at the latest x minutes before their ETA/TTA. Do you agree on this Queue active limit value? If so, do you think x=50 minutes is an acceptable value?

TTA cannot be treated any longer by the ARR DCB Queue before starting being treated by the AMAN a certain time before the TTA in order to stabilize the pre-sequence.

Do you think it is acceptable? Could such region be set to [TTA-50 min; TTA-40 min]?

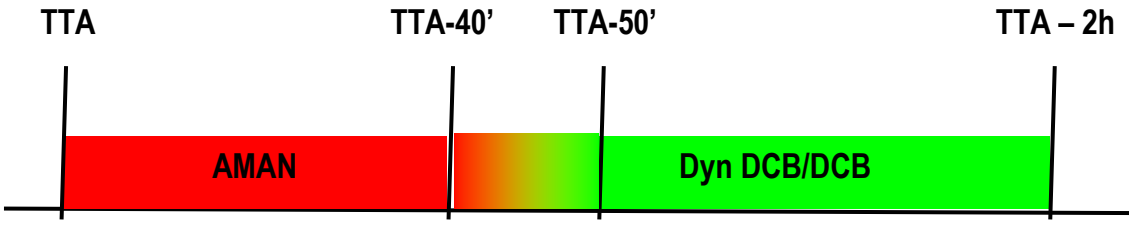

Figure 12: AMAN vs Dynamic DCB.

9.1.2 Questions related to the Gaming Scenario

QUESTION #2.1

Can the AMAN and dynamic DCB processes be managed by a unique system (extended AMAN) or must there be two distinct systems?

QUESTION #2.2

In case of a unique extended AMAN, who is the "owner" of the system knowing that there might be a network impact? At which level i.e. local, sub-regional, and regional the operational requirements of the system and associated operational procedures should be defined?

QUESTION #2.3

In both cases, is there a need to manage the network effect? Which are the actors involved? Which CDM processes are required? Which decision support tools and network indicators are needed?

QUESTION #2.4

Which criteria/factors influence the determination of the temporal planning horizon of the AMAN? Of the Dynamic DCB process?

QUESTION #2.5

On which point of the 4D trajectory the DCB constraints should be applied regarding the TTA? The FAF? The IAF? At the transition between DCB queue and AMAN horizon? Should the application point of the DCB measure be the same as the AMAN's?

QUESTION #2.6

When a TTA is issued, which measure must be applied in case of no reply from the AOC? What to do if the returned business trajectory does not cope with the proposed TTA and does not solve the imbalance through application of a later TTA proposed by the AO?

QUESTION #2.6B

Is there a need for implementing a Ground trajectory tool in order to:

- Check compliance of S-R/BT with ATM constraints;
- Validate that the proposed S-R/BT does not create adverse effect on the NOP;
- Provide assistance to SBT elaboration.

QUESTION #2.7

What are the degrees of freedom of the AOC for re-planning BTs? For example, can the AOC decide to increase the taxiing time in the business trajectory to absorb part of the delay? Does this require a specific CDM process at the departure airport?

QUESTION #2.7B

Do you think that slot swapping, flight cancellation, negotiation of TTA… are part of the standard process or have to be dedicated to UDPP?

QUESTION #2.8

What are the indicators e.g. delays, hourly demand/capacity imbalance, capacity decrease on which decisions to trigger UDPP are based?

QUESTION #2.9

What is the temporal horizon for UDPP? Does it deal only with flights in the short-term planning phase?

QUESTION #2.10

Concerning the application of the UDPP, do you think PREDEFINING the list of priority flights is relevant? Why?

QUESTION #2.11

When several flights have the same ETA, then do you think airborne fights should have the priority over the flights having a RBT but still on ground, which themselves have priority over those having a SBT? Any suggestion?

9.1.3 Questions related to the Process Simulation

QUESTION #3.1

What are the differences between 2.3.2 “Propose a DCB solution” and 3.1.3 “Propose a Dynamic DCB solution” processes? Need to clarify the conditions and the time of activation, as well as the frontier between the short term processes and the execution ones.

QUESTION #3.2

What are the differences between 3.1.3.1.2 “S/R/E a Dynamic DCB solution at Airspace Level” and 3.1.3.2.2 “Apply the Dynamic DCB solution” processes? From the Operational Scenario one needs to clarify:

- which one performs the DCB queues TTAs calculations in what-if mode;
- which one updates these TTAs in the NOP;
- Who is responsible for updating the new EOBT agreed between AOCs and APOCs. (SBT case).

QUESTION #3.3

If a TTA is assigned to an airborne-flight, who is going to propose the initial proposal to achieve it?

- Executive controller looking only at the airspace under his responsibility;
- Sub-regional Manager looking at the whole airspace until the AMAN Active horizon and advising the executive controller;
- the flight crew?

QUESTION #3.4

Are 10 minutes enough to manage all these actions?

- the sub-regional manager is informed about the lack of capacity;
- DCB queue solution is selected;
- Network Function calculates TTAs;
- flight crews and AOCs are informed;
- AOCs vs APOCs negotiations;
- Flight crew vs Executive Controller negotiations;
- all flights agree with their TTAs and the way to achieve them.

9.2 QUESTIONNAIRE EP3 WP3.3.3

9.2.1 Questions related to the Operational Scenario

QUESTION A:

According to the Operational Scenario *"OS-34 Military Collaboration during Medium/Short Term Planning"* the VGA is made of a core region which is a CBA of approximately 100NM (TBV) diameter and two additional lobes required to facilitate long distance air-to-air fighting. (length of the lobes?)

QUESTION B:

Clarification on the **different responsibilities** of the AMC or Airspace Management Cell and the Sub-regional Managers at FAB Level.

- Who detects an imbalance?
- Who analyse the best airspace Organization?
- Who applies the solution?

QUESTION #1

Military Collaboration in the Medium & Short-Term (page 7)

It is assumed that 90% (TBV) of the airspace requirements are known 2 days (TBV) before ops (i.e. before the end of the medium-term planning phase). It is also assumed that the remaining 10% (available 2 h or less before execution) deal with quick response alerts or such and as a consequence are not planned by definition and necessity of training relevance (train as you fight).

Question:

What is the availability of this Information? When? Unexpected Events?

Do you consider that the Major/Special Exercises represent the 90% of the airspace requirements?

Do you consider that the day-to-day Exercises represent the 90% of the airspace requirements?

QUESTION #2

Military Collaboration in the Medium & Short-Term (page 10)

We are some weeks before operation. Mission requirements get more and more precise. They are integrated in the NOP. The exercise consists of 2 formations composed of 4 fighters each. The formations will train in FOX TA, a subpart of ALL_FOX TA adapted to the mission needs (FOX TA is a Military Variable Profile Area) from 6:00 to 8:00 (TBV). The rest of the area is released and notified to the AMC. The NOP is updated. The Airspace Users proposes the best solution for all the concerned users, having the ability to perform the sectorisation definition and the sectorisation impact analysis, in coordination with the Sub-regional network

manager, and under the supervision of the Regional network manager. As a consequence of a use of a subpart of ALL FOX TA, this will trigger impacted SBTs by offering capacity opportunities.

Does an airspace reservation release always imply capacity gains/opportunities?

QUESTION #3

Military Collaboration in the Medium & Short-Term (page 10)

…the DCB process activities are continuously iterative, collaborative and interactive.

Question:

What are the main Roles and Responsibilities in this negotiation process? Timeframe? Interactions?

9.2.2 Questions related to the Exercise Assumptions

QUESTION #4

Traffic 2020 will be used.

Question:

Is it necessary to use a real traffic for 2020? Any particular situation to consider?

QUESTION #5

We are from 1 day to 1 hour before the operation. The trajectory intentions are almost known but there is still a percentage unknown. Episode 3 has provided traffic for 2020 and for the execution phase (everything is known).

Question:

Would be an error if EP3 WP3.3.3 don't consider this uncertainty at the short-term planning phase?

QUESTION #6

Question:

Can be considered for the exercise that the military traffic is OAT?

QUESTION #7

Locations to allocate the military airspace reservation.

Question:

Could you provide some hints? For instance:

- *Close to the military bases;*
- *High complexity zones in order to squeeze the interactions among users when complex situations;*
- *Others.*

QUESTION #8

EP3 WP3.3.3 intends to reproduce particular situations of the operational scenario:

- *Validation Scenario Example #1: VGA planning;*
- *Validation Scenario Example #2 Release a VGA area.*

Question:

Are there other changes on the airspace reservation that are interesting to be analysed?

QUESTION #9

Question:

Which are the possible Airspace Organizations in order to balance demand and capacity?

Examples:

- *Airspace configuration including military activity:*
  - *Change of configuration with the same number of sectors;*
  - *Different number of sectors;*
  - *Opening Scheme.*
- *Temporary route structure;*
- *Flight Level Capping;*
- *Advisory Routing;*
- *Others.*

Assumption: Queue Management is not applied as DCB measures (including UDPP)

QUESTION #10

Question:

Other particularities can be taken into account? For instance:

- Aircraft Capabilities to cross (along a corridor) military airspace reservation;
- For those aircraft that cannot access to NOP, they will be treated as today (2009).

Assumption: SWIM-enabled NOP is operational, 75% (TBV) of the aircraft are nodes connected to the network via SWIM.

QUESTION #11

Question:

How these predefined solutions are obtained? Are they prepared and triggered depending on the High/Medium/Low Capacity Imbalance? For instance:

- *For a High Capacity Imbalance the EP3 WP3.3.3 exercise should open the maximum number of sectors i.e. new airspace configurations along with a temporary route structure;*
- *For a Medium Capacity Imbalance EP3 WP3.3.3 exercise can use just conditional routes;*
- *For Low Capacity Imbalance EP3 WP3.3.3 exercise can use a light variation on the airspace configurations.*

QUESTION #12

Question:

According to the responsibilities of every actor in the simulation (1 day to 1 hour), which information will they need to take decisions?

- *Sub-regional Manager;*
- *Civil Airspace Users;*
- *Military/Exercise Director;*
- *Civil/Military Airspace Manager.*

QUESTION #13

Question:

Apart from Commercial Users (like Iberia or Air France), what kind of AOCs would be interesting to the involved in the gamming? (Commercial, low cost, business, general aviation)?

QUESTION #14

Question:

Which are the preferred routes for different AOCs (Commercial, Low Cost, Business, General Aviation)? Which are the priorities? For instance:

- *Less Fuel Consumption (optimum flight levels);*
- *Direct Routes;*
- *Punctuality;*
- *No cancellations;*
- *Others.*

QUESTION #15

Question:

When an imbalance is detected, how many solutions will be provided by the sub-regional manager to the users?

- *Every of them with the correspondent cost of solution?*
- *The best one in terms of the cost of solution for everybody?*

QUESTION #16

Question:

How the Sub-regional Manager detects an imbalance at the timeframe of our exercise (end of medium term to short term)?

For instance, imbalances on capacity nodes (traffic density) or traffic complexity?

In case of considering that Complexity should be measured, which is the maximum permissible complexity?

9.2.3 Questions related to the Validation Scenarios

QUESTION #17

"The Civil/Military ASM in coordination with the sub-regional network manager evaluates by means of advanced tools the least penalizing orientations of the ALPHA lobes and the airspace organization required with an associated 'cost of solution'."

Question:

Which is the meaning of least penalising for orientations of the VGA lobes? Which are the indicators/metrics considered for this selection?

QUESTION #18

"The Civil/Military ASM in coordination with the sub-regional network manager evaluates by means of advanced tools the least penalizing orientations of the ALPHA lobes and the airspace organization required with an associated 'cost of solution'."

What do you think the cost of solution is? Does every airspace configuration come along with, e.g. gain in capacity, associated delays, flown extra miles for users, cost for implementation? Or is a combination of them?

QUESTION #19

The Sub-regional Manager communicates the possible orientations to AOCs.

The Users (AOC) evaluate the two potential solutions and the associated air traffic demand (SBTs and RBTs), taking into account the constraints related to the new reservation (ALPHA lobes) and the weather conditions at low altitude.

Question:

Does the Sub-regional Manager notify only to the affected AOCs?

QUESTION #20

The Sub-regional Manager communicates the possible orientations to AOCs.

The Users (AOC) evaluate the two potential solutions and the associated air traffic demand (SBTs and RBTs), taking into account the constraints related to the new reservation (ALPHA lobes) and the weather conditions at low altitude.

Question:

Who are the affected flights? Should EP3 WP3.3.3 exercise take into consideration the initial SBTs when the VGA was planned?

10 ANNEX B: PLANNING AND LIST OF EXPERTS

This annex lists the experts that have participated within EP3 WP3.3.1 Collaborative Network Planning Expert Group.

- Stéphane Deycard / Alfredo Gómez de Segura (AENA) – EP3 WP3.3.1 Leader
- Serge Manchon (EUROCONTROL)
- Sohnke Mahlich (EUROCONTROL)
- Giuseppe Murgese (EUROCONTROL)
- Roger Guerreau (EUROCONTROL)
- Julien Morvan (EUROCONTROL)
- Pierre Loubieres (EUROCONTROL)
- Leila Zerrouki (EUROCONTROL)
- Matt Greenaway (NATS)
- Zlatko Meic (EUROCONTROL)
- Claude Chamayou (DSNA)
- David Zwaaf (LVNL)
- Armand Jongen (LVNL)
- Antonio Corpa (Iberia)
- Maria Isabel Martín (Iberia)
- Christian Verlohren (DFS)
- Debora Palombi (ENAV)
- Giorgio Matrella (ENAV)
- Daniel Schuller (NATS)
- Fabio Grasso (EUROCONTROL – Military Unit)
- Viviane Davy (EUROCONTROL – Military Unit)
- Pedro Abello Solé (AENA)
- Patricia Criscuolo (SICTA)
- Gérard Mavoian (EUROCONTROL) – EP3 WP3.3.2 Leader
- Patricia Lopez de Frutos (AENA) – EP3 WP3.3.3 Leader
- Jose Manuel Risquez (INECO)
- Xavier Ruiz (INECO)
- Sara Luis (INECO)
- Nicolas Suarez (ISDEFE)
- Marta Sánchez (ISDEFE) – EP3 WP3.3.5 Leader

END OF DOCUMENT