EPISODE 3

Single European Sky Implementation support through Validation

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EXECUTIVE SUMMARY

The objective of the Episode 3 (EP3) WP5.3.1 TMA Expert Group exercise has been to provide expert support regarding SESAR ConOps Arrival and Departure management processes.

The EP3 WP5.3.1 TMA Expert Group has contributed to the Episode 3 objective to support SESAR Development Phase activities, and thus focusing on supporting the following activities:

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

The EP3 WP5.3.1 TMA Expert Group has provided TMA expert support to:

- WP5 - TMA Exercises and Concept Refinement;
- WP6 - Technical Validation;
- WP2.4.3 - TMA Safety Assessment.

The main objective of the support was to provide key answers to questions presented by each exercise leader, and make assumptions on how the SESAR concept will operate. The EP3 WP5.3.1 TMA Expert Group also provided support in setting priorities for subsequent validation sessions.

The main expert results and output can be found in the:

- Questions and Assumptions spreadsheet in which questions, answers and concept assumptions are compiled and presented;
- Storyboard - presentation of an assumed Arrival Management Process in Core Europe.

Furthermore, in contribution to the validation methodology used, this document offers information on experience and lessons learnt on the EP3 WP5.3.1 TMA Expert Group exercise.

The exercise leaders of WP5.3.4, WP5.3.5 and WP5.3.6 have provided recommendations based on the results from their respective Fast Time Simulation and Prototyping sessions exercises. The EP3 WP5.3.1 TMA Expert Group has reviewed the recommendations and added some additional recommendations and comments.

1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

This document provides the report on the results of the WP5.3.1 TMA Expert Group, which shall contribute to the elaboration of the Integrated Report of work package WP5 TMA & Airport.

1.2 INTENDED AUDIENCE

The document is intended for the following audience:

- Episode 3 participants, especially:
  - WP 2.2 Clarification and Refinement of SESAR ConOps;
  - WP 2.4.1 Performance Framework;
  - WP 2.4.3 Safety Assessment;
  - WP 4.3.1 En-route Expert Group;
  - WP 5.1 WP Management and Coordination;
  - WP 5.2.1 Validation Strategy and Support;
  - WP 5.2.2 Operational Concept Refinement;
  - WP 5.3.2 Airport Expert Group;
  - WP 5.3.4 Multi Airport TMA operations in core area of Europe;
  - WP 5.3.5 TMA Trajectory and Separation Management;
  - WP 5.3.6 Prototyping of a Dense TMA;
  - WP 5.4 TMA and Airports Results' and Analysis and Report;
  - WP 6 Technological Enablers.
- SJU Project Leaders.

1.3 DOCUMENT STRUCTURE

This document has been split into 11 chapters and 4 annexes. First chapter contains the executive summary. Chapters 1 and 2 provide a concise description of the work carried out by the EP3 WP5.3.1 TMA Expert Group, based on the EP3 WP5.3.1 TMA Expert Group Plan [4]. Sections 3 to 8 include the results obtained. Chapter 3 is focused on the ATM concept being addressed within the Expert Group (EG) sessions whereas chapters 4 to 8 are focused on the support that the EG provided to other work packages. Chapter 9 contains summarises the EG outcomes through a set of conclusions and recommendations and finally referenced documents throughout the text are included in chapter 10.

The most relevant document for the work of the EG, e.g. questionnaires and a questions and assumptions spreadsheet, are included in the annexes at the end of the document.

The information that has not been included as part of this report is listed below:

- Minutes of the EP3 WP5.3.1 TMA Expert Group Meetings;
- Low level questions and assumptions discussed (although these are all included in the Annex of Questions/Assumptions Spreadsheet);
- DOD Descriptions [8];

- Whole text of Operational Scenarios reviewed.

1.4 BACKGROUND

Episode 3 is charged with beginning the validation of the operational concept expressed by SESAR Task 2.2 and consolidated in SESAR D3 [15]. The emphasis is on obtaining a first assessment of the ability of different concept elements to contribute to the defined performance benefits in the 2020 time horizon corresponding to ATM Capability Level 2/3 and the Implementation Package IP 2. The validation process as applied in EP3 is based on version 2 of the E-OCVM [3] which describes an approach to ATM Concept validation.

Based on the corresponding EP3 WP5.3.1 TMA Expert Group plan [4] and validation exercises results, analysis are performed to provide evidence (preferably measured) about the ability (of some aspect) of the concept to deliver on (some aspect) of the performance targets. According to step 4 of the E-OCVM, an Expert Group report should be produced to lay down the evidence of qualities and shortcomings together with issues and recommendations.

The document reports on the EP3 WP5.3.1 TMA Expert Group activities performed within WP5: TMA & Airport.

The EP3 WP5.3.1 TMA Expert Group has supported the validation process in the areas related to the SESAR concept clarification for the main purpose of preparing the validation scenarios. One important task has been to work in close cooperation with the validation exercises to help in clarification on how the area chosen is representative for the ECAC area. In doing so, it must be said that all terminal areas and airports are unique in terms of traffic structure and load, environment and procedures. Episode 3 is not designing an ECAC representative airport or airspace. However conclusions can be drawn for the ECAC area. Although across the area local constraints are different, conclusions and results from local exercises are useful and can be extrapolated to other cases. So the results must be carefully used giving special attention to how in some aspects they are related to the environment they were derived from. This is one of the tasks to ensure that reporting on results and conclusions drawn are done in a careful way to support SESAR Development Phase in best of ways.

The EP3 WP5.3.1 TMA Expert Group has worked in close relation with the EP3 WP5 validation exercises. Its key outputs have been to provide key assumptions on how the concept will operate, used as input to support the exercises. These agreed assumptions have been documented in the Q/A spreadsheet.

The EP3 WP5.3.1 TMA Expert Group supports the three EP3 exercises: WP5.3.4 Multi Airport TMA operations in the core area of Europe, WP5.3.5 TMA Trajectory and Separation Management and WP5.3.6 Prototyping of a Dense TMA. Furthermore, support to the development of Operational Scenarios in WP 5.2.2. has been provided.

In addition, the EP3 WP5.3.1 TMA Expert Group supports and provides input for EP3 WP6 Technological Enablers, EP3 WP2.4.1 Performance Framework and EP3 WP2.4.3 Safety Aspects.

1.5 GLOSSARY OF TERMS

Term	Definition
A-CDA	Advance Continuous Descent Approach
AENA	Aeropuertos Espanoles y Navegación Aérea
AMAN	Arrival Manager
ANSP	Air Navigation Services Provider

Term	Definition
APP	Approach Control
ASAS	Airborne Separation Application System
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
CASSIS	CTA/ATC integration studies
CDA	Continuous Descent Approach
CDM	Collaborative Decision Making
CTA	Controlled Time of Arrival
ConOps	Concept of Operations
2D	2 Dimension
3D	3 Dimension
4D	4 Dimension
DCB	Demand and Capacity Balancing
DFS	Deutsche Flugsicherung GmbH
DOD	Detailed Operational Description
DOW	Description of Work
ECAC	European Civil Aviation Conference
EEC	EUROCONTROL Experimental Centre
EG	Expert Group
ENAV	Ente Nazionale Assistenza al Volo
E-OCVM	European Operational Concept Validation Methodology
E-TMA	Extended TMA
FAF	Final Approach Fix
FTS	Fast Time Simulation
FUA	Functional Airspace
ICAO	International Civil Aviation Organization
IAF	Initial Approach Fix
INECO	Ingeniería y Economía del Transporte, S.A.
IOC	Initial Operating Capability
IP	Implementation Phase
KPA	Key Performance Area
KPI	Key Performance Indicator
LVNL	Netherlands Air Traffic Control
MOM	Minutes of Meeting
NLR	Dutch National Airspace Laboratory
NOP	Network Operations Plan

Term	Definition
OI	Operational Improvement
OS	Operational Scenario
PBN	Precision Based Navigation
P-RNAV	Precision Area Navigation
PMS	Point Merge System concept
PTC	Precision Trajectory Clearance
RBT	Reference Business Trajectory
RTA	Required Time of Arrival
RTS	Real Time Simulation
SESAR	Single European Sky ATM Research and Development Programme
SBT	Shared Business Trajectory
SDD	Safety Design Document
SICTA	Sistemi Innovativi per il Controllo del Traffico Aereo
SJU	SESAR Joint Undertaking
STAR	Standard Terminal Arrival Route
TMA	Terminal Control Area
THAV	Thales Avionics
TOD	Top of Descent
TR6	Thales Air Systems
Q/A	Questions and Assumptions
WP	Work Package

Table 1: Glossary of Terms

2 EXPERT GROUP SCOPE AND JUSTIFICATION

2.1 STAKEHOLDERS

EP3 WP5.3.1 TMA Expert Group Partners are:

- AENA;
- Airbus;
- DFS;
- ENAV;
- EUROCONTROL;
- INECO;
- ISDEFE;
- LFV;
- LVNL;
- NATS;
- NLR;
- SICTA;
- THAV;
- TR6.

2.2 DESCRIPTION OF ATM CONCEPT BEING ADDRESSED

In Europe high complexity operations routinely occurs in terminal areas. The particular challenge for terminal area operations is to increase the overall capacity such that closely located airports can operate at maximum capacity and a reasonable level of over-flying traffic can be accommodated.

The main operational concept elements in line with the SESAR Detailed Operational Description E5 - Arrival/Departure [8], addressed by EP3 WP5, are:

- Trajectory Management;
- Continuous Descent Approach (CDA);
- Precision Based Navigation (PBN);
- Advanced Arrival Management applications;
- Medium Term Conflict Detection applications;
- Integrated Arrival / Departure Management applications;
- Controlled Time of Arrival applications (CTA);
- 2D Precision Trajectory Clearances (PTC-2D);
- 3D Precision Trajectory Clearances (PTC-3D);
- Automation in ATC.

2.3 Exercise Objectives

The main objective of the TMA Expert Group has been to support the validation exercises within WP5 in an iterative way by providing key answers to questions presented by each exercise leader, and make assumptions on how the SESAR concept will operate. The Expert Group also has provided support in setting priorities for subsequent validation sessions, as in the case of EP3 WP5.3.6 Prototyping of a Dense TMA.

Another objective has been to support the SESAR concept refinement and development of operational scenarios. The Expert Group works closely with EP3 WP5.2.2 to support these tasks.

The EP3 WP6 Technological Enablers, led by Airbus, carries out technical validation with the aim to demonstrate industry readiness to meet the future requirements on ground and in airborne systems. The work package also refines various scenarios, different from the ones mentioned above and used for technological validation purposes. The EP3 WP5.3.1 TMA Expert Group objective in this sense has been to support WP6 in reviewing these validation scenarios.

The EP3 WP5.3.1 TMA Expert Group also supported EP3 WP2.4.3 Safety Assessment in SESAR concept safety assessment.

2.4 Expected Output

The EP3 WP5.3.1 TMA Expert Group has worked in close cooperation and dialogue with each exercise/work package leader. The following results were expected when the work was planned and can be said is still valid as a general description of what has been the out:

- Description and definition of SESAR concept assumptions and hypotheses to be used for modelling of the validations exercises;
- Answers to questions provided by exercise leaders on SESAR concept issues e.g. ATC methods and procedures, ground / airborne systems, aircraft operations;
- Assessment of the metrics proposed by exercise leaders;
- Assessment on how subsequent exercise sessions are to be carried out in an efficient way by prioritising ‘hot topics’ and key elements of the SESAR concept
- Assessment of the validation results from the exercises individually and development of higher level recommendations for TMA operations based on expert group observations.

2.5 Tools, Techniques and Methodologies

The EP3 WP5.3.1 TMA Expert Group has used different methodologies when supporting the different work packages. The six work packages supported are WP 5.2.2, WP5.3.4, WP5.3.5, WP5.3.6, WP2.4.3 and WP6. They have all had different needs of support, and they have listed these needs specifically.

2.5.1 WP5.3.4 and WP5.3.5 - FTS exercises

The Fast Time Exercises are WP5.3.4 Multi Airports TMA and WP5.3.5 Separation Management in the TMA have had similar requirement of support. The following describes how the cooperation and support were carried out:

Each Exercise Leader described their support needs, and discussed with EP3 WP5.3.1 TMA Expert Group Leader what way the support best could be organised. A plan was made up, which mainly worked this way:

- Exercise Leaders sent a document describing the areas of support needed and a list of issues and questions for the EP3 WP5.3.1 TMA Expert Group to consider prior to a meeting with the expert group.
- In the meetings the Exercise team and the EP3 WP5.3.1 TMA Expert Group discussed each item questions were answered. Assumptions were made and formulated on how to apply the concept take operational as well as technical (airborne and ground systems) aspects into consideration. Notes were taken, and answers, comments and assumptions were recorded in a Questions and Assumptions spreadsheet [13]. This information was used in the preparation of the exercise. It is important that the assumptions used and operational and technical valid prerequisites are clearly documented in the exercise plans, for reference when simulation results are being discussed and assessed. When preparing a validation exercise, whether it is FTS or prototyping, the SESAR ConOps needs to be broken down, concretely described how it is assumed to work. Since the ConOps is not mature and has not been studied to a large degree this is sometimes quite difficult, but still needs to be done. Assumptions have to be made, and these assumptions have to be clearly documented in the validation exercise plans. It may very well turn out that some assumptions were very close to what is actually materialized in the future, and others were not.
- If an expert could not attend the meeting he/she would send his/her reply to the Exercise and Expert group leaders prior to the meeting. In some instances experts (particularly technical experts) have chosen not to come to the meeting since issues are mainly operational, but have instead been on stand by via telephone, should any specific technical issue be raised in the meeting. This has worked well and reduced travel costs considerably.

Three meetings were held to support WP5.3.4 and WP5.3.5.

The exercise leaders of WP5.3.4 and WP5.3.5 have provided recommendations based on the results from their respective exercises. The EP3 WP5.3.1 TMA Expert Group has reviewed the recommendations and added some additional recommendations and comments as shown in the Annex 4.

2.5.2 WP5.3.6 - Prototyping exercise

The Exercise Leader of WP5.3.6 Prototyping of a Dense TMA discussed with the EP3 WP5.3.1 TMA Expert Group what way the best support could be organised. A plan was made up, which mainly work this way:

There were four exercise sessions, three in EEC/Bretigny prepared and run by EUROCONTROL, and one in Naples run by ENAV. A common strategy and plan for how the support would work was agreed as follows:

- The Exercise leader and team prepared and conducted the first session with no support from EP3 WP5.3.1 TMA Expert Group; WP5.3.6 had agreed first session objectives/content and underlying concept elements in both a TMA EG meeting prior to EP3 Project Suspension and concluded at a WP5 Progress Meeting in September (paper provided by 5.3.6 on the sessions for approval by WP5 Leader).
- After each session results were compiled and analysed by the simulation team.
- A meeting with the EP3 WP5.3.1 TMA Expert Group was held after each session, the results and recommendations were presented. Next session was discussed. EP3 WP5.3.1 TMA Expert Group commented on the structure and the detailed objectives to encourage advanced and useful additions to ensure SESAR ConOps alignment. As an example the EP3 WP5.3.1 TMA Expert Group discussed prioritisation of concept elements such as mix of 4D/non 4D aircraft and

implementation of CTA through an RTA function. The prototyping was also to picture an advanced arrival management concept with an extended AMAN horizon.

Four meetings were held to support WP5.3.6.

The exercise leader of WP5.3.6 has provided recommendations based on the results from the prototyping sessions. The EP3 WP5.3.1 TMA Expert Group has reviewed the recommendations and added some additional recommendations and comments as shown in the Annex 4.

2.5.3 WP2.4.3 - Safety Assessment

The leader of WP2.4.3 Safety Assessment discussed with the EP3 WP5.3.1 TMA Expert Group Leader what would be the best way to support. The task was to help out and to review the development of the TMA Safety Design Document (SDD) and thus to ensure and that the operational and technical descriptions were in line with ConOps. A strategy and plan were agreed, which mainly work this way:

- The author of the SDD sent a first draft to the experts, and a guideline on how and what areas specifically the experts should review and comment. This was sent prior to meeting held in February of 2009.
- In the meeting, lasting two days, the document owner proposed operational and technical issues to be discussed and agreed on, again similar to the support for the validation exercise above, on how the ConOps would or could work. Notes were taken.
- On the request of the document owner, the expert group then formally reviewed the SDD, with nearly all experts providing comments in a review sheet.

One meeting was held in Naples in February of 2009. The result was reflected in the TMA SDD [12].

2.5.4 WP6 - Technical Validation

The team of WP6, Technical Validation, discussed with EP3 WP5.3.1 TMA Expert Group Leader what would be best way to support. The task was to support the development of the WP6 Technical Scenarios. A strategy and plan for the support were agreed, which mainly work this way:

- A major part of the two last EP3 WP5.3.1 TMA Expert Group meetings in April and May 2009 were designated the technical scenarios related to 4D operations and ASAS applications.
- WP6 presented the scenarios; page by page we went through and discussed the description. The TMA expert group felt that there was a lack of operational detailing which led to a risk of misunderstanding on under which circumstances the scenario occurred. It was felt this could lead to misunderstanding or misinterpretation once the results are available. One solution would be to in parallel develop operational scenarios to support the technical ones.
- The discussion never concluded on how far and to what operational detailing the technical scenarios needed to go.
- The discussion has then continued on the EP3 website and its review room.

Two expert group meetings were held focusing on scenario review. The results can be found in the WP6 Technical scenarios descriptions [11].

2.5.5 WP5.2.2 - Operational Scenarios Development

The team of WP5.2.2, Operational Concept Refinement, discussed with EP3 WP5.3.1 TMA Expert Group what would be the best way to support. The task was to help out on the refinement of the operational concept. Since only a few operational scenarios were to be used to support exercise preparation, it was agreed that no general review of the suggested required scenarios were to be done by the EP3 WP5.3.1 TMA Expert Group. Instead this plan for support was agreed:

- The EP3 WP5.3.1 TMA Expert Group would support the exercises as required by each exercise leader.
- The result of the support would be documented in the Questions and Assumptions Spreadsheet (Q/A), and in the storyboard if applicable (not all exercises uses storyboard technique).
- WP5.2.2 would use the Q/A spreadsheet and storyboard to support the development of operational scenarios.
- The exercise leaders of WP5.3.4, WP5.3.5 and WP5.3.6 have provided recommendations based on the results from their respective FTS and Prototyping sessions exercises. The EP3 WP5.3.1 TMA Expert Group has reviewed the recommendations and added some additional recommendations and comments as shown in the Annex 4. The result of the review will be used by WP5.2.2 to support concept refinement and if needed the updating of the operational scenarios.
- One operational scenario, the OS-35 flying CDA and merge was reviewed in an EP3 WP5.3.1 TMA Expert Group meeting. The review resulted in an update and further development of the scenario.

2.6 Relationships or Dependencies

The EP3 WP5.3.1 TMA Expert Group leader has attended other expert group meetings of WP4.3.1 and WP 5.3.2. It is important to keep close contact with the Airport and En-route expert group so that inter-phasing operational aspects are not dealt with differently so that contradictory assumptions are made on different groups. This can easily be done since the future arrival management process starts well into the en-route airspace at or before top of descent, in the E-TMA.

The EP3 WP5.3.1 TMA Expert Group has worked in close liaison with the work package leaders to find an efficient working method for the individual support required.

The EP3 WP5.3.1 TMA Expert Group has been playing an important role by being the link of SESAR conceptual matters between the EP3 TMA exercises 5.3.4, 5.3.5 and 5.3.6 and the WP5.2.2 Operational Concept Refinement. The EP3 WP5.3.1 TMA Expert Group has supported the exercise leaders during the preparation phase in defining the validation scenarios, and been making assumptions and hypotheses on operational matters to be used for modelling of the exercises.

An important task of the EP3 WP5.3.1 TMA Expert Group has been to ensure alignment with SESAR ConOps within and between the EP3 TMA exercises.

Once exercises have been carried through and results obtained, the EP3 WP5.3.1 TMA Expert Group supports in integrating the results and report back to the EP3 WP5.2 Validation and Operational Support, and thus the WP5.2.2 Operational Concept Refinement. The EP3 WP5.3.1 TMA Expert Group provides results and conclusions to be presented in the EP3 WP5.4 Consolidated Report. The group also supports the consolidated report by taking on a bridging role within EP3 WP5 to ensure comprehensive and correct integration of results from the different WP5 exercises.

The EP3 WP5.3.1 TMA Expert Group has been coordinating closely with WP4.3.1 and WP5.3.2 expert groups to ensure that SESAR conceptual matters on the borderlines between en-route, TMA and airport are correctly addressed, and that conflicting assumptions and hypotheses on the same or similar concept matters are not provided by the different expert groups.

2.7 ASSUMPTIONS

In preparing the EP3 WP5.3.1 TMA Expert Group work, it was decided that the leaders of EP3 WP5.2.2, WP5.3.4, WP5.3.5, WP5.3.6, WP6 and WP2.4.3. were to state their support needs and requirements. In this way it was ensured that all support needed was to be covered. This has been working fine through the project.

3 OPERATIONAL DETAILS RELATED TO ATM CONCEPT BEING ADDRESSED

3.1 General Operational Details

The work of the TMA Expert Group is related to the Episode 3 DODs which are composed by WP 2.2. The relevant DOD is E5 Arrival and Departure – High and Medium/Low Density Operations [8].

The Lines of Change and Operational Improvements covered by EP3 WP5 TMA exercises are:

Line of Change	OI step ID and title
L01-05 Airspace User Data to Improve Ground Tools Performance	IS-0303 Use of Predicted Trajectory (PT) to Enhance ATM Ground System Performance through TMR
L02-07 Enhancing Terminal Airspace	AOM-0601 Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA Where Suitable
L02-07 Enhancing Terminal Airspace	AOM-0602 Enhance Terminal Route Design Using P-RNAV Capability
L02-08 Optimising Climb/Descend	AOM-0701 Continuous Descent Approach (CDA)
L02-08 Optimising Climb/Descend	AOM-0702 Advanced Continuous Descent Approach (A-CDA)
L03-01 Collaborative Layered Planning Supported by Network Operations Plan	DCB-0103 SWIM enabled NOP
L06-03 ATC Automation in the Context of Terminal Area Operations	CM-0405 Automated Assistance to ATC Planning for Preventing Conflicts in Terminal Area Operation
L07-01 Arrival Traffic Synchronisation	TS-0102 Arrival Management Support Improvements (incl. CDA, P-RNAV)
L07-01 Arrival Traffic Synchronization	TS-0103 Controlled Time of Arrival (CTA) through Use of Datalink
L07-01 Arrival Traffic Synchronisation	TS-0303 Arrival Management into Multiple Airports
L07-01 Arrival Traffic Synchronisation	TS-0305 Arrival Management Extended to En Route Airspace
L08-02 Precision Trajectory Operations	CM-0601 Precision Trajectory Clearances (PTC)-2D based on pre-defined 2D routes
L08-02 Precision Trajectory Operations	CM-0602 Precision Trajectory Clearances (PTC)-3D based on pre-defined 3D routes

Table 2: List of Operational improvements

3.2 Refinement of the Operational Scenarios

Only one operational scenario was reviewed by the EP3 WP5.3.1 TMA Expert Group. That is the scenario OS-35 High Density TMA Arrival- Flying CDA Merging [10].

The result of this activity can be found in the WP5.2.2 Scenario Description of OS-35.

3.3 Refinement of the Technical Scenarios

The Technical Validation Scenarios D6.4-01 Initial-4D / ASAS S&M transition, and ASAS manoeuvres ("Remain Behind", "Merge then remain behind", "Heading then Merge") have been addressed and discussed during two expert group meetings [11].

The results can be found in the WP6 updates of the scenarios.

3.4 Storyboard – Arrival Management in Core Europe

This storyboard was produced in preparation of the WP5.3.4 exercise and presents in a simple visual way, the proposed procedures and methods used and modelled in WP5.3.4 FTS.

The storyboard and its concept, although developed for the WP5.3.4 using the Arrival Management process of the Schiphol and Düsseldorf as the target environment, is considered by the EP3 WP5.3.1 TMA Expert Group in most aspects to be valid for similar complex areas of the ECAC area. Only the latter part of the concept addressing the procedures and methods for the final adjustments of the arrival flows can be seen as local i.e. for Schiphol the plan is to use independent CDAs parallel runways in 2020. Other airports major may use PBN downwind extensions or PMS or even consider open loop vectors to be the most efficient method to ensure maximum capacity and efficiency.

The Storyboard is supported by a one page word document with clarifications to avoid misunderstandings and misinterpretations. It reads as follows:

The area of interest for the WP5.3.4 simulation includes one TMA managing an airport with high-density traffic (Schiphol) and a second TMA, handling a number of large interacting airports within the TMA (Düsseldorf area).

It should be noted that for the simulation, and for the SESAR operation itself, Arrival Manager (AMAN) functionality should be considered to be operating within a horizon (time or distance to destination) that would allow minimum flight-efficiency impact on flights that have a time constraint at their destination. This would imply AMAN operating to horizons above its current use, and also operating seamlessly across ACC borders. This simulation does not consider how these processes/improvements will be put in place.

It is assumed, for the simulation and for the context of operations in SESAR, that a degree of 'smoothing' of traffic will be achieved by DCB, such that arrival traffic will enter the AMAN Horizon smoothed to approx. +2/-3 minutes, in relation to their planning. It is also assumed that this 'degree of smoothing' will allow adequate time for further smoothing and control of the flights by application of an AMAN constraint at the IAF, without major flight inefficiency or loss of arrival capacity – Assumptions A, B, C.

On 'capturing' the flight, the AMAN will downlink the trajectory projection [based on unconstrained arrival] from 4D capable aircraft, and will process and present a planned sequence. AMAN sequencing will rely on the aircraft capability of meeting the IAF with an accuracy of +/- 30 sec. - Assumption D. 4D aircraft will fly autonomously to their given constraint, while ground system will provide trajectory management support to non-4D equipped aircraft to achieve this accuracy.

In the en-route and E-TMA sectors arrival flows will follow dedicated routes towards each TMA entry point. In each flow there will exist mixed-equipped traffic. Some aircraft will be 4D capable and will 'self-manage' their time constraint, and others will be managed by ATC, with system support, to meet their AMAN-planned time and sequence. It is assumed that system support will be in place, and of a level, to allow ATC to cater for this mixed-equipped traffic without significant workload impact – Assumption E.

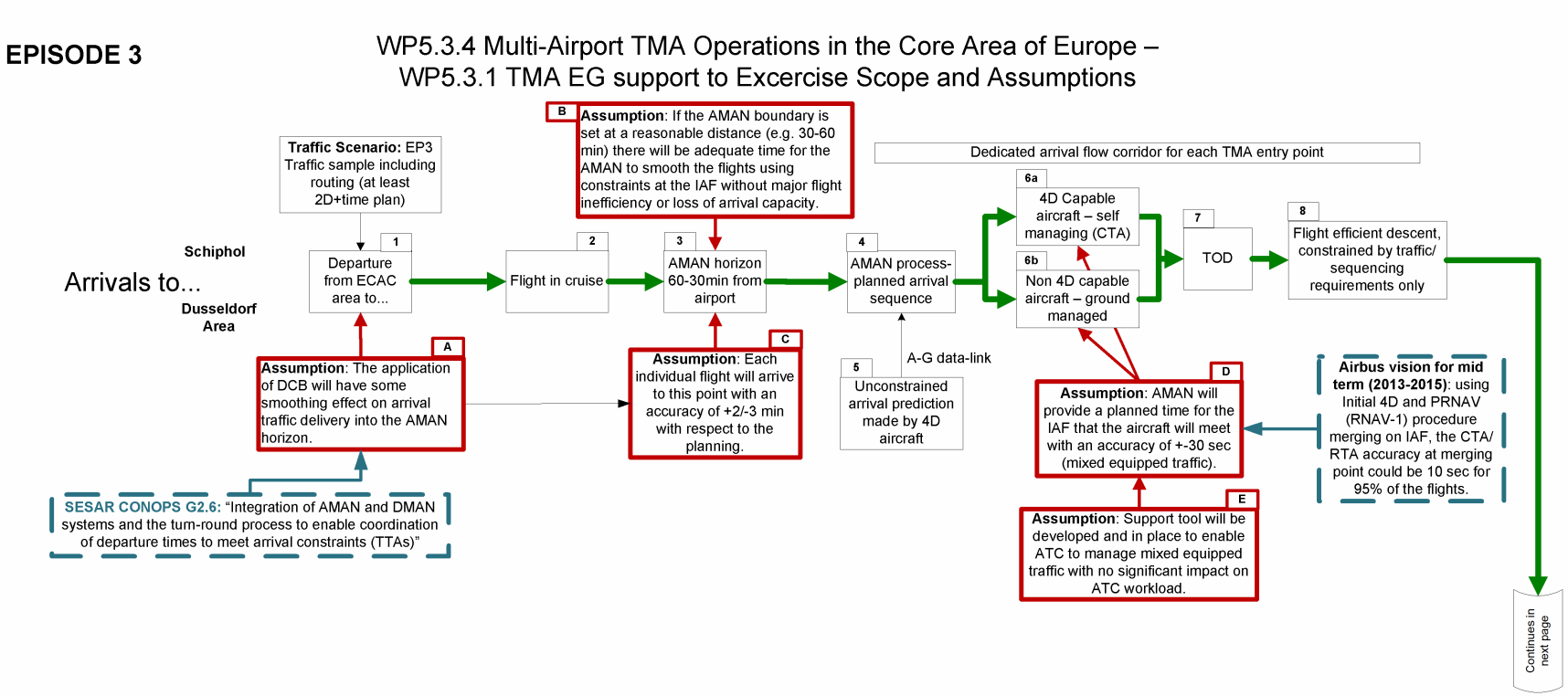
After TOD aircraft will be facilitated, to as large a degree as possible, with a flight efficient descent, constrained only by other traffic (inbounds or crossings). The ATC ground system will continuously monitor flights with regard to them meeting their time constraints. If aircraft

appear to be deviating significantly from their times, the ground system will alert the controller, in order for appropriate action to be taken – Assumption E.

Flights will be spaced to allow a continuous CDA for the portion of the flight from FL70 to touch-down. If aircraft are to be left 'unconstrained' in this final portion of flight a spacing of approximately 2min will be required at around 30NM DTG – Assumption G. This is supported by previous OPTIMAL studies in Amsterdam. A spacing of less than 2min [but still respecting normal separation criteria] may, however, be considered if a portion of the CDA is 'prescribed', which would reduce aircraft performance/speed variability in this arrival segment – Assumption H.

Exception handling by ATC for missed approaches/go-arounds would be routine in nature, and aircraft would be reinserted in the sequence where/when appropriate. An element of headroom in the capacity figure would reduce the impact these cases would have on following traffic. No headroom in the capacity would have a more significant impact on following traffic – Assumption I.

The storyboard is a one-page diagram. For increased readability in this report the diagram has been split and is present on two pages.



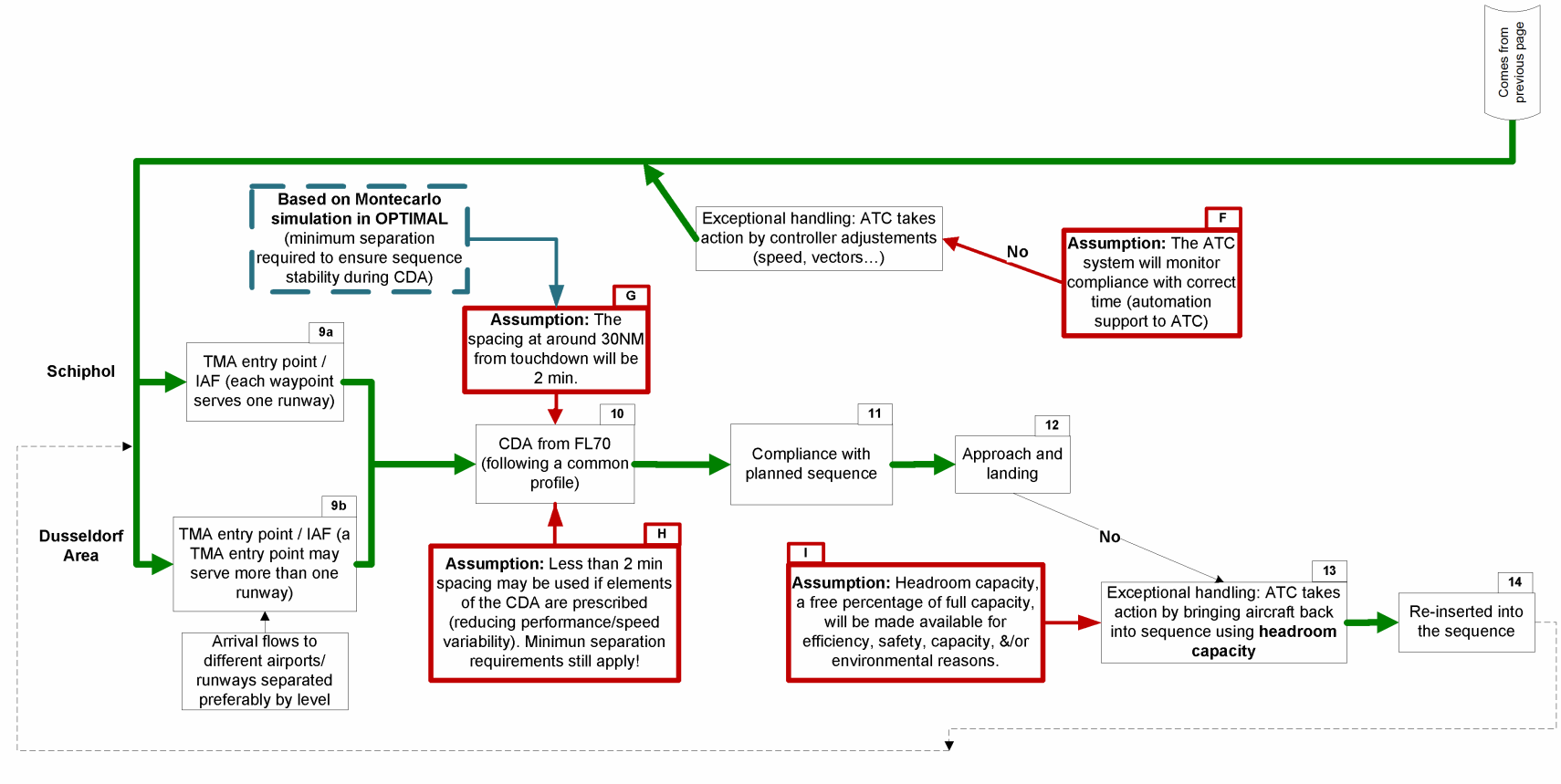


Figure 1: E-TMA Storyboard

4 SUPPORT TO WP5.3.4

4.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

The EP3 WP5.3.4 Multi Airport TMA examined Arrival and Trajectory Management with Continuous Descent Approaches. The objective of the fast-time exercise was to validate that the ATM capability of E-TMA/TMA airspace in a multi hub-airport environment (Schiphol and Düsseldorf area) is sufficient to cope with increased demand in each airport.

The experiment addressed those areas of the SESAR concept that allow to improve departure and arrival operations to and from hub and large airports by enhanced flight management and planning, that are expected to be effective when traffic is operated within an enhanced airspace environment, and that are operating under enhanced executive procedures.

One main objective of the experiment was to measure the effect of enhanced planning on executive operations to and from hub airports within an airspace environment that is optimised towards the requirements of the airports of interest under partly idealised airspace conditions. Performance assessment of Queue Management, comprising traffic management, traffic synchronisation, sequencing and planning, was done. The experiment aims to measure achievable performance improvement by advanced Queue Management under realistically simulated future operational conditions. It is assumed that conceptual ideas can be brought to operation, but it has to be validated yet, if success is achievable in dense complex areas, operating under “real” constraining conditions.

4.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

The EP3 WP5.3.1 TMA Expert Group mainly provided support on how to build a viable and realistic arrival management concept for the Schiphol and Düsseldorf area, thus an arrival management process starting from top of descent (TOD) and ending with landing.

Work had already been carried out in the ANSPs of LVNL and DFS looking at future TMA operations for the area. These ideas formed the basis for the discussions.

The EP3 WP5.3.1 TMA Expert Group and NLR, LVNL and DFS met to discuss and confirm a (E-TMA/TMA) concept for 2020 based on the SESAR ConOps. The result of the meeting and thus the arrival management concept agreed is presented in a Storyboard a one page diagram [14]. The storyboard has a short attachment of text to clarify a few things to avoid misunderstanding of the meaning of the, on purpose, relatively short text bullets in the storyboard.

It should be noted that in the meeting the EP3 WP5.3.1 TMA Expert Group including representatives from DFS and LVNL had a common view that the basic concept elements and ideas in the Storyboard are applicable for the whole of the ECAC area. For the last part of the approach for Schiphol PRNAV STARs with CDAs to parallel runways are mentioned. Other large ECAC area airports may use other conceptual ways of management the inbounds.

In preparation of the meeting the FTS team of NLR, DFS and LVNL sent questions on how to apply the ConOps to the EP3 WP5.3.1 TMA Expert Group. These were dealt with in the meeting and the answers can be found in the Questions and Assumptions Spreadsheet. Some answers are built in the concept description in the Storyboard.

4.3 FEEDBACK ON THE EXERCISE RESULTS

4.3.1 Feedback on DODs and Scenarios

The EP3 WP5.3.1 TMA Expert Group has reviewed the WP5.3.4 exercise results and recommendations. The feedback on the recommendations can be found in the Annex 4.

Recommendations from WP5.3.4 for modifications additions to the DODs and scenarios will be consolidated by the EP3 WP5.3.1 TMA Expert Group, and put in table recommendation and put into WP2 recommendation spread sheet.

4.3.2 KPIs / KPAs

The EP3 WP5.3.1 TMA Expert Group has not made any initial assessment on the expectations on the relevant WP5.3.4 selected KPIs and KPAs.

The results on KPIs and KPAs from the exercise report are provided the WP5 report.

4.3.3 Overall Feedback on the Exercise Recommendations

The recommendations from the WP5.3.4 exercise and the EP3 WP5.3.1 TMA Expert Group overall feedback these recommendations can be found in the Annex 4.

5 SUPPORT TO WP5.3.5

5.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

The EP3 WP5.3.5 TMA Trajectory, Separation and Conflict Management analysed, by the use of fast time simulations (FTS), the possible improvement of Trajectory and Separation Management in a complex TMA due to the introduction of the following SESAR concepts:

- An alternative complex 2D and 3D route structure, both in Departures and Arrivals;
- Alternative 3D P-RNAV structures in Arrivals;
- 2D and 3D Precision Trajectory Clearances (PTC) in Arrivals and Departures.

This exercise also analysed the transition between airspace where User Preferred Trajectories are in operation and airspace where the traffic levels require the Pre-Defined Route structure to be imposed on the trajectories.

In this context, the aim of WP5.3.5 is to provide evidence on the expected increment of Capacity in High density TMAs through the implementation of new separation modes included in the SESAR Concept.

The main objectives of WP5.3.5 were:

1. Assess the operational impact of the introduction of the Allocation of Departure/Arrival Route, the Allocation of Departure/Arrival Profile, 2D/3D Departure/Arrival routes and PTC-2D/3D SESAR concepts in terms of:
   - Airspace capacity and Controller workload (reducing controller task load per flight and the need for tactical interventions);
   - Flight efficiency (temporal efficiency);
   - Safety aspects: Number of potential conflicts and number of controller overloads / under loads.
2. Assess the operational impact of the introduction of 3D P-RNAV + CDAs SESAR concepts focused on Arrivals:
   - Airspace capacity and Controller workload (reducing controller task load per flight and the need for tactical interventions);
   - Flight efficiency (temporal efficiency);
   - Safety aspects: Number of potential conflicts and number of controller overloads / under loads.
3. Clarify, in close relation with the EP3 WP5.3.1 TMA Expert Group, how the transition from one structured TMA to a small or larger TMA can affect both the TMA and the surrounding En-route airspace, where there is a User Preferred Route environment.

5.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

The EP3 WP5.3.1 TMA Expert Group mainly provided support on how to build the viable and realistic applications of 2D/3D and PTC-2D/3D Departure/Arrival Routes, Departure/Arrival Profiles, and introduction of 3D P-RNAV + CDAs.

In preparation of the meeting the FTS team of AENA, INECO and SICTA sent questions on how to apply the ConOps to the EP3 WP5.3.1 TMA Expert Group. The questions covered issues like conceptual solutions, ATC workload and separation standards. They were dealt with in the meeting and the answers can be found in the Questions and Assumptions

Spreadsheet. Technical experts who could not attend the meeting were on stand by via telephone.

5.3 FEEDBACK ON THE EXERCISE RESULTS

5.3.1 Feedback on DODs and Scenarios

The EP3 WP5.3.1 TMA Expert Group has reviewed the WP5.3.5 exercise results and recommendations. The feedback on the recommendations can be found in the Annex 4.

Recommendations from WP5.3.5 for modifications additions to the DODs and scenarios will be consolidated by the EP3 WP5.3.1 TMA Expert Group, and put in table recommendation and put into WP2 recommendation spread sheet.

5.3.2 KPIs / KPAs

The EP3 WP5.3.1 TMA Expert Group has not made any initial assessment on the expectations on the relevant WP5.3.5 selected KPIs and KPAs.

The results on KPIs and KPAs from the exercise report will go into the WP5 report.

5.3.3 Overall Feedback on the Exercise Recommendations

The recommendations from the WP5.3.5 exercise and the EP3 WP5.3.1 TMA Expert Group overall feedback on these recommendations can be found in the Annex 4.

6 SUPPORT TO WP5.3.6

6.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

The EP3 WP5.3.6 experiment (4 prototyping sessions) primarily aimed at refining roles, procedures and working methods of the controllers, and assessing the impact, in terms of operability from the ground standpoint, of aircraft adhering to an RBT with CTA while achieving a CDA.

The first prototyping session aimed at refining roles, procedures and working methods of the controllers, and assessing the operability and acceptability of A-CDA in a P-RNAV route structure. The second session aimed at assessing the impact of respecting time constraints (Controlled Time of Arrival – CTA) on the operability and acceptability of A-CDA in an improved new P-RNAV route structure. The third session aimed at confirming the acceptability and operational feasibility of A-CDA down to the Final Approach Fix (FAF) in the improved P-RNAV environment and assessing the impact of mixed aircraft RTA equipage on this acceptability and operational feasibility. The fourth session aimed to evaluate, in a different environment like the high density Rome TMA, the use of ASPA S&M application combined with the use of P-RNAV and A-CDA.

6.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

There were all in all four consecutive exercise sessions, three in Paris/Bretigny prepared and run by EUROCONTROL, and one in Naples run by ENAV.

After each session results were compiled and analysed by the simulation team.

A meeting with the EP3 WP5.3.1 TMA Expert Group was held after each session, the results and recommendations were presented. The next session was then discussed. The Expert Group made suggestions on the structure and the detailed objectives to encourage inclusion of advanced and useful additions to ensure SESAR ConOps alignment. As an example the expert group discussed prioritisation of concept elements such as mix of 4D/non 4D aircraft and implementation of CTA through an RTA function. It was also suggested that WP5.3.6 prototyping exercise would picture an advanced arrival management concept with an extended AMAN horizon starting from TOD.

6.3 FEEDBACK ON THE EXERCISE RESULTS

6.3.1 Feedback on DODs and Scenarios

The EP3 WP5.3.1 TMA Expert Group has reviewed the WP5.3.6 exercise results and recommendations. The feedback on the recommendations can be found in the Annex 4.

Recommendations from WP5.3.6 for modifications additions to the DODs and scenarios will be consolidated by the EP3 WP5.3.1 TMA Expert Group, and put in table recommendation and put into WP2 recommendation spread sheet.

6.3.2 KPIs / KPAs

The EP3 WP5.3.1 TMA Expert Group has not made any initial assessment on the expectations on the relevant WP5.3.6 selected KPIs and KPAs.

The results on KPIs and KPAs from the exercise report will go into the WP5 report.

6.3.3 Overall Feedback on the Exercise Recommendations

The recommendations from the WP5.3.6 exercise and the EP3 WP5.3.1 TMA Expert Group overall feedback on these recommendations can be found in the Annex 4.

7 SUPPORT TO WP2.4.3

7.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

The objective of WP2.4.3 is to support and provide input to the on-going initial safety assessment of the overall SESAR Operational Concept, circa 2020, carried out at EEC in parallel with, and in close cooperation with, EP3.

In doing so the approach to safety assessment being followed for SESAR is very much broader than traditional method of carrying out safety assessment in European ATM, in that it focuses as much on the "proof of concept" in the absence of ATM system failure as it does on the causes and consequences of such failures.

The safety assessment is based on three models of SESAR:

- Barrier Model (BM), which captures the essential functionality and safety parameters of the SESAR ATM Service, for Terminal Area operations;
- Functional Model (FM), which describes the underlying ATM System in abstract, functional terms that are independent of the subsequent system design;
- Logical Model (LM), which describes the actors (human and equipment-based) that make up the ATM System, in terms that are independent of the eventual physical design.

The rationale for producing these models is that neither the SESAR ConOps nor the DODs yet contain sufficient detail for a useful safety assessment to be performed.

The WP2.4.3 will develop three Safety Design Documents (SDD) one for each of the three ATM services of aerodrome, TMA and en-route operations.

The purpose of this Safety Design Document (SDD) is to present a "safety view" of the design of the ATM system for TMA operations for two timeframes: as exists currently, and as will exist under the SESAR Concept in the year 2020.

The results of the safety assessment process are given in the EP3 Safety Assessment Report for Terminal Areas (SAR) which makes extensive reference to the information contained in the present document.

7.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

The cooperation with and the support asked for from the EP3 WP5.3.1 TMA Expert Group concerned the development of the Safety Design Document (SDD) for SESAR Terminal Area operations [12]. The main task was to answer questions concerning the SESAR Operational Concept as applied at the level of the Logical Model, to get the Expert group general agreement on the form of the SESAR Safety Targets for Terminal Area operations and to assess the safety consequences of failure of elements of the SESAR ATM Barrier Model of the SESAR ATM Functional Model.

7.3 FEEDBACK ON THE EXERCISE RESULTS

7.3.1 Feedback on the Validation Methodology

The models were improved with suggestion from the experts, but the high number of assumptions that where needed to develop the models resulted in a lack of confidence on the final results. Although the experts supported the method, the final results need further revision once further details on SESAR concept are known.

7.3.2 Feedback on DODs and Scenarios

Not applicable for the support of WP2.4.3.

7.3.3 KPIs / KPAs

Not Applicable for the support of WP2.4.3.

8 SUPPORT TO WP6

8.1 OBJECTIVES, DESCRIPTION AND METHODOLOGY OF THE EXERCISE

The objective of WP6 is to carry out technical validation. WP6 supports the system level assessment of the SESAR concept's ability to deliver the defined performance benefits in the 2020 timeframe.

WP6 does so by validating air and ground functions linked to concept elements, which IOC is around 2013-2015, and delivering initial performance and industrial feasibility elements paving the way towards the target concept. For this purpose scenarios have been developed to be used during technical validation activities.

8.2 ASSUMPTIONS AND EXPECTATIONS CONSOLIDATED WITH THE EXPERTS

The main area of support to WP6 relate to the technical scenario development. The main task of the EP3 WP5.3.1 TMA Expert Group was to review the scenarios from an operational viewpoint and help making them operationally aligned with the ConOps. The EP3 WP5.3.1 TMA Expert Group felt that although the scenarios were developed for technical validation, the operational environment described should be more detailed and elaborated in order to show that they fit in and are aligned with the ConOps. The WP6 scenario development was supported in two Expert Group meetings; however, the scenarios could not be completed by WP6 within the timeframe of the Expert Group Task. The EP3 WP5.3.1 TMA Expert Group had no additional time and effort to extend its activity with regard to the overall EP3 schedule.

8.3 FEEDBACK ON THE EXERCISE RESULTS

8.3.1 Feedback on the Validation Methodology

The strategy and plan for support agreed as described in section 2.5.4 were mainly followed. The last two Expert Group meetings involved discussions and review of the draft technical scenario document related to 4D operations and ASAS applications.

The process of presenting the current status of the scenarios to the expert group during a meeting and discussing them was very useful. However, the task to support the scenario development was not completed in WP6 as explained above. There were still issues that needed to be further discussed. This discussion has continued on the EP3 website review room. The results can be found in the WP6 Technical scenarios description [11]. It is therefore important that discussions and cooperation on the scenarios start early.

8.3.2 Feedback on DODs and Scenarios

The EP3 WP5.3.1 TMA Expert Group will not be involved in reviewing the WP6 validation exercise results and recommendations. Therefore no feedback will be given to update the WP6 related DODs or Operational Scenarios.

8.3.3 KPIs / KPAs

The EP3 WP5.3.1 TMA Expert Group has not made any initial assessment on the expectations on the relevant WP6 selected KPIs and KPAs.

9 CONCLUSIONS AND RECOMMENDATIONS

Based on the experience and lessons learnt from the work carried out by the EP3 WP5.3.1 TMA Expert Group show and confirm that an expert group can play an important role in the ATM validation process.

The European Operational Concept Validation Methodology (E-OCVM) [3] mentions expert group activities as a means in the validation process. Judgemental techniques are described. But, the E-OCVM does not in detail elaborate any further on the value or benefits of using an expert group.

The fixed Objectives of the DOW meant that there was limited flexibility on how the Expert Group provided input to the TMA Exercises. The Expert Group could provide valuable input to decide on the content of the exercises to be carried out on a concept.

The Expert Group had fourteen partners, it is recommended to have a smaller group to simplify management and ensure a focused approach from all partners. This would lead to a more consistent set of experts participating and reduced work to ensure participants is at the same level of understanding.

The planning of an expert group to support the different activities without knowing the level of detail or number of questions to be fielded meant the TMA Expert Group did not have time to finalise all answers in support of the exercises, a decision on priority was required. However, the support that was given through the EP3 WP5.3.1 TMA Expert Group was successful in meeting its objectives.

If the Expert Group had a chance to plan and prepare the task more freely, the efficiency and results could have been even better.

The TMA Expert Group has provided support to the lessons learnt workshops and this will help to ensure even better use of the expert group role in future ATM validation.

9.1 LESSONS LEARNT ON EXPERT GROUP ROLE AND ACTIVITY

The expert group must be carefully set up taking into consideration:

- Type of experts required;
- Size of the group;
- Partners involved;
- Knowledge of current operations;
- Knowledge of future concepts;
- Availability;
- Commitment.

The group must be given the possibility to reach a common understanding of the issues that the group will deal with. This does not mean that everybody needs to have the same view or agree on all aspects but there should be common platform for the work to be efficient.

A common understanding of the ConOps is required as is a common understanding of the current operations.

Training could be carried out to enhance participants understanding of the concept, the time and effort to do this task should not be underestimated.

9.2 ASSUMPTIONS ON HOW THE CONOPS WILL WORK

Breaking down the SESAR ConOps and making assumptions are important. It has been the most important task of the TMA expert group. Nobody can claim that they have all the answers to how the ConOps will work in detail e.g. procedures and methods of various elements. The ConOps are and should be a very high level description.

When initial validation starts as in EP3 the ConOps must be broken down to a workable level, and thus assumptions must be made. Documenting the assumptions made is important. Assumptions may turn out to be wrong or partially wrong. They may turn out to be correct and good. This is all part of the validation process. But there must be no doubt on how the results from an exercise came about and what concept assumptions were used when recommendations are stated, challenged and scrutinized.

The EP3 WP5.3.1 TMA Expert Group has played an important role in support and thus ensuring that the concept assumptions made are well thought through and that concept elements chosen for validation are aligned with the SESAR ConOps.

9.3 OVERALL CONCLUSIONS ON THE EXERCISES

The Expert Group considered that the understanding of the implications of the SESAR concept had been advanced by the exercises by providing more concrete implantations of the SESAR principles in a variety of geographic locations.

All the exercises highlighted the need for any design to take into account a wide range of factors, including the interactions with the other phases of flight (eg en route and airport operations) and the compromises there must be between different objectives while giving priority to safety. The outcome of the trade-offs required will be sensitive to the operating policies of the service providers and users in the region. While general principles can be developed, their relative importance for an individual implementation may differ substantially.

9.4 MEETINGS

Expert group meetings with each client, i.e. work packages, is an important and fruitful way working method. The meetings must be well prepared and structured.

Questionnaires were sent to the participants prior to meetings. Here the client listed issues and questions to be addressed. This worked well and made the meetings quite efficient.

Being a chairman and leading the discussion is a challenge. Good facilitation is important and the meetings must be well structured. Sometimes discussions which are out of scope and time need to be cut short in order to be focused and efficient and to bring about good results, conclusions and assumptions.

Travelling to meetings is costly and consumes time. In some cases experts did not come to the meeting, stayed back in their office and stood by on phone should any questions come up regarding their special expertise. This happened a few times for meetings when airborne technical and operational issues were not the main focus. This worked very well and saved money and time.

Tele conference is a very useful means for discussion. It can replace a meeting very well in many situations.

Meeting minutes must be taken. This makes everybody aware of how the expert group work progress and which conclusions were made.

9.5 STORYBOARD

Documenting results on the Expert Group work in a useful way is important. The most important task of the EP3 WP5.3.1 TMA Expert Group has been to break down the ConOps

into clear statements of assumptions on how they will or can work e.g. methods and procedures. Any validation exercise, FTS or Prototyping, needs to state in their exercise plan how the validated concept is working.

The EP3 WP5.3.1 TMA Expert Group felt very early in the process that a short compact easy-to-read solution for this was to be found. The result was the Storyboard. This is a two-page document consisting of a one page diagram and a one page support text.

The diagram shows the operational concept for e.g. the Schiphol-Düsseldorf as a flow of arrival traffic from TOD to landing. The diagram has some text boxes stating the concept assumptions agreed. The one page text page elaborates a bit more to avoid misunderstanding and misinterpretations.

The storyboard turn out to be an excellent way of documenting and briefing other stakeholders on the concept assumptions made, and thus triggered off good discussions on the concept solution agreed involving players outside the EP3 WP5.3.1 TMA Expert Group. Thick documents are often not read. The storyboard does not say all, but it gives good platform for many to see the direction and to be used a basis for further discussions.

9.6 Q/A SPREADSHEET

The storyboard is good short way of compiling for example a validation concept as in the case of WP5.3.4. However, more documentation is needed to support the expert group work. Prior to concluding and agreeing on a ‘story’ in a storyboard detailed discussions are need on different aspects. These may be airborne or ground technical issues, ATC procedures issues, separation issues, airspace issues, etc. The expert has used a Question and Assumptions spreadsheet [13] to compile as many relevant questions and their answers as possible. This document is intended as a reference to be used to bring light to how the grouped work, what kind of questions the various work packages had and the answers give. Assumptions made are also compiled here.

9.7 BRAINSTORMING WITH THE USE OF WHITEBOARD

The EP3 WP5.3.1 TMA Expert Group used brainstorming technique to develop concept assumptions and storyboards.

Expert Group brainstorming activities can enhance real-time simulations or human in the loop prototyping for specific concept assessment/validation. The whiteboard is used to draw, play and imagine what happens ‘in the air and in the ATC ops room’ and thus simulating the concept elements. Good facilitation is needed. Notes need to be taken.

The right people need to take part: controllers, pilots and other actors. The group has to have a positive attitude towards change and believe that change is needed, but yet being critical to what realistically can be done. Both the pilots and controllers professions are historically conservative and maybe not too keen on changes. Controllers often feel comfortable with the way their current work. The feeling of ‘leave things the way they are’ is understandingly safety related. But, it does not often promote the speed of development within ATC.

The results of brainstorming sessions, a kind of gaming exercise, can be very useful although in contrast to Real Time Simulations no objective results based on recordings and measurements will be obtained.

9.8 RECOMMENDATIONS ON THE EXPERT GROUP ITSELF

The role of the expert group should be reconsidered if such a body is to be called on again in work such as this. The Expert Group supported simulations and exercises as requested and to the best of its ability, but the main scope and direction of the exercises had already been set up when the expert group was involved in the process.

For a group such as the EG to work to its [considered] best, the EG needs to be involved in the decision and planning phases for the work being done and validated in areas such as 5.3. Only then its expertise be utilised to the maximum, providing comment and recommendations on the work done considered against what the EG would have expected in the first place.

10 REFERENCES AND APPLICABLE DOCUMENTS

10.1 REFERENCES

[1] **TMA2010+,** TMA2010 RTS02 Validation Report, V1.0, 15/06/2009

[2] **CASSIS,** CASSIS Concept of Operations, V1.0, 18/12/2008

[3] **E-OCVM,** European Operational Concept Validation Methodology

10.2 APPLICABLE DOCUMENTS

[4] **Episode 3,** WP5.3.1 TMA Expert Group Plan, D5.3.1-01, V2.00, 18/12/2008

[5] **Episode 3,** Expert Group Guidelines, V1.00, 05/12/2008

[6] **Episode 3,** Expert Group Report Template, E3-WP0-I0333-GUI-V1.00, V1.00, 09/04/2009

[7] **Episode 3,** WP5 Validation Strategy, D5.2.1, V1.01, 07/04/2009

[8] **Episode 3,** SESAR Detailed Operational Description: Arrival and Departure - High and Medium/Low Density Operations - E5, D2.2-037, V1.00, 06/02/2009

[9] **Episode 3,** Performance Framework Document, D2.4.1-04, V3.03, 03/03/2009

[10] **Episode 3,** OS-35 High Density TMA Arrival - Flying CDA Merging, E3-WP2-I0241-OS-V0.10-os-35, V0.10, 17/11/2008

[11] **Episode 3,** WP6 Technical Validation Scenarios, D6.4-01, V0.13, 22/06/2009

[12] **Episode 3,** WP2.4.3 Safety Design Document for SESAR TMA operations, Internal document, EP3 SDD TMA V03b, 04/04/2009

[13] **Episode 3,** WP5.3.1 Questions & Assumptions Spreadsheet, Internal document, E3-WP5-I0115-WKP, V0.02, 20/03/2009

[14] **Episode 3,** WP5.3.1 Storyboard WP5.3.4, E3-WP5-MOTH20090331-OS, V0.01, 05/11/2008

[15] **SESAR,** The ATM Target Concept D3, DLM-0612-001-02-00a, September 2007

Annex 1: Questionnaires

The questionnaires distributed to the EP3 WP5.3.1 TMA Expert group are listed in the table below.

Source	Document Title	Document ID
WP2.4.3	Brief for TMA EG on Safety (Annex D: Current List of Questions from the TMA Safety Assessment)	E3-WP5-MWKS20090224-WKP-V0.01
WP5.3.4	D5.3.4 - Questions for the TMA EG to support preparation of FTS	E3-WP5-TMA EG MAD-2-Sep-08-NLR-WP5-3-4
WP5.3.4	D5.3.4 - Questions for the TMA EG to support preparation of FTS	E3-WP5-TMA EG AMS-8-Oct-08-NLR-WP5-3-4
WP5.3.5	D5.3.5 - Questions for the TMA EG to support preparation of FTS	ep3-aena-wp4.3.1.1.2-questionnaire1
WP5.3.5	D5.3.5 - Aspects on Transition Issues Analysis to be Addressed by The Expert Group – Questionnaire 1	E3-WP5-I0158-WKP-V1.00
WP5.3.5	D5.3.5 - Aspects on Transition Issues Analysis to be Addressed by The Expert Group – Questionnaire 2	E3-WP5-I0159-WKP-V1.00

Annex 2: Planning and List of Experts

These are the dates of EP3 WP5.3.1 TMA Expert Group meetings held in support of the various work packages as indicated:

Meetings		
Date	Location - Host	Subject
04-03-2008	Rome - ENAV	WP5.3.1 TMA EG Kick-Off
17-03-2008	Amsterdam - NLR	Support to WP5.3.4
01-04-2008	Paris, Brétigny – EUROCONTROL	Support to WP5.3.6
02-09-2008	Madrid – Ineco	WP5 - TMA Review (DOW 3.0)
08-10-2008	Amsterdam – NLR	Support to WP5.3.4
21-10-2008	Rome – ENAV	Support to WP5.3.5
20-11-2008	Paris, Brétigny – EUROCONTROL	Support to WP5.3.6
13-12-2008	Paris, Brétigny – EUROCONTROL	Support to WP5.3.6
28-01-2009	Paris, Brétigny – EUROCONTROL	Support to WP5.3.6
24-02-2009	Naples – SICTA	Support to WP2.4.3
05-03-2009	Madrid – Aena	Support to WP5.3.5
31-03-2009	Amsterdam – LVNL	Support to WP6
13-05-2009	Stockholm – LFV	Support to WP5.2 and WP6

Table 3: Meetings held by the EP3 WP5.3.1 TMA Expert Group

These are the experts provided by the partners:

List of Experts	
Company	Experts
LFV	Claes Rundberg Staffan Törner Lars Rappich Yvonne Matsson Åke Wall
ISDEFE	Raquel García Marta Sánchez Iban Alvarez
LVNL	Ronald Dubbeldam Hub Erens
NATS	Richard Faris
NLR	Hugo de Jonge Jos Beers

List of Experts	
Company	Experts
SICTA	Patrizia Criscuolo
Thales Avionics	Xavier Blanchon Guy Deker Thierry Person
TR6	Xavier Jourdain
AENA	Patricia Ayllón Maite Cano
AIRBUS	Philippe Pellerin Sabine Vieyres Jean Louis de-Menorval
DFS	Reinhard Balzer
ENAV	Giorgio Matrella Fabrizio Maracich
EUROCONTROL	Paul Conroy Diarmuid Houlihan Terence Symmans Bruno Favennec Derek Fowler (JDF CONSULTANCY LLP) Randall De-Garis Dijana Pasic
INECO	José Manuel Risquez Esther Martin Alexander Dorta

Table 4: Partners and experts provided to the EP3 WP5.3.1 TMA Expert Group

Annex 3: Questions and Assumptions Spreadsheet

The purpose of the "Questions and Assumptions Spreadsheet" [13] used for the WP5.3.1 TMA Expert Group has been to document most of the questions and there answers for reference. The assumptions agreed, between the TMA Expert Group and the Exercises, mainly of how the ConOps will work and thus will be applied in Ep3 validation exercises of FTS and Prototyping are also listed in the spreadsheet.

Below some examples from the spreadsheet are presented (all information on the questions, answers and assumptions can be found in the Questions and Assumptions Spreadsheet):

WP 5.3.1 - TMA Expert Group - Questions and Assumptions Spreadsheet

Notes: This spreadsheet covers Questions from WP5 exercises that the EG has responded to and Assumptions made jointly by the WP5 Exercise and TMA Expert Group for the preparation of the simulation exercise.

Nº	Date	Raised by	CONCEPT						WP5 Excercises	Q/A	QuestionText	Answer / Assumption Text	Comments
			Queue Mgt	CDA	Airspace Mgt	Conflict Mgt	Trajectory Mgt	Sep Mgt					
1	02/09/2008	H.W.G. de Jonge (NLR)		✔					5.3.4	Q	Support to define CDA procedures in limitedly available airspace with the capability to accomplish high capacity during high density periods with tightly sequenced flows. 1) CDAs capacity problems: (…)	See WP5.3.4 Storyboard (and/or WP5.3.4 FTS Experimental Plan)	This is one of the questions that were the basis for WP5.3.4 and TMA EG workshop, and the response was used for creation of the storyboard
2	02/09/2008	H.W.G. de Jonge (NLR)		✔	✔				5.3.4	Q	Support to solve safety issues concerning CDA procedures performed on tightly (…)	See WP5.3.4 Storyboard (and/or WP5.3.4 FTS Experimental Plan)	This is one of the questions that were the basis for WP5.3.4 and TMA EG workshop, and the response was used for creation of the storyboard

WP 5.3.1 - TMA Expert Group - Questions and Assumptions Spreadsheet

Notes: This spreadsheet covers Questions from WP5 exercises that the EG has responded to and Assumptions made jointly by the WP5 Exercise and TMA Expert Group for the preparation of the simulation exercise.

Nº	Date	Raised by	CONCEPT						WP5 Excercises	Q/A	QuestionText	Answer / Assumption Text	Comments
			Queue Mgt	CDA	Airspace Mgt	Conflict Mgt	Trajectory Mgt	Sep Mgt					
3	02/09/2008	H.W.G. de Jonge (NLR)	✔						5.3.4	Q	Support to achieve sequencing of a dense multiple-airport/runway arrival flow entering a TMA (…)	See WP5.3.4 Storyboard (and/or WP5.3.4 FTS Experimental Plan)	This is one of the questions that were the basis for WP5.3.4 and TMA EG workshop, and the response was used for creation of the storyboard
77	10/10/2008	H.W.G. de Jonge (NLR)						✔	5.3.4	A		Assumption A: The application of DCB will have some smoothing effect on arrival traffic delivery into the AMAN horizon.	1) Richard Faris (NATS): I think the extent to which the arrival rate will be 'smoothed' is yet to be determined. The ConOps certainly (…)
78	10/10/2008	H.W.G. de Jonge (NLR)						✔	5.3.4	A		Assumption B: If the AMAN boundary is set at a reasonable distance (e.g. 30-60 min) there will be adequate time for the AMAN to smooth the flights using constraints at the IAF without major flight inefficiency or loss of arrival capacity.	

Annex 4: TMA Expert Group Recommendations

In the spreadsheet below, the WP5 Exercises Recommendations are listed in the left column, and the WP5.3.1 TMA Expert Group recommendations and/or observations are listed in the right column:

WP5.3.4 RECOMMENDATIONS	WP5.3.1 TMA EG Recommendation/Comment
R1) Part of the validated benefits of early arrival management in WP5.3.4, FTS on Multi-airport TMA, was derived from DCB measures to arrive on-time at TOD. These measures were beneficial by ensuring low variability of demand at TOD and benefits were achievable by imposing highly accurate departure constraints. It is recommended to further develop this concept element as part of DCB.	The need is to properly assess and regulate the arrival volume to negate the possibility of over delivery. The actual sequence is not essential but the number is. It is assumed, for the simulation and for the context of operations in SESAR, that a degree of 'smoothing' of traffic will be achieved by DCB, such that arrival traffic will enter the AMAN Horizon smoothed to approx. +2/-3 minutes, in relation to their planning. It is also assumed that this 'degree of smoothing' will allow adequate time for further smoothing and control of the flights by application of an AMAN constraint at the IAF, without major flight inefficiency or loss of arrival capacity. The actual departure constraints mentioned in this recommendation were simply a mechanism to ensure a reasonably accurate DCB delivery (+2/-3 as per simulation assumption). This is aligned to TTA mechanism in the DODs. It is this delivery that provides the foundations for the benefits that are detailed in the simulation.
R2) Critical parts of the concept, assessed by WP5.3.4, FTS on Multi-airport TMA, addressed adapted use of airspace and airspace management. This aspect is the responsibility of several ANSPS involved in the applicable operations and it might be their interest to look at appropriate compromising solutions for all airspace users, for example in the context of creating Functional Airspace Blocks (FABs).	Airspace design decisions will be crucial in implementing future traffic management and future designs must incorporate input from all actors concerned, including airspace users, national authorities and ATM management units.

WP5.3.4 RECOMMENDATIONS	WP5.3.1 TMA EG Recommendation/Comment
R3) The validation of the concept, assessed by WP5.3.4, FTS on Multi-airport TMA, underlined the need to extend En-route service provision with a new service to support on-time arrival over a significant waypoint in support of arrival traffic synchronisation of hub airports. It is recommended to further develop this aspect of En-route service provision.	This comment refers to the way, in the future, that aircraft will need to be delivered in a DCB-type of organisation. Although not yet fully defined, this would include aspects such as employing airborne functionality such as RTA to self-manage to constraints, and extending the application of AMAN and Arrival Management in general to earlier stages of the flight. It also includes more sophisticated rules being employed in the AMAN and Arrival Management processes than are currently the case, and moving away from current strict structures of TMA, en route, current and upstream ACCs and areas of operation.

Table 5: TMA Expert Group Recommendations/Comments for WP5.3.4 Recommendations

WP5.3.5 RECOMMENDATIONS	WP5.3.1 TMA EG Recommendation/Comment
1. Recommendations on Allocation of Departure/Arrival Route/Profile Tools	
R1) The Allocation Departure/Arrival Route/Profile concept should be refined taking into account that Parallel Separation between Procedures: although 6NM is the general "parallel separation" required between the nominal and alternative SID or STAR, it is necessary to define the design parameters from the divergence/convergence point until the point where 6NM can be assured.	
R2) The concept should specify the de-confliction scope of the Allocation Tool.	This is not a concept issue, but an Allocation Tool design issue where needed (it will not be needed everywhere). It needs to be integrated with other tools available where this Allocation Tool is used. An Allocation Tool could be used in different ways depending on the needs of the Area in which it operates. (Capacity constraints are different from environment constraints). However, the basic operating principles will be similar (best practice would evolve). Further development of tools need to be done taking into account other developments and tools, and not on a stand-alone mode.
R3) It is recommended that the Allocation Tool chooses between two options (i.e. left or right predefined alternatives), as well as proposing some speed adjustments to improve the resolution efficiency.	Although this is a specific finding for the simulation for the specific scenario, the opinion of the EG is that any Allocation Tool has to be fit for purpose in the local environment the tool is working in.
2. Recommendations on 2D/3D PTC	
R4) It has been assumed that the route allocation tool solves a conflict between two flights using the same procedures (routes) but not between aircraft using different procedures (routes). It needs to be clarified if this is true and if so, which "same procedures (routes)" are considered.	Although this is a specific finding for the simulation for the specific scenario, the opinion of the EG is that any Allocation Tool has to be fit for purpose in the local environment the tool is working in.
R5) When 2D and 3D capable aircraft co-exist, alternative procedures (routes) with FL restrictions should also be defined.	Precise handling of traffic mix will be determined by the different mixes and different capabilities as well as designing needs. The way a conflict is solved depends on many aspects (for example, % of capabilities).

WP5.3.5 RECOMMENDATIONS	WP5.3.1 TMA EG Recommendation/Comment
R7) When all aircraft are PTC-3D capable, the Route/Profile Allocation Tool should: a. Propose an alternative profile (Route) without FL restriction (predefined Left or Right) to solve conflicts between flights using the same SID or STAR; b. Propose an alternative profile with a FL restriction (predefined Left or Right) to solve conflicts between crossing flights (i.e. ARR vs. DEP).	The Allocation Tool should be kept as simple as possible.
3. Recommendations on CRE analysis	
R8) The transition aspects from one airspace structure (either dealing with sectorisation or with routes structures) need to be defined, taking into account the outputs obtained. a. The possible TMA definitions need to be defined in advance in the Long Term Planning. b. The daily TMA structure expected for the day of operations needs to be defined and updated if necessary in the Medium-Short Term Planning Phase.	Significant changes in route structure and operation need to be well defined and planned well in advance.

Table 6: TMA Expert Group Recommendations/Comments for WP5.3.5 Recommendations

WP5.3.6 RECOMMENDATIONS	WP5.3.1 TMA EG Recommendation/Comment
Recommendations related to concept maturation and assessment	
Important Note: As the prototyping sessions were of a short duration and involved a limited number of participants the results should be regarded as trends rather than results backed by statistical evidence. This needs to be taken into account in the following recommendations. *Further maturation of the concept should be carried out through human-in-the-loop experiments after the Episode 3 timeframe in order to address open issues identified above, including the following aspects:*	
R1) The scope of these prototyping sessions was too restricted to enable a full evaluation of the effect of RTA in a terminal area to be made. Nevertheless, initial indications are that use of RTA to comply with a CTA could be useful to provide a suitably-measured flow into the airspace around an airport. However, the exact positioning of the RTA/CTA points would be location-, airspace- and complexity-specific and would, in any event, need to be placed at a sufficient distance from final approach to allow controllers to provide the necessary safe separation as well as to construct an efficient sequence and optimal landing spacing. Instead of the IAF, which was also a merging point, a point further out such as a TMA entry point could for instance be considered as CTA point. Then between that point and the IAF, subject to a sufficient level of strategic de-confliction and to inbound traffic delivery conditions, “standard” speed control could be used to ensure separation.	The unconstrained freedom for the aircraft when self-managing to a time constraint can be an issue not only at single merge/metering points irrespective of their location. This is the subject of ongoing investigations - and future investigations in SESAR JU WP5.6.1.
R2) As a contributing factor to the above issue, the reduction in the controller’s situation awareness regarding the aircraft’s speed schedule when flying an RTA to adhere to a CTA should also be addressed. To increase the situational awareness of controllers, information on aircraft intent should be available to the ground system, in particular speed. Note that the same recommendation came out from the EP3 En Route prototyping sessions (WP4.3.4 En Route Validation Report).	Information currently available within the aircraft systems (though not necessarily available for downlink at the moment) could be provided (e.g. through ADD) to the ground system for display on the controller position to enhance situation awareness.
R3) Along similar lines regarding speed adjustments, the interdependency between RTA and A-CDA, i.e. their relative priority and the interaction with separation assurance should be clarified.	RTA/CTA is a capacity related enhancement. CDA is flight efficiency/environment related; the requirement is to ascertain the trade-off between the two enablers in the specific context of the drivers (capacity, environment, efficiency) for the TMA or the operations concerned.

WP5.3.6 RECOMMENDATIONS	WP5.3.1 TMA EG Recommendation/Comment
R4) The concept introduces time constraints dynamically issued by an arrival manager (AMAN) for metering purposes. As a known limitation in session 3, these constraints (CTAs) were actually scripted and the displayed arrival sequence, presented on the AMAN timeline, was static. Consequently it was not possible – nor intended – to explore dynamic aspects of the sequence optimisation in the session. After sufficient maturation is achieved in TMA airspace through further small scale human in the loop experiments, a larger scale Real Time simulation should be conducted, involving more sectors, enabling dynamic aspects of the arrival sequence management through e.g. an AMAN to be assessed.	Future large scale real time simulations should be carried out in the context of pre-deployment activities. Note. R4, R5, R7 and R8 are simulation-specific and not directly dealing with the concept; the EG does not have the necessary knowledge to comment on these.
R5) Compatibility with departures (which were scripted in Task 1 sessions) could be confirmed in the frame of a Real Time simulation, also providing a more realistic environment.	
R6) The 4th prototyping session (in Task 2) limited to just one week, including training, to test the introduction of new concepts as PMS, CDA and ASPA S&M has allowed only subjective feedbacks: Despite this the new concept viability has been proven.	PMS and CDA concept were tried in the first three sessions (task 1). The fourth session introduced ASPA S&M. As stated in the WP5.3.6 (and R7 below) only having one week to introduce, train and investigate this new aspect is a limiting factor. The viability should be seen in that context.
R7) Simulation reduced duration and platform limitations reduced the full potential of the concept (Task 2) being investigated.	
R8) The limited effort permitted simulating only four sectors, it was not possible to manage properly the upstream traffic with an additional workload on the simulated sectors (Task 2).	
Recommendations on prototyping approach	
R9) The interactions between En Route and TMA: further concept maturation/assessment activity e.g. in the frame of the SESAR JU, will most probably involve issues concerning different airspaces, and/or more detailed aspects related to their interfaces (e.g. En Route delivery to TMA). In this context, it will be of utmost importance to continue ensuring appropriate co-ordination at the level of operational concept descriptions, and at that of operational experts involved in different validation exercises and/or different projects.	

Table 7: TMA Expert Group Recommendations/Comments for WP5.3.6 Recommendations

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