04.07.07 Final Project Report

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Abstract

After the finalization of the different activities of P04.07.07-D01 presents the main achievements, and contributions to SESAR and lessons learnt from the project.

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This deliverable consists of SJU foreground.

Table of Contents

List of tables

List of figures

Publishable summary

The SESAR concept envisages managing capacity in high density airspace by matching capacity to forecast demand where possible. When no further capacity adjustment is possible, demand may be altered by a series of separate actions or 'layers' that cumulatively reduce complexity.

The P04.07.07 "Implementation of Dynamic Capacity Management in a High Density Area" comprised mainly two aspects.

- In the first instance, **Dynamic Capacity Management Concept** where the capacity should be adjusted by ATC authorities to best support the predicted demand.

  A local decision supporting tool and their procedures where applied in a high density area to evaluate the most suitable ACC sector configuration during the day of operations (Barcelona ACC). This assessment was made in terms of capacity matching forecast demand approximately eight hours before the operation.

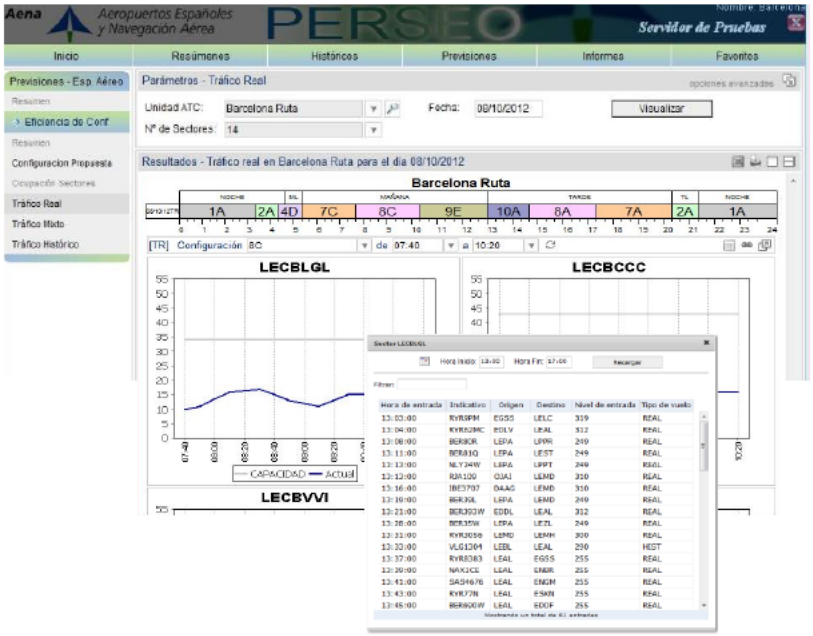

Figure 1: DCM Local Supporting Tool Interface

After the validation exercise was completed, the following conclusions were stated:

- The functionalities included in the proposed supporting tool are ready for deploying with full operational capability in any ACC, although the following minor modifications should be implemented before its deployment:
  - Inclusion of the occupancy counts;
  - Display of the saturation periods, if any, in the proposed airspace configurations;

- Advisory about the most suitable demand source at the moment of the request;
- Allowing the modification of the declared capacity.

- The What-if functionality was useful to support the selection of the most suitable airspace configuration, improving the situational awareness;
- The accuracy of the mixed demand forecast was considered the most adequate to perform the planning of the next ATCOs' shifts in nominal conditions. However, in non-nominal conditions the most appropriate demand source would be the CHMI data;

  The accuracy of the demand forecast should be improved in the case of non-nominal conditions. Statistical analysis, e.g. data mining, is needed to find traffic patterns associated to special circumstances (i.e. Christmas, Easter, sport events, strikes...) which allows a reliable demand profile to be constructed.
- In nominal conditions, the optimisation of the airspace configuration supported by a tool and taking into account the number of available human resources allows increasing the number of flights handled by each sector as well as reducing, or, at least, maintaining the number of saturation periods (demand over capacity declared per sector).
- As a conclusion of this economic study it can be confirmed: comparing the baseline (Daily Operation without the DCM Local Supporting Tool) versus the operation with the Tool (with the assumptions taken), it will obtain a positive NPV, meaning the project is feasible in economic terms.

- A second aspect is to modify demand. P04.07.07 developed a '**layered' concept** to support complexity reduction validated in V2 phase.

  The 'high density airspace' chosen as the scenario for this complexity reduction aspect was the UK/Irish airspace that lies to the east of Oceanic airspace. Early morning arrivals to Europe from North America cluster around their optimum trajectory and frequently arrive as a bunch, which can interact with first rotation UK/Irish aircraft, creating traffic of high complexity. The complementary layered planning concepts, addressed by P04.07.07, were the following:
  - A NATS-developed *Oceanic Domestic Interface Manager* (ODIM) that provides the oceanic clearance planner with information to enhance their decision making in order to reduce the complexity of aircraft departing oceanic airspace;
  - *High Level Direct Routing* that aims to take advantage of the improved Medium Term Conflict Detection tools that have been deployed into Swanwick Area Control Centre (ACC), together with improved Flexible Use of Airspace procedures. This will increase the lateral separation of aircraft at an earlier stage into separate over-flight and UK inbound streams. Therefore, High Level Direct Routing concept permits aircraft overflying the UK to take a more direct track to their destination, thereby saving fuel and reducing traffic bunching.
  - An *Inbound Longitudinal Streaming* concept that uses an extended arrival manager (AMAN) horizon concept developed within SESAR P05.06.04 to provide

longitudinal streaming of UK arrival flows at an earlier stage. Note that the P05.06.04 focus is on reducing workload in the TMA and smoothing the arrival flow whereas P04.07.07 sought to integrate the same concept for a benefit in en route airspace well before the descent phase.

The following changes/achievements were recorded between the baseline and the concept solution utilising HLDR plus inbound longitudinal streaming:

1. The number of calculated potential conflicts among flights affected by the concept reduced by between 0.7% and 5.6%, implying a reduction in controller workload and complexity.
2. At a concept level, the lateral dispersal of flights leaving oceanic airspace and taking up direct routing was dependent upon the availability of medium term conflict detection tools to detect potential conflicts that are now more widely dispersed.
3. Fuel burn was reduced by an average of 170 kg per overflying aircraft and 312 kgs per inbound aircraft that was subjected to slowing and streaming of aircraft at altitude, reducing and in some cases eliminating the need for holding.

With regards to the ODIM concept, the workload and number of conflicts were improved as follows:

- A 30% reduction in workload associated with peaks in traffic flow rate
- A 5% reduction in workload associated with the relative separation of aircraft
- A 20% reduction in conflicts due to altitude distribution of traffic
- As well as a 30% reduction in conflicts due to crossing traffic.

However, it should be noted that these benefits from the ODIM concept are approximate maximum values and are applicable to the workload associated with oceanic traffic only. The overall sector benefit provided would be highly dependent on the proportion of overall traffic that is oceanic; it will therefore vary from sector to sector and throughout the day.

To conclude, it should also be noted that it is not currently known whether these improvements can be aggregated (V3 activities were not planned for this planning concept).

1 INTRODUCTION

1.1 Purpose of the document

The purpose of this document is to:

- Summarise the results and conclusions relating to the concerned Members' participation in the Project (publishable summary);
- Describe the contribution of the Members to the development of new Standards and Norms Proposals in the Project;
- Describe the contributions made, through the Project, to the roadmap for deployment activities;
- Explain the progress made, through the Project, towards the execution of the ATM Master Plan;
- Provide an overview of the final achievement of the Deliverables and an explanation of the discrepancies between the planned and the actual work carried out in the Project;
- Provide for each Member involved in the Project, a Project Costs Breakdown Form of the total Eligible Costs incurred by the Member during the Project, including interest accrued on the Pre-Financing payments and any other Revenue related to the Project.
- Analyse the lessons learnt at project level.

1.2 Intended readership

Intended audience of the document are:

- P04.07.07 Project Members (AENA, NATS, SELEX);
- Project Members of the same OFA (P04.03, P04.07.01, P07.05.03, P07.06.05 and P10.08.01);
- Other projects: P05.06.04;
- Project Members of the technical project P13.02.03;
- Federating Projects: 4.2, 5.2, 6.2 and 7.2 for Consolidation;
- Transversal Projects: WPB for architecture and performance modelling and B.4.2 Maintenance of the Target Concept [1].

1.3 Inputs from other projects

P13.02.03 was responsible for developing a prototype according to the operational requirements defined by P04.07.07 (further information in P04.07.07 D25 – FINAL OSED [1]). This prototype acted as a decision-making tool and allowed OPS Supervisor to detect and assess traffic imbalances on the day of operation from eight to two hours in advance.

1.4 Glossary of terms

Term	Definition
Airspace Configuration	Is a pre-defined and coordinated organisation of ATS routes and/or terminal routes and their associated airspace structures, including airspace reservations/restrictions (ARES), if appropriate, and ATC sectorisation.
Airspace Management	Airspace Management is integrated with Demand and Capacity Balancing activities and aims to define, in an inclusive, synchronised and flexible way, an optimised airspace configuration that is relevant for local, sub-regional and regional level activity to meet users requirements in line with relevant performance metrics. Airspace Management primary objective is to optimise the use of available airspace, in response to the users demands, by dynamic time-sharing and, at times, by the segregation of airspace among various airspace users on the basis of short-term needs. It aims at defining and refining, in a synchronised and a flexible way, the most optimum airspace configuration at local, sub-regional and regional levels in a given airspace volume and within a particular timeframe, to meet users requirements while ensuring the most performance of the European Network and avoiding as much as possible any disruption. Airspace Management in conjunction with AFUA is an enabler to improve civil-military co-operation and to increase capacity for the benefit of all users.
Dynamic Capacity Management	Concept proposed by P04.07.07 to adapt the capacity to the traffic load by grouping and de-grouping sectors and managing the staff resources.
Dynamic sectorisation	The geographical and vertical limits of a control sector will be adapted to the traffic flow to optimise the capacity in real-time. Flexible sectorisation does not imply that ATC will be faced with sector configurations that are not known either to them or to the supporting FDP and RDP systems. Sector configurations will be part of the pre-determined scenarios of the ACC and will be simulated and training will be provided prior to usage.
PERSEO	Web-based local tool where the forecast demand is based on the processing of massive historical data obtained from multiple sources of information or a mix of real traffic data and these historical data. This tool includes an optimization algorithm to provide the most suitable airspace configuration.
Sector	A sector is the area of responsibility assigned to a Unit of Control. A

Term	Definition
	sector is composed of one or several elementary sector.
Sector Cluster	A sector cluster represents a group of adjoining airspace blocks that are treated as a single ATM airspace. A sector cluster consists of several ATC sectors and multi-sectors.
Sector configuration	Airspace configuration in the Centre of Control (ACC)/ Sector Cluster i.e. the relation between the Units of Control and sectors.
Sector configuration schedule	List of planned sector configurations with their time of activation.

1.5 Acronyms and Terminology

Term	Definition
ACC	Area Control Centre
ATFCM	Air Traffic Flow and Capacity Measures
AO	Airline Operator
AMAN	Arrival Manager
ANSP	Airspace Navigation Service Provider
CHMI	CFMU Human Machine Interface
CFMU	Central Flow Management Unit
DCB	Demand-Capacity Balancing
dDCB	Dynamic DCB
DOD	Detailed Operational Description
FMP	Flow Management Position
FUA	Flexible Use of Airspace
MTCD	Medium Term Conflict Detection
NAT	North Atlantic
NOP	Network Operations Plan
ODI	Oceanic/Domestic Interface
ODIM	Oceanic Domestic Interface Manager
OI	Operational Improvement

Term	Definition
OTS	Organised Track Structure
OFA	Operational Focus Area
OSED	Operational Service and Environment Definition
PERSEO	Platform for the Analysis of Network Effects of Sector Configuration
SJU	SESAR Joint Undertaking
SPR	Safety and Performance Requirements
SWP	Sub-Work Package
TLPD	Traffic Load Prediction Device
TMA	Terminal Manoeuvring Area
UDPP	User-Driven Prioritisation Process
UIR	Upper Information Region

2 Project contributions

The Operational Improvements (OIs) and theirs associated enablers which were addressed by 04.07.07 are presented in the following tables:

- **Layered Planning Concept -** Contributions for V3 maturity level:

  DCB-0205 "Short Term ATFCM Measures" was partially addressed in V2 activities.

EN Code	Enablers
NIMS-08	Strategic and pre-tactical demand-capacity balancing evaluation, simulation and display tools
NIMS-13a	Capacity planning and scenario management equipped with tools to identify the possible re-routed flights/flows providing the best benefits
NIMS-27	Network DCB sub-system enhanced with improved accuracy of processing real-time data
PRO-038	FCM Procedures to enable application of flow management techniques on traffic streams closer to real-time
CTE-C11A	Pan European Network Service (PENS).

Table 1: Enablers Addressed in V2

- **Dynamic Capacity Management Concept** - contributions for V4 maturity level:

  CM-0102-A 'Automated Support for Dynamic Sectorisation and Dynamic Constraint Management' was partially addressed in V3.

EN Code	Enablers
ER APP ATC 15	Flight Data Processing: support for Dynamic Sectorisation and Dynamic Constraint Management.
PRO-220a	ATC Procedures related to Detection and Resolution of Complexity, Density and Traffic Flow Problems.

Table 2: Enablers Addressed in V3

2.1 Contributions to the roadmap for deployment activities

The project produced deliverables of V2/V3 maturity and did not contribute to the deployment phase (v4). This section is therefore not applicable for the project.

2.2 Contribution to standardization

This section is not applicable for this project as its aim was to improve the data provided by existing tools not involved in standardisation.

3 Project lessons learnt

What worked well?
The combined input of the different partners (AENA and NATS) has allowed for more 'generic' concept solutions to be developed.
Support & guidance from IS and transversal project 4.2
In general, the level of data/information sharing in SJU's Web was thorough
What should be improved?
The programme change request process needs to be quicker and more pragmatic. These changes should be based on logic and requirements of the project and not based on the existing data architecture.
The "quality" process needs to focus on the content and not adherence to the templates. The deliverable templates are too restrictive and are not always suitable for concept development documentation so adherence to these is not a measure of real quality.
The numbers of management tasks as well as their scope were increasing during the life cycle of this project . Therefore, this task has required much effort that cannot planned.
The combined input of the different partners has allowed a more generic concept. However, the common associated documents, planning of required exercises as well as the whole planning of the project is practically unmanageable if these inputs are in different phases.
The validation process for documents needs to be quicker and clear. A standard, detailed and common process should be defined. This process must include time to receive comments/clarification from external reviews, SJU, IS (all at the same time) as well as a determined time to know the status of each document. It would avoid modifying a document three months after its delivery when it is the basis of the current activity (e.g V3 Validation Report).

Table 3 - Project lessons learnt

4 Project achievements

4.1.1 Project deliverables

Del. code	Del.Name	Description	Assessment Decision	Explanations
04.07.07.D01	*Management Report*	It summarizes all the internal coordination activities amongst the partners in order to better achievement of the objective. Project close out report will be produced.	No reservation (P)	The Management Report was elaborated and updated in the SJU's WEB. However, this deliverable has been replace by the present document: "04.07.07 Final Project Report"
04.07.07.D03	Initial OSED	Interim OSED based on SJU Template.	No reservation (P)	
04.07.07.D04	V2 Validation Plan	It describes the initial validation plan taking into account the following aspects: 1- Initial maturity level of the concepts 2- The Transition Criteria to be defined for V1-V2 transitioning and V2-V3 transitioning 3-- Validation activities in V2 (operational scenarios, use cases, Performance Indicators, mock ups).4- Coordination of timescales amongst dependant projects	No Reservation	
04.07.07.D05	Initial SPR	Interim SPR based on SJU Template.	No reservation (P)	
04.07.07.D20	Preliminary OSED	This is a consolidated OSED that includes operational procedures, operational requirements and defined scenarios to be validated. This document is based on SJU template and it will be published to be disseminated externally.	No reservation (P)	
04.07.07.D21	V2 Validation Report	This document will include what level of benefit can be provided by each concept 'layer', and show what interaction is required by each concept element. It is focused on v2 activities.	*To be assessed*	
04.07.07.D22	Preliminary SPR	Preliminary SPR document is based on SJU template and it will be published to be disseminated externally.	No Reservation	

04.07.07.D23	V3 Validation Plan	V3 Validation Plan	*To be assessed*	
04.07.07.D24	Validation Report	V3 Validation report: This Deliverable will collect the results obtained by means of the KPI defined, from each validation exercise conducted. It will also include a final concept maturity assessment.	*To be assessed*	
04.07.07.D25	Final OSED	Final OSED	*To be assessed*	
04.07.07.D26	FINAL SPR	FINAL SPR	*To be assessed*	
04.07.07.D27	Cost Benefit Analysis	Business Case: The Deliverable evaluates the project value, which can be qualitative and quantitative.	*To be assessed*	

Table 4 - List of Project Deliverables

5 Total Eligible Costs

This section is based on the Project Costs Breakdown Forms of the eligible costs incurred by project Members during the project and these will be sent to the SJU separately by each member. The Project Manager should not complete this section.

6 References

[1] SESAR P04.07.07 D25 Final OSED, Version 00.02.00, 12th April 2013.

[2] B4.2 Initial Service Taxonomy document

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