Final Project Report

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Abstract

After the finalization of the different activities of P 05.07.04, D.000 presents the main achievements, contributions to SESAR and lessons learnt of the project.

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None.

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Publishable summary

P05.07.04 addresses the current limitations in practical implementation of P-RNAV in TMA operations, enabling a move to integrated P-RNAV management in high-density traffic situations, throughout the day.

The project is focused in complex European TMAs, multi-airport TMAs and TMAs with significant aircraft noise constraints, such as densely populated areas where traffic density requires an increment in capacity and P-RNAV procedures are planned or further developed, taking Madrid, Milan and London as reference scenarios and extending the results to generic complex TMAs in Europe.

Two techniques for sequencing and merging traffic flows were investigated: Trombone procedures and Point Merge Systems (PMS). The technique to be implemented in any specific TMA depends upon local circumstances and airspace availability.

Typically, Trombone procedures can apply Sequencing & Merging closer to final approach than Point Merge Systems. However, in the Madrid Trombone design, the merging occurs far upstream with the turn onto Final Approach facilitated by a 'P-RNAV grid'; the Point Merge System in London provided base leg turns onto Final Approach for some airfield approaches, while the PMS design for Milan TMA provided for two single leg structures located beside the ECL (extended RWY centre line) in order to merge incoming traffic toward the final approach track.. These test cases demonstrate a P-RNAV route structured TMA can be designed to mitigate constraints when sufficient consideration is given to design around the local conditions.

Trombone procedures are similar to 'current day' vectoring operations meaning that it is relatively comfortable for controllers and pilots to adjust to this systemised procedure. The Human Factors analysis, using the AENA "NORVASE" tool, confirmed this result. Also the symmetry of the trombone design makes easy to resolve airport configuration changes.

Point Merge Systems provide a higher degree of structure and standardisation, allowing them to become homogenous designs that can be applied to multiple airports; the PMS designs for each single-runway airport in the London TMA shared similar dimensions. This homogeneity provides potential benefits in transferability of skills, which leads to potential capacity increase and/or cost efficiency. The same considerations can be applied to Milan TMA design, where PMS proved to be very efficient in standardizing also recovery after contingencies (runway closure, emergency, bad weather and so on).

The Human Factors analysis determined that the simplicity of operation of the Point Merge System meant that it is intuitive for controllers to use, i.e. simple for a new trainee controller to pick up the technique. However, the procedure is less intuitive for the pilot, placing an increased importance on the controller informing the pilot of expected route, constraints and 'time on leg' prior to entering the STAR. Since PMS shifts the controller tasks from radar vectoring to radar monitoring, particular attention has to be placed in continuous training practices in order to maintain a good confidence in tactical vectoring.

The improvements in Human Factors - in the form of significantly reduced controller workload, improved situational awareness and reduced R/T when compared to the current operation - delivers safety and capacity benefits. Controller capability to deal with non-nominal scenarios is also improved in some cases.

In bad weather conditions the reversion to a radar vectoring environment has proven to be feasible, if absolutely necessary, although increasing significantly the workload.

An increase in the track miles for Arrivals is likely to be needed to accommodate the lateral holding in the sequencing & merging techniques (Trombone procedures and PMS). However, vertical profiles can be greatly improved for Arrivals and Departures.

Application of P-RNAV procedures has enabled the design of de-conflicted SIDs and STARs. For Departures, the structured routes and well-defined (closed loop) operations for Arrivals allows departing aircraft an unrestricted initial climb phase of flight. CCDs were carried out for the majority of departures. This was shown by quantified fuel and CO_2 figures from the London TMA test case and corroborated by the results from Milan and Madrid. The vertical profiles improvements are expected to provide a corresponding reduction to Noise impact.

Solutions for specific CDO manoeuvres have been analysed, although not tested. CDO in high traffic periods seems to be not feasible.

The cost of implementing these concepts is low for the Airspace User, because The P-RNAV concept is mature; regulations already exist and many aircraft are already equipped.

The cost of implementing these concepts is high for the Air Navigation Service Provider because they can only be implemented as part of a complete TMA redesign, which is an intensive and extensive process.

Note that a complete TMA redesign will consolidate costs & benefits from multiple initiatives so this 'High' cost cannot be considered against this concept alone.

Scenarios:

1.- Trombone based design was used for Madrid TMA P-RNAV arrival procedures to Barajas, Torrejon and Getafe airports. Also P-RNAV allowed the design of departure routes from the three airports, de-conflicted from arrivals.
Barajas has two independent RWY's for arrivals and departures, Torrejon and Getafe operates single RWY.

2.- Arrival and Departure P-RNAV routes were designed for the 5 main commercial airports of the London TMA: Heathrow, Gatwick, Stansted, Luton & City. These designs incorporated Point Merge Systems for Arrivals to each airport.
London Heathrow has dependent dual runway operations and the other four use single runway operations.

3.- Arrival and departure routes were designed also for Milan TMA, taking into account mainly Milan Malpensa and Milan Linate. In particular a PMS arrival design structure were developed for Milan Malpensa, also with new departures. New departures were also designed for Milan Linate airport.

4.- Two integrated scenarios, one trombone based and a second based on Point Merge, were produced as documentation, and delivered to SWP 5.3 for an integration exercise with P.05.06.04 AMAN.

1 Introduction

1.1 Purpose of the document

The purpose of this document is, as stated in the Multilateral Framework **Error! Reference source not found.**, to

- Summarises the results and conclusions relating to the concerned Members' participation in the Project (publishable summary);
- Describe the contribution of the Member 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

EURCONTROL and SJU are involved in all the activities of the projects. Indeed, SJU will determine what is acceptable or not during the whole lifecycle of the project.

Airspace Users - The AU's are represented by the pilots / (pseudo-pilots) / AUs involved in the simulation. Military Airspace Users are part of the intended readership.

ATC - Controllers participated in the sessions providing feedback and assessment of the operational procedures. Military Airspace Managers are part of the intended readership.

Airports - The airport and the surrounding areas are affected in this project due to the modification of TMA, STARs and SIDs of respective airport.

ANSPs - AENA, NATS and ENAV - They are directly involved in the structure and standardization working methods for the implementation of P-RNAV and point-merge in the TMA. They also supervised the activities during the simulation.

Industry - There is an intended Industry involvement in the future implementation when it is going to be a necessity to demonstrate that these procedures are flyable in a real scenario (AIRBUS).

EASA - Regulator, Inspector

There are also several projects that can be interested in this document:

Transversal projects:

5.2 - Consolidation of Operational Concept Definition and Validation

5.3 - Integrated and Pre-Operational Validation & Cross Validation

These project validation activities are going to be considered in the integration of AMAN in the procedures.

5.7 - TMA Trajectory and Separation Management

Operational projects:

4.7.3 - Use of Performance Based Navigation (PBN) for En Route Separation Purposes

5.6.2 - QM-2 – Improving Vertical Profile

5.6.3 - QM-3 – Approach Procedure with Vertical Guidance (APV)

5.6.4 - QM-4 – Tactical TMA and En-route Queue Management

5.7.2 - Development of 4D Trajectory-Based Operations for separation management using RNAV/PRNAV

1.3 Inputs from other projects

No inputs from other projects were received, but there were co-ordinations with P.5.6.4 and SWP.5.3 projects. Two P-RNAV scenarios for complex TMA were provided to SWP5.3. One of the scenarios is based in the trombone design for Madrid TMA and the second for the Point-Merge in Complex TMA concept. Both scenarios will be used for the integration with Extended AMAN Horizon exercises to be carried out by SWP .5.3.

SPW5.3 is responsible for the production/update of the OSEDs resulting from these validation exercises.

1.4 Glossary of terms

VHC – Very High Capacity

HC – High Capacity

2 Project contributions

2.1 Progress made toward the ATM Master Plan

Work Stream 1 (WS1) is in service of OFA02.01.01 “Optimised RNP Structures”;

Work Stream 2 (WS2) is in service of OFA02.01.02 “Point Merge in Complex TMA”.

LEGEND

Completely: the OIs/EN can be considered for transition to V4.

Partially: some additional issues have to be addressed before implementation.

Not covered: not addressed by the project.

OIs contributing to Step 1 or Deployment Baseline (DB), based on project OSEDs/VALRs (D03, D05 & D06) that used Master Plan Data Set 002.30, commensurate with the European ATM Master Plan Edition 1, March 2009.

AOM-0601 Terminal Airspace Organization Adapted through Use of Best practice, PRNAV and FUA (where suitable)	DB	*Partially*	WS1: Spanish Airspace FUA is very restricted so within this project we have assumed the liberalization of such restricted areas. We are aware that in a future where this scenario is going to be implement a negotiation with the military authorities should be carried out in order to fully implement these procedures WS2: Terminal Airspace capacity was enhanced by exploiting RNAV capabilities to optimise placement of SIDs/ STARs, Terminal airspace structures were designed to evenly distribute ATC, and flight crew, workload and minimise adverse ATM-related environmental impact. FUA was not covered.
AOM 0602 – Enhanced Terminal Airspace with Curved/Segmented Approaches and PRNAV Approaches (where suitable)[1]	DB	*Partially*	WS1: All the approach and departure procedures has been designed and later simulated with continuous P-RNAV curves and segments WS2: All Arrivals used RNP-based segmented approaches, with vertical constraints, to respond to local operating requirements such as conflict with departures and environmental impact.
AUO-0501 Visual Contact Approaches when Appropriate Visual Condition prevail[2]	DB	***Not Covered***	

[1] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), AOM-0602 has been split into AOM-0602-A, AOM-0602-B and AOM-0602-C, all of which refer to more specific solutions that P5.7.4 was not scoped to assess.
[2] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), AUO-0501 has been deleted.

AOM-0404 Optimized Route Network using advanced RNP1	**Step 1**	***Completely***	WS1: All the procedures has been designed and tested as RNP1 (See OSED and Validation report for further details) WS2: All procedures were designed using one P-RNAV/RNP1 route structure, with such routes extending from final approach into the TMA feed sectors.
AOM-0603 Enhanced Terminal Airspace for RNP-based Operations[3]	**Step 1**	***Partially***	WS1: All the procedures has been designed and tested as RNP1 (See OSED and Validation report for further details) WS2: Terminal Airspace was further enhanced with the use of RNP terminal routes (incl. RNP1 SIDs and STARs).
AO-0703 Aircraft Noise Management and Mitigation at and around Airports[4]	**DB**	***Partially***	WS2: All Arrivals and Departures were designed to minimize aircraft noise emissions, as far as possible, given the other influencing factors (e.g. capacity).

ENABLERS

A/C-04 - Flight management and guidance to improve lateral navigation (2D RNP)	***Not Covered***	Technical capability from the Deployment Baseline that can support this concept
BTNAV-0206 - Community Specifications for RNP - Development of a means of compliance to PBN manual RNP : European initiative towards worldwide recognition.	***Not Covered***	This is being further developed externally to SESAR, for example by EUROCONTROL through Flight Plan 2012
CTE-N3a – ABAS[5]	***Not Covered***	Technical capability from the Deployment Baseline that can support this concept
CTE-N5a - DME / DME[6]	***Not Covered***	Technical capability from the Deployment Baseline that can support this concept
HUM172-02 - Regulations and standards[7]	***Partially***	No new standards or certifications need to be defined by the project
HUM172-04 – Training[8]	***Partially***	WS2: Human Factors considerations have been captured in the validation exercises and OSED, with some training needs identified.
HUM172-07 - System design encompassing training feasibility[9]	***Partially***	WS2: Human Factors considerations have been captured in the validation exercises and OSED, with some training needs identified.
HUM173-04 - Social & People Management Factors[10]	***Partially***	WS2: Human Factors considerations have been captured in the validation exercises and OSED, with some training needs identified.

[3] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), AOM-0603 has been changed but the P5.7.4 assessment still applies.
[4] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), AO-0703 has been changed but the P5.7.4 assessment still applies.
[5] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), CTE-N3a has been deleted.
[6] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), CTE-N5a has been deleted.
[7] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), HUM172-02 has been deleted.
[8] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), HUM172-04 has been deleted.
[9] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), HUM172-07 has been deleted.
[10] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), HUM173-04 has been deleted.

HUM173-05 - Change and Transition Management Factors[11]	***Not Covered***	No clear purpose of this Enabler for the R&D phase.
PRO-AC-04a - A-RNP Cockpit Procedures - A-RNP Cockpit Procedures	***Partially***	WS2: Some feedback on the concept obtained through feasibility Cockpit Session, referred to in the VALR and used to inform the OSED.
PRO-207a - A-RNP Procedures - ARNP Procedures covering ground operational tasks in Approach ATC	***Partially***	WS2: ATC Procedures have not been fully defined but design recommendations and limitations are identified in Sections 4 & 5 of the OSED.
PRO-021 ATC Procedures to facilitate the design and utilization of more noise sensitive and efficient SID/STAR routings including CDA and to integrate PRNAV capabilities into the TMA route structure	***Partially***	WS2: ATC Procedures have not been fully defined but design recommendations and limitations are identified in Sections 4 & 5 of the OSED.
PRO-070 ATC Procedures for the application of Visual and Contact approaches where advantages can be achieved	***Not Covered***	AUO-0501 not covered
PRO-190 ATC Procedures for Managing Environmental Noise Capacity	***Partially***	WS2: ATC Procedures have not been fully defined but design recommendations and limitations are identified in Sections 4 & 5 of the OSED.
PRO-019 ATC Procedures to integrate arrival and departure streams in such a manner as to permit more continuous climb and descent profiles	***Partially***	WS2: ATC Procedures have not been fully defined but design recommendations and limitations are identified in Sections 4 & 5 of the OSED.
PRO-ENV-15 ASM Procedure to ensure that airspace is designed to avoid unnecessary noise and emissions from non-optimal departure profiles (noise and atmospheric emissions)	***Partially***	WS2: ATC Procedures have not been fully defined but design recommendations and limitations are identified in Sections 4 & 5 of the OSED.

At the submission date of this document, no mature data regarding quantified benefits in terms of performance indicators from either B4.1 or B5 were given.

2.2 Contributions to the roadmap for deployment activities

This section is not applicable for the project.
The project did not contribute directly to the roadmap for deployment activities but the following aspects of deployment have been considered.

The concept:

- Is applicable to TMAs with Very High Capacity (VHC) or High Capacity (HC) needs.
- Can be deployed as a localised concept, i.e. for specific TMAs, but will potentially impact surrounding ACC sectors in terms of interface.
- Must be deployed as part of a TMA airspace change.
- Is not dependent on any new technological development or standards.

[11] In Master Plan Data Set 8 (European ATM Master Plan Edition 2), HUM173-05 has been deleted.

2.3 Contribution to standardization

This section is not applicable for the project.

P-RNAV structures are compliant with current standardization.

Point Merge and Trombone route extensions are procedural airspace constructs. Any implementation of these concepts needs to be as part of a wider airspace design change, which means they should follow the standard process for implementation of airspace design (dependent on the regulatory terms covering the applicable FIR).
Standards on RNAV (ICAO Doc 9573) and PBN (ICAO Doc 9613) are needed to support the concepts but these standards are already defined and are being further developed externally to SESAR, for example by EUROCONTROL through Flight Plan 2012. Therefore, no new standards or certifications need to be defined as part of this project.
There is no industrialisation of new system components necessary.

Airbus, ATR, BAe, Boeing, Bombardier, Cessna, Dassault Falcon, Embraer, Fokker, Gulfstream… (see D03 – Final OSED Madrid TMA for further details) have their FMS compliant with P-RNAV standardisation JAA TGL-10 and FAA AC n90-96A.

CMC Electronics, Garmin International, General Electrics, Rockwell Collins, Universal Avionics System Corporation have their avionics products fully compliant with P-RNAV standardisation.

EASA and FAA have LOAs related with Navigation Data suppliers compliance like EAG, Lufthansa Flight Nav., Jeppensen, Garmin, Honeywell, Smiths Aerospace, CMC… etc.

3 Project lessons learnt

This section identifies the main lessons learnt of the project and that may help the Programme to be improved.

What worked well?
The combined input of the different partners (AENA/ECTL/ENAV/NATS/AUs) allowed for more 'generic' concept solutions to be developed.
Development of airspace designs for specific test cases enabled detailed consideration of constraints in applicable operational environments, whilst the co-ordination and comparison of test cases enabled a broader view. The combination of these aspects enabled a more robust concept development.
In general, the level of data/information sharing between project partners was open and thorough.
Support & guidance from some of the transversal projects (depending on their level of maturity) was very helpful.
Access to applicable expertise in the European ATM field enabled inventive ideas & solutions to be tabled.
What should be improved?
Stable programme guidance. There were too many unknown variables making it difficult to plan effectively; many things changed since the PIR was written, e.g. delivery to OFAs.
The programme change request process needs to be quicker and more pragmatic.
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. Support & guidance from some of the transversal projects (depending on their level of maturity) was obstructive.
Alternative/deputy points of contact for key project contributors would have been beneficial when the principle member was unavailable and may have sped up some of the deliverables.
Interfaces and co-ordination with other operational primary projects may have benefited from interdependency agreements, e.g. the link with P5.6.4 and/or P5.6.7.

Table 1 - Project lessons learnt

4 Project achievements

4.1.1 Project deliverables

This section provides an overview of the Deliverables and explanations of the discrepancies between the planned and actual work carried out in the Project

Del. code	Del.Name	Description	Assessment Decision	Explanations
5.7.4.D01	P5.7.4 Project Management Plan	Project Management Plan (PMP) presents the organisational framework and describes the management processes to be implemented during the project *P5.7.4 Execution Phase*.	No Reservation	
5.7.4.D03	P5.7.4 Final OSED - Madrid TMA	The document will include Operational, Safety and Performance Requirements, and Operational Procedures regarding the Implementation of full P-RNAV in Madrid TMA. Internal documents as initial operational scenarios, initial procedures, FHA, among others will feed this final deliverable. Three versions of the document are foreseen to show progress of the activity.	Reservations requiring clarification or revision	This Final OSED contains as annexes the Benefit Mechanisms document, Validation Plan, VREP, Safety case, Security Case, Environment Case, HF case & Cost effectiveness analysis.
5.7.4.D04	P5.7.4 Implementation Plan - P-RNAV Procedures in Madrid TMA	The document will include all necessary information, together with the Final OSED, prior to the implementation of P-RNAV in the Madrid TMA. Certain aspects as LoA's, BDA's, flight tests, among others, will not be included, since they need to undertake pure implementation activities.	Reservations requiring clarification or revision	
5.7.4.D05	P5.7.4 Publish Final OSED for Point Merge in Milan TMA	The document will also include operational procedures. Various versions of the document will be issued	Reservations requiring clarification or	As per the formal OSED template v02.00.00, there should be one OSED per OFA, so D05 and D06 were combined into one document as

		considering updates after validation activities are performed.	revision	part of Task 13.
5.7.4.D06	P5.7.4 Publish Final OSED for Point Merge in London TMA	Operational Requirements determined as part of the report on Implementation of Point Merge in the LTMA, as published by NATS.	Major reservations	As per the formal OSED template v02.00.00, there should be one OSED per OFA, so D05 and D06 were combined into one document as part of Task 13
5.7.4.D07	P5.7.4 Publish SPR for Point Merge in Milan TMA	Safety and Performance Requirements regarding investigations on Point Merge and other P-RNAV issues in a complex TMA (Milan multi-airport TMA)	No Reservation	TBC – uploaded to Extranet on 9th July 2012.
5.7.4.D08	P5.7.4 Publish SPR for Point Merge in London TMA	Safety and Performance Requirements regarding investigations on Point Merge and other P-RNAV issues in a complex TMA (London multi-airport TMA)	No Reservation	As per the formal SPR template v02.00.00, "*The SPR documents addresses requirements that apply to Operational concept elements that are described in the corresponding OSED*", so D07 and D08 were combined into one document.
5.7.4.D09	P5.7.4 Publish Interoperability for Point Merge	Interoperability requirements regarding implementation of point merge and relation with other concept elements or systems, e.g. AMAN.	Removed	This deliverable was cancelled due to the project pure operational nature. See CR839.
5.7.4.D10	P5.7.4 Publish Project Validation Plan	The document will include the validation strategy and the experimental plans for all validation activities to be undertaken in the project. Updates will be performed at certain points. The main update foreseen will be after V2 activities completion.	No Reservation	TBC – uploaded to Extranet on 24th April 2012.
5.7.4.D11	P5.7.4 Publish Preliminary Validation Report for Point Merge	The validation report of V2 will include all validation results and conclusions from the different validation exercises. Integration and consolidation to provide general results on progresses achieved regarding Point Merge and	No Reservation	Accepted by SJU with "No Reservation" on 6th January 2012. Comments addressed and deliverable updated to v01.00.00

		other P-RNAV implementation issues will be illustrated in this document.		
5.7.4.D12	P5.7.4 Publish Final Validation Report	V3 validation report will include results and conclusions of human in the loop large activities and initial integration with other concepts, such as AMAN capability.	No Reservation	Accepted by SJU with "Reservations requiring clarification or revision" on 6th January 2012. Comments addressed, deliverable updated to v00.02.00 and uploaded to Extranet on 11th June 2012
5.7.4.D13	Publish Integrated OSED	P5.7.4 will collaborate with SWP5.3 and P5.6.4 to undertake integration activities steered by SWP5.3 and including Point Merge implementation in complex TMAs plus Arrival Manager. The main output of P5.7.4 will be an integrated scenario and corresponding procedures including AMAN provided by SWP5.6.	Critically Deficient	The published deliverable was found not to fully cover the initial description. It was rejected by the SJU and P.5.7.4 was asked to produce a new deliverable to accomplish with the initially defined content.
5.7.4.D14	Final Business Case and Transition Feasibility Report	This will be a report illustrating all results and conclusions of the project that will be structured focused in providing a stakeholders' decision support tool for implementing P-RNAV in complex TMAs.	No Reservation	TBC – uploaded to Extranet on 9th July 2012.
5.7.4.D16	Integrated Scenario: Point Merge in Complex TMA with AMAN Extended Horizon	This deliverable supplies to SWP.5.3. the Point Merge scenarios for integration with P.5.6.4 AMAN		This deliverable was produced to fulfil the expected content of D13.

Table 2 - 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] Master Plan Data Set 8 (European ATM Master Plan Edition 2Name of project, Title of document2, Identification number, Edition, date

7 Annex – Transition feasibility

Criteria	Response Optimized RNP	Response Point Merge
[V3.O.VV.1] Is there at least one Validation objective defined to assess the feasibility of each performance requirement in each relevant application context?	Yes, See Validation Plan 3.4 – Validation Objectives	Validation Objectives 1-8 have been defined in the VALP **Error! Reference source not found.**; these were derived from Stakeholder Expectations given in the VALP and the formal KPAs defined by B4.1 **Error! Reference source not found.**. The context is complex (multi-airport) TMA; the two test cases identified in the VALP are London & Milano.
[V3.O.VV.2] Are there Validation success criteria and metrics defined for each Validation objective?	Yes, See Validation Plan 3.4 – Validation Objectives for success criteria and 4.1.3.1.1. – Analysis Method	Validation success criteria are defined for each Validation Objective in the VALP **Error! Reference source not found.**.
[V3.O.VV.3] Is each Validation objective associated to at least one Validation scenario?	Yes, See Validation Plan 3.5 – Validation Scenarios	8 nominal scenarios are defined in the VALR **Error! Reference source not found.**, which apply to all Validation Objectives defined in the VALP. 46 non-nominal scenarios are defined in the VALR.
[V3.O.VV.4] Is each Validation scenario associated to one Validation organisation?	All scenarios are referred to ANEA Madrid ACC center of simulation.	4 nominal scenarios apply to NATS and 4 nominal scenarios apply to ENAV. 41 non-nominal apply to NATS and 5 non-nominal apply to ENAV.
[V3.O.VV.5] Has the pre-industrial validation environment been specified, integrated and tested?	Yes, during 2 weeks from 17th of October 2011 to 28th of October during the RTS (See Validation Report for further details)	Real-Time Simulators were used by NATS and ENAV to validate London and Milano TMAs respectively. Both platforms are able to represent the system under evaluation to high fidelity. Suitably qualified/rated ATCOs operated all measured sectors. Details in Sections 4.2.4/4.3.4/5.2.3 of the VALP **Error! Reference source not found.**.
[V3.O.VV.6] Have all planned Validation exercises and reviews been completed and	Partially, see Validation Report for exercise completeness.	All planned Validation Exercise reported in the VALR **Error! Reference**

documented with Validation reports?		**source not found.**,
[V3.O.VV.7] [Do Validation reports provide evidence that success criteria of all Validation objectives are satisfied?	Partially, see Validation Report	All Success Criteria were assessed but not all of them were satisfied. The reason for unsatisfied success criteria is due to implementation specific issues, as stated in the Conclusion, i.e. no impact to the fundamental concept. We can conclude that airspace designs need to be carefully considered and assessed prior to implementation; recommendations are given in section 5.2 of the VALR **Error! Reference source not found.**,
[V3.O.VV.8] Do Validation reports provide quantitative evidence that all the expected benefits are reached?	Partially, some reports weren't able to provide quantitative results but qualitative results were given in terms of capacity, workload and cost-effectiveness. See the corresponding cases to see the quantitative results	Quantitative evidence provided in the VALR and summarised in Section 4.1.1 **Error! Reference source not found.**,

Table 3: Validation Feasibility

Question area	Optimized RNP	End of V3	Answer
Programme	Management and Development Plan	*[V3.P1.1] Has the ATM Service Management and Development Plan been updated and approved?*	*N/A*
Business	Business Case	*[V3.B3.1] Is the Business case up to date according to phase results, documented and approved?*	*Yes, the Business case has been built with the most up-to date in terms of cost breakdown, safety data, procedures design, security assessment reference material and reports treated as baseline were the most up-to-date ones that AENA department possess.*
	CBA	*[V3.B4.1] Is the CBA up to date according to phase results, documented and approved?*	*Yes, the Business case has been built with the most up-to date in terms of cost breakdown and reports treated as baseline were the most up-to-date ones that AENA department possess.*
	Environment Case	*[V3.B5.1] Is the Environment case up to date according to phase results, documented and approved?*	*Yes, the Environmental case was based in a typical day of October 2011. That GSI file was a representative one of the most updated demand in Madrid TMA.*
Operation	Operational	*[V3.O1.1] Is the*	*Yes, see Final OSED for Madrid TMA*

al	Concept	*Operational concept document up to date according to phase results and approved?*	
	Human Factors Case	*[V3.O2.1] Is the Human Factor case up to date according to phase results, documented and approved by HP experts?*	*Yes, See Human Factor Case* https://extranet.sesarju.eu/WP_05/Project_05.07.04/Project%20Plan/Forms/AllItems.aspx?RootFolder=%2fWP_05%2fProject_05.07.04%2fProject%20Plan%2fT003%20-%20Full%20P-RNAV%20Impl.%20In%20Madrid%20TMA%20-%20Operational%2c%20performance%20and%20safety%20aspects%2fD03%20-%20P5.7.4%20Final%20OSED%20-%20Madrid%20TMA%2fAnnexes&FolderCTID=0x0120009506F724D58BB141BAA16F219769CCE6&View={E8428DE2-6485-48E7-9019-0C3292DA595D}
	Validation	*[V3.O3.1] Have the Validation plan, exercise plans and reports been produced and approved?*	*Partially, See Validation Report* https://extranet.sesarju.eu/WP_05/Project_05.07.04/Project%20Plan/Forms/AllItems.aspx?RootFolder=%2fWP_05%2fProject_05.07.04%2fProject%20Plan%2fT003%20-%20Full%20P-RNAV%20Impl.%20In%20Madrid%20TMA%20-%20Operational%2c%20performance%20and%20safety%20aspects%2fD03%20-%20P5.7.4%20Final%20OSED%20-%20Madrid%20TMA%2fAnnexes&FolderCTID=0x0120009506F724D58BB141BAA16F219769CCE6&View={E8428DE2-6485-48E7-9019-0C3292DA595D}
	Safety Case	*[V3.O4.1] Is the Safety case up to date according to phase results, documented and approved by Safety experts.*	*Yes, See Safety Case* https://extranet.sesarju.eu/WP_05/Project_05.07.04/Project%20Plan/Forms/AllItems.aspx?RootFolder=%2fWP_05%2fProject_05.07.04%2fProject%20Plan%2fT003%20-%20Full%20P-RNAV%20Impl.%20In%20Madrid%20TMA%20-%20Operational%2c%20performance%20and%20safety%20aspects%2fD03%20-%20P5.7.4%20Final%20OSED%20-%20Madrid%20TMA%2fAnnexes&FolderCTID=0x0120009506F724D58BB141BAA16F219769CCE6&View={E8428DE2-6485-48E7-9019-0C3292DA595D}
	Transition	*[V3.O5.1] Is the Transition plan up to date according to phase results, documented and approved?*	*Yes, See Implementation Plan* https://extranet.sesarju.eu/WP_05/Project_05.07.04/Project%20Plan/Forms/AllItems.aspx?RootFolder=%2fWP_05%2fProject_05.07.04%2fProject%20Plan%2fT004%20-%20P-

			RNAV%20Implementation%20Plan%20Development%20%28Madrid%20TMA%29%2fD04%20-%20P5.7.4%20Implementation%20Plan%20-%20P-RNAV%20Procedures%20in%20Madrid%20TMA&FolderCTID=0x0120009506F724D58BB141BAA16F219769CCE6&View={E8428DE2-6485-48E7-9019-0C3292DA595D}
	Standards and Regulations (S&R)	*[V3.O6.1] Are final OCD, SPR and INTEROP defined, approved and aligned with the expectations of the Standardisation Roadmap and provide sufficient evidence for adoption by Standardization bodies?*	*No, for this operational project and context these document were removed from project deliverables. INTEROP is not applicable and SPR (see Safety Case): https://extranet.sesarju.eu/WP_05/Project_05.07.04/Project%20Plan/Forms/AllItems.aspx?RootFolder=%2fWP_05%2fProject_05.07.04%2fProject%20Plan%2fT004%20-%20P-RNAV%20Implementation%20Plan%20Development%20%28Madrid%20TMA%29%2fD04%20-%20P5.7.4%20Implementation%20Plan%20-%20P-RNAV%20Procedures%20in%20Madrid%20TMA&FolderCTID=0x0120009506F724D58BB141BAA16F219769CCE6&View={E8428DE2-6485-48E7-9019-0C3292DA595D}*
System	Design	*[V3.S1.1] Have the Technical Architecture and Technical Specification been produced and approved (ready to be used for industrialization and for standardization, if so intended)?*	*Not applicable in a pure operational project. New systems aren't need nor a prototype development*
	Implementation and Verification	*[V3.S2.1] Has the pre-industrial prototype of the solution been built, verified according to the plan and approved as compliant to its specification?*	*Not applicable in a pure operational project. New systems aren't need nor a prototype development*
	Security	*[V3.S3.1] Have the results of the phase undergone a Security assessment to ensure that the SESAR Security*	*Not applicable in a pure operational project. New systems aren't need nor a prototype development*

		policy has been correctly applied?	

Table 4: Assessment Feasibility for Optimized RNP

Question area	Point Merge	End of V3	Answer
Programme	Management and Development Plan	*[V3.P1.1] Has the ATM Service Management and Development Plan been updated and approved?*	N/A
Business	Business Case	*[V3.B3.1] Is the Business case up to date according to phase results, documented and approved?*	This document provides the Business Case.
	CBA	*[V3.B4.1] Is the CBA up to date according to phase results, documented and approved?*	Assessment of Costs & Benefits is provided in this document by P5.7.4. The CBA for the OFA will be provided by transversal project P16.6.6
	Environment Case	*[V3.B5.1] Is the Environment case up to date according to phase results, documented and approved?*	Emissions and Noise results are quantified and reported in the VALR **Error! Reference source not found.**,
Operational	Operational Concept	*[V3.O1.1] Is the Operational concept document up to date according to phase results and approved?*	The OSED **Error! Reference source not found.** has been updated with the results of the VALR **Error! Reference source not found.**.
	Human Factors Case	*[V3.O2.1] Is the Human Factor case up to date according to phase results, documented and approved by HP experts?*	Human Factor results are quantified and reported in the VALR **Error! Reference source not found.**.
	Validation	*[V3.O3.1] Have the Validation plan, exercise plans and reports been produced and approved?*	The VALP **Error! Reference source not found.** and VALR **Error! Reference source not found.** have been formally delivered to the SJU.
	Safety Case	*[V3.O4.1] Is the Safety case up to date according to phase results, documented and*	The Safety Assessment Report (SAR) **Error! Reference source not found.** has been formally delivered to the SJU. The OSED **Error! Reference source not found.** and SPR **Error! Reference source**

		approved by Safety experts.	**not found.** have been updated accordingly.
	Transition	*[V3.O5.1] Is the Transition plan up to date according to phase results, documented and approved?*	There is no Transition Plan created prior to the Implementation Phase.
	Standards and Regulations (S&R)	*[V3.O6.1] Are final OCD, SPR and INTEROP defined, approved and aligned with the expectations of the Standardisation Roadmap and provide sufficient evidence for adoption by Standardization bodies?*	The OSED **Error! Reference source not found.** and SPR **Error! Reference source not found.** have been formally delivered to the SJU. The INTEROP does not apply to this project and concept.
System	Design	*[V3.S1.1] Have the Technical Architecture and Technical Specification been produced and approved (ready to be used for industrialization and for standardization, if so intended)?*	This concept addresses airspace & procedural change only; there is no counterpart system thread for this concept.
	Implementation and Verification	*[V3.S2.1] Has the pre-industrial prototype of the solution been built, verified according to the plan and approved as compliant to its specification?*	This concept addresses airspace & procedural change only; there is no counterpart system thread for this concept.
	Security	*[V3.S3.1] Have the results of the phase undergone a Security assessment to ensure that the SESAR Security policy has been correctly applied?*	This concept addresses airspace & procedural change only; there is no counterpart system thread for this concept.

Table 5: Assessment Feasibility for Point Merge

For all the reasons exposed above, the Project 5.7.4 WS1 and WS2 are considered ready to be implemented and head to V4.

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