Episode 3

Single European Sky Implementation support through Validation

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DOCUMENT CONTROL

Approval

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1.00	13/04/2010	Approved	Catherine Palazo	Approved by the Episode 3 consortium
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0 INTRODUCTION

0.1 PURPOSE OF THE DOCUMENT

This document cumulates and summarises the project Episode 3 activities and results over the full duration.

The project started on 18th April 2007. It had a suspension from 22nd April 2008 to 31st July 2008. The project ended on 17th December 2009. The whole duration was 32 months.

This document is ready for direct publication by the European Commission from section 1.

0.2 INTENDED AUDIENCE

The audience for this document is the European Commission who sponsored the Episode 3 (EP3) project, the SESAR community at large, and more particularly the SESAR JU who will find activities driven by each EP3 work package and associated results.

0.3 DOCUMENT STRUCTURE

This document is structured according to project reporting in FP6 guidance and instructions, with two parts:

- **Project execution** including a summary description of EP3 objectives, contractors involved, work performed and end results. It briefly describes the methodologies and approaches employed. It explains the impact on SESAR and its sub-projects.
- **Dissemination and use** including a list of SESAR projects that should use EP3 material as input to their work, the description of EP3 activities for disseminating EP3 knowledge and where publishable results are available.

References and a Glossary of terms can be found at the end of this document.

1 PROJECT EXECUTION

1.1 OBJECTIVES

The Episode 3 Project was submitted in response to the fourth Call of Proposals on Aeronautics and Space thematic priority, research area 4 “Increasing the operational capacity and safety of the air transport system”, IP13 Improvement of ATM system processes through validation.

In the first instance, the proposal responded to the European Commission request to validate the C-ATM concept of operation defined in the European Commission’s C-ATM project (Project reference 502911) [16]. The European Commission’s independent assessors under this basis accepted Episode 3.

Before the end of the C-ATM project [16], the European Commission and EUROCONTROL launched a TEN-T call for an industry-led project to define and plan the research and implementation requirements necessary to implement the next generation European ATM system. The successful project, SESAR, was launched in April of 2006. One of the core deliverables in SESAR is the future European ATM concept.

During the pre-contract negotiation, the European Commission requested that Episode 3 reorient its validation approach to provide a first assessment of the SESAR concept and to support SESAR wherever possible through its activities. The Episode 3 consortium accepted this challenge and this document describes the processes that were put in place to achieve this goal.

The European Commission also agreed that Episode 3 would integrate the SESAR concept detail during the first six months of the project to ensure Episode 3 uses the latest information concerning the concept. As a risk-reduction exercise, EUROCONTROL - at the request of the Episode 3 partners - prepared detailed operational documents based on the SESAR prioritised concept elements scheduled for delivery in October 2006.

However, the SESAR operational concept was not finalised until July 2007. The protracted discussions that lead to the final compromise were such that it was not possible to make a timely start working on an agreed core of concept elements.

The Episode 3 project therefore started before any stabilised concept had emerged, and one of the high-priority activities of the first months of the project was the drafting of initial Detailed Operational Descriptions (DODs) documents by EUROCONTROL.

During the last quarter of 2007, Episode 3 reviewed the initial description of work in order to align the exercises with the SESAR priorities as defined in the SESAR D3 deliverables.

The current description of work resulted from three contract amendments:

- Contract amendment N°1 was accepted in July 2007 and updated the DOW to remove the two following partners: NEOMETSYS, the effort of which was temporarily transferred to EUROCONTROL; and SMITHS, the effort and tasks of which have been transferred to Thales Avionics.
- Contract amendment N°2 (in its accepted form) is built on version 3.0 [1] of the technical annex made official the departure of three partners - SELEX-SI, HUNGAROCONTROL and LPS - and accepted recommendations from the technical assessment undertaken by SESAR JU.
    - Removal of cycle 2
    - Replacement of Real Time Simulations by lighter prototyping sessions
    - Proposal for new exercises based on current SESAR JU priorities

- Re-structuring of the Work Breakdown Structure to better address the revised content.

In addition, this amendment also includes the re-allocation of tasks from NEOMETSYS to EUROCONTROL, AENA and ISA Software.

- Contract amendment N°3 is built on version 3.1 [2] of the technical annex and was accepted in September 2009. It was done flowing the termination of QUEENS University of Belfast's involvement in the project end November 2008. Some of the budget left unused by QUEENS has been re-used in a new activity covering airport collaborative planning and involving EUROCONTROL, LVNL and Air France as part of WP3.

All partners engaged in Episode 3 are dedicated to the support of SESAR through Episode 3 and have committed to this fact through the legal agreements in the project's Consortium Agreement Document.

Episode 3 brings together key multi-disciplinary stakeholders in the European ATM system, including many organisations participating in SESAR, and covering all aspects of the system from strategic and tactical planning through to Air Traffic Control and Airport operations.

The objective of SESAR is to develop a performance oriented ATM system that exploits the advanced capabilities of 21st century technology to provide a cost-efficient service to the airspace user. Episode 3 was initiated by the European Commission DG TREN to undertake early validation activities to explore the concepts and systems proposed for SESAR. The project has allowed technical experts to begin the process of validation of the SESAR concept and gain relevant experience, prior to the start of the SESAR JU programme.

Given the wide scope of the SESAR concept and diverse range of performance improvements envisaged, Episode 3 has only been able to address a limited number of research topics. In summary the project focused on:

- Creating structured, consolidated concept documentation for the 2020 ConOps and adding concept detail in key operational areas;
- Initial operability and process feasibility assessments;
- Early performance assessment studies;
- Initial supporting technical needs impact assessment;
- Building experience in the application of validation methodologies, techniques and tools in the concept of a large-scale concept, including aspects of low maturity.

1.2 PROJECT PARTNERS AND STRUCTURE

CO = Coordinator; CR = Contractor

Role	No.	Participant name	Short name	Country	Enter project	Exit project
CO	1	The European Organisation for the Safety of Air Navigation - EUROCONTROL	ERC	Belgium	Month 1	Month32
CR	2	Entidad Pública Empresarial Aeropuertos Españoles y Navegación Aérea	AENA	Spain	Month 1	Month32
CR	3	AIRBUS France	AI-F	France	Month 1	Month32
CR	4	Deutsche Flugsicherung GmbH	DFS	Germany	Month 1	Month32

Role	No.	Participant name	Short name	Country	Enter project	Exit project
CR	5	Nats En Route Ltd	NATS	United Kingdom	Month 1	Month32
CR	6	Deutsches Zentrum für Luft- und Raumfahrt	DLR	Denmark	Month 1	Month32
CR	7	Nationaal Lucht- en Ruimtevaartlaboratorium	NLR	Netherlands	Month 1	Month32
	8	Place holder (formerly BAES)				
CR	9	Direction des Services de la Navigation Aérienne	DSNA	France	Month 1	Month32
CR	10	ENAV s.p.a.	ENAV	Italy	Month 1	Month32
CR	11	Ingeniería y Economía del Transporte, S.A	INECO	Spain	Month 1	Month32
CR	12	ISA Software	ISA	France	Month 1	Month32
CR	13	ISDEFE	ISDEFE	Spain	Month 1	Month32
CR	14	LUFTFARTSVERKET	LFV	Sweden	Month 1	Month32
CR	15	Place holder (formerly Neometsys)				
CR	16	SELEX Sistemi Integrati	SELEX	Italy	Month 1	Month13
CR	17	SICTA	SICTA	Italy	Month 1	Month32
	18	Place holder (formerly SMITHS Aerospace)				
CR	19	THALES Avionics	THAV	France	Month 1	Month32
CR	20	THALES AIR SYSTEMS S.A.	TR6	France	Month 1	Month32
CR	21	Queens University of Belfast	QUB	United Kingdom	Month 1	Month17
CR	22	Civil Aviation Authority of China Air Traffic Management Bureau	ATMB	China	Month 1	Month32
CR	23	Civil Aviation Authority of China Centre of Aviation Safety Technology	CAST	China	Month 1	Month32
CR	24	AustroControl	ACG	Austria	Month 1	Month32
CR	25	HungaroControl	HGC	Hungaria	Month 1	Month13
CR	26	Letove prevadzkove sluzby Slovenskej republiky (Slovakia)	LPS	Slovakia	Month 1	Month13
CR	27	Luchtverkeersleiding Nederland	LVNL	Netherlands	Month 1	Month32

Table 1 List of partners in the Episode 3 consortium

Episode 3 is broken into seven work packages: WP0, 1, 2, 3, 4, 5, 6.

The general principle is that each of the validation work packages (*i.e.,* WP3, WP4, and WP5) has four sub-work packages:

- Management;
- Requirements;
- Validation; and
- Results consolidation.

WP6 has a slightly different structure with a dedicated sub-work package for all infrastructure developments.

WP1 was active until the project suspension (20th April 2008), and has been suppressed as the absence of cycle 2 did not justify maintaining a work package for relatively minor platform developments.

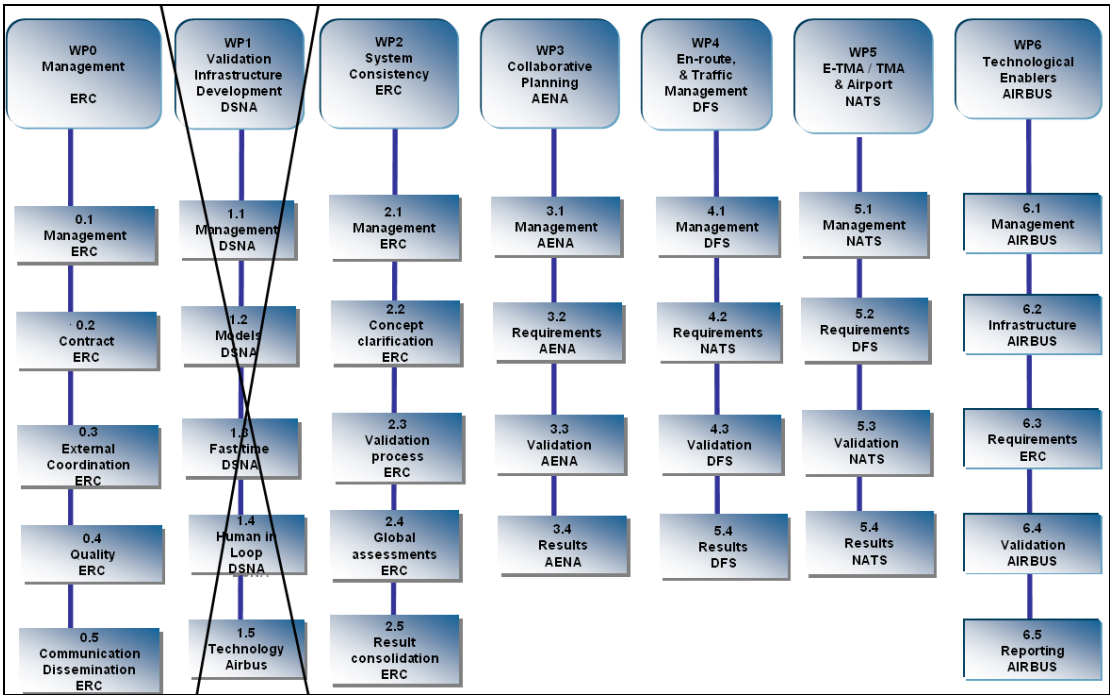


Figure 1 Episode 3 Work Breakdown Structure

1.3 WORK PERFORMED AND END RESULTS

Foundations of the Episode 3 Work Programme

Episode 3 based its work on the six main SESAR definition phase deliverables, SESAR D1 – D6 (ref: [6] [7], [8], [9], [10], [11]) and endorsed supporting documents such as the SESAR Concept of Operations (ConOps) [12] and the SESAR Performance Objectives and Targets Report [13]. Episode 3 also used relevant results from previous European Commission-funded projects such as EMMA [17]. The validation methodology applied was the European Operational Concept Validation Methodology (E-OCVM) v2 [14] for the operational validation and the NASA Technology Readiness Level (TRL) was used to assess concept elements maturity for the technical validation.

Experimental Methodology

Episode 3 applied the E-OCVM process to produce an integrated validation strategy both at the project level and at the exercise level. A high-level set of validation aims was defined that then co-ordinated a set of validation strategies at the work package level. The definition of the exercises had been bottom-up, being specified in the project Description of Work, however, the preparation of the strategies allowed the links and common themes between

and across the various exercises to be understood thus easing the process of integrating results and supporting decisions on priorities.

The Episode 3 supplemented the E-OCVM material with the provision of templates for key milestone documents and guidance notes for innovative validation techniques for ATM. This approach has maximised the sharing of good practice in validation methodology, planning, the conduct of exercises and the reporting.

The range of validation techniques, both conventional and innovative for ATM, employed by Episode 3 included the use of Fast-time simulation, modelling, and small-scale prototyping, Expert Groups and gaming.

- The expert group technique is based on gathering skilled professionals whose experience is relevant to the studied topic, using structured discussion and facilitation to drive the discussions. Expert groups are used at all stage of validation, to define objectives, detail the concept and analyse validation results.
- Gaming techniques gather experts playing real life situations, allowing the exploration of roles and responsibilities in a structured way. Gaming sessions can be paper based, web based, or use a full simulation platform.
- Prototyping sessions are designed as a series of small-scale real time simulations particularly useful to have a first assessment of the feasibility of a concept element.
- Modelling and fast time simulations use a range of tools to study airspace or airport operations. They need a model of reality that can be input into the tool to extract (often) quantitative results. Results have to be interpreted carefully as the constraints of the tool may restrict greatly the representativeness of the input data.

The experience of using these techniques has resulted in recommendations on the suitability of the techniques according to the maturity, scope and type of concept. Episode 3 also developed and applied approaches for integrating the results from these diverse validation exercises to provide the higher level conclusions required by decision makers. Feedback on the application of E-OCVM v2 [14] and the use of new techniques has been captured in E-OCVM v3 issued in early 2010 [15].

The technical needs impact study structured its exercises around the Technology Readiness Level (TRL) approach, the standard methodology of the aerospace industry. This approach provides a set of coherent objectives to be addressed that will progressively mature an initial concept into a fully developed system ready for deployment. The Episode 3 priority was to mature the technology that could be deployed in the mid-term (2013), the maturity level targeted was TRL 4, which aims to finalise the algorithms on the experimental platform prior to their development on the target hardware.

Development of the 2020 Concept Documentation (WP2)

The SESAR Concept Of Operations represents a paradigm shift from an airspace based environment to a trajectory based environment:

- Trajectory Based Operations imply a new approach favouring airspace user preferred routing, using pre-defined routing only when necessary, eg for capacity of safety reasons. Trajectories are first private to the each user (BDT or Business Development Trajectory), then shared among stakeholders to facilitate planning (SBT for Shared Business Trajectory), and then become a contract between the used and ATC (RBT or Reference Business Trajectory), which is the “trajectory that the user agrees to fly and ATC agrees to facilitate”.
- Collaborative Planning reflected in a Network Operations Plan developed at local, sub-regional and regional levels will allow balancing demand and capacity thanks to wide information sharing.

- Airports will become an integral part of the ATM system and the ground activities will become part of the trajectory, thanks to Enroute-to-enroute operations. Collaborative airport planning will also allow better usage of scarce resources.
- New separation modes with new division of tasks between air, ground and automated tools, will allow increase of capacity without jeopardising safety.
- System Wide Information Management (SWIM) shall underpin the entire ATM system and support all aspects of collaborative planning, and collaborative resolution of problems.

The concept development task had two main aspects. The first was the structured analysis of the ConOps and associated SESAR Definition Phase documentation to provide a coherent approach to describe the concept. The second element was the iterative development of detailed descriptions of the key elements of the concept.

The WP2 based the structured analysis of the concept on the breakdown of Air Traffic Management (ATM) service provision into a set of processes. This iterative breakdown into sub-processes concluded when it was judged that the process, actors and data were sufficiently coherent for well-scoped process description, this required between 3 and 5 levels of breakdown. The resulting model, SESAR ATM Process Model [4] was implemented using SADT and captured into the Navigator tool developed by the Episode 3.

The baseline concept documentation produced in Episode 3 was the set of Detailed Operational Descriptions (DOD). The aim of the DODs was to develop a set of documents that represented a consensus understanding of the concept and its detailing in EP3. The set of DODs comprises 10 volumes including an overarching document, providing the contextual information, a Lexicon and individual documents concerning various phases of flight and various ATM domains.

The DODs that focused on ATM domains used a common template and described the concept in terms of elemental ATM processes. The development of the documents was iterative, with an initial version, provided as input to the validation exercises and based on existing material including the SESAR Definition Phase documents. The following interim DODs provided the additional details requested by the Episode 3 exercises. And the final DODs incorporated the exercise results. During the DOD development, there were continuous discussions and current operational experts reviewed the documents against SESAR concept to further refine and detail the concept.

The decomposition of the ATM system into elemental processes was effective for ensuring comprehensive coverage, but the description was fragmented and not user-friendly for the operational reader or ideally aligned to the scope of validation activities such as Expert Groups or prototyping sessions. That is why we developed an alternative approach based on Operational Scenarios that provided a transverse view of the operations through a multi-DOD coverage and 28 Operational Scenarios were published. Again, the development was iterative starting with initial versions, which the concept development team reviewed before refining, developing and sometimes reworking as the validation exercise team did with storyboards. In order to provide further details on how the concept worked, Use Cases were developed, which resulted in 14 Use Cases being developed out of the 194 identified Use Cases.

The results from the concept work stream were a set of DODs, Operational Scenarios, Storyboards and Use Cases for 2020. This has been complemented by lessons learnt on how to develop a coherent, integrated concept description and recommendations for updates to the ConOps [12].

Collaborative Network Planning (WP3)

Because much of Long-term Planning phase (more than 6 months before the day of operations) relates to internal commercial business processes, Episode 3 consortium was not

able to provide this type of expertise. Therefore, Episode 3 focused on clarifying SESAR Collaborative Planning processes for Short and Medium-term Planning phases rather than for Long-term Planning phase.

The Expert Groups started preliminary work on concept clarification. They supported the refinement of the operational processes at airspace and network levels during the Medium/Short-term Planning phases. This resulted into elaborating the Operational Scenarios concerning the military collaboration in the Medium/Short-term Planning and the resolution of capacity shortfalls during the Short-term Planning phase.

The following step for concept clarification was the assessment of the feasibility of the processes. In this context, Episode 3 expanded the repertoire of cost-effective validation techniques suited to early stages of concept validation. Episode 3 explored Gaming techniques as key methods for Collaborative Planning validation/clarification. These techniques are essentially human-in-the-loop activities, but they are suitable for concepts where the aim is to improve the strategic decision-making processes and as such, the impact is only felt hours or days after making decisions. Process modelling complemented these techniques, allowing a more analytical approach to assess new procedures.

Three Gaming exercises addressed the SESAR Collaborative Network Planning processes associated to the management of arrival traffic congestion situations during Short-term Planning phase and Execution phase and associated to Advance Flexible Use of Airspace situations, i.e. military users propose a new airspace reservation. In this context, as well as targeting the process feasibility, these exercises helped identifying potential functionalities of the tools to support decision-making processes. Furthermore, it allowed the exploration of alternative validation techniques, and provided preliminary performance assessments for SESAR.

Overall, the developed processes implemented aspects of the Collaborative Network Planning concepts described in SESAR and resulted in positive indications on performance.

Management of the trajectory En-route (WP4)

Episode 3 provided Expert Groups, Gaming exercises, Fast-Time Simulation and Prototyping sessions to clarify the SESAR ConOps in the En-route phase of operations and to assess its operability. Either the Expert Groups refined the concept, in terms of complexity management, or either supported the other En-route validation exercises or provided an integrated global view of exercise results. The Gaming exercises used a variety of approaches, this provided both operational results and lessons learnt on this innovate validation technique. The operational results included the acceptability of the roles and procedures required for the new separation modes, the complexity management concept and the role of collaborative decision making during RBT execution. The Fast-time simulation addressed the potential for departure time management allowing management of workload in the sector.

The prototyping exercises involved three sessions, for duration of one week each, and were performed in a SESAR intermediate timeframe (2013) for the En-route Environment in the Maastricht airspace. The Separation Management Expert Group iteratively defined the content and focus of the sessions. The sessions started by refining possible options (e.g. airspace, routes, and scenario), then they assessed the operability and acceptability to the controller of managing the most challenging En-route traffic scenario where all flights had either Target Times of Arrival (TTA)[1] or Controlled Times of Arrival (CTA)[2] associated with their RBT. In parallel, the sessions implemented the detailed process of negotiating a CTA

[1] The TTA reflects the intent of aircraft and ATC on a particular point

[2] The CTA reflects a stricter constraint on the point once the aircraft is inside a landing sequence

including the necessary displays in the cockpit and controller working positions, and the processes and new phraseology.

The results of the studies concluded that the controllers were positive about the new working procedures, though the adherence to time constraints reduced when traffic loads were heavy. Overall, the studies indicated that the concept could provide positive contributions to capacity and predictability metrics, but given the maturity and scope of the exercises, it was not possible to provide quantitative data.

Management of the RBT in the TMA (WP5)

Within the context of Episode 3, the TMA was determined to be the airspace in close proximity of one or more airports where all the aircraft trajectories would be determined to some extent by the departure or arrival airport constraints. The teams performed two sets of Fast-time simulations and a Prototyping exercise. The Technological enablers work package (EP3 WP6) also considered the operability of ASPA Sequencing & Merging at the cockpit and controller working positions.

The TMA Expert Group supported the TMA exercises by providing answers to questions and assumptions and helped to break down the ConOps into a feasible and realistic 'ATM system' components that could be addressed in a TMA exercise. The Expert Group also supported the exercises by ensuring common assumptions, feedback and sharing of results, which improved the process of results integration and concept refinement.

The Multi Airport TMA Fast-time simulation examined arrival and trajectory management with continuous descent approaches. The TMA trajectory Fast-time simulation followed a similar approach, but its focus lay on 2D and 3D PBN route structures for arrivals and departures, alternative complex 2D/3D routes and 2D/3D Precision Trajectory Clearances, as well as transition between low-density and high-density operations. Results were positive trends against the KPA for the modelled TMA.

The prototyping session studied the implications of arrival management using a PBN route structure in the Dublin and Roma TMAs. This study has produced useful conclusions about airspace design e.g. relative positioning of merge points and metering points, the operability of the proposed procedures as well as posing questions on the level of bunching in flows that the TMA controllers will need to manage. The Roma Prototyping sessions assessed the ASPA Sequencing & Merging, as well as the industrial platforms in EP3 WP6. Overall, the involved controllers were positive about the benefits of the proposed systems, but raised some issues, including situation awareness when the aircraft is following its RBT, particularly in relation to the speed profile of the aircraft.

Airport Operations (WP3 & WP5)

The integration of the airports into the ATM system is a fundamental principle of the SESAR ConOps, so this domain was included in the scope of the Episode 3. However, as there were a number of other EC airport projects underway during this period, this was not a major element of the project. Two Expert Groups, a Gaming exercise and a Fast-time simulation focused on collaborative airport planning, runway capacity and surface operations.

The Airport Expert Group focusing on collaborative planning established the main characteristics of the Airport Operations Plan that would support a total airport management concept. It also elaborated the issues associated with performance monitoring against collaboratively agreed targets, as well as the required processes that will permit a re-planning in the case of deviation from the targets. The team chose the airport Palma de Mallorca. Operational experts worked on a modelling platform with a prototype Airport Operational Plan using realistic interfaces.

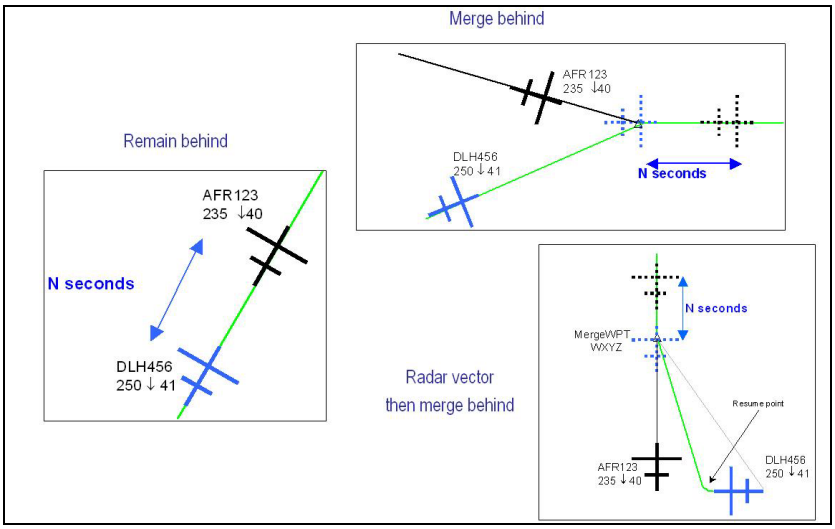
The second Expert Group focused on the execution of the RBT at the airport, including the transition from SBT to RBT. The experts went through a step by step approach, going from

today's problems to the solutions proposed by SESAR for the taxi-in and taxi-out process. This team created 'storyboards' based on Operational scenarios. The runway capacity assessment was performed using Fast-time simulation to understand the impact of concepts including Time-Based Spacing, Brake-to-vacate, reduced wake turbulence separations. The results demonstrated positive trends in runway capacity and, in the case of Brake-to-Vacate, runway occupancy time.

Technological Enablers (WP6)

The technology assessment focused on air and ground ATM capabilities to be deployed in 2013-2015 timeframe, rather than 2020, the focus for most of the Episode 3 activities. The aim was to mature those capabilities that will be the building blocks for the ultimate SESAR objectives for 2020 and beyond. The focus areas were specifically maturing the aircraft 4D capabilities, required for trajectory-based operations, ASAS (or Airborne Separation Assistance System) procedures, reflecting the drive to delegate tasks to the cockpit, and the use of airborne data in the ground systems, with its potential to improve the effectiveness of automation.

The following 3 ASAS manoeuvres have been studied:



As the major task in this piece of work, the team developed an integrated air/ground industrial validation platform. The platform linked together the Airbus cockpit simulator (EPOPEE) and Thales Avionics FMS simulator on the airside, with the Thales Controller Working Position and traffic simulators. The integrated platform allowed to assess new air-ground system capabilities and to emulate a range of datalink messaging types.

The technology aspects related to 4D focused on the Initial 4D concept, which is a full 4D trajectory with a single time constraint, the control time (RTA/CTA). This work included the assessment and refinement of the FMS algorithm to achieve the single control time, the controller/pilot datalink messaging requirements for agreeing the time, the display requirements of the CTA/RTA data for both controller and pilot and options for meteo update processes, i.e. Time window and ground processing required to update FDPS with the downlinked trajectory. The studies, which included operability trials, increased the maturity of these aspects from the initial 4D functionality.

The ASAS functionality was implemented for the ASAS spacing (ASPA) Sequencing and Merging application for both the airborne and ground systems. The scope of work included the control required to maintain acceptable dynamic behaviour of the aircraft during the manoeuvre, the displays required for the pilot and controller to initiate and monitor the manoeuvre and checks for robustness of systems and operation. The exercise explored the transition from 4D to ASAS processes and concluded on defining the datalink required messages, the alignment of the 4D and ASAS displays and procedural aspects.

Investigating the benefit of the downlinked parameters on the ground trajectory prediction demonstrated that, in the absence of aircraft mass data, a downlinked 4D trajectory providing a set of 4D change points where the time dimension was provided as either an estimate with a single CTA/RTA, substantially improved the ground prediction. Operational experience of downlink of individual downlinked parameters, such as selected flight level can significantly improve safety by reducing the probability of level busts.

Performance Assessment (WP2)

An element of the Episode 3 scope was to address aspects of performance of the proposed SESAR ConOps. This work fell into two main areas, the development of a Performance Framework and an initial performance assessment task. The performance assessment itself fell into two areas, local assessments of elements of the concept and first steps to producing an ECAC-wide assessment of the complete SESAR ConOps. The local assessments have been described in earlier sections, so this section only presents the ECAC-wide assessments

Performance Framework

The objective of Episode 3 Performance Framework is to provide a methodology for future assessment of the SESAR concept on a 2020 ECAC-wide basis as no such approach or model currently exists. The aim of the methodology is to allow the aggregation of validation measurements of many different types: at different levels of granularity, e.g. local versus regional, and uncertainty, e.g. expert judgement versus simulation.

The methodology, founded on the performance output from SESAR definition phase, is based on:

- An understanding of the elements that contribute and influence the performance (Influence diagrams);
- An ECAC Model that represents the elements that are linked and the mechanism to combine their influences (Influence models);
- The definition of a catalogue of common Performance Indicators (PIs) as references to ensure consistency and capture data about the influencing factors from exercises, Expert Group, current and past studies. This was supported by maintaining, where appropriate and feasible a consistent of assumptions.

In a number of cases, safety and Environment being particular examples, much work has already been undertaken to develop bespoke models for the complex relationships that need to be taken into account when forecasting performance against these KPA. The Performance Framework therefore allows for this data to be input directly at the appropriate level to provide the integrated performance picture.

The following performance areas were particularly studied in Episode 3:

- Airport capacity, with a focus on improved runway operations
- Airspace capacity, studying how new separation modes in TMA has a potential to increase capacity

- Temporal efficiency, with a focus on minimising delays
- Fuel efficiency by studying variations to the optimal profile in terms of fuel.
- Flight efficiency improvements through better planning processes
- Predictability studied from the perspective of On time operations, in Enroute 4D trajectory management.
- Safety was addressed through the development of an integrated risk picture and a first assessment of the overall SESAR impact on safety.
- Environment focusing on a selection of SESAR OI's impacting the environment, a refinement of the performance framework for the environment KPA, and a specific study on local air quality.

ECAC-wide Performance Assessments

The ECAC-wide performance assessments that took place in Episode 3 were related to the safety, Environment and efficiency KPA. The safety and efficiency assessments used the methodologies that have been developed for these specific areas, whereas the efficiency assessment was an initial evaluation using the performance framework, which aimed as much to prove the performance framework as to provide some early ideas about the ability of the SESAR ConOps to meet its efficiency target.

The Episode 3 Safety studies at the ECAC level have used the EUROCONTROL Integrated Risk Picture approach to establish the contribution of the SESAR ATM concept to aviation risk. This top-down Systemic Risk Assessment approach showed how the safety target set by SESAR can be achieved. The next step is to create a Safety Target Achievement Roadmap (STAR), demonstrating how ATM will minimise risks while evolving from the present to the future ConOps.

The safety analysis was not able to demonstrate that the SESAR ConOps met its safety target, but because the study was based on a high-level description of the concept, the numerical results are not considered mature, so will be subject to substantial revision as more information becomes available. Nevertheless, the work is considered sufficiently stable to identify ways to reduce ATM contribution to accident risks, and hence to improve the safety of the SESAR ConOps.

Episode 3 developed a framework for the assessment of the Environment KPA as there was not any recognised guidance material. This framework provides a pragmatic and consistent set of methods, tools, and metrics that is aligned with the Episode 3 Performance Framework.

The Environment assessment has developed influence models for four Environmental focus areas to identify the relation to other KPA and to identify potential dependencies and trade-off effects. Furthermore, a systematic screening and scoping of the proposed concept identified the Operational Improvements steps linked to Environment and Meteorology. EP3 completed a study on operational measures to improve the air quality at airports. A second study investigated potential shortfalls of the available noise models to assess the proposed concept and identified improvements. The scope of the Environment assessment task, while of ECAC-wide relevance, was not sufficient to provide quantitative data on the Environment performance at the ECAC level.

The Efficiency KPA used data from various sources, expert opinion, the Fast-time simulations undertaken in Episode 3 and data from the Performance Review Unit (from EUROCONTROL). The effort allocated to the assessment was limited but while EP3 observed a strong positive trend, it was not possible to demonstrate that the SESAR target was met.

Lessons Learnt from Episode 3 and output to SESAR

Episode 3 is unique in taking an integrated view of the SESAR ConOps and was the first EC funded project whose primary baseline was the SESAR definition phase documentation and results. As such, the project has placed a high priority on capturing lessons learnt from its activities in order to make this experience available to the SESAR JU.

The main lessons learns have been:

- Building an ATM process model was essential to produce the DOD's by giving a common structure that was easy to understand.
- DOD's were seen as a major outputs of EP3, and they allowed structuring the concept detailing activities. However they were not suitable as a document to support validation activities, for which Operational Scenarios and Storyboards were much more useful.
- In concept detailing activities, it is important to designate a concept authority, possibly supported by a group, who can arbitrate in case of differing opinions.
- More guidance must be provided in relation to the Concept Lifecyle Model, and especially on how to define concept maturity, how to select the appropriate validation tool, and the available validation techniques.
- Assumptions made during the course of validation must be recorded in order to fully appreciate validation results.
- There is a clear link between validation tools and concept maturity, expert groups and gaming exercises are useful in the low maturity stages, where as prototyping sessions and modelling can be used for more mature concept elements.
- The establishment of a performance framework must be better supported by validation: the representativeness of the validation data must be assessed to qualify the results, and all validation results must be reviewed by the team developing the performance framework.
- While producing the performance framework, the use of influence diagrams was assessed, showing the interest of this technique in helping understand how the concept would deliver improvements.

Lessons learnt activities have been undertaken at the project level and within individual validation activities and they form an essential element of the EP3 Final Report and Recommendations [3].

Key deliverables

The key deliverable of the project is the EP3 Final Report and Recommendations [3].

Each Validation Work Package has also produced a work package consolidated report, (D3.4-01, D4.4-01, D5.4-01 and D6.5-01).

In each validation work package, main deliverables are:

- Validation strategy/requirements (D3.2.1-01, D4.2.1-01, D5.2.1-01, D6.3-01);
- Exercises plans (Dx.3.y-01);
- Exercise reports (Dx.3.y-02, 03,…);
- WP2, the system work package has produced as main deliverables:
  - Detailed Operational Descriptions (D2.2-040,…D2.2-048);
  - Operational Scenarios (D2.2-050);

- Performance framework and Influence Diagrams (D2.4.1-04x);
- Top-Down SESAR systemic risk assessment (D2.4.3-02);
- Environment assessment validation framework (D2.4.4-01).

All these documents and other more detailed deliverables are available on www.episode3.aero .

Conclusions

Episode 3 has brought together a diverse range of stakeholders in the ATM Industry some first steps in validating the SESAR ConOps, thereby paving the way for the SESAR development phase activities. The project has developed approaches for the integrated development and detailing of the SESAR ConOps, the integrated validation of less mature aspects of a concept and has built up a knowledge base of lessons learnt on the processes involved.

The operational and process assessments of the ConOps for 2020 concluded that, overall, the operators, i.e. controllers, planners and pilots were positive about the new ways of working. Although EP3 highlighted areas where more work was needed, the exercises raised no significant issues on the operational and process feasibility of the ConOps. The performance assessment concluded that, while it could be seen that the ConOps would have a positive impact on the SESAR KPA, the maturity of the overall concept and detailed understanding of the benefit mechanisms meant that the ECAC-wide assessments, performed in Safety and Efficiency, were able to demonstrate that relevant targets were met.

The experience of the validation work demonstrated that the task of measuring overall performance of an integrated concept is challenging. The remit of Episode 3 did not include cost-effectiveness studies, and given the requirements for additional tools, systems and new actors, this should be a priority in further work.

2 DISSEMINATION AND USE

2.1 EXPLOITABLE KNOWLEDGE AND ITS USE

2.1.1 Episode 3 input to SESAR projects

The following table provides a list of SESAR projects that should use Episode 3 material as an input to their work.

In general, most SESAR work packages should consider the information provided in the DODs and other WP2 input. At the level of SESAR projects, individual exercise reports are useful to consider.

SESAR		Episode 3	
WP	**Name**	**WP**	**Useful outputs for SESAR**
WP B	Target Concept and Architecture Maintenance	WP2	ATM process model, DODs, performance framework
WP C	Master Plan Maintenance		
WP 03	Validation Infrastructure Adaptation and Management	WP2	Lessons learnt on validation techniques, validation strategy documents
WP 04	En Route Operations	WP4, WP2	E6 DOD, related operational scenarios and WP4 exercise results
WP 05	TMA Operations	WP5, WP2	E5 DOD, related operational scenarios and WP5 TMA exercise results
WP 06	Airport Operations	WP3, WP5, WP2	M1, E1, E2/3 DODs, related operational scenarios WP3 results on airport planning, APOC and WP5 results on runway and surface management
WP 07	Network Operations	WP3, WP2	M2/3 and E4 DODs and related scenarios, WP3 results related to network planning
WP 08	Information Management		
WP 09	Aircraft	WP6, WP2	E6 DOD and WP6 exercise results
WP 10	En-Route & Approach ATC Systems	WP4, WP5, WP2	E5 and E6 DODs, results from WP6 exercises, conclusions from WP4 and WP5 (TMA) Expert Groups
WP 12	Airport System	WP3, WP5	WP3 results on airport planning , APOC and WP5 results on runway and surface management
WP 13	Network Information Management System	WP3	WP3 results related to network planning
WP 14	SWIM Technical Architecture		
WP 15	Non Avionic CNS System		
WP 16	R&D Transversal Areas	WP2	Environment, and safety approach for SESAR validation, validation lessons learnt, influence diagrams for trade-off study

Table 2 Episode 3 input to SESAR projects

2.1.2 Validation environment and its use

2.1.2.1 CHILL platform

The ISA Software CHILL validation and modelling platform was used as the main gaming platform for WP3 capacity-demand balancing experiments held in Madrid. This platform is a network based interoperable simulation and validation platform that supports models or human in the loop working positions to carry out future ATC concept assessment experiments.

In the scope of Episode 3 Collaborative planning experiments, working positions and decision support tools were provided for network/military collaborative airspace management and user-preferred solution gaming exercises. In addition many enhancement were included to provide 'what-if' analysis facilities, capacity demand balancing tools, information sharing capabilities and many prototypes of SESAR conceptual elements.

More information can be obtained with ISA Software, Ian Crook, (ian@isa-software.com).

2.1.2.2 RAMS Plus

In support to the WP5 validation activities ISA Software has provided enhancements and scenario design/development support for validation studies using RAMS Plus Airport & ATC simulation and validation assessment tool. Episode 3 project partners in WP5 activities have used the tool, requested enhancement and performed validation study experiments relating to Airport, TMA and ATC concept elements from the SESAR definition phase.

RAMS Plus is one of the few commercially available validation and assessment simulators that is truly trajectory-based and enhancement have been included to support Episode 3 partners in the assessment and validation of SESAR concept elements in the TMA and Airport domain, including:

- Advanced arrival/departure modelling for complex TMA analysis;
- Precision Trajectory Clearance (PTC) departures including 3D and 4D departure clearance;
- Alternate SID modelling concept;
- Use of departure cones/tubes;
- Required Time of Arrival (RTA) modelling;
- Target Time of Arrival / Metering concepts;
- Implementation of Path-object modelling concepts and Point-Merge model enhancements;
- Enhancement of existing 4D trajectory based model components;
- Aircraft equipment based separation models;
- Modelling of equipment-based separation management;
- 2D, 3D and 4D clearances;
- P-RNAV operation in TMA including CDA modelling.

2.1.2.3 ACCES APOC platform

DLR's ACCES facility was used as an airport operations centre (APOC). ACCES provides a flexible infrastructure with up to ten operator working positions as well as a large powerwall to show a situation overview to all operators. All working positions are equipped to access

different PCs running CDM and stakeholder specific systems as well as Voice over IP communication.

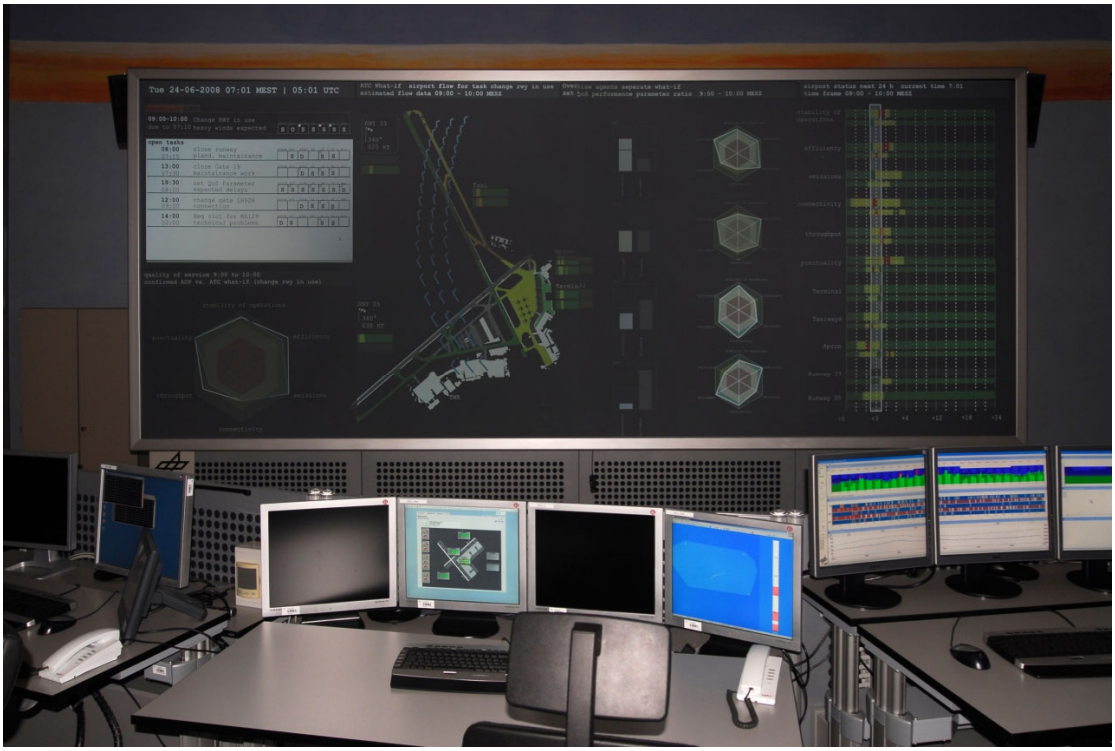


Figure 2 APOC simulator ACCES

In addition, a suite of real-time simulation tools is required to simulate the airside processes. The setup for this simulation suite is shown in Figure 2 APOC simulator ACCES. At the top of the figure is the APOC, hosting the SWIM airport database as well as the support tools for the APOC agents, the Total Operations Planner (TOP) with its stakeholder's clients. The TOP is a pre-tactical planning tool capable of planning all flights of the day taking into account the flight schedules, agreed performance parameters (e.g. capacity, throughput) for the airport as well as user preferences. The TOP plans the day of operation initially at the flow level only, but the final hours before execution time are also planned at the event level. The output of the TOP becomes part of the AOP, once the stakeholders have activated it.

This platform is owned by DLR, more information can be obtained with Reiner Suikat, (reiner.suikat@dlr.de). This platform will be used in SESAR and in German National projects.

2.1.2.4 Air/Ground integration platform

As part of WP6, Airbus, THALES Avionics and THALES Air Systems have developed an integration platform jointly.

The platform is composed of several elements already developed (EPOPEE, FMS, EUROCAT…) but that needed to be further modified/adapted for the purpose of the Episode 3 WP6 technical validation.

The Figure 3 hereafter presents an outline view of this platform.

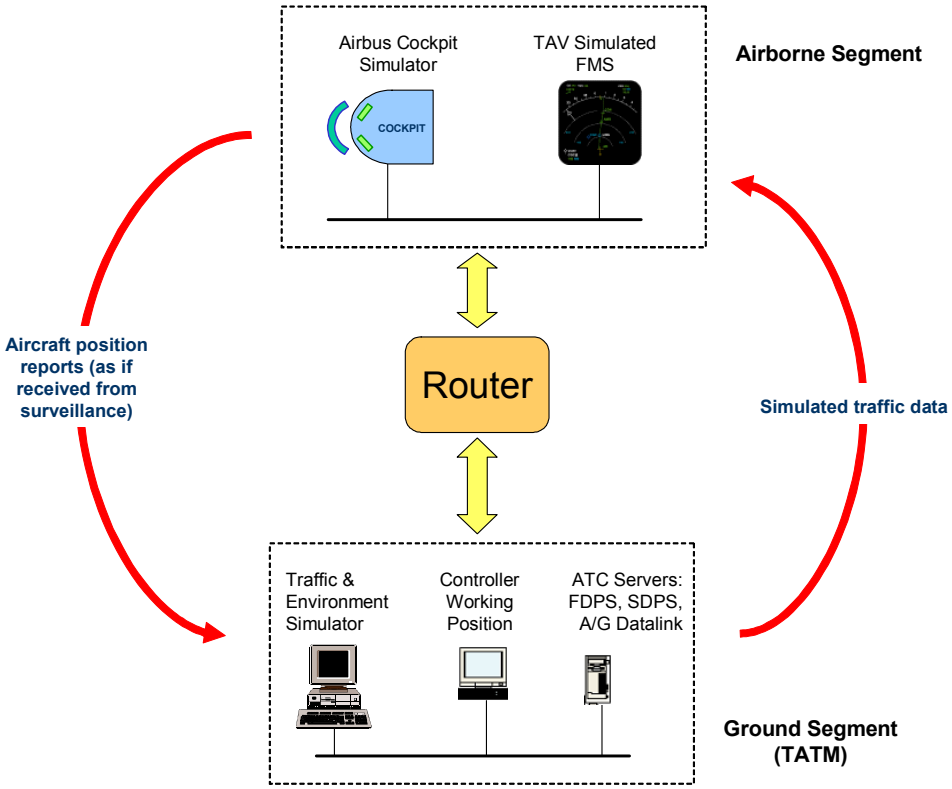


Figure 3 Outline view of the 4D trajectory exchange validation platform

This platform is composed of two segments:

- A ground segment, which hosts an industrial operational ATC system, on a compact hardware configuration. The baseline platform, provided by Thales Air Systems, includes the same ATC components as used in European operational ATC systems.
- An airborne segment composed of a cockpit simulator provided by Airbus where FMS and ATSU sub-segments provided by THAV are integrated.

For both, the airborne and ground segments, facilities are provided for off-line data preparation (for setting the operational parameters of the validation exercises), supervision and data recording/observation of the experiment.

The picture hereafter shows the cockpit part of the air segment platform:

Figure 4 EPOPEE platform cockpit

EPOPEE is a research simulator developed by AIRBUS for multi aircraft R&D activities (Single Aisle, Long Range, A380), which provides:

- A high fidelity aircraft simulation associated to high level of flexibility for evolutions;
- Fully simulated test means;
- Multi AIRBUS aircraft simulations;
- Flexible graphic workshop;
- Capability of integration (or coupling) of external models or simulations from partners or suppliers.

For the purpose of Episode 3, EPOPEE is configured such as to be representative of an Airbus A340-600 with all needed operative system.

SESAR will use this platform for technical evaluations. More information with Patrick Lelièvre at Airbus (Patrick.p.lelievre@airbus.com).

2.1.2.5 CAST modelling tool

The Comprehensive Airport Simulation Tool (CAST) developed by the Airport Research Centre GmbH in Aachen Germany, has started to receive considerable recognition amongst the airport community as a result of its capability to accurately model passenger flows through a terminal and to simulate the impact of infrastructural and procedural changes. CAST has been used in a number of studies for different airport operators but has also been used by EUROCONTROL in connection with initiatives such as ACARE. Through its medium term concept validation work, EUROCONTROL has also sponsored a number of enhancements to the CAST model specifically in relation to the (previously less mature) airside modelling.

Given the similarities of scope between the CAST model and the process analysis work of the Palma de Mallorca Expert Group, the simulator was identified as a suitable support tool for elaborating monitoring processes required to aid decision making. It was therefore considered

desirable to ensure that CAST could become a fully integrated part of the Palma de Mallorca Expert Group work to be able to provide a quantitative assessment of any potential performance benefits that may be possible through improved data sharing and improved process monitoring.

In order to achieve this capability it was necessary to integrate the Palma de Mallorca landside infrastructure (check-in counters, security screening, passport control, boarding gates etc) as well as a representative traffic sample and associated stand / gate allocation into the CAST model. The tasks of ground handling services (resources, procedures, transit paths etc) have been fully included in the model, as the apron and ramp configuration.

A static screenshot from the CAST model of the Palma de Mallorca terminal infrastructure and parking locations is shown in Figure 5 hereafter.

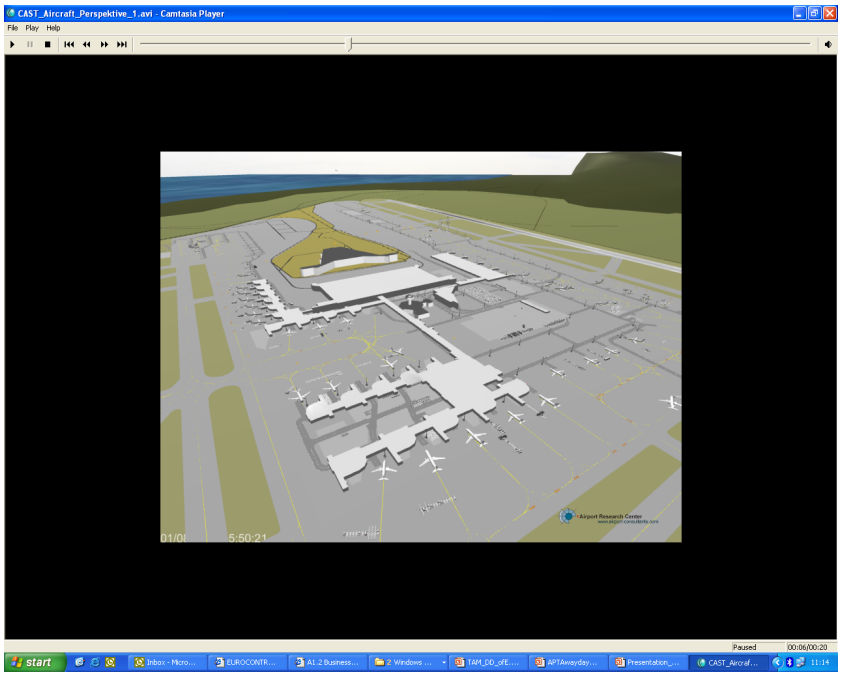


Figure 5 CAST model

More information on www.airport-consultants.com.

2.1.2.6 DARTIS platform

The DARTIS platform was initially developed by EUROCONTROL in support to the CAMES project (Cooperative ATM Measures for a European Single Sky) [18] to perform ATFCM real-time simulations or on site trials in a pre-operational context. The Episode 3 release is an intermediate step in the process of building a validation platform enabling to demonstrate and validate concepts defined by the SESAR program such as “Business/Mission Trajectory Management & Demand Capacity Balancing”.

The main functions of DARTIS are:

- Flow analysis and load prediction;
- Overload detection (both in terms of traffic and occupancy counts);
- Capacity management;
- DCB Sequencing (i.e. dynamic TTA allocation function);
- Rough AMAN simulations;

- Trajectory management (mainly SBT, RBT is roughly covered).

This platform will be used in the evaluations of SESAR WP7.

2.1.2.7 CATS/OPAS

DSNA developed this Fast-time simulator, and was used in EP3 WP4. In the context of Episode 3, DSNA added a new functionality to CATS/OPAS, enabling an optimisation algorithm to take as input the delays allocated to aircraft.

2.1.2.8 PROMAS

INECO developed this modelling tool, and enhanced for the purpose of Episode 3 evaluations in EP3 WP3 and WP4. This tool emulates the components of a complex system and reproduces the activities involved in it, focusing on the study of non-consistencies, processes bottlenecks, useful procedures, and data flows.

PROMAS is a tool representing the operation of any type of organisation or system by means of Fast-time simulations based on discrete events.

This software requires a set of components and procedures to build the scenario. To complete any scenario, it was required to create additional functions which were easily aggregated to the platform because of its high modularity and scalability.

The programme performs the role of the components in the scenario and reproduces the system operation activities by using the Logic and Execution Modules and the internal Trigger and Agenda functions.

After each run, this software provides a detailed event log referring to the system operations. After processing the simulation output data, the required information is extracted to evaluate relevant outputs.

PROMAS can be used in conjunction with RAMS Plus to provide performance data as well.

More information on PROMAS can be obtained with Laura Serrano, from INECO (laura.serrano@ineco.es).

2.1.2.9 ATM Nemmo

ATM-NEMMO, an innovative macroscopic approach to air transport modelling developed by ISDEFE for Episode3, is based on the application of different techniques from the Complex Systems field (such as graph theory, diffusion analysis, and cooperative analysis) to the modelling and simulation of the ATM network. The main characteristics of the platform are:

- Performance assessment of ATM system at network-wide level;
- Modelling of different phenomena as "stochastic effects", which represent the uncertainty associated to the behaviour of certain elements of the ATM system;
- High degree of flexibility, which allows the modelling of different rules or operational improvements in an easy, cost-effective manner;
- Tractability, both in terms of computational resources and of modelling time.

ATM-NEMMO allows obtaining indicative ECAC performances at network level, providing an optimum trade-off between accuracy and flexibility. The tool is modular and easy to customize so as to implement new features and to define particular details applying over a flow of aircraft or even over a single aircraft, if needed.

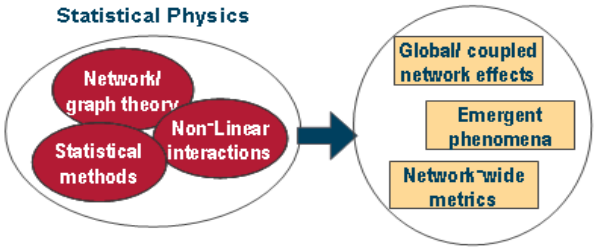


Figure 6 ATM-NEMMO Modelling Paradigm

The model layers are:

- Heterogeneous nodes with capacity restrictions: airports and high congestion areas;
- Network topology (connections between nodes) and distance layer (link's lengths);
- Simulations parameters: capacities, arrival/ departure ratios, aircraft performances, uncertainty of ATM system, etc;
- Local rules: how traffic flows diffuse across the network;
- Global and local variables: performance indicators (capacity, efficiency, predictability, etc.) Trends (probability distributions) of performances are obtained from repeated simulation runs, and maximum and minimum performance scenarios are characterised: "Anything that can happen will happen".

The diffusion of the traffic through the network is performed according to the ATM capacity constraints, so traffic is dynamically adapted to these constraints, according to the defined rules associated to the recreation of the ATM processes. Besides, the level of granularity of the rules can be customised from traffic flows to individual flights.

More information on ATM-NEMMO can be obtained with Marta Sanchez from ISDEFE (mscidoncha@isdefe.es).

2.2 DISSEMINATION OF KNOWLEDGE

The following dissemination activities have taken place during the year:

- A document has been prepared to identify all links between Episode 3 exercises and activities with SESAR projects. This document was sent to the SESAR JU for dissemination to SESAR work package or project leaders. The information in this document has been embedded in the SESAR/Episode 3 navigator, also on the website.
- A first meeting took place with the SESAR JU and the EC in Brussels on the 21st of January 2009. This resulted in a first presentation of the project to M. Standar, head of validation at the SESAR JU.
- A presentation was made to the Validation Forum (the body in charge of managing maintenance of E-OCVM, attended by the EC, the S-JU and representatives of ATM research) to present the conclusions of Episode 3 first lessons learnt workshop (workshop organised in March 2009).
- An article has been published by PSCA International, an independent public service review on Episode 3 project and CATS (Contracted Air Traffic Services) project in the context of SESAR. The review was published in June 2009.
- Videos and photographs were taken during various validation exercises and are available on our website as communication material.
- During the 8th ATM seminar, held in Napa, California (US) in June 2009, the following Episode 3 papers were presented:
    - A systems-engineering approach for assessing the safety of the SESAR Operational Concept, by Eric Perrin, from EUROCONTROL, based on work done in Episode 3 WP2.4.3.
    - 4D-Trajectory Deconfliction Through Departure Time Adjustment, by Cyril Allignol and Nicolas Barnier from DSNA, based on work done in Episode 3 WP4.3.2.
- Papers on the performance framework (Episode 3 WP2.4.1) and on Episode 3 WP3 activities were proposed for the 28th Digital Avionics Systems Conference in Orlando, Florida (US) on 25-29 October 2009.
- A joint Episode3/ CAATS II dissemination forum has been organised in Brussels on 13-14 October 2009. A press release has been published in the days following this event, around 100 people participated to the event.
- A seven minutes video presenting the project results has been produced and posted on our website.
- Specific dissemination sessions have been organised with Episode 3 partners, inside EUROCONTROL, NATS and DFS. Communication material in the form of presentation has been prepared for these sessions, and will be used in further dissemination actions.
- An Ebook has been produced from the material available in the DODs and posted on our website.

2.3 PUBLISHABLE RESULTS

The project Episode 3 results in improvements to existing platforms and in deliverables that should be considered as input to SESAR.

The only information relevant to this section is the list of public documents hereafter, which are available on www.episode3.aero .

Deliverable Id	Public Document
WP0 – Episode 3 Management	
D0.2-02a	First Period Activity Report – Publishable Executive Summary (April 08)
D0.2-02b	Second Year Activity Report – Publishable Executive Summary (Jul 09)
D0.2-02c	Second Period Activity Report – Publishable Executive Summary (17/12/09)
D0.2-02d	Publishable Final Activity Report
D0.4-02	Documentation & Configuration Management Plan
WP2 – System consistency	
D2.0-01	EP3 Consolidated Validation Strategy
D2.2-01b	ATM Process Model Diagrams
D2.2-01c	Final SADT Diagrams
D2.2-040	SESAR DOD (G - General)
D2.2-041	SESAR DOD (L - Long Term Planning)
D2.2-042	SESAR DOD (M1 - Collaborative Airport Planning)
D2.2-043	SESAR DOD (M2 - Medium-Short Term Network Planning)
D2.2-044	SESAR DOD (E1 - Runway Management)
D2.2-045	SESAR DOD (E2/3 - Apron & Taxiways Management)
D2.2-046	SESAR DOD (E4 - Network Management in the Execution Phase)
D2.2-047	SESAR DOD (E5 - Conflict Management in Arrival & Departure Operations)
D2.2-048	SESAR DOD (E6 - Conflict Management in En-Route Operations)
D2.2-049	SESAR DOD - Glossary of Terms and Definitions (Lexicon)
D2.2-050	Operational Scenarios - Annex to SESAR DOD G
D2.2-051	Use Cases - Annex to SESAR DOD G

Deliverable Id	Public Document
D2.3-02	Validation Requirements for Performance Framework
D2.3-06	Lessons learnt for the Application of E-OCVM to integrated Validation Processes
D2.3-07	Lessons learnt for the Application on Assumption Management
D2.4.1-01	Traffic Demand 2006-2020-X3
D2.4.1-04	Performance Framework
D2.4.1-04a	Influence Diagrams - Annex to EP3 Performance Framework
D2.4.1-04b	Catalogue of PIs and Traceability OI Step vs ECAC PIs - Annex to EP3 Performance Framework
D2.4.1-04c	User Manual for the Influence Model - Annex to EP3 Performance Framework
D2.4.1-04d	ECAC wide Performance model and Input data repository - Annex to EP3 Performance Framework
D2.4.3-01	White Paper on the SESAR Safety Target
D2.4.3-02	SESAR "Top-down" Systemic Risk Assessment
D2.4.3-03	Note on risk model validation
D2.4.3-04	Method for Systemic Risk Assessment for Units of Operation
D2.4.4-01	Environmental Assessment Validation Framework
D2.4.4-02	Environmental and Meteorological Screening & Scoping of the SESAR Operational Improvement Steps
D2.4.4-03	Requirement enhancements of existing Noise Assessment Models to validate SESAR Operational Improvements steps
D2.4.4-04	Measures to reduce local aircraft emissions
D2.4.4-05	Archive on Human Factors assessment : Today's operational task analysis
D2.5-01	Final Report and Recommendations
D2.5-02	Dissemination Package
WP3 - Collaborative planning processes	
D3.2.1-01	Collaborative Planning Process WP3 Validation Strategy
D3.3.1-01	Medium & Short Term Network Planning and Collaborative Airport Planning - Expert Group Experimental Plan
D3.3.1-02	Collaborative Network Planning Expert Group Report
D3.3.1-03	Analysis of the SESAR Collaborative Planning Information: Demand and Capacity
D3.3.1-04	Airline/Airport Data Exchange

Deliverable Id	Public Document
D3.3.1-05	Collaborative Airport Planning Expert Group Report
D3.3.2-01	Experimental Plan for Business Trajectory Management and Dynamic DCB
D3.3.2-02	Simulation Report on Business Trajectory Management and Dynamic DCB
D3.3.2-02a	Gaming experiment - Annex A to Simulation Report on Business Trajectory Management and Dynamic DCB
D3.3.2-02b	Process Simulation – Annex B to Simulation Report on Business Trajectory Management and Dynamic DCB
D3.3.3-01	Experimental Plan on Airspace Organization and Management
D3.3.3-02	Simulation Report on Airspace Organization and Management
D3.3.4-01	Experimental Plan on Collaborative Airport Planning
D3.3.4-02	Simulation Report on Collaborative Airport Planning
D3.3.5-01	Experimental Plan on Global Performances at Network-Wide level
D3.3.5-02	Report on Macro modelling on Global Performances at Network-Wide level
D3.4-01	Collaborative Planning Results and Consolidation
WP4 – En Route and traffic management	
D4.2.1-01	En-route and Traffic Management WP4 Validation Strategy
D4.3.1-01	En-route Expert Group Plan
D4.3.1-02	En-route Expert Group Report
D4.3.1-02a	Questionnaires - Annex to En-route Expert Group Report
D4.3.1.1.1-01	En-route Complexity Management Expert Group Plan
D4.3.1.1.1-02	En-route Complexity Management Expert Group Report
D4.3.2-01	Plan for FTS on 4D Trajectory management and complexity reduction
D4.3.2-02	Simulation Report on 4D Trajectory management and complexity reduction
D4.3.3-01	Gaming Plan on Queue, Trajectory and Separation Management
D4.3.3-02	Gaming Report on Queue, Trajectory and Separation Management
D4.3.4-01	Prototyping Experimental Plan on Queue, Trajectory and Separation Management
D4.3.4-02	Prototyping Report on Queue, Trajectory and Separation Management
D4.4.-01	En-Route Consolidated Assessment Report

Deliverable Id	Public Document
WP5 - Airport and TMA	
D5.2.1-01	Airport and TMA WP5 Validation Strategy Update
D5.3.1-01	TMA Expert Group Plan
D5.3.1-02	TMA Expert Group Report
D5.3.2-01	Airport Expert Group Plan
D5.3.2-02	Airport Expert Group Report
D5.3.3-01	Runway Operations Fast Time Simulation Plan
D5.3.3-02	Runway Operations Fast Time Simulation Report
D5.3.4-01	Fast Time Simulation Plan on Multi- Airport TMA Operations in the core area of Europe
D5.3.4-02	Fast Time Simulation Report on Multi- Airport TMA Operations in the core area of Europe
D5.3.5-01	Simulation Plan on Separation Management in the TMA
D5.3.5-02	Simulation Report on Separation Management in the TMA
D5.3.6-01	Exercise Plan - Prototyping of a dense TMA
D5.3.6-02	Report on the Prototyping of a dense TMA
D5.4-01	TMA and Airports Consolidated Assessment Report
WP6 - Technological enablers	
D6.2-01	Overall Description of the WP6 Platform and its capabilities
D6.3-01	Requirements for Technical Validation
D6.3-02	Report on the Benefits of Using Airborne Data in Controller Tools
D6.4-01	Technical Validation Scenarios
D6.5-01	Technological Enablers Validation Report
D6.5-01a	4D Airborne Navigation Capability for CTA/RNP-Annex A to Technological Enablers Validation Report
D6.5-01b	Air-Ground Initial 4D Mgt - Annex B to Technological Enablers Validation Report
D6.5-01c	ASAS Spacing - Annex C to Technological Enablers Validation Report
D6.5-01d	Transition 4D - ASAS - Annex D to Technological Enablers Validation Report
D6.5-01e	Platform - Annex E to Technological Enablers Validation Report

Table 3 List of Episode 3 Public Documents

3 REFERENCES

3.1 REFERENCES

[1] **Episode 3** **DOW 3.0** - Description of Work - Annex 1 to the Contract - Version 3.0 - 10 July 2008 - Applicable from 1st August 2008 to September 2009 (beginning of the reporting period)

[2] **Episode 3** **DOW 3.1** - Description of Work - Annex 1 to the Contract Version 3.1- Revised version 3.0 prepared on 10 July 2009 and submitted for acceptance to the European Commission during the reporting period and accepted in September 2009 - Applicable from September 2009 to end of project

[3] **Episode 3** **Final Report and Recommendations** - D2.5-0 - www.episode3.aero

[4] **Episode 3** **SESAR ATM Process Model** - D2.2-01a - www.episode3.aero

[5] **Episode 3** **Navigator tool** - www.episode3.aero

[6] **SESAR** **D1 - Air Transport Framework - The Current Situation**
SESAR Definition Phase - Milestone Deliverable 1 - DLM-0602-001 Version 3 - 20/07/2006
http://www.sesarju.eu/news-press/documents-reports

[7] **SESAR** **D2 - Air Transport Framework - The Performance Target**
SESAR Definition Phase - DLM-0607-001-02-00a - December 2006 - http://www.sesarju.eu/news-press/documents-reports

[8] **SESAR** **D3 - The ATM Target Concept**
SESAR Definition Phase - DLM-0612-001-02-00a - September 2007 - http://www.sesarju.eu/news-press/documents-reports

[9] **SESAR** **D4 - The ATM Deployment Sequence**
SESAR Definition Phase - DLM-0706-001-02-00 - January 2008 - http://www.sesarju.eu/news-press/documents-reports

[10] **SESAR** **D5 - SESAR Master Plan**
SESAR Definition Phase - DLM-0710-001-02-00 - April 2008 - http://www.sesarju.eu/news-press/documents-reports

[11] **SESAR** **D6 - Work Programme for 2008-2013**
SESAR Definition Phase - DLM-0710-002-02-00 - April 2008 - http://www.sesarju.eu/news-press/documents-reports

[12] **SESAR** **ConOps - Concept of Operations**
SESAR Definition Phase - DLT-0612-222-02-00 - https://www.atmmasterplan.eu/http://prisme-oas.atmmasterplan.eu/atmmasterplan/faces/public/infoLibrary/structInfoLibrary.jspx

[13] **SESAR** **Performance objectives and Targets Report**
SESAR Definition Phase - RPT-0708-001-01-02 - https://www.atmmasterplan.eu/http://prisme-oas.atmmasterplan.eu/atmmasterplan/faces/public/infoLibrary/structInfoLibrary.jspx

[14] **E-OCVM V2** **European Operational Concept Validation Methodology**
Ref: 07/02/28-08 - 17/03/2007 - www.eurocontrol.int/valug

[15] **E-OCVM V3** **European Operational Concept Validation Methodology** Ref:07/02/28-08 - 17/03/2007 - www.eurocontrol.int/valug

[16] **C-ATM** **Co-operative Air Traffic Management - A research project in FP6 supported by the European Commission -** Ref: 502911 - https://extranet.eurocontrol.int/http://prisme-oas.hq.corp.eurocontrol.int/vdr/public/jsp/HOME.jsp?ROLE=101

[17] **EMMA** **European Airport Movement Management by A-SMGCS** - https://extranet.eurocontrol.int/http://prisme-oas.hq.corp.eurocontrol.int/vdr/public/jsp/HOME.jsp?ROLE=101

[18] **CAMES** **Co-operative ATM Measures for a Single European SkyG -** https://extranet.eurocontrol.int/http://prisme-oas.hq.corp.eurocontrol.int/vdr/public/jsp/HOME.jsp?ROLE=101

3.2 GLOSSARY OF TERMS

Term	Definition
3D-PRNAV	Precision Area Navigation – in vertical dimension it is possible to define vertical restrictions along 2D route.
4D Management	4-Dimensions Trajectory Management
A-CDA	Advanced Continuous Descent Approach
ACARE	the Advisory Council for Aeronautical Research in Europe
AFUA	Advanced Flexible Use of Airspace concepts
AMAN	Arrival Manager
AOP	Airport Operational Plan
API	Application Programming Interface
APOC	Airport Operations Centre
ASAS	Airborne Separation Assistance System
ASPA	ASAS Spacing
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATSU	Air Traffic Services Unit
ATM	Air Traffic Management
BtV	Brake to Vacate
CAP	Crossing and Passing
CAST Fast Time simulation	Tool
CDA	Continuous Descent Approach
CDM	Collaborative Decision Making
CHILL	Gaming tool-platform
ConOps	Concept of Operations
CTA	Controlled Time of Arrival

Term	Definition
DARTIS	Validation tool
DCB	Demand and Capacity Balancing
DCDU	Data link Control and Display Unit
DOD	Detailed Operational Description
DOW	Description of Work (part of the Contract with the European Commission)
EC	European Commission
ECAC	European Civil Aviation Conference
EG	Expert Group
E-OCVM	European Operational Concept Validation Methodology
EP3	Episode 3
EPOPEE	The Airbus research cockpit simulator
EUROCAT	The Thales Air Systems industrial Air Traffic Management product
EVEREST	The Thales Avionics simulated Flight Management System
EXCOM	Executive Committee
FDPS	Flight Data Processing System
FMS	Flight Management System (on board)
FTS	Fast Time Simulation
IAF	Initial Arrival Fix
KPA	Key Performance Area
KPI	Key Performance Indicator
MTR	Mid-Term Review
MTCD	Medium Term Conflict Detection
MUACC	Maastricht Upper Airspace Control Centre
NOP	Network Operations Plan
PBN route	Performance Based Navigation Route
PMB	Project Management Board
PMP	Project Management Plan
PROMAS	Validation tool
P-RNAV	Precision Area Navigation
PRU	Performance Review Unit (EUROCONTROL)
PTC-2D, PTC-3D	Precision Trajectory Clearance-2 dimensions, -3 dimensions
Q/A	Questions and Answers (table)
RBT	Reference Business Trajectory
RNP	Required Navigation Performance
RTA	Required Time of Arrival

Term	Definition
SESAR ConOps	SESAR Concept of Operations
S-JU or SESAR JU	The SESAR Joint Undertaking
SBT	Shared Business Trajectory
STAR	Safety Target Achievement Roadmap
SW	Software
SWIM	System Wide Information Management
TAM	Total Airport Management
TBS	Time Based Spacing
TED	Trajectory Editor
TMA	Terminal Area
TOP	Total Operations Planner
TRL	Technology Readiness Level
TTA	Target Time of Arrival
UDPP	User Driven Prioritisation Process
WP	Work Package

Table 4 Glossary of Terms

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