Final Project Report

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Abstract

The project 06.03.01 addressed the Airport Operations Management and Surface Management domains.

For the Airport Operations Management domain, the project has contributed to the development and validation of the concept related to the European ATM Master Plan Essential Operational Change "Airport operations plan" [2]

For the Surface Management domain, the project performed Real-Time simulations and Live trials/Shadow mode trials to assess the level of maturity reached by the European ATM Master Plan Essential Operational Changes "Automated assistance to controller for surface movement planning and routing", "DMAN integrating surface management constraints" and "Airport Safety Nets". The project equally provided consolidated validation results for the final production of the related concept documents.

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Acronyms

Acronym	Definition
A-CDM	Airport Collaborative Decision Making
ADS-B	Automatic Dependent Surveillance-Broadcast
A-CWP	Advanced Controller Working Position
A-SMGCS	Advanced Surface Movement, Guidance and Control Systems
AGL	Airfield Ground Lighting
AOP	Airport Operations Plan
APOC	AirPort Operations Centre
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATV	Air Transit View
CATC	Conflicting ATC Clearances
CDM	Collaborative Decision Making
CMAC	Conformance Monitoring Alerts for Controllers
CPDLC	Controller-Pilot Data Link Communications
CTOT	Calculated Take-Off Time
D-TAXI	Datalink Taxi Support
DCB	Demand and Capacity Balancing
DMAN	Departure Manager
E-OCVM	European Operational Concept Validation Methodology
FDP	Flight Data Processing
FMP	Flow Management Position
INTEROP	Interoperability Requirements
KPA	Key Performance Area
KPI	Key Performance Indicator

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LVP	Low Visibility Procedures
NOP	Network Operations Plan
OFA	Operational Focus Area
OI	Operational Improvement
OSED	Operational Service and Environment Definition
PCP	Pilot Common Project
R/T	Radio Telephony
RMAN	Runway Manager
RTS	Real Time Simulation
SESAR	Single European Sky ATM Research
SPR	Safety and Performance Requirements
SWIM	System Wide Information Management
TIBT	Target In-Block Time
TLDT	Target Landing Time
TOBT	Target Off-Block Time
TSAT	Target Start-Up Approval Time
TTA	Target Time of Arrival
TTM	Target Time Management
TTOT	Target Take-Off Time
UDPP	User Driven Priority Process
VALP	Validation Plan
VALR	Validation Report
WG	Working Group
WP	Work Package

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1 Project Overview

The project 06.03.01 addressed the Airport Operations Management and Surface Management domains.

For the Airport Operations Management domain, the main objective of the project was to develop and validate the SESAR concept. The project was responsible for further validating the concept at the V2 maturity level as well as concluding the V3 activities. Finally, the project was responsible for the delivery of the final Airport Operations Management documentation and was also responsible for a number of tasks which were performed in order to prepare the future research work.

For the Surface Management domain, the project performed Real-Time simulations and Live trials/Shadow mode trials to assess the level of maturity reached by validated SESAR solutions and to provide validation results for the final production of the concept documents.

1.1 Project progress and contribution to the Master Plan

Surface Management Domain

The Surface Management activities of the project have addressed the following European ATM Master Plan [2] Essential Operational Changes:

- "Automated assistance to controller for surface movement planning and routing"
- "DMAN integrating surface management constraints"
- "Airport Safety Nets".

For these features, the project performed iteratively several integrated validations to mature step by step the concepts developed in the programme. The validations executed during the project duration were performed by Real Time simulations, Live and Shadow mode Trials:

- A real time simulation performed in 2013 to validate Surface Safety Nets, enhanced ADS-B ground station and A-CWP at V3 level using Milan-Malpensa environment,
- A real time simulation performed in 2014 related to the validation of Surface Safety Nets and Routing and planning function in an Advanced Controller Position at V3 level using Madrid-Barajas environment.
- A real time simulation performed in 2016 assessing Advanced Controller Working Position integrated with Safety Nets, DMAN/A-SMGCS and Airport FDP at V3 level in the Milan Malpensa environment. Within the scope of this validation, a flight trial was also executed assessing the D-TAXI service from both ground and on-board side and the manual taxi routing functionality from the on-board perspective.
- A real time simulation performed in 2016 assessing A-SMGCS advanced functions airport safety nets and routing, integrated in an A-CWP at V3 level using Paris Charles-de-Gaulle environment.
- A real time simulation performed in 2015 refining the A-SMGCS safety nets, datalink, routing, and guidance, integrated in an A-CWP at V3 level in the Hamburg environment. The focus of this experiment was on the controller interface.
- A real time simulation performed in 2016 assessing the integration of airport safety nets for controllers and advanced Surface Management with the support of taxi routes via datalink, all in an advanced CWP at V3 level in Barcelona-El Prat environment on a cross runway layout. Additionally the simulation was considering an enhanced airport Flight Data Processing system.

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- A shadow mode/live trial performed in 2016 at Riga airport building upon the conclusions and recommendations from previous V2 validations further refining the concept of airport safety nets, routing, and guidance, integrated in an A-CWP at V3 level in an operational environment.
- A real time simulation performed in 2015 assessing the Follow-the-Greens concept developed within the SESAR programme using Munich environment. This Guidance means are characterized by Airfield Ground Lighting (AGL) that provides automated assistance to controller surface movement Planning and Routing.
- A live trial performed in 2015 at Paris Charles de Gaulle airport whose objective was to assess the enhanced traffic situational awareness and airport safety nets for the vehicle drivers.

Airport Operations Management Domain

The Airport Operations Management activities of the project have addressed the European Air Traffic Management Master Plan [2] Essential Operational Change "Airport operations plan" by developing the following conceptual elements:

- Development of the Airport Transit View (ATV) concept, representing the visit of an aircraft to the airport, and the working methods to integrate the appropriate information into the Airport Collaborative Decision Making process;
- Development of the four services associated to Airport Operations Management: Steer Airport Performance, Monitor Airport performance, Manage Airport performance and Post Operations analysis;
- New communication and interaction patterns between stakeholders of airport operations linked to collaborative rolling Airport Operations Plan /Network Operations Plan management;

The project performed a set of validations of these conceptual elements that are described in section 1.2

The project also contributed to SESAR Solution #21 (Airport Operations Plan and AOP-NOP Seamless Integration) that aims to support the European ATM Master Plan's key feature of 'Network Collaborative Management & Dynamic Capacity Balancing' by using the high level SESAR concept of High Performing Airport Operations to achieve a full integration of airports into the ATM network, ensuring a seamless process through Airport Collaborative Decision Making (A-CDM).

Operational Improvements (OIs) for Surface Management and Airport Operations Management Domains

During its lifecycle, the project contributed for all domains of activities to mature the following operational improvement steps referenced in the integrated roadmap version DS16 (table below). Increasing their maturity was achieved through the development and testing of the operational concept in consecutive validation exercises within the project as well as through the development of the prototype within the corresponding technical project.

Code	Name	Project contribution	Maturity at project start	Maturity at project end
TS-0203	Departure Management supported by Route Planning and Monitoring	The project contributed to the validation of this OI with the RTS in Milan Malpensa environment.	V2	V2

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AO-0205	Automated Assistance to Controller for Surface Movement Planning and Routing	The project contributed to the validation of this OI with the Live trials in Riga and the four RTS in Paris Charles de Gaulle, Barcelona, Milan Malpensa and Hamburg environments.	V1	V3
AUO-0308-A	Datalink services used for provision of ground related clearances and information	The project contributed to the validation of this OI with the Live trials in Riga and the three RTS in Barcelona, Milan Malpensa and Hamburg environments.	V2	Partial V3
AO-0222-A	Enhanced Guidance Assistance to Mobiles based on the Automated Switching of Taxiway Lights and Stop Bars according to the Airfield Ground Lighting (AGL) Operational Service	The project contributed to the validation of this OI with the Live trials in Riga and RTS in Munich environment.	V2	V3
AO-0215	Airport ATC provision of ground-related clearances and information to vehicle drivers via datalink	The project contributed to the validation of this OI with the RTS in Hamburg environment, but only assessing the controller aspects of the OI	V1	V2
AO-0206	Enhanced Guidance Assistance to Airport Vehicle Driver Combined with Routing	The project contributed to the validation of this OI with the RTS in Milan Malpensa environment	V1	V2
AO-0223	Enhanced safety in LVP through use of virtual block control	The project contributed to the validation of this OI with the RTS in Milan Malpensa environment	V2	V3
AUO-0603-A	Enhanced Guidance Assistance to aircraft on the airport surface combined with routing in Step 1;	The project contributed to the validation of this OI with the RTS in Milan Malpensa environment	V2	Partial V3
AO-0104-A	Airport Safety Nets for Controllers in Step 1	The project contributed to the validation of this OI with the Live trials in Riga and the four RTS in Paris Charles de Gaulle, Barcelona, Milan Malpensa and Hamburg environments.	V2	V3
AO-0105	Airport Safety Net for Vehicle Drivers	The project contributed to the validation of this OI with the live trial at Paris Charles de Gaulle airport.	V2	V3
AO-0204	Airport Vehicle Driver's Traffic Situational Awareness	The project contributed to the validation of this OI with the live trial at Paris Charles de Gaulle airport.	V2	V3

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AO-0801-A	Collaborative Airport Planning Interface	The project contributed to the maintenance of the evolving content of the Airport Operations Plan (AOP) including an initial identification of elements that are common between the AOP and NOP; and means to allow the exchange of information between the AOP and NOP.	V2	V3
AO-0802-A	A-CDM process enhanced through integration of landside (passenger only) process outputs	The project contributed to the enhancement of airport airside processes with the inclusion of landside (passenger flow only) process outputs that can affect ATM performance e.g. through delayed departures.	V2	V3
AO-0803	Integration of Airports into ATM through the Monitoring of Airport Transit View (Extension of Performance Monitoring building on A-CDM)	The project contributed to the improvement of ATM/airport operations through the integration and monitoring of Airport Transit Views (aircraft flows). An Airport Transit View describes the visit of an airframe to an airport. This includes the connections with inbound-outbound airborne segments (which are parts of SBT/RBT) as well as the main A-CDM milestones (e.g. TLDT, TIBT, TOBT/TSAT and TTOT).	V2	V3
AO-0804	Collaborative Airport Performance Management	The project contributed to the development of the Airport Operations Performance Management concept. The concept identifies the functional and technical requirements required to manage the airport's processes. Specifically it requires an impact assessment of proposed tactical changes to operational inputs and rules by the decision support tools and procedures that facilitate the collaborative decision making involving all airport stakeholders.	V2	V2
DCB-0309	Airport Demand – Capacity Balancing (A-DCB)	The project contributed to the proactive assessment of the balance between available airport capacity and scheduled/forecast demand given the prevailing and/or forecast weather and other operational conditions. Focus on runway capacity.	V2	V2

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DCB-0310	Improved consistency between airport and ATFCM planning	The project contributed to improved efficiency in the management of airport and ATFCM planning. Airport planning is continuously refined with the application of local airport CDM processes. The overall network planning proposes CTOT/TTA for all regulated flights. For those flights where the allocated constraints will have a negative impact (e.g. disturbing airport/airline operations), the Network shall take into account this information in order to possibly re-allocate CTOT/TTA.	V2	V3

SESAR solutions for Surface Management and Airport Operations Management Domains

Based on the list of the covered OIs, P06.03.01 contributed to the following SESAR solutions:

Surface Management Domain

- Solution #02 - Airport Safety Nets for Controllers: conformance monitoring alerts and detection of conflicting ATC clearances
- Solution #04 - Enhanced Traffic Situational Awareness and Airport Safety Nets for the Vehicle Drivers
- Solution #14 - Departure Management integrating Surface Management constraints;
- Solution #22 - Automated assistance to controller for surface movement planning and routing
- Solution #23 - D-TAXI service for CPDLC application
- Solution #26 - Manual Taxi Routing function
- Solution #47 - Guidance assistance through airfield ground lighting
- Solution #48 - Virtual Block Control in Low Visibility Procedures (LVPs)

Airport Operations Management Domain

- Solution #21 (Airport Operations Plan and AOP-NOP Seamless Integration).

1.2 Project achievements

Surface Management Domain

The validation exercises performed by the project aimed at assessing the SESAR solutions previously mentioned with regard to their maturity level.

The solution #02 – “Airport Safety Nets for controllers: Conformance Monitoring Alerts for Controllers (CMAC) and detection of Conflicting ATC Clearances (CATC)” has been evaluated by five exercises of the project. Based on qualitative results, it is considered that this solution is bringing benefits with regards to its KPAs; Safety and Human Performance. From the project perspective, this solution has completed V3 maturity level according to E-OCVM and will contribute to the PCP under AF#2 "Airport Integration and Throughput".

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The Solution #14 – “Departure Management integrating Surface Management constraints” has been assessed by the RTS in Milan Malpensa environment. No quantitative assessment was executed due to unexpected behaviours of the routing and planning prototype (and of the related integration with DMAN). Therefore, no significant conclusions have been collected. V3 is not completed; further research and trials should be performed.

The solution #22 – “Automated Assistance to Controller for Surface Movement Planning and Routing” has been evaluated by all exercises. Based on qualitative results, it is considered that the solution is bringing benefits with regards to its KPAs; Human Performance, Predictability and Safety. This solution is therefore considered as having completed V3 maturity level and will contribute to the PCP under AF#2 "Airport Integration and Throughput".

The solution #23 – “D-TAXI service for CPDLC application” has been addressed by the live/shadow mode trials in Riga and three RTS in Barcelona, Milan Malpensa and Hamburg environments. The results indicate that the solution has not yet completed V3. To do so more live trials possibly involving real aircraft and communication infrastructure should be performed and some aspects, identified by the project, should be made to improve the solution. Further research and trials should be performed.

The solution #26 – “Manual Taxi Routing” has been assessed by the RTS in Milan Malpensa environment. Benefits of Manual Taxi on situation awareness compared to the current operations are overall positive, especially at the gate in static environment, but the insertion of the route by the Pilot Monitoring should be easier to not decrease too much situation awareness. However, it should be associated with an appropriate means to enter it manually in a timely manner, easily and so that it reflects exactly the initial voice clearance. Besides, other interaction means more user-friendly is to be further studied in the future. Based on the validation results, the solution has not yet completed V3 maturity level. Further research and trials should be performed.

The solution #47 – “Guidance Assistance through Airfield Ground Lighting” was addressed by the live/shadow mode trials in Riga and RTS in Munich environment. Controller feedback highlighted when the lights function correctly without problem, that efficiency and safety are improved. The RTS in Munich also identified benefits in term of performance with an average reduction of duration of the ground movements by up to 27%, a reduction of fuel burn up to 17%, a decreased of ground movement stops up to 66% and a decrease of R/T communications up to 21%. This solution is therefore considered as having completed V3 maturity level.

The solution #48 – “Virtual Block Control in LVPs” has been assessed by the RTS in Milan Malpensa environment. The investigated Virtual Block Control by means of Virtual Stop Bars has been confirmed to increase the level of safety thanks to an improvement of both pilots’ and controllers’ situational awareness. This solution is considered as having completed V3 maturity level.

The Solution #04 - "Enhanced Traffic Situational Awareness and Airport Safety Nets for the vehicle drivers" was addressed by the live trial at Paris Charles de Gaulle airport and confirmed the benefits of the SESAR solution in terms of safety and situational awareness. This solution is considered as having completed V3 maturity level.

Furthermore, the results of the validation exercises performed by the project provided input to update the final SESAR concept documents OSED/INTEROP/SPR related to "Integrated Surface Management" and "Airport Safety Nets" [4] [5] [6][13] [14] [15] [16].

Airport Operations Management Domain

The project activities were oriented around a number of different threads:

- Performing a number of V3 validation exercises whose operational concept had been developed as part of the work of OFA05.01.01
- ‘Contributing to’ a number of exercises outside of OFA 05.01.01 but for which there was a strong airport component

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- Producing the final set of OFA documentation (OSED, SPR and INTEROP).
- Executing a number of dedicated validation exercises using real-time and fast-time high-fidelity simulation gaming that technically were at V2 level due to the application of this technique but in fact contributed to V3 maturity by updating the operational concept beyond V2 rather than simply proving feasibility. These activities were performed at different airports of various sizes and operating environments with a strong focus on the APOC concept, performance-based airport management and validating AOP content alongside the Airport Transit View (ATV). The use of the ATV in these exercises contributed towards AO-0803 in particular reaching final V3 maturity.
- Performing a small number of research activities designed to mature the airport operations management concept and to help pave the way for the future research programme.

V2 and V3 exercises for Airport Operations Management

At the V3 level of maturity, exercises were performed in the form of real-time simulation, shadow mode as well as live trial. Each allowed the concept to be demonstrated in the live working environment or as near to it as possible and in all cases used pre-industrial prototypes developed by partners from the Airport Systems Work Package throughout the course of the SESAR1 Programme.

- In the area of airside / landside process integration, a highly successful live trial took place in July 2015 in the airport of Palma de Mallorca. This activity aimed to show that data relating to landside processes at the airport could be incorporated into the AOP and used to assess the impact on ATV management, i.e. airside processes.

- In the area of APOC processes and multiple stakeholder decision-making, a V3 exercise took place in February 2016 based on Real Time Simulation at the premises of industry partner AT-One in Braunschweig, Germany. The activity took advantage of a sophisticated validation platform capable of integrating the full range of required prototypes supplied by industry partners to support the operational concept under test, as well as providing a realistic simulated environment to allow stakeholders to role-play in the APOC environment

- In the area of Airport Demand and Capacity Balancing, (DCB) at the V2 level, an exercise using Real Time Simulation took place in July 2014 on the premises of industry partner Selex (now Leonardo) in Rome, Italy. The gaming simulation was based on the tower environment of Milan Malpensa Airport.

- Also in the area of DCB, another exercise, at V3 level was carried out in March 2016 on ENAV's Platform based on the tower environment at Malpensa and had as its main objective to implement the Airport Collaborative Decision Making (A-CDM) concept by sharing the information provided by DMAN, Surface Management (including Runway Manager) through SWIM.

- Finally in the area of DCB, a V3 exercise using Real Time Simulation took place in January 2016 on the premises of the platform supplier AT-One in Braunschweig, Germany. Its purpose was to use a more sophisticated prototype developed following previous exercises to integrate DCB monitoring and management within an APOC setting and introduce basic aspects of the User Driven Prioritization Process (UDPP) for airspace users. In capacity-constrained situations the APOC can decide on KPI preferences which lead to an optimised split between arrival and departure capacity using the Runway Manager (RMAN) tool, which proposes the best runway configuration plan for the next few hours. Forecasted landing and take-off times can also be provided, enabling UDPP, which looked at departure flight

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prioritisation beyond the time scope of a typical pre-departure sequence, which is an extension of the slot-swapping concept.

Airport Operations Management Coordination outside of OFA05.01.01

In the area of AOP/NOP integration with Target Time Management (TTM), a key high-level business priority for the SESAR Programme is to integrate airports into the network, that is, airports effectively become ground nodes of the network featuring ground-based trajectories that are optimised by the airport to allow the network to be balanced at the global level. To enable this, the network must be able to receive information from airports and vice versa (AOP-NOP integration), while at the same time using new procedures to ensure that traffic is delivered to airports in a smooth predictable flow that can be efficiently handled in the ground node (ATV turn-round sector) resulting in stable departure predictability. Building on the work of previous validation activities both within and outside OFA05.01.01, P06.03.01 provided a significant contribution to a V3 level exercise using Shadow Mode in May 2016, based at Madrid Airport and including traffic flows operating at Barcelona, Palma de Mallorca and Alicante airports; additionally involving the three associated ACCs governing their respective TMA traffic volumes.

In the domain of the User Driven Prioritisation Process (UDPP), a highly valuable exercise at the V2 level of maturity was performed as a collaboration between project P06.03.01 and OFA05.03.06 "UDPP" with the objective of investigating the UDPP process. This exercise focussed on the process of allowing airspace users to designate flight priorities and considerable progress was made in both the concept development as well as important issues such as equity.

V2 Gaming simulations for Airport Operations Management

A number of V2 exercises were performed by the project in collaboration with various partner airports. The simulation platform employed for these activities was a highly realistic representation of the APOC, containing all functionality of the OFA05.01.01 concept, and a highly realistic airport modelling environment. The aim of each exercise was globally to demonstrate to the operational community in each airport the key elements of the SESAR concept. As such, there was a strong element of communication and outreach associated to each exercise. In addition, the participating airports were able to visualise how the SESAR Airport Operations Management concept could be applied to their specific operational situation.

Study activities for Airport Operations Management

P06.03.01 performed a number of study activities designed to enhance both the robustness of the Airport Operations Management operational concept as well as slightly longer term studies with the aim of providing valuable guidance notably to the future research project.

The robustness of the performance monitoring process was enhanced through the development of a ‘low-level’ performance dashboard and associated KPA/KPI. A number of validation activities across OFA05.01.01 had highlighted the necessity to have both ‘high level’ performance indicators for an airport but also more ‘low-level’ indicators. As described above, the first prototype of such a tool was evaluated in the airport of Paris Charles de Gaulle with highly positive feedback being obtained from the participating operational community.

In the domain of Cyber-security, an exploratory study has been performed during SESAR1 into cyber-security issues associated to an APOC and the Total Airport Management concept [31]. This study has provided highly valuable guidance for future Risk Assessment activity.

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1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project.

Reference	Title	Description
D86	6.3.1 D75 6.3.2 Release 3 Validation Report	This validation report describes the results of two Release 3 step 1 V3 exercises that covered mainly Airport Safety Nets, Enhanced Situational Awareness, Integrated Surface Management and A-CWP Airport in Madrid-Barajas and Milano-Malpensa operational environments
D134	Delivery of VALR EXE 549 (Airside - Landside integration)	This validation report describes the results of an exercise to show that data relating to landside processes at the airport could be incorporated into the AOP and used to assess the impact on ATV management, i.e. airside processes.
D136	Delivery of VALR EXE 010 (Integrated Validation of the DCB Monitoring and Management Processes) V3	This validation report describes the results of an exercise to demonstrate that In capacity-constrained situations the APOC can decide on KPI preferences which lead to an optimised split between arrival and departure capacity using the Runway Manager (RMAN) tool, which proposes the best runway configuration plan for the next few hours.
D140	Delivery of VALR EXE 669 ENAV proposition	This validation report describes the results of an exercise to demonstrate the support mechanisms for all involved ATM stakeholders in their decision-making processes by displaying airport arrival/departure capacity forecasts and weather observations and forecasts (an integrated MET service)
D142	Delivery of VALR EXE 757 (Airport Operations Centre: Airport Performance Monitoring and Management) V3	This validation report describes the results of an exercise to demonstrate that all airport stakeholders can maintain their situational awareness of current and predicted airport performance based on the information at their disposal (AOP) and that they can accurately identify predicted impacts on their business processes so as to facilitate the decision making process
D144	Delivery of VALR EXE709	This validation report describes the results of an exercise to demonstrate how situational awareness improves with displayed alerts and warnings, with positive impact on airport capacity (departure capacity shortage), efficiency (reduction of peak delay) and predictability (departure punctuality
D145	OFA 05.01.01 Final OSED	This document is the Operational Services and Environment Description (OSED) related to the Airport Operations Management element of the SESAR operational concept defining he SESAR Step 1 operational services, operational methods, environments, scenarios, use cases and requirements.

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D146	OFA 05.01.01 Final INTEROP	This document is the INTEROP document related to the Airport Operations Management element of the SESAR operational concept focusing on the interoperability requirements based on the operational requirements mentioned in the OFA 05.01.01 OSED and SPR
D147	OFA 05.01.01 Final SPR	This document is the Safety and Performance Requirements (SPR) document related to the Airport Operations Management element of the SESAR operational concept defining the SESAR Step 1 performance requirements associated to the Predictability, Efficiency and Flexibility Key Performance Areas (KPAs) impacting mostly Airport Operations Management and other KPAs impacting in a second stage like Safety, Security, Environment.
D149	Consolidated DEL Release 5 Validation Report with 06.09.02 T1031	This validation report describes the results from the Release 5 exercises which collectively investigated Airport Safety Nets, specifically Conflicting ATC Clearances (CATC) and Conformance Monitoring Alerts (CMAC), Departure Management supported by route Planning, and enhanced A-SMGCS functionalities, such as Routing and Guidance and how these functionalities are integrated into the Advanced Controller Working Position (A-CWP) and support the above functionalities. - A real time simulation in the Milan Malpensa environment. Within the scope this validation, a flight trial was also executed; - A real time simulation using Paris Charles-de-Gaulle environment. - A real time simulation in the Hamburg environment. - A real time simulation in Barcelona-El Prat environment; - A shadow mode/live trial at Riga airport.
D151	EXE 724 VALR	This validation report describes the results obtained from this live trial validation at Paris Charles de Gaulle airport whose principal objective was to assess the enhanced traffic situational awareness and airport safety nets for the vehicle drivers.
D153	EXE 759 VALR	This validation report provides detailed evidence of the various and significant operational benefits of the Follow-the-Greens AGL Guidance service from the controllers' and flight crew's point of view in a virtually simulated Munich Airport environment. The results of this V3 real time simulation address different Key Performance Areas and derived from 20 performed Scenarios under different visibility conditions.

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1.4 Contribution to Standardisation

Surface Management Domain

The project has produced relevant results for EUROCAE WG41 "Surface Movement Guidance and Control Systems" and WG78 "Standards for Air Traffic Data Communication Services" to build standards for CMAC and CATC services (part of PCP AF#2) as well as A-SMGCS Routing (part of PCP AF#2) and A-SMGCS Guidance with D-TAXI and AGL operations.

Airport Operations Management Domain

The primary piece of legislation relevant to Solution #21 is the current Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan.
It is expected that standardisation will be largely achieved by uniform application of the Solution data pack, in particular the requirements and procedures described in the Operational Service and Environment Definition (OSED) document for which the project P06.03.01 has been a major contributor both in the document drafting as well as the execution of the supporting validation activities.

1.5 Project Conclusion and Recommendations

Surface Management Domain

The project has achieved its objectives by conducting integrated validations assessing the SESAR solutions developed by the SESAR program for Surface and Runway Management activities.

The following conclusions are based on P06.03.01 results and do not preclude other projects to have a different view especially with regards to maturity level reached for the addressed solutions.

- The solution #02 – “Airport Safety Nets for Controllers: Conformance Monitoring Alerts for Controllers (CMAC) and detection of Conflicting ATC Clearances (CATC)”.
    - The solution has completed V3 maturity level and is considered to be ready to proceed to deployment under PCP AF#2 "Airport Integration and Throughput".
- The Solution #04 - "Enhanced Traffic Situational Awareness and Airport Safety Nets for the Vehicle Drivers"
    - The solution has completed V3 maturity level.
- The Solution #14 – “Departure Management integrating Surface Management constraints”
    - The solution has not yet completed V3 maturity level.
- The solution #22 - “Automated Assistance to Controller for Surface Movement Planning and Routing”.
    - The solution has completed V3 maturity level and is considered to be ready to proceed to deployment under PCP AF#2 "Airport Integration and Throughput".
- The solution #23 – “D-TAXI service for CPDLC application”
    - The solution has not yet completed V3 maturity level.
- The solution #26 – “Manual Taxi Routing”
    - The solution has not yet completed V3 maturity level.

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- The solution #47 – “Guidance Assistance through Airfield Ground Lighting”
    - The solution has completed V3 maturity level.
- The solution #48 – “Virtual Block Control in LVPs”
    - The solution has completed V3 maturity level.

The P631 integrated validations have provided great values and results to assess the maturity level reached by the addressed SESAR solutions. The process of defining common objectives for several integrated validations should be kept for S2020 integrated validation approach as this has facilitated the interpretation of results for the concept updates.

For S2020 research, the project recommends to perform integrated validations with Real-Time simulations but equally as much as possible by doing live/shadow mode trials to assess concepts in more realistic situations.

For the mature SESAR1 solutions, as only one live/shadow mode trial has been performed during SESAR1, the project recommends doing additional demonstrations to help de-risking the deployment of the solutions that are planned for the PCP.

Airport Operations Management Domain

P06.03.01 has performed activities at both the V2 and V3 levels of validation maturity as well as coordinating the production of the final set of OFA05.01.01 documentation. Great steps forward have been made and key elements of the concept are being taken forward to deployment notably through the PCP process.

Further work is required in future research programme and its associated validation exercises both to further refine the SESAR1 airport operations management concept and also to introduce new elements into the concept such as, for example, the monitoring of environmental performance indicators within the Airport Operations Plan.

In the domain of the APOC Processes and notably the multi-stakeholder decision making process, further work is required to streamline the exchange of information between different stakeholders so as to find a better balance between a ‘formalised’ approach and one which offers more flexibility, with the aim of converging more quickly to an agreed strategy between different stakeholders and supporting an efficient recovery to normal operations. Optimisation of APOC alert / warning thresholds will need further study, again to find the right balance between informal problem resolution and the more formalised impact assessment / solution message process. In particular validation results provided much valuable guidance for future research [40] but further concept development and stakeholder consensus building is necessary.

In the domain of Performance Monitoring, the OFA05.01.01 OSED defines a number of key performance indicators for display in the APOC. Whilst these indicators are highly valuable for the monitoring of the global airport situation, they are not always necessarily at a sufficiently detailed level of granularity to allow problem identification and resolution. A highly promising validation exercise with Paris Charles de Gaulle airport employed a prototype performance dashboard, displayed as a ‘video-wall’ covering different aspects of the airport operation. This dashboard was specifically designed to allow ‘fine grain’ performance monitoring and management covering both airside and landside processes. The philosophy behind such a dashboard needs to be taken forward into future research programme so that generic guidelines relating to the dashboard principles (both content and HMI) can be developed.

One recurring theme in a number of validation exercises at both V2 and V3 levels, notably those linked to the APOC process was the importance of a ‘what-if’ decision-support tool. Essentially such a tool is designed to answer the question “what will be the impact of a given decision at certain time intervals in the future”. Clearly the development of such a tool requires considerable research and validation. So whilst SESAR1 identified the importance of such a tool to the unanimous agreement of all APOC stakeholders, detailed concept development and validation activities will only commence in future research programme. For the eventual deployment of such a capability, it is likely that

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techniques related to big data analysis and machine learning will need to be employed. In addition, such techniques will also be relevant for the post-operations analysis phase and the ‘closure of the loop’ with the strategic performance steering.

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2 References

[1] SESAR Programme Management Plan, Edition 03.00.01

[2] European ATM Master Plan

[3] Multilateral Framework Agreement ("MFA") signed between the SJU, EUROCONTROL and its 15 selected members on August 11, 2009, amended on 14 June 2010, 19 October 2010 and 2 July 2012

[4] 06.07.02, OFA04.02.01 (Integrated Surface Management) Final OSED, D46, 00.01.00, 08/09/2016

[5] 06.07.02, OFA04.02.01 (Integrated Surface Management) Final SPR, D45, 00.01.00 09/09/2016

[6] 06.07.03, OFA04.02.01 (Integrated Surface Management) Final INTEROP, D28, 00.01.00 16/09/2016

[7] 06.03.01, P06.03.01 Release 5 Validation Plan, D148, 00.01.02, 26/01/2016

[8] 06.03.01, Consolidated DEL Release 5 Validation Report (with 06.09.02 T1031), D149, 00.01.00, 02/09/2016

[9] 06.03.01, EXE 724 VALP, D150, 00.01.01 21/05/2015

[10] 06.03.01, EXE 724 VALR, D151 , 00.01.01, 7/01/2015

[11] 06.03.01 EXE 759 VALP, D152, 00.01.00, 14/11/2014

[12] 06.03.01 EXE 759 VALR, D153, 00.01.01, 7/3/2016

[13] 06.07.01, Final OSED for CATC and CMAC, D32, 00.01.00, 5 September 2016

[14] 06.07.01, Final OSED for Alerts for Vehicle Drivers, D77, 00.01.01, 7 June 2016

[15] 06.07.01, Final SPR for Alerts for Vehicle Drivers, D78, 00.01.01, 9 September 2016

[16] 06.07.01, Final INTEROP for Alerts for Vehicle Drivers, D79, 00.01.00, 27 July 2016

[17] 06.05.04 AirPort Operations Centre (APOC) definition, APOC initial concept (V1), D01, 00.02.00, March 04, 2011

[18] 06.05.04 AirPort Operations Centre (APOC) definition, Validation Plan (v1), D02, 00.01.00, July 01, 2011

[19] 06.05.04 AirPort Operations Centre (APOC) definition, Initial Technical Feasibility Report (V1), D03, 00.02.00, March 25, 2011

[20] 06.05.04 AirPort Operations Centre (APOC) definition, Mock-up Availability Note (V1), D04, 00.01.00, September 05, 2011

[21] 06.05.04 AirPort Operations Centre (APOC) definition, Initial Validation Report, D05, 00.02.00, November 07, 2011

[22] 06.05.04 AirPort Operations Centre (APOC) definition, OFA 05.01.01 OSED Edition 1, D07, 00.01.00, April 30, 2012

[23] 06.05.04 AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated OSED Edition 2, D08, 00.02.00, April 30, 2013

[24] 06.05.04 AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated SPR Edition 2, D11, 00.01.01, October 09, 2013

[25] 06.05.04 AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated INTEROP Edition 2, D12, 00.01.01, December 04, 2013

[26] 06.05.04 AirPort Operations Centre (APOC) definition, Consolidated EXE-06.05.04-VP-013 Validation Plan, D25, 00.01.00, May 16, 2014

[27] 06.05.04 AirPort Operations Centre (APOC) definition, Consolidated EXE-06.05.04-VP-013 Validation Report, D13, 00.02.01, October 21, 2015

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[28] 06.05.04 AirPort Operations Centre (APOC) definition, OFA.05.01.01 Consolidated OSED Edition 3, D16, 00.03.01, April 08, 2015

[29] 06.05.04 AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated SPR Edition 3, D19, 00.02.01, July 09, 2015

[30] 06.05.04 AirPort Operations Centre (APOC) definition, OFA 05.01.01 Consolidated INTEROP Edition 3, D20, 00.02.05, July 08, 2015

[31] 06.03.01 Cyber-security application for SESAR OFA 05.01.01, 00.01.00 27/10/16

[32] 06.03.01 Release 3 Validation Report, D86, 00.01.00, 14/05/2015

[33] 06.03.01 Delivery of VALP EXE 549 (Airside - Landside integration), D133 00.01.00, April 08, 2015

[34] 06.03.01 Delivery of VALR EXE 549 (Airside - Landside integration), D134 00.01.01, December 23, 2015

[35] 06.03.01 Delivery of VALP EXE 010 (Integrated Validation of the DCB Monitoring and Management Processes) V3, D135 00.01.01, December 21, 2015

[36] 06.03.01 Delivery of VALR EXE 010 (Integrated Validation of the DCB Monitoring and Management Processes) V3, D136 00.03.02, September 06, 2016

[37] 06.03.01 Delivery of VALP EXE 669 ENAV Proposition, D139 00.02.00, March 31, 2016

[38] 06.03.01 Delivery of VALR EXE 669 ENAV Proposition, D140 00.02.00, September 01, 2016

[39] 06.03.01 Delivery of VALP EXE 757 (Airport Operations Centre : Airport Performance Monitoring and Management) V3, D141 00.01.01, November 26, 2016

[40] 06.03.01 Delivery of VALR EXE 757 (Airport Operations Centre : Airport Performance Monitoring and Management) V3, D142 00.01.01, August 19, 2016

[41] 06.03.01 Delivery of VALP EXE 709, D143 00.00.05, January 09, 2015

[42] 06.03.01 Delivery of VALR EXE 709, D144 00.01.00, May 19, 2016

[43] 06.03.01 OFA 05.01.01 Final OSED, D145 00.04.00, September 30, 2016

[44] 06.03.01 OFA 05.01.01 Final INTEROP, D146 00.03.00, October 15, 2016

[45] 06.03.01 OFA 05.01.01 Final SPR, D147 00.03.00, September 30, 2016

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