Final Project Report

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Abstract

This document is the Final Project Report for P6.5.2. It provides a summary of the goals and achievements of the project.

The remit of the project was the validation of the Airport Operations Plan (AOP) which is an integral element of the SESAR Airport Operations Management concept. This report therefore describes how the project approached its main objective and how it has contributed both to the evolution of the AOP and also to the overall validation roadmap of the OFA 05.01.01.

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This deliverable consists of SJU foreground.

1 Final Project Report

1.1 Project Aim

This Section provides an overview of both the initial aims of the project corresponding to its first baseline but also an overview of how the project baseline has evolved during its lifecycle.

The main aim of 6.5.2 according to the Project Initiation Report (PIR) published in May 2010, (Reference [4] was the validation of the Airport Operations Plan (AOP) – the content of which had previously been developed within P6.5.1. The project was required to develop:

1. Scenarios describing the updating of the AOP in the different phases of planning.
2. An Initial computer-based model demonstrating how different stakeholders would interact with and update the AOP.

It was recognised by the P6.5.2 partners that the production of the above material would not in itself satisfy the main remit of the project, namely the "validation" of the AOP. Therefore an additional two "questions" or validation themes (at V2 maturity) were proposed as they were considered as being fundamental to ensuring that the AOP supports the operational concept being pursued. A final 'integrated validation' at V3 maturity was also foreseen.

Theme 1: "Does the AOP permit a logical extension of the philosophy behind the flight segment of the aircraft 4D trajectory to the ground segment?"

The main activity here was the validation of the notion of the AOP as a 'rolling plan' updated as a function of the evolving aircraft status.

Theme 2: "*Has the content of the AOP been defined in such a way as to permit the evolution toward a performance based management approach?*"

This main activity was an assessment of the degree of situational awareness that could be provided through the AOP – covering both the 'aircraft' elements and the 'passenger' (landside) elements. In addition, an initial assessment of the feasibility of managing airport operations as a function of the evolution of certain key performance areas was also envisaged.

Integrated validation

The PIR planned that P6.5.2 would conclude with a specific validation activity designed to assess the operability, acceptability and usability of the AOP from the perspective of different airport actors, including airlines, but using specifically the verified AOP prototype provided by industry (INDRA) within the framework of P12.6.2.

At the beginning of the project, the partners were EUROCONTROL (Leader), SEAC, AENA and THALES. Whilst the contribution of EUROCONTROL, SEAC and AENA was envisaged for the duration of the project, the contribution of THALES was only foreseen as part of the AOP modelling activity. In addition, the project foresaw close links with INDRA (P12.6.2) responsible for the AOP prototype development as well as P6.5.4 responsible for the definition of the APOC concept and procedures since it was identified at that early stage that the AOP would constitute one of the main sources of information within the APOC.

The creation of the OFA 05.01.01 resulted in a number of changes to the project baseline for P6.5.2 as compared to the PIR, notably:

- The necessity for P6.5.2 to contribute to OFA documentation (OSED, SPR and INTEROP).

- The need for greater collaboration between projects in the execution of V3 activities.

In particular, as part of the OFA OSED, SJU/IS provided modelling support for the overall airport operations management architecture and this also covered the AOP. As a result, the THALES modelling was no longer necessary and the intended modelling task was replaced in order to cover the contribution of P6.5.2 to the 1st edition of the OSED.

The evolution of the validation roadmap at the OFA level resulted in V3 validations being planned principally within P6.3.1 and therefore some of the latter activities of P6.5.2 were changed in terms of their scope and objectives.

Nevertheless, the majority of activities originally envisaged in the PIR have been executed as planned and more details relating to the specific achievements of each are provided below in Section 1.3.

1.2 Contributions to the roadmap

Through three different validation activities, the project contributed to four different OI steps as described in the ATM Master Plan (Data Set 13 as frozen on 3rd October 2014).

These OI steps correspond to:

OI Step	Title
AO-0801	Collaborative Airport Planning Interface
AO-0802	A-CDM process enhanced through integration of landside (passenger and baggage) process outputs
AO-0803	Integration of Airports into ATM through Monitoring of Airport Transit View (Extension of Performance Monitoring building on A-CDM)
AO-0804	Collaborative Airport Performance Management

The coverage of these OI steps as a function of each validation exercise is indicated in the following Table:

Exercise	AO-0801	AO-0802	AO-0803	AO-0804
VP-546 (AOP fast-time simulation)		✓	✓	✓
VP-547 (AOP real-time simulation)	✓	✓	✓	✓
VP-648 (AOP shadow-mode trial)	✓		✓	

Each of the above validation activities were at the V2 maturity level.

VP-546 (AOP Fast-time simulation) contained a dedicated passenger process monitoring in line with the specifications described by P6.5.1. Baggage process monitoring was not addressed. The feasibility of providing automated alerts to airspace users based on the results of the process monitoring was demonstrated. The full Airport Transit View (ATV) timestamps were included in the simulation and these were updated in line with the evolving aircraft process. Finally, one aspect of the collaborative airport performance management, namely the automated generation of overall airport performance related alerts was demonstrated, although as this was limited to a fast-time simulation, the utility of such alerts was not explored. The principal outcome of the simulation was to demonstrate the feasibility of maintaining the AOP as a 'rolling plan' with fully integrated automated alerts. In particular:

- all aircraft (ATV) timestamps were maintained up to date as a result of the evolving aircraft situation
- As a function of the timestamps and process performance, alerts were raised and shown to (simulated) stakeholders.
- (simulated) stakeholder inputs to the plan were made and the updating of the AOP as a function of these inputs was demonstrated.

The construction of the simulation was based on a series of so-called "swim-lane" diagrams, an example of which is given below:

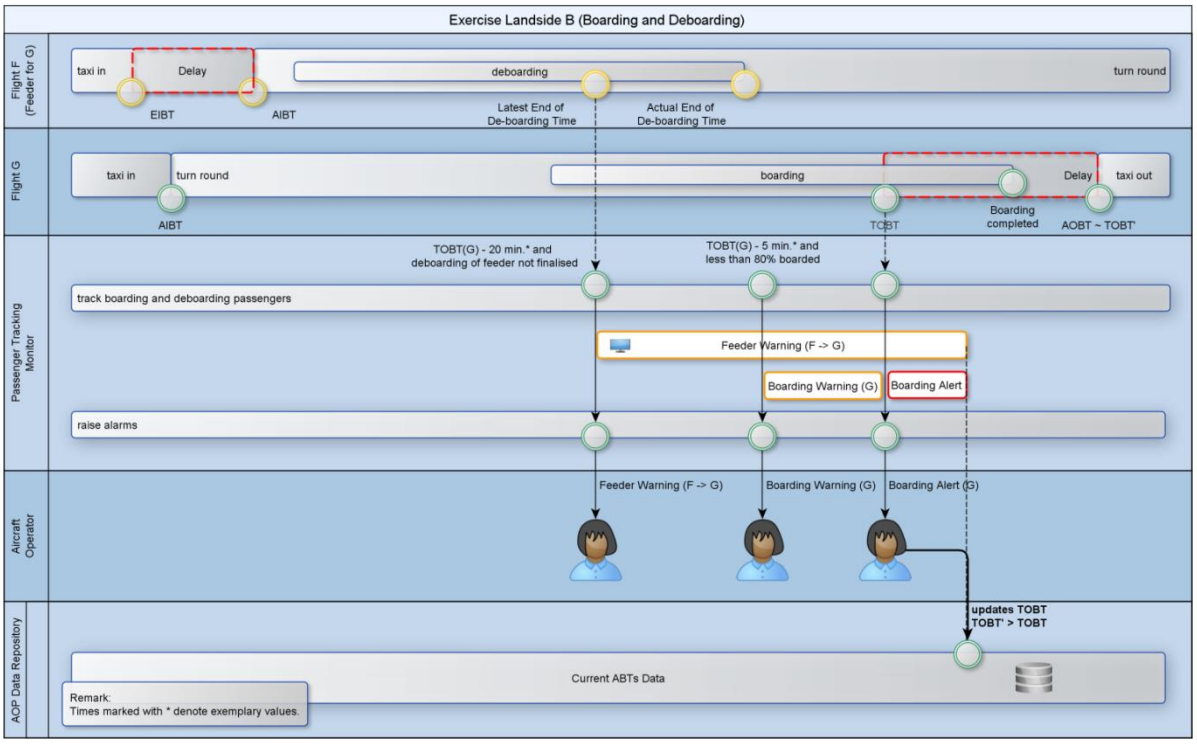

Figure 1 : Boarding / De-boarding interaction diagram

These diagrams provide a highly detailed and precise description of the interaction between the aircraft and passenger processes, the automated alerts and the stakeholder interaction with the AOP for a given 'perturbation' – the example above relating to a delayed departure due to late arriving transfer passengers. By modelling the AOP in such a way, it was possible to demonstrate that if stakeholders are provided with the relevant timestamps in a timely manner that the AOP can be maintained as a fully coherent, 'rolling' plan. This fast-time simulation served as a pre-cursor to the gaming simulation (VP-547) which explored identical situations to those described in the swim-lane diagrams but with active stakeholder participation.

In terms of contribution to the OI step maturity, the impact of VP-546 was as follows :

AO-0802 : full V2 maturity for the passenger process elements (baggage not simulated).

AO-0803: full V2 maturity for the ATV elements

AO-0803 : partial V2 maturity in so far as overall airport performance and individual process performance were both integral elements of the simulation although the 'collaborative' element was not explored by virtue of the fact that this was limited to fast-time simulation.

VP-547 (AOP real-time simulation) was based on an extension of the platform used for VP-546 which offered stakeholders the possibility to interact with the system, to assess the information presented to them and to explore the utility of such information. A dedicated interface was provided for each stakeholder in order to facilitate an assessment of the utility of the AOP information in relation to the collaborative airport management process. The same OI steps as in VP-546 were also assessed with the additional inclusion of AO-0801. The execution of VP-547 at Airbus Defence & Space premises in Les Mureaux, France is pictured below :

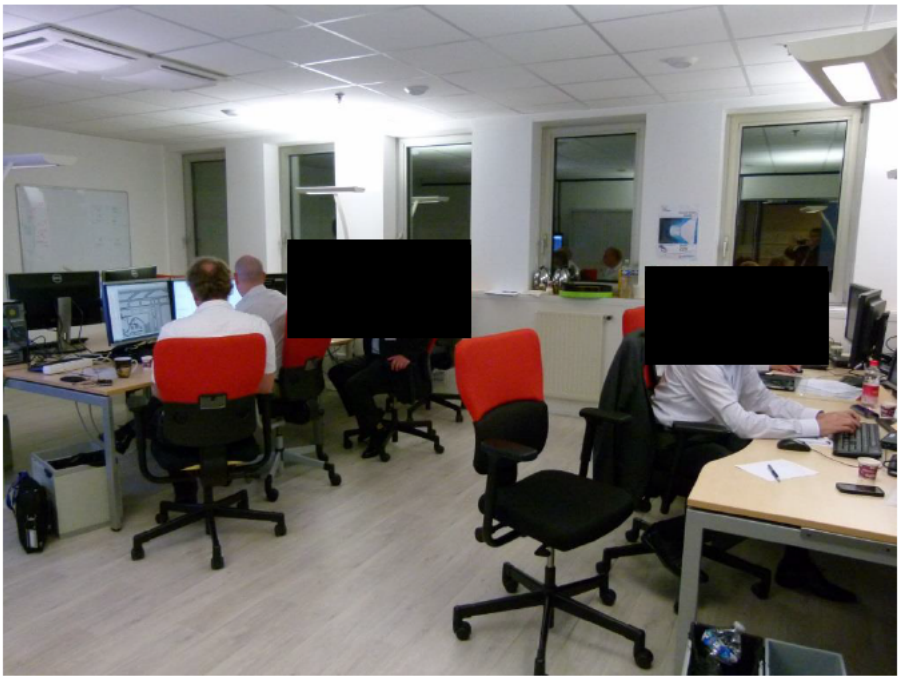

Figure 2 : VP-547 gaming simulation

Three main conclusions could be drawn on completion of VP-547:

1. The validation platform was considered to be highly realistic and the availability of a common data set (the AOP) for all stakeholders was considered to be a major step forward.
2. The situational awareness was considered higher in the solution scenario (AOP with automated alerts) than in the reference scenario.
3. The approach to airport performance monitoring and management needed further work and refinement.

Concerning this final point, the approach adopted in VP-547 was to indicate to stakeholders the evolution of certain airport KPIs (as defined in 6.5.1) over time. An example of the "performance view" is demonstrated in the following screenshot :

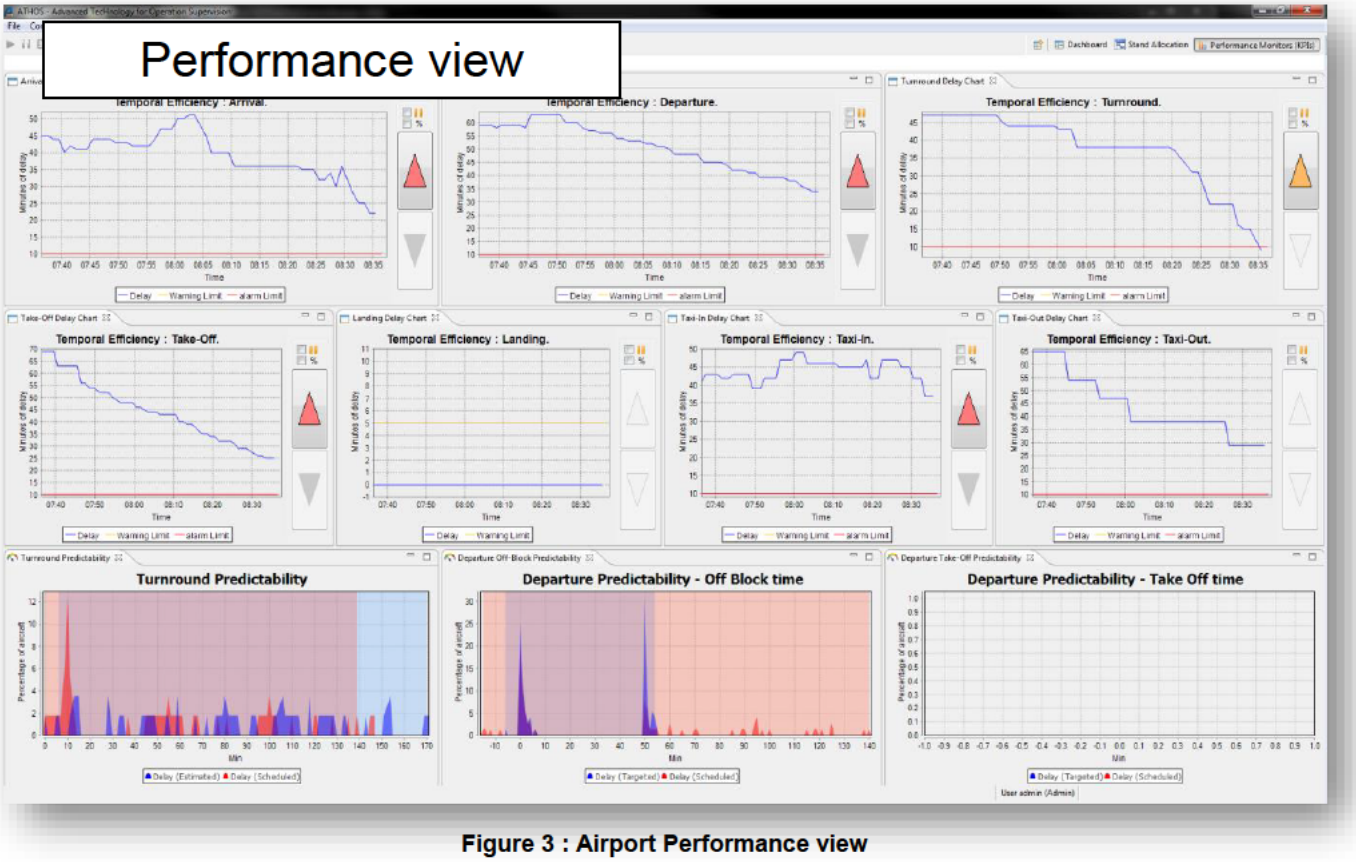

Figure 3 : Airport Performance view

The various stakeholders (both airport and airline operations) indicated that such performance graphs did not help their decision-making in so far as the 'root cause' of a given problem was not apparent. It should be noted that an identical conclusion was drawn recently within project 6.5.4 as part of its APOC validation activity (VP-013). As a result, the project 6.3.1 is now working in the area of airport performance along a number of principal axes as follows:

1. Definition of a more intuitive performance 'dashboard' offering a clearer indication of the adherence of the current and predicted airport performance to the targets set within the performance steering process.
2. The possibility to 'drill down' to obtain more information on specific performance drivers so as to isolate the contributing factors to the performance deviation.
3. The development of a 'what-if' capability as an aid to the decision-making (performance management) process.

These three activities are all currently being developed at the time of writing. It is planned to perform a V2 maturity gaming workshop within 6.3.1 in early 2016 to demonstrate the feasibility of the approach and both proposed SESAR 2020 Solutions within PJ04 will take the work further forward.

In terms of contribution to the OI step maturity, the impact of VP-547 was as follows:

AO-0801: full V2 maturity in so far as the collaborative planning interface integrating all of facets of the AOP was demonstrated (and appreciated by stakeholders) within the exercise.

AO-0802 : full V2 maturity for the passenger process elements (baggage not simulated).

AO-0803: full V2 maturity for the ATV elements

AO-0804 : partial V2 maturity in so far as more development (as described above) around collaborative performance management was identified as being required.

VP-648 (based on the INDRA AOP prototype) contained an implementation of the collaborative airport planning interface enabling both the presentation of information to stakeholders from the AOP but also permitting stakeholders to input certain information onto the AOP. There was also a full monitoring of the ATV. VP-648 demonstrated that the collaborative planning interface and the monitoring of the ATV could both be realised in an operational environment. In addition, the architecture realised for this exercise in Palma de Mallorca (PMI) resulted in a measured improvement of both arrival and departure predictability (40% and 30% respectively) when compared to that achieved in the existing airport operational environment.

In terms of contribution to the OI step maturity, the impact of VP-648 was as follows :

AO-0801: full V2 maturity in an operational environment.

AO-0803: full V2 maturity in an operational environment.

The work of 6.5.2 in these three validation exercises has had significant impact on the work of the OFA. In particular, VP-547 served as a pre-cursor for the 6.5.4 VP-013 exercise. Indeed, the platform developed for VP-547 was further enhanced to include some of the defined APOC processes and many of the organisational and operational lessons learned from VP-547 were carried forward into VP-013. On the other hand, VP-648 was the pre-cursor to the Release 3 exercise (VP-609) focussed on TTA and performed in PMI. In particular the Indra AOP prototype integrated into the PMI environment was used for both VP-648 and VP-609.

In terms of Enablers, P6.5.2 focussed its attention primarily (but not limited to) on Airport-03, namely the Airport Operations Plan management tool. This Enabler is defined as “A local management tool allowing all airport CDM partners to access and update the AOP (which provides a common and collaboratively agreed rolling plan that will form the single source of airport operations information)”. The focus on this particular Enabler is important to note since not only is it central to all four OI steps covered by the project but also the entire OFA.

1.3 Project Achievements

The project has contributed to the definition and validation of the AOP in a number of different areas as described below:

Validation platform development and utilisation

An early activity of the project was the implementation of the AOP data elements and timestamps as well as the airport performance monitoring and alerting process into a fast-time simulation. Through the detailed analysis of the different simulated stakeholder interactions it was possible to demonstrate the feasibility of the AOP as a rolling plan.

As a means of promoting stakeholder awareness, understanding and buy-in of the concept, it also performed a real-time simulation with the objective of exploring the situational awareness of different stakeholders gained through the AOP. The platform used for this simulation was procured by EUROCONTROL in the context of P6.5.2 and it has subsequently been used by 6.5.4 (VP-013) with extensions covering the APOC decision-making process. The platform will also be used within 6.3.1, by WP7 for the execution of VP-730 and also for V2 maturity validations in the context of SESAR2020.

Preparation of prototypes / V3 validations

The project worked closely with INDRA (P12.6.2) in relation to the development of the AOP prototype and its first use in a shadow-mode environment within VP-648. The same architecture concerning the interface between the AOP prototypes was subsequently used in the V3 live trial (VP-609) focussing on the airport role in the Target Time of Arrival process.

Communication and dissemination

In addition to the stakeholder (both airport operator and airlines) participation in the real-time simulation activities of P6.5.2, the project was also responsible for two dissemination videos which were placed into the public domain.

The first of these focussed on the Airport Operations Management concept encapsulated within OFA 05.01.01. The link to this video can be found at:

www.youtube.com/watch?v=E9fbEW9rnc0

At the time of writing, this video has been viewed in excess of 5600 times.

The second video focussed on the real-time simulation (VP-547) of the analysis of situational awareness in relation to the AOP. The link to this video can be found at:

http://m.youtube.com/watch?v=AruGA3m1vTk

Again, at the time of writing, this video has been viewed in excess of 1700 times.

The principal R&D question addressed by the project relates to the degree to which situational awareness of different stakeholders can be improved as a result of sharing common information and benefiting from automatic warnings and alerts relating to deviations from the plan. Through the different validation exercises, the project has significantly contributed to the maturity of the definition of the AOP that has now been attained.

1.4 Project Key Deliverables

The following table indicates the status of the project deliverable as perceived by the Project Leader at the time of writing. Some small differences with the Deliverable Register on the project SJU extranet site have been observed and these differences have been communicated to the SJU.

Code	Deliverable Name	SJU Template	Handover	Assessment Decision
D01	Close out report (This present document)	FPR		
D02	AOP Update concept document	GEN	27/05/2011	No reservation (P)
D03	AOP Update scenarios and Use Cases	GEN	12/08/2011	No reservation (P)
D04	Mock-up requirements capture	GEN	08/09/2011	Reservation/s requiring clarification/s[1]
D05	Mock-up availability note	AN	13/03/2012	No reservation (P)
D07	Contribution to V1 OFA OSED	OSED	05/08/2013	No reservation (P)
D08	Theme 1 Validation Plan	VALP	13/03/2012	No reservation (P)
D09	Theme 1 Validation report	VALR	27/11/2012	No reservation (P)
D10	Delivery Note for Contribution to OFA 05.01.01 OSED Edition 2	OSED	09/08/2013	No reservation (P)
D11	Theme 2 Validation Plan	VALP	28/01/2013	No reservation (P)
D12	Theme 2 Validation report	VALR	21/11/2013	No reservation
D16	VP-648 Validation Plan	VALP	12/04/2013	Reservation/s requiring clarification/s (to be checked)
D20	VP-648 Validation Report	VALR	21/11/2013	No reservation

[1] These reservations were required to be resolved during the reporting of the THALES modelling study but as explained elsewhere that activity did not take place as it was superseded by the OFA OSED content.

The Deliverables of type VALR produced by 6.5.2 are described below :

1.4.1 D09 - Theme 1 Validation report

This document [11] describes the results of the V2 - AOP validation activity, EXE-06.05.02-VP-546. These validation exercises were performed to explore the feasibility of maintaining a dynamic “rolling” AOP, updated both through stakeholder input and as part of the overall airport process monitoring.

The main conclusions from this fast-time simulation were that:

- The ATV timestamps related with A-CDM milestones can be maintained in real time in order to reflect the visit of an aircraft to an airport. The notion of ‘linking’ arriving flights with the subsequent departure through the ATV (the “airline airframe” view”) was found to be fully feasible and worthy of future investigation in shadow mode trials during 2013 using the Indra IBP.
- The performance monitoring is able to calculate and record appropriate KPA data.
- The airside airport process warnings and alerts were correctly triggered and raised for allocated stakeholders.
- After the updates of the responsible stakeholders the AOP was rebalanced, and hence the warning/alerts were erased.
- The airport process monitors can be maintained in real time in order to reflect the dynamic airside and landside process status.

The main recommendations were that:

- The CAST tool, the airport model and the implementation of the AOP concept can be used as basis for the foreseen gaming exercise (EXE-06.05.02-VP-547) during 2013.
- All core AOP requirements that were defined in the VALP can now be carried forward into OSED Edition 2 and form the basis for the work of WP12.

1.4.2 D12 - Validation Report for EXE-06.05.02-VP-547 (Airport Operations Plan Gaming)

The validation exercises described in this report [14] concentrated on the quality of situational awareness gained through the availability of the AOP data and automated monitors. The exercises were performed in line with the SESAR approach to validation in terms of a ‘reference’ and a ‘solution’ scenario. In this particular case, the reference scenario provided limited data (limited to the A-CDM timestamps) and the solution scenario provided a fully integrated AOP with the timestamps defined for the Airport Transit View as well as a host of automated alerts relating to airport process and performance monitoring.

The aim behind the validation exercise was to provide input into the refinement of the OFA05.01.01 OSED requirements as well as guidance for WP12 in their activities associated to the development of Industrial Based Prototypes (IBP) in support of V3 validation activities.

The exercises took place in June 2013 at EADS ASTRIUM premises in Les Mureaux, France in collaboration with EUROCONTROL, SEAC airports and airline representatives.

The main conclusions from the exercise were that:

- The validation exercise was found to be successful by all involved partners. They stressed the high value of this kind of validation technique and all participants stated that they would readily participate in similar future activities.
- The analysis of the process warnings/alerts from the simulation platform revealed that the raised warnings/alerts from the system could be handled properly and coincidentally gained quick situational awareness. It also highlighted that stakeholders react to warnings only after collecting more background info. Especially the TOBT warning was taken seriously and got several manual updates. The Security Throughput Warning Alert that resulted in several manual updates is also worth to be mentioned. The stand warnings were also frequently used to solve problems before they escalated. It could be stated that the integration of the landside monitoring has substantial influence on operational decisions.
- The analysis of the performance indicators did not reveal a considerable gain of performance because disturbance did not reach a high level of intensity to make collaborative decisions. Furthermore the presented KPIs were used only rarely but not to influence a decision.
- A very important conclusion was that the stakeholders in these exercises acted on an operational level and were not responsible to manage the performance of an airport. This is distinctly delegated to the APOC that was not subject of the validation exercise.

The main recommendations were that:

Future Validation activities should….

- Note carefully the feedback obtained in relation to the difficulty of using the airport performance KPIs within the decision-making process and also note the fact that the differentiation between an alert and a warning was sometimes difficult and that certain warnings were seen as distracting. In particular, VP-013 with its increased scope, including the APOC decision-making process, should address both of these issues in detail.
- Note the positive feedback concerning the utility of the airport configuration map and superimposed aircraft positions and provide such a facility for assessment as an aid to enhancing the situational awareness of partners within the APOC.
- Pay particular attention to the fact that validation scenarios within the airport operations management concept can, by definition, be quite lengthy in their duration as they will ideally cover the phases of problem identification, problem management/mitigation and finally the recovery period; The validation platform used for this exercise was able to execute in an ‘accelerated mode’, although this is complex from both a preparation perspective and also from the perspective of the participants being able to attain/maintain their situational awareness. Nevertheless, such functionality is likely to be needed in future platforms hosting simulation activities within the OFA.
- Be mindful of the fact that the preparation of such a simulation constitutes a significant amount of work that goes far beyond simply publishing a SESAR Joint Undertaking compliant Validation Plan. Typically the tasks of data preparation, scenario construction and platform verification are all very time and effort consuming. In addition, the tasks of preparing training material and planning the training phase of the exercise should in no way be underestimated.
- Be mindful of the fact that the potential “user” community of such simulations goes beyond the Airspace User and Airport Operator community that took part in VP-547. Future exercises must involve a wider community e.g. ground handlers and also pay particular attention to ensure that the “right” profiles from each organisation are present most notably from the airline community.
- Pay particular attention to the intended post-exercise data analysis that will be performed so as to ensure that this data is gathered and stored in a ‘user-friendly’ manner. VP-547 performed a significant amount of work after the exercise to filter the desired recorded data and this task should be minimised, or at best eradicated, in the future.

Concerning the feedback retained in relation to the operational concept, the project recommended that:

- All KPIs be discussed and modelled in a working group composed of airport and airline experts in order to identify those KPIs which have most meaning and relevance for the task of airport operations management. Such an activity will be proposed within the newly defined P6.3.1.
- The chat functionality and improved HMI be the subject of the development of requirements for future editions of the OSED (and SPR / INTEROP) as appropriate.
- The technological challenge around the integration or fusion of information from the landside in the AOP be further investigated. The planned VP-549 has an important role to play here.

1.4.3 D20 - VP-648 Validation Report

This report [16] provides the background and results of this AOP validation activity (V2) dedicated to check the feasibility of a “rolling” plan which is continuously updated to improve the quality of the information displayed, as well as the structure displayed based on the ‘Airport Transit View’ (ATV) concept to improve operations management.

The main conclusions of the validation activity were:

- The ATV timestamps related with A-CDM milestones can be maintained in real time in order to reflect the visit of an aircraft to an airport.
- The airside airport process warnings and alerts were correctly triggered and raised for allocated stakeholders, and allowed an improvement in the quality of the information displayed.
- After the updates by the responsible stakeholders the AOP was rebalanced, and hence the warning/alerts were erased.
- The integration of data coming from different sources and managed by a Business Management Model is able to improve stakeholder’s situation awareness.
- The integrated model provided by the ATV concept is able to provide improved departure predictability compared to the fragmented systems in use.
- Arrival predictability: up to 40% better compared to the isolated Airport Operator Systems.
- Departure predictability: up to 30% better than actual fragmented system.

1.5 Contribution to new Standards and Norms

There was no necessity for the project to contribute to new Standards and Norms as its focus was too early in the validation lifecycle.

1.6 Recommendations

The project expended considerable effort in the development of the validation platform used for both its fast-time and real-time simulation activities. This platform allowed a number of stakeholders to evaluate the AOP concept in highly realistic conditions. As a result the feedback obtained was of high added value in the elaboration of the concept and the project therefore recommends that further development of the concept both in SESAR 1 and onward into SESAR2020 at V2 be based on the use of realistic simulation scenarios hosted on an appropriate platform.

A number of areas of the concept linked to the AOP require further development and testing. In particular, it is recommended that an accelerated programme toward validation and testing of the following key conceptual elements be performed:

- Airport performance management
- “Total” Airport performance monitoring and alerting
- Integration between the AOP and NOP

As described earlier in the document, project 6.3.1 is working on improving the approach to airport performance management particularly around the development of performance dashboards, drill-downs and ‘what-if’ support to the decision-making process.

A specific V3 exercise in release 5 (VP-549) focussing on landside performance monitoring and alerting will take place in PMI in Summer 2015 under the auspices of 6.3.1

The definition of the sharing of information between the AOP and NOP has been recently the focus of a dedicated study group comprising experts from both WP6 and WP7. The finalisation of this interface leading to European standardisation as well as the further development of airport / network collaborative processes will take place in SESAR2020.

P6.5.2 has now successfully delivered against all of its tasks in its current baseline and the only remaining activity for the project is its closure process. The P6.5.2 partners therefore recommend that the SJU approve this current report so as to formalise the project closure as soon as possible.

2 References

[1] SESAR Programme Management Plan, Edition 03.00.01

[2] European ATM Master Plan, Edition 2

[3] Latest Project Baseline, Edition 04.09.2013

[4] 06.05.02-PIR-PART1-00.03.00, Edition 00.03.00, May2010

[5] Airport Operations Plan Validation, AOP Update Concept Document, P06.05.02 – D02, Ed.00.01.00, 04.03.2011

[6] Airport Operations Plan Validation, AOP Update scenarios and use cases, P06.05.02 – D03, Ed.00.01.00, 01.08.2011

[7] Airport Operations Plan Validation, Mock-up requirements capture, P06.05.02 – D04, Ed.00.01.00, 12.08.2011

[8] Airport Operations Plan Validation, Mock-up availability note, P06.05.02 – D05, Ed.00.01.00, 13.03.2012

[9] Airport Operations Plan Validation, Contribution to V1 OFA OSED, P06.05.02– D07, Ed.00.01.00, 05.08.2013

[10] Airport Operations Plan Validation, Theme 1 Validation Plan, P06.05.02 – D08, Ed.00.02.00, 01.06.2012

[11] Airport Operations Plan Validation, Theme 1 Validation Report, P06.05.02 – D09, Ed.00.01.00, 23.11.2012

[12] Airport Operations Plan Validation, Delivery Note for Contribution to OFA 05.01.01 OSED Edition 2, P06.05.02 – D10, Ed.00.01.00, 18.09.2013

[13] Airport Operations Plan Validation, Theme 2 Validation Plan, P06.05.02 – D11, Ed.00.02.00, 29.04.2013

[14] Airport Operations Plan Validation, Validation Report for EXE-06.05.02-VP-547 (Airport Operations Plan Gaming), P06.05.02 – D12, Ed.00.02.00, 31.01.2014

[15] Airport Operations Plan Validation, VP-648 Validation Plan, P06.05.02 – D16, Ed.00.01.01, 14.02.2013

[16] Airport Operations Plan Validation, VP-648 Validation Report, P06.05.02 – D20, Ed.00.02.00, 16.01.2014

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