EPISODE 3

Single European Sky Implementation support through Validation

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Alan Marsden	EUROCONTROL
Contributing partners within the Episode 3 Consortium	
EUROCONTROL, AENA	
Contributing partners external to the Episode 3 Consortium	
Air Berlin, Air Europa, EasyJet	
Acciona Ground Handling Services, IBERIA Ground Handling Services	
Airport Research Centre, Aachen Germany	

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DOCUMENT CONTROL

Approval

Role	Organisation	Name
Document owner	EUROCONTROL	Alan Marsden
Technical approver	AENA	Pablo Sánchez Escalonilla
Quality approver	EUROCONTROL	Catherine Palazo
Project coordinator	EUROCONTROL	Philippe Leplae

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EXECUTIVE SUMMARY

The EUROCONTROL Airport Collaborative Decision Making (A-CDM) initiative was developed with a view to enhancing the quality of both airport and network operations through the sharing of accurate information, particularly relating to arrival and departure estimates. Whilst a number of airports are well advanced in the introduction of the various A-CDM concept elements, the overall philosophy is still far from being embraced as a standard throughout Europe. The lack of a harmonised approach to collaborative airport planning means that a number of characteristics are inherent in the system, each of which may be true to varying degrees in individual airports, namely:

- Limited data sharing both amongst the airport actors and with the network;
- Limited knowledge of operational constraints of different actors;
- Airport operations are generally oriented toward throughput within the allowable envelope of environmental constraints and there is no overall performance framework;
- Limited visibility concerning the evolution of future operations e.g. the return to nominal capacity after a disruption.

The SESAR Consortium, during the programme definition phase identified the need to build on the A-CDM foundation as a means of strengthening the information sharing between airports and the wider network but to specifically reinforce the collaborative element of the local airport decision making process. The following R&D requirement was identified as being necessary for the SESAR development phase:

> *“Study of airport processes associated with common understanding of a common planning process, common situational awareness and a common performance framework, as well as the tools to visualise the predicted performance (capacity, environmental load, delay etc) as these do not exist today, nor do the procedures”*[1]

A fundamental aspect of the future SESAR concept is the evolution toward a performance based ATM system. This notion of performance management is therefore a cornerstone of the future airport concept which foresees an “integrated” airport management framework, where all major aircraft operator, airport, aerodrome ATC and ground handling processes are conducted using common data sets and agreed procedures. This future method of airport management, can, with some justification, be referred to as Total Airport Management (TAM).

The core information basis of TAM is the Airport Operations Plan (AOP). The AOP, through the judicious definition of its format, content and interfaces, must be the vehicle which permits the collaborative decision making process and adherence to the agreed performance framework. The AOP must also be the information source which permits airports to be fully integrated into the network planning process and this will be achieved through the appropriate sharing of information content between the AOP and the Network Operations Plan (NOP).

[1] SESAR DLT-0612-222-00-15 DRAFT0.15, Page 189

In terms of performance indicators, the notion of reduced costs, increased throughput and increased efficiency are important for each airport actor. Punctuality is an important issue for passengers and therefore the commercial interests of the airlines. Increasingly, the impact of aircraft operations on both noise and pollution mean that “green” considerations will play a key part in the airport operational decision-making process. The AOP therefore represents the common vision that each actor will have relating to airport performance and the decision as to how to “trade-off” the different and often conflicting performance parameters as a function of different stakeholder requirements varying over time will be achieved through a collaborative redefinition of the AOP.

This report describes the results of a number of ‘expert group’ meetings held with the stakeholders at the airport of Palma de Mallorca (PMI). The aim of these meetings was to elaborate both the potential content of the AOP and a number of early ideas in the domain of situational awareness and monitoring. The scope of the expert group sessions was therefore closely aligned with the SESAR R&D requirement relating to common situational awareness and the need for a common performance framework.

The report proposes a number of services which the TAM concept should enable and provides a high-level breakdown of the content of the AOP which will be necessary if these services are to be realised. One key element of the future concept will be the notion of performance monitoring and re-planning in the event of deviations from the agreed performance levels. In this context, the report proposes an initial framework for both an ‘aircraft monitor’ and a ‘passenger monitor’ which will both be necessary if the objective of full airside and landside integration is to be realised. The links with the Work Programme of the SESAR Joint Undertaking are described. Finally the report concludes with a number of reflections concerning the key lessons learnt in relation to the expert group process in an attempt to maximise the utility for future operational concept development using such a validation technique.

Whilst the SESAR Work Programme has been defined in a way as to take this work forward, the deliberations of this expert group are believed to represent the most mature elucidation yet of the SESAR concept for future airport operations in terms of the potential content of the AOP and the issue of airport performance monitoring.

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1 INTRODUCTION

1.1 SESAR OPERATIONAL CONCEPT FOR COLLABORATIVE AIRPORT PLANNING

The SESAR Operational Concept states that airport operations during the medium/short term planning phase will be built upon the framework of Airport Collaborative Decision Making (A-CDM) but with further enhancements to the decision making process. In the current system, despite improved data sharing, notably through the A-CDM initiative (See a detailed implementation Manual for A-CDM [2]), there still remains the reality that operational decisions within an airport are implemented largely as the result of "reactive management" rather than "predictive management". Invariably the "solution" is limited to maximising the immediate interests of those responsible for making a given decision. SESAR therefore proposes a concept whereby operational decisions, particularly those during periods of reduced capacity, taken by any given airport actor may be made in the full knowledge of the operational constraints and/or priorities of other actors who may be impacted by the decision. The management of degraded situations will therefore be improved, coupled with an earlier recovery to normal operations. The focus of this document is therefore in the "Airport Planning" phase as illustrated below:

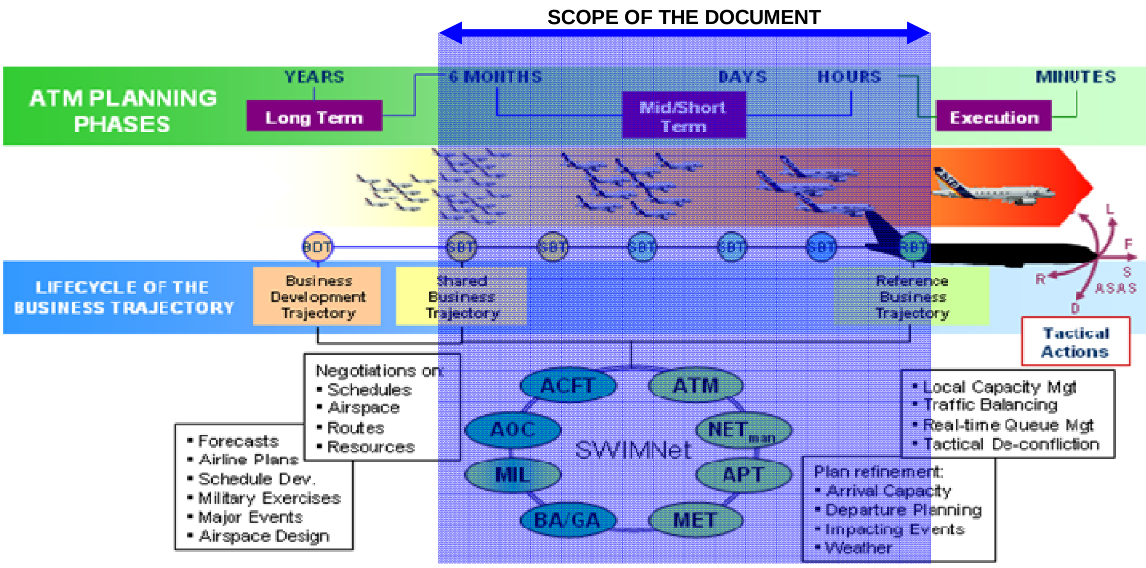

Figure 1 : ATM Planning phases

A fundamental aspect of the future SESAR concept is the evolution toward a performance based ATM system. This notion of performance management is therefore a cornerstone of the future airport concept which foresees an "integrated" airport management framework, where all major aircraft operator, airport, aerodrome ATC and ground handling processes are conducted using common data sets and agreed procedures. This future method of airport management, can, with some justification, be referred to as Total Airport Management (TAM).

The initial high-level TAM concept was developed jointly by EUROCONTROL and DLR in a series of workshops during 2006 and detailed in the form of an Operational Concept and Logical Architecture document [1]. This Operational Concept was then further elaborated in the context of Episode 3, specifically by taking a process-oriented view of the Airport Planning phase. The result of this work was published in the form of a Detailed Operational Description (Reference [2]). This Detailed Operational Description (DOD) is based on the premise that in order to move toward a performance-based airport management philosophy, it is necessary that all major aircraft operator, airport, aerodrome ATC and ground handling processes are conducted using common data sets and agreed procedures. This common data set is referred to as the Airport Operations Plan (AOP). The AOP will contain pertinent data which is continually refined as more accurate information becomes available. Through the judicious definition of its format and content, it must be the vehicle which facilitates the collaborative decision making process within the agreed performance framework. The monitoring of the airport performance in relation to the commonly agreed plan will be performed through direct access to the pertinent elements of the AOP.

The main concept elements of TAM which are being proposed herein are fully aligned with the SESAR Work Programme. The definition and validation of the AOP content will be performed under the auspices of the SESAR Joint Undertaking (SJU) within Work Packages 6.5.1 and 6.5.2 respectively. Within TAM, it is envisaged that the collaborative management of the AOP and the resultant decision making and arbitration process will be performed with an Airport Operations Centre (APOC). The definition of the APOC in terms of roles, responsibilities and procedures is foreseen within SJU Work Package 6.5.4.

The AOP must also be the information source which permits airports to be fully integrated into the network planning process and this will be achieved through the appropriate sharing of information content between the AOP and the Network Operations Plan (NOP). The exact relationship between the AOP and the NOP is the focus of SESAR Work Package 6.5.3.

This report describes the results of a number of ‘Expert Group’ meetings held with the stakeholders at the airport of Palma de Mallorca (PMI). The aim of these meetings was to elaborate both the potential content of the AOP and a number of early ideas in the domain of situational awareness and monitoring. The scope of the Expert Group sessions was therefore closely aligned with the SESAR R&D requirement relating to common situational awareness and the need for a common performance framework. ***The results described in this report are intended to provide early information, guidance and risk reduction to SJU Work Package 6.5.1.***

Particular areas that the attention of the Expert Group has focussed on are the following:

- The move from “reactive management of situations” to “predictive management”.
- A Performance based management approach. This is clearly reflected in the ‘passenger monitor’ presented later in the report.
- Situational awareness (monitoring): airside, landside and the link between them;
- The potential for increased predictability to reduce buffers in the system;
- The importance of improved data (information) sharing to increase operational efficiency
- Current operational problems and the possibility to either solve them or at least better manage them in a collaborative environment – as a means of ‘validating’ the concept ideas.

1.2 INTENDED AUDIENCE

Within the context of the agreed Episode 3 contract, this report represents a formal deliverable for acceptance by the European Commission. Apart from the contractual obligation, the report is also intended to provide source material for WP2 of Episode 3 as part of the task of refining the Detailed Operational Descriptions (DOD) and Operational Scenarios relating to collaborative airport planning. Notably the content of DOD M1 [2] and the operational scenarios referring to the turn-round task and the AOP in the planning phase will be totally coherent with the findings of this expert group. Ultimately, this report is intended to fulfil the need to add more detail to the 'high-level' nature of the airport concept defined in the third deliverable (D3) of the SESAR Definition Phase (SESAR D3 [4]) and the related deliverable DLT222 [6].

The report is also delivered for approval to the airport of Palma de Mallorca in order to be used as a key input to enable the elaboration of the functional specifications associated with their initial steps toward implementing the 'monitoring' elements of the AOP.

Finally, the report is intended to provide key material for the SJU. As previously stated, the definition of the content of the AOP and the wider elaboration of the TAM concept will be performed by the SJU in WP6.5 and its constituent sub-work packages. The expert group sessions with PMI are believed to have reached a sufficient level of maturity so as to allow the SJU partners to structure their relevant work programme around the key 'themes' of the AOP which are described in Section 5.

1.3 Document structure

Section 2 describes the collaboration between EUROCONTROL and AENA which resulted in the creation of a group of experts in airport operations and whose remit was to focus on airport processes and the extent to which these processes are performed in a collaborative nature. In so doing, it was the aim to consider the requirements for a future airport concept based around information sharing as a means to increasing the planning horizon. The methodology for the expert group sessions and associated support tools are presented in Section 3. The current problems in Palma de Mallorca (PMI) and the potential for better managing these problems in a collaborative environment is the focus of Section 4.

Section 5 goes on to present a high level proposal for the content of the Airport Operations Plan (AOP) in terms of a number of 'themes' which were elaborated within the expert group. These themes have the role of providing the totality of services required by the Total Airport Management (TAM) concept but importantly their correct definition should enable the particular problems experienced in today's operations to at best be solved but at the very least to be better predicted. An analysis of current operational problems in PMI and their relationship to the proposed AOP themes is therefore presented.

One of the key themes identified for the AOP is that of airport performance monitoring and problem detection. The experts focused their attention on how reliable and accurate data relating to arrival and departure estimates coupled with the turn-round milestones of A-CDM could be integrated to provide a view of the status of each aircraft which the airport is concerned by. Similarly an analysis of the landside process performance and identification of potential bottlenecks can lead to an earlier prediction of potential problems in the passenger flows. The findings of the experts relating to both the aircraft and passenger monitors, as well as the necessity to fully integrate them, are presented in Section 6.

Section 8 concludes the report by highlighting a number of the main lessons learned during the study as well as the authors' perspective on the benefit that this work has yielded for the SESAR Development Phase.

1.4 Glossary of Terms

Please refer to the Episode 3 Lexicon [4].

Term	Definition
A-CDM	Airport Collaborative Decision Making
AENA	Aeropuertos Españoles y Navegación Aérea
ANSP	Air Navigation Service Provider
AOP	Airport Operations Plan
APOC	Airport Operations Control Centre
ATC	Air Traffic Control
ATM	Air Traffic Management
CAST	Comprehensive Airport Simulation Tool
DLR	Deutchs Zentrum für Luft-und Raumfahrt

Term	Definition
DOD	Detailed Operational Description
EIBT	Estimated in-block time
ELDT	Estimated Landing Time
EOBT	Estimated off-block time
FMS	Flight Management System
KPA	Key Performance Area
KPI	Key Performance Indicator
LVP	Low Visibility Procedures
NOP	Network Operations Plan
OCC	(Airline) Operational Control centre
PMI	Palma de Mallorca
SESAR	Single European Sky ATM Research and Development Programme
SESAR JU or SJU	SESAR Joint Undertaking
TAM	Total Airport Management
TSAT	Target Start-up approval time (issued by ATC at A-CDM airports)
TOBT	Target Off-block time (communicated to partners at A-CDM airports)
TTOT	Target Take Off time

Table 1: Glossary of Terms

2 THE COLLABORATIVE AIRPORT PLANNING EXPERT GROUP

A series of informal discussions between EUROCONTROL and AENA during both the SESAR Definition Phase and in the context of A-CDM development highlighted a strong interest on the part of the management of the airport of Palma de Mallorca (PMI) in the future Total Airport Management (TAM) concept for airport operations. A potential "win-win" situation was therefore identified in so far as Episode 3 could take forward its future concept work with the aid of operational experts from PMI whilst for the PMI stakeholders, they would both:

- participate directly in potential future evolutions in the management processes at their airport, thereby enhancing the sense of 'ownership';
- gain a detailed insight into how the future concept may be able to address specific problems associated with their own operations.

The process of detailed tripartite discussions between EUROCONTROL, AENA HQ and PMI started in spring 2008. In June 2008, a team from EUROCONTROL and AENA/PMI gave an initial presentation to the airport operator, representatives of airport security, ground handling services and a number of incumbent airlines which highlighted both the TAM concept and the aims behind the expert group process within the wider context of the Episode 3 project.

In November 2008, following further discussions with PMI management, a formal invitation to participate in the first series of expert group sessions was issued to the following organisations:

Acciona Ground Handling Services	IBERIA Ramp Handling Services
AENA PMI Airport Operations	Air Berlin
Air Europa	EasyJet

Table 2 : Expert group participants

It was agreed that the expert group sessions would focus on the turn-round and boarding processes and the passenger flows. The "timely integration" of these different processes and flows is a fundamental element of the TAM concept. Therefore the expert groups would focus on the underlying processes and the necessary information sharing between them in order to achieve the required level of integration.

The Air Traffic Control (ATC) authority at an airport is seen as a key partner in the collaborative decision making process. This is true in both the A-CDM concept (through the issuing of TSAT and the management of the adherence to the TTOT) and in the future TAM concept where much of the probable information content of the AOP will be the responsibility of ATC (decisions concerning runway capacity during LVP to cite one example amongst many). However, the focus of this report is specifically on the planning phase of airport operations and the generation of a "first-pass" AOP. During this phase the role of ATC is less crucial and therefore the expert groups did not include ATC participation. The constitution of similar expert groups within the SJU work programme to address the APOC functionality and the collaborative re-planning of the AOP will however require ATC participation.

It was agreed between EUROCONTROL and PMI to conduct each expert group session according to a specific format dependant on the scope and maturity of the particular element being discussed, as follows:

Bilateral meetings: Individual meetings between EUROCONTROL and each of the above organisations. This approach was designed to ensure maximum involvement of each participant and the maximum 'relevance' of the discussion at all times.

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Plenary sessions: Open to all participants to validate findings from the bilateral meetings and the "off-line" work conducted by EUROCONTROL/AENA. As a result, these meetings sought to agree and propose enhancements to PMI airport operations in line with the TAM concept, notably those which could be achieved through the creation and appropriate updating of the AOP.

From the perspective of the Episode 3 project, it should be noted that the participation of members of the above organisations in each expert group session was given voluntarily. No costs to Episode 3 (either travel or allowances) have been incurred by any PMI participant in the local expert group sessions.

The fact that all participants from PMI involved in the expert group sessions are current operational staff with limited time availability presented a particular challenge from an organisational perspective. However the key challenge for the EUROCONTROL team members was to strike the right balance between:

- focussing on specific PMI operations, which is a natural tendency for the participants and for which their expertise is the most accomplished, against
- the need to develop a generic concept with associated guidelines which could be seen as applicable to the wider airport community.

The extent to which this work proves useful for both PMI in their future AOP implementation and the SJU in structuring their work programme will be testament as to whether this objective was accomplished successfully.

3 EXPERT GROUP METHODOLOGY

3.1 PROCESS ANALYSIS

Each expert group session was structured so as to focus on a description of the way that relevant processes are performed today and, more importantly, how it was considered that these processes could and should be performed in the future from the perspective of enhancing overall efficiency and ultimately the on-time departure of flights. Therefore each expert group sought to extract:

- A detailed description of the existing process which each organisation is involved in. Typical questions posed by the project team related to the decision making process, the information which is shared and its accuracy.
- Typical problems which can occur and the reasons for these problems but particularly the shortcomings in the existing process which may not allow such problems to be foreseen or easily managed.
- An understanding of how the existing operation could be enhanced so as to improve both the predictability and the overall efficiency. This may include the provision of data which today is either not available or is of poor quality, or a change to the way in which the operation is currently performed.
- An understanding of relevant Key Performance Indicators (KPIs) for each process and how the process may be monitored in real-time so that deviations from the planning may be detected and thereby permitting decisions to be taken in a timelier manner.

An example of the support material used in the process analysis associated with aircraft turn-round is given in the following diagram. Such material permitted the attention of the experts to focus on specific sub-elements of the overall process but importantly to consider the notion of 'alarms' and 'milestones' which could form an integral part of the process monitoring.

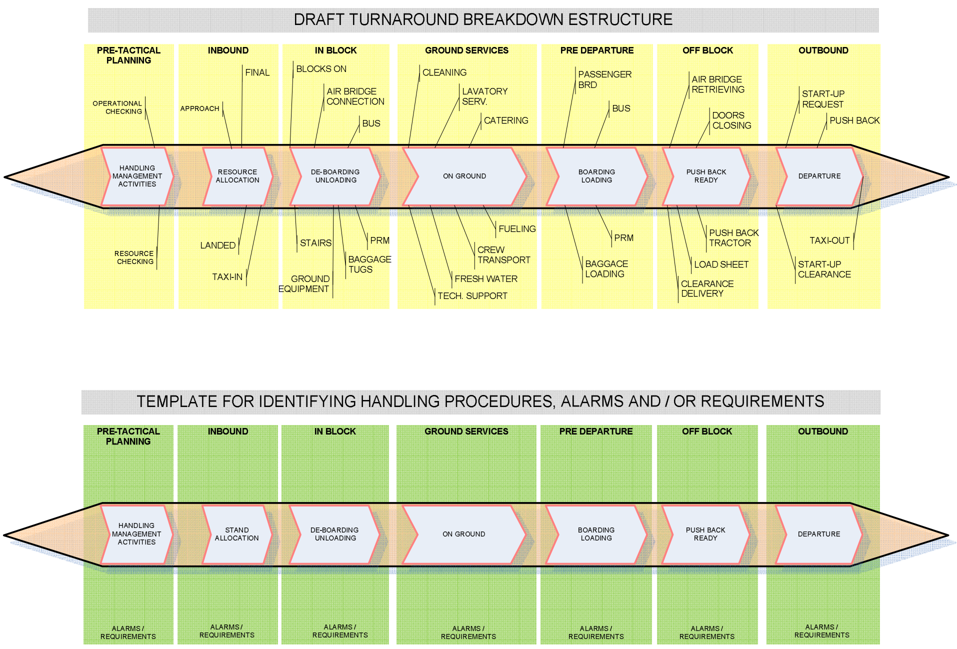

Figure 2 : Turn-round Breakdown Structure

3.2 FAST-TIME SIMULATION SUPPORT

The Comprehensive Airport Simulation Tool (CAST) developed by the Airport Research Centre (ARC) 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[2]. 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 PMI expert group, the simulator was identified as a suitable support tool for elaboration of the monitoring processes required to aid decision making. It was therefore considered desirable to ensure that CAST could become a fully integrated part of the PMI Expert Group work so as to be able to provide a quantitative assessment of any potential performance benefits which may be possible through improved data sharing and improved process monitoring.

In order to achieve this capability it was necessary to integrate the PMI 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 has the apron and ramp configuration.

A static screenshot from the CAST model of the PMI terminal infrastructure and parking locations is shown in the following Figure 3.

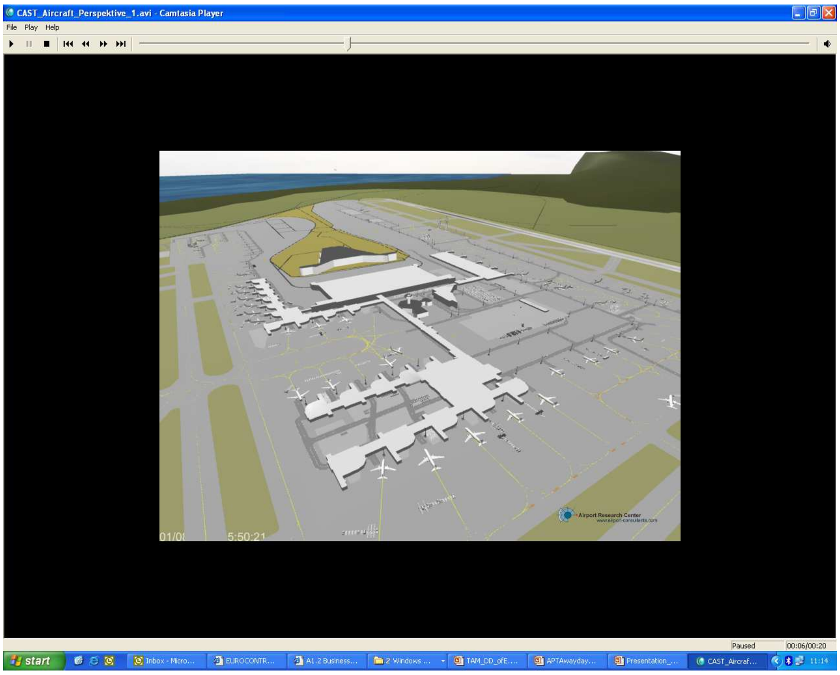

Figure 3 : CAST model

2 Advisory Council for Aeronautics Research in Europe

A meeting held in EUROCONTROL on 10 December 2008 with the participation of PMI and ARC assessed the suitability and fidelity of the CAST model for analysing PMI operations. The representatives from PMI stated that they considered the model to reflect sufficiently the PMI infrastructure and the specific test scenarios used as part of the validation yielded results which were highly coherent with actual operations in PMI.

In order to create a connection between the CAST simulation and the PMI expert groups, it was decided to present in a first instance to the experts a model of a subset of the current problems that they frequently encounter (refer to Section 4 for a more detailed description) and which were of particular concern to each actor:

- “Late” stand/gate modifications
- The process times associated with security screening

A stand modification of an arriving aircraft can occur at various times before the scheduled arrival time, and the new stand allocated can be located at places where the constraints imposed to the handling agents will be different, depending mainly on the distance between the ‘old’ and the ‘new’ stand. The objectives of the CAST simulation were therefore to demonstrate to the experts the impact of the particular choice of new stand on the management of the ground pool of equipment and resources to accommodate the turn-round of the aircraft.

The analysis via CAST of both stand modifications and landside process times was presented to the experts in plenary session. In particular, the physical layout of the two security gates at PMI, which often results in queues being longer at one than the other, was also demonstrated through CAST. A presentation of the relationship between available resource capacity and resultant queue creation and dissipation was well appreciated and helped the experts to understand the advantages of performance monitoring and pro-active management. In addition, the utility of monitoring the total process execution time (described in detail in Section 6.2) was demonstrated to the experts as a potential KPI for inclusion in the AOP.

The detailed low-level results of each specific CAST scenario are not presented herein but have been provided to PMI as material to assist in their own internal development actions. From the Episode 3 perspective, the use of CAST brought a relatively innovative approach to the expert group sessions. The benefits of the approach were found to include:

- The highly interactive nature of the CAST tool permitted the experts to visualise operations at their own airport and better appreciate the importance of shared information and stable planning.
- The impact of non-optimal capacity and demand balancing associated with landside resources and the resultant (rapid) queue build up and (slow) queue dissipation was easily visible as was the potential impact on punctuality.

Nevertheless, despite the above advantages, the project team were careful to ensure that the work associated with CAST was limited to achieving the necessary functionality to support the development of the TAM concept. In other words, it was important that the tool itself not become the focus of the work.

4 CURRENT OPERATIONAL PROBLEMS

The following section describes the initial discussions with the operational experts concerning their perceptions of current operations. Whilst being specific in nature to PMI, this section is intended to highlight the need for improved collaborative airport planning and information sharing. Indeed, many of the problems highlighted are known to be experienced at other airports in an identical or very similar manner. When discussing specific problems faced by each organisation, a number of topics were raised during the meetings which have to be considered as falling outside the scope of the current study. For example, the airport layout (vehicle routes, one-way systems, equipment storage facilities, etc) may have a significant impact on predictability and efficiency of operations but such “hard” constraints are not addressed within the TAM concept. These discussions, whilst both interesting and useful in the wider context of airport management are not therefore reported in this document.

4.1 ACCIONA GROUND HANDLING SERVICES

ACCIONA provides ground handling services to a number of airlines but the major complexity of its operation is linked to the provision of services to Air Berlin. This airline strives to achieve high load factors by operating coordinated flows between Germany and Spain / Portugal via a hub operation located at PMI. ACCIONA ensures ground handling services to individual Air Berlin flights but also manually ensures the baggage transfer between flights for transferring passengers. This operation is therefore susceptible to the physical distance between parking stands as well as the predictability and stability of gate allocation to inbound flights.

Currently, stand/gate allocation is performed by the airport operator (AENA) and provided to ACCIONA up to 3 hours before the Estimated Landing Time (ELDT). The perception of ACCIONA is that this initial allocation is not optimised from the perspective of hub connectivity. The allocation is also subject to late revision and such late changes can often severely impact ACCIONA operations in relation to its objective of ensuring timely equipment availability. Under normal circumstances the timely provision of ground handling services is guaranteed by ACCIONA monitoring the ATC approach frequency and updating their internal systems with the ELDT once the aircraft is on final approach.

Problem detection during the turn-round process is based on the physical monitoring of individual process execution by the ramp agent assigned to each flight. In line with recognised practices, delays of more than 15 minutes are notified to the airline and departure estimates are updated accordingly. The early arrival of flights, sometimes significantly earlier than their flight plan, can cause major problems in terms of resource availability. ACCIONA operations can be largely characterised as “re-active” - managing problems as they occur and with little stable planning information.

4.2 IBERIA RAMP HANDLING SERVICES

IBERIA is currently developing and evaluating a simple tool combining Excel and Visual Basic for obtaining a partial view of the airport status in real-time. This program integrates information from the IBERIA internal system with information from the AENA airport systems (e-SIA and SCENA) and is used to obtain a global view of the airport status in real time. Such a monitoring tool could form the basis for the requirement definition for eventual integration into the APOC.

A major concern for IBERIA handling is the uncertainty surrounding the accuracy of the estimated landing time (ELDT). An increased visibility concerning the target off block times will also help internal resource management. A number of key milestones and indicators were identified which could improve the efficiency of their operation. These relate to baggage flows and particularly the start of de-boarding and the start of boarding.

Globally, those staff responsible for the turn-round process are not aware of the passenger process status and the staff responsible for the passenger processes have little or no visibility concerning the turn-round progress – despite the fact that the on-time departure of a flight requires that both of these processes be successfully executed in a timely manner. From the ramp agent's point of view, such improved visibility could provide a significant performance enhancement. For example, during periods of long queues at the security control, the passengers arrive at the boarding gate in a more dispersed fashion. This subsequently impacts on the required number of buses in the event that passengers need to be transported to a remote gate.

4.3 Palma de Mallorca Airport Operations, AENA

At H-24 hours, the fist check-in desk resource allocation is carried out. This information is notified to the airlines and requests for changes are then addressed by the airport operator until the execution phase.

A number of information sources are used by the airport operator in order to obtain accurate flight information within their own system. These include messages from SACTA (Automated System of Air Traffic Control) and ICARO (Spanish Flight Plan System) as well as messages from the handling companies. However, there is often much inconsistency between estimates from different sources. Changes to arrival and departure estimates (EIBT and EOBT) have a significant influence on the allocation of airport resources and the airport endeavours to disseminate these changes to interested parties (handling companies, airlines) and landside processes (police, security, …).

A number of key milestones, all available through different sources, were highlighted as being appropriate for integration into the airport system as a means of improving overall predictability and whose integration into the content of the AOP could be automated. These include:

- The pre-boarding time from the handling agent.
- Boarding started.
- The Actual landing time (ALDT). Currently only the estimate is included.
- The Actual In-block time (AIBT). Currently this is a manual input. In addition, there is an "information gap" during the turn-round process between the arriving aircraft reaching the parking stand and the commencement of boarding of the subsequent departure. In the first instance to mitigate this situation, the airport is trying to introduce in the minimum turn-round time that will depend on the airline, the handling company and the aircraft type. This time will be used to calculate a first estimated take-off time (ETOT).
- The Actual Off Block Time (AOBT). Currently this is a manual input.
- The Actual Take-Off Time (ATOT). This is entered automatically into the airport systems from SACTA, but only if the call signs (ICAO - ANSP and IATA – airport) are correlated. A non-correlation alarm is therefore important in the current environment.

Considering specifically the passenger flows, it was highlighted that there is universally a "common check-in" procedure i.e. each check-in desk catering for several flights. Late passengers are routed by assistants to dedicated check-in desks if it is anticipated that their transit time through security screening may cause them to miss their flight. There is little information concerning the potential check-in load, which is heavily influenced by the timing of arrival at the airport of the tour operator buses.

4.4 AIR BERLIN

The particularities of the Air Berlin operation in PMI were described above. The problems that they face as a consequence relate to the fact that the airport infrastructure of PMI was not specifically designed from the point of view of optimising a hub operation. Physical constraints necessitating the operation of flights into and out of different terminals, along with the consequential complexities of passenger and baggage transfer are frequent constraints in the summer period.

The key to managing these constraints in real-time lies in accurate arrival and departure estimates as well as stand allocation predictability and stability. This will necessitate the fusion of data from different sources (airline, airport, ground handler) so as to provide the airline and pilots with the most reliable information in their decision making.

Late gate changes were cited by Air Berlin as impacting their operations due to potential for increased passenger / baggage transit times. Improved information concerning transfer gate allocation should effectively be part of the AOP content and subsequently made available to the passengers in the terminal.

Air Berlin uses common check-in counters with specific processes in place to cater for late passengers. These include the redirection to a dedicated check-in desk as well as being escorted through ‘rapid’ security screening gates.

The non-optimal allocation of resources to the security screening processes as a function of the passenger demand can have a significant impact on the on-time departure of flights. Decisions concerning whether or not to depart without a number of late passengers has to take into account a host of different factors (destination, possibility for re-booking etc) but it is considered that this decision making process could be improved by having a better understanding of where in the overall process the majority of passengers are situated. Air Berlin has gone some way to addressing this problem by placing a number of agents in the ‘sensitive’ areas (check-in, security and boarding) in order to alert the company of the status of the queues in real-time in these areas. A more automated system, fully integrated into the AOP could improve this.

As described earlier, Air Berlin ground handling (airside) operations are performed by ACCIONA. The passenger processes are managed by a different company, AGA. Coordination between these companies is limited and specifically AGA has little or no information on the progress of the aircraft turn-round due to milestones not being shared by ACCIONA. A specific example of a single ‘milestone’ being potentially available in the AOP and subsequently available to all concerned parties concerns the ‘Ready for Boarding’ status. Currently, this information is notified by phone or walkie-talkie by the ramp agent to ACCIONA operation control, after to AGA passenger service and finally, to the boarding desk. This notification should be automatic from ramp agent to boarding desk, e.g. via PDA.

AGA needs to have specific and accurate information concerning the allocation of boarding gates and the number of incoming passengers. Again, Air Berlin states that airport operations should avoid, or, at least notify quickly, the last minute changes of the stands. As mentioned previously the fact that much operational data is based on manual input leads to inaccuracies in the information and inconsistencies between different sources with no ‘common’ data source accessible by the different actors (from airport, airline and ground handling).

4.5 AIR EUROPA

Air Europa, in common with the other participating airlines, is susceptible to changes to the gate and stand allocation and the consequential impact on transfer baggage / passengers. Air Europa also carries a large number of 'inter-line' passengers i.e. passengers transferring from another company to one of their own flights in PMI and therefore accurate estimates concerning the arrival time distributed amongst the airport partners would be particularly beneficial.

They also highlighted the lack of information relating to transit time and its predicted variability through the security screening process.

In order to improve these problems Air Europa and AENA have linked their information systems but further development is necessary. Such an integration is considered to be essential for optimising the operational decision process related to the necessity to delay a flight or not.

The main problems are identified in the passenger handling. Some passengers arrive late to the boarding gate due to congestion in the security process and, primarily in the morning due to the long queues at the check-in process.

To mitigate the passenger impact on the aircraft delay, Air Europa tries to gain some insight into the progress of the overall process through knowledge of the number of passengers checked-in and the number already on board. For connecting passengers this analysis is compromised due to uncertainties surrounding the necessary transit time. This problem is significant due to the long distances that passengers in transit are sometimes required to negotiate.

During low visibility conditions, due to the lack of surveillance on the apron, the operations are strongly degraded due to ATC imposed restrictions.

In order to improve the operations at the airport and optimise the stand allocation process, Air Europa proposed to share their information from the aircraft Flight Management System (FMS) regarding appropriate time estimates and the aircraft registration.

4.6 EASYJET

EasyJet operates "low fare" point to point operations at the airport of PMI. It performs its own handling operations and strives to achieve high fleet utilisation through short turn-round times of typically 30 minutes. The main limit to their operations is their ground handling equipment availability with operations currently limited to the simultaneous service of 6 flights. The nature of the EasyJet operation in PMI means that they are particularly susceptible to late stand and gate changes as well as bottlenecks in the terminal, notably at the security screening.

5 THE AIRPORT OPERATIONS PLAN – PROPOSED THEMES

Following the initial set of bilateral expert group sessions and based on the information that was recovered, EUROCONTROL and AENA/PMI proceeded to shape the concept and analyse the way in which the availability of data within the AOP could be used to address some of the specific problems cited by the participants. These findings, described below, were then validated in plenary session with the experts.

The TAM concept should be based on three "pillars":

1. A collaborative Airport Operations Plan (AOP).
2. An Airport Performance framework with specific performance targets.
3. An Airport Operations Centre (APOC). Within the TAM concept, the APOC is seen as the platform which permits operators to communicate and co-ordinate, to develop and maintain dynamically joint plans and to execute those in their respective area of responsibility. The main information source shared between the actors in the APOC is therefore the AOP. The APOC should therefore be equipped with a real-time monitoring system, a decision support system and a set of collaborative procedures which will ensure a fully integrated management of landside & airside airport processes .

The integration of these pillars will therefore lead to the provision of a number of "services" as follows:

- Performance Planning Service,
- Monitoring and alerting Service,
- Decision Support Service,
- Analysis Service.

There will be two main references used in the management of (the) airport operations, the AOP and the agreed Airport Performance Targets. The AOP will include traffic demand, the availability of resources and the updated knowledge of any element or event that may affect airport operation. The agreed Airport Performance Targets constitute the other key reference to be used in the airport management, firstly in the elaboration of the AOP and secondly in the real time process of updating the AOP.

In order to facilitate the above services, the AOP content has been divided into a number of themes defined as follows:

AOP theme	High level Content
AOP 1	**Demand / Capacity Assessment**. Assessment of demand and resource availability. Comprising flight plans, airport slots, special events, work in progress, strategic planning, airport configurations, capacities, airport infrastructure, equipment availability,…
AOP2	**Performance Trade-off Assessment**. Priority setting between the selected performance areas (Safety, Capacity, Time-Efficiency, Predictability, Environmental Sustainability and Flexibility)
AOP3	**Monitoring the AOP**. Detection of deviations from planning and raising of alerts, supported by: A Common Traffic Situational Awareness ('aircraft monitor') A Common Passenger Situational Awareness, provided by landside monitoring systems ('passenger monitor')
AOP4	**Decision making support**. Appropriate algorithms to assess potential impact of proposed changes to the AOP. This will be closely linked to the performance trade-off assessment (AOP2)
AOP5	**Management**. Implementation of existing A-CDM procedures, particularly the pre-departure sequence based on the Target Off block Time (TOBT). Also integration of new TAM procedures to improve TOBT accuracy and fully integrate landside and airside processes.

Table 3 : Proposed AOP themes

For each of the above AOP themes, the following minimal information requirements were identified with the experts:

AOP 1 (Demand / Capacity Assessment)

Resource assessment:

- Airport configuration;
- Capacities of different sub-elements; runway; apron; terminal; TMA;
- Work In Progress and scheduled time, including operational impact;
- Resource allocation strategy, including environmental constraints and rules .

Schedule:

- Reference Business Trajectories / Shared Business Trajectories;
- Special flights.

External elements:

- Weather forecast;
- Industrial action;
- Special events and Unexpected events.

Knock-on effect:

- Problems in other airports or sectors with strong connections. Airport role as node of the ATM Network.

AOP 2 (Performance Trade-Off Assessment)

The inclusion of all relevant KPIs needed to determine the airport operational diagnostic in both real-time and a time horizon of several hours.

Provision of appropriate tools in support of enhanced situational awareness and exploiting the most accurate data available. At the very least, the provision of an 'aircraft monitor' and 'passenger monitor', in order to move toward full airside and landside integration.

Operational procedures related to potential actions to take in the event of deviations of specific KPIs from their agreed targets.

AOP 3 (Performance Monitoring)

The objective of the monitoring system is to develop a model of the airport operation in real time. This model should provide every expected event in the near future (from minutes to a few hours time frame). The event prognosis should provide appropriate alerts to enable an assessment as to whether individual processes are evolving in a "normal" way, that is to say at least in line with the planning.

The use of the detected alerts will be to help to provide a timely possibility to update the plan in line with the strategies identified in AOP2. Actions and responsibilities will have to be assigned to the actors involved.

Key processes to consider are "local" passengers, transit passengers and the "aircraft process". The idea is to monitor these three processes raising alerts when deviations from the plan may have an impact on the performance targets. The aircraft process has to provide the appropriate degree of visibility regarding the link between the inbound flight and the subsequent departure. In order to achieve this, a number of milestones are proposed – some of which are already present in the A-CDM framework – coupled with a detailed analysis of the passenger process performance.

Aircraft Milestones:

- Actual Landing Time (ALDT), Actual In Block Time (AIBT);
- Open doors at arrival, Boarding Started, Ready to Push;
- Actual off-Block Time (AOBT), Actual Take-off time (ATOT).

For passenger monitoring, other research has explored the use of technology (RFID tags, mobile phones etc) as a means of knowing where each and every passenger is physically located in the airport. That approach is not advocated here. Instead, the approach is to compare the actual process performance (measured for example in terms of throughput of passengers per time interval) compared with the nominal values as a means of detecting potential problems due to process degradation.

AOP 4 (Decision Making Support)

The monitoring of the agreed performance targets will lead to the occurrence of a number of potential alarms in the case of a deviation. In some cases, this will lead to a modification to the performance priorities and a consequential change to the AOP. In the elaboration of this decision making process each actor should be provided with appropriate decision making support tools so as to assess a number of 'what-if' solutions.

AOP 5 (Management)

Common Situation Awareness (CSA) will allow for a proactive participation of the stakeholders in the AOP and is therefore an absolute prerequisite for the APOC. For example, the stand allocation can be managed at two levels of granularity. A macroscopic allocation can be performed by the Airport Operator, taking into account parameters such as 'Schengen' requirements or aircraft type constraints but then a finer granularity allocation could be performed by the airline operator or ground handler who propose a specific solution to the Airport Operator to exploit the potential opportunities that are currently lost. Procedures for such a 'philosophy change' will need careful definition and may require local airport specific fine-tuning.

Fundamental to the TAM philosophy is the fact that the AOP be based on stable and reliable data and this in all operational conditions. For example, TOBT predictability should be kept to within a certain tolerance to enhance stand allocation decisions and accurate pre-departure sequence construction by ATC. Specific actions by airlines and handling agents will be required to be defined in order to ensure that the AOP is "fed" with the most accurate data by the most appropriate actor at any given time. For example, in order to optimise the accuracy of the TOBT, it is proposed that both the handling agent and the airline issue separately their estimate of the TOBT should either consider that the scheduled departure time may be compromised. In this way, problems with the handling processes during turn-round as well as 'internal' airline operational decisions such as the decision to wait for connecting passengers will be captured.

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5.1 MAPPING CURRENT PROBLEMS TO THE PROPOSED AIRPORT OPERATIONS PLAN CONTENT

The next phase in the analysis has been to identify for each of the five AOP elements defined above, which ones may have a specific impact on addressing those problems raised by the expert group sessions. The aim of this analysis was to test whether or not the proposed AOP themes are sufficiently large in their scope to address the specific problems highlighted for PMI. The following table provides an indication of those AOP elements which will be directly implicated in the solution / detection of each priority problem raised in the PMI expert group sessions. This mapping has been validated in plenary expert group session.

Problem	Shared data	Monitoring	Predictability	New Procedures
Hub stand allocation	X	X	X	X
Last minute changes (stand and gate)	X	X	X	X
Long distances and bottle necks at apron	X	X		X
Early arrivals	X	X		X
Early check-in		X		X
Last minute bridge failure		X		X
Boarding gate occupied by previous flight	X	X	X	X
Unreliable information from the airport operator	X	X	X	
Visibility concerning airport resource availability	X	X		X

Table 4 : Problem list and mapping to future AOP content elements

6 THE 'MONITORING' ELEMENT OF THE AIRPORT OPERATIONS PLAN

When addressing the question of the monitoring service which will be provided following the implementation of the AOP, the experts have focussed their attention on two separate processes, namely the 'aircraft process' and the 'passenger process'. The aircraft process covers the link between arriving and departing flights (primarily within the turn-round task although enriched with other data available through A-CDM)) and the passenger process covers those 'landside gates' (security, customs etc) which the passenger is required to pass through. The timely integration of the two processes (which ideally occurs simultaneously at the commencement of boarding) is identified as being fundamental to the on-time departure of flights.

6.1 THE AIRCRAFT MONITOR

A mock-up of what could constitute an aircraft monitor which was elaborated with the experts is shown in the following diagram:

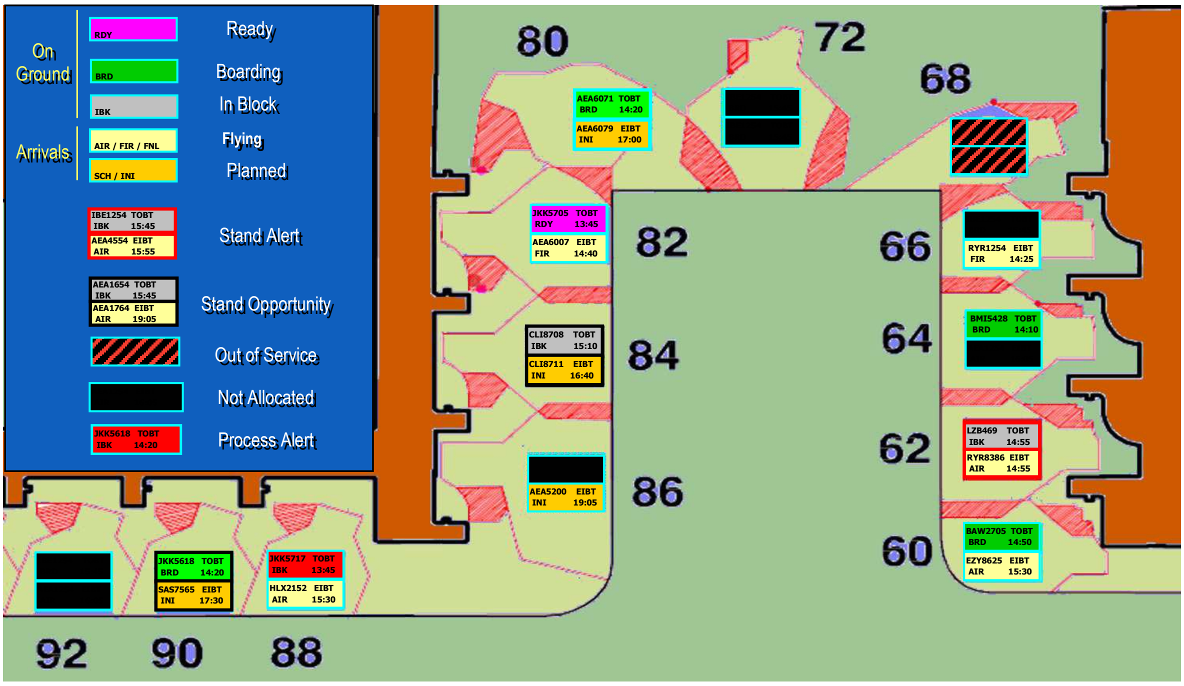

Figure 4 : Mock-up interface of the aircraft monitor

The philosophy is to superimpose accurate arrival (EIBT) and departure (TOBT) estimates onto an interface which can be used for process optimisation. The global view provides a quick assessment of the airport situation that can be obtained at a glance, but also each stakeholder can concentrate on their specific area of their interest. Through the choice of colours and various warning symbols both the aircraft status and consequential impact on process (in this particular example the process would be gate management) management can be shown through the same interface.

The key (top left hand corner) corresponds to the various states that an aircraft can pass through during the turn-round as well as indicating the target times related to the departure. Similarly the arrivals are indicated as well as accurate arrival estimates to the stand. This information is then available in a linked window with the system automatically issuing a number of alerts and messages based on the status and time estimates.

Based on accurate CDM estimates relating to in-block and TOBT, coupled with reliable data from the airport operator, the following stand messages could be available and illustrated as in the diagram using appropriate colour coding:

- Stand overlap (TOBT, EIBT conflict)
- Stand opportunity (EIBT delayed resulting in usage possibility)
- Stand not allocated
- Stand unavailable
- Unreliable TOBT

6.2 THE PASSENGER MONITOR

The main objective is to ensure the full synchronisation of passenger and aircraft flows. These two processes meet at the “Boarding Meeting Point”; i.e. the aircraft status being “boarding” and the passenger status being “boarding gate open”. Both departure passengers from the airport and transit passenger flows are addressed in this section.

In order to monitor the passenger flow, different sub-processes have been identified, starting at the check in sub-process (the access of passengers to the airport sub-process is an external input to the passenger monitor) and ending at the transit time of passengers from the last control sub-process to the gate.

In order to assess passenger process synchronisation with the aircraft process, a productivity performance indicator has been defined and assigned to each sub process. Performance indicators should be chosen to facilitate situational diagnosis so that mitigation actions can be triggered in order to recover the initially planned situation or to develop a new AOP if necessary, for example in the case of a heavy disruption.

Passenger process alerts can be triggered if the combined sub-process productivity indicates a risk of compromise. These alerts must be based on an agreed deviation from the standard performance; base-line or quality of service performance to be used as the performance reference for alert triggering. A similar analysis can be done for transit passengers. In this situation a new aircraft status is introduced in the aircraft arrival phase: De-boarding status and a new de-boarding sub-process for the transit passenger flow.

Two key reference indicators have been identified as having a major influence in the Check-in and Security Screening sub-processes performance. The first, most influencing factor is the sub-process throughput, which will have a direct impact in the second key performance reference indicator: the sub-process time (queue + check-in or screening time).

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The key to monitoring the passenger process is knowledge of the time required from leaving the check in to arriving at the boarding gate (for non-transferring passengers) and the time required from de-boarding to the departure gate for transferring passengers. The relationship between this time and the TOBT is a strong indicator that a management decision on the part of the airline will be required. Essentially this decision will entail either the creation of a new TOBT or the decision to leave the passengers on the ground. For each individual applicable process (check-in, security, etc) it will be necessary to have reference performance indicators (expected process time) and real-time monitoring as follows:

Relevant KPIs :
Productivity : passengers / minute
Queue size
Process time

Local monitoring:
Productivity
Process Time
Alerts

Figure 5 : Key Performance Indicators and process monitoring

For local passengers, the monitoring of each individual applicable process allows to derive an overall process time (referred to as the ‘P parameter’ within the expert group discussions) allowing determination of the necessity for an alarm indicating that the passenger flow and the TOBT are inconsistent:

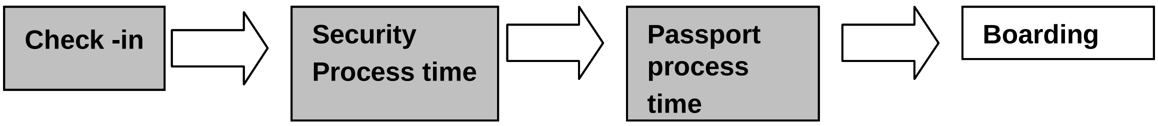


Figure 6 : Local passenger process time analysis

The associated alarm, ‘Risk of late arrival to the gate’, will be generated if:
TOBT < P + Current Time + K

where P is determined through the real-time process monitors and also takes into account the pure ‘walking time’ as a function of the check-in area and aircraft gate. The parameter k is a pseudo process time related to the boarding process which is typically expected to be of the order of 5 to 10 minutes although this requires confirmation during operational validation.

For transit passengers, the necessity for an alert is determined through monitoring the relationship between the time of de-boarding and the TOBT. Therefore, the real-time monitoring process should be in a position to calculate the time required from opening the aircraft doors to the passenger being able to present themselves at the boarding gate for their onward flight. This time is essentially an issue of the physical distance and the process time associated with transit passenger security checks.

All process times must be associated to a threshold level (parameter) to raise alerts for launching predefined procedures.

6.3 AIRSIDE AND LANDSIDE INTEGRATION

The previous sections have highlighted the monitoring of the aircraft process and also the outline requirements for passenger process monitoring. From the overall concept of landside / airside integration, these two processes need to be linked together. The following diagram proposes an architecture for achieving this:

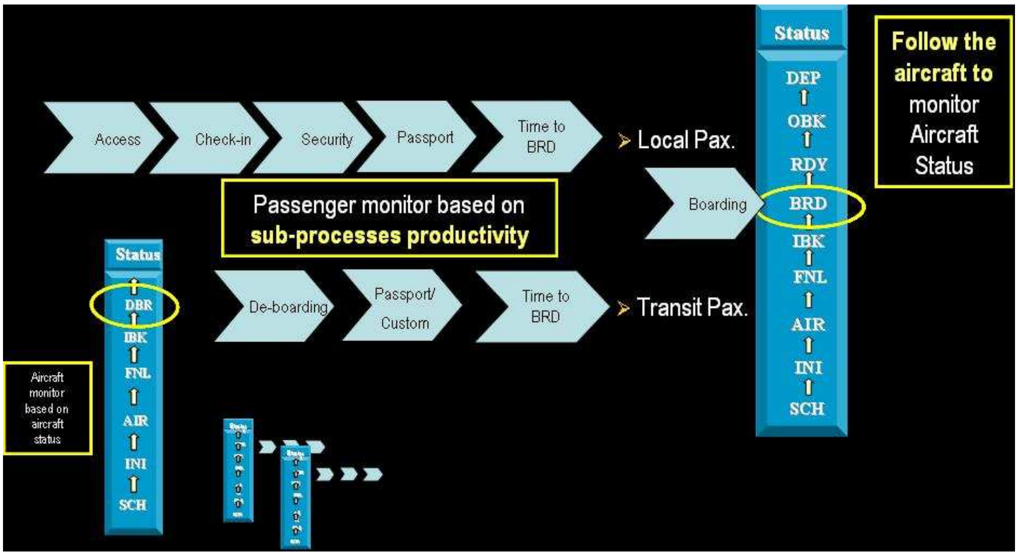
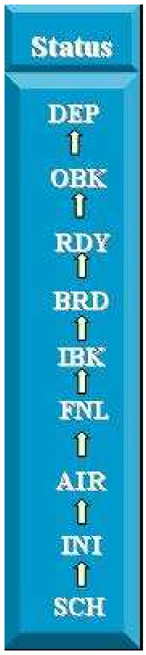


Figure 7 : Integrated aircraft and passenger monitor



Using accurate CDM estimates coupled with automated real-time monitoring, each individual aircraft can be allocated a specific 'status' (…, final approach, in-block, ready,…) as illustrated. The relationship between the status and the TOBT is monitored to ensure the compatibility of the aircraft turn-round progress with the latest departure estimate. Similarly, the passenger flows for both local and transit passengers (using similar information from each 'feeder' flight) are monitored so as to automatically indicate an incompatibility between the passenger flows and the TOBT.

The differences between this fully integrated approach and that currently employed are essentially twofold:

- Within A-CDM, the 'boarding open' milestone is recommended since the absence of this milestone at a certain time before TOBT is a very useful indicator that the departure will be delayed. Unfortunately however, the opening of the boarding gate at a pre-defined time before TOBT is not *per se* a reliable indicator that the TOBT will be respected since no account is taken of the fact that not all passengers may be actually at the boarding gate.
- Some monitoring systems allow airline OCCs to analyse the potential for a delayed departure by viewing, for example, the current status of the 'feeder' flights. One such example of this kind of tool (GAETAN) was

demonstrated by Air Europa. However, the usage philosophy of such tools is based on an “information pull”, i.e. the operator is required to search for current status information based on his or her expertise and experience. Whilst any tool should possess such facilities, the approach proposed here is that of an “information push” i.e. the appropriate information or alert is displayed automatically to the operator based on the real-time linked aircraft and passenger process monitoring.

6.4 IMPROVED MANAGEMENT OF OFF-BLOCK TIMES

The following diagram illustrates a proposal elaborated with the experts which seeks to provide an improved accuracy in the TOBT estimate through the active participation of both the airline and ground handler. It employs both the integrated monitoring system described in the previous section and the real-time knowledge of each actor.

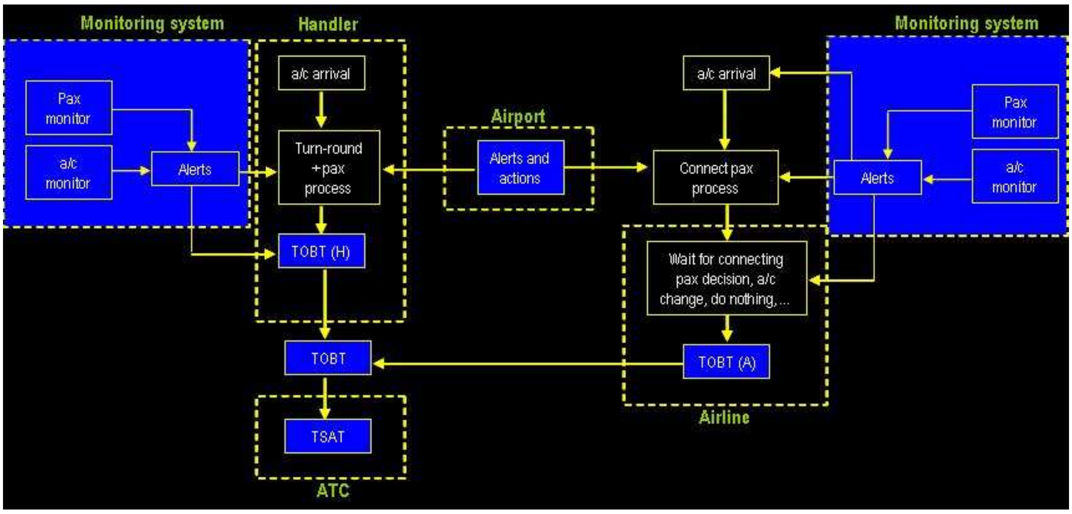


Figure 8 : Actor interfaces to the monitoring system

For ease of interpretation, the integrated airside and landside monitor is shown twice on the diagram. However, this is only schematic. The key is that this is the **same** monitoring system available to both the airlines and the handlers.

Each stakeholder plays his role in the TOBT process in a shared commitment to meet the target. In the case of any constraint which renders conformance to the target impossible, each actor will be expected to communicate their estimate of the process delay in order to establish the new TOBT.

The airline role is to monitor both the aircraft and passenger process and update the TOBT in the event that any operational decision (e.g. wait for transferring passengers) or constraint means that the current TOBT will not be respected. The system is therefore provided, if necessary and **only** if necessary, with a new update TOBT(A).

Similarly the handler analyses the same monitoring system. Based on the information and associated alerts, coupled with the real-time monitoring of the turn-round process, the handler is in a position to provide, only if necessary, an update TOBT(H).

The system then automatically calculates the TOBT (based on MAX(TOBT(A), TOBT(H)) for provision to ATC and other TAM partners (for TSAT calculation) and for updating of the AOP.

The philosophy therefore is to ensure only required updates are made, so as to avoid work creation, but to ensure that both the airline and handlers are actively involved in the provision of accurate data.

The A-CDM development process has already addressed the issue of ‘multiple TOBTs’ within various fora. It is important to note that the approach described here does not advocate the issuing of more than one TOBT. Instead, the single TOBT which is issued to ATC and shared between the partners should be derived automatically, where appropriate, from information emanating from more than one source.

7 AN EXAMPLE OF EXPECTED PERFORMANCE BENEFITS

In order to illustrate the expected benefits of improved data quality a simulation of the impact of improved TOBT accuracy on one of the major problems highlighted by the PMI experts has been performed. This problem relates to the last minute changes in stand or gate allocation which has been identified by the handling agent as a major cause of inefficiency, ultimately leading to the potential for departure delays.

In the stand allocation planning, time buffers are used from one aircraft to the following one in order to reduce the probability of stand overlapping. Depending of the buffer size and the combined arrival-departure variability, stand overlapping is however produced, necessitating last minute changes.

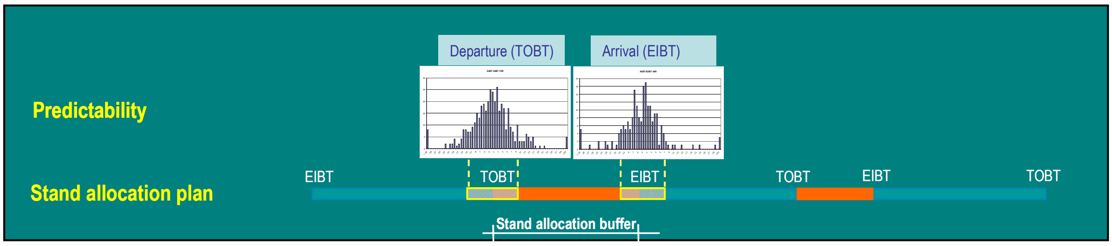


Figure 9 : Stand buffer versus predictability

The figure bellow shows a case study for stand allocation last minute changes. The probability of stand overlapping is shown in the Y axis of the graphic resulting from the combined effect of Departure (TOBT) and Arrival (EIBT) variability.

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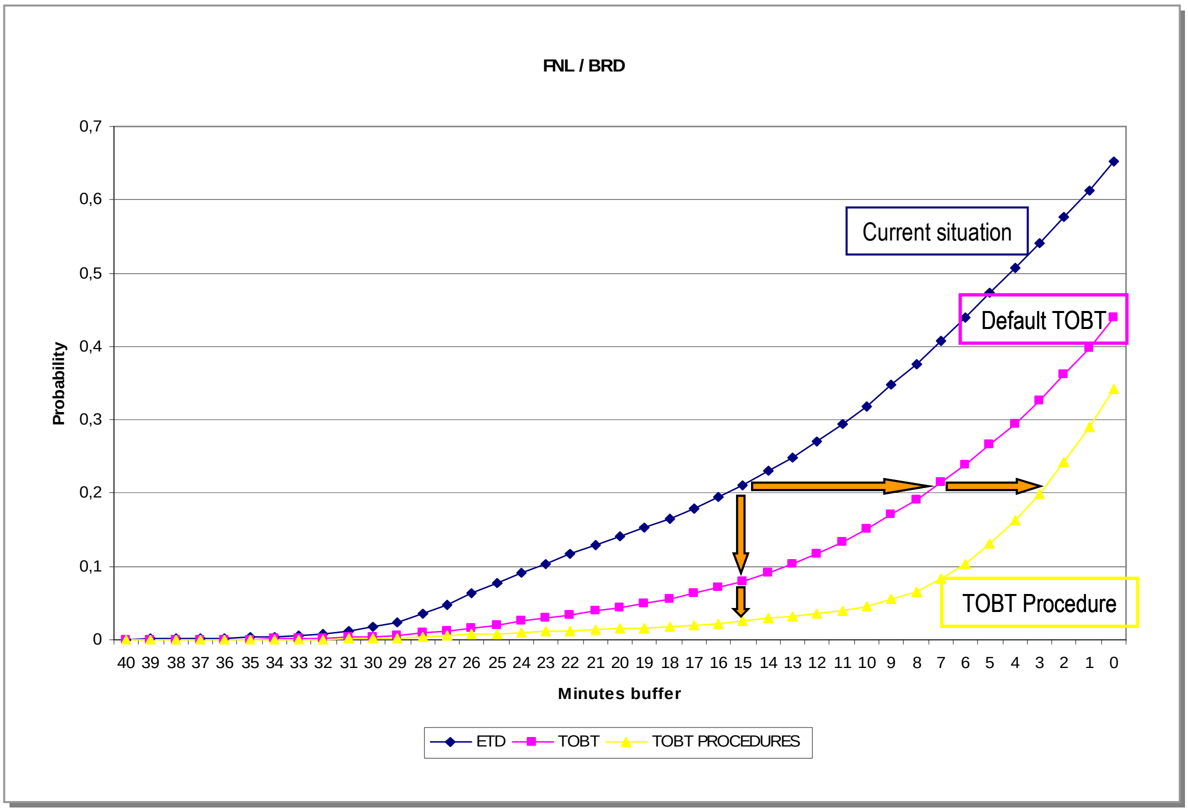

Figure 10 : Stand buffer versus overlapping probability

On the X axis the stand separation buffer (on a reducing scale) is shown in minutes.

Three different scenarios are represented in the graphic. True traffic data has been extracted from a European Airport under an A-CDM implementation project for the three selected scenarios. In all three cases, the measured arrival traffic predictability shows how the estimated arrival times deviate in a range that varies from 0 to + 10 minutes from their expected times

Normal, non-CDM operation. - In the normal operational scenario the measured airport departure predictability shows a variability of the Actual Departure Times ranging from -5 to + 25 minutes in respect of their Estimated Departure Times (ETD).

For this scenario the blue graphic shows a 20% stand overlapping probability for a stand allocation, buffer separation of 15 minutes.

Default TOBT operation. - Aircraft traffic monitoring has been implemented in this scenario. Under this process oriented, information management environment, a default TOBT can be calculated, with no operator intervention. The departure predictability of Actual Departure Times respect of the default TOBT situation ranges from -10 to +15 minutes

The graphic in purple shows how this small predictability improvement introduced by the default TOBT scenario reduces the risk of overlapping (maintaining the 15 minutes buffer) to approximately 9%.

TOBT Procedure scenario. - A first stage, simple TOBT procedure has been implemented, which provides a slightly better predictability, with a variability range from -10 to + 10 minutes of the Actual Departure Times compared to the Improved TOBT times.

The yellow graphic shows a further reduction of the stand overlapping risk to approximately 3%. This scenario allows the overlapping risk to be maintained under 10%, thereby reducing the stand overlapping buffer to less than 10 minutes, which results in a much more efficient use of the available stand capacity.

The main conclusion of this exercise is that by introducing “soft” A-CDM TOBT procedures; i.e. by updating the TOBT at boarding status whenever the handling agent expects a delay greater than 10 minutes, the full benefit reflected in the graphic will be obtained. This action will be needed in less than 20% of the departing flights managed by each handling agent, which represents an insignificant additional workload which is expected to be highly compensated by the benefits obtained and the potential reduction in some other tasks.

8 CONCLUSIONS

This report commenced by describing in some detail the future concept for collaborative airport planning opitimised by Total Airport Management. The Airport Operations Plan (AOP) is fundamental to this concept. However, SESAR must address not only the question of the content of the AOP and how that content varies over time, but crucially it must address how the AOP is to be used as the vehicle which ensures the monitoring of the airport performance against agreed performance criteria. The collaborative processes which ensure that the AOP is modified in an appropriate way in the event of deviations will also occupy much of the time of those involved in the SESAR Definition Phase.

Episode 3 has provided the opportunity to start this development and this report has provided a detailed insight into the deliberations and work of the PMI expert group. The focus of their work has been on the high-level AOP content but particularly on the initial development of a fully integrated airside and landside monitoring system. A potential architecture and a proposal for some automatic alerting mechanisms is the fruit of this reflection.

The content of this report is very much ‘work in progress’. The ideas presented are believed to provide a sound basis for the elaboration of the focus of the SESAR Work Programme but it is crucial that the proposed monitoring architectures be evaluated in field trials at candidate airports in order to evaluate their utility in relation to the TAM concept but also the feasibility from a technical perspective. Notably, the expert group has assumed that the identified data with the required accuracy is always available “somewhere” in the PMI airport environment but this assumption requires validation. Furthermore, the expert group has enabled more detail to be added to the processes defined in the interim M1 DOD.

This exercise has left the authors with the belief that the expert group process is a valuable tool particularly at the early stage of concept development. However, a number of pre-conditions should be met and issues borne in mind:

Detailed discussions on particular concept elements are best held using small, ‘common interest’ groups. This is particularly the case for airports, where the principal actors are performing different operational functions and with very different constraints. This approach ensures maximum relevance of the discussion at all times and also ensures the maximum participation of each individual. Only when the initial ideas reach a certain level of maturity should the information be presented to a much wider audience where there is an increased possibility of conflict between actors or the emergence of ‘dominant’ individuals.

Operational experts are expert in the ‘current’ system and, with few exceptions, it is not necessarily a trivial process for them to focus on future, more abstract, ideas. The approach adopted with PMI which was essentially that of simple, open questions along the lines:

> *“How does the current process work? What can go wrong? Why does it go wrong? What can be done to improve the situation? What information would you like to have in a more timely fashion? etc*

seemed to work very well.

The use of support material in the form of mock-up through to fast-time simulation is important provided the right balance between the tool functionality and concept development is maintained. The use of static and "dry" documentation should be avoided wherever possible.

The right balance concerning the frequency of the expert group sessions should be found. Sufficient regularity is necessary to maintain the momentum of the group but it is important that progress is seen to be made between the meetings and that new material is available each time so as to maintain interest. As a result, the workload of the project team between the sessions should not be underestimated.

This work has been carried out within the context of Episode 3 and information concerning its progress has been disseminated on a number of occasions both internally to the project participants and to the European Commission / SJU. An expert group focussing on the execution element of airport operations (notably efficient runway and taxi-way management) has been conducted within Work Package 5 of Episode 3 although only limited coordination between the two expert groups was possible. Further airport concept development and primarily the transition from the planning phase to the execution phase are therefore necessary.

A gaming simulation covering some elements of the TAM concept was performed by DLR within the context of EP3 Work Package 3.3.4. The parallel nature of these two activities meant that the reflections of the PMI expert group notably concerning the AOP content were not implemented into the gaming exercise. The first real opportunity to perform such work is anticipated within SESAR Work Package 6.5.2 and principally Work Package 6.5.4.

As a final recommendation, it is strongly urged that the SESAR Joint Undertaking and the SESAR Airports Consortium (SEAC) form their own opinion as to the utility of this work. In the event of a positive conclusion, these organisations should take the necessary steps to ensure that the work is carried forward within the SESAR Development Phase.

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9 ACKNOWLEDGEMENTS

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10 REFERENCES

[1] **EUROCONTROL** Total Airport Management (Operational Concept and Logicial Architecture) Version 1.0 October 2006

Jointly produced by EUROCONTROL and DLR (copies may be obtained on request from alan.marsden@eurocontrol.int)

[2] **EUROCONTROL** Airport CDM Implementation Manual Version 3 December 2008 http://www.euro-cdm.org/implementation_manual.php

[3] **Episode 3** DOD M1 Collaborative Airport Planning Detailed Operational Description E3-D2.2-022 V3.0

[4] **Episode 3** Glossary of Terms E3- D2.2-039 V1.00 06-02-2009

[5] **SESAR** D3 The ATM Target Concept

DLM-0612-001-02-00a, September 2007

[6] **SESAR** ConOps in Task 2.2.2 Deliverable (DLT 2.2.2/D3) DLT-0612-222-00-15 DRAFT0.15 SESAR Consortium 2007

ANNEX 1 : PARTICIPATING EXPERTS

Name	Organisation	Role
Richard Gulliver	Acciona	Deputy Ramp Manager
Ramón Castelltort	Acciona	Operations Manager
Bartolomé Vaquer	Acciona	Ramp Manager & Deputy Station Manager
Bartolomé Rosselló	PMI Airport Operations	Operations Manager
Juana Mesquida	PMI Airport Operations	Passenger Processes Manager
Marta Ugalde	PMI Airport Operations	Security Operations
Alexandra Rosiak	Air Berlin	Area Manager Spain Ground Operations
Michaela Lünsmann	Air Berlin	Area Manager Portugal Ground Operations
Rolf Brand	Air Berlin	Captain and Chief Pilot PMI
Jaime Fernández	EasyJet	Airport Manager
Joan Rossello	Air Europa	Deputy Operations Manager Air Europa
Gaspar Llinas	Air Europa	Station Manager Air Europa handling
Olga Fernández	Air Europa	Operations Manager Air Europa handling
Michael Laubrock	ARC	CAST Project Manager
Uta Kohse	ARC	CAST simulation expert
Martina Dauner	ARC	CAST simulation expert
Alan Marsden	EUROCONTROL	Episode 3 Work Package Manager
Eduardo Goni	EUROCONTROL	Airport Operations and CDM Expert
Louis Sillard	EUROCONTROL	Airport Operations and CAST Expert

Table 5 : Participating experts

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