EPISODE 3

Single European Sky Implementation support through Validation

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EXECUTIVE SUMMARY

The business or mission trajectory of an airspace user of any kind represents their intention to operate in a desired way. In the SESAR concept air traffic and other services will facilitate the execution of these trajectories and will ensure that these are delivered in a safe and cost effective way within the infrastructural and environmental constraints.

The operations at airports form the ground segment of the business trajectory. The airport throughput is one of the main processes that determine the on-time performance of the Reference Business Trajectory. It is not only the beginning and the end of the trajectory; it is also the connecting process between two consecutive flights. The efficiency of this “turn-round” process determines whether delays increase or can be recovered.

Operations at the airport are divided into planning and executing of the business trajectory.

The links between the planning and execution must be clearly identified to give a transparent, efficient and cost effective solution at the airport.

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, 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.

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 daily operation at an airport involves the real-time, safe and efficient management of aircraft and vehicles movements on the airport surface. Short notice changes and/or refinements to the planning of surface movements are handled using a mixture of collaborative processes and tactical interventions. The latter are handled according to a previously agreed set of rules or the operational insight of the Air Traffic Controllers and Apron Managers.

EP3 WP3.3.1 – Collaborative Airport Planning Expert Group [5] was responsible for refining the planning processes and improvements proposed in SESAR using the latest developments in TAM.

For this exercise, looking at the execution phase of the Trajectory, improvements in Runway [15] and Apron/Taxiway [16] management were analysed. Additionally links between the planning (WP3.3.1) and execution were identified. These links are principally the triggers for changes to the (planned) trajectory initiated during landing or departing of an aircraft (Execution Phase).

The work of the expert group described in this report contributes to improving efficiency, predictability and capacity at the airport ‘airside’ activities whilst contributing to the overall EP3 objectives. The technical output of this exercise will be presented to SESAR WP6 (Airport Operations) and SESAR WP9 (Aircraft Systems)

This report describes the results of a number of expert groups meetings held with the exercise partners and invited operational experts working in the ‘airside’ domain. The aim of these meetings was to elaborate on the proposed SESAR concept elements related to use of the runway and apron/taxiway during departing and landing at an airport (execution of the plan).The report provides indications of the Key Performance Areas (KPA) that would be affected. 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.

1 INTRODUCTION

1.1 SESAR OPERATIONAL CONCEPT FOR THE EXECUTION PHASE OF THE REFERENCE BUSINESS TRAJECTORY

The execution phase of the trajectory has been divided into runway and apron/taxiway Management within EP3.

The SESAR concept addresses the following objectives regarding runway management during the execution phase:

- Increase runway throughput: Reducing dependency on wake turbulence separation, minimising Runway Occupancy Time (ROT), using time based Final Approach Spacing in head wind conditions and implementing Reduced Departure Spacing;
- Increase runway utilisation: Implementing arrival and departure management tools, optimising runway configuration/mode of operation, implementing new procedures during Low Visibility Conditions (LVC), optimising the use of existing and future airport (runway) infrastructure and available capacity and strategically de-conflicting and separating traffic on the airport surface;
- Eliminate runway incursions: Providing better situational awareness for the controller, aircrew and vehicle drivers, advanced surveillance systems and advanced, automated systems may be considered such as “auto-brake” to make it impossible for an aircraft or vehicle to cross selected stop bars.

Increasing runway throughput and runway utilisation has to be achieved within the SESAR safety goals. The most important issue is that new procedures and tools and implementation of best practices are harmonised in such a way that no differences in operation appear for users (Pilots) throughout Europe and preferably worldwide.

The SESAR concept addresses the following objectives regarding the management of apron and taxiway movement during the execution phase:

- Enhanced scheduling of airport surface movements in normal and congestion situations and in coordination with runway operations and turn-round operations will provide increased operational efficiency;
- Visual enhancement technology will provide increased situational awareness for aircrew and vehicle drivers during night and reduced visibility conditions;
- Onboard features will allow to anticipate safety hazardous situations through the provision of warnings directly to aircrew and drivers as well as to ATC controllers;
- Advanced, automated, systems may be considered such as “auto-brake” to make it impossible for an aircraft or vehicle to cross active red “stop bars”;
- Planning of surface routes may consider constraints imposed by the need to minimise the environmental impact especially surface holding or the need to avoid braking or changes in engine thrust levels as the aircraft moves from the runway to the stand or vice versa.

As surface movement efficiency is to be increased without compromising the level of safety, particularly the risk for runway incursions, a range of actions need to be taken. Better situational awareness for the controller, aircrew and vehicle drivers including conflict detection and warning systems will not only enhance airports surface movement safety but will also create "room" for surface movement efficiency and contribute to the required airport capacity increase.

Advanced Surface Movement Guidance and Control System (A-SMGCS) will provide enhanced information to controllers whilst Cockpit Display of Traffic Information (CDTI) technology will provide aircrew and vehicle drivers with guidance and traffic information. On airports where A-SMGCS is not implemented by 2020, non-cooperative surveillance systems NCSS (e.g. SMR) which are in the scope of SMGCS will help providing visual information to ATCO at low visibility conditions.

The report describes the results of a number of Airport 'Expert Group' meetings. The aim of these meetings was to elaborate the activities, roles and responsibilities for landing or departing aircraft taking into consideration the current problem, ongoing projects and the proposed SESAR concept elements.

The principal output is in the form of 'storyboards' giving a simple pictorial view of the results.

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 airport 'airside' activities related to the execution of the SESAR Reference Business Trajectory. 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 D30).

The report is also delivered for approval to the airport expert group participants and EP3 partners.

Finally, the report is intended to provide key material for the SJU, specifically SESAR WP6.3 and WP6.7.

1.3 Document Structure

Section 2 describes the creation of a group of experts whose remit was to focus on airport operations during landing and departure to refine the requirements for a future airport concept based around improved sharing of information and use of the latest tools for runway and apron/taxiway management. The methodology for the expert group sessions is presented in Section 3. 'Understanding the Problem' (Session 1) is described in Section 4.

'Understanding the Solution' is described in Section 5 (Sessions 2 and 3).

'Refining the Solution' including Comments on all Scenarios reviewed leading to Storyboards reads for Final review is shown in Section 6 (Sessions 4, 5 and 6).

Section 7 gives the conclusions on the concept elements addressed, using an expert group (with Comments from the experts) as a validation tool. The final storyboards with major modifications carried out and outstanding Comments are included here also.

The findings of the experts relating to the SBT to RBT agreement workshops are included in Annex A.

1.4 Glossary of Terms

1.4.1 The Storyboard

Storyboards are sequences of images which demonstrate the relationship between individual elements and actions within a system. The formation of these representations into a sequence conveys further information regarding the structure, functionality and options available within the intended system. The storyboard can be shown to others to allow others to visualise the composition and scope of a concept and offer critical feedback. This method can be used early in the design cycle where the use of storyboards supports the exploration of design possibilities and the early verification of user requirements.

This method is of general relevance, especially to products in which there a complex structure of information is being developed.

Feedback can be gained on system functionality, style and also navigation options early on in the development cycle where changes can be more easily implemented.

- The method promotes communication between designers and users.
- Storyboards can be created quickly and easily.
- Only minimal resources and materials are required.

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- The technique can be utilised by those with little or no human factors expertise.

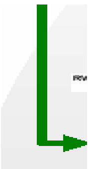
Storyboards provide a platform for exploring design options via a static representation which can be shown to both potential users and members of a design team. This can result in the selection and refinement of particular design options. This filtering process can be a valuable precursor to prototyping activities.

Limitations of storyboards: Because of their simplicity, storyboards do not support the evaluation of fine design detail and do not accurately convey system responsiveness.

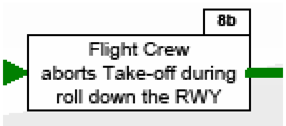
1.4.2 How to read the Storyboards

Here is a description of how to read the storyboards included in this document.

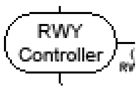
- Green arrows show the main flow of the process being depicted



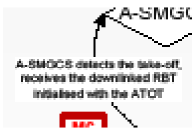
- The boxes along the flow show the actions of the main actor, normally Aircraft or Flight Crew (Flight Crew is the actor as defined in the OS)



- The boxes with rounded corners out of the main stream, depict the ATC actors, i.e. RUNWAY controllers etc

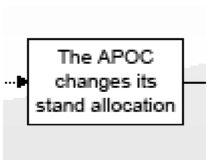


- The dotted lines represent communication or issuing information

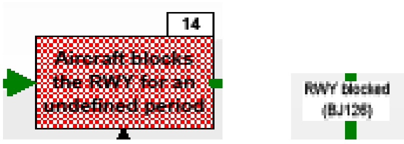


- The diamond shape boxes show tools or systems (e.g. A-SMGCS)

- The hexagonal boxes show systems which have not been precisely defined in the OS



- Red boxes or clear boxes show incidents impacting the normal process (exceptions)



- Green boxes represent RBT changes, the triggers to re-planning and the link to WP3. Therefore the green boxes are also links to the SBT, NOP or APOC

1.4.3 Document Glossary

Term	Definition
A/C	Aircraft
A-CDM	Airport Collaborative Decision Making
A-SMGCS	Advanced Surface Movement Guidance and Control System
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
AOP	Airport Operations Plan
APOC	Airport Operations Control Centre
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer / Air Traffic Controller
ATM	Air Traffic Management
BIC airport	Best In Class airport
BtV	Brake to Vacate
CAST	Comprehensive Airport Simulation Tool
CDM	Collaborative Decision Making
CDTI	Cockpit Display of Traffic Information
ConOps	SESAR Concept of Operations
CREDOS	Crosswind – Reduced Separations for Departure Operations
CTA	Controlled Time of Arrival
DLR	Deutchs Zentrum für Luft-und Raumfahrt
DOD	Detailed Operational Description
DOW	Description of Work (annex to the contract)
EIBT	Estimated in-block time
EOBT	Estimated off-block time
EP3	Episode 3

Term	Definition
IMC	Instrument Meteorological Conditions
KPA	Key Performance Area
KPI	Key Performance Indicator
LVC / LVP	Low Visibility Conditions / Low Visibility Procedures
NCSS	Non-Cooperative Surveillance System
NOP	Network Operations Plan
OI step	Operational Improvement Step
RBT	Reference Business Trajectory
ROT	Runway Occupancy Time
R/T	Radio Telephony
RTA	Required Time of Arrival
SESAR	Single European Sky ATM Research and Development Programme
SESAR JU or SJU	SESAR Joint Undertaking
SBT	Shared Business Trajectory
SMAN	Surface Manager
SWIM	System Wide Information Management
TAM	Total Airport Management
TBS	Time Based Spacing
TMA	Terminal Manoeuvre Area
TOBT	Target Off-block time
TOD	Top Of Descent
TSAT	Target Start-up approval time
TTA	Target Time of Arrival
TTOT	Target Take Off Time
TWR	Tower Controller

Table 1 - Glossary of Terms

The Episode 3 Lexicon contains a list of agreed acronyms and definitions [14].

2 THE AIRPORT EXPERT GROUP

"The make-up of the Expert Group in terms of roles, behaviours and variety was critical in ensuring the objectives were met*." – EP3 Lessons Learnt Workshop*

An Airport Expert Group was included in the original EP3 DOW [19] to support airport related Fast Time modelling exercises related to Runway and Turn-round performance and to provide support to the planned cycle 2 activities.

During the freeze of EP3 (April 2008 – July 2008) a re-alignment of exercises was carried out to create DOW 3.0 0.

The turn-round performance exercise was no longer necessary and was covered within the collaborative planning WP3 of EP3. Cycle 2 activities were removed from the project scope.

The re-alignment exercise highlighted the importance to clearly identify the interface and added value of the EP03 WP5.3.2 Airport Expert Group in relation to the EP3 WP3.3.1 Collaborative Airport Planning Expert Group.

DOW 3.0 0 indicates what the differences and links between the two expert groups are.

The EP3 WP3.3.1 report [5] is an excellent document highlighting how improved collaborative decision making at the airport can be achieved during the planning phase of the SESAR business trajectory.

The approach taken within WP3.3.1 and the timescales for both groups meant that it was not possible to coordinate and investigate some important Questions for execution such as how plans are put into effect (i.e. Questions about necessary precision of plan and the level of flexibility available to tactical controllers). They are ruled out because the WP3 Expert Group specifically excluded controllers (for good reasons documented in the report), and the suggested planning improvements do not cover the planning of SBT and RBT.

This expert group focused on the execution phase of the SESAR business trajectory, the 'airside' activities.

The success of the expert group depended on participation of operational experts for the duration of the exercise.

The following sections detail the expert roles required and how the roles were filled.

2.1 ATC TOWER CONTROLLERS

Tower controllers control the traffic arriving and/or departing from an airport, maintain the traffic within safety constraints and manage the traffic according to RBTs agreed whenever possible

As NATS was leading the exercise both Heathrow and Gatwick airport Tower ATC management teams were approached to secure involvement.

Both Heathrow and Gatwick ATC management were very supportive of the expert group and due to the commitment of staff well in advance it was decided that it would be very difficult to get controllers from both airports to attend the meetings.

Gatwick ATC had been involved in the previous expert group and ties were in place so Gatwick ATC agreed to continue to provide support and use of the conference room for expert group meetings (located at the Old Tower at Gatwick airport).

Richard Newns, an experienced ATC Tower Controller (including both Runway and Ground movement control) was secured for the group with support from the ATC Manager Andy Taylor.

DFS provided Reinhard Balzer an experienced Airport ATC Controller in Germany (Frankfurt) and commercial Pilot.

LFV support was given by Claes Rundberg leader of the EP3 TMA Expert Group (WP5.3.1), an experienced Approach Controller, and Ake Wall also joined from LFV an experienced Airport ATC Controller.

Francis Richards, a freelance consultant working at Eurocontrol in Brussels was also secured through Eurocontrol. Francis Richards was previously Airside Manager at Heathrow and Gatwick airports.

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Reinhard Balzer, Ake Wall, Claes Rundberg and Francis Richards also had experience of previous European Projects.

2.2 AIRPORT GROUND HANDLER

The Airport Ground Handler participates in controlling the movement of Aircraft on the ground within an airport environment and manages the aircraft fleet at the terminals ensuring best use of resources to meet the airlines schedule.

British Airways at Gatwick was approached and Jonathan Lofthouse, a Ground Handling Manager was secured. This support was provided free of charge.

Easyjet were also approached to get a view from a low cost airline using contracted out Ground Handling agents but unfortunately no-one could attend the meetings.

2.3 PILOT

Pilots fly aircraft into many different airports and manoeuvre the aircraft during landing and departure.

Reinhard Balzer is a commercial pilot and provided support during the meetings.

John Tobin, a commercial pilot flying for Virgin Transatlantic also participated (not as Virgin representative).

Both pilots provided valuable experience of arriving and departing from small, medium and large international airports.

2.4 SESAR CONOPS EXPERTS

Knowledge of the SESAR ConOps for understanding and interpretation is a key support role for refinement of the concept and understand the implications of the SESAR paradigm in Europe.

Securing SESAR ConOps expertise at the correct time was a key to meeting the objectives.

Communication with key SESAR experts such as Andy Barff (now retired from Eurocontrol) and Richard Faris (NATS) during the definition, planning and execution of the exercise assisted the experts in getting in the correct mindset for the future.

Ros Eveleigh, Paul Humphreys and Francis Richards from Eurocontrol provided support on the ConOps and relayed information from other experts when required within Eurocontrol.

Richard Faris from NATS participated in email exchanges and attended when possible. John Greenwood from NATS facilitated and led discussions on the key SESAR topic “SBT to RBT agreement”.

All exercise partners provided participants with knowledge of the SESAR ConOps.

2.5 ATC RESEARCH AND DEVELOPMENT

Knowledge of the latest developments in airport ‘airside’ activities was crucial to support a refinement of the SESAR ConOps with achievable steps building on the latest findings in the field.

All partners provided expertise with knowledge in this area. During the kick off meeting some key people with knowledge of the latest status and trends in airport improvements were identified. As successive meetings were planned then experts from the different arenas were brought in to assist, wherever possible these people continued with the group.

Frank Morlang from DLR gave presentations on European Projects such as EMMA2 and TAM.

Roger Lane and Eduardo Goni Modrego from Eurocontrol provided support for Airport CDM and the implementation of CDM in Europe.

2.6 AIRCRAFT MANUFACTURER

Knowledge of the latest aircraft developments to support refinement of the storyboards with potential improvements in aircraft technology and air/ground communication was required to ensure aircraft could support the refinements discussed for 2020.

Fabrice Villaume of Airbus presented 'Brake to Vacate' with data link the key enabler to providing improved Runway and Taxiway efficiency. Fabrice Villaume also participated in meetings and discussions.

Patrick Lelièvre (EP3 WP6 Leader) of Airbus also participated in meetings.

2.7 GROUP FACILITATOR

Continuous communication and negotiation with participants and partners was required to ensure a positive, focused team environment was maintained.

Richard Powell and John Greenwood from NATS with support from Marta Sanchez Cidoncha and Iban Luis Alvarez Escotto of ISDEFE ensured the meetings were organised and contributors were aligned to provide best output.

2.8 EXPERT GROUP MEETINGS

Meetings were organised principally at Gatwick Airport (Old Tower Conference Room) with one meeting held in Madrid hosted by INECO and one meeting at CAA house in central London.

The meetings were well attended with a cross section of experts and European countries represented.

Where experts could not attend, efforts were made to gain their opinion by use of email and telephone in advance.

Four of the meetings were one day meetings and two were two day meetings (held in Madrid in Jan 09 and Gatwick and CAA house in March 09).

All participants of the meetings were punctual and made considerable efforts to participate, coming from many different countries.

The challenges for this expert group were:

- To ensure participation and consistency in each meeting (not just to turn up);
- To provide a positive, open and friendly environment to allow discussion;
- Get the participants to come to agreement;
- To align experts on the current situation;
- Experts to agree on the baseline (current status + ongoing project recommendations);
- Output that represented the true reflections and discussions that took place.

The extent to which this work proves useful for the SJU in refining the airport planning and execution activities will show how useful the output of this group has been. The key issue is to ensure the relevant work packages within SESAR take the work into account during their project initiation.

3 EXPERT GROUP METHODOLOGY

Each expert group session was structured to meet the specific objectives in line with the following approach.

3.1 APPROACH FOR EXPERT GROUP SESSIONS

For each of the expert group sessions the objectives and approach is listed in the following table.

Session	Exercise Objective	Session Objective	Approach Taken	Responsible
1	Understanding the Problem	Agree on current situation at Airport for Arrival and Departure Tolerances	Provide UK examples of Arrival and Departure timelines with tolerances and discuss	John Greenwood
2	Understanding the Solution	Review Ongoing Projects (TAM, CDM, EMMA2) – Agree Baseline	Present 'state of the art' in this area using Experts who worked on EMMA2, CDM and TAM. Allow discussion and move towards a baseline (starting point)	Frank Morlang
3	Understanding the Solution	Present SESAR	SESAR Presentations on Performance Targets and Network Operations with Airport	John Greenwood
4 – Day 1	Refining the Solution	Start to build Storyboards from Scenario review	Scenarios presented in MS PowerPoint as simplified text	John Greenwood
4 – Day 2	Refining the Solution	SBT to RBT agreement	Structured Brainstorming session using **If Then Else** Approach	John Greenwood
5 – Day 1	Refining the Solution	Review Storyboards and remaining Scenarios	Storyboards reviewed (including Q/A Spreadsheet) Scenarios reviewed (in PowerPoint)	Richard Powell
5 – Day 2	Refining the Solution	SBT to RBT agreement	Review output from previous session and refine with wider audience	John Greenwood
6	Finalising the Solution	Review Storyboards	Review Storyboards with outstanding C:s and Q/A spreadsheet	Richard Powell

Table 2 - Expert Group Sessions

4 UNDERSTANDING THE PROBLEM

4.1 SESSION 1 – CURRENT TOLERANCES AT THE AIRPORT

The objectives of the Airport Expert Group revised for DOW 3.0 0 were presented.

The objective of this meeting was to agree on the current tolerances (+/- time in minutes for EOBT and Take-Off Time) for Departures and Arrivals at the airport.

The group looked at the current situation at the airport to get the group in agreement on the actual problem. This was carried out by using two examples, one for departure tolerances and one for arrival tolerances and holding discussions on the tolerances seen at relevant Airports in Europe (specific expertise from Gatwick and Düsseldorf).

Note1 on current method of working: Inbound and Outbound capacity is balanced by Tower Controllers who liaise with TMA Controllers to agree spacing between departures and arrivals. ATCO experience is very important and the current method allows for flexible use of resources to meet the demand.

Note2 on current method of working: Peak runway rates of 52 to 56 movements per hour are frequently achieved at Gatwick. However, airport capacity is scheduled at no more than 51 movements per hour. A firebreak is included to give the daily capacity (not expected to have airport saturated the whole day).

Tolerances (acceptable deviation from the planned target times) during departure from stand to actual departure time were discussed and the following agreed:

"Currently there is a wide tolerance level that is acceptable in the current operations to have considerable time differences (tolerance) between the planned and actual take off (airborne) times". This could range from a few minutes before planned take off time to more than an hour after planned departure time.

Tolerances during arrival were also discussed and the following agreed:

"Currently there is a lack of certainty of arrival times during the arrival process at an airport for the major stakeholders". Expected arrival times during the arrival process differed considerably for the relevant stakeholders and examples were shown for the Operator and Tower Controller -TWR at the destination Airport. The Operator has some knowledge of the aircraft's expected arrival time within progressively improved boundaries as the aircraft approached the airport. However the TWR had no information until the aircraft flew into the adjacent TMA.

The goal is to provide stakeholders with smaller tolerances and higher achievement of the targets both for departing and arriving aircraft, this will also mean better accuracy for airports and passengers.

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5 UNDERSTANDING THE SOLUTION

5.1 SESSION 2 - UNDERSTANDING THE SOLUTION – LINK TO STATE OF THE ART

The group were presented with the latest information from the ongoing projects in Europe related to the improvement of the 'airside' concept elements to be addressed. This provided a baseline for the expert group to work from when creating a vision of a 2020 airport.

Experts in the group had participated in the latest related projects and gave presentations regarding the following projects:

- EMMA2 (European Airport Movement Management by A-SMGCS, Part 2): Harmonize A-SMGCS in Europe giving:
- Reduction of R/T load;
- Reduction of misunderstandings between ATCO and Pilot;
- Better Situation Awareness of the ATCO;
- Better Situation Awareness of the Flight Crews and Vehicle Drivers;
- Reduction of average taxi time and congestions of taxi ways;
- Shorter average reaction time of the ATCO to potential or even actual conflict situations;
- Reduction of workload to an appropriate level in demanding situations;
- Shorter average reaction time of flight crews and vehicle driver to critical surface movement situations.
- Airport CDM (Collaborative Decision Making):
- Improve planning and resource utilisation through better (and more accurate) information sharing;
- Recover quicker from adverse conditions;
- Improve planning at a network level.
- TAM – Total Airport Management (next step after CDM):
- Improved predictability;
- Resources can be used more efficiently, keeping sufficient flexibility to cater for the unforeseen;
- More transparency;
- Cooperative negotiation and equity for all stakeholders;
- Trade-off;
- With direct involvement of stakeholders in determining performance targets.
- Brake To Vacate (as part of EP3 WP5.3.3 Runway Exercise):
- Improved Runway Occupancy Times (ROT);
- Improved predictability;
- Potential negotiation mechanism for Runway Exit/Taxiway usage from TOD.

Comments (C) Question (Q) and Assumptions raised during the presentations were included in the Q/A Spreadsheet and the major assumptions are listed in this report.

NOTE: Even with Airport CDM in place the following shows the limitations:

- Lack of collaborative strategic planning between Airport partners;
- Limited facilities for real-time data sharing;
- Inflexible responses to real-time events;

- Inability to exploit potential for efficiencies and capacity gains offered new capabilities.

5.2 SESSION 3 – UNDERSTANDING THE SOLUTION - SESAR

This session reviewed the agreement of the group in relation to the previous sessions (Tolerances, State of the Art) and introduced the SESAR concept, including the performance targets, an overview of the concept at the airport and the results of the EP3 WP5.3.3 Runway Fast Time Simulation.

5.2.1 Presentation of Results of Runway Fast Time Simulation EP3 WP5.3.3

The EP3 WP5.3.3 Exercise had completed and the results of the Operational Improvement Steps addressed were presented.

The exercise explored the benefits of Brake to Vacate (BtV), Wake Turbulence Separation reduction in Cross Wind conditions (CREDOS), Time Based Spacing (TBS) and Reduced ILS Safety Area (protected zone) and particular combinations of these proposed improvements.

The results of the exercise can be found in the report [19]. The major input to the Airport Expert Group work is the BtV results on improving predictability and the method of negotiating the runway exit with the aircraft when using the additional OI Step “BtV with data link”.

With the use of data link the minimum braking distance can be transmitted from the aircrew to ATC from TOD, ATC can then provide the most relevant exit point and the aircraft can predict with better accuracy the time between the runway exit and gate thus supporting improved predictability and efficiency.

NOTE: Currently a 7 minutes generic time from landing to stand is used by British Airways at Gatwick. The benefits of having more accurate predictions would be considerable.

NOTE: The best and worst runway exit points should be studied (e.g. for Airbus340) to assess the impact of using either.

5.2.2 SESAR

The difference between today’s operations and SESAR was discussed. Today the problems are managed by ATC and the solution given to the flight; with SESAR, the constraints, instead of the solutions, are given to the aircraft, so the users have more control over the solution. SESAR will allow users to choose the preferred solution taking into account ATM constraints (27000 flights daily in Europe rising to 45000 in 2020 and beyond).

SWIM which will enable sharing of all information, including the Network Operations Plan (NOP), via publish/subscribe mechanisms was described.

One of the major risks of SESAR is the involvement of the stakeholders. Especially the airlines as they should see the rewards according to the required investment.

SESAR’s airport objectives of improving Airports were discussed:

1. Improve Best In Class (BIC) Airports (Gatwick is BIC for single runway operations) by reducing separation (TBS in EP3 WP5.3.3).
2. Bring Other Airports up to BIC levels.
3. Improve Low Visibility Operations at BIC to that of normal operations.

The major Issues/Assumptions highlighted during the discussions were:

- To improve BIC Airports using TBS techniques implies a risk since a single delay will be propagated throughout the day. The initial view was to keep the Peak capacity as it is today to maintain resilience.
- With Low Visibility Conditions the group agreed that capacity in non low visibility conditions would not be maintainable, even with the best of the technologies. We could only hope to close the gap between low visibility and normal conditions.

- There is no standard procedure to assess the capacity of the airports. Airport Operations Control Centre (APOC) and airlines should agree on guidelines for measuring capacity.
- The assertion that controller workload reduction leads to capacity increases must be carefully considered. Various procedures are impacted by the reduction. Before reducing Controller workload to increase capacity the constraints related to planning, ATC and airport operations should be considered.
- It was highlighted that beyond a certain traffic level, opening new sectors will not be a solution as the coordination work required will push the workload over a manageable level.

A SESAR presentation on Trajectory Based Operations was given and the transition from Shared Business Trajectory (SBT) to Reference Business Trajectory (RBT) was discussed.

The time when the SBT becomes an RBT was shown as hours before execution but the group agreed this would be just before execution (minutes before).

ATM Capability Levels were presented showing the level of ATM capability planned at each different SESAR Implementation Package (IP).

Assumption: (after advice from R Faris) is to take at least three ATM capability levels (mixed equipment) in 2020.

The RBT is updated in real time during the execution phase (throughout the flight) including the ground portion of the trajectory. The enabler is technology which will determine the accuracy of the data: the initial assumption is that ATM 0-1 or 2 aircraft's data will be shared by ANSPs though not with the level of accuracy of data coming from ATM 3 capability level and beyond, so negotiation via SWIM will also be possible.

The subject sits between EP3 WP5 (execution of the trajectory) and EP3 WP3 (planning of the trajectory).

The following targets were discussed (from SESAR D2 – The performance target [5]):

- 73% Increase in Traffic by 2020,
- x10 Increase in Safety,
- -10% Effect on Environment,
- -50% Gate-to-Gate ATM Costs.

The airport as a part of the SESAR network was shown and discussed using the following diagram:

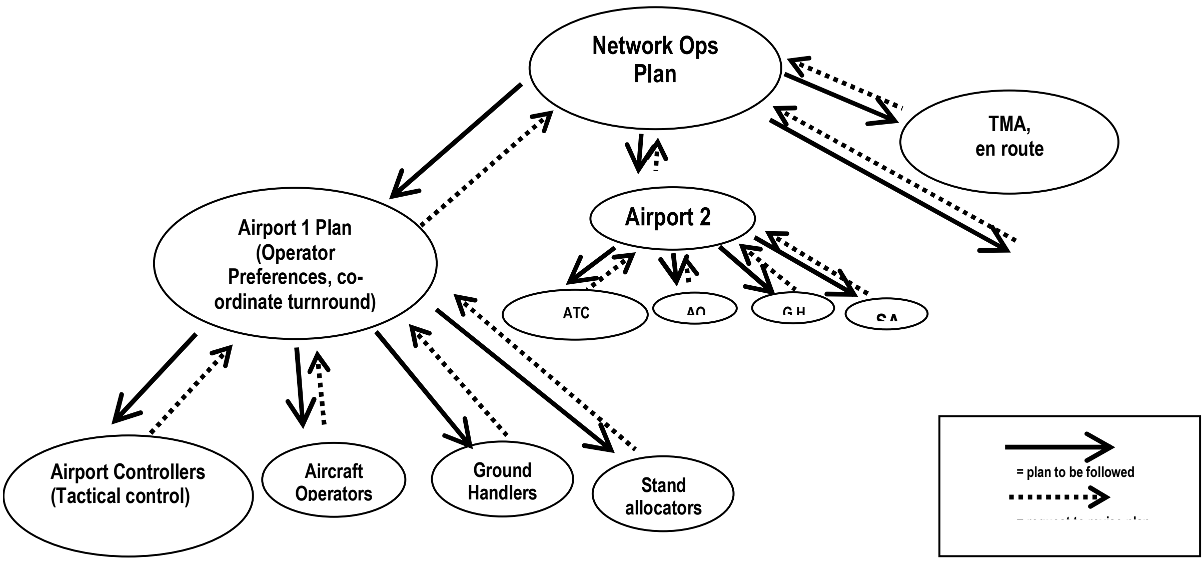

Figure 1 - SESAR Philosophy – Airports in the Network

This diagram shows that in SESAR there will be an integrated network allowing shared information between all actors. The decision making process including roles and responsibilities will be covering the complete network and not only the local Airport. This diagram simplifies the change in paradigm in the future. - adhering to a Network Plan

Key enablers at airports were presented. Some innovations are more mature than others. Regarding the coordination between the landing runway and the TMA, DSNA MAESTRO tool provides an AMAN planning tool for Paris - Charles de Gaulle Airport.

The Advanced Airport Surface Movement Guidance and Control System (A-SMGCS) is an enabler that will provide improved predictability for Runway/Stand/Runway sequence. EMMA2 project is focused on this system development. Some Questions were posed on this:

- What is A-SMGCS level 3 and when will be implemented?
- Will Automatic Routing System be available in aircraft?
- How arrival/departure queues are managed?

Regarding the Runway/Stand/Runway sequence, it was highlighted that Tower controllers work through shared information to define working procedures based on other actors' preferences.

Issue: is automation an enabler for the taxiing? Today taxi speeds are not monitored or constrained: they depend on the pilot. Airbus view is that it's likely to have **Automated Taxi Speeds**. The system would need to know possible taxi speeds, which vary between aircraft. The general concern is if this **will have a significant impact on efficiency or predictability**. **An opportunity was identified**: if taxi times and, thus, expected take-off times are known in the cockpit, this would allow pilots to start the 2nd engine at the appropriate time and avoid delays due to 2nd engine not being ready.

Issue: Communication limitation: if the communication can be performed via data link (reduction of controller and pilot misunderstanding), the automation will provide benefits. Additionally, the benefits of A-SMGCS on a particular airport could depend on how efficient the airport layout is.

Other Questions that arose were:

- What is the STANSTEAD Airport departure sequence process? (Neither slots or First Come First Served is used)?
- Comparing Munich and Gatwick Airports: both have two mixed mode runways, but Munich is not able to give as much movements per hour as Gatwick. It would be interesting to see which variables/ constraints are leading to that difference.

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C:The Trade-Offs between efficiency, flexibility and predictability are currently in operation but will be more open and shared in SESAR. Therefore, they need to be addressed when refining the concept (for example, when confronting efficiency and flexibility, several Questions arise: RBT is created before or after the DMAN sequence? The RBT can be totally different from the SBT?)

5.2.2.1 Airport Operational Scenarios (OS) Presentation

A number of Operational Scenarios (OS) related to airport operations have been produced within EP3.

All scenarios were reviewed to identify relevant items for the Airport Storyboards, checking the consistency of the vocabulary used and to provide a suitable form of presentation in order to ease the collaborative review in forthcoming meetings.

Richard Faris highlighted the importance of being careful in breaking the OS down, in order not to miss the interactions between them.

Key OS assumptions were reviewed to identify Questions (Q) and assumptions (A) for the Q/A spreadsheet:

The OS assumptions, Questions and issues identified were:

Assumption/Recommendation: *The airport will be equipped with Advanced Surface Movement and Guidance Control System (A-SMGCS), bringing support to the Tower Runway Controller and the Tower Ground Controller for guidance of vehicles on the airport movement area. A-SMGCS is a system providing routing, guidance and surveillance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level while maintaining the required level of safety. The System (A-SMGCS) will monitor the RBT and update it if necessary. Therefore, required modifications during execution of the RBT and consequently on the Airport Operational Plan (AOP) will be automatically disseminated into the Network Operations Plan (NOP) via the System-Wide Information Management (SWIM)*

Q: What level of development can be expected for A-SMGCS by 2020? The Assumption was to be agreed prior to the next WP5 Airport EG meeting

Q: How will A-SMGCS update the RBT? A possibility is that the RBT is updated by the A-SMGCS if the taxi being performed is different from that in the RBT (to be checked with EMMA 2)

Assumption: Key stakeholders for the RBT update (time on Stand, taxiway used) will be the Stand Planners of Airlines. Here there is an interaction with EP3 WP3 Airport EG: the Stand Planner needs to know, from a Planning Phase point of view, type of AC, passenger restrictions, if busses needed, etc.

> ***C:*** *The BA Stand planning tool allows the creation of rules to associate type of AC with certain Stand restrictions in order to reduce rework and save money.*

Assumption: There are some assumptions currently “operating” about Stand Planners: for instance, at Gatwick, it is considered that more than one Stand Planner introduces complexity. In SESAR, the tendency is to reduce people, so one Stand Planner and one Ground Handling Agent for the complete airport would be the most efficient way to manage. But how realistic is that in 2020? This is part of the objectives of the APOC, though the agreement of all Airlines could be difficult to obtain.

Assumption: It was highlighted that nowadays different Handling Agents use different procedures, different working methods, unions, business models, etc.

Q: Would it make a difference to have one Push-back Planner? The role is assumed nowadays by the stand planner.

Assumption: One common issue is that Ground Handling Agents have problems related to resources availability (having the required resources in the right place at the right time). Storing of equipment at best locations at the airport is critical and very difficult/restrictive.

Assumption**:** in 2020 all planning resources will be driven automatically.

Q: Will the ground-based RBT include speed information for taxi? Is it something to be included in the planning? Has speed an importance in the ground portion of the RBT? It could allow the Handling Agent to know the expected stand arrival time.

Q: Will the Pilot be given a speed restriction or a specific speed to follow?

Assumption: It is to be determined if RBT (including speed) is updated automatically by the system or by a controller. The accepted **assumption** is that it is appropriate that A-SMGCS updates the RBT

Assumption: The Estimated Time of Arrival (ETA) at Stand is very important and highly dependent on taxiway delays, it is crucial that these changes are updated in the RBT

- *The ground movement of an aircraft is considered part of the Business Trajectory by SESAR. However, it is not practical to issue the ground taxi route before the aircraft indicates that it has completed the boarding process and is ready for engine start and push back. The filed Shared Business Trajectory (SBT) will contain generic times/routings for ground taxi but, except at airports where no options exist, will not specify the precise routing. When the flight crew indicates that they are ready for start/pushback the System (A-SMGCS) will calculate the most advantageous routing, taking into account the departure sequence (if any). The Tower Ground Controller will confirm its suitability and provide it to all concerned actors via SWIM. The proposed taxi route will be incorporated into the a/c system which in turn will provide an update to the Business Trajectory, refining the generic data agreed with the RBT.*

Assumption: Airbus confirmed that Data link/DTAXI will be in place in 2020

Assumption: It will probably use an average time between the crew calling for push-back and the crew ready for taxi, but variability is high. There is currently a big difference between airborne times for the same off-blocks time. The Ground Controller can provide a good estimation about the time needed for the flight to be airborne: should this information be shared with the flight crew?

Q: The impact of sharing real time information with AOP (including the information in the NOP) is an issue to be considered with EP3 WP3 Airport EG.

Assumption: The estimation of push-back time and the taxi time are critical to calculate the airborne time. These estimations are a key issue of interaction between the planning phase and the execution phase, so have to be discussed with EP3 WP3 Airport EG. *The accuracy of the information being shared has a significant impact on the efficiency*.

Assumption: Tower Runway and Tower Ground Controllers at Gatwick can pack/gap arrivals/departures, where flexible use of taxiways is possible. Following Gatwick methods in this sense could be a quick-win for other Airports (Soton, Bristol, Cardiff, etc.) provided that flexible use of taxiways is not restricted

Assumption: A possible improvement will be to have prediction tools to assist controllers in Best In Class Airports

Assumption: The Runway Status can be transmitted by the pilot to the following aircraft. In busy airports like Gatwick the interval between aircraft is very tight so probably the reception of the information would arrive too late to be useful. At Gatwick, it is expected that this information is transmitted to following aircraft by ATC, and **not** by the Pilot

- *Aircraft might be able to land with Brake-to-Vacate (BtV), a procedure enabling to vacate the runway at a pre-selected runway exit coordinated with the Tower Runway Controller by voice or data-link, and based on BtV avionics that controls the deceleration of the aircraft to a fixed speed at the selected exit. The arrival scenario (OS-12) covers both cases: with and without BtV*

Assumption: With BtV aircraft may propose a runway exit point. Then A-SMGCS calculates the best taxi route to stand (may be different to the original proposal), informing Ground Controller and Aircraft. Richard Newns C:: it is difficult in some cases to have a predicted taxi-in(e.g. at Gatwick, from vacating the runway to a certain stand there can be four different possible routes)

Q: Are there standard exit taxi routes at most airports?

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Assumption: Top Of Descent (TOD) is an important point: where predictions and decisions are made. Therefore knowing the rapid exit point at TOD has an impact on predictability

Assumption: An accepted assumption is that a taxi/Airport map will be uploaded to all aircraft in 2020. When will taxiway be uploaded to the aircraft by A-SMGCS? A possible **assumption** is that by 2020 there will be available information on other aircraft using taxiways

Some other general concerns highlighted:

Assumption: Heterogeneity of the airport operations: depends on what is being measured to obtain the delays (or the performances at the airport) as currently airports operate differently

Assumption: If data-link is not assumed to be fully operative, then the communication method would require further definition

6 REFINING THE SOLUTION

6.1 Session 4 – Day 1 - Start to build Storyboards

The objective of Day 1 of session 4 was to achieve a common understanding of the SESAR ConOps and Operational Scenarios related to the Execution Phase at the Airport. The meeting was to provide a starting point for deeper clarification of the related concepts and the discussions triggered provided Questions (Q) and Assumptions that served as input to the two storyboards and building on the work already commenced.

The meeting held at INECO, Madrid 26 January 2009 reviewed the SESAR concept at the airport 'airside'. This was achieved by presenting the Operational Scenarios in a simplified format in MS PowerPoint rather than textual documents.

Comments on the Scenarios were included in the Minutes of Meeting and those for OS-12 (Landing and Taxi to Stand) and OS-13 (Taxi Out and Departure) used to create initial versions of the storyboards.

The scenarios and all versions are presented with Comments (C for Comments, Q for Questions, Assumptions, Issues) showing the progressive moving towards the final storyboards and conclusions.

6.1.1 A-SMGCS

6.1.1.1 A-SMGCS Equipment Scope

- A-SMGCS provides Routeing and Guidance advice to Ground Controllers and Runway Controllers
- A-SMGCS predicts hazardous situations and alerts/informs if:
- Aircraft does not conform to clearance.
- Aircraft is in conflict with another aircraft.
- Aircraft is likely to enter a runway without clearance.
- Aircraft is likely to enter an area not on its cleared route.
- All aircraft will be equipped with:
- Surface Movement Alerting Function (route conformance, runway incursion, conflict checking),
- Ground Traffic Display,
- Moving Map Display.

6.1.1.2 A-SMGCS Equipment Scope Comments

Assumption: The scope is for cooperative traffic.

Q: Are we applying segregation of ALL traffic or just Aircraft? (There are a lot of vehicles particularly on Aprons).

Assumption: The Vehicle Transponder shows a vehicle presence but not the identification of the vehicle.

Q: There is a Risk of making assumptions supposing certain capabilities that the system does not or will not have.

Q: Are all the vehicles in the airport going to be equipped to be detected and presented by A-SMGCS? The issue is if all the aircraft in the manoeuvring area are collaborative.

Q: If all vehicles are shown then there is a clutter problem on the display?

Q: There is a risk of adding complexity to the system and the operations if there is the possibility of hiding or showing certain information under certain conditions. But also, if we avoid the automatic detection system, we miss the benefit of detecting runway incursions.

Q: Runway incursions: how to manage? This is a Q: for ICAO maybe? The detected conflict could be directly delivered to the pilot, and the controller might be informed. The benefit of jumping the controller is to not miss time. The issue has been studied in prototyping: the controller is able to identify the situation before the pilot. The conclusions is that informing the pilot adds risk because the pilot is can only take action seconds before the conflict is going to occur, whereas the controller can take action before that.

Q: Is this an advisory service or routing information service providing traffic information?

Q: What type of vehicle will be displayed? Will it include a type in the label?

6.1.2 OS 12 – Landing and Taxi to Stand

The following versions of this Scenario were presented:

1. Land with Brake-to-Vacate
2. Land without Brake-to-Vacate
3. Taxi to Stand
4. Change in Stand Allocation
5. Go-Around

6.1.2.1 Land with Brake to Vacate

6.1.2.1.1 Scenario

- Flight is cleared for Final Approach by TMA Approach controller
- Flight is transferred to Tower Runway controller and establishes communication
- A-SMGCS proposes a taxi-in route which is accepted by Ground controller
- A-SMGCS transfers the runway exit point and the taxi route to the aircraft by data link
- The aircraft Brake-to-Vacate system verifies that the exit point is acceptable
- Runway controller verifies that runway is clear, and gives landing clearance
- Flight crew land the aircraft. Runway controller verifies that aircraft takes the agreed runway exit

6.1.2.1.2 Comments

Q: BtV is physically acting on the aircraft? **Yes**. Concern about the benefits of BtV was raised (NLR). Reinhard’s view was that the main benefit would be predictability: ATC has the same knowledge about the best exit point, and the performance of the aircraft is not a lot better, but with BtV when ATC identifies the best exit point the aircraft is asked if this can be achieved, and if the aircraft agrees then predictability is improved

Assumption: BtV is a method of reducing airline maintenance costs by saving brake wear and tear and reducing reverse thrust

Assumption: BtV ensures predictability and reduces risk of A/C entering Critical areas

C: Safety Margins need to be addressed

C: Chronological order should be changed. Bullet point number three is maybe the first. The taxi-in has an impact in the final sequence. So it is important to define clearly when this information is going to be agreed/ transferred. **Link with 5.3.1** (TMA Expert Group)

C: The proposal of taxi route could be the other way round (from A/C to GRD), or the proposal from the aircraft can be limited to the exit point. Also feedback by voice could be necessary.

Q: BtV is going to give as much predictability as Airbus is saying? Until the aircraft is on the ground you cannot ensure that the exit point will be achieved. Some concerns about proposing a taxi-in still in the air. It depends on the airport. For complex airports, like Gatwick this is probably more difficult.

Assumption: 90% of A/C will use the same exit point

Assumption: The Ground Profile (Trajectory) will be updated using A/C information (H, M, L) and different exit points according to the Taxi Layout and Taxi Routes

Assumption: A study has been carried out to see how often the standard taxi route is changed because of conflicts: 10-30% and mainly for inbounds.

Q: to use push-back cars to runway holding point to reduce the taxi-out conflicts and fuel consumption is possible?

Q: A-SMGCS able to predict the taxi-in? Q: for EMMA 2. The A-SMGCS is connected to the AMAN, and the AMAN dynamically calculates the ground situation. More sophisticated system is **assumed**. A Study showed how often the standard taxi route is changed because of conflicts: 10-30% and mainly for inbounds.

Q: Benefit of the A-SMGCS proposing a taxi-in? The A-SMGCS proposes in the air the initial route, which may not vary (90-70%) from the final one, so the Ground Controller has more information for planning the taxi routes.

Assumption: Nowadays it is accepted/expected that some go-arounds occur. The scenario should help to reduce this.

Q: For airlines, we're assuming the priority is to arrive at stand ASAP. Pilots asked about one thing they would like to be able to do, to miss an exit point to allow overtaking of an aircraft already in the taxi way, by exiting the next exit point on the runway and positioning before the other aircraft.

Assumption: Benefit of BtV: the aircraft cannot say that it missed an exit because it could not brake hard enough, because that will be automatic.

Assumption: SESAR Benefits (Taxi in/Out times): inbound and outbound can be better predicted so controllers can predict GRD conflicts easier. The better the in-block/off-block times are predicted, the better the gates can be managed (including all resources). The RBT can be predicted and met. It's one of the principal benefits of CDM.

Q: A-SMGCS functionalities in this OS are level 4. Routing is in level 3, and planning in 4, but these two issues cannot be clearly separated.

Assumption: Clarification: for BtV to work A-SMGCS is not required, but BtV works better with A-SMGCS level 4.

Assumption: BtV will help also improving predictability because it will help pilots that are not familiar with the specific airport.

Q: What is Brake to Vacate effectiveness in Poor Weather?

Q: GRD system proposes Taxi Routes to Aircraft according to BtV exit point, how does the coordination work if Pilot does not agree to Exit Point? Could this be the Pilot who asks for a specific Exit Point and Taxi Route to Stand? (Bullet 3).

Q:/Answer: Bullet 3: Message is sent -10 miles out?

Assumption: Brake To Vacate does not influence Final Approach Separation. Brake to Vacate is to optimise Runway Occupancy and improve GRD Taxiway operations and predictability at the airport

6.1.2.2 Landing without BtV

6.1.2.2.1 The Scenario

- ***Flight is cleared for Final Approach by TMA Approach controller***
- ***Flight is transferred to Tower Runway controller and establishes communication***
- ***A-SMGCS proposes a taxi-in route which is accepted by Ground controller***
- ***A-SMGCS transfers the runway exit point and the taxi route to the aircraft by data link***
- ***The aircraft has no Brake-to-Vacate system and cannot verify the exit point***
- ***The aircraft misses the exit point***
- ***The runway controller issues an alternative exit***
- ***The A-SMGCS creates a new planned taxi route, which is accepted by the Ground Controller and data linked to the flight crew***
- ***The APOC staff update the turn-round plan***

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6.1.2.2.2 Comments

C: The BtV has an influence on the separation margin with the next aircraft to be reduced with BtV? Concern if BtV is an enabler for reducing separation in final approach. With BtV it is accepted that we can still miss an exit. This is the view of Airbus, but in 5.3.3 the view was that there are many factors affecting the separation in final approach. Again, main impact of BtV is predictability. It is important to highlight that minimum separation is shaped by wake-vortex, and that the separation reduction we are trying to reach is not below the minimum by using BtV.

Q: Is there any significant difference between this scenario and the previous one? With BtV we can still miss exit point. So the two scenarios could be changed to **Miss/don't miss the exit point**, making a note to say that with BtV there is a **much reduced** possibility of missing the exit.

Q: It is difficult to predict the Taxi Routes accurately when the aircraft is so far out (in current operations). How will the GRD System manage this level of uncertainty?

You only get an update turn-around plan when the aircraft is in the stand, so the last bullet may be also in the other scenario. It depends on the airport: where the arrival time is defined? The turn-around plan is continuously being updated in real-time, so the bullet may be changed to confirm or not the current plan. Again, improved predictability can be seen as the benefit.

Assumption: Advantage for airlines is better stand management (currently planned well in advance)

Assumption: BtV provides better predictability for stand times and will allow better estimation and actual departure times. Without BtV there is a risk of slipping 4/5 minutes.

6.1.2.3 Taxi to Stand

6.1.2.3.1 The Scenario

- ***Runway Controller transfers the aircraft to Ground Controller by data link or R/T***
- ***Ground controller clears the aircraft to taxi along the planned route***
- ***A-SMGCS monitors the progress of the aircraft along the planned route***
- ***A-SMGCS monitors the progress of the aircraft with regard to other traffic and airport resources (stand status, taxiways in service)***
- ***Scenario finishes when the flight arrives at stand***

6.1.2.3.2 Comments

Q: What it is the purpose of the A-SMGCS? It is not a separation tool and does not monitor conflicts, but monitors compliance with current taxi routes to update the planning in case of non compliance. The rules are not defined yet. Although it is seen as a safety tool the False Alarms generated restrict its use: **See previous Comments on A-SMGCS**.

Q: How will the Pilot use the system? Does this replace the Pilot looking out of the window? Is this a heads up display or does the Pilot need to move his head?

Assumption: According to the ITWP (Integrated Tower Working Position) the A-SMGCS is used to update the route, show the status of A/C on routes and monitor progress.

C: Visualisation and platform presented is being done for WP6.9.2 in SESAR: future A-SMGCS package.

Q: What level of A-SMGCS is to be provided (bullet 4)? 3 or 4?

Q: Overload of information, who needs to be informed and who needs to act on the information, Clear Roles and responsibilities required

Q: Will there be a speed limit for Taxiing? Speed conformance also monitored? This could reduce risk of taking off on a taxiway

Q: Without speed restrictions/conformance then there will be variability in taxi times

C: Objective at LHR to reduce average taxi in time from 7 minutes (as currently)

Assumption: A-SMGCS/SMAN cannot be used as separation tool if no speed is included

RECOMMENDATION: Clearance for portions of the taxiways could be provided (NLR)

Q: Does the runway controller transfer the aircraft to the ground controller? The controller talks to the pilot nowadays. A clearance is not needed to leave the runway.

Q: Individual lights for taxi? This is done differently at different airports. A-SMGCS could switch the individual taxi routes on as the Aircraft moves long the taxi ways. At least at major hubs, this could be a light bubble around the aircraft moving light bubble using Green and Red for Taxi lighting?

Q: Is a clearance needed when the route is not changed or only when there is a change to the plan? It is done automatically (if no change), not by voice or any human triggered communication, but with a tick on the system.

Q: There is a speed limit in the taxi way. The idea is to have an alert if the speed is being out of certain limits. Speed conformance monitoring.

Q: Provide Alerts only when the Vehicle infringes on Taxiways or when crossing taxiways.

Q: Not all vehicles should be cooperative, Towing vehicles on the Taxiways will add to the confusion (especially if conflicts are shown), decision on types of vehicles and areas to cover required. What are the rules for displaying a vehicle in the system?

Q: ATCO thinks it is not possible to provide Conflict Management on Taxiways.

Q: What will the procedures be? How will the system be updated in the future?

Assumption: Conflict goes to Pilot. How does the system help the actors work together to find a solution? ATCO is informed of Conflict only. This adds complexity and time to find a solution.

C: Runway Incursion in America is a big problem

Q: System provides colour showing severity of alert (amber, then red)? ATCO has alert before Pilot, who reacts? Source of confusion

6.1.2.4 Change in stand allocation

6.1.2.4.1 Scenario

- ***BJ125 has landed and is taxiing along its planned route***
- ***An outbound aircraft is delayed at its allocated stand***
- ***The APOC changes BJ125's stand allocation***
- ***The system informs the Ground Controller and Flight Crew of the BJ125's new stand allocation***
- ***The Ground Controller requests a new taxi route from the system***
- ***The system provides a new route, which is accepted by the Ground Controller and data linked to the flight crew of BJ125***
- ***The Ground Controller clears BJ125's flight crew to taxi via the new route***
- ***The APOC revises the turn-round plan as necessary)***

6.1.2.4.2 Comments

C: This is a small change compared to current operations.

Q: The "system" is the one of the APOC: so the airport CDM platform?

6.1.2.5 Go around

6.1.2.5.1 Scenario

- ***The preceding aircraft has a technical problem, and cannot exit the runway***
- ***The Tower Controller notifies the system that the runway is blocked for an undefined period***

- ***The Runway Controller instructs the aircraft to execute a missed approach and to contact the TMA Approach Controller***
- ***The RBT is revised***

6.1.2.5.2 Comments

Q: 2nd bullet confusing: The notification of the Ground Controller to the system is not needed because there will be alerts for that. But still the other approaching aircraft have to be informed. We need to clarify what the **system** is in this sentence.

Q: The undefined period should be refined, since depending of the blocking type the human have a clear idea of the period, and estimation to be fed into the process and to take decisions about how to proceed.

Q: There are other possibilities for go-around, and not only this one**.** Why are the other go-around reasons not represented here? We have three different possibilities independent of the runway problem.

Assumption: The RBT must be revised not only for the individual aircraft but for all the aircraft in the airport, inbound and outbound.

This issue is maybe more related to TMA than to taxi.

Q: Do we need to supply Operational Scenarios for the complete Concept?

Q: Improvement in Go-Around will be very beneficial to airlines

Q: What happens to the RBT when a go-around is carried out?

C: In Current Ops a go-around triggers a red light at the TMA (from LHR)

6.1.3 Taxi-Out and Take-Off

Two versions of this Scenario are presented, Nominal Taxi-Out and Take off and Non-Nominal Taxi-Out and Take off

6.1.3.1 Nominal Taxi-Out and Take Off

6.1.3.1.1 Pre-Conditions

- ***The TOBT is confirmed, the RBT is recorded in the NOP and up-linked to the aircraft FMS***
- ***TSAT is agreed between ATC and Aircraft Operator and sent by Data-link (D/L) to the Flight Crew 20 minutes in advance***
- ***The departure clearance (including TSAT and planned taxi route information) is issued to the Flight Crew by data link***
- ***Ground handling is completed, aircraft doors are closed and the Flight Crew is ready to leave stand***
- ***Aircraft is under Tower Ground Controller responsibility***

6.1.3.1.2 Taxi Out 1 Scenario

- **At TSAT, pilot sends data link request for start-up and pushback**
- **Ground controller responds with start-up and pushback clearance, via R/T or data link**
- **Flight crew request taxi clearance, via R/T or data link**
- **Ground Controller issues the taxi-out clearance, using D/L or R/T. The planned taxi route from the departure clearance becomes a cleared taxi route**
- **Flight Crew acknowledge the taxi-out clearance using D/L or R/T and proceed to taxi. The Flight Crew performs the RBT taxi-out following the designated route displayed on the CDTI and using visual navigation aids (e.g. taxiway lighting). Airport Moving Maps (CDTI) provide the Flight Crew with information on the surface traffic that supplements out-the-window observations and see-and-be-seen procedures**

6.1.3.1.3 Taxi Out 2 Scenario

- ***Tower Ground Controller uses A-SMGCS to monitor the aircraft movement and track progress against RBT taxi-out route. A-SMGCS updates the RBT and TTOT if necessary. At the same time, the Tower Ground Controller uses the System (A-SMGCS) to monitor the progress of the aircraft with regard to other surface traffic***
- ***If several Tower Ground Controllers are operating at the airport, transfer of control of the aircraft between them is done by D/L or R/T***
- ***The aircraft reaches the runway holding point and the Tower Ground Controller transfers the responsibility to the Tower Runway Controller, using D/L or R/T. The RBT is updated (TTOT) and propagated into the NOP via SWIM***

6.1.3.1.4 Comments on pre-conditions and Taxi Out 1

Assumption: Flight Crew is ready for push-back instead of ready for leaving the stand

Q: 2nd Bullet: To up-link TSAT to the flight crew 20 min before the taxi start is meaningless, since it will change a million times (60 – 70 % change) in that period of 20 min.

Start-up (TSAT) is currently agreed with pilot, not with aircraft operator. But behind the second bullet there is the airport CDM: TSAT planning for many aircraft.

Q: 4th Bullet Point, remove "flight crew"

Assumption: 2nd Bullet, this represents Airport CDM not current Ops.

Assumption: The different Business Models involved will affect decision making and due to the money stakeholders will not agree and not share sensitive data

Assumption: Airlines look at the type of passengers and amount on aircraft to make decisions (Business Passengers over cheaper travel etc)

6.1.3.1.5 Comments on Taxi Out 2

C: 2nd Bullet: Transfer of control is not done by D/L, but transfer of communication, change wording to "transfer of communication".

Q: 3rd Bullet: What is the RBT departure order (done in CDM)? TSAT or TTOT? Example – Munich CDM can be presented

Q: Decision Making of GRD/TWR Controller currently carried out. How is this represented in the system for departure sequencing? How is the departure sequencing calculated?

Assumption: Departure Sequence number will be on label

6.1.3.1.6 Take off Scenario

- ***The Tower Runway controller gives clearance to "line up and wait" using R/T, and the Flight Crew lines-up the aircraft***
- ***The Tower Runway Controller, by visual reference or using the System (A-SMGCS), verifies that the runway is free of obstacles for the take-off of the aircraft. The Tower Runway Controller issues the take-off clearance via R/T***
- ***Flight Crew initiates the take-off roll and lifts-off. The System (A-SMGCS) detects the take-off, receives the down linked RBT initialised with the Actual Take-Off Time (ATOT) and publishes the updated synchronised RBT in the NOP***
- ***The Flight Crew proceeds with the climb out and the Tower Runway Controller assisted by the System (A-SMGCS), verifies that the aircraft has safely taken-off***
- ***At the agreed point and/or altitude, the controller instructs the Flight Crew using R/T or D/L to transfer communications to the Executive Controller (Departure TMA). The scenario ends when the system records that the flight has been safely transferred to the Executive Controller (Departure TMA)***

6.1.3.1.7 Comments

Q: Scenarios with GRD Controllers do not mention Visual Reference, or is this an assumption? Remove the visual reference, or review pre-conditions, since the Tower Runway controller is not required to be able to visually review the runway in SESAR. Assumption maybe needed and consistency in OS have to be checked (this seems to be the first reference to visual checking in the OS).

C: 4th Bullet: Change "Safely taken off" to "taken off".

Q: Last bullet: flight crew is instructed to transfer communication. This might be automatically done at a certain altitude in the future. Problem with automatic transfer: when the tower controller still has instructions and automatically lost communication. NOTE: LHR did not like automated.

Q: Is there a SID included in the departure profile?

C: Add Bullet for "line up aircraft"

6.1.3.2 Non-Nominal Taxi-Out and Take-Off

The following aircraft are part of this scenario

- **BJ124 took-off as planned (nominal case)**
- **BJ125 has technical fault on take-off roll**
- **BJ126 was lining up when runway blocked**
- **BJ127 was taxiing out when runway blocked**

6.1.3.2.1 Aborted Take off

6.1.3.2.1.1 Aborted Take-off Scenario

- ***After receiving take-off clearance the aircraft has a technical fault on commencing take-off. It is unable to vacate the runway. The A-SMGCS records that the aircraft has not taken off, and it cancels the RBT***

6.1.3.2.1.2 Comments

Assumption: There is a tolerance to cancel the RBT.

6.1.3.2.2 Runway blocked during line-up

6.1.3.2.2.1 Runway blocked during line up scenario

- The runway is blocked by an aircraft with a technical fault. The Tower Controller cancels the departure clearance, and transfers the aircraft back to the Ground Controller.
- The ground controller returns the aircraft to stand or to a remote holding area

6.1.3.2.2.2 Comments

C: "Cancels line up" instead of "cancels departure clearance".

C: Transfer to ground controller is not needed: the aircraft must stay under the tower runway controller control while it is on the runway.

Q:: There are several possibilities: to stay there waiting for the runway to be liberated, other runway to be used, Tower controller issues a clearance to taxi out and then there is a transfer of communication to the ground controller, back to stand or to a holding point.

C: Airline would not want aircraft back to stand unless the airport is closed. The Aircraft would wait at the holding point to not lose its departure sequence.

C: There is no benefit in a remote holding area, which could compromise the building of a new sequence.

6.1.3.2.3 Runway blocked during taxi out

6.1.3.2.3.1 Runway blocked during taxi out Scenario

- ***The runway is blocked by an aircraft with a technical fault.***
- ***The Ground Controller cancels the RBT and all previous clearances.***
- ***The Ground controller requests a taxi route back to stand from the A-SMGCS***
- ***The Ground controller receives a taxi route back to stand from the A-SMGCS, and issues it to the flight crew***
- ***The flight crew follow the clearance and return to stand***

6.1.3.2.3.2 Comments

C: as for previous scenario, the aircraft would remain in its current position and not move.

Q: Maybe the RBT is not cancelled, but delayed/ postponed. Additionally, again the issue of what is the RBT and how it is managed (Make RBT into SBT? all RBTs to be recalculated?)

6.1.4 OS-17-solve hazardous situations during taxiing

A-SMGCS equipment scope and Comments can be found in 6.1.1.1.

6.1.4.1 Arrival Exits Taxiway at Unintended Location

6.1.4.1.1 Scenario

- ***A-SMGCS provides alert to Ground Controller, and Surface Movement Alerting system provides alert to Flight Crew***
- ***Flight crew stop the aircraft and contact Ground Controller***
- ***A-SMGCS proposes a new route to stand***
- ***Ground controller accepts the route and issues clearance***
- ***New route is data linked to aircraft***
- ***Flight crew taxi to stand according to new clearance***

6.1.4.1.2 Comments

Assumption: Most efficient (emissions) taxi route is used for re-route. Does it consider other aircraft? Check What EMMA2 proposes. Leave conflict management to Controller

Assumption: Nowadays the controller detects conflicts and tells the pilot the alternative taxi so the aircraft is not stopped.

Assumption: If conflict management is left to the controller, then it won't possible for the A-SMGCS to predict the route.

Assumption: Less Aircraft on Taxiways due to better prediction (SESAR).

6.1.4.2 Aircraft approaches intersection with converging traffic

6.1.4.2.1 Scenario

- ***BlueJet 123 is taxiing in to stand***
- ***BlueJet 124 is taxiing out to runway***
- ***They are approaching a taxiway intersection***
- ***The Ground Traffic display alerts the flight crew of BJ123***
- ***BJ123 flight crew slow down and avoid conflict***
- ***The Ground Controller monitors the situation to guarantee it is solved in a safe way***

6.1.4.2.2 Comments

Q: How is the priority established? Is the controller deciding? If there is a clear rule, then the traffic controller may not be needed. Currently, the rules might be different in different countries. Generally, in good visibility is pilot responsibility, and as visibility decreases, the responsibility is transferred to controller.

C: Bullet 6, Controller "Controls" not "Monitors".

Assumption: There are different rules at different airports for taxiway usage.

C: "The controller is alerted" is missing. Every actor (both pilot and the controller) should be alerted in this case. Problem: false alarms. At each intersection, the aircraft has to wait for clearance. The system can alert of converging aircraft while the aircraft are already being held at a certain point, or are going to be held. This is different for the runway. **Q**. How to define the separation needed in taxi ways to issue an alarm? The problem with false alarms is that they desensitize humans, so they won't be prepared when there is a real alarm.

C: Rewrite: All participants are informed of Alert and Controller resolves conflict (DLR). Parkair has algorithm to work out Conflict Alarm with speed etc.

Q: False alarms are an issue. Parkair – Alerts are not useful on GRD. There are many reasons for Potential Conflict – Pilots talking to stewardesses etc. A Tuning Algorithm is required (DLR)

Assumption: Runway/Taxiway Conflict + Taxiway/Taxiway Conflicts are different and known by the system

6.1.4.3 Taxiing Aircraft overtakes same direction traffic

6.1.4.3.1 Scenario

- ***BlueJet 123 is taxiing to stand***
- ***BJ123 overtakes same direction traffic***
- ***The A-SMGCS considers this a deviation from assigned route and provides a deviation "information" alert. At the same time, flight crew receive an alert from the on-board Surface Movement Alerting system***
- ***The A-SMGCS proposes a new taxi-in route. The Ground Controller accepts the route and issues it to BJ123 flight crew***
- ***BJ123 flight crew taxi to stand according to revised clearance***

6.1.4.3.2 Comments

Q: The scenario doesn't seem relevant. Find out why this scenario was included.

6.1.4.4 Crossing Red Stop Bar

6.1.4.4.1 Scenario

- ***BlueJet 124 is taxiing to its departure runway***
- ***Ground controller has switched the stop bar to red, via the EFPS***
- ***BJ124 crosses the stop bar and enters the runway protected area***
- ***A Runway Incursion Alert is triggered in the control tower and in the cockpit***
- ***The flight crew stop the aircraft***
- ***The Ground Movement controller issue new instructions***

6.1.4.4.2 Comments

C: 2nd Bullet: The ground controller is not switching the red bar, but the tower runway controller is

6.1.5 OS-16 - Turn-round management

Turn-round management is part of WP3.3.1 (collaborative airport Planning expert group). However the SESAR proposed solution in the Operational Scenario was reviewed by this group for consistency and to provide an ATC viewpoint not covered in WP3.3.1

6.1.5.1 Scenario

- ***Flight departs from origin***
  - ***Inbound RBT, including planned in-block time (EIBT) is automatically updated***
  - ***APOC updates the stand allocation, and Ground Handling Agent plans resources to match plan***
  - ***The system proposes updates to the turn-round plan, which might involve revising the outbound SBT***
  - ***The Airline Station Manager validates the plan updates***
- ***Aircraft commences final approach***
  - ***Inbound RBT, including planned in-block time (EIBT) is automatically updated***
  - ***APOC updates the stand allocation, and Ground Handling Agent plans resources to match plan***

- ***The system proposes updates to the turn-round plan, which might involve revising the outbound SBT***
- ***The Airline Station Manager validates the plan updates***

6.1.5.2 Comments

C: 1st Bullet: "estimated" in block time not "planned"

C: 4th bullet (both): The airline station manager is the APOC, change wording accordingly.

Question: Link with WP3: APOC is not clearly defined, requires clear definition.

C: Change "planned" by "estimated" in-block time to refer to EIBT, for consistency.

6.1.5.3 Turn-round management – Exception 1 Scenario

- ***The airline has another flight from this airport severely delayed by late arrival of the planned aircraft***
- ***The AOC re-allocates the flight to the current aircraft.***
- ***The SBT for both outbound flights are updated and propagated to the AOP and NOP***

6.1.5.4 Turn-round management – Exception 1 – Comments

Question: Clarification of AOC, Airline Operation Centre required

6.1.5.5 Turn-round management – Exception 2 Scenario

- ***Boarding starts later than planned***
- ***The Ground Handler Agent updates the expected time to complete boarding***
- ***The Ground Handler Agent updates the TOBT***
- ***The system updates the TSAT and the SBT, which are propagated into the NOP***

6.1.5.6 Turn-round management – Exception 2 – Comments

C: Bullets 2 and 3 are the same thing, modify

6.1.6 Output from session 4 day 1

A Questionnaire was created from the outstanding Questions and assumptions on all Scenarios discussed and sent out to experts in preparation for the next session and to assist in the creation of the storyboards (v1).

6.2 Session 4 – Day 2 – SBT to RBT - Workshop

On 27 January 2009 at INECO's premises in Madrid the 1st Brainstorming session on the hot topic "SBT to RBT agreement" was carried out.

The Oval Mapping brainstorming technique planned was deemed inappropriate for this type of session and a new technique was introduced as follows:

The "if then else" approach was used to present a number of options. The complete discussion papers and results can be found in Annex – SBT to RBT agreement.

6.3 Session 5 – Day1 - Review Storyboards and remaining Scenarios

Session 5 took place in London, UK. The 1st Day was at Gatwick Old Tower, the 2nd Day (SBT to RBT) at CAA House in Central London.

The objective of Session 5 Day 1 was to review principal outstanding Comments, review the v1 storyboards and remaining Scenarios.

The following sections show the principal Questions and answers feeding into the next version of the storyboards and the Comments on the storyboards presented at the meeting.

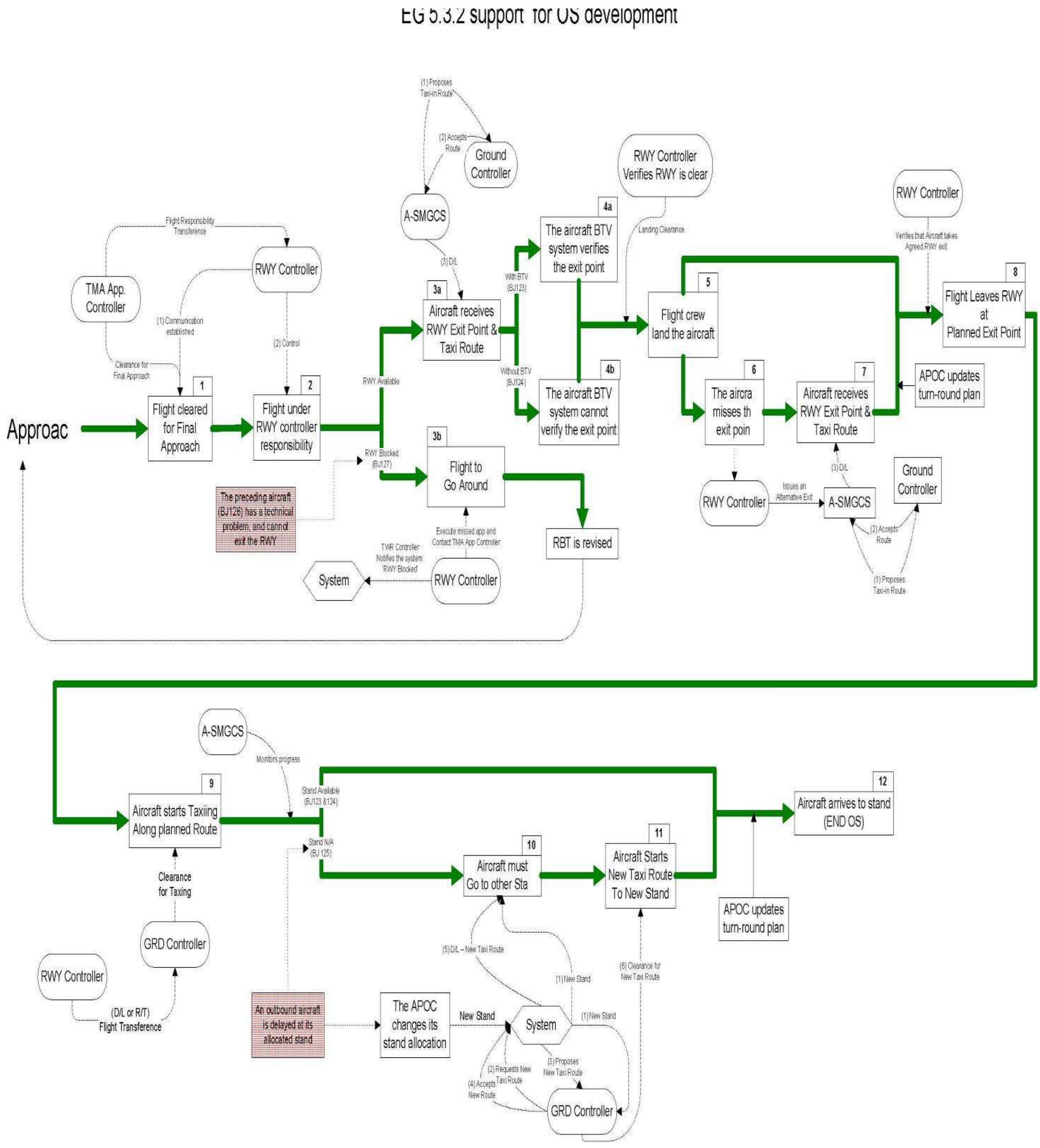
For a description of the Storyboard and the different shapes and meanings, please refer to section 1.4 - Glossary of Terms.

6.3.1 Top Six Open Questions and agreed answers

Top six open Q:s from the EP3 Airport Expert Group	
Q1	When using A-SMGCS, who is responsible for Conflict Resolution; and what is a conflict on the ground?
A1	ATC is responsible for managing surface movement and Pilot is responsible for A/C safety. ATC can delegate tasks to the Pilot; this would generally be in good weather conditions. *[ICAO-A-SMGCS]* conflict definition was agreed (ref. [15]): A situation when there is a possibility of a collision between aircraft and/or vehicles.
Q2	Will pilots be given a speed restriction or a specific speed to follow in the taxi? (That is, does the RBT ground segment require specific speeds?)
A2	It is better to give specific times for certain points of the route than speed restrictions. Speed restriction may likely have a bad impact on actual movement of the aircraft during taxiing with good visibility.
Q3	What surveillance accuracy is required for A-SMGCS Level 4 (routeing and control)? Wing Tip Clearance is critical – if surveillance accuracy is 7M and Wing Tip Clearance is 4M what is the impact?
A3	The wing tip clearance must be ensured by the airport infrastructure, i.e. by taxiways width, etc.
Q4	Who will participate in the SESAR Airport Operations Centre? Will the ATC/TWR Supervisor be included?
A4	ATC will be part of the AOC but there is no need for the ATC actor to be physically at the AOC room. Information must flow between ATC and AOC.
Q5	What level of planning does the Airport Operations Centre perform? Does it act on the Airport Plan only, or can it change the Network Plan?
A5	It acts on the AOP and on the NOP
Q6	Using spacing / Time Based Separation (TBS) techniques carries a risk, since a single delay may be propagated throughout the day causing a big impact. Is it better to keep Peak Capacity as it is nowadays, to maintain resilience?
A6	The Q: seems to be confusing, Not Applicable

Table 3 - Top six Questions and Answers

6.3.2 Review Q/A related to Storyboard and Landing and Taxi to Stand (OS-12) and Create version 2



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6.3.2.1 Comments

The V1 storyboard for Landing and Taxi to Stand was reviewed on screen and Comments noted as follows.

Q: When is Runway exit point (BtV) and Taxiways passed to A/C? At Top of Descent (TOD)?

C: Generally accepted that automated tool will provide better use of taxiways and routes (30 routes in operation at Gatwick currently).

Q: 3 Runways at Stockholm (Arlanda), Normal taxi routes used during peak times and optimised taxi routes used during off peak times, is this possible for all airports?

Q: Do planned routes and cleared routes need to be provided using colour (red/amber/green)?

Q: Are tools sophisticated enough? Will constant recalculation be required?

Potential Solution: Ensure clear functionality, roles and responsibilities for all parties involved. Use common/default routes with balance between planned and cleared routes (red/amber/green)

Assumption: Runway Exit Point should not move (after being given to A/C)

Assumption: Crossing traffic will be taken into consideration by SMAN (all conditions at airport for potential conflicts, use of restricted areas should be included in SMAN).

C: 4b – reword to remove “BtV system” as there is no system

C: 3a + 4a + 4b are before 1

C: Change 4a and 4b to be aircraft verifies not “BtV system”

C: Options 1, 2, 3

1. Earliest Exit
2. Preferred Exit
3. Missed Exit

SMAN will provide Option and this will be agreed with by A/C (or proposal by A/C and agreement by SMAN?)

Assumption: BtV provides greatest benefit during low visibility

Q: What is the impact of missing exit point currently? (Workload increase and airline costs?)

Assumption: 1 minute currently, at Gatwick there are roughly 118 seconds between arrivals, go around is acceptable with 10 seconds leeway

Issue: Pilot would like as early as possible notice for clearance to land, currently it is very late. ATCO wants to ensure safety measures met (ILS Areas, runway) before providing clearance to land. There needs to be reconciliation (within Europe) of when Landing Clearance is given

C: Add Timing information for processes (e.g. Agreement for Taxi/Exit between A/C and Ground/SMAN for clearance)

C: For 8, Aircraft leaves runway

Q: Roles and responsibilities for runway exit/taxi route clearance not clear, how would this work. Current proposal is from GRD Controller to A/C, this could be from A/C to GRD or from Approach to A/C.

A: further exercises are required with simulation to see best method when concept approach agreed

Assumption: There is a big advantage for Pilots and ATC if the Pilot knows his route when leaving the exit of the Runway, there will be less or no hesitation when leaving the runway, saving time and reducing potential safety issue (pilot may not be aware A/C is blocking runway).

C: For 7: Ground Controller “verifies”, not “accept”, remove both lines to GRD Controller

C: Aircraft arrives “on” stand.

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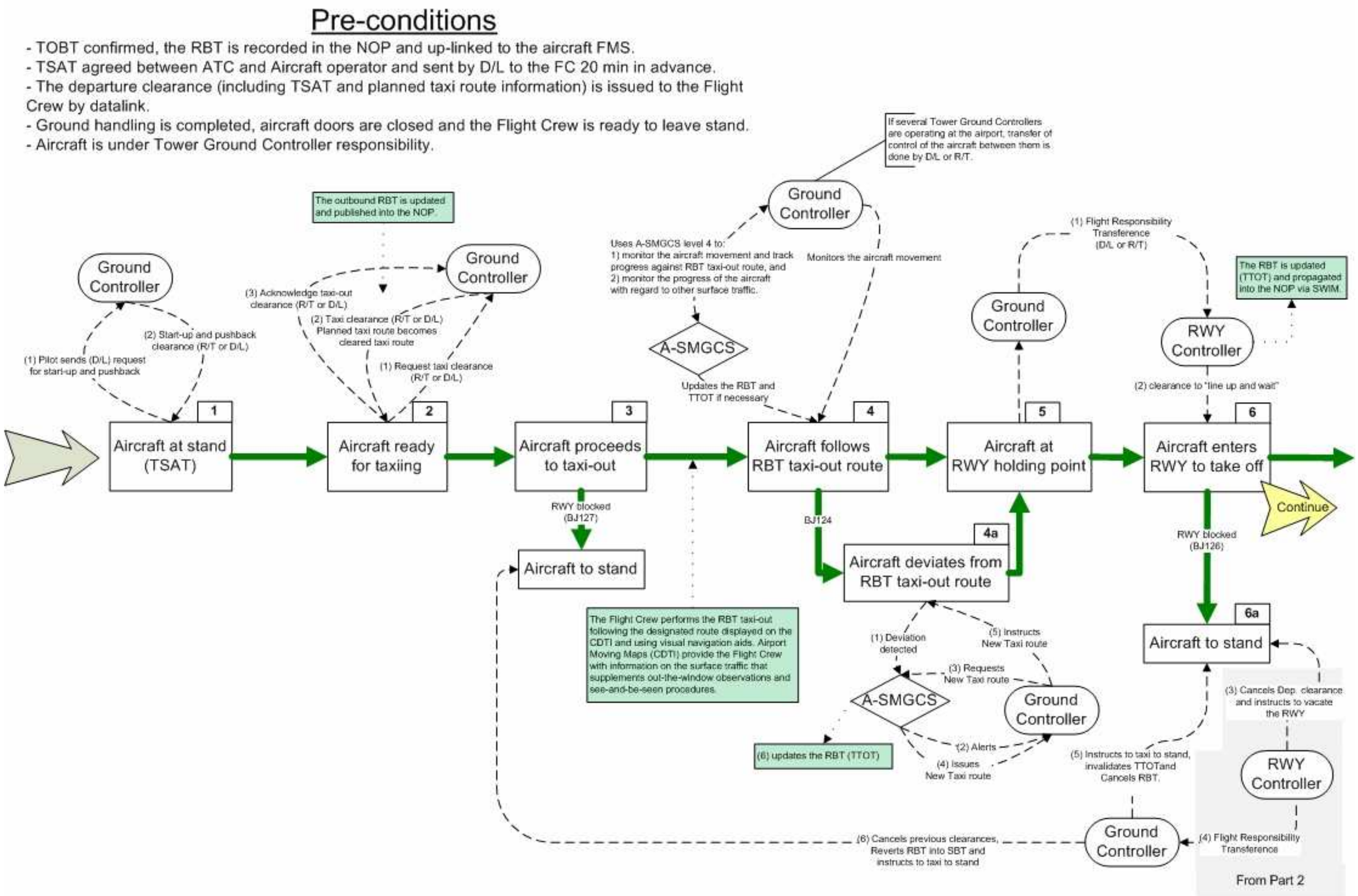
C: for 10, A/C also waits somewhere else, may use empty stand, check with Airport CDM

C: for 10, A/C may stop due to unforeseen circumstances anywhere in process

Assumption: From 9, A-SMGCS monitors and updates system with more accurate information

6.3.3 Review Scenario related to Stand, Taxi out and Departure (OS-13) to create version 2 of the Storyboard



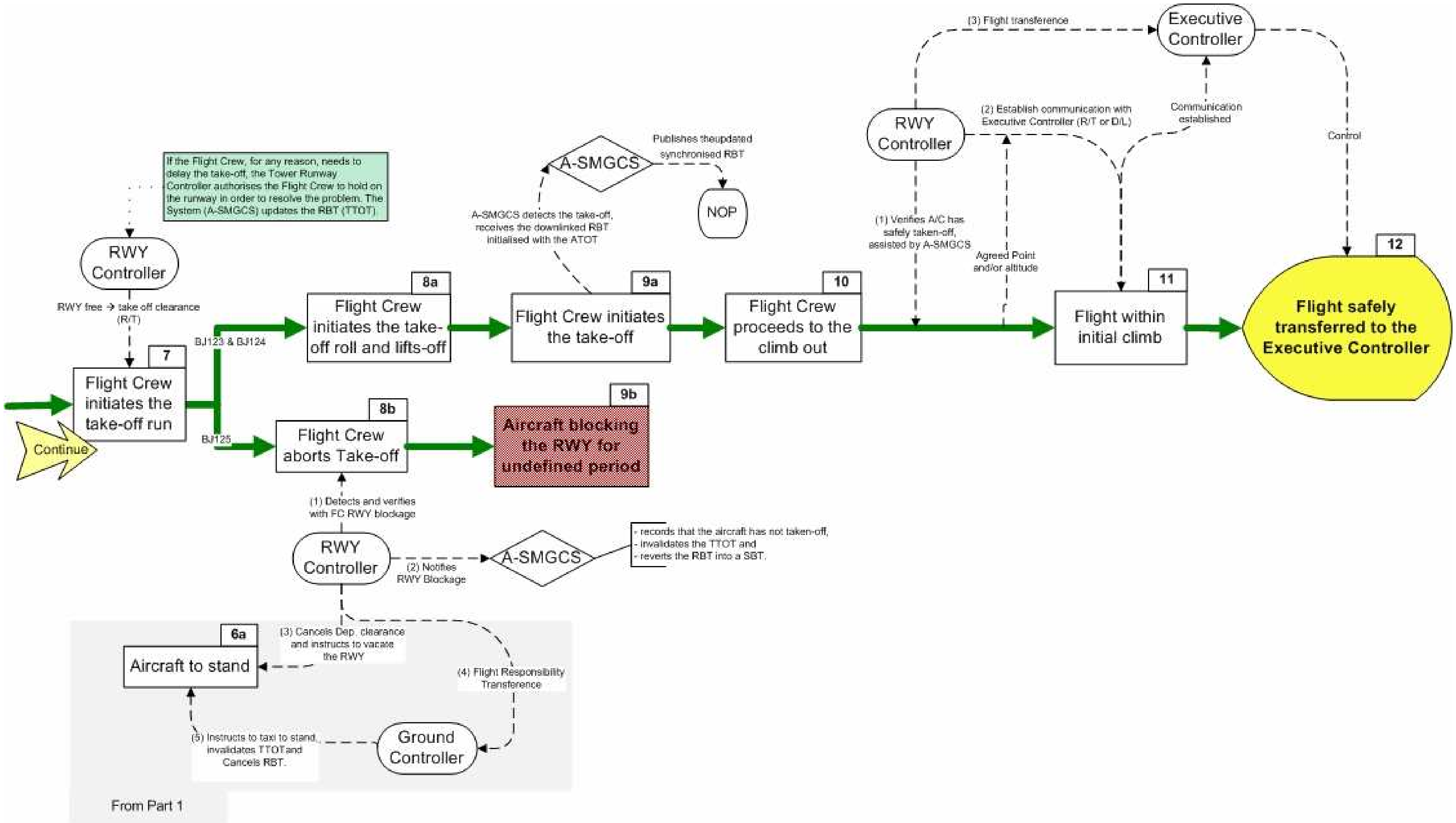


Figure 2 - OS13 - Taxi-Out and Take-Off Storyboard V1

6.3.3.1 Comments

The V1 storyboard for Stand, Taxi out and departure was reviewed on screen and Comments noted as follows.

C: For 2, Start and Pushback to be swapped (the sequence of pushing-back and start-up is not fixed for all airports, so this shall not be added to the v2 of the storyboard)

C: for 2, Planned then cleared taxi route

Q/Risk: Concerns arose about planned routes not becoming cleared routes because the pilot tends to follow the planned one.

Answer/Mitigation: pilot will follow what the CDTI says and this will provide the cleared route (most updated).

Assumption: Some A/C cannot follow certain routes; the system in the future will know this and plan the taxiways to be used accordingly. Currently A/C following taxiways that cannot support the A/C are penalised and A/C goes to the Sin Bin.

Q: Between 3 and 4, an A/C may stop (unforeseen problem), and a) Block Taxiway or b) go to remote taxiway then start taxiing, c) go to stand - This needs to be included and a re-plan instigated

Assumption: for 4: The RBT can be a sequence of waypoints, just to have taxi detailed routes but no speed constraints.

Q: Do we consider there is a deviation from the RBT (TTOT) when a waypoint is missed?

Q: Will the RBT include a buffer to allow flexibility to meet the TTOT (Waypoint 1: Time to Leave Stand and Waypoint2: Time for Take off)?

Assumption: Speed constraints in the RBT may be a way to ensure that aircraft are at the RBT way points at the time planned, within a tolerance interval.

Q: Will the RBT include detailed waypoints with expected times to monitor the progress of the A/C during the Ground Segment of the RBT? (More predictability = less flexibility).

Answer: R Pierce: Yes, taxi speeds are required according to SESAR

Assumption: A Simulation will be required to analyse the best method to be used for taxiing during different times and with different configurations

C: 6 – There would be another RUNWAY for departures, new TWY and new TTOT

C: Add box after 7 for Decision deciding on Take off

C: 8a is not necessary

C: add a new process – Add new Taxiway to alternative runway and new TTOT (RBT to be updated)

C: 9a should be flight is airborne and become 8a

C: Add Abort during Roll down Runway, a) go to hold, b) go to stand

C: Add box for A/C not completing departure and returning to Airport

The decision point between 10 and 11 depends on the airport.

6.3.4 Operational Scenario Review

The outstanding Scenarios were reviewed and Comments provided.

6.3.4.1 Closely Spaced Parallel Operations in IMC (OS-29)

6.3.4.1.1 Background

- Parallel runway approaches are considered independent if they are at least 1035m apart

- Between 1035m and 1525m approaches must be monitored by a high precision, high update surveillance system
- In Visual Meteorological Conditions in the USA, independent approaches are performed at smaller spacings
- Achieving similar operations in IMC would increase airport capacity

6.3.4.1.2 Constraints

- ILS guidance is less accurate further from the runway. This is one constraint.
- Aircraft are deemed separated when on the ILS, but not before. "Capture Levels" must be at least 1,000ft apart.
- Path following error – low on ILS, higher when capturing
- No Transgression Zone (NTZ), 600m wide and continuously monitored, is required today
- Wake vortex transport between glide slopes must be considered
- In-trail separation minima are currently 3Nm, exceptionally 2.5Nm, for radar and runway occupancy reasons. Time-Based Spacing aims to maintain arrival rate in headwinds. A review of these issues is needed.

Note that RNP and ASAS can mitigate 1 to 4, and Wake Vortex detection systems could mitigate 5

6.3.4.1.3 Scenario

- ***BJ123 is cleared for continuous descent approach to 27L, following RNP transition to join Final Approach***
- ***RJ456 receive similar clearance for 27R***
- ***Flight crews will receive warning if aircraft deviates from assigned path***
- ***Paths are designed so that position accuracy can be guaranteed provided that crosswind at ILS joining level is <60kt (otherwise, dependent approaches are needed)***
- ***Arrival TMA controller checks that BJ123 and RJ456 have identified each other.***
- ***Longitudinal spacing is irrelevant***
- ***Vortex risk must be considered***
- ***Both pilots receive vortex transport forecasts***
- ***Both aircraft are equipped with vortex detection system and pilots will see vortex within 1Nm on their Head-Up Display***
- ***If vortices are forecast to travel to other runway, dependent operations must be used***

6.3.4.1.4 Comments

C: f there is a go around between an outbound and an inbound, it could produce a problem.

Q: 5th Bullet – What is USA achieving?

Issue: If you have a go-around, there could be an issue with visibility of departures

Assumption: Page 2: ILS moving to MLS (GPS)

Assumption: Page 2: Bullet 2: CDAs are possible but more difficult; "SOMA" is used in the states

Assumption: TBS will be used to maintain Capacity, there will be no improvement with this scenario

Assumption: Point 6: if 2 parallel runways then 2NM is possible

Q: how will Point 6 work with 2NM spacing when considering Wake Vortex Issues?

Assumption: Point 4: ASEP/CSPA Extension of current visual procedures (not ACAS)

Q: ASEP – Which A.C is responsible for lateral separation?
Assumption: Pilot will have display with Target to be separated from

6.3.4.2 OS-21 Departure from Non-Standard Runway

6.3.4.2.1 Scenario

- ***The airport has two parallel runways, one used for arrivals and one for departures***
- ***A departure requests use of the arrival runway, because it is longer and there are high winds***
- ***The request is made after TSAT allocation, 10 minutes before TOBT, because there has been an unexpected change in wind conditions***
- ***The apron is between the two runways***
- ***The A-SMGCS is aware that the departure will not comply with TSAT. It reverts the RBT to an SBT***
- ***Tower Ground Controller informs TMA Approach Planning Controller of when departure will be at hold***
- ***Approach Planning Controller, using AMAN, creates suitable gap***
- ***There may be delay for the aircraft after the gap, and reactionary delay to later aircraft. New TTAs are assigned.***
- ***Approach Planning Controller provides APOC with time window for departure***
- ***APOC staff revise the pre-departure sequence***
- ***Tower Supervisor, with DMAN, updates the departure sequence***
- ***New TSAT is issued to flight using non-standard runway***
- ***New RBT is issued for flight using non-standard runway***
- ***SBT and RBT (including stand plan) are revised, if necessary, for other affected flights***
- ***New RBT is linked to departure from non-standard runway***
- ***TSAT and new taxi route is sent to flight crew***
- ***Departure Clearance is issued***
- ***Departure is handled as normal by Ground Controller and Runway Controller***

6.3.4.2.2 Comments

Issue: (R Balzer) Inbound A/C cannot be delayed, normal to plan the departure in a vortex gap (plus nominal time) – R Newns

C: 14th Bullet: Change in Stand Plan not required as BJ123 will wait and hold not on stand

6.3.4.3 OS-31 – Handle Unexpected Closure of an Airport Airside Resource

Item skipped due to lack of time.

6.3.4.4 OS-30 – Handle Planned Closure of an Airport Airside Resource

Item skipped due to lack of time.

6.3.4.5 Management of Vehicles on Manoeuvring Area (OS-32)

6.3.4.5.1 A-SMGCS Scope

- A-SMGCS provides Routeing and Guidance advice to Ground Controllers and Runway Controllers
- A-SMGCS predicts hazardous situations and alerts/informs if:
  - Vehicle does not conform to clearance
  - Vehicle is in conflict with other vehicles or aircraft
  - Vehicle is likely to enter a runway without clearance
  - Vehicle is likely to enter an area not on its cleared route
- All vehicles needing ATC clearance will be equipped with:

- Surface Movement Alerting Function (route conformance, runway incursion, conflict checking)
- Ground Traffic Display
- Moving Map Display

6.3.4.5.2 Scenario

The full scenarios are available in the slide format but were deemed too long to include here and the Comments did not warrant their inclusion. Four versions of vehicles using the manoeuvring area were discussed:

- ***Crew Shuttle must travel to secondary apron, crossing a runway***
- ***Runway Inspection***
- ***Route Deviation in Fog***
- ***Tow of an Aircraft from Maintenance Area to Stand***

6.3.4.5.3 Comments

Q: Which Visibility is relevant to this Scenario (3/4)?

Q: Infringement of restricted areas monitored?

Q: Crew Shuttle not realistic, this could be Fire Brigade

Q: It is not likely that runway will be closed (loss of capacity)

C: There are a minimum of 4 runway inspections/day and runways normally remain open (Manchester has runway closures for inspections)

C: GRD Controller contacts technician not the other way round

6.4 Session 5 – Day 2 – SBT to RBT - Workshop

On 27 March 2009 at CAA Premises in London the 2nd Brainstorming session on the hot topic "SBT to RBT agreement" was carried out with a wider audience including representatives from the WP2, WP3, WP4 and WP6 of EP3.

A report of the meeting is available in the Annex "SBT to RBT agreement".

6.5 Session 6 – Review of V2 of Storyboards and final review of expert group

The objective of the meeting was to review the V2 of the storyboards regarding OS 12 and OS 13 and to agree on the final report of the Expert Group.

For a description of the Storyboard and the different shapes and meanings, please refer to section 1.4 - Glossary of Terms.

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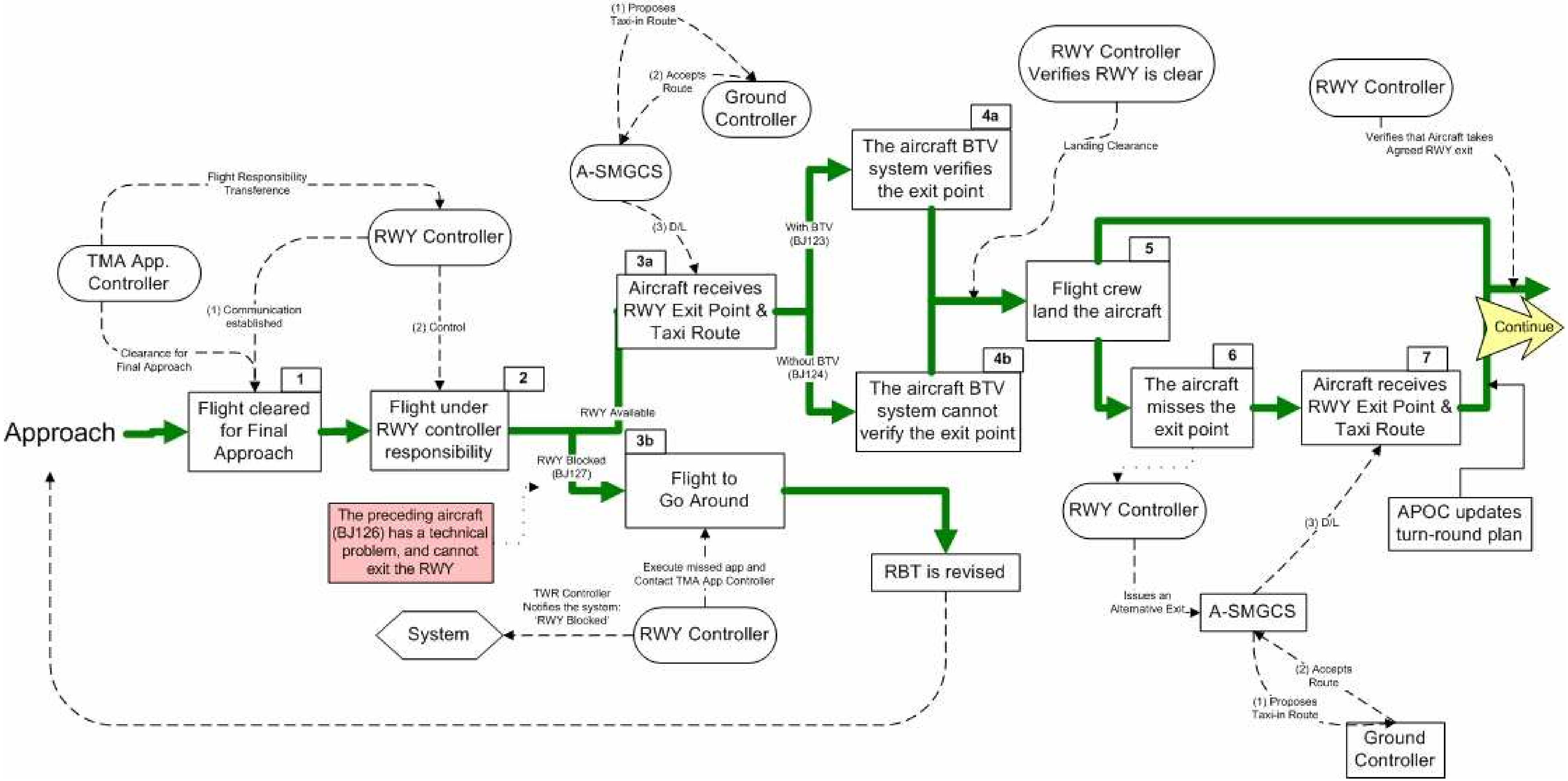
6.5.1 OS-12 – Landing and Taxi to Stand Storyboard



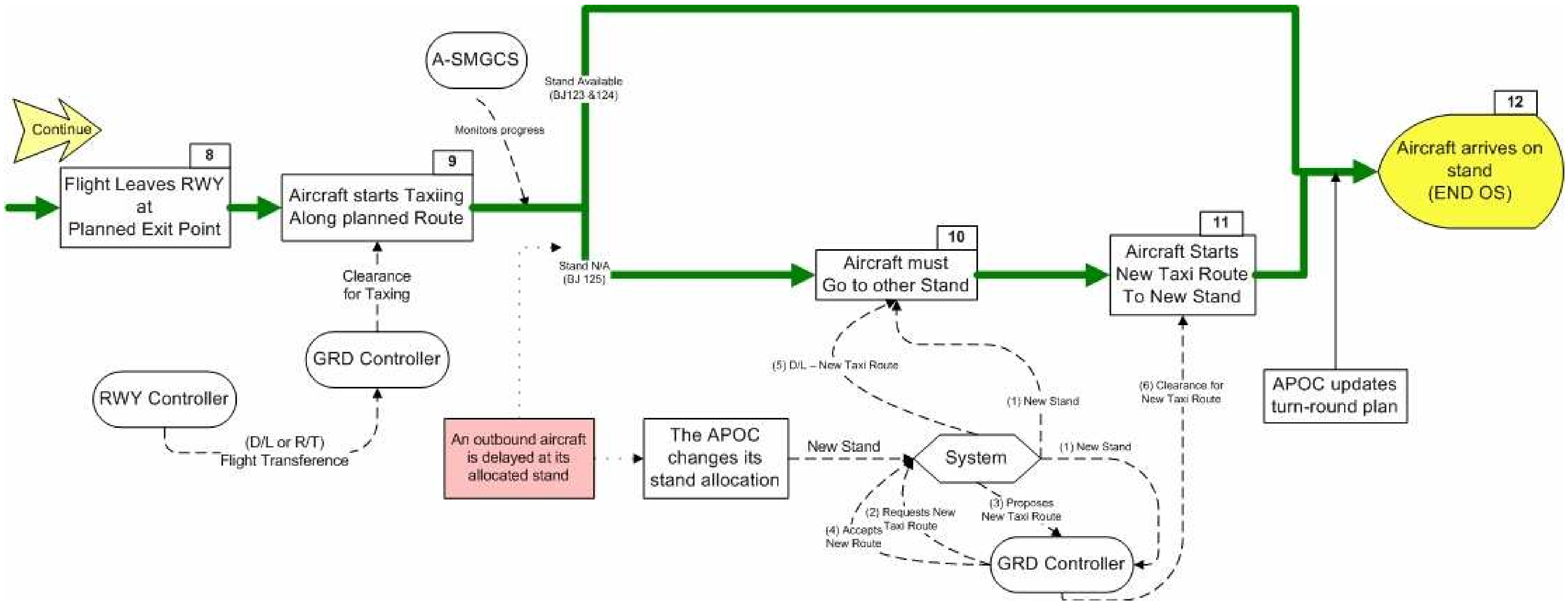


Figure 3 - OS12 - Landing and Taxi to Stand Storyboard V1

6.5.1.1 Comments

6.5.1.1.1 General Comments on Taxiway management

C: C4 (Storyboard summary) – This is possible anywhere in process

C: Use of Speed – Way Points and time restrictions is not possible. Speed control has different needs and different priorities.

C: SMAN dictating speed is not possible because more flexibility is required.

C: The combination of Ground speed variation plus Milestones plus Time constraints could be possible.

Safety Issue – Speed limitation (R Balzer) – Company Business Model as it is currently will have limits per block for time (Pilots get overtime etc).

C: Taxi Speed could be related to average speed. The planning system keeps timing internal.

Assumption: Improved Communication – Pilot informs ATC (if he brakes too hard etc)

C: SMAN – Provides average taxi speed. Give Pilot target time to be at end of runway. Tolerance of 2 minutes is reasonable (not 5 min).

C: Better commitment could be achieved by Regulated Target Times – Pilots do not comply very well the target times, maybe because they are not capable? – A solution could be Increase Automated Method of Pilot conforming to Target Time

C: Stronger rules for airlines are required.

C: Runway could be allocated to an Airline for a particular time.

C: External influences affecting Taxi times must be taken into account.

C: Stricter Policy and commitment by Airlines/Pilots are required.

C: Guided Line on Taxiway or Satellite Navigation type system in A/C could be a solution – Issue: costs at Airport to improve systems could be very large – Highlight this as an Issue for Investment.

C: Prescriptive Taxiing may lose Runway Capacity.

C: Using certain queue of A/C for ROT might mean being more aware and having much more predictability or flexibility.

C: More accurate estimates of how things can change mean Flexibility.

C: Airport Coordination causes delay – Düsseldorf Coordinate pre-departure slots (e.g. at 0605h – 15 departures in 10/15 minutes)

C: Runway Slot instead of off block time could be used. Scheduling would depend on the runway configurations, e.g. Use of Easterly/Westerly Operations (plan a, plan b).

C: Lower Tolerances to be agreed between Airlines, Airports and ATC

C: The tolerances could be built into RBT and agreed. Tolerances could be a way of penalising an Airline.

C: Precise Times for gate and Runway Time – Share resources

C: Negotiation at APOC would be much easier face to face. System does not convey context easily.

C: A possibility would be use of video conferences for APOC negotiation.

C: Moving the person makes it easier, i.e. teams at airports – Airline team, Pilot team, Handling teams (Passengers – Missing from team) – **HIGHLIGHT** – Also use of latest technology for tracking passengers and providing information to passengers.

C: At Terminal 5 (Heathrow Airport), it is not allowed go through security at less than 35 min before departure.

C: The Runway Controller does not look at tolerances but looks at Runway Occupancy time (ROT). Tolerances of off block time may be used to allow best use of Runway.

C: Wake Vortex is a bunch with same category – Similar with Departure Routes – Must be managed with DMAN/SMAN.

C: DMAN can prioritise according to different criteria (wake vortex, departure route) – Configuration of DMAN can be Airport Specific.

C: schedules are rarely followed due to many reasons, e.g. change of A/C type.

C: Committing to a departure sequence one hour before departure is not possible.

C: Changes to Airport Configuration require Civil Engineering.

C: Fleets will change – Southampton single Taxi way causes delay. Business Benefits will be the push. There must be Stand/Taxi/Runway Balance for Capacity and maximum resource usage.

C: Capacity depends on the type of A/C – it is difficult to talk about capacity at an airport. It has been done at airports already (LGW/LHR). For example, factors like lunchtimes have reduced capacity.

C: Priority on flexibility vs. predictability depends on how many a/c are managed.

C: Where Runway is bottleneck (LHR) there will be better shared information.

C: Busy airports need to clarify what acceptable delay is.

C: DMAN knows the delay/priority of the NOP.

C:: Different Stakeholders are involved – ATC Tower/GRD/Airlines/APOC.

C: Current Operations have flexibility at EOBT – Controllers knowledge of airport allows estimating the airborne sequence. Systems currently in place (via electronic strips).

C: There is a trade off between Probability vs. Flexibility vs. Predictability

C: Certain amount of Controller input/intuition can be automated.

C: DMAN sequence is not mandatory but flexible. It can be recalculated closer to departure time, meaning better predictability.

6.5.1.1.2 Comments on OS12 storyboard (v2)

Q: Who initiates negotiation for exit point?

Assumption: Crews try to meet Optimum Exit Point.

Assumption: Exit point can be met when suits. Airlines do it currently, e.g. LHR.

C: Pilots are trained differently to APOC.

C: Runway occupancy payment could be introduced.

C: Flight Sequence, i.e. 3 aircraft going back to stand, is not realistic for this scenario.

C: Box 2 - Could be a practical clearance not complete clearance (as possibility perceived in storyboard).

C: Green Box – Changes to NOP could be done or not depending on tolerances but information is available.

6.5.2 OS13 - Stand, Taxi out and Departure Storyboard V2

The following diagram shows the Storyboard for OS13 Stand Taxi Out and Departure, updated following Comments from Session 4.

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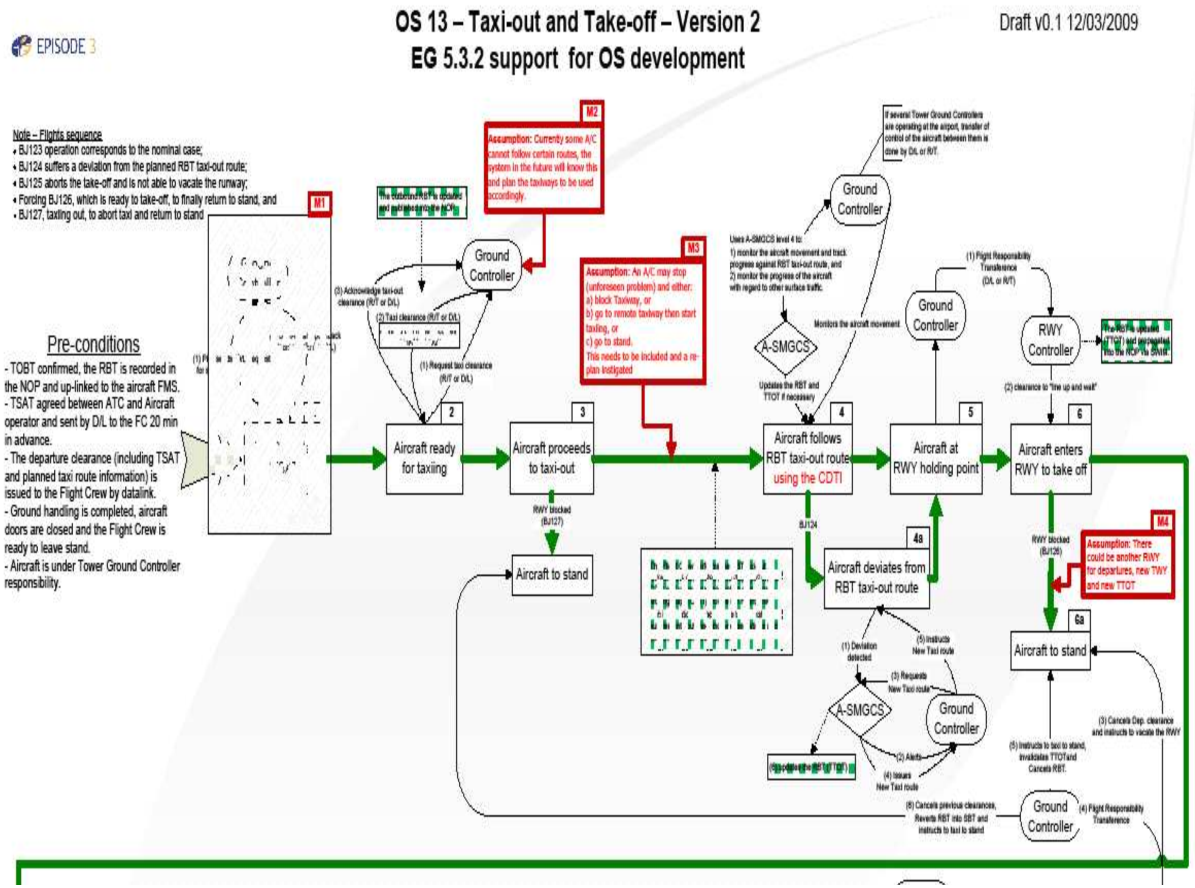

EPISODE 3
OS 13 – Taxi-out and Take-off – Version 2
EG 5.3.2 support for OS development
Draft v0.1 12/03/2009
Note – Flights sequence
• BJ123 operation corresponds to the nominal case;
• BJ124 suffers a deviation from the planned RBT taxi-out route;
• BJ125 aborts the take-off and is not able to vacate the runway;
• Forcing BJ126, which is ready to take-off, to finally return to stand, and
• BJ127, taxiing out, to abort taxi and return to stand
Pre-conditions
- TOBT confirmed, the RBT is recorded in the NOP and up-linked to the aircraft FMS.
- TSAT agreed between ATC and Aircraft operator and sent by D/L to the FC 20 min in advance.
- The departure clearance (including TSAT and planned taxi route information) is issued to the Flight Crew by datalink.
- Ground handling is completed, aircraft doors are closed and the Flight Crew is ready to leave stand.
- Aircraft is under Tower Ground Controller responsibility.
M1
M2
Assumption: Currently some A/C cannot follow certain routes, the system in the future will know this and plan the taxiways to be used accordingly.
Ground Controller
(3) Acknowledge taxi-out clearance (R/T or D/L)
(2) Taxi clearance (R/T or D/L)
(1) Request taxi clearance (R/T or D/L)
2
Aircraft ready for taxiing
3
Aircraft proceeds to taxi-out
RWY blocked (BJ127)
Aircraft to stand
M3
Assumption: An A/C may stop (unforeseen problem) and either:
a) block Taxiway, or
b) go to remote taxiway then start taxiing, or
c) go to stand.
This needs to be included and a re-plan instigated
If several Tower Ground Controllers are operating at the airport, transfer of control of the aircraft between them is done by D/L or R/T.
Ground Controller
Uses A-SMGCS level 4 to:
1) monitor the aircraft movement and track progress against RBT taxi-out route, and
2) monitor the progress of the aircraft with regard to other surface traffic.
A-SMGCS
Monitors the aircraft movement
Updates the RBT and TTOT if necessary
4
Aircraft follows RBT taxi-out route using the CDTI
BJ124
4a
Aircraft deviates from RBT taxi-out route
(1) Deviation detected
(5) Instructs New Taxi route
(3) Requests New Taxi route
A-SMGCS
Ground Controller
(2) Alerts
(4) Issues New Taxi route
Ground Controller
5
Aircraft at RWY holding point
(1) Flight Responsibility Transference (D/L or R/T)
RWY Controller
(2) clearance to "line up and wait"
6
Aircraft enters RWY to take off
RWY blocked (BJ126)
M4
Assumption: There could be another RWY for departures, new TWY and new TTOT
6a
Aircraft to stand
(3) Cancels Dep. clearance and instructs to vacate the RWY
(5) Instructs to taxi to stand, invalidates TTOT and Cancels RBT.
Ground Controller
(4) Flight Responsibility Transference
(6) Cancels previous clearances, Reverts RBT into SBT and instructs to taxi to stand

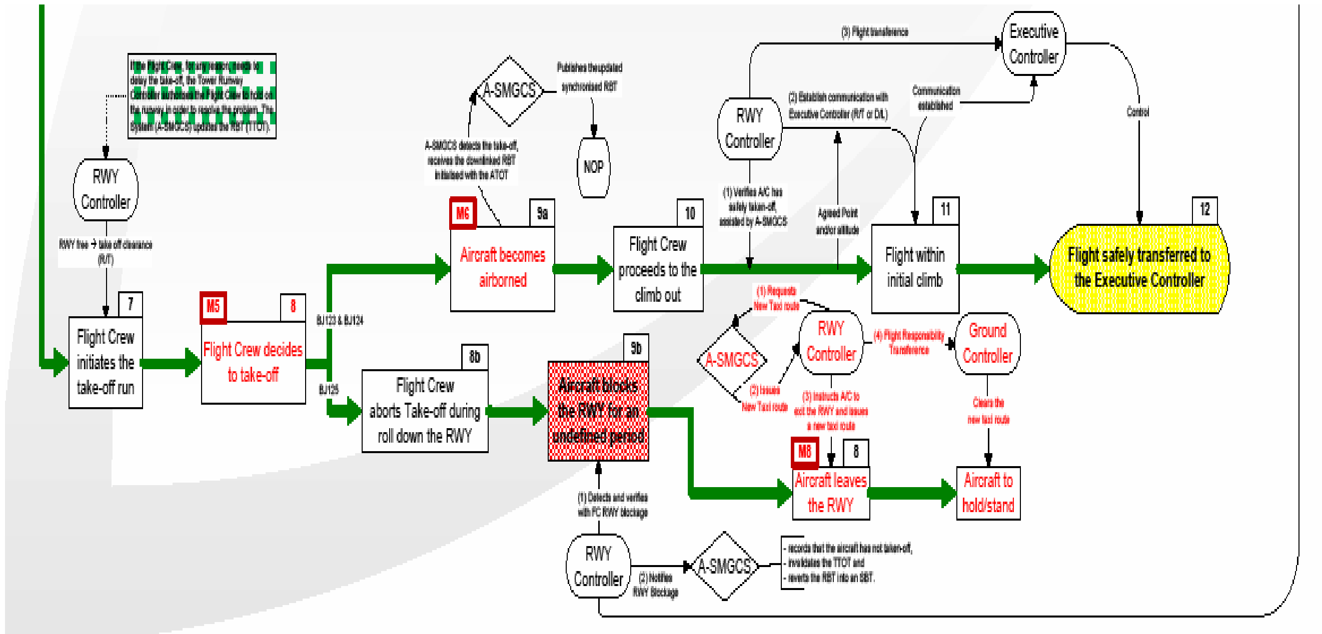


Figure 4 - OS13 - Stand, Taxi-Out and Departure Storyboard inc. comments sess4

6.5.2.1 Comments

C: Ground system updates RBT according to live data – update + revision process has been discussed but is not clear yet.

Recommendation: Criteria for RBT update + revision on ground segment of RBT should be provided – Link to SBT to RBT and RBT updates.

C: RBT for GRD includes EOBT, TTOT.

C: Remove Box 8.

C: Process around 9a needs more work (who is responsible for RBT) – Airlines? – Updates?

C: Not clear how the 'activation' message updates the NOP.

Q: How does GRD Radar detect A/C has taken off? Is it an A/C transponder? Is the signal sent to the A-SMGCS?

C: After Box 10 CTR verifies A/C has safely taken off (assisted by A-SMGCS (done by Gatwick)).

Q: How does this occur? Currently A/C (Pilot) will report Airborne.

Recommendation: Clarify when RBT becomes an SBT (BJ125) and then how the process of creating an RBT from the new SBT is (go back to Runway queue).

Recommendation: RBT should have some tolerances for going back in Queue (no need for SBT to RBT re-issue).

Recommendation: After Box 8 – RBT/SBT is updated with new taxiway back to Stand and re-plan taking into account other taxiway users and stand etc – Plan update.

Recommendation: Monitoring of Plans against Possibilities should be done. NOP should consider new constraints.

Q: Does A-SMGCS reset RBT to SBT? (level 4 does conflict resolution)

Q: is A-SMGCS level 4 capable of doing these updates?

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

7.1.1 Concept Related Conclusions

- Predictability and efficiency at the airport 'airside' can be improved by use of latest Air/GRD communication coupled with improvements in Surface Management tools and Aircraft improvements (BtV) when negotiating the runway exit and taxi route from the runway (Storyboard 1);
- Predictability and efficiency at the airport 'airside' can be improved by use of latest Air/GRD communication coupled with improvements in Surface Management tools and Aircraft improvements when negotiating the stand, taxi out and departure of an aircraft at an airport (Storyboard 2);
- There is a "trade off" between flexibility and predictability to ensure the optimum solution;
- Airside Operations (landing, taxiing, take off) could be improved considerably during poor weather conditions by use of technology at the airport and in the aircraft;
- Triggers for Trajectory updates have been identified for the key operations at the airport (departing and landing), the link between planning and execution. See "RBT Update" on Storyboards for triggers;
- Use of Speed: Way Points and time restrictions are not possible. Speed control has different needs and priorities. SMAN dictating speed was seen as too restrictive and will lead to loss of flexibility which is needed by TWR with so many different causes of aircraft delays during taxing;
- Investments at airports to support guided lines or SATELLITE NAVIGATION type system could be very restrictive – Issue for Investment;
- Prescriptive taxiing may cause loss of runway capacity; this requires a trade off between flexibility and predictability KPAs;
- A system providing more accurate estimates of how things change would be of benefit (lower tolerances need to be agreed between Airlines, Airports and ATC);
- Where Runway is bottleneck to capacity (e.g. LHR) then better shared information will improve situation;
- The resulting conclusions and storyboards provided by the work of the expert group described in this report may bring improvements to runway throughput and airport capacity, provided that appropriate supporting operational procedures, equipment, certified flight operations, ATM rules and controller working methods are introduced.

7.1.2 Conclusions on use of Expert Group

- The use of an Expert Group is extremely valuable in ensuring progressive Change Management of the Concept in realistic steps;
- A consistent set of experts with a cross section across the area to be covered is essential;
- Establishment of an agreed baseline to start from is critical for success;
- Excellent knowledge of ongoing and previous projects is important to understand the state of the art;

- Clear objectives for steering the expert group are necessary;
- Flexibility (including people skills) when managing experts is an art in itself and should not be underestimated;
- Facilitation skills are important to meet objectives within the often short timeframe of meetings with experts;
- The EP3 WP5.3.2 Airport Expert Group highlighted the benefits of the Expert Group technique on clarifying a high level concept of operations.
- The use of experts from different areas and different backgrounds provided an interesting and positive environment to provide the 'Airside' concept elements that could be envisaged for the timeframe of 2020.
- The group agreed on the current problem and also that the proposed solution could not be expected to include a completely automated taxi way system with speed and time constraints due to the large number of exceptions that occur during taxiing;
- The Airport Expert Group presented realistic Scenarios (Storyboards) for 2020 with the use of BtV and up linked/negotiated Taxiway routing for both arriving and departing aircraft. The results showed a trade off between flexibility and predictability to maintain capacity during low visibility operations and potential improvements in efficiency, predictability and environment at the airport 'airside'. Airlines could also benefit with more accurate information and turn-round times could be improved as resources could be allocated at a more precise level of detail;

7.2 RECOMMENDATIONS

7.2.1 Concept related Recommendations

The following recommendations should be seen as potential further work to be carried out on the concept related to the Airport 'airside' concept elements addressed in the Airport Expert Group. If Recommendations are related to specific DODS or Scenarios then the DOD/Scenario is included (e.g OS-12, DOD E2/3).

- Limitations due to the high number of changes in aircraft behaviour during taxiing will limit the amount of automation that can be carried out within the time frame. This means a "trade off" between flexibility and predictability; It is recommended to further investigate the balance of Flexibility and Predictability through further validation (possibly by Role Play);
- The use of Speed and Time during the Ground Segment of the Business Trajectory. Although these items were discussed and not seen as viable by the group to maintain current capacity, more investigation including simulations are required;
- The interface between the ground based tools with the SESAR Reference Business Trajectory and it's continued update either by or using the ground system requires further investigation;
- Clearance for portions of the taxiways could be provided (OS-12);
- The following clarification should be brought to DOD E2/3: The ground movement of an aircraft is considered part of the Business Trajectory by SESAR. However, it is not practical to issue the ground taxi route before the aircraft indicates that it has completed the boarding process and is ready for engine start and push back. The filed Shared Business Trajectory (SBT) will contain generic times/routings for ground taxi but, except at airports where no options exist, will not specify the precise routing. When the flight crew indicates that they are ready for start/pushback the System (A-SMGCS) will calculate the most advantageous routing, taking into account the departure sequence (if any). The Tower Ground Controller will confirm its suitability and provide it to all concerned actors via

SWIM. The proposed taxi route will be incorporated into the a/c system which in turn will provide an update to the Business Trajectory, refining the generic data agreed with the RBT

- Definitions for RBT Tolerances before update or revision should be discussed with the relevant stakeholders;
- The links between the AMAN, SMAN and DMAN when managing the Business Trajectory should be investigated;
- It is recommended to review the Operational Scenarios against the Storyboards (OS-12, OS-13) and Scenario comments;
- (OS-12, OS-13)It is recommended to use the Storyboards as a starting point for Airport Concept work in SESAR (WP6.2);
- In addition the group discussed what is implied by 'RBT agreement', including the responsibilities of Airport ATC and what pre-conditions are needed on the SBT. This is a Hot Topic because it is fundamental to understanding the management of the Business Trajectory during execution. There are different interpretations of this aspect of the SESAR ConOps, and therefore collaboration between stakeholders should be commenced as soon as possible to highlight the potential issues and possible solutions. The report on 'SBT to RBT transition' is included in Annex.
- For the 'RBT agreement' issue, the reflections of the group indicate the complexity of the subject and required steps to continue further with this key concept area. A method of approaching such issues with a group of experts is provided and two possible interpretations of the concept for further discussion. WP2 of EP3 has taken the output from these workshops and produced a "straw man" description following further expert analysis. WP5 has provided Comments on the "straw man" document and considers this also to be valuable input to further discussions within SESAR;
- OS-12 - Add time information for the processes (e.g. Agreement for Taxi/Exit between A/C and Ground/SMAN for clearance)?
- OS-12 - There is a big advantage for the pilots and for ATC if a Pilot knows his taxi route when leaving the exit of the Runway. This will reduce hesitation when leaving the runway, saving time and reducing potential safety issues (pilot may not be aware that the aircraft is blocking the runway);
- OS-12 - for Step 10 (see storyboard in section 7.3.1) the aircraft could also wait somewhere else or use an empty stand;
- OS-12 - the aircraft might stop due to unforeseen circumstances anywhere in the process (not just at Step10 in storyboard).
- OS-12 - SMAN could provide options for the exit to be agreed with the aircraft (or proposal by A/C and agreement by SMAN?). The options are:
    - Earliest Exit
    - Preferred Exit
    - Missed Exit
- OS-12 - the roles and responsibilities for issuing a runway exit/taxiway route clearance needs clarification;
- OS-12 - for Step 1 in Storyboard - the negotiation process for exit point could be initiated by the aircraft;
- OS-12: The timing of the allocation of a taxi-in route in the scenario should be reviewed as the taxi-in route may impact the landing sequence, so should be allocated before flight is cleared to final
- OS-13 - A Simulation will be required to analyse the best method to be used for taxiing during different periods and with different configurations. The methods

might include either speed constraints or controlled times on certain waypoints of the ground segment of the RBT;

- OS-13 - Roles and responsibilities of RBT update during actual take off not clear (EP3 WP3 and Airport CDM);
- OS-13 – Experts do not agree that TSAT should be issued 20 minutes in advance, this is too early to be able to fix a time. OS-13 should therefore be rephrased.
- OS-13 - When does an RBT become an SBT (RBT may remain an RBT if within certain tolerances and go back to RUNWAY queue) during ground segment of RBT;
- OS-13 - RBT/SBT us updated with new taxiway back to stand and re-plan takes place (NOP). Roles and responsibilities of RBT/SBT update requires further clarification (does A-SMGCS rest RBT to SBT?);
- OS-13 - Provide average taxi speed or time for pilot to be at end of runway with a tolerance (+/- 2 mins seems reasonable not +/- 5 mins). Increasing automation of pilot conforming to target times would be great improvement;
- OS-13 - Runway could be allocated to an airline for a particular time period (Runway slot not off block time);
- OS-13 A new process must be added i.e. add a new Taxiway to an alternative runway and new TTOT (RBT to be updated) where additional runways exist.

7.2.2 Recommendations on use of Expert Group

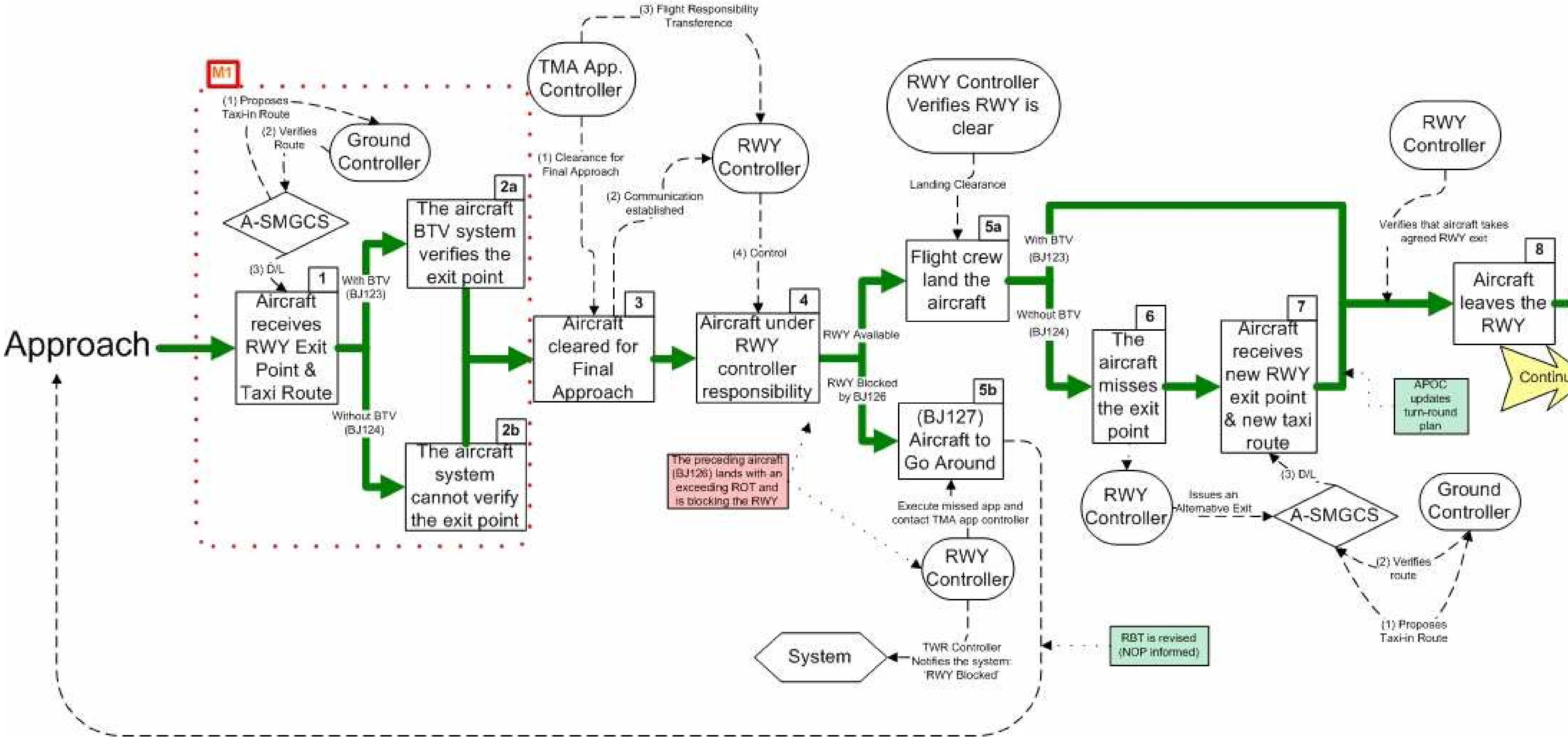
- It is recommended that Expert Groups are investigated further for supporting concept refinement and validation exercises in SESAR;
- Facilitation of Experts when researching high level concepts, the approach to ensure an agreed baseline and steps to reach objectives should be further investigated;
- The SBT to RBT report highlights several areas that require further investigation, see Annex A. How to take discussions and put improvements into operation outside of the scope of the group (i.e. regional airports could benefit from Experts knowledge of different airports within Europe represented).

7.3 Final Storyboards

Please see below for the final storyboards created following review of the Operational Scenarios (OS-12 Landing and Taxi to Stand, OS-13 Taxi-Out and Departure). Here you can see the level of automation and roles & responsibilities seen as optimum for arriving and departing aircraft when using the proposed updated ground and air tools related to Runway and Taxiway Management (DOD E1, E2/3 respectively [15], [16]).

7.3.1 OS-12 – Landing and Taxi to Stand (v2 final)

The final storyboard for OS-12 is shown on two pages for clarity.



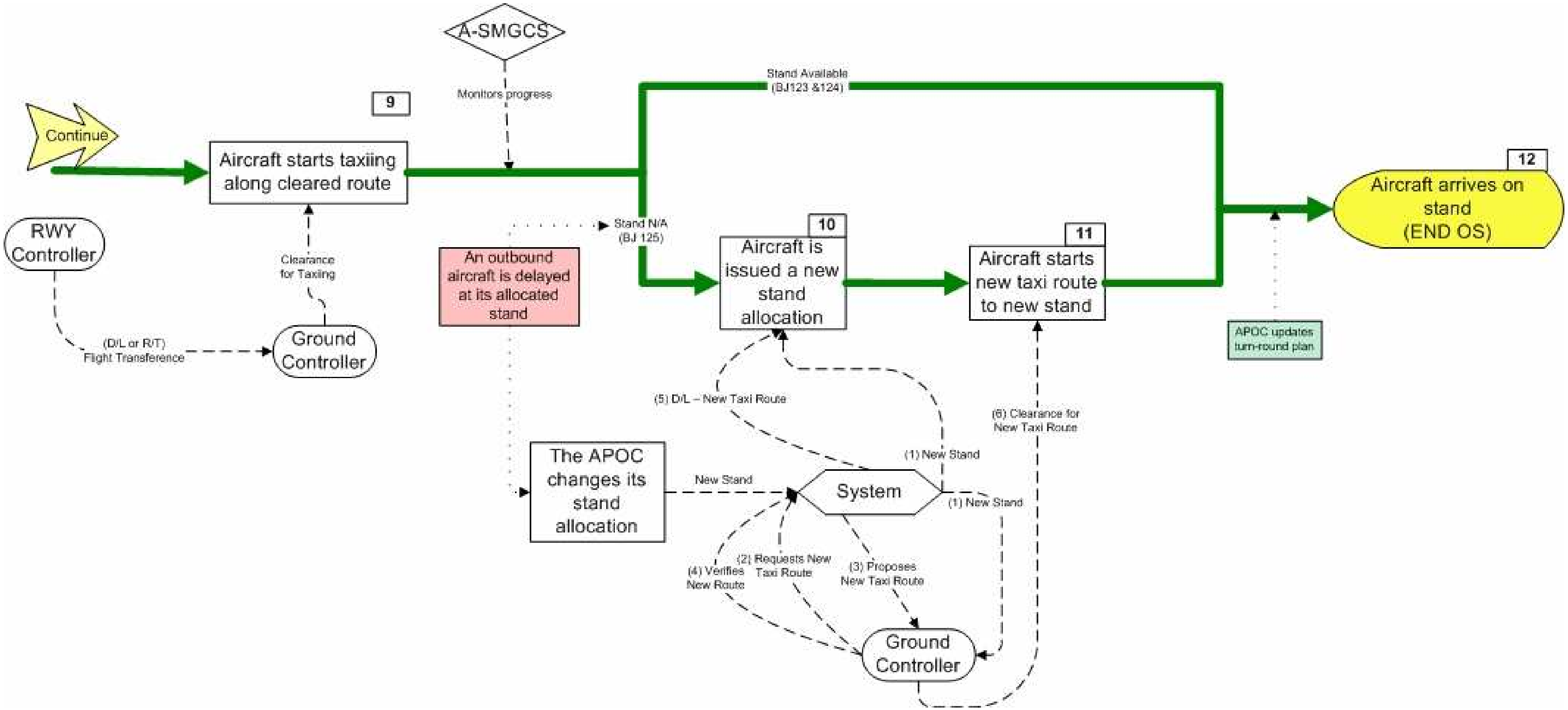


Figure 5 - OS12 - Landing and Taxi to Stand Storyboard V2

7.3.1.1 Major changes from initial version v1

Version 2 of the storyboard (SB) corresponds to the final version of the operational scenario 12 (ref. E3-WP2-I0233-OS-V0.40-os-12) developed from an initial version (v1) including all C:s agreed by the EP3 WP5.3.2 Airport Expert Group.

The major modifications (**M**) made to the initial version of the storyboard are:

M1: The RUNWAY exit point and the taxi route should be issued as soon as possible, before the aircraft being cleared for final approach. This means that the boxes
3a, 4a and 4b of the SB v1 are 1, 2a and 2b of v2.

M2: To avoid using the words “aircraft” and “flight” in the same diagram. The word “flight” was removed from the boxes in the mainstream and the word “aircraft” is equivalent to “flight crew” or “flight”, depending on the context.
M3: Use of the word “verify” instead of “accept” when the controller receives a proposed route from the A-SMGCS.

Note: Outstanding comments on OS-12 have been included in the Concept Recommendations.

7.3.2 OS-13 – Stand, Taxi out and Departure (v2 final)

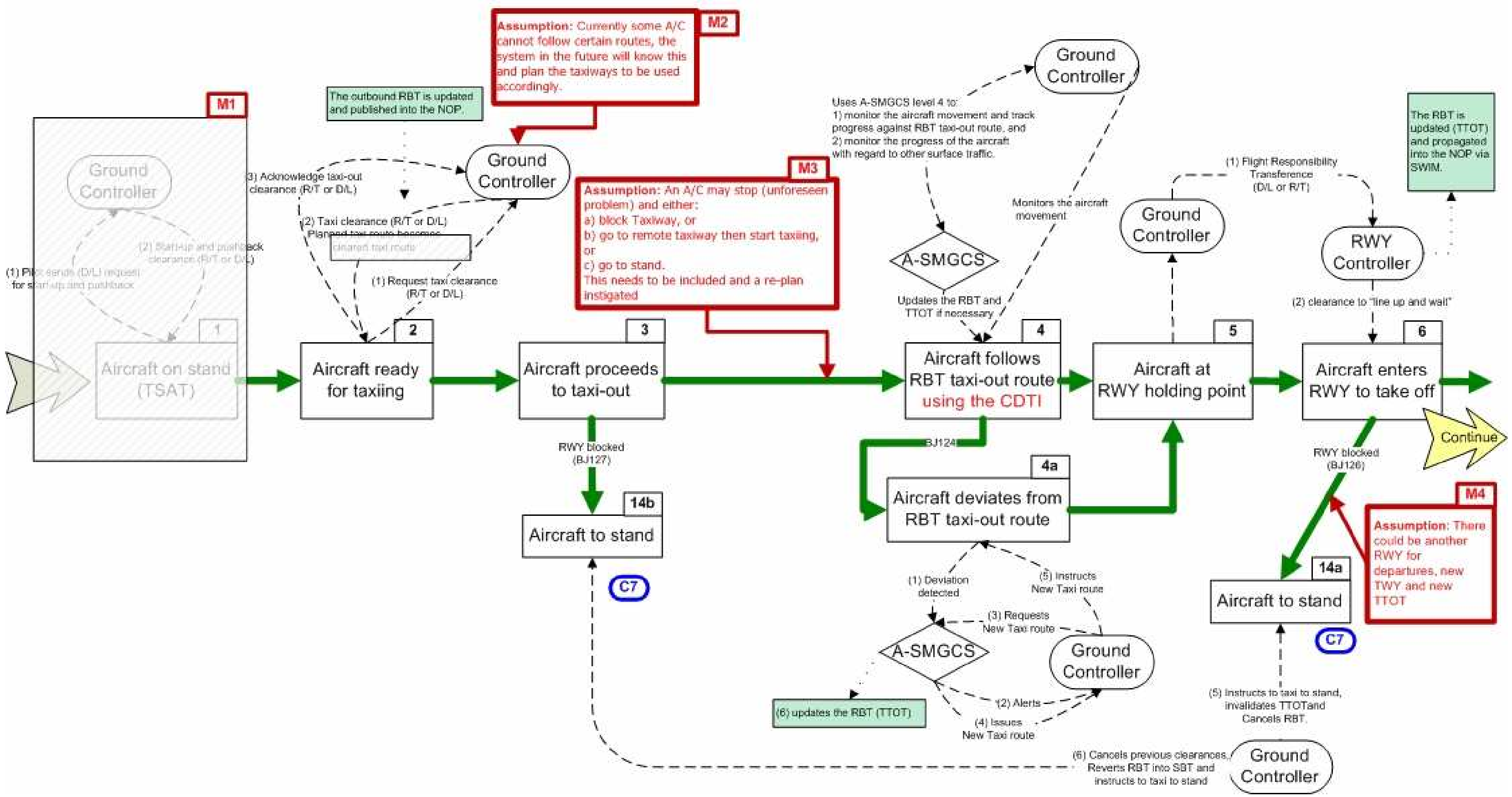
The Storyboard for OS-13 is shown on two pages for clarity.

Pre-conditions

- TOBT confirmed, the RBT is recorded in the NOP and up-linked to the aircraft FMS.
- TSAT agreed between ATC and Aircraft operator and sent by D/L to the FC 20 min in advance.
- The departure clearance (including TSAT and planned taxi route information) is issued to the Flight Crew by datalink.
- Ground handling is completed, aircraft doors are closed and the Flight Crew is ready to leave stand.
- Aircraft is under Tower Ground Controller responsibility.

Note – Flights sequence

- BJ123 operation corresponds to the nominal case;
- BJ124 suffers a deviation from the planned RBT taxi-out route;
- BJ125 aborts the take-off and is not able to vacate the runway;
- Forcing BJ126, which is ready to take-off, to finally return to stand, and
- BJ127, taxiing out, to abort taxi and return to stand



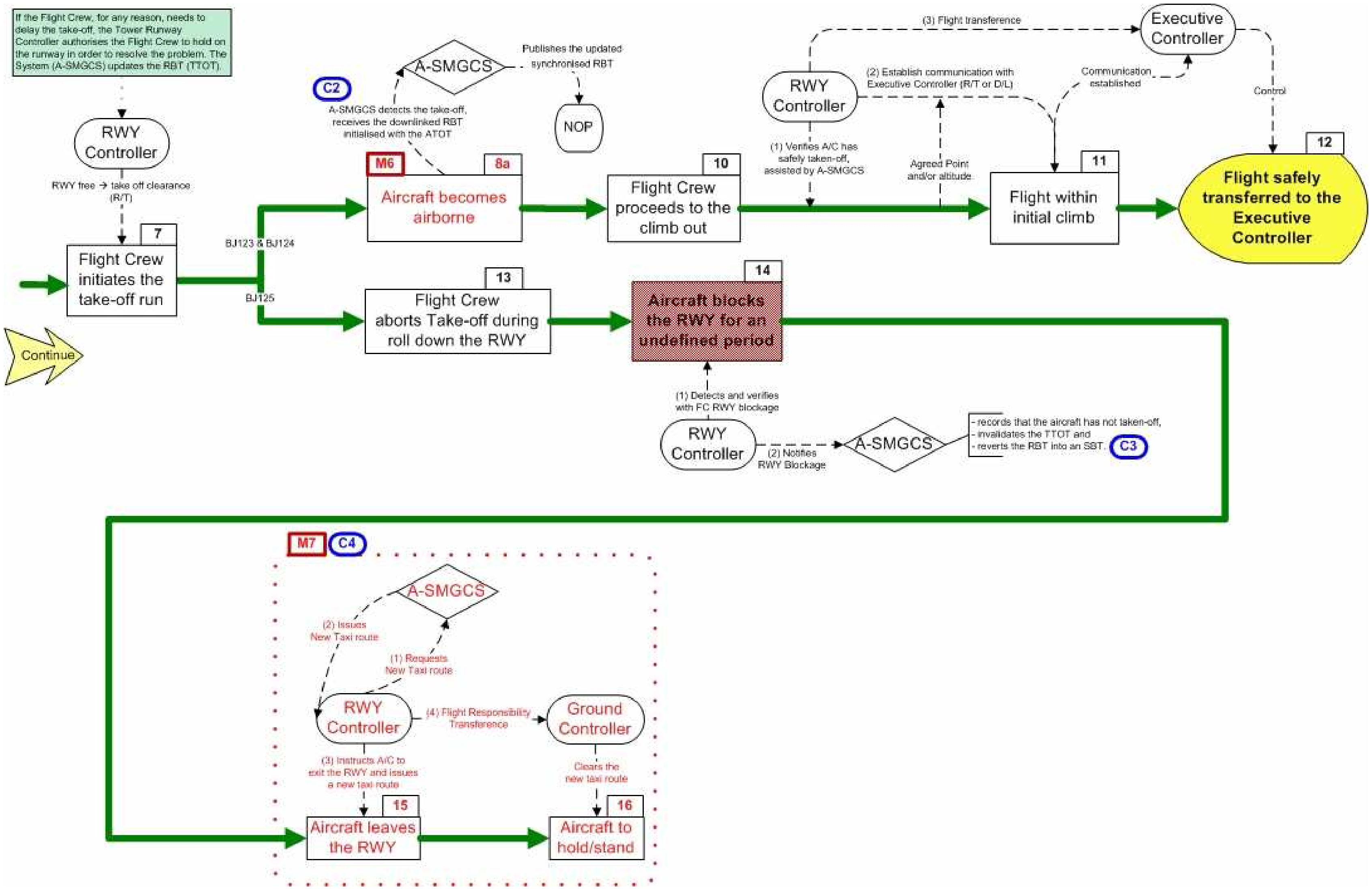


Figure 6 - OS13 - Stand, Taxi-Out and Departure Storyboard V2

7.3.2.1 Major changes from initial version v1

Version 2 of the storyboard (SB) corresponds to the final version of the operational scenario 13 (ref. E3-WP2-I0234-OS-V0.50-os-13) developed from an initial version (v1) including all C:s agreed by the EP3 WP5.3.2 Airport Expert Group.

The major modifications (**M**) made to the initial version of the storyboard are:

M1: The sequence of push-back and start-up is not fixed for all airports and it is not really important for the process, so it should be removed.

M2: Assumption: Currently some A/C types cannot follow certain routes; the system in the future will know this and plan the taxiways to be used accordingly.

M3: Between boxes 3 and 4, an A/C may stop due to an unforeseen problem and a) block Taxiway or b) go to remote taxiway then start taxiing or c) go to stand – This needs to be included and a re-plan instigated. Note: An aircraft may stop due to unforeseen problems anywhere in the process**.**

M4: In box 6 – There could be another RUNWAY for departures, a new Taxiway and a new TTOT.

M5: A box after 7 must be added for decision for Take-Off.

M6: Box 8a is not necessary and should be removed. 9a should be flight is airborne and become 8a.

M7: Add Abort during Roll down Runway, a) go to hold and b) go to stand.

Note: Outstanding comments on OS-13 have been included in the Concept Recommendations.

7.4 SBT TO RBT

The SBT to RBT hot topic showed the importance of concept clarification of “Hot Topics” of the SESAR ConOps and a method of addressing such topics. Although a clear solution was not found experts discussed and started to agree on key definitions such as TTA, RTA and CTA and the implications of using a Trajectory Based operation.

The full report on SBT to RBT agreement can be found in Annex A.

7.5 THE EXPERT GROUP AS A VALIDATION TOOL

The Location, type of expert, specific expert experience, and group bonding (by facilitation) are seen as key elements to address when setting up and running an Expert Group.

Some Comments from the Experts on the Expert Group:

Things that worked well included:

- Good cross section of experts
- Good team spirit
- Input from experts was easily forthcoming
- Positive environment
- Use of storyboards
- Use of Questionnaires
- Familiarisation by experts
- Consistent participation by same experts
- A pragmatic and realistic solution was provided in the two storyboards

Things that could have been improved included:

- Difficult to capture many excellent discussions outside the scope of E3 WP5.3.2 (limited to OS and storyboards). There is a wider implication than SESAR of discussions (current airport operations)
- Use of Operational Improvement Steps to easily link work with SESAR timescales. However this could also be seen as a way of reducing the effectiveness of the group by looking at low level issues rather than the general problem and discouraging open debate.
- Presentation of current projects was not easy to present a baseline for the group to work from. More time in preparation of the A-SMGCS levels and what is supported would have helped reduce the outstanding Q:s. More information on Airport CDM manual earlier would similarly have reduced overheads.
- More airline expertise would have been beneficial although commercial pilots and private pilots did attend and British Airways were represented (but not officially) at the key meetings.
- Runway Management Fast Time Simulation Report [19] was presented but results could be seen as only one opinion.
- Knowledge of Concept was a limiting factor for the group. Although discussions and clarifications took place more SESAR expertise would have been beneficial. The lack of detail in the SESAR ConOps indicates that there is limited knowledge available and the Airport CDM, TAM and EMMA2 experts present were the best available experts.
-

Some Issues raised by the Expert Group include (from final debrief in May 09):

- There are lots of developments especially in Aircraft by Airbus and Boeing. Links between the ATC world and the Airline Industry need to be improved.
- 2012 Olympics Preparation: What is the planning for the Olympics and how can it be influenced?
- Smaller Local airports: How will increased numbers of Very Light Jets be included in future plans?
- How will the SBT/RBTs be managed in more complex airspace with more airports including the links between Civil and Military operations?
-

Feedback on the progressive approach taken

The strategy of getting all experts to agree on the current problem and then progressively look at the solution worked well. There are problems in presenting text based information to a group of operational experts, they need to be motivated. The method of describing scenarios in simplified presentations was a good method. The use of Storyboards helped considerably and can be seen as one of the major contributions from the exercise.

Flexibility on changing the plan meant the group responded to the structured brainstorming introduced by John Greenwood (“If then else” approach) rather than sticking to the Oval Mapping Brainstorming technique.

Links to ECAC wide airport types

The principal airport involved was Gatwick, the Best In Class (BIC) single runway airport in the world.

Although benefits to other single runway operations were identified, the group were careful to consider multi runway operations (i.e. reviews of Scenarios included discussions on use of an alternative runway, etc).

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

8 REFERENCES

[1] EMMA2 for EMMA2 documentation please refer to web site **http://www.dlr.de/emma2**

[2] **EUROCONTROL** Airport Collaborative Decision Making Implementation Manual V4 http://www.euro-cdm.org/implementation_manual.php

[3] **Eurocontrol** Understanding Trajectory Management OATA-MCS-32-02 Version 1.3 May 2009

[4] **TAM** Total Airport Management (Operational Concept and Logical Architecture) Version 1.0, October 2006

[5] **SESAR** **D2** Performance Framework The Performance Target DLM-0607-001-02-00a December 2006

[6] SESAR **D3** The ATM Target Concept DLM-0612-001-02-00a September 2007

[7] **Episode 3** Collaborative Airport Planning Expert Group Report D3.3.1-05

[8] Episode 3 TMA Expert Group Report D5.3.1-02

[9] Episode 3 Runway Fast Time Simulation Report D5.3.3-02 V1.01

[10]Episode 3 TMA and Airports Consolidated Assessment Report D5.4-01

[11] **Episode 3** Final Report and Recommendations D2.4-01

[12]Episode 3 **OS-12** Landing and Taxi to Stand – Annex to SESAR Final DOD E3-D2.2-050

[13]Episode 3 **OS-13** Taxi-out and Take-off – Annex to SESAR Final DOD D2.2-050

[14] **Episode 3** Glossary of Terms and Definitions D2.2-039 V1.0 January 2009

[15] Episode 3 **DOD-E1** Runway Management D2.2-034 V1.00

[16] Episode 3 **DOD-E2/3** Apron & Taxiways Management D2.2-035 V1.00

[17] **Episode 3** Airport Expert Group Experimental Plan D5.3.2-01 V2.00

[18]Episode 3 **DOW** Description of Work – Annex to Contract with European Commission Revision 3.0 10.07.2008

[19] Episode 3 **DOW** Description of Work – Annex to Contract with European Commission Revision 2.8 18.04.2007

[20]Episode 3 WP5 Validation Strategy D5.2.1-01 V1.01

[21]E-OCVM European Operational Concept Validation Methodology E-OCVM, V2.0, March 2007

A ANNEX: SBT TO RBT REPORT

A.1 RECORD OF THE MEETING

A.1.1 Status of this Meeting Record

This record is not an Official EP3 View of Trajectory Management. It is a record of a brainstorm of options for procedures related to trajectory management as they affect airports. The aim was to develop some options and to consider their consequences, and feed the results to other Work Packages.

The meeting was intended to support EP3 WP3, in refining procedures for Network Planning; EP3 WP5, in developing an Airport Storyboard; and EP3 WP2, in demonstrating system consistency.

The final view of EP3 on RBT creation will be documented by WP2.

A.1.2 Background to this Workshop

EP3 developed several scenarios describing airport operations in SESAR. Many of the Airport Scenarios include a step when the RBT of one or more aircraft is revised. This session of the Expert Group aimed to expand this step and review its implications. It was hoped to clarify Q:s such as “Is information from the Network Plan and/or from RBTs used by Airport Controllers?” and “Is there any incentive for an operator to respect a Target Time which has been assigned to manage delay?”

A.1.3 Method Used for the Workshop

The aim of the Workshop was to develop a description of airport operations based around the concept of Trajectory Management.

It had originally been planned to use the ‘Oval Mapping’ technique to explore issues and goals for each airport actor in this workshop. However, it was believed before the workshop that the goals of actors were reasonably well understood, and a more pressing issue was to explore the extent to which all goals could be met simultaneously. The workshop therefore aimed at a deeper investigation of airport operations.

Clearly, a key decision is the agreement of a trajectory as an RBT, when the operator, airport ATC, and Network become committed to the trajectory. Participants were therefore asked to consider the moment at which an RBT is agreed; to look forward and consider the implications of this agreement for the pilot, operator, airport, and ANSP; and to look backwards and describe any necessary pre-conditions, such as the validation of an SBT.

A.1.4 Related Documents

Ian Ramsay distributed copies of an updated version of *Understanding Trajectory Management* (Ref [3]), which had been accepted by the SESAR Joint Undertaking.

A.1.5 Structure of this Meeting Record

These notes have been structured by first stating a “mainstream” interpretation of the ConOps, which is believed to be in line with the views of those involved in drafting the

SESAR Concept of Operations; and then repeating this interpretation with issues and Q:s noted following each paragraph.

A.1.6 Subsequent Use of the Meeting Output

The meeting did not conclude with clear and coherent options for RBT agreement. Instead, one possible process was documented, and Q:s about it were raised.

Subsequently it was noted that several of the Q:s which had given rise to uncertainty also underlay C:s made about Scenario OS-38 – Trajectory Management in the En Route Phase, developed as part of Work Package 4. The Q:s included the nature of a target (is it an optional constraint, or a constraint with loose tolerances?), and which parties are involved in negotiation when an RBT is revise. In order to clarify the underlying issues as concisely as possible, a 'Straw Man' Concept Interpretation was developed within Work Package 4, drawing on the content of this workshop. Following several rounds of discussion by e-mail, the 'Straw Man' was passed to WP2 (System Consistency) and developed further. At the time of writing, Version 0.8 of the Straw Man is in the EP3 Library.

A.2 A View of RBT Agreement

The following view of RBT agreement and utilisation, which draws off Reference [3], was proposed:

a) The SESAR ConOps is in many ways similar to today's method of operation. Today's Flight Plan meets the definition of an RBT, because the operator agrees to fly it and the ANSP and airport agree to facilitate it. SESAR aims to improve on today's system by operating with more predictability, better conformance to plan, and revision of plans when necessary.

b) SESAR is a layered planning system. Continuous refinement of the SBTs will lead to improved demand/capacity balancing, and the agreement of trajectories which meet user needs to the fullest possible extent.

c) The Airspace User owns the SBT and the RBT. Legal and business requirements will determine whether it is the pilot or the Operations Centre who has responsibility at any time.

d) The SBT is refined on an iterative basis in the months, days and hours before operation, to achieve the business goals of the aircraft operator whilst meeting published constraints. The SBT will be loaded into the FMS by the pilot. When the pilot is confident that the flight can operate at a particular time (within the standard RBT tolerance, to be defined), he/she will convert the SBT into an RBT, and this change will be promulgated throughout the system. Because SBT refinement has considered all ATM constraints, the SBT will automatically be accepted as an RBT by all ANSPs when the pilot requests agreement.

e) The aim of SESAR is to deliver all aircraft on time at their destination. This is a change from the current system, which aims to maximise the throughput of each airport or sector locally with less regard for the overall network.

f) The Ground Sections of the RBT, at origin and destination, differ from the Airborne Section of the RBT as follows:

- Trajectory Management Requirements, which define when the RBT is automatically updated, may not apply on the ground.

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- If the taxi route is changed, the RBT will not be changed. However, if there is a significant delay (criteria to be determined) in the taxi time contained in the RBT, then there will need to be an RBT revision process or a reversion to SBT.
- The Ground Sections of the RBT exist to support DMAN and Surface Planning, and is not used for conflict management. The Airborne Sections will be used to support improved traffic presentation in SESAR IP2 (using levels and routeing), for deconfliction in IP3 (using levels, routeing and Time Constraints).

g) The Ground Section of the RBT will have less precise estimates than the Airborne Section, to allow for possible sequence optimisation and for variation in times for pushback, start engines, and taxi. Any time constraints will be agreed as part of RBT negotiation. Once a flight is airborne, the estimates will be more precise, and constraints (CTO or CTA) will be applied if needed.

h) The Airborne Sections of the RBT are used to reduce complexity, using level, routeing and time constraints. Constraints will only be applied if they are needed. If the trajectory of a flight is not impeded or constrained by the trajectory of another flight it only needs to conform to the route and levels in its RBT, and it does not need to conform to the time. A TTA or TTO is not a constraint, it is an estimate used for planning purposes. All the waypoints in the RBT are usually ETOs. It does not matter if the pilot does not fly the RBT in the time dimension if there are no constraints; the estimated times will be updated whenever the trajectory deviates beyond a specific limit. For equipped aircraft the SESAR Trajectory Management Requirements (TMR) will apply, and for other aircraft the estimates will be updated if the flight is not within ±3 minutes of them, just as required by ICAO rules today. The purpose of TMR is to maintain synchronisation between the on-board trajectory (flight intent) and the Ground Systems trajectory, and not to keep the flight within the tolerance. The TTA may be entered into the FMS, or the Electronic Flight Bag, or maintained by the Airline Operations Centre.

A.3 Issues Arising from this View

above. In this section the ConOps interpretation is repeated, with issues inserted after the relevant paragraph.

a) The SESAR ConOps is in many ways similar to today's method of operation. Today's Flight Plan meets the definition of an RBT, because the operator agrees to fly it and the ANSP and airport agree to facilitate it. SESAR aims to improve on today's system by operating with more predictability, better conformance to plan, and revision of plans when necessary.

Issue: An important Q: for SESAR will be developing a view of the tolerances and expected accuracy in conforming to RBTs. If the tolerances are too relaxed, then performance will be similar to today's ATM system, with the RBT being like a flight plan. If the tolerances are too rigid, then excessive effort may be needed for frequent re-planning, and there will be an increased possibility that flights will "miss a constraint" and that a new RBT can only be accommodated after significant delay or re-routeing in order to manage downstream complexity in the light of other trajectories to which the system is committed. Tolerances are an important issue for validation.

It is likely that a trade-off between predictability and flexibility will be needed, as procedures are refined.

b) SESAR is a layered planning system. Continuous refinement of the SBTs will lead to improved demand/capacity balancing, and the agreement of trajectories which meet user needs to the fullest possible extent.

c) The Airspace User owns the SBT and the RBT. Legal and business requirements will determine whether it is the pilot or the Operations Centre who has responsibility at any time.

Q:: Is the RBT defined as the trajectory set in the FMS?

Argument For: this would ensure that the aircraft is flying the RBT, by definition.

Issue (1): the RBT is a ground trajectory, and if the FMS is operating to a defined airspeed then a meteorological prediction is needed to define the RBT. If the RBT is defined as the trajectory in the FMS, does this imply that the system takes the airborne Met prediction as the 'Master' view?

(One view is that this does not matter. If the airborne nowcast is the same as the forecast, nothing changes. If the Met has changed and it impacts on any time constraint on the RBT, then the there is an RBT revision.)

Issue (2): the Ground may have a more complete view of expected actions needed to manage complexity or potential conflicts. This information is needed to define the RBT.

(One view is that this does not matter. If the ground knows that changes to the RBT are necessary, then a request for Revision will be sent to the aircraft.)

Issue (3): the RBT may have a constraint – for example, a CTO with tolerance ±45 seconds. If the flight is 30 seconds behind its defined time then it is conforming to its RBT. However, it is not true to say that the RBT has been shifted backwards in time by 30 seconds.

It is operating within tolerances however the next scheduled downlink will realign the air and ground systems and the ETAs will be revised by 30 seconds: resetting the ground based tools that utilize the trajectory information. It is for this reason that safety nets rely upon surveillance data (augmented by trajectory information) rather than the other way around.

Issue (4): Is the FMS capable of holding all the information which will be part of the RBT? This Q: can only be answered once the format of the RBT is defined.

d) The SBT is refined on an iterative basis in the months, days and hours before operation, to achieve the business goals of the aircraft operator whilst meeting published constraints. The SBT will be loaded into the FMS by the pilot. When the pilot is confident that the flight can operate at a particular time (within the standard RBT tolerance, to be defined), he/she will convert the SBT into an RBT, and this change will be promulgated throughout the system. Because SBT refinement has considered all ATM constraints, the SBT will automatically be accepted as an RBT by all ANSPs when the pilot requests agreement.

e) The aim of SESAR is to deliver all aircraft on time at their destination. This is a change from the current system, which aims to maximise the throughput of each airport or sector locally with less regard for the overall network.

Issue: A typical constraint caused by congestion will allow some trajectories to stay as planned while other operators must choose a new level, route, or time of operation. In this case it will be difficult for operators to find an equitable solution. Principles by which the SBTs are refined will need to be developed.

One option for refinement is “First-filed, first-to-choose revised trajectory”.

Issue (1): There will be an advantage to operators who file as early as possible, and the implications for equity and possibilities for “gaming” will need to be examined.

Issue (2) There is a likelihood that the overall totality of trajectories will not fully utilise the capacity of the airspace, because if an optimum trajectory is defined for each aircraft in turn without considering subsequent aircraft the overall situation may be worse than might be obtained by considering all aircraft. For example, it might be best to resolve complexity by making small changes to two trajectories, but under sequential planning one trajectory may be unchanged and the second changed by a large amount.

Another option is that Users negotiate new trajectories a fixed time horizon before operation. (This is equivalent to producing a ‘Validated SBT”, as suggested by the SESAR Performance Framework.) This planning horizon must be defined carefully, because if it is too short then the Network Plan will have less stability, while if it is too long the capacity and ATM constraints may change before operation. (For instance, constraints may be affected by changes of runway direction, other meteorological effects, and system staffing and engineering issues.)

Issue (1): In order to make the negotiation of SBTs meaningful, a method will be needed to ensure that when RBTs are agreed they are in accordance with negotiated priorities. This contravenes the principle of agreeing the best available RBT when an aircraft is ready for departure.

Issue (2): It will probably be complicated to define ATM constraints such that all ANSPs will commit to facilitating trajectories which conform to them. It is expected that constraints will be defined as CTOs or CTAs when flights are airborne, but can the network operate efficiently if there are no constraints on airborne time in advance of CTOs and CTAs being defined?

Issue (3): As well as the initial planning and refinement of SBTs, on most days there will be many times when revisions to RBTs will be needed during operation. Perturbations which affect the whole network may be caused by changes of runway direction, blocked runways, or winds that are different from forecast. The revision of RBTs will have to be achieved within compressed timescales, with urgent decisions needed for many flights. The effect of such re-planning on Network Operation and the facilitation of user-preferred trajectories will need to be examined. The idea of 'A Catalogue of Solutions" may be useful in re-planning, but it needs more development.

f) The Ground Sections of the RBT, at origin and destination, differ from the Airborne Section of the RBT as follows:

- Trajectory Management Requirements, which define when the RBT is automatically updated, may not apply on the ground.
- If the taxi route is changed, the RBT will not be changed. However, if there is a significant delay (criteria to be determined) in the taxi time contained in the RBT, then there will need to be an RBT revision process or a reversion to SBT.
- The Ground Sections of the RBT exist to support DMAN and Surface Planning, and is not used for conflict management. The Airborne Sections will be used to support improved traffic presentation in SESAR IP2 (using levels and routeing), for deconfliction in IP3 (using levels, routeing and Time Constraints).

g) The Ground Section of the RBT will have less precise estimates than the Airborne Section, to allow for possible sequence optimisation and for variation in times for pushback, start engines, and taxi. Any time constraints will be agreed as part of RBT negotiation. Once a flight is airborne, the estimates will be more precise, and constraints (CTO or CTA) will be applied if needed.

Issue (1): The Eurocontrol Airport CDM Manual has been developed through extensive consultation with many stakeholders, and tested through implementation and operational use. It would be sensible to use procedures and definitions from this manual in refining the SESAR ConOps for airport operations.

Issue (2): The way in which airport operations will be influenced by network considerations is not clear. The SESAR ConOps states "*Flights should be able to depart when they are ready to do so; subject only to any allocated target time at destination and constraints at departure airport, resulting in a target take-off time.*"

(Para 2.2.4.1.5, Ref [6]). This implies that the origin airport will not consider network effects in its airborne time, except for the case of flights bound for a congested airport and already inside its AMAN horizon.

Issue (3): It has been suggested that pilots will be expected to choose that time at which they call for start-up and pushback in accordance with their TTA. However, this is not in line with the principle that a TTA is not a constraint, and that target times will be changed if the preferred trajectory changes.

Issue (4) DLR have a DMAN tool which can respect the immediate position (ie the position of aircraft on the taxiways) when re-planning. This is something which tower controllers do today, but tool support might be needed if airport operations are required to take more account of network optimisation under SESAR.

Issue (5): It makes it simpler to plan departures when the origin airport does not consider network effects, but it probably makes it harder to plan arrivals. Is this a useful change?

i) The Airborne Sections of the RBT are used to reduce complexity, using level, routeing and time constraints. Constraints will only be applied if they are needed. If the trajectory of a flight is not impeded or constrained by the trajectory of another flight it only needs to conform to the route and levels in its RBT, and it does not need to conform to the time. A TTA or TTO is not a constraint, it is an estimate used for planning purposes. All the waypoints in the RBT are usually ETOs. It does not matter if the pilot does not fly the RBT in the time dimension if there are no constraints; the estimated times will be updated whenever the trajectory deviates beyond a specific limit. For equipped aircraft the SESAR Trajectory Management Requirements (TMR) will apply, and for other aircraft the estimates will be updated if the flight is not within ±3 minutes of them, just as required by ICAO rules today. The purpose of TMR is to maintain synchronisation between the on-board trajectory (flight intent) and the Ground Systems trajectory, and not to keep the flight within the tolerance. The TTA may be entered into the FMS, or the Electronic Flight Bag, or maintained by the Airline Operations Centre.

Issue (1): This view of the ConOps means that the time dimension of the RBT has minor importance for estimates and targets, and only constraints will be important for operators and executive controllers.

Issue (2): The way in which constraints are defined will be critical for safety, network efficiency, and predictability. So far there has been little work on this subject.

Issue (3): If CTO and CTA constraints are set before take-off, the RBT will have significant uncertainty. (Though in F4.4.2 the SESAR ConOps states that a CTA will be calculated after the flight is airborne, so this case may be contrary to the ConOps.) This means that it may be necessary to revise constraints after take-off, or else to fly in an inefficient way to meet them. The alternative is that CTO and CTA are only defined after take-off; this is likely to provide strong incentives not to absorb any expected delay on the ground, in the way in which the CFMU organises today, because it will not reduce the amount of delay to be absorbed in the air and will therefore increase the overall share of delay.

Issue (4): The RBT is a sequence of waypoints with associated times. Will the waypoints include the Initial Approach Fix and the Runway Threshold at destination? If so, is the destination airport committed to facilitating the achievement of these times? If so, it places strong constraints on the AMAN, and strong requirements for accurate planning when the RBT is agreed.

Issue (5): On a rigorously logical view of the ConOps, there is a contradiction between stating that the RBT is defined as the trajectory which the airspace user agrees to fly and the ANSP agrees to facilitate, and stating that the RBT is automatically updated when there is deviation but no constraints are breached. It might be useful to modify one of these statements.

A.4 PARTICIPATING EXPERTS

Name	Organisation	Expertise
John Greenwood	NATS	Airport Operations
Richard Powell	NATS	EP3 Project Manager
Peter Simonsson	NATS	Performance Framework
Reinhard Balzer	DFS	Airport Controller and Procedure Development
Åke Wall	LFV	Airport Controller and Procedure Development
Claes Rundberg	LFV	Airport Controller and Procedure Development
Ian Ramsay	Eurocontrol HQ	SESAR Concept
Bill Booth	Eurocontrol EEC	ATM and Validation
Guiseppe Murgese	Eurocontrol EEC	Information Management, Airport Operations
Roger Lane	Eurocontrol EEC	Airport CDM
Francis Richards	Eurocontrol HQ	Airport Operation
Patrick Lelièvre	Airbus	Aircraft Systems
Bart Klein-Obbink	NLR	Safety and ATM
Frank Morlang	DLR	Airport Systems and Operations
Ibán Alvarez	ISDEFE	Airport Systems and Operations
Marta Gabaldón	INECO	Airport Systems and Operations

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B ANNEX: PLANNING AND LIST OF EXPERTS

Meeting Date	Location	Participants (company)	Objective
26 Sept 08	NATS, Gatwick, UK	R Powell (NATS) C Wilson (NATS) J Greenwood (NATS) R Newnes (NATS) A Taylor (NATS)	Identify Airport Expert Group Objectives according to new EP3 DOW (3.0) - Achieved
28 Oct 08	NATS, Gatwick, UK	R Powell (NATS) J Greenwood (NATS) R Newnes (NATS) R Balzer (DFS) F Morlang (DLR) J Lofthouse (BA) N Suarez (ISDEFE) M Sanchez-Cidoncha (ISDEFE) O Fernandes (INECO) C Wilson (NATS)	To review the Airport Expert Group Objectives and current understanding of Airport ATC Tolerances Present Ongoing Projects – CDM, EMMA2, TAM Achieved
26 Nov 08	NATS, Gatwick, UK	R Powell (NATS) J Greenwood (NATS) R Newnes (NATS) A Taylor (NATS) P Humphreys (ERC) F Villaume (AIRBUS) R Faris (NATS) J Lofthouse (BA) M Greenaway (NATS) M Sanchez-Cidoncha (ISDEFE) Giulio Maira (AENA)	To gather together different expertise to discuss SESAR as starting point of the EP3 WP5.3.2 Airport Expert Group work Achieved
26 Jan 09 (Day 1) 27 Jan 09 (Day 2)	INECO, Madrid, Spain	R Powell (NATS) J Greenwood (NATS) R Newnes (NATS) C Barbas (INECO) P Humphreys (ERC) F Richards (ERC) F Morlang (DLR) J Lofthouse (BA) B Klein-Obbink (NLR) R Balzer (DFS) E Goni-Modrego (ERC) M Sanchez (ISDEFE) R Lane (ERC) Mayte Cano (AENA)	To review the Airport related Scenarios (Day 1). Commence collaborative work with EP3 WP3 on the SBT to RBT hot topic (Day 2) Achieved

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Meeting Date	Location	Participants (company)	Objective
		C Rundberg (LFV) I Alvarez (ISDEFE) M Gabaldon (INECO)	
25 Mar 09 (Day 1)	NATS, Gatwick, UK	R Powell (NATS) J Greenwood (NATS) R Newnes (NATS) P Humphreys (ERC) F Richards (ERC) F Morlang (DLR) B Klein-Obbink (NLR) P Lelièvre (AIRBUS) R Balzer (DFS) R Lane (ERC) C Rundberg (LFV) Ake Wall (LFV) I Alvarez (ISDEFE) M Gabaldon (INECO) Giulio Maira (AENA)	To review the Airport related Scenarios and Q:naires (6 Top Issues). Review OS 12 and OS 13, to create new versions of the storyboards Landing and Taxi to Stand Taxi out and depart Achieved Note: Attendees of 2nd Day (SBT to RBT workshop) is included in A.4
18 May 09	NATS, Gatwick, UK	R Powell (NATS) J Greenwood (NATS) R Newnes (NATS) C Barbas (INECO) P Humphreys (ERC) F Richards (ERC) R Balzer (DFS) Ake Wall (LFV) I Alvarez (ISDEFE) R Eveleigh (ERC)	Review C:s on Storyboards to finalise Storyboards Review outstanding Scenario C:s Provide Input into Airport Expert Group Report (Good, Bad Points) Achieved

Table 4 - List of meetings and participants

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