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SAFETY ASSESSMENT OF AIRPORT COLLABORATIVE DECISION MAKING (A-CDM)

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Abstract

This document presents a safety assessment of the Airport CDM (A-CDM) Project. The relevant A-CDM milestones, flight phases and data flows have been systematically analysed. The safety impacts of A-CDM have been identified and documented. Where concerns or new hazards have been found, appropriate risk mitigation has been proposed.

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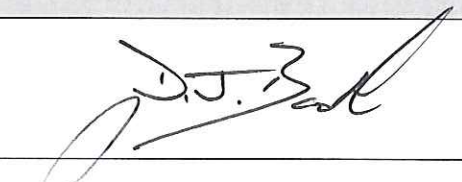
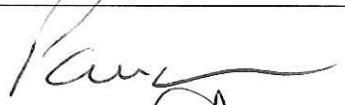
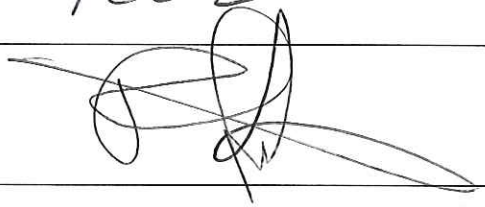
David Booth A-CDM Implementation Manager		01/02/2016
Paul Adamson Head of Airport Unit		01/02/2016
Joe Sultana Director Network Manger		01/02/2016

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1 EXECUTIVE SUMMARY

Objectives and Method

This document presents the safety assessment for the Airport Collaborative Decision Making (A-CDM) project. The objectives of this safety assessment are to:

1. Identify the operational differences between pre and post A-CDM operations for all partners and all flight phases associated with airport operations.

2. Assess the safety impact (positive and negative) of the differences identified for all A-CDM partners under normal operating conditions (Success Case) and failure conditions (Failure Case).

3. For safety concerns and hazards identified in 2), identify mitigations to ensure that A-CDM will maintain or improve safety.

The safety assessment approach consisted of the following steps:

• The A-CDM system was defined based on the Operational Concept Document (OCD) and the Functional Requirements Document (FRD). In particular the Milestones (MST) underpinning the A-CDM concept, the Functional Groups (FG) and the data flows/ items were defined. It is recognised that the pre-CDM situation could vary significantly between airports and between airport partners. For this study a pre-CDM situation has been defined which lacks the elements and FGs described in the OCD and FRD. Thus the safety impact described in this report may be greater than that experienced by airport partners which already have some parts of A-CDM in operation.

• The safety impacts of A-CDM were analysed assuming that the A-CDM system was operating as described in the OCD and FRD. This is termed the "Success Case". For each Milestone and relevant flight phase, A-CDM was compared with the pre-CDM situation from the viewpoint of each airport partner.

• Potential issues and concerns and new hazards associated with failures of the A-CDM system were also analysed (termed the "Failure Case"). For each data item identified in the A-CDM documentation the flow of information between source and recipient was identified. The potential worst credible effects of loss or corruption of this information were then identified.

The outputs of this generic analysis, in terms of safety impacts and mitigations, will be sensitive to local airport conditions. Therefore local safety assessments (as required by ESARR4) will need to review these outputs and update them for their local airport situation. Guidance on conducting such local assessment has been provided in this report.

Conclusions

This generic safety assessment concludes that A-CDM will lead to no adverse safety impacts with the mitigations identified in this report.

A very limited number of potential safety concerns have been identified. The Success Case issues would be adequately mitigated by practicable procedural and Safety Management System (SMS) recommendations which have been proposed. In particular clear definitions of roles and responsibilities are required to ensure that all relevant personnel understand how A-CDM information is to be used. The Failure Case issues are mostly adequately mitigated by practicable procedural recommendations. In addition, there may be a need for some system equipment requirements (e.g. Software Assurance Level) for certain data items within A-CDM. An initial set of key data items has been identified in this generic study which local assessments would need to check to determine if system equipment requirements are needed, or whether failure effects are adequately mitigated by other means.

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2 INTRODUCTION

2.1 Background

Airport CDM is one of the projects maintained by the Network Manager. This document presents the safety assessment for the A-CDM project.

2.2 Objectives of Safety Assessment

The objectives of this safety assessment are to:

1. Identify the operational differences between pre and post A-CDM operations for all partners and all flight phases associated with airport operations.

2. Assess the safety impact (positive and negative) of the differences identified for all A-CDM partners under normal operating conditions (Success Case) and failure conditions (Failure Case).

3. For safety concerns and hazards identified in 2), identify mitigations to ensure that A-CDM will maintain or improve safety.

2.3 Overview of Safety Assessment Approach

The Safety Assessment Approach is summarised in Figure 2.1 below:

• The A-CDM system was defined based on the Operational Concept Document [2] and the Functional Requirements Document [3]. In particular the Milestones (MST) underpinning the A-CDM concept, the Functional Groups (FG) and the data flows/ items were defined (Section 2 of this report).

• The safety impacts of A-CDM were analysed assuming that the A-CDM system was operating as described in the OCD and FRD. This is termed the "Success Case". For each Milestone and relevant flight phase, A-CDM was compared with the pre-CDM situation from the viewpoint of each airport partner (ground handler, airport operator, aircraft operator, ATC, NMOC, etc.). Potential safety benefits of A-CDM were identified and documented. Any potential issues and concerns with A-CDM in its normal operating mode were also identified and appropriate mitigations proposed (Section 3 of this report).

• Potential issues and concerns and new hazards associated with failures of the A-CDM system were also analysed (termed the "Failure Case"). For each data item identified in the A-CDM documentation the flow of information between source and recipient was identified. The potential worst credible effects of loss or corruption of this information were then identified. In some cases there were no safety effects. For those cases where there could potentially be safety effects, suitable mitigations have been identified and proposed (Section 4 of this report).

• The outputs of this generic analysis, in terms of the safety benefits and mitigations, will be sensitive to local airport conditions. Therefore local safety

assessments will need to review these outputs and update them for their local airport situation (see Section 5 of this report).

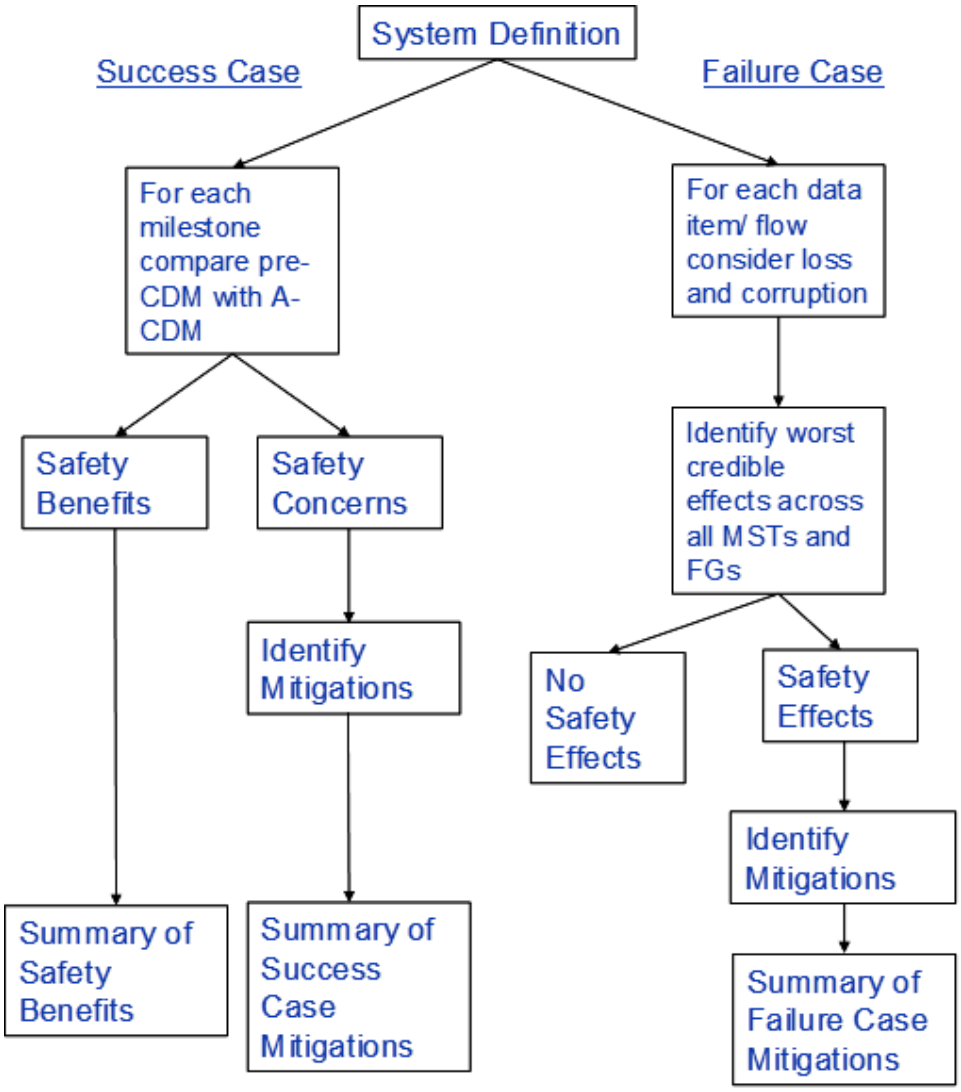

Figure 1 Overview of A-CDM Assessment Approach

Within the safety assessment the following safety criteria have been used (Safety Plan [4]):

• Airport risks are not to be increased (consistent with ESARR4 and ATM 2000+); and

• Airport risks are to be further reduced As Far As Reasonably Practicable.

2.4 Document Structure and Relation to Other Documents

This safety assessment report is structured as follows:

• Section 2 provides a system description of the A-CDM project;

• Section 3 presents the Success Case analysis described above;

• Section 4 covers the Failure Case analysis described above;

• Section 5 presents a discussion of the results including how this generic analysis can be used at a local airport level;

• Section 6 summarises the validation and verification activities associated with this safety assessment; and

• Section 7 presents the main conclusions and recommendations.

Appendix I provides the full Success Case and Failure Case analysis broken down by relevant Milestones and airport partners. Appendix II contains a specific analysis of failures of the A-CDM alarms.

Safety assessment reports are being prepared for the ACE and RWY SAF projects in parallel with this document. Three safety case documents will also be prepared for RWY SAF, ACE and A-CDM. As noted above a safety case already exists for A-SMGCS.

2.5 Participants

EUROCONTROL's A-CDM Project has received considerable support from EUROCONTROL's Safety department and external A-CDM stakeholders in the conduct of this safety assessment. Workshops, post-workshop analysis and reviews of documents have been supported by personnel with a mix of disciplines and expertise including A-CDM designers, ATCOs, Air Navigation Service Providers, aircraft operators and safety experts. This assistance is gratefully acknowledged. Further details of participants in the safety assessment are given in Appendix I.

2.6 Definitions

Mitigation	Steps taken to control or prevent a hazard [or concern] from causing harm and reduce risk to a tolerable or acceptable level (taken from ESARR4)
System	Understood to include equipment, people and procedures

3 SYSTEM DESCRIPTION

3.1 Purpose of the A-CDM Project

Airport Collaborative Decision Making (A-CDM) aims at improving operational efficiency at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources.

Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners, knowing their preferences and constraints and the actual and predicted situation.

The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools.

Most airport related operational improvement initiatives launched until now were oriented towards improving performance of an individual partner at an airport. However, optimising the capacity of an airport involves interaction amongst all airport partners working as a team. Individual partners must co-ordinate their decisions and activities by sharing information and resources to attain shared goals.

The common goals of A-CDM are as summarised in the diagram below:

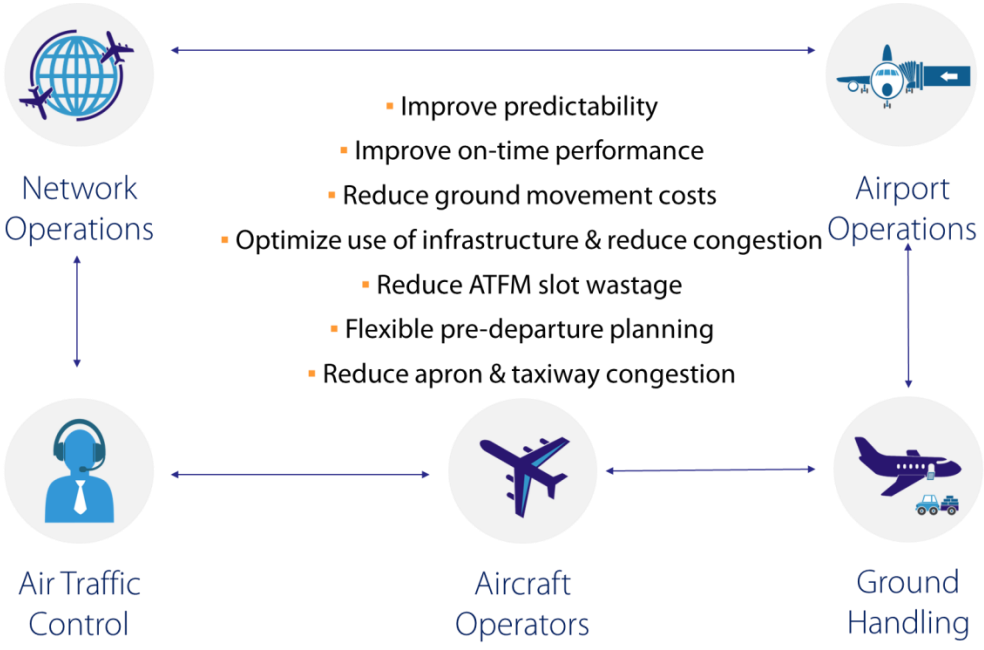

Figure 2 A-CDM Common Goals

3.2 A-CDM Concept Elements

3.2.1 Overview

The Airport CDM concept is divided into the following Elements [2]:

- Airport CDM Information Sharing;
- A-CDM Turn-round Process – Milestones Approach;
- Variable Taxi Time Calculation;
- Collaborative Management of Flight Updates;
- Collaborative Predeparture Sequence;
- A-CDM in Adverse Conditions; and
- Advanced Concept Elements

A phased, bottom-up approach is planned for implementation of each element with each implementation step delivering an incremental benefit, which will become even more significant as the Airport CDM Concept Elements mature.

Some of the Airport CDM Elements also serve to create the environment without which other elements cannot work. The Operational Concept therefore assumes that some Elements are implemented before the others are considered, as described in the following sub-sections.

3.2.2 Airport CDM Information Sharing

Airport CDM Information Sharing is essential for achieving common situational awareness (CSA) through the exchange and sharing of all pertinent information, including data recording and post-operational analysis. It also forms the foundation upon which all other Elements operate and as such must be implemented first. This element is supported by Functional Group 0, the User Interface (UI)/ Airport CDM Information Sharing Platform (ACISP) and Functional Group 1, Airport CDM Information Sharing (see FRD [3]).

3.2.3 The A-CDM Turn-round Process (Milestone Approach)

Focusing on the turn-round process and linking flight segments with the NMOC, this Element improves inbound and outbound traffic predictability. Together with A-CDM Information Sharing, it provides the foundation of the ground traffic network, essential for system-wide planning improvements. This Element is essential if the full potential of A-CDM Information Sharing is to be realised. It is related to Functional Group 2 [3].

3.2.4 Variable Taxi time Calculation

Variable Taxi Time Calculation aims at improving the accuracy of calculations associated with the ground movement of aircraft, such as estimated take off times. This Element is a pre-requisite for the implementation of the

Collaborative Management of Flight Updates. It is related to Functional Group 3 [3].

3.2.5 Collaborative Management of Flight Updates

This Element ensures that ATFM has the required flexibility to cope with modifications in departure times, due to traffic changes and operators' preferences. It requires the availability of precise taxi times provided by Variable Taxi Time Calculation and the A-CDM Turn-round Process. It is related to Functional Group 4 [3].

3.2.6 Collaborative Predeparture Sequence

This Element enhances flexibility and helps in optimising airport resources. It is related to Functional Group 5 [3].

3.2.7 A-CDM in Adverse Conditions

This Element facilitates the dissemination of capacity changes and recovery from disruption, ensuring flexibility and optimum use of available resources. It is related to Functional Group 6 [3].

3.2.8 Advanced Concept Elements

These Elements will enhance and extend common situational awareness and increase collaboration between airport partners by utilising advanced technologies and linking with advanced tools, i.e. A-SMGCS, AMAN / DMAN.

The Advanced Concept Elements are still under development and are ex-scope with respect to the current safety assessment. The scope of this safety assessment covers Functional Groups up to FG 6.

3.3 System Assumptions

In conducting the analysis of potential system failures in Section 4 it has been assumed that backwards interference to data sources feeding into ACIS has been guarded against by the design of the data sources. More detailed assumptions have been documented in Annex I.

4 SUCCESS CASE ANALYSIS

4.1 Overview

The A-CDM project optimises the information flow, decision making and collaboration of partners within an airport. As part of the safety assessment, the safety impacts of A-CDM under normal operating conditions have been analysed as shown in Figure 2.1 under “Success Case”. The analysis process involved two safety workshops with A-CDM partners (see Appendix I for participants) and post workshop analysis.

4.2 Analysis by Milestones, Phases and Airport Partners

The main structure for the Success Case analysis was provided by the A-CDM Milestones from the FRD ([3], Section 3.3.8.1). At the beginning of the first safety workshop three other key phases were added, namely “Flight Update Message (FUM) generated by NMOC”, “Landing” and “Taxi-out/Departure”. The full list of Milestones/ Phases is shown in Table 4.1 below.

Appendix I presents the complete Success Case Analysis. For each phase, the pre-CDM and A-CDM situation is summarised. Based on this the safety implications for each A-CDM partner are identified and documented. Finally potential safety benefits and any potential concerns are summarised.

These summaries of potential benefits and concerns have been copied into Tables 4.1 and 4.2 below, together with appropriate risk mitigations for the concerns.

4.3 Main Outputs

4.3.1 Potential Safety Benefits

The following potential safety benefits of A-CDM covering all conditions have been identified from Table 4.1:

• The timely and increased provision of key information could both improve the situational awareness of all partners and allow them to plan better. In turn these improvements may enhance reaction to unexpected events and reduce the frequency of rushed operations thereby reducing the occurrence of “error-prone” situations.

• Better planned operations may allow workload peaks and troughs to be smoothed and reduce the probability of overload on any of the partner personnel and the probability of RT frequency overload.

• It could lead to better planning of flows of traffic. This may have a particular safety benefit in the case of inbounds and outbounds within airport cul-de-sacs and enhances the traffic planning for runways in mixed mode operation. It could potentially reduce the number of aircraft moving simultaneously in close proximity.

• Better planned operations may reduce the probability of last minute changes. In particular, ground handlers should have fewer occasions where they have to travel across the airport in a hurry to react to an unexpected event.

• Certain A-CDM alarms help identify inconsistencies or other problems in data flows which otherwise may have gone un-noticed.

Although these potential safety benefits were identified by the experts in the safety workshops, it must be stressed that A-CDM is not a “safety tool” and should not be seen as one. Clearly its prime purpose is to improve operational efficiency at an airport. Thus, while the potential safety benefits of A-CDM identified above are valid outputs from the assessment process, they should not be considered “safety measures” as such.

4.3.2 Potential Issues and Concerns

The potential issues and concerns in Table 4.2 are:

• Increased potential for Ground Handlers’ unauthorised interference with flight plan data.

• Slight workload increases for certain personnel in entering and updating A-CDM information.

These concerns should be adequately addressed by the following two mitigations:

S1 Service Level Agreements (SLAs) and agreed procedures between Aircraft Operators and Ground Handlers on change access to Flight Plan Information are to be formalised.

S2 Update training and resource needs analysis for all partners. These analyses, which are a typical component of a mature Safety Management System, should cover:

• Review of workload and other demands versus human and other resources;

• Ensuring that training and procedures cover input, receipt and correct use of A-CDM information;

• Ensuring appropriate Human Machine Interface for all users of A-CDM; and

• Updated definition of roles and responsibilities.

Overall, with these mitigations in place, under normal operations A-CDM should not have an adverse impact on safety.

Milestones / Flight Phases	Potential Safety Benefits
MST 1 - Flight Plan Submission	1. Increased transparency in Flight Plan data 2. A-CDM correlation alarms help to identify inconsistencies in flight plan information
MST 2 – EOBT -2hr	1. Reduction of workload for Ground Handlers & Airport Operator due to advance availability of flight information 2. Reduction in ATC workload due to better planning in Stand and Gate management
MST 3 - Take off from outstation	1. Reduction of workload for Ground Handlers, Airport Operator and Aircraft Operator due to advance availability of flight information hence reducing probability of making errors 2. Better co-ordination for airport partners allowing better planning and smoother operations
Flight Update Message (FUM) generated by NMOC	1. Enhanced landing estimates coupled with variable taxi times provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload and hence reducing likelihood of errors 2. More accurate information on traffic loading to ATC reducing ATC workload peaks and RT 3. Better aircraft and crew planning for aircraft operators

Milestones / Flight Phases	Potential Safety Benefits
MST 4 – Local radar update	1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators 3. More accurate indication of traffic loading for ATC
MST 5 - Final Approach, MST 6 – Landing, Taxi-in period & MST 7 – In Block	1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of errors 2. Better aircraft and crew planning for aircraft operators
MST 8 - Ground handling starts	1. Reduction of Ground Handler's workload if Ground Handling start time is automatically obtained 2. Better estimates on stand/gate vacation leading to potential reduction in errors made by Ground Handler/Airport operator.
MST 9 – TOBT update prior to TSAT issue	1. Reduction of RT loading and workload for ATC 2. Allows better planning for NMOC
MST 10 – TSAT issue	1. Better planning at push-back leading to potential reduction in errors by Ground Handlers and Airport Operator 2. Improved planning of the taxi flow towards the runways enhances the traffic planning for runways in mixed mode operation

Milestones / Flight Phases	Potential Safety Benefits
MST 11 - Boarding starts	1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. ATC has advance notice of possible delays enhancing planning
MST 12 - Aircraft ready	1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. Potential reduction in RT loading for ATC
MST 13 - Start up request & MST 14 - Start up approved	1. Better planning of resources and equipment for Ground Handlers, reducing error likelihood 2. Better stand-gate planning for Airport Operator reducing error likelihood 3. Reduction of frequency congestion for ATC and pilots 4. Better planning and flow of taxiing aircraft both inbound and outbound especially in cul-de-sacs
MST 15 - Off Block	1. Better stand-gate planning for Airport Operator reducing error likelihood
Taxi out/Departure & MST 16 - Take off	1. Reduction of en-route sector overloads for ATC 2. Reduction of en-route sector over-deliveries for NMOC due to increased number of aircraft departing within CTOT tolerance window
Adverse conditions A-CDM	Overall improvement in recovery and management of adverse conditions for all partners, both during and after the event, on a network basis and locally.

Table 1 Analysis of Potential Safety Benefits under Success Case by Milestones/Phases (see Appendix I for more details)

Milestones/ Flight Phases	Issues and concerns	Mitigation for Concerns	Mitigation Owner
MST 1 - Flight Plan Submission	1. Increased potential for Ground Handlers' unauthorised interference with flight plan data	S1. Service Level Agreements (SLAs) and agreed procedures between Aircraft Operators and Ground Handlers on change access to Flight Plan Information are to be formalised.	Ground Handlers and Aircraft Operator
MST 9 – TOBT update prior to TSAT issue	1. Workload increase for Ground Handlers and Aircraft Operator in inputting TOBT data and correcting corrupt data	S2. Update training and resource needs analysis.	All partners
MST 10 – TSAT issue	1. Slight workload increase for ATC if DMAN is not present	S2. Update training and resource needs analysis.	ATC
MST 11 - Boarding starts	1. Possible slight increase in workload for Ground Handler to resolve boarding alarms 2. Possible slight increase in workload due to recalculation of TSAT by ATC	S2. Update training and resource needs analysis.	All partners

Table 2 Analysis of Potential Issues and Concerns under Success Case by Milestones/Phases (see Appendix I for more details)s)

5 FAILURE CASE ANALYSIS

5.1 Overview

In parallel to the analysis of A-CDM during normal operations, an analysis of system failures has also been undertaken as shown in Figure 2.1 “Failure Case”. For this generic analysis, the analysis has been focussed on loss and corruption of information flowing around the ACDM system. Clearly other failures could be envisaged, e.g. delay of data, data presented out of sequence etc. However, it is typical in a traditional analysis of system failures that by analysing loss and corruption and considering the worst credible effects of the failures, any potential safety impacts will be identified.

5.2 Outputs of Failure Analysis

Table 5.1 summarises the failures from Appendix I that could have a safety impact together with proposed mitigations that should be considered. It should be noted that there are likely to be local specific measures already in place that will act as mitigations for many of these failures. Thus local safety assessments are required to review these generic safety impacts and worst case credible effects. How these local safety assessments should be conducted is further discussed in Section 6.2.

The mitigations (F1 to F4) are procedural and related to equipment system requirements. In many cases high specification equipment system requirements may be unnecessary due to mitigators already built into the local system or due to the proposed procedural mitigations below. Local safety assessments can be used to determine what Software Assurance Levels (SWALs), etc. are appropriate.

5.3 Alarms Failure Case Results

The Failure Case analysis in Appendix I looked at the A-CDM alarms in terms of safety mitigations for certain failures in dataflows. Thus, if key alarms failed to go off the effect of this was considered. However, A-CDM also consists of other alarms that were not directly included in this initial analysis as they are not key safety mitigators. Thus the remaining alarms were also considered in an extra analysis (see Appendix II). Again the worst credible effects due to spurious operation (corruption) of these alarms were identified and documented. In all cases the worst case effects are minor workload increases for relevant partners shown in Appendix II. Thus, equipment system safety requirements will also need to be developed covering spurious operation of these alarms.

Table 5.1 Failure Case Analysis

Data Flow / Item	Failure	Worst Credible Effects	Mitigation	Mitigation Owner
Flight Plan Correlation Failure alarm	This alarm mitigates against various potential flight plan data corruption, e.g. incorrect aircraft type. Thus if it fails to alarm when required, errors may be missed.	Misidentification of aircraft type, for example, could lead to inappropriate stand allocation or wake turbulence spacing	F1a: Equipment system requirement	Equipment system designer
TOBT	Corrupted TOBT	Start-up based on corrupted TOBT requiring ATC to resolve downstream, workload increase	F1b: Equipment system requirement F2: Procedure for EOBT/ TOBT originators to review these data and correct if corrupted.	Equipment system designer Ground Handler / Airport Operator
EXOT	Corruption of EXOT	Departure outside CTOT tolerance, increasing ATC workload	F1c: Equipment system requirement	Equipment system designer
TTOT	Corruption of TTOT	Departure outside CTOT tolerance, increasing ATC workload	F1d: Equipment system requirement	Equipment system designer
Default Turn Around Time	Corruption of Default Turn Around Time	Sub-optimum sequencing, increasing ATC workload	F3: Ground handlers to update turn-around time on CDM system if system indicates deviation by more than +/- 15 mins.	Ground Handler

TSAT	Loss or corruption of TSAT	Potential for aircraft starting at incorrect times	F4: ATC to cross-check EOBT and CTOT information before issuing startup instructions based on TSAT.	ATC

6 LOCAL ASSESSMENT

The Failure Case analysis has identified a limited number of data flows/ items which could have a safety impact if failures should occur. Appropriate equipment system requirements and procedures should adequately mitigate their risk. Deciding on what exactly is appropriate will require local safety assessments as described below.

Figure 6.1 summarises how the local A-CDM failure analysis can make use of the generic analysis summarised in Section 5 above

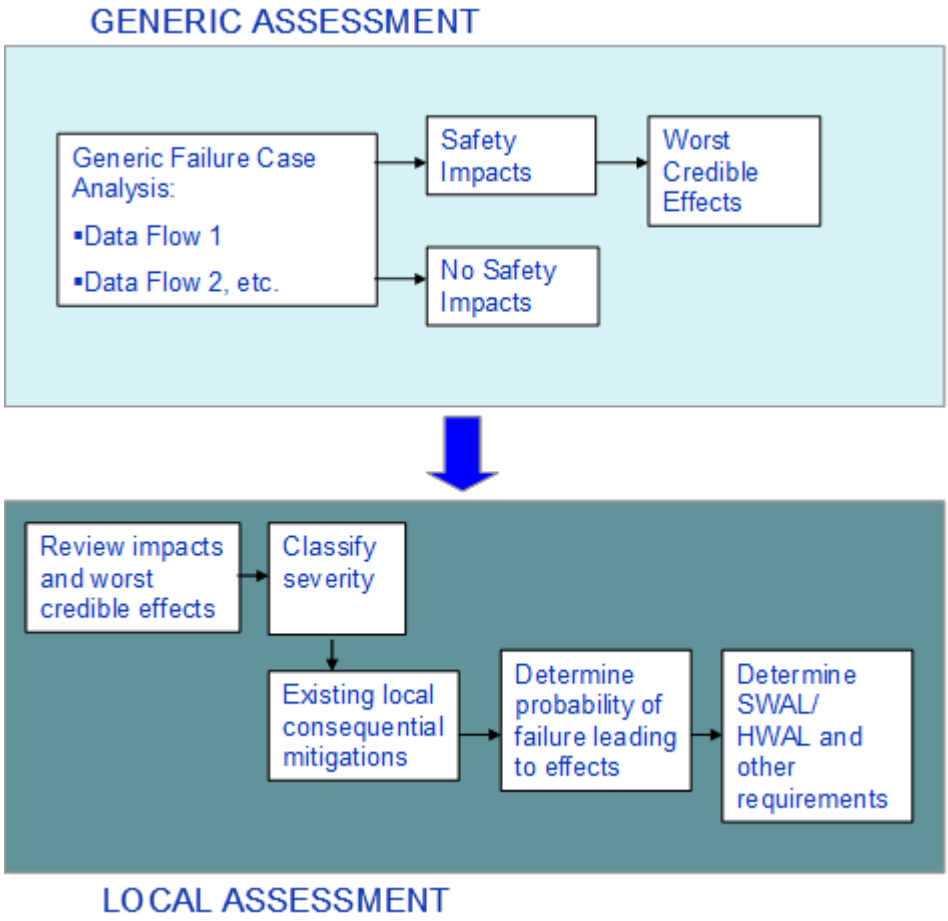

Figure 3 Generic and Local Failure Case Analysis

The generic analysis has made an initial identification of those data flows/ items which could have a safety impact if failure occurs. Based on this screening, the worst credible effects of safety related failures have also been identified.

It is proposed that local assessments build on this generic way in the following manner:

1. Review whether in the local situation under study, failures of each A-CDM data flow would indeed have safety impacts (see Annex I, sections 1-5, last column, for predicted safety impacts on each airport partner). If failures do have local safety impacts, review whether the worst credible effects from the generic study (Table 5.1) are appropriate.

2. For those failures with local safety impacts classify the severity of the effects. Severity classes and examples of effects corresponding to these classes are given in ESARR4 [5].

3. Identify, analyse and document all the mitigations that will reduce the probability of the failure leading to the worst credible effects (consequential mitigations). These mitigations could include, for example, ATC procedures, other systems for transferring and displaying information, training given to airport partners etc.

4. Taking account of all these mitigations and local airport factors (e.g. traffic density/ complexity) estimate the probability of the failure leading to the identified effects. The EUROCONTROL Safety Assessment Methodology [6] gives guidance about probability estimation in the context of SWAL allocation. The growth of future traffic needs to be considered in this process as the system needs to be safe throughout its intended life.

5. Use EUROCONTROL SAM guidance [6] or equivalent industry guidance to determine suitable equipment system safety requirements. For Software Assurance Levels (SWAL) the SAM shows a matrix of effect severity classes and the probability of a failure generating those effects to identify which SWAL is required.

The 5 step approach above is a simplified description of the Assurance Level allocation process; for a more detailed description EUROCONTROL's SAM [6] should be consulted.

7 VALIDATION AND VERIFICATION

The following verification activities have been conducted during this safety assessment:

• Review of Safety Plan describing safety assessment activities, carried out by EUROCONTROL's APR stakeholders and DAP/SSH (2 review cycles)

• Internal APR Progress meetings at which updates to the method were discussed and agreed with EUROCONTROL's APR stakeholders and DAP/SSH (28th February, 22nd June and 10th August 2006)

• External stakeholder meetings at which the method was presented and feedback received (16th June and 7th September 2006)

• Review of safety assessment document structure and of the draft safety assessment report by EUROCONTROL's APR stakeholders and DAP/SSH.

The following validation has also been carried out:

• Review of safety assessment outputs by internal and external stakeholders at 2 safety workshops, 16th June and 7th September 2006.

• Review by APR stakeholders of the outputs in Appendix I of this report (2 review cycles)

• Review of outputs by DAP/SSH at these workshops and through review of the draft safety assessment.

8 CONCLUSIONS

The three objectives set out in section 2.2 have been met, namely:

1. The operational differences between pre and post A-CDM operations have been defined for all partners and flight phases in Annex I.

2. The safety impacts of the operational differences for the Success Case and Failure Case have been assessed in Annex I and summarised in sections 3 and 4 above respectively.

3. For potential issues and concerns and new hazards, suitable mitigations have been defined in sections 4 and 5.

This generic safety assessment concludes that A-CDM will lead to no adverse safety impacts with the mitigations identified in this report.

A very limited number of potential issues and concerns have been identified. The Success Case issues would be adequately mitigated by practicable procedural and Safety Management System (SMS) recommendations which have been proposed. In particular clear definitions of roles and responsibilities are required to ensure that all relevant personnel understand how A-CDM information is to be used. The Failure Case issues are mostly adequately mitigated by practicable procedural recommendations. In addition, there may

be a need for some system equipment requirements (e.g. Software Assurance Level) for certain data items within A-CDM. An initial set of key data items has been identified in this generic study which local assessments would need to check to determine if system equipment requirements are needed, or whether failure effects are adequately mitigated by other means.

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Annex 1 - A-CDM SUCCESS AND FAILURE CASE RESULTS

The analysis presented in this appendix is based on a series of safety workshops and post-workshop analysis. The participants in this process are detailed in the Table below together with the organisation they were representing. Two main workshops were held with EUROCONTROL and external stakeholders and the participation in each is indicated below.

Name	Role / Organisation	External 1	External 2
Elizabeth Lagios	A-CDM Project Manager, EUROCONTROL	✓	✓
Zarko Sivcev**	CFMU Safety and Quality Manager, EUROCONTROL	✓	✓
Dave Hogg**	Airport CDM Project Expert, EUROCONTROL	✓	✓
Dave Booth*	Airport CDM Project Expert, EUROCONTROL	✓	✓
Marc Matthys**	Capacity, A-CDM and Punctuality, Belgocontrol	✓	✓
Luigi Locoge	ATCO, Belgocontrol	✓	
Albert Coenan	Air Traffic Flow Manager, SN Brussels Airlines	✓	✓
Christopher Machin	DAP/SSH, EUROCONTROL	✓	✓
Edward Smith*	DNV, Facilitator		✓
Roger Lee*	DNV, Recorder / Facilitator	✓	✓

* Main post-workshop analysis

** Main reviewers

Table 3 Reviewers of workshop and post-workshop analysis

The spreadsheet below details the outputs from the workshops and post-workshop analysis. Potential safety benefits of A-CDM are indicated by "+" and potential issues and concerns by "-". The analysis is presented for each of the following partners in turn: Ground Handler (green columns), Airport Operator (light blue columns), Aircraft Operator (orange columns), ATC (purple columns), and NMOC (blue columns). Finally the assessment and proposed mitigations are summarised. It should be noted that the explicit impact on pilots is not included. Clearly many of the impacts will also benefit pilot, e.g. reduced RT at start-up, but these have not been described explicitly for each milestone and flight phase.

1. Ground Handler

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	All Ground Handlers now have direct access to flight plan information	**In standard operations:** (+) Increased transparency on relevant changes (EOBT, Aircraft Type, Aircraft Reg) to flight plan (-) Interference from handling agent on ATC flight plan and hence probability of error occurrence increased. Mitigated by SLAs and procedures
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from NMOC to Flight Plan Filer and ATC (all concerned	Slot Allocation is fed into a centralised platform and then displayed to all partners.	All Ground Handlers get direct access to Slot Allocation	**In standard operations:** (+) No need to look for the Slot Allocation Message or ask other partners for

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
		ANSPs)		Information	messages. Workload reduction resulting in more time to verify other safety critical activities
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	Movement messages readily available	**In standard operations:** (+) No need to look for the MVT message or ask other partners for messages. Workload reduction resulting in more time to verify other safety critical activities
Flight Update Message (FUM) generated by NMOC	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	Enhanced landing estimate, coupled with variable taxi times will give more accurate In Block time	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	Direct access of the FIR Entry information translated into updated ETAs	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC.	All partners will be informed of start of final approach,	Direct access of the Start	**In standard operations:** (+) Better planning of

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
		Information of this phase of flight is not always provided to airport partners	more accurate estimates of next phases of flight	Approach information translated into updated ETAs	stand set-up, reduction of probability of aircraft hitting equipment
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	Direct access of the landing time information translated into updated In Block time	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	Using the variable taxi-times facility in CDM, more accurate In Block time will be available	**In standard operations:** (+) Better planning of stand set-up, reduction of probability of aircraft hitting equipment
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No change	No Change
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	Ground Handler to input AGHT into ACISP. Ground Handler may manually input update of TOBT	**In standard operations:** (+) If ground handling start is automatic at AIBT then Ground Handler's workload may be reduced. (-) If Ground Handler has

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
					to input ground handling start time manually workload may increase slightly
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	Submit TOBT to all partners	**In standard operations:** (-) Workload increased **In failure circumstances:** (-) Should the information displayed be corrupted, Ground Handler would be required to manually correct this on the ACIS system to avoid aircraft startup/takeoff outside CTOT tolerance, increase in workload
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	Visibility of TSAT information	**In standard operations:** (+) Better planning of resources and equipment reducing the risk of ground incidents
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	If a boarding alarm is raised the ground handler will be required to resolve the discrepancy	**In standard operations:** (-) Possible slight increase in workload

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	No change	No change
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	Ground handlers will have access to TSAT and this will enable them to plan their push back resources better	**In standard operations:** (+) Better planning of resources and equipment reducing the risk of ground incidents
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	No Change	No Change
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off,	Aircraft taxis to holding point. Default taxi time available to ATC and	With CDM variable taxi time calculations are used to give a more accurate	No change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm	NMOC	estimate of take off time		
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No change	No Change
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

2. Airport Operator

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	No Change
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from NMOC to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	Better visibility of slot information	**In standard operations:** (+) Airport operator workload may reduce as a result of better planning
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	Movement messages readily available	**In standard operations:** (+) No need to look for the MVT message or ask other partners for messages. Workload

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
					reduction resulting in more time to verify other safety critical activities
Flight Update Message (FUM) generated by NMOC	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	Enhanced landing estimate, coupled with variable taxi times will give more accurate In Block time	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	Direct access of the FIR Entry information translated into updated ETAs	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	Direct access of the Start Approach information translated into updated ETAs	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning,

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
					reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	Direct access of the landing Time information translated into updated In Block time	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	Using the variable taxi-times facility in CDM, more accurate In Block time will be available	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
		Accurate time not always available to all partners.	and remove manual input		
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	Airport Operator will have direct access to AGHT and any updates to TOBT	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	Visibility of TOBT information	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	Visibility of TSAT information	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Suspension Alarm, Flight De-Suspended Alarm				stressful situations & hence reducing mistakes being made
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Earlier warning of possible delay to departing flight.	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	**In standard operations:** (+) Stand & Gate planning may improve as the opportunity to tow aircraft off stand or utilise remote holding facilities increases due to advance display of aircraft status
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	Stand & gate management will know the precise time that an aircraft will leave the stand	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning,

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm				reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	Stand & gate management will know the precise time that an aircraft has left the stand	**In standard operations:** (+) Better planning can result in enhanced stand-gate planning, reduction in late stand changes, reduction in stressful situations & hence reducing mistakes being made
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm,	Aircraft taxis to holding point. Default taxi time available to ATC and NMOC	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	CTOT Compliance Alarm, Flight Suspension Alarm				
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No Change	No Change
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

3. Aircraft Operator

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	No Change
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from NMOC to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	No Change	No Change
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	Movement messages readily available	**In standard operations:** (+) No need to look for the MVT message or ask other partners for messages. Workload reduction resulting in more time to verify

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
					other safety critical activities
Flight Update Message (FUM) generated by NMOC	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	Enhanced landing estimate which coupled with variable taxi times will give more accurate In Block time	**In standard operations:** (+) Better aircraft and crew planning
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	Direct access of the FIR Entry information translated into updated ETAs	**In standard operations:** (+) Better aircraft and crew planning
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	Direct access of the Start Approach information translated into updated ETAs	**In standard operations:** (+) Better aircraft and crew planning
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	Direct access of the landing Time information translated into updated In Block time	**In standard operations:** (+) Better aircraft and crew planning
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work	ATC issue taxi-ing instructions, all partners might	All partners will have accurate in bound taxi times and In	Using the variable taxi-times facility in	**In standard operations:**

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	in Progress	not be disseminated with this information	Block times	CDM, more accurate In Block time will be available	(+) Better aircraft and crew planning
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	Remote AOCs will have access to ACISP	No Change
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	No Change	No Change
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	Submit TOBT to all partners	**In standard operations:** (-) Workload increased **In failure circumstances:** (-) Should the information displayed be corrupted, Airport Operator would be required to manually correct this on the ACIS system to avoid aircraft startup/takeoff

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
					outside CTOT tolerance, increase in workload
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	Visibility of TSAT information	**In standard operations:** Enhanced information but no foreseeable safety change
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Earlier warning of possible delay to departing flight.	No Change
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	No Change
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	No Change	No Change
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the	ATC issues start up approval at TSAT. The Actual Start up	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
		flight progress strip (paper or electronic)	Approval Time is input into the ACISP and disseminated to all partners		
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	Earlier notification of actual push back especially with non ACARS equipped aircraft	No Change
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm	Aircraft taxis to holding point. Default taxi time available to ATC and NMOC	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	Earlier indication of estimated take off time	No Change
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

4. ATC

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	**In failure circumstances:** (+) If credible corruption of flight plan modification message occurs, CDM correlation alarm will mitigate risk.
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from NMOC to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	Better visibility of slot information	**In standard operations:** (+) ATC workload may reduce as a result of better planning in stand and gate management by other partners.
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	No Significant Change	**In standard operations:** (+) Better co-ordination for Airport Partners resulting in better planning
Flight Update	EET, Capacity	Currently procedure	FUM with accurate ETO	No Significant	**In standard operations:**

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
Message (FUM) generated by NMOC	Information, Flow Management Attribute, Regulation Cancelled Alarm	does not exist for using FUM	and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	Change	(+) More information on when aircraft is active, reducing workload and RT.
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	No Change	No Change
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	No Change	No Change
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	No Change	No Change
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation,	ATC issue taxi-ing instructions, all partners might not be	All partners will have accurate in bound taxi times and In Block times	No Change	No change as assumed that separate ATC systems already display Stand and Gate Allocation and WIP

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Work in Progress	disseminated with this information			
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No Change	No Change
MST 8 - Ground handling starts	EOBT, TTOT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT and TTOT	EOBT information is displayed in ACIS and ATC displays simultaneously.	**In failure circumstances:** (-) Corrupted Default Turn Around Time can generate a corrupted EOBT, this is a safe but sub-optimum sequence which might need ATC to resolve therefore increasing ATC workload.
MST 9 - Final update of TOBT	TOBT, TTOT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	TOBT available	**In standard operations:** (+) More information on when aircraft is active, reducing workload and RT. **In failure circumstances:** (-) If TOBT is credibly corrupted, startup clearance could be based on corrupted TOBT information, requiring ATC to resolve downstream, workload increase
MST 10 - ATC issues TSAT	TSAT, TTOT, ETOT, EOBT	Dissemination of TSAT procedure currently	ATC provides all partners with TSAT information	No change - auto generated	**In standard operations:** (+) Improved planning of the taxi flow towards

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	does not exist			the runways enhances the traffic planning for runways in mixed mode operation (-) If DMAN is not present this might be performed manually hence more workload **In failure circumstances:** (-) Aircraft could be started at incorrect time if TSAT information is credibly corrupted (-) If TTOT is credibly corrupted on ACIS, ATC might instruct aircraft to takeoff outside CTOT tolerance time.
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Earlier warning of possible delay to departing flight which may result in revised TOBT	**In standard operations:** (+) Advance notification of possible delays (-) Possible slight increase in workload due to recalculation of TSAT
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	Using milestone process ATC have a better guarantee of aircraft readiness	**In standard operations:** (+) Potential reduction in R/T as aircraft should not declare readiness when they are not
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	Aircraft requests start up approval from ATC at TSAT	**In standard operations:** (+) Decrease in frequency congestion as pilot requests start up clearance at a specified time. Better planning and flow of taxi-ing aircraft both inbound and outbound especially in cul-de-sacs

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm				
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	EXOT, TTOT times are now available on ACIS display.	**In failure circumstances:** (-) Credibly corrupted EXOT might lead to credibly corrupted TTOT, causing aircraft to depart outside CTOT. ATC needs to resolve this, hence increasing workload
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	No change	No change as assumed that separate ATC systems already display Stand and Gate Allocation
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT	Aircraft taxis to holding point. Default taxi time available to ATC and NMOC	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	More accurate estimated take off times give better CTOT compliance	**In standard operations:** (+) Better CTOT compliance reduces the risk of en route sector overloads

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Compliance Alarm, Flight Suspension Alarm				
MST 16 - Take off	ATOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	No change	No change as assumed that separate ATC systems already display Runway in Use
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

5. NMOC

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	No Change	No Change
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from NMOC to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	No Change	No Change
MST 3 - Take off from outstation	Movement Messages (MVT), Airborne Alarm, EOBT	ACARS for some airlines, ICAO Movement message protocols	Aircraft Movement Information from ANSP or Ground Handler or Airlines or ACARS. Now information is available to all partners	No Change	No Change
Flight Update Message (FUM) generated by NMOC	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the	No Change in workload. Message will be issued automatically.	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
			airport and will be input into the ACIS.		
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	No Change	No Change
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	No Change	No Change
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	No Change	No Change
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	No Change	No Change
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	No Change	No Change
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-	Ground Handling event starts and time is recorded by Ground Handler but not generally	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	around alarm, EOBT Compliance Alarm	disseminated to other partners	trigger update of downstream events e.g. automatic update of TOBT		
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	NMOC will receive more accurate EOBT	**In standard operations:** (+) Better planning, more accurate information
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	NMOC gets EOBT AND ETOT update via DPI messages	**In standard operations:** (+) Better planning, more accurate information
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	Possible update of EOBT and ETOT via DPI message	No Change
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	No Change	No Change
MST 13 - Start up request	SID Allocation, Flight Suspension	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Alarm, Flight De-Suspended Alarm				
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all partners	No Change	No Change
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	No Change	No Change
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT Compliance Alarm, Flight Suspension Alarm	Aircraft taxis to holding point. Default taxi time available to ATC and NMOC	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	More accurate estimated take off times contribute to better monitoring of the CTOT compliance and, if necessary, trigger appropriate warning messages to ensure CTOT is adhered to.	**In standard operations:** (+) Better CTOT compliance reduces the risk of en route sector over-deliveries
MST 16 - Take off	TTOT, Runway in Use, Regulation	Actual take off from the runway. Time recorded by ATC or by	Actual Take Off Time recorded on ACISP either automatically	No Change	No Change

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Operational Impact	Safety Impact
	Cancelled Alarm	ACARS.	or manually and available to all partners.		
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	Improved recovery from Adverse conditions. Improved management during and after adverse event on a network basis and locally.	No consensus. Some experts thought that smoother operations during and after adverse event would have potential safety benefits. Others thought that current procedures should already be in place to ensure safety.

Success Case Safety Assessment Summary and Mitigations identified

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
MST 1 - Flight Plan Submission	Flight Plan, Aircraft registration and Aircraft ID, ADEP/ADES, Flight Plan Modification Message, Flight Plan Already Correlated Alarm, Flight Plan Correlation Failure Alarm	Flight Plans are submitted to IFPS from Flight Plan Filer	When there is an inconsistency between flight plan and airport slot, correlation alarm will be triggered. Information is fed into a centralised platform and then displayed to all partners	**Potential safety benefits:** 1. Increased Transparency in Flight Plan data 2. Correlation Alarms help to identify inconsistencies **Issues and concerns in Normal Operating Conditions:** 1. Probability of increase in Ground Handlers' unauthorised interference with flight plan data	**In standard operations:** 1. Service Level Agreements (SLAs) and agreed procedures with Ground Handlers on change access to Flight Plan Information are to be formalised. **In failure circumstances:** 1. Safety requirements on loss and corruption of Flight Plan Correlation Failure alarms to be generated
MST 2 - ATFM Slot Allocation	SAM, Regulation Cancelled Alarm	Slot Allocation information is distributed from NMOC to Flight Plan Filer and ATC (all concerned ANSPs)	Slot Allocation is fed into a centralised platform and then displayed to all partners.	**Potential safety benefits:** 1. Reduction of workload for Ground Handlers & Airport Operator due to advance availability of flight information 2. Reduction in ATC workload due to better planning in Stand and Gate management	
MST 3 - Take off from outstation	Movement Messages (MVT),	ACARS for some airlines, ICAO Movement	Aircraft Movement Information from ANSP or Ground	**Potential safety benefits:** 1. Reduction of workload for Ground Handlers, Airport Operator and Aircraft Operator due to	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
	Airborne Alarm, EOBT	message protocols	Handler or Airlines or ACARS. Now information is available to all partners	advance availability of flight information hence reducing probability of making errors 2. Better co-ordination for ATC with partners allowing better planning and smoother ops	
Flight Update Message (FUM) generated by NMOC	EET, Capacity Information, Flow Management Attribute, Regulation Cancelled Alarm	Currently procedure does not exist for using FUM	FUM with accurate ETO and ELDT, based on radar data, issued for all inbound flights. Differences of +/- 5 mins incurred en-route will generate new message. Message will be received by one partner on the airport and will be input into the ACIS.	**Potential safety benefits:** 1. Enhanced landing estimates coupled with variable taxi times provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload and hence reducing likelihood of mistakes and ground incidents 2. More accurate information on traffic loading to ATC reducing ATC workload and RT 3. Better aircraft and crew planning for aircraft operators.	
MST 4 - FIR Entry	Flight Plan Cancellation Alarm	Aircraft FIR entry is co-ordinated between ATCs. Information only available when partners request from ATC	All partners will be informed of FIR entry and more accurate arrival times	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators 3. More accurate indication of traffic loading for	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
				ATC **No Issues or concerns identified.**	
MST 5 - Final Approach	None Identified	Final approach phase is co-ordinated by ATC. Information of this phase of flight is not always provided to airport partners	All partners will be informed of start of final approach, more accurate estimates of next phases of flight	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators **No Issues or concerns identified.**	
MST - Landing	EIBT	ATC record landing time on Flight Progress Strip, all partners might not be disseminated with this information	All partners will have actual landing times	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft operators	
MST 6 - Taxi-in period	EIBT, Stand/Gate Allocation, Work in Progress	ATC issue taxi-ing instructions, all partners might not be disseminated with this information	All partners will have accurate in bound taxi times and In Block times	**Potential safety benefits:** 1. Enhanced availability of flight phase information provide better stand/gate planning for Ground Handlers and Airport Operators, reducing workload hence reducing likelihood of mistakes and incidents 2. Better aircraft and crew planning for aircraft	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
				operators	
MST 7 - In Block	EIBT	In Block time recorded manually, automated (docking systems), verbally by pilot or by ACARS. Accurate time not always available to all partners.	In Block time disseminated via ACISP to all partners. Long term using ASMGCS data will enhance accuracy and remove manual input	**No Potential safety benefits identified.**	
MST 8 - Ground handling starts	EOBT, Default Turn Around Time, Minimum Turn-around alarm, EOBT Compliance Alarm	Ground Handling event starts and time is recorded by Ground Handler but not generally disseminated to other partners	Actual Start of Ground Handling Time input into ACISP by Ground Handler and this may trigger update of downstream events e.g. automatic update of TOBT	**Potential safety benefits:** 1. Reduction of Ground Handler's workload if Ground Handling start time is automatically obtained 2. Better estimates on stand/gate vacation leading to reduced stress/workload and potential reduction in error made by Ground Handler/Airport operator. **Issues and concerns under normal operating conditions:** 1. Slight workload increase for Ground handler if need to input Ground Handling time manually	**In standard operations:** 1. Update Training and Resource Needs Analysis **In failure circumstances:** 1. Ground handlers to update turn-around time on CDM system if system indicates deviation by more than +/- 15 mins.

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
				Issues and concerns under failure conditions: 1. Corruption of default turn around time can lead to sub-optimum sequencing, increasing ATC workload.	
MST 9 - Final update of TOBT	TOBT, SRM, SLC, Regulation Cancelled Alarm, Minimum Turn-around alarm, EOBT Compliance Alarm	Submission of TOBT Procedure does not exist currently	Aircraft handlers or aircraft operator send update to all partners	**Potential safety benefits:** 1. Better estimates on stand/gate vacation leading to reduced stress/workload and reduction in error made by Airport operator. 2. Reduction of RT loading and workload for ATC 3. Allows better planning for NMOC **Issues and concerns under normal operating conditions:** 1. Slight workload increase for Ground Handlers and Airport Operator in inputting TOBT data and correcting corrupt data **Issues and concerns under failure conditions:** 1. If TOBT is credibly corrupted, startup clearance could be based on corrupted TOBT information, requiring ATC to resolve downstream, workload increase	**In standard operations:** 1. Update Training and Resource Needs Analysis **In failure circumstances:** 1a. EOBT/TOBT originators shall review the displayed EOBT/TOBT entry and correct if corrupted. 1b. Loss and Corruption Systems Requirement for TOBT to be generated
MST 10 - ATC issues TSAT	TSAT, ETOT, EOBT Compliance Alarm, Flight	Dissemination of TSAT procedure currently does not exist	ATC provides all partners with TSAT information	**Potential safety benefits:** 1. Better planning at push-back reducing stress, workload and errors made by Ground Handlers and Airport Operator	**In failure circumstances:** 1. ATC to cross-check EOBT and CTOT information before issuing

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
	Plan Cancellation Alarm, Flight Suspension Alarm, Flight De-Suspended Alarm			2. Improved planning of the taxi flow towards the runways enhances the traffic planning for runways in mixed mode operation **Issues and concerns under normal operating conditions:** 1. More workload for ATC if DMAN and AMAN are not present **Issues and concerns under failure conditions:** 1. Potential increase in ATC RT workload if TSAT is lost and potential for aircraft starting at incorrect times under corruption of TSAT 2. TTOT corruption has the potential to cause aircraft takeoff outside CTOT tolerance, increasing ATC workload	startup instructions based on TSAT. 2. Safety requirements for corruption of TTOT shall be generated.
MST 11 - Boarding starts	Minimum Turn-around alarm, Boarding Alarm, EOBT Compliance Alarm	In most cases boarding start time only known by ground handler	Disseminated to all partners by ACISP and any delays in boarding triggers an alarm for action as the TOBT/ TSAT may not be met.	**Potential safety benefits:** 1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. ATC has advance notice of possible delays enhancing planning **Issues and concerns in normal operating conditions:** 1. Possible slight increase workload for Ground Handler to resolve boarding alarms 2. Possible slight increase in workload due to recalculation of TSAT by ATC	**In standard operations:** 1&2. Update Training and Resource Needs Analysis

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
				No Issues or concerns in failure conditions identified	
MST 12 - Aircraft ready	Regulation Cancelled Alarm	If aircraft is ready well before CTOT, pilot will advise ATC and request a slot improvement	More automated indication of aircraft readiness via the milestone process and transparency in ACIS	**Potential safety benefits** : 1. Enhanced gate-planning for Airport Operator, potentially reducing errors 2. Potential reduction in RT loading for ATC **No issues or concerns identified.**	
MST 13 - Start up request	SID Allocation, Flight Suspension Alarm, Flight De-Suspended Alarm	Aircraft requests start up approval from ATC	Aircraft requests start up approval from ATC at TSAT	**Potential safety benefits:** 1. Better planning of resources and equipment for Ground Handlers, reducing risks of ground incidents 2. Better stand-gate planning for Airport Operator reducing errors made 3. Reduction of frequency congestion for ATC and pilots 4. Better planning and flow of taxi-ing aircraft both inbound and outbound especially in cul-de-sacs	
MST 14 - Start up approved	EXOT, Regulation Cancelled Alarm	ATC issues start up approval and records the time on the flight progress strip (paper or electronic)	ATC issues start up approval at TSAT. The Actual Start up Approval Time is input into the ACISP and disseminated to all	**No significant safety benefit has been identified** **Issues and concerns under failure conditions:** 1. Corruption of EXOT may lead to aircraft to depart outside CTOT, increasing workload for	**In failure circumstances:** 1. Safety requirements on loss and corruption of EXOT data

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
			partners	ATC.	
MST 15 - Off Block	Stand/Gate Allocation	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time not necessarily disseminated among all partners	Aircraft pushes back from or vacates the parking position. Time recorded by ACARS, automated docking guidance systems, ATC (e.g. ASMGCS) or manually. Time input into ACISP and disseminated among all partners	**Potential safety benefits :** 1. Better stand-gate planning for Airport Operator reducing errors made	
Taxi out/Departure	Runway and Taxiway conditions, RWY to be used for take off, Runway configuration, Aircraft Type, Regulation Cancelled Alarm, CTOT	Aircraft taxis to holding point. Default taxi time available to ATC and NMOC	With CDM variable taxi time calculations are used to give a more accurate estimate of take off time	**Potential safety benefits:** 1. Reduction of enroute sector overloads for ATC 2. Reduction of enroute sector over-deliveries for NMOC	

Flight Phases	Risk Bearing Data Items	Without CDM	With CDM	Summary	Mitigation Recommendation
	Compliance Alarm, Flight Suspension Alarm				
MST 16 - Take off	TTOT, Runway in Use, Regulation Cancelled Alarm	Actual take off from the runway. Time recorded by ATC or by ACARS.	Actual Take Off Time recorded on ACISP either automatically or manually and available to all partners.	**No significant potential safety benefits identified**	
For All Flight Phases in Adverse Conditions	No extra risk relevant items identified	Information on Adverse Conditions is obtained from traditional airport communications mechanisms	Improvement in transparency and timely provision of adverse conditions information	No consensus from experts concerning potential potential safety benefits.	

Annex 2 - A-CDM ALARMS SAFETY ASSESSMENT

Alarm	Flight Phase	Worst Credible Effects under failure condition	Proposed Mitigation
NMOC Error Alarm	Alarm has been removed from specification		
Flight Plan Correlation Failure Alarm	MST 1 - Flight Plan Submission	Possible minor workload increase for airline operator and ATC under corruption.	System Safety Requirement
Regulation Cancelled Alarm	• MST 2- **ATFM** Slot Allocation, • FUM generated by NMOC • MST 9 - Final updates of TOBT • MST 12 - Aircraft ready • MST 14 - Start-up approved • Departure • MST-16 Takeoff	Possible minor workload increase for ground handler, airport operator, airline operator and ATC under corruption.	System Safety Requirement
Airborne Alarm	MST 3 - Takeoff from outstation	Possible minor workload increase for ground handler, airport operator, airline operator and ATC under corruption.	System Safety Requirement
Minimum Turn-around Alarm	• MST 8 – Ground Handling Starts • MST 9 – Final Update of TOBT • MST 11- Boarding Starts	Possible minor workload increase for ground handler and airline operator under corruption.	System Safety Requirement
Boarding Alarm	MST 11 - Boarding Starts	Possible minor workload increase for ground handler, airline operator and airport operator under corruption.	System Safety Requirement

Alarm	Flight Phase	Worst Credible Effects under failure condition	Proposed Mitigation
EOBT Compliance Alarm	• MST 8 – Ground Handling Starts • MST 9 – Final Update of TOBT • MST 10- ATC Issues TSAT • MST 11- Boarding Starts	Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
TOBT Confirmation missing	To be removed from manual		
CTOT Compliance Alarm	Departure	Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
Flight Plan Already Correlated	MST 1 - Flight Plan Submission	Corruption: • Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
Flight Plan/Schedule Discrepancy Alarm	MST 1 - Flight Plan Submission	Possible minor workload increase for ground handle and airport operator under corruption.	System Safety Requirement
Flight Schedule Cancellation Alarm	Alarm deleted from the manual		
Flight Plan Cancellation Alarm	• MST 4 – FIR Entry • MST 10 – ATC issues TSAT	Possible minor workload increase for ground handler, airline operator, airport operator and ATC under corruption.	System Safety Requirement
Flight Suspension Alarm	• MST 10 – ATC issues TSAT • MST-13 Start-up Request • Departure	Possible minor workload increase for ground handler, airline operator, airport operator and ATC and NMOC under corruption	System Safety Requirement

Alarm	Flight Phase	Worst Credible Effects under failure condition	Proposed Mitigation
Flight De-Suspended Alarm	• MST 10 – ATC issues TSAT • MST-13 Start-up Request • Departure	Possible minor workload increase for ground handler, airline operator, airport operator and ATC and NMOC under corruption	System Safety Requirement

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9 REFERENCES

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10 ABBREVIATIONS

Abbreviations and acronyms used in this document are available in the EUROCONTROL Air Navigation Inter-site Acronym List (AIRIAL) which may be found here:

http://www.eurocontrol.int/airial/definitionListInit.do?skipLogon=true&glossaryUid=AIRIAL

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