EPISODE 3

Single European Sky Implementation support through Validation

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0 EXECUTIVE SUMMARY

The Environmental Assessment Validation Framework (Episode 3 D2.4.4-01) promotes the use of the EC Strategic Environmental Assessment (SEA) Approach (Directive 2001/42/EC) to assess the SES Concept.

The first two steps of the SEA consist of the "Screening and Scoping" of the proposed concept to determine whether an environmental assessment is necessary (screening) and to determine the issues to be included (scoping) in the further detailed impact assessment (SEA step 3).

This Episode 3 (EP3) document covers the above first two steps of the SEA, the screening and scoping, of the SES concept for proposed Operational Improvements (OIs), to identify those OI steps, which are of particular relevance for the environment and are expected to provide improvement with regards to the impact aviation causes.

Analysis of available SESAR documentation indicates that this document presents the first screening and scoping for Environment and Meteorology of the proposed SES concept.

The analysis was performed early 2008 with many aspects of the concept description not being very detailed. In consequence, this document should be understood as a starting point.

The screening and scoping has been applied to the four focus areas, e.g. Meteorology (MET), Noise, Local Air Quality (LAQ) and Global Emissions (GE).

The results are based on the analysis of the documentation on the Operational Improvements (OIs) available in the SESAR Concept of Operations and the Episode 3 ATM Process Model.

As a result, the report proposes per each above mentioned focus area a list containing the most 'promising' OIs steps for later, more detailed impact assessment.

This is important for the political decision making process at European level, since last would allow to relate the estimated environmental benefit against the required cost for implementation of the OI steps.

The following table has been produced exclusively for the summary section of this document. Preferably, the table shall not just simply be cut & paste elsewhere. The interested readers are invited to refer to the specific chapters to assure full understanding of this screening and scoping exercise.

The specific planning on impact assessment (SEA Step3) shall be based on the more detailed information available in the summary paragraphs of each focus area chapter.

		Environment			
OI Step		MET	NOISE	LAQ	GE
AOM-0203:	Cross-Border Operations Facilitated through Collaborative Airspace Planning with Neighbours		(x)		
AOM-0204:	Europe-wide Shared Use of Military training Area				x
AOM-0501:	Use of Free Routing for Flight in Cruise Inside FAB Above Level XXX				x
AOM-0502:	Use of Free Routing from ToC to ToD				x
AOM-0503:	Use of Free Routing from Terminal Area Operations-exit to Terminal Area Operations-entry				x
AOM-0601:	Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA Where Suitable				x

AOM-0602:	Enhanced Terminal Airspace with Curved/Segmented Approaches, Steep Approaches and RNAV Approaches where Suitable		x		x
AOM-0701:	Continuous descent approach (CDA)		x		x
AOM-0702:	Advanced Continuous descent approach (ACDA)		x		x
AOM-0703:	Continuous climb departure		x		
AOM-0704:	Tailored arrival		x		x
AOM-0705:	Advanced continuous climb departure		x		
AOM-0803:	Dynamically shaped sectors unconstrained by predetermined boundaries	x			
AO-0207:	Surface management integrated with DMAN and AMAN			x	
AO-0301:	Crosswind reduced separations for departures and arrivals	x			
AO-0302:	Time based separation for arrivals	x			
AO-0303:	Fixed reduced separations based on wake vortex prediction	x			
AO-0304:	Dynamic adjustment of separations based on real-time detection of wake vortex	x			
AO-0402:	Interlaced take-off and landing			x	
AO-0403:	Optimized dependent parallel operations		(x)	x	
AO-0501:	Improved operations in adverse conditions through airport CDM	x			
AO-0601:	Improved turn-round process through CDM	x			
AO-0602:	Collaborative pre-departure sequencing			x	
AO-0603:	Improved operations de-icing operation through CDM	x			
AO-0701:	Effective collaboration between ATM stakeholders supported by environmental management systems			x	
AO-0703:	Noise management to limit exposure to noise on the ground	x	x		
AO-0704:	Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance	x		x	
AUO-0203:	Shared Business/Mission Trajectory				x
AUO-0204:	Agreed RBT/Mission Trajectory through Collaborative Flight Planning				x
AUO-0304:	Initiating Optimal Trajectories through Cruise-Climb Techniques				x
AUO-0501:	Visual contact approaches when appropriate visual conditions prevail	x		x	
AUO-0502:	Enhanced visual separation on approach (ATSA-VSA)	x			
AUO-0504:	Self-adjustment of spacing depending on wake vortices	x	(x)		
AUO-0701:	Use of runway occupancy time (ROT) reduction techniques			x	
AUO-0702:	Brake to vacate (BTV) procedure			x	
AUO-0703:	Automated BTV using data link			x	
AUO-0801:	Environmental restrictions accommodated in the earliest		x		

	phase of flight planning				
AUO-0802:	Ground movement techniques to reduce gaseous emissions and noise disturbance		x	x	
AUO-0803:	Visual reduced noise footprint departure	x	x		
IS-0407:	Interoperability between AOC and Weather Information Systems	x			
IS-0501:	Use of Airborne Weather Data by Meteorological Service to Enhance Weather Forecast	x			
TS-0102:	Arrival management supporting TMA improvements (incl. CDA, P-RNAV)		(x)	x	
TS-0103:	Controlled time of arrival (CTA) through use of data link			x	
TS-0104:	Integration of SMAN constraint into AMAN			x	
TS-0106:	Multiple controlled times of over-fly (CTOs) through use of data link			x	
TS-0201:	Basic departure management (DMAN)	x	(x)	x	
TS-0202:	Departure management synchronised with pre-departure sequencing			x	
TS-0203:	Integration of surface management constraint into departure management			x	
TS-0301:	Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace	x	(x)	x	
TS-0303:	Arrival management into multiple airports			x	
TS-0304:	Integrated arrival/departure management in the context of airports with interferences (other local/regional operations)			x	
TS-0305:	Arrival management extended to the en route airspace			x	
TS-0306:	Optimized departure management in the queue management process			x	
DCB-0201:	Interactive network capacity planning			x	
CM-0501:	4D Contract for Equipped Aircraft with Extended Clearance PTC-4D				x

Table 1: Operational Improvements expected to reduce the environmental impact

x = influence

(x) = direct/indirect influence as enabler

1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

The SESAR 2020 Concept is expected to be environmentally efficient. Politic has defined the target level by expecting the concept to be able to reduce the environmental impact compared to 2005 by 10% on an ECAC wide base. To provide evidence that the concept is able to perform accordingly, it needs to be systematically assessed. The first step of such required verification is an initial review of the available concept description aiming to identify those concept elements, which are linked to environment. In a second step, the identified elements are put in the order of their potential to reduce the impact. These two steps are referenced as “Screening and Scoping” and are part of the Strategic Environmental Assessment (SEA) approach applied within Episode 3. This report documents the results of the environmental and meteorological screening and scoping of the SESAR 2020 concept within the scope of the Episode 3 project.

1.2 INTENDED AUDIENCE

This document is relevant to all stakeholders of EP3. It is specifically relevant to those involved in SESAR WP16.3 and any other SESAR concept validation project succeeding Episode 3, since it is expected that those will perform the detailed impact assessment of the OIs identified in this document. The use of the information provided by this document aims to avoid additional effort for those projects.

Information that similar work had already been undertaken by SESAR was not confirmed. No publicly available document on environmental screening and scoping of the SES concept could be identified at the SESAR portal.

The analysis was performed early 2008 with many aspects of the concept description not being very detailed and mainly relying on an very early version of the SESAR-EPISODE3 Information navigator(ATM process model v1.2). In consequence, this document should be understood as a starting point.

1.3 DOCUMENT STRUCTURE

This document is structured as follows:

- Section 0 contains the executive summary for this document;
- Section 1 introduces into the context, how the documents relates to it, provides background information and determines the scope of this deliverable;
- Section 2 provides information on the screening and scoping of the concept for OIs with meteorological relevance performed by Austrocontrol;
- Section 3 holds information on the screening and scoping of the concept for OIs with relevance to ‘Noise’. This section has been developed by INECO;
- Section 4 informs on the screening and scoping of the concept for OIs with relevance to ‘Local Air Quality’. It has been produced by NLR;
- Section 5 delivers the screening and scoping result for the focus area ‘Global Emissions’ and was worked out by SICTA;
- Section 6 contains the document references.

1.4 Background

Civil aviation contributes 2-3% of global carbon emissions. NO_x is emitted directly into atmospheric layers sensitive to it. Particle matter and organic compounds from aircraft exhaust impact on the local air quality in the neighbourhood of airports. An increasing number of European citizens are exposed to significant noise levels produced by air transport.

The International Panel for Climate Change (IPCC) urges all nations to act rapidly to avoid climate change, which otherwise could have dramatically consequences.

International commitments engage industry for significant reductions of their environmental impact. The Kyoto protocol requires CO_2 reductions compared to 1990 emissions of 8/12% by 2008/12; the last G8 Summit in Germany expects 20% CO_2 reduction for 2020.

At the same time, society asks for more mobility and consequently traffic forecast indicate significant increases of the demand in future.

The impact reductions, as defined as ACARE goals to be obtained in 2020 compared to the year 2000 through the Technology Domains developed in the Clean Sky JTI, are:

- 50% reduction of CO_2 emissions through drastic reduction of fuel consumption;
- 80% reduction of NO_x emissions;
- 50% reduction of external noise;
- A green design, manufacturing, maintenance and disposal product life cycle.

On top of the reductions provided by the technology domains, IPCC estimates a potential of about 12% for operational flight efficiency improvements in the current ATC/ATM system. SESAR requires a target of a 10% reduction to environmental impact per-flight.

Even if those goals are achieved, the reductions will be absorbed by the ongoing growth in aircraft movements. It seems likely therefore, that air transport will not be able to reduce its environmental impact whilst continuing to serving demand. This situation requires all stakeholders in the air transport system to demonstrate that the maximum is being done to reduce its environmental impact as much as possible, whilst serving demand.

This generates a necessity to perform a systematic and complete environmental impact assessment to programmes such as SESAR and EP3.

1.5 Glossary of Terms

Term	Definition
3D	3 dimensional
4D	4 dimensional
ACC	Air Traffic Control Centre
ACDA	Advanced Continuous Descent Approach
ADS-B	Automatic Dependant Surveillance – Broadcast
AFIS	Aerodrome Flight Information Service
AFUA	Advanced Flexible Use of Airspace

Term	Definition
AIM	Aeronautical Information Management
AIS	Aeronautical Information System
AIXM	Aeronautical Information Exchange Model (AIS Static part)
AMAN	Arrival MANager
AMXM	Airport Mapping Exchange Model
ANSP	Air Navigation Service Provider
ANXM	Airport Operations Information Exchange Model
AO	Aircraft Operations
AOC	AO Concept
AOM	Aircraft Operations Management
AoR	Area of Responsibility
APV	Approach Procedure with Vertical guidance
ASAS	Airborne Separation Assistance System
ASAS-S&M	ASAS Spacing and Merging
ASEP	Airborne Separation, including execution of separation against specified trajectories
ASM	Air Space Management
ASMGCS	Advanced airport Surface Movement Guidance and Control System
ASTERIX	Data format for ANSP data exchange between ATCC
ATC	Air Traffic Control
ATCC	ATC Centre
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSA	Air Traffic Situation Awareness
ATSA-ITP	ATSA – In-Trail Procedure
ATSA-VSA	ATSA – Visual Separation on Approach
ATSAW	Air Traffic Situational Awareness
ATSU	Air Traffic Service Unit
AUO	Airspace User Operation
BTV	Brake To Vacate
CCD	Continuous Climb Departure
CDA	Continuous Descent Approach
CDM	Collaborative Decision Making
CDM-A	CDM Airports
CFIT	Controlled Flight Into Terrain

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Term	Definition
CFMU	Central Flow Management Unit
CM	Constraint Management
CTA	Controlled Time of Arrival
CTO	Controlled Time of Over-fly
DCB	Demand and Capacity Balancing
DMAN	Departure MANagement
DMEAN	Dynamic Management of the European Airspace Network
EATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
ENXM	Environmental Information Exchange Model
ETA	Estimated Time of Arrival
FAB	Functional Airspace Bloc
FMP	Flow Management Position
FOIPS	Flight Object Interoperability Proposed Standard
FUA	Flexible Use of Airspace
GAT	General Air Traffic
GBAS	Ground Based (GNSS) Augmentation System
GNSS	Global Navigation Satellite System
HLO	High Level Objective
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IOC	Initial Operational Capability
IOP	Interoperability
IS	Industrial Support
LAQ	Local Air Quality
LoAs	Level of Acceptance(s)
LTO	(ICAO) Landing and Take-Off cycle
LVP	Low Visibility Procedure
METAR	Meteorological Aerodrome Report
MLS	Microwave Landing System
MTOT	Managed Take Off Time
NAP	Noise Abatement Procedure
NPA	Non Precision Approach
NOP	Network Operations Plan

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Term	Definition
NOTAM	Notice to AirMan
OAT	Operational Air Traffic (military)
OCE	Operational Concept Element
OFIS	Operational Flight Information System
OI	Operational Improvement
OPTIMAL	Optimised Procedures and Techniques for the Improvement of Approach and Landing (OPTIMAL)
OSED	Operational Services and Environment Definition
P-RNAV	Precision area navigation
PEN	Pan European Network
RBT	Reference Business Trajectory
RET	Rapid Exit Taxiways
RHP	Runway Holding Position
RNP	Required Navigational Performance
ROT	Runway Occupancy Time
RTA	Real Time of Arrival
RWY	Runway
SA	Situational Awareness
SBT	Shared Business Trajectory
SPM	Sustainability Performance Management
SID	Standard Instrument Departure
SII	Sourdine II
SES	Single European Sky
SESAR	SES ATM Research
SMAN	Surface MANager
STAR	Standard Arrival Route
SWIM	System Wide Information Management
SNOWTAM	SNOW NOTAM
TA	Tailored Arrival
TAM	Total Airport Management
TIXM	Terrain Information Exchange Model
TMA	Terminal Area
TMA	Terminal Control Area
TMA	Terminal Manoeuvring Area
TS	Traffic Synchronisation
TTA	Target Time of Arrival
TWR	Tower
UAC	Upper Air Space Control

Term	Definition
UDPP	User Driven Prioritization Process
VFR	Visual Flight Rules
Wrt	With reference to
WX	Weather
WXXM	Weather Information Exchange Model

2 METEOROLOGY – SCREENING OF THE OPERATIONAL CONCEPT

2.1 INTRODUCTION

The goal of this chapter is to provide a list with elements of the proposed concept and their interaction with and their dependency of meteorological phenomena.

The analysis is made at Operational Improvement Step level.

The issue analysis corresponds to the first step of SEA approach, the screening and scoping of a new concept.

The result is a list that summarizes those OI steps for which a meteorological interaction was identified.

This resulting list can be used in later stages of EP3 WP2.4.4 or assessment projects following EP3 to indicate which OI step should be investigated in more detail.

The descriptions of the OIs and OI steps in this document are taken from SESAR information document.

In total five different operational contexts are defined:

- Airport;
- En route;
- Information management;
- Network;
- TMA.

The OIs (L01-01 to L10-08); covering subject areas such as the optimization of climb and approach procedures, are further detailed in OI steps. Each OI step has a unique code (for example AOM-0701); these codes are used to refer to the different OI steps.

The screening and scoping for meteorological relevant OI steps as documented in this chapter has been performed using the following logic:

> An OI step is considered relevant from a meteorological point of view if improved forecast methods or similar would increase the effectiveness of an OI. Also, an OI step is considered meteorologically relevant, if the weather would directly influence the effectiveness or efficiency of an OI. An OI step that is used during adverse or severe weather conditions or is highly beneficial during such conditions but cannot be influenced by improved forecast methods, is considered “**not relevant**” in the context of this document.
>
> In other words, the criteria for relevance are the direct influence of meteorological information on the effectiveness or efficiency of an OI.

During the process all OIs have been investigated at OI step level, but only those of meteorological relevance are mentioned in this chapter to limit the size of the document.

To give a good indication of the effects of an OI step, not only the direct effects should be considered. Particularly the impact on capacity is discussed as capacity improvements may often be reduced by meteorological events.

The described effects of the different OI steps are based on assumptions and in most cases not on research results.

2.2 AIRPORT

2.2.1 Optimizing climb/descent

2.2.1.1 AOM-0701: Continuous descent approach (CDA)

Goal is that under specific circumstances (low traffic density), simple CDA is used at airport through adapted procedures (no need for further ground system automation).

Effect:

CDA is very difficult under adverse weather conditions and therefore primarily an OI during stable weather conditions. A CDA climatology for each airport would give estimates whether this OI step is of significant magnitude on a per airport basis.

2.2.1.2 AOM-0702: Advanced Continuous descent approach (ACDA)

This improvement involves the progressive implementation of harmonized procedures for CDAs in higher density traffic. Continuous descent approaches are optimized for each airport arrival procedure. New controller tools and 3D trajectory management enable aircraft to fly, as far as possible, their individual optimum descent profile (the definition of a common and higher transition altitude would be an advantage).

Effect:

If this OI step is implemented, more aircraft can fly CDAs, but still CDA is very difficult under adverse weather conditions and therefore primarily an OI during stable weather conditions. A CDA climatology for each airport would give estimates whether this OI step is of significant magnitude on a per airport basis.

2.2.1.3 AOM-0703: Continuous climb departure (CCD)

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. When traffic permits, continuous climb departure is used to reduce noise by a higher altitude trajectory around the airport. Fuel consumption is reduced by flying optimized profile (no vertical containment required).

Effect:

Similar to CDA OI steps, CCD is more difficult in adverse weather conditions or in certain circumstances even impossible. Beside low traffic density it is more efficient in stable weather conditions as well. Hence, the importance from a meteorological perspective is present, but assumed to be low.

To estimate the magnitude of this OI step, a CCD climatology per airport is needed.

2.2.1.4 AOM-0704: Tailored arrival

This procedure is a kind of Continuous Descent Approach (CDA) in which descent is made mostly on idle power. The objective is to minimise fuel consumption (operating cost) as well as noise emission. In an operating environment with low traffic volume these optimized approaches can easily be made (as already done at several airports worldwide, especially during night time) but in case of high traffic volume the concept has still to be proven.

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Effect:

Similar to AOM-0703, Tailored Arrival can be more difficult in certain adverse weather conditions. Beside low traffic density it is more efficient in stable weather conditions as well. Hence, the influence from a meteorological perspective is present, but assumed to be low.

To estimate the magnitude of this OI step, a CCD climatology per airport is needed.

2.2.1.5 *AOM-0705: Advanced continuous climb departure*

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. The goal is to use continuous climb departure in higher density traffic. This should be enabled by system support to trajectory management.

Effect:

Similar to AOM-0703, Advanced CCD is very difficult under adverse weather conditions and therefore primarily a promising OI step for stable weather conditions. Beside low traffic density, it is more efficient in stable weather conditions as well. Hence, the importance from a meteorological perspective is present, but assumed to be low.

To estimate the magnitude of this OI step, a CCD climatology per airport is needed.

2.2.2 Increasing flexibility of airspace configuration

En route capacity OI steps may especially be influenced by weather events.

2.2.2.1 *AOM-0801: Flexible Sectorisation Management*

Sector configuration management is improved as a function of airspace management (Network Operations Plan) to ensure balance between demand and capacity at European network level through more effective resource utilisation, improved flexibility in staff rostering, adaptation and synchronisation of opening schemes across centres, and more generally speaking through harmonisation of working practices.

Improved agreements with the ATCOs, better working practices and planning tools lead in some cases to significant reductions of delays without any additional investments. Best practices need to be expanded at European network level in order to make available the latent capacity that still exists in some parts of Europe.

Effect:

No meteorological interaction.

2.2.2.2 *AOM-0802: Modular Sectorisation Adapted to Variations in Traffic Flows*

Airspace is apportioned to small elementary sectors or modules. Modules are grouped in control sectors according to grouping principles and pre-defined sectorisation scenarios adapted to the main traffic flows predicted for each day of operation. The appropriate sectorisation scenario is activated based on the assessment of the predicted traffic demand and probably large-scale adverse weather conditions like cold fronts.

The optimisation of the sectorisation is achieved not only by collapsing/de-collapsing control sectors, but also by modification of the number and types of modules building a control sector. This approach to sector configuration management provides an optimised resources

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management and should contribute to deliver the capacity needed to meet variations and increases in traffic demand, as well as early accommodation of user preferred routing.

Effect:

Low meteorological interaction in cases where the sectorisation scenario must take into account adverse weather conditions on a large scale.

2.2.2.3 AOM-0803: Dynamically Shaped Sectors Unconstrained By Predetermined Boundaries

ATC sectors shape and volumes are adapted in real-time to respond to dynamic changes in traffic patterns and/or short term changes in users' intentions.

Dynamic Sectorisation offers additional options in situations where the usual structure is reduced and typical patterns do not work, the objective being to handle not only recurrent traffic but also unpredictable changes in traffic demand (e.g. due to sudden weather problems, system outages).

Effect:

This OI step is designed to increase flexibility, for instance to handle sudden changes in available capacity due to unpredicted weather changes etc. Sectorisation will have to take into account meteorological conditions. Therefore the meteorological impact on this OI step is assumed to be medium to high.

2.2.2.4 AOM-0804: Dynamic Management of Terminal Airspace

Benefits may be gained by dynamic adjustment of airspace boundaries of terminal airspace in order to respond in real time to changing situations in traffic patterns and/or runway(s) in use.

TMA configuration will have to be adapted dynamically in order to cope with allocated (2D, 3D) arrival/departure routes which may change depending on traffic complexity. Refer to SESAR Concept of Operation v10 - section F9.2 [5] .

Effect:

Higher adaptability to sudden changes in weather conditions and related changes in capacity. Adjustment of airspace boundaries must take into account weather conditions, e.g. thunderstorms. Meteorological influence is assumed to be medium.

2.2.2.5 CM-0102: Automated Support for Dynamic Sectorisation and Dynamic Constraint Management

This improvement relates to the dynamic management of airspace/route structure. The system provides support for decision making based on pre-defined sector sizing and constraint management in order to pre-deconflict traffic and optimise use of controller work force.

Complexity in very busy airspace may be so high that it will not be possible to manage it with conventional ATC means; managing controllers' workload becomes crucial. One way of doing it is through this operational improvement:

- dynamic resizing and change of sector's shape and volume contributes to equal distribution of workload throughout sectors in one centre/FAB and it could be done only through automated systems which continuously evaluate traffic complexity in the future and propose optimum sectorisation solutions;

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- present measures to reduce complexity are mainly based on static constraints, which "defend" sectors from very complex situations, as the information on the trajectories (TP) certainty improves, it will be possible to remove this static system of constraints and replace it with dynamic constraint management supported by automation. This will provide possibilities for the users to fly as close as possible to their "business trajectories".

Effect:

Higher adaptability to sudden changes in weather conditions and related changes in capacity. Sectorisation will have to take into account meteorological conditions. Therefore the meteorological impact on this OI step is assumed to be medium.

2.2.2.6 *SDM-0201: Remotely Provided Aerodrome Control Service*

Tower control service is delivered, where applicable, from an ATC facility elsewhere than at an affected airport. Air traffic controllers in this facility use information collected from remote tower sensor systems to perform real-time tower operations.

Enhanced ATC service can be offered to places not normally eligible for ATC, e.g. rural or smaller airports presently using only AFIS or nothing at all. Services will be easier and more cost-effective to provide, regardless of time and place.

Effect:

No meteorological interaction.

2.2.2.7 *SDM-0202: Transfer of area of responsibility for trajectory management*

Improved interoperability allows areas of responsibility to be transferred between ATSUs according to demand identified through the publication of the RBT.

Current procedures where LoAs between adjacent ATSUs allow controllers to work outside of their own AoR are extended through improved interoperability to make the procedure more dynamic and flexible.

Effect:

No meteorological interaction.

2.2.2.8 *SDM-0203: Generic' (non-geographical) controller validations*

Advanced automation support allows controllers to hold more generic validations (e.g. validation according to airspace type and tool-set) rather than validations for specific (geographic) sectors.

Generic validations will allow greater flexibility to match ANSP resources to predicted demand.

Effect:

No meteorological interaction.

2.2.3 Management/revision of reference business trajectory (RBT)

The management/revision of RBT OI contains four OI steps, two of these have an impact on airport level (AUO-0302 and AUO-0303), while both others (AUO-0301 and AUO-0304) only have an impact on the en route segment.

2.2.3.1 AUO-0301: Voice Controller-Pilot Communications (En Route) Complemented by Data Link

Voice communications are complemented (not replaced) by services allowing flight crews and controllers to conduct operational exchanges through data link. Data com are intended for use in non-time critical situations and may be applied instead of or in combination with voice communications.

The use of data communication will reduce communication errors, thus contributing to higher safety levels. Voice communications have a number of drawbacks in today's busy traffic environment.

Effect:

No meteorological interaction.

2.2.3.2 AUO-0302: Successive authorisation of reference business/mission trajectory (RBT) segments using data link

Pilot's requests to controller for start-up, push back, taxi, take-off clearances, etc. will be transmitted by data link.

Effect:

No meteorological interaction.

2.2.3.3 AUO-0303: Revision of business/mission trajectory (RBT) using data link

The pilot will automatically be notified by data link of trajectory change proposals (route including taxi route, altitude, time and associated performance requirements as needed) resulting from ATM constraints arising from, for example, ad hoc airspace restrictions or closing of a runway. ATM constraints may also be expressed in terms of requests such as RTA in support of AMAN operation or runway exit in support of BTV operation. On the other hand, the controller is notified by data link of aircraft preferences in terms of STAR, ETA, min/max ETA, runway exit, etc.

Effect:

No meteorological interaction.

2.2.3.4 AUO-0304: Initiating Optimal Trajectories through Cruise-Climb Techniques

An optimal thrust setting is selected for the climb and the aircraft climbs as weight is decreased though fuel burn.

Aircraft fly their individual optimum trajectories to the maximum extent possible, minimising fuel burn.

Effect:

Meteorological conditions determine whether this OI step can be executed or not, otherwise no meteorological interaction.

2.2.4 Departure traffic synchronisation

2.2.4.1 TS-0201: Basic departure management (DMAN)

Runway capacity is considered as a principal constraint in today's air traffic control system. Several problems exist with regard to optimising departure sequences. Uncertainties of pushback, start-up and taxi times limit the capability of aerodrome control to achieve their preferred sequence. Several actors can influence the sequence of the departures, with each actor seeking to apply local and individual optimisation resulting in a potential for under utilisation of the runway.

Goal is to develop a system that determines the optimum runway for departure (if appropriate) and the optimum order for the departure sequence taking into account departure times, slot constraints, runway constraints such as departure rate, wake vortex separation, distance in trail, etc.

Effect:

Capacity relevant weather conditions such as crosswinds, surface conditions, wake turbulence are a main constraint to runway capacity. The importance of meteorological issues for this OI step is assumed to be high.

2.2.4.2 TS-0202: Departure management synchronised with pre-departure sequencing

The collaborative pre-departure sequence is used by ATC while sequencing departing aircraft as and when feasible.

This OI step is related to AMAN-DMAN integration, wake vortex detection, trajectory de-confliction, airport resource management, runway throughput, 3D/4D precision trajectories and 4D-contract.

Effect:

This OI step will have a positive effect on the departure management and should lead to better predictable departure traffic. Capacity relevant weather conditions such as crosswinds, surface conditions, wake turbulence are a main constraint to runway capacity. The importance of meteorological issues for this OI step is assumed to be medium.

2.2.4.3 TS-0203: Integration of surface management constraint into departure management

To improve the effectiveness of DMAN including the optimization of ground movement traffic in order to reduce the additional constraint of the airport surface capacity. This should lead to a more stable departure sequence thanks to a better awareness of traffic situation on ground.

Effect:

This OI step will have a positive effect on the efficiency, since the OI step is expected to reduce the queuing time and hence increase capacity. Capacity relevant weather conditions such as ice, snow, fog, crosswinds, surface conditions, wake turbulence are a main constraint to surface capacity, including runway, taxiways, apron and gates. The importance of meteorological issues for this OI step is assumed to be medium.

2.2.4.4 TS-0302: Departure management from multiple airports

While basic departure management considers only the distribution of initial departure routes, there is a need for the consideration of the departure traffic flows into the en-route environment and interactions with other traffic flows. The system should provide support to departure metering and coordination of traffic flows from multiple airports to enable a constant delivery into the en-route phase of flight.

Effect:

This OI step will focus on the coordination of departure management at different airports. Meteorological influence on this OI step will therefore be only indirect via the departure management at a specific airport.

2.2.4.5 TS-0306: Optimized departure management in the queue management process

The take-off sequence is built as predicted take-off times achieve a required level of accuracy. The precise point at which take-off times are known with sufficient accuracy will depend on the accuracy and reliability of the data available on the status of the turn-round process. Initially the required level of accuracy may not be achieved until the aircraft has requested push-back. It is however expected that during the SESAR time-frame the improving view on the status of the turn-round process will enable valid departure sequences to be built earlier. This earlier sequencing will enhance departure and arrival queue management collaboration. With knowledge of the target time of arrival (if applicable), the elapsed time derived from the trajectory, the departure and arrival demand for the runway(s) and the dependent departure route demand from adjacent airports, the system (DMAN) calculates the optimum take-off time and the surface manager will determine the associated start-up and push-back times and taxi route.

Effect:

Very limited and indirect interaction with meteorological issues.

2.2.5 Managing interactions between departure and arrival traffic

2.2.5.1 TS-0301: Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace.

Enabling complementary and optimised spacing of arrivals and departures, minimising airborne delays and also minimising departure queuing. The system provides assistance to the controller to manage mixed mode runway operations, and identify and resolve complex interacting traffic flows.

Effect:

This OI step is expected to reduce the queuing time and hence increase capacity. Capacity relevant weather conditions such as crosswinds, surface conditions, wake turbulence are a main constraint to runway capacity. The importance of meteorological issues for this OI step is assumed to be high.

2.2.5.2 *TS-0304: Integrated arrival/departure management in the context of airports with interferences (other local/regional operations)*

The effectiveness of AMAN-DMAN will improve by including the operations of close airports with interferences. Integration of AMAN and DMAN with the CDM processes between airports with interferences.

Effect:

This OI step is expected to reduce the queuing time and hence increase capacity. Capacity relevant weather conditions such as crosswinds, surface conditions, wake turbulence are a main constraint to runway capacity. The importance of meteorological issues for this OI step is assumed to be medium.

2.2.6 Airborne situational awareness

The airborne situational awareness consists of three OIs, of which one has an impact on the airport level (AUO-0401), while both others (AUO-0402 and AUO-0503) have an impact on the en route and TMA segment.

2.2.6.1 *AUO-0401: Air Traffic Situational Awareness (ATSAW) on the Airport Surface*

Information regarding the surrounding traffic (incl. both aircraft and airport vehicles) during taxi and runway operations is displayed in the cockpit. The electronic flight bag is extended with a moving map and other traffic (aircraft+vehicles) information.

The objectives are to improve safety (e.g. at taxiways crossings, before entering an active runway, before take-off, etc) and to reduce taxi time in particular during low visibility conditions, e.g. fog, heavy snow-rain fall and by night.

Effect:

No meteorological interaction. Of course ATSAW is beneficial during adverse weather conditions. However, improved forecast technologies do not influence ATSAW itself.

2.2.6.2 *AUO-0402: Air Traffic Situational Awareness (ATSAW) during Flight Operations*

Surrounding traffic position is displayed in the cockpit.

The objective is to provide the flight crews with an "enhanced traffic situational awareness" irrespective of visual conditions, in order to improve safety of flight and efficiency of air traffic control. In all airspace, the flight crews will be better able to detect an unsafe situation.

Effect:

No meteorological interaction.

2.2.6.3 *AUO-0503: In-trail Procedure in Oceanic Airspace (ATSA-ITP)*

Procedure applicable in non-radar oceanic environment permitting a 'climb-through' or 'descend-through' manoeuvre to pass a 'blocking' aircraft, using a distance-based longitudinal separation minimum with the blocking aircraft during the ITP manoeuvre.

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

The objective is to enable aircraft that desire flight level changes in oceanic and remote airspace to achieve these changes on a more frequent basis, thus improving flight efficiency and safety. ATSA-ITP is a step to ASEP-ITP. ASEP-ITP will come later as the system requirements are expected to go beyond what is currently available.

Effect:

No meteorological interaction.

2.2.7 ASAS Spacing and ASAS Cooperative Separation

These OI step does not interact with meteorological issues.

2.2.8 Self-separation

Self separation OI consists of two OI steps (AUO-0504 and CM-0704).

2.2.8.1 AUO-0504: Self-Adjustment of Spacing Depending on Wake Vortices

The spacing is adjusted dynamically by the pilot based on the actual strength of the vortex of the predecessor. This implies that aircraft can determine the wake vortex characteristic they generate and broadcast this information to neighbouring aircraft.

Minimum separation will lead to maximum capacity. Furthermore, making the vortices detectable to pilots adds a further layer of protection.

Effect:

Increased knowledge of wake vortices and their life span is required, in particular their dependencies on meteorological influences. Thus high a meteorological relevance of this OI step is given.

2.2.8.2 CM-0704: Self-Separation in Mixed Mode

The self-separation is extended to all airspace to allow mixed-mode of separation. This self-separation mode needs the authorization of the controller.

The objective of mixed mode of operation is to avoid segregation of flights according to aircraft capabilities in order to facilitate the transition to new mode of operation/separation and to facilitate access to all users (segregation may be unavoidable for other performance objectives). This means that the ground will have to provide the required service to less capable users according to their capabilities without penalising the others. The transition to this objective is a research issue.

Effect:

No meteorological interaction.

2.2.9 Safety Nets Improvements (TMA, En Route)

These OI steps have not interaction with meteorology.

2.2.10 Improving safety of operations on the airport surface

Most of the OI steps that fall under the improvement of the safety of operations on the airport surface only contribute to the safety. This holds for AO-0101, AO-0102, AO-0104, AO-0202 and AUO-0605. The two remaining OI steps have also an impact on respectively efficiency and capacity.

2.2.10.1 AO-0101: Reduced Risk of Runway Incursions through Improved Procedures and Best Practices on the Ground

ECAC airports and aircraft operators develop procedures and apply recommendations contained in the European Action Plan for the prevention of runway incursions (e.g. compliance of infrastructure with ICAO provisions, best practices on flight deck procedures for runway crossing, while taxiing; assessment for pilots regarding aerodrome signage, markings and lighting.).

Refer to European Action Plan for the Prevention of Runway Incursions [7].

Effect:

Limited effect of meteorological conditions, e.g. precautions for low visibility.

2.2.10.2 AO-0102: Automated Alerting of Controller in Case of Runway Incursion or Intrusion into Restricted Areas

The system detects conflicts and infringements of some ATC rules involving aircraft or vehicles on runways, and provides the controller with appropriate alerts. Whereas the detection of conflicts identifies a possibility of a collision between aircraft and/or vehicles, the detection of infringements focuses on dangerous situations because one or more mobiles infringed ATC rules. This improvement addresses also incursions by an aircraft into an area where the presence of an aircraft (or vehicle) is temporarily restricted or forbidden (e.g. closed taxiway, ILS or MLS critical area).

Provision of a safety net for runway operations, capable of detecting and preventing most dangerous hazards resulting from deviations or errors.

Effect:

No meteorological interaction.

2.2.10.3 AO-0103: Improved runway-taxi lay-out, signage and markings to prevent runway incursions

Improvements in lay-out of taxiway system as well as location of runways with respect to the terminal/apron, including better placed runway crossings, use of additional perimeter taxiways, avoiding alignment of the main taxiways with entries or exits, use of perpendicular intersections. Include also enhanced signage and markings and use of red stop bars.

Effect:

No meteorological interaction.

2.2.10.4 AO-0104: Airport Safety Nets including Taxiway and Apron

The systems detect potential conflicts/incursions involving mobiles (and stationary traffic) on runways, taxiways and in the apron/stand/gate area. The alarms are provided to controllers, pilots, and vehicle drivers together with potential resolution advisories (depending on the complexity of resolution possibilities). The systems also alert the controller in case of unauthorized / unidentified traffic.

Current automated alerting system is limited to the runway and is based upon a set of rules that assist controllers in detecting the most serious conflicts. This system has no knowledge of aircraft intent and in some cases the time window to determine and communicate a solution may be very limited.

Effect:

No meteorological interaction.

2.2.10.5 AO-0201: Enhanced ground controller situational awareness in all weather conditions.

The improvement of this service lies in expediting the arrival and departure flows on the runway system and the movement of taxiing aircraft and other vehicles on the manoeuvring area, while reducing the potential for loss of separation, i.e. ground traffic throughput improvements (all vehicles with two-way communication means, e.g. aircraft, including towed a/c, and service vehicles).

Effect:

No meteorological interaction. Of course this OI step is beneficial during adverse or severe weather conditions. Improved forecast methods will however not influence the service itself.

2.2.11 Improving traffic management on the airport surface

2.2.11.1 AO-0203: Guidance assistance to airport vehicle driver

Information regarding the surrounding traffic (incl. Both aircraft and airport vehicles) during taxi and runway operations is displayed in the vehicle driver's cockpit.

Effect:

No meteorological interaction. Of course Airport Vehicle Driver's Traffic Situational Awareness is beneficial during adverse weather conditions. However, improved forecast technologies do not influence the service itself.

2.2.11.2 AO-0205: Automated assistance to controller for surface movement planning and routing

This improvement is applicable to airports with a complex layout; the system provides the controller with the best route calculated by minimizing the delay according to planning, ground rules, and potential conflicts with other mobiles. The system informs the ground controller of any deviation from route/plan it has detected.

Effect:

No meteorological interaction. Of course surface movement planning and routing has to take into account weather-induced difficulties like snow removal. However, improved forecast technologies do not influence the service itself.

2.2.11.3 AO-0206: Enhanced guidance assistance to airport vehicle driver combined with routing

The system displays dynamic traffic context information including status of runways and taxiways, obstacles, and an airport moving map.

Effect:

Relevant in particular in adverse meteorological conditions, e.g. low visibility, but no meteorological interaction with respect to impact on the OI step.

2.2.11.4 AO-0207: Surface management integrated with DMAN and AMAN

To improve the aerodrome throughput, AMAN and DMAN need to be considered as a combined entity, itself closely linked to SMAN especially at airports with runways used for both arriving and departing flights. The taxiing process is considered as an integral part of the process chain from arrival to departure and AMAN/DMAN is integrated with CDM processes between airport operator, aircraft operators and air traffic service provider at the same airport.

Effect:

Capacity relevant weather conditions such as crosswinds, surface conditions, wake turbulence are a main constraint to airport capacity and thus have direct influence on DMAN and AMAN. The importance of meteorological issues for this OI is assumed to be medium, because the sequencing is primarily influenced by performance and routing decisions as well as aircraft operator's demands. Meteorological considerations, e.g. wrt to wake turbulence, will only be secondary optimisation criteria.

2.2.11.5 AUO-0602: Guidance Assistance to Aircraft on the Airport Surface

The system provides the pilot with an airport moving map showing taxiways, runways, fixed obstacles and own aircraft position.

Effect:

No meteorological interaction.

2.2.11.6 AUO-0603: Enhanced guidance assistance to aircraft on the airport surface combined with routing.

The system displays dynamic traffic context information including status of runways and taxiways, obstacles, route to runway or stand. Ground signs (stop bars, centreline lights, etc.) are triggered automatically according to the route issued by ATC.

Effect:

No meteorological interaction. Of course enhanced guidance assistance is beneficial during adverse weather conditions. However, improved forecast technologies do not influence the service itself.

2.2.11.7 AUO-0604: Improving airport collaboration in the pre-departure phase

Flight crew will be supported by advanced tools for ground operations. The use of advanced aircraft automated systems such as e.g. auto-brake (making it impossible for an aircraft to cross a lit stop bar) and auto-taxi (optimizing speed adjustment).

Effect:

Only very limited meteorological interactions, e.g. auto taxi must take into account movement area surface conditions.

2.2.12 Improved operations in adverse conditions through airport CDM

Systematic strategies are agreed and applied by CDM partners to deal with predictable (e.g. forecasted adverse weather, industrial action, scheduled maintenance) or unpredictable adverse conditions (e.g. unforeseen snow or fog, accident). This involves effective methods of exchanging appropriate information on the expected or actual arrival of such conditions, special procedures, and system support to facilitate the sequencing of operations where needed (e.g. de-icing). It is important to notice that these measures will effect only one fourth of the operational time on average since they only apply in conditions that do not occur regularly for most airports. Nevertheless on specific airports, where adverse weather conditions are prevalent for extensive amounts of a year, the effect must not be underestimated.

2.2.12.1 AO-0501: Improved operations in adverse conditions through airport CDM

In contrast with today's ad hoc solutions to unforeseen disruptions, prompt decision making, flexibility and adaptability of partners are facilitated during periods of reduced capacity, allowing for a faster recovery to normal operations. Systematic strategies are agreed and applied by CDM partners to deal with predictable (e.g. forecast bad weather, industrial action, scheduled maintenance) or unpredictable adverse conditions (e.g. unforeseen snow or fog, accident). This involves effective methods of exchanging appropriate information on the expected or actual arrival of such conditions, special procedures, and system support to facilitate the sequencing of operations where needed (e.g. de-icing).

Effect:

This OI step focuses on mitigating capacity loss due to adverse weather conditions. High interaction with meteorological issues as airport operation is strongly influenced by weather conditions, in particular adverse conditions such as turbulence, icing, thunderstorms etc.

2.2.12.2 AO-0601: Improved turn-round process through CDM

In the existing environment, there is often no visible link established between the airborne and ground segments of flights, known and shared by all partners. This results in changes in one segment not being communicated to all the partners and hence they are unable to anticipate the impact and take appropriate measures to re-plan resources and necessary activities. This results in poor data quality and predictability especially for departing aircraft. A set of milestones in the turn-round process are established at airport and flight progress is monitored against those milestones. The information is shared by all involved partners, not only at the airport concerned but also in other relevant units such as the CFMU and destination airport. The completion of a milestone triggers decision making processes for downstream events. Shared information on the progress of turn-round will be used to estimate departure demand and enable arrival/departure balancing.

Effect:

High meteorological interaction as the turn-around process may be influenced by meteorological factors such as thunderstorms or icing.

2.2.12.3 AO-0602: Collaborative pre-departure sequencing

The objective is to enable flights to leave their stands in the optimum order based on the operational situation. The pre-departure sequence refers here only to the organization of flights from the stand/parking position. Pre-departure sequences are established collaboratively with the airport CDM partners concerned taking into account agreed principles to be applied for specified reasons (e.g. slot compliance, airline preferences, night curfew, evacuation of stand/gate for arriving aircraft, etc.).

The resulting pre-departure list is used by ATC while sequencing departing aircraft, as and when feasible. In contrast to the other OIs described in this paragraph, this OI will not only be beneficial in adverse conditions.

Effect:

No meteorological interaction.

2.2.12.4 AO-0603: Improved operations de-icing operation through CDM

De-icing stations are managed through CDM procedures enabling airport and ANSP to know the flights to de-ice and establish sequences accordingly.

Effect:

High meteorological interaction as the meteorological conditions forecasted directly influence de-icing operations.

2.2.12.5 DCB-0304: Airport CDM extended to Regional Airports

Airport CDM is extended to include interconnected regional airports. Relevant CDM-A airports at regional level and the Central Flow Management Unit exchange information, especially in support of improving the estimated time of arrival for all flights bound to the region.

Extending CDM comes in complement to local CDM implementations in the improvement of arrival times' predictability, enhances the network benefit and improves the flow management process.

Effect:

No meteorological interaction.

2.2.12.6 AO-0402: Interlaced take-off and landing.

The goal of this OI step is to provide mitigation for the inherent delays/queuing associated with capacity constrained airports and to gain a significant capacity enhancement without impacting the overall queue management concepts. Instead of segregated use of multiple runways, interlaced take-off and landing procedures can be envisaged.

Effect:

The main effect of this OI is an increase in capacity, which can lead to a reduction in queuing time if the number of take-offs and landings per day does not increase. Primarily feasible in stable meteorological conditions, therefore medium influence.

2.2.12.7 AO-0403: Optimized dependent parallel operations

Dependencies between multiple runways determine the practical runway capacity which, in most cases, is lower than the combined single runway capacities. Capacity gains can be achieved by increased utilization of the combined runways. Reducing dependencies between runways by implementing more accurate surveillance techniques and controller tools as well as advanced procedures, will enlarge the capabilities of existing runway configurations (like closely spaced parallel runways).

Effect:

This OI step leads to an increase in capacity. Capacity relevant weather conditions such as crosswinds, surface conditions, wake turbulence are a main constraint to runway capacity. The importance of meteorological issues for this OI step is thus assumed to be medium.

2.2.12.8 AUO-0701: Use of runway occupancy time (ROT) reduction techniques

Evidence suggests that there is a measurable difference in the efficiency of both pilots and airlines in the use of runways. Saving just one second on every movement could result in one slot gain every two hours, so it is in the interests of all parties to ensure that vital seconds are not lost. The main flight operations elements that affect the ROT include not only braking distance or runway/taxiway design but also pilot's awareness of ROT requirements, pilot's reaction times to line-up/departure clearances, pre-departure actions, etc. This improvement addresses enhancements to operating practices of airlines and pilots in that respect.

Effect:

Evidence from studies at major, capacity critical airports has demonstrated that enhanced awareness amongst the pilot community improves the way that they are able to operate and can produce significant enhancements in runway capacity. Meteorological issues that influence runway surface conditions (e.g. temperature, precipitation etc.) influence the applicability of this OI step. Thus the meteorological interaction is medium.

2.2.12.9 AUO-0702: Brake to vacate (BTV) procedure

Brake to vacate at a pre-selected runway exit coordinated with ground ATC by voice.

Effect:

Since this OI step leads to an increase in capacity, the queuing time will be reduced. Meteorological issues that influence runway surface conditions (e.g. temperature, precipitation etc.) influence the applicability of this OI step. Thus the meteorological interaction is medium.

2.2.12.10 AUO-0703: Automated BTV using datalink

Landing aircraft can make optimal use of existing exits (runway exit taxiways or other) by adapting their braking techniques. During blue sky situations the pilot can adapt its braking as he can see the exit from quite a distance. During low visibility conditions this will become more difficult and longer ROTs will occur. Assisting the pilot in optimal braking techniques will result in lower ROTs and thus increasing capacity. Automated braking to vacate at a pre-selected runway exit coordinated with ground ATC through data link, and based on BTV avionics that controls the deceleration of the aircraft to a fixed speed at the selected exit.

Effect:

This OI step improves AUO-0702 and leads to a further increase in capacity. Meteorological issues that influence runway surface conditions (e.g. temperature, precipitation etc.) influence the applicability of this OI step. Thus the meteorological interaction is medium.

2.2.13 Maximising runway throughput

The main effect the OIs described in this paragraph will be an increased runway capacity for landing aircraft, but if less time is needed for landing aircraft, this time can also be used to increase the number of departing aircraft, which in turn will lead to less ground queuing.

2.2.13.1 AO-0301: Crosswind reduced separations for departures and arrivals

The objective is to reduce dependency on wake vortex operations, which under suitable weather conditions, will lead to reduced arrival / departure intervals, with a positive effect on delays and runway throughput. Under certain crosswind conditions it may not be necessary to apply wake vortex minima.

Effect:

High meteorological interaction: Weather conditions such as crosswind strongly influence this OI step. Further research on the influence of meteorological factors such as humidity, temperature distribution etc. is needed.

2.2.13.2 AO-0302: Time based separation for arrivals

The intent is to mitigate the effect of wind on final approach sequencing so as to achieve accurate and more consistent final approach spacing and recover most of the capacity lost under strong headwind. Constant time separations independent of crosswind conditions and wake vortex existence are introduced. Time based separation is an option to replace the distance criteria currently used to separate trailing aircraft on the approach beyond the wake vortex of the leading aircraft.

Effect:

The goal this OI step is to reduce the time between landing aircraft under windy conditions, thereby increasing the capacity. High meteorological interaction as wind conditions determine the applicability of this OI step.

2.2.13.3 AO-0303: Fixed reduced separations based on wake vortex prediction

Separation standards are too conservative for a variety of meteorological situations. The use of a statistical model that gives wake-vortex behaviour with fixed aircraft separations (e.g.

from collection of all relevant combinations of wake vortex behaviours in meteorological situations) could be an intermediate step towards individual wake-vortex forecasting. In the applicable situations, the controller uses reduced aircraft separations derived from forecasted wake vortex behaviour.

Effect:

High meteorological interaction: Weather conditions strongly influence this OI step. Further research on the lifespan of wake vortices and on the influence of meteorological factors such as humidity, temperature distribution etc. is needed.

2.2.13.4 AO-0304: Dynamic adjustment of separations based on real-time detection of wake vortex

The controller optimizes aircraft separations by taking the actual wake-vortices strength into account.

Effect:

Wake vortex as meteorological interaction. Increased knowledge of wake vortices and their life span as well as further research on the influence of meteorological factors such as humidity, temperature distribution etc. is needed. The meteorological interaction is high.

2.2.13.5 AO-0305: Additional rapid exit taxiways (RET) and entries

In some cases, where for example backtracking after landing is required or new aircraft types at an airport cannot use existing high-speed exits, infrastructure improvements may be needed. Appropriate runway exits are provided for the aircraft mix using the runway. The ROT as well as the predictability is based on the number of exits, the design/shape of the exit, the location with respect to the landing threshold as well as pilot/airline behaviour policy. Finding a well accepted balance between number, shape and location is necessary. Multiple runway entries and a wide holding area can help to optimize the sequencing process for departing aircraft and can generate significant operational benefits during periods of traffic congestion.

Effect:

No meteorological interaction.

2.2.14 Improving operations under adverse conditions including low visibility

2.2.14.1 AO-0502: Improved operations in low visibility conditions through enhanced ATC procedures

Operations in poor weather are responsible for considerable delays within Europe. There are differences in the ways low visibility procedures (LVP) are applied, and in the procedures used. This gives the potential for considerable short term benefits from the collaborative development and implementation of procedures (e.g. best practices). LVP are collaboratively developed and are implemented at applicable airports involving in particular a harmonized application across airports and the use of optimized separation criteria.

Effect:

The capacity will increase during low visibility conditions due to standardized procedures. Medium interaction, as the development of the procedures must take into account meteorological influences.

2.2.14.2 AO-0503: Reduced ILS sensitive and critical areas

ILS tuning will increase runway capacity during limiting visibility conditions (landing aircraft will free the runway earlier). This seems even more important with the introduction of new large aircraft and their effect on the ILS when taxing near/parallel to the landing runway. Smaller ILS sensitive and critical areas in CAT II/III are created through changes in the ILS antenna and ILS interception procedures (due to smaller angle of localizer beam).

Effect:

No meteorological interaction.

2.2.14.3 AO-0504: Improved low visibility runway operations using MLS

Accurate and sustainable landing systems are necessary for reliable airport operations during all weather operations. MLS (in the short term) is less vulnerable to disruptions/interferences.

Effect:

No meteorological interaction.

2.2.14.4 AO-0505: Improved low visibility runway operations using GNSS/GBAS

The main benefit of using GNSS or GBAS is the increased runway capacity in poor weather conditions as the glide path and azimuth signals will face hardly any interference from previous landing aircraft or other obstacles.

Effect:

Airport restrictions (low visibility procedures / low visibility operations) caused by ILS sensitive and critical areas will be reduced and may even disappear. This offers the potential to perform CAT II and III approaches without the additional low visibility margins between aircraft. This will allow maintaining approach capacity independently of visual conditions. Of course this OI step is beneficial during adverse or severe weather conditions. Nevertheless it is considered to have no meteorological interaction since improved forecast methods will not influence the service itself.

2.2.14.5 AUO-0403: Enhanced Vision for the Pilot in Low Visibility Conditions

Out the window positional awareness is improved through the application of visual enhancement technologies thereby reducing the difficulties of transition from instrument to visual flight operations.

Enabling in a transparent way the transition from IFR (head in) to visual flight operations (out the window).

Effect:

No meteorological interaction.

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

2.2.14.6 AUO-0404: Synthetic vision for the pilot in low visibility conditions

The system in the cockpit provides the pilot with a synthetic/graphical view of the environment using terrain imagery and position/attitude information.

Effect:

Of course this OI step is of high relevance during adverse or severe weather conditions. Nevertheless it is considered to have no meteorological interaction since improved forecast methods will not influence the service itself.

2.2.15 Visual conducted approaches

2.2.15.1 AUO-0501: Visual contact approaches when appropriate visual conditions prevail

A significant benefit in declared capacity can only be achieved at airports with a low probability of instrument meteorological conditions (IMC) and LVP. Visual contact approaches are applied instead of IFR operations when appropriate visual conditions prevail. The legally approval of this type of VFR procedure for IFR traffic in Europe is a prerequisite.

Effect:

High interaction; weather conditions must allow VFR operation for duration of the approach. Short-term forecasts with high quality required.

2.2.15.2 AUO-0502: Enhanced visual separation on approach (ATSA-VSA)

The objective is to facilitate successive approaches for aircraft cleared to maintain visual separation from another aircraft on the approach. However, applicability within core European airspace appears to be very limited and for airports that do not currently use visual separation on approach, there is unlikely to be a case to introduce Enhanced Visual Separation. The application (ATSA-VSA) helps crew to achieve the visual acquisition of the preceding aircraft and then to maintain visual separation from this aircraft.

Effect:

High interaction; weather conditions must allow visual separation operation for duration of the approach. Short-term forecasts with high quality required.

2.2.16 Implementing sustainable operations at airports

2.2.16.1 AO-0701: Effective collaboration between ATM stakeholders supported by environmental management systems

The goal is to manage the operation and onward development of an airport in such a way as to effectively curb the facility's impact on the environment. The airport companies have therefore to introduce a modern, long-term environmental management system. This management system creates the foundations for a comprehensive and all-encompassing approach to environmental policy. ATM operational stakeholders adopt a sustainability policy supported by appropriate environmental management system to facilitate standard setting, monitoring and continuous improvement. Sharing best practices between airports, ATC, local airlines is a first step.

Effect:

No meteorological interaction.

2.2.16.2 AO-0702: Improved relations to neighbours

ATM stakeholders have to improve their understanding of the existing and emerging perceptions, and needs and expectations of society, especially in terms of the management of adverse socio-environmental impacts. A better understanding by the local community of the real disturbance is achieved through provision of more accurate and accessible information (noise, tracks, air emission, etc.) as well as through improvements in decision-making, consultation process and impact management (better transparency towards community). A commonly agreed development path for the airport and the surrounding communities is achieved (incl. e.g. noise protection zones, noise protection programs).

Effect:

Besides the likely influence weather conditions may have on noise propagation and emission dispersion (LAQ), there are no meteorological issues present.

2.2.16.3 AO-0703: Noise management to limit exposure to noise on the ground

This improvement involves the application of a range of noise reducing measures including:

- Night noise management regimes with restrictions during night (e.g. noise preferential use of runways);
- Implementation of noise quotas (e.g. noise quota for the airport, per runway heading, at several points around the airport) and noise account for each airline;
- Noise limitations on the ground (e.g. engine test forbidden at night, no reverse thrust).

Effect:

Weather conditions have a likely effect on noise propagation, therefore the meteorological interaction is high.

2.2.16.4 AO-0704: Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance

The airport taxiway design and the associated procedures are optimized in such a way as to reduce the queue and taxiing (dual taxi routes separating inbound and outbound traffic, new taxiways and RET, preferential runway use, standard routing, etc.). The associated procedures for this infra-structure are developed considering reductions to air pollution and noise disturbance levels of aircraft.

Effect:

Weather conditions have a likely effect on noise propagation and emission dispersion, therefore the meteorological interaction is high.

2.2.16.5 AO-0705: Reduced water pollution

De-icing stations are created where the fluids, spoiled on the apron, can be collected and treated. Furthermore, technical solutions for the bio-degradation of de-icing fluids are implemented. Application techniques are developed in collaboration with airlines to improve the anti-icing treatment on aircraft at the stands so that the amount of glycol released in the storm water can be reduced.

Effect:

AO-0705 leads to reduced water pollution, but has no meteorological issues present.

2.2.16.6 AO-0706: (Local) monitoring of environmental performance

The environmental performance (compliance to operational procedures, key performance indicators) of ATM stakeholders at the airport is recorded and monitored in support of continuous improvement process. In particular, it is possible to determine the amount of airport related versus external pollution. This improvement involves use of noise monitoring system, flight tracking and air quality monitoring system.

Effect:

No meteorological interaction.

2.2.16.7 AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

4D-Trajectory management is not only about the business intention of the aircraft operator. Environmental sustainability restrictions have to be taken into account. Environmental sustainability restrictions are becoming more and more a significant restriction for the execution and planning of the business trajectories of aircraft operators. It is in the interest of all ATM-stakeholders (aircraft operators and airports) to take into account the (most often local) environmental restrictions in the early phase of flight planning.

Effect:

No meteorological interaction.

2.2.16.8 AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

Time management techniques and aircraft movement technologies are developed which reduce both fuel consumption and noise by taxiing aircraft (e.g. taxiing with not all engines operating) or towing the aircraft to/from the runway with all engines off. The use of electric (instead of hydro-carbon powered) auxiliary power units and ground handling vehicles further reduces the noise and particulate pollution around parked aircraft.

Effect:

No meteorological interaction.

2.2.16.9 AUO-0803: Visual reduced noise footprint departure

The objective is to maintain the necessary safety of flight operations whilst minimizing exposure to noise on the ground. Continuous improvements in engine and airfoil design provides Aircraft operators have to be pro-active in the development of operating techniques which take advantage of technological improvements to shrink the noise footprint on departure. The improvement comes through better rates of climb, reductions in required thrust percentage, quieter engines coupled with better SID route planning and altitude usage. Airspace users work with ATM to develop noise abatement procedures.

Effect:

Weather conditions have a likely effect on noise propagation, therefore the meteorological interaction is high.

2.3 INFORMATION MANAGEMENT

2.3.1 Improving flight data consistency and interoperability

2.3.1.1 *DCB-0301: Improved consistency between airport slots, flight plans and air traffic flow management (ATFM) slots*

The objective is to ensure realistic scheduling to meet airline demands in line with capacity declarations. Benefits will be found in slot adherence, delay reduction and ultimately cost efficiency. Goal is to ensure convergence between airport slots, ATFM slots together with airport slot monitoring process in order to improve consistency on a daily basis and to reduce delays.

Effect:

No meteorological interaction.

2.3.1.2 *DCB-0302: Collaborative management of flight updates*

The objective is to enhance tactical capacity planning for the entire ATM network by ensuring completeness of information between en route and airport operations. Airports need to be seen as being a part of the whole ATM system in a gate-to-gate environment. As the tactical manager of the total network load, ATFCM has to collaborate with air traffic control, aircraft operators, and airport in a genuine partnership.

The goal of this OI step is that the interface between airports and ATFCM is reinforced at the tactical level in order to improve predictability of operations through exchanges of accurate departure and arrival times, CFMU providing airports with arrival estimates up to 3 hours prior landing (taking account of updated information on flight progress) whilst airports provide CFMU with flight data updates before take-off.

Effect:

Meteorological risks may influence departure and arrival times, but for this OI step this is an indirect issues as it emphasizes on information exchange.

2.3.1.3 *IS-0101: Improved flight plan consistency pre-departure*

Reprocessing and effective dissemination of flight plan amendments before estimated off block times together with defined responsibilities will ensure one single flight plan before departure supporting accurate and updated flight data for airspace users, airports and ATM. All partners should be able to access this data to calculate local profiles. The process will be sufficiently flexible to allow aircraft operators to take advantage of airspace improvements or changed circumstances. Goal is to assure that airspace users, airport and ATM have a consistent view of the filed flight plan including late updates until departure.

Effect:

Meteorological risks may influence departure and arrival times and operators will take into account meteorological conditions, but for this OI step this is an indirect issues as it emphasizes on information exchange.

2.3.1.4 IS-0102: Improved management of flight plan after departure

The process will provide an effective interface between ATC, ATFCM, and Airport with regard to deviations from the current flight plan. The goal of this OI is that the ATFCM is aware of deviations from flight plan incl. Route changes, diverting flights, missing flight plans, change of flight rules (IFR/VFR) or flight type (GAT/OAT). This enables a better assessment of the impact of airspace changes on aircraft while in flight, an improved monitoring of actual traffic situation and, if necessary, the triggering of revisions to the network and airports operations plan.

Effect:

Meteorological risks may influence departure and arrival times, but for this OI step this is an indirect issues as it emphasizes on information exchange.

2.3.2 Improving aeronautical and weather information provision

2.3.2.1 IS-0201: Integrated Pre-Flight Briefing

The data required during the pre-flight phase are provided and presented in an integrated and flexible manner. The user can access various/information sources such as AIS, ARO, MET and ATFM which provide NOTAM, SNOWTAM, MET messages, FPL and related messages or network management messages.

This is about integrating all information relevant to a flight (including any Network Management constraints in force, e.g. level capping) into one package.

Effect:

Meteorological influence only in so far as the MET information is part of the briefing and the perceived quality of a briefing thus depends also on the quality of the meteorological information.

2.3.2.2 IS-0401: Automatic Terminal Information Service Provision through Use of Data link

Compiled ATIS information specifically relevant to the departure, approach and landing phases of flight (such as runway in use, current weather, airport and facility conditions) is transmitted to the aircrew by data link. ATIS messages (synthesised voice) can be generated fully automatically or at the controller's request.

Effect:

Meteorological influence only in so far as the MET information is part of the ATIS.

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2.3.2.3 IS-0402: Extended Operational Terminal Information Service Provision Using Data link

Current meteorological and operational flight information derived from ATIS, METAR and NOTAMs/SNOWTAMs, specifically relevant to the departure, approach and landing flight phases is transmitted to pilots by data link. The flight crew has real-time access to the relevant airport operational parameters applicable to the most critical phases of flight (ATIS, METAR and OFIS).

The main objective is to provide pilots with easy access to the widest possible range of information to support the decision making process whilst reducing cockpit workload and enhancing safety.

Effect:

Meteorological influence only in so far as the MET information is part of the ATIS.

2.3.3 From AIS to AIM

2.3.3.1 IS-0202: Improved Supply Chain for Aeronautical Data through Common Quality Measures

Common data quality measures are implemented with a view to improving the end-to-end integrity of aeronautical data throughout the data chain, encompassing all actors involved from origination through to publication, and potentially up to the end user of Aeronautical Information.

The availability, consistency and integrity of aeronautical data are crucial in the transition from ground based radio-NAV to R-NAV/RNP/GNSS waypoint Nav. The objective is to support regulators and service providers in implementing controlled, traceable and auditable processes ensuring compliance with ICAO Annex 15 requirements. The scope is flight critical and essential navigational data.

Effect:

No meteorological interaction.

IS-0203 and IS-0204 have no meteorological interaction.

2.3.4 Implementing system wide information management (SWIM)

This OI includes all aspects of creating, sharing, obtaining, providing, protecting and using information. Includes all aspects related to operations that continue to be airspace based (e.g. military).

2.3.4.1 IS-0701: SWIM – baseline and initial common information model based on existing and consistent standards.

An initial common information model covers the existing information models such as AIXM (AIS static part), WXXM (weather information), AMXM (airport mapping), FOIPS (flight information), and ASTERIX (Surveillance Information). It also addresses the information models for demand & capacity and ATFCM scenario. It ensures the overall consistency

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between all these models. It also looks for an agreement on the data quality requirements for the different partners and different data types/elements. This OI step forms a commonly agreed initial model baseline but the model will continuously evolve from the IOC date onwards (e.g. to complement it with the dynamic aeronautical information, ENXM, Terrain data, aircraft information, etc ...). It does not mean that further OI steps need to be defined after that one which is just provided to show a pre-requisite on which SWIM will be implemented.

Effect:

Meteorological influence only in so far as the MET information is part of SWIM.

2.3.4.2 IS-0702: SWIM – European ground communication infrastructure

In order to implement SWIM services and move from a product centric to a data centric approach, SWIM will have to be supported by a Communication network on top of which some basic services provided through an IOP middleware will have to be made available and integrated within each EATMS system having a role & responsibility (at least one of the main ones identified during D3: User, Contributor, Publisher). The communication network can be made available through interconnected national networks first, then through the Pan-European Network (PEN).

Effect:

No meteorological interactions.

2.3.4.3 IS-0704: SWIM – ground-ground limited services

This represents the first implementation of some SWIM services between at least two area control centres to exchange flight data information. In order to ensure the efficiency of the information exchanges also the necessary meteo and aeronautical information needs to be shared. It is envisaged also that Surveillance information will start to be shared through dedicated SWIM services.

Effect:

Meteorological influence only in so far as the MET information is part of SWIM.

IS-0703, IS-0705 and IS-0710 also have no meteorological issues present.

2.3.5 Weather information for ATM planning and execution

2.3.5.1 IS-0406: Aircraft Dissemination of Information on Weather Hazards to Other Aircraft

Significant weather events captured by onboard system such as wake vortices or severe turbulence are broadcast to other airspace users.

The objective is to inform other airborne users of significant conditions, e.g. wake turbulence, icing, etc. which may be of safety concern to individual aircraft or multiple aircraft, e.g. increased vertical separation.

Effect:

Primarily an air-air communication issue, no direct meteorological interaction.

2.3.5.2 *IS-0407: Interoperability between AOC and Weather Information Systems*

Use by meteorological service of airborne-derived weather information as available from AOC in order to improve weather forecast.

Effect:

Important meteorological issue; significant improvement of weather forecast can be expected.

2.3.5.3 *IS-0501: Use of Airborne Weather Data by Meteorological Service to Enhance Weather Forecast*

Specified weather data are captured by airborne aircraft and down linked to the meteorological service in support of forecasting, significant weather reporting and data collection. (This may be "contract" or "event" driven).

The objective is the provision of meteorological products which are more informed and accurate.

Effect:

Important meteorological issue; significant improvement of weather forecast can be expected.

2.4 NETWORK

2.4.1 Enhanced Seasonal NOP Elaboration

2.4.1.1 *DCB-0101: Enhanced Seasonal NOP Elaboration*

The contents of Summer and Winter versions of the NOP - consolidating the existing information on traffic demand and capacity plans - are improved using feedback from previous season. Stakeholders contribute more efficiently to the elaboration of the NOP and updates are integrated more dynamically.

Effect:

No meteorological interaction.

2.4.1.2 *DCB-0102: Interactive Rolling NOP*

The Network Operation Plan provides an overview of the ATFCM situation from strategic planning to real time operations (accessible from 6 months to the day of operation) with ever increasing accuracy up to and including the day of operations. The data is accessible online by stakeholders for consultation and update as and when needed, subject to access and security controls. The elements and formats of the NOP will be established taking into account the requirements of the users of these plans. It will be possible for them to access and extract data for selected areas to support their operation and, if required, to create their specific operations plan. The NOP will also be updated taking into account the actual traffic situation and real time flow and capacity management.

A validated consistent information relating to the intentions and decisions of stakeholders has to be available and widely shared in relation to the use and management of European airspace from strategic planning through to archiving data post flight. For example: military demand for route and airspace, implemented ATFCM scenarios to address demand / capacity imbalances.

Effect:

No meteorological interaction.

2.4.1.3 DCB-0103: SWIM enabled NOP

The NOP is in fact a 4 dimensional virtual model of the European ATM environment. It is a dynamic, rolling picture that provides a relational image of the state of the ATM environment for past, present and future. The user, via the appropriate applications, is able to view this image, moving the window along the timeline and focusing on any particular aspect or aspects he or she is interested in.

The plan itself is the result of the complex interactions between the trajectories shared into the system, the capacity being offered, the actual and forecast MET conditions, resource availability, etc. and the automatic and manual negotiations that have been carried out. While a user will only need to see the part of the picture he is concerned with together with its broader implications in order to carry out an action on and with the plan, the applications themselves always use the totality of the information available in the SWIM environment.

Effect:

Meteorological information is an input to the NOP, yet there is no direct meteorological interaction.

2.4.1.4 DCB-0201: Interactive network capacity planning.

The interactive network capacity planning process reflects the cooperative approach indicated in the DMEAN concept of operations to improve the ATM network performance year on year. Up-to-date and comprehensive capacity data and information from ANSPs and airports is available. The process offers an interactive support to stakeholders in the development of medium-term plans. Capacity planning information, data and tools are available on-line. Latent capacity is used to relieve bottlenecks through consolidated capacity planning process based on coordination and network synchronization of ANSPs/airports enabling the adaptation of the capacity delivery where and when required.

Effect:

Meteorological information is an input to the planning process, yet there is no direct meteorological interaction.

2.4.2 Air traffic flow management (ATFM) slot swapping

2.4.2.1 AUO-0101: ATFM slot swapping.

The objective is a more flexible management of departure or arrival regulations especially during an airport critical event, and more freedom of choice for airspace users to adapt their operations. Aircraft operators' tactical priorities are introduced in a cooperative process with the CFMU through ATFM slot exchanges (such slot exchange could be for instance between flights within a single company or within a strategic alliance of companies). CFMU may propose slot exchanges between flights to minimize the overall inconvenience to the community as a whole with the objective of minimizing the total ATFM delay.

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Effect:

This OI step is an operational tool for the airspace users especially at major hubs when serious congestion may happen. Here it may lead to a higher capacity and efficiency. No meteorological interaction as OI step focuses on management flexibility.

2.4.2.2 AUO-0102: User driven prioritisation process (UDPP).

This process can be used in case of disruptions of the network and at congested airports. This process leaves room for airspace users to trade slots if they individually agree to do so, based on agreements and rules that are transparent to the other actors but that respect sets of rules agreed by all parties. The process is permanently monitored by the Network Management function in order to make sure that an acceptable solution is available in due time and that all concerned parties are aware of any adverse network wide effects that may develop.

Effect:

This OI step will increase the efficiency since airspace users will adapt opportunities to their needs. It should be noted that if the users are determining the prioritization process, this will lead to less efficient traffic than traffic optimized without any user preferences. No meteorological interaction as OI step focuses on management flexibility.

2.4.3 Improving network capacity management process

DCB-0204, DCB-0205, DCB 0206, DCB 208and DCB 305 have no meteorological interface.

2.4.3.1 DCB-0207: Management of Critical Events

Critical events refers to a sudden and usually unforeseen event leading to a high drop in ATFCM capacity, involving many partners and requiring immediate action to minimise consequences and to retrieve network stability. A pan-European procedure is established for managing Industrial Action events which can be tailored to individual countries needs/requirements thus leading to better utilisation of limited available capacity.

Management of critical events remains a key at European ATM network level as it is dependent on the willingness of all actors to participate in CDM processes. The management of critical events, be it pro-active (known events) or reactive (unplanned, but prepared) is essential to minimise their impact on the network situation.

Effect:

Meteorological issues such as adverse weather conditions are one essential producer of critical events. Yet the management of these events has no direct meteorological interaction.

2.4.3.2 DCB-0303: Improved Operations at Airport in Adverse Conditions Using ATFCM Techniques

Integrate ATFCM measures with optimised collaborative procedures at airports to manage cases of significant changes to airport capacity, and in particular sudden capacity shortfalls and recovery from that situation.

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Effect:

Meteorological issues are one factor of capacity reductions; thus meteorological information plays an important role in this OI step.

2.4.4 Monitoring ATM performance

No meteorological interactions are present in this section.

2.5 TMA

2.5.1 Arrival traffic synchronisation

2.5.1.1 TS-0102: Arrival management supporting TMA improvements (incl. CDA, P-RNAV)

Improved arrival management in combination with optimised runway utilisation procedures and infrastructure will assure the capability to build a safe, continuous, expeditious and optimised flow of arriving aircraft towards, on and vacating the airport runway(s). This enhanced AMAN will help to smooth throughput, and will, in fact, provide consistent spacing (even in very windy weather) because it looks at aircraft-to-aircraft relationship rather than just fixed spacing requirements. AMAN support is improved to facilitate the use of P-RNAV in the terminal area together with the use of CDA approaches. Sequencing support based upon trajectory prediction will also enhance operations within the terminal area thus allowing a mixed navigation capability to operate within the same airspace and provide a transition to eventual 4D operations.

Effect:

This OI step will facilitate the use of continuous descent profiles and will increase the capacity due to better spacing between aircraft. Arrival management is not possible under adverse weather conditions and therefore this OI step is only applicable during stable weather conditions. A climatology for each airport would give estimates whether this OI step is of significant magnitude on a per airport basis.

2.5.1.2 TS-0103: Controlled time of arrival (CTA) through use of data link

When initially issued, the CTA represents the current optimised sequence that can still be changed if circumstances dictate. For a short flight, the CTA should be very close to the pre-take-off target time of arrival (TTA) and is calculated as soon as the flight is airborne. For longer flights the CTA must be available well before planned top-of-descent and is calculated when the flight passes the AMAN sequencing horizon. The CTA is an ATM imposed time constraint on a defined merging point associated to an arrival runway. The CTA (which includes wake vortex optimization) is calculated after the flight is airborne and published to the relevant controllers, arrival airport systems, user systems and the pilot. All partners in the system work towards achieving the CTA.

Effect:

No meteorological interaction.

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2.5.1.3 TS-0104: Integration of SMAN constraint into AMAN

To improve the effectiveness of AMAN including the optimization of ground movement traffic in order to reduce the additional constraint of the airport surface capacity. This should lead to a more stable arrival sequence due to a better awareness of the traffic situation on ground.

Effect:

This OI step leads to a more stable arrival sequence, capacity relevant weather conditions are the interacting meteorological issues. Influence is medium.

2.5.1.4 TS-0106: Multiple controlled times of over-fly (CTOs) through use of data link

The CTOs allow to perform precise sequencing not only on arrival (CTA) but also on other intermediate merging points e.g. in en-route. The CTOs are ATM imposed time constraints set on successive defined merging points for queue management purposes. The CTOs are computed by the ground actors on the basis of the estimated times provided by the airspace user (airline operation centre or flight crew). They have to be met by the aircraft with the required performance.

Effect:

This OI step leads to a more stable arrival sequence, weather conditions such as wind must be taken into account for the calculation. Interaction is medium.

2.5.1.5 TS-0303: Arrival management into multiple airports

Assistance to multiple airport arrival management in the terminal area environment is becoming increasingly necessary especially in view of the emerging use of secondary airports which are located in close proximity to major airport hubs. In a complex terminal airspace environment there may be significant interaction between traffic flows into a number of these airports. The interaction of such traffic flows in relation to arrival management must be analysed. The system provides support to coordination of traffic flows into multiple airports in the vicinity to enable a smooth delivery to the runways.

Effect:

This OI step leads to a more stable arrival sequence, capacity relevant weather conditions (turbulence, icing, etc.) are the interacting meteorological issues. Interaction is medium.

2.5.1.6 TS-0305: Arrival management extended to the en route airspace

The system integrates information from arrival management systems operating out to a certain distance (e.g. 200 NM) to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by using speed control to absorb some of the queuing time.

Effect:

This OI step leads to a more stable arrival sequence, capacity relevant weather conditions are the interacting meteorological issues. Interaction is low.

2.5.2 ASAS separation

2.5.2.1 TS-0105: ASAS sequencing and merging as contribution to traffic synchronisation in TMA (ASPA-S&M)

The benefit of this OI is a decrease in the workload of the controller, and to allow more regular flow to the runway, and increase the runway throughput. The flight crew ensures a spacing from designated aircraft as stipulated in new controller instructions for aircraft spacing. The spacing could be in time or space. The controller remains responsible for providing separation between aircraft. The crew is assisted by ASAS and automation as necessary.

Effect:

No meteorological interaction.

2.5.2.2 TS-0107: ASAS manually controlled sequencing and merging.

The ASAS sequencing and merging application is used by the flight crew to merge behind an identified target aircraft and then to maintain a defined spacing during descent and approach. Its use reduces controller task load, assists in the conduct of CDAs, and improves the predictability and stability in the flow of traffic for optimum use of an airport runway.

Effect:

No meteorological interaction.

2.6 CONCLUSIONS OF THE METEO SCREENING

Here, all OI steps with a high importance are listed in alphabetical order. An OI step is considered relevant from a meteorological point of view if improved forecast methods or similar would increase the effectiveness of an OI step. An OI step that is used during adverse or severe weather conditions or is highly beneficial during such conditions but cannot be influenced by improved forecast methods, is considered "**not relevant**" in the context of this document.

AOM-0803	Dynamically shaped sectors unconstrained by predetermined boundaries
AO-0301	Crosswind reduced separations for departures and arrivals
AO-0302	Time based separation for arrivals
AO-0303	Fixed reduced separations based on wake vortex prediction
AO-0304	Dynamic adjustment of separations based on real-time detection of wake vortex
AO-0501	Improved operations in adverse conditions through airport CDM
AO-0601	Improved turn-round process through CDM
AO-0603	Improved operations de-icing operation through CDM
AO-0703	Noise management to limit exposure to noise on the ground
AO-0704	Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance
AUO-0501	Visual contact approaches when appropriate visual conditions prevail

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AUO-0502	Enhanced visual separation on approach (ATSA-VSA)
AUO-0504	Self-adjustment of spacing depending on wake vortices
AUO-0803	Visual reduced noise footprint departure
IS-0407	Interoperability between AOC and Weather Information Systems
IS-0501	Use of Airborne Weather Data by Meteorological Service to Enhance Weather Forecast
TS-0201	Basic departure management (DMAN)
TS-0301	Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace

3 NOISE – SCREENING & SCOPING OF THE OPERATIONAL IMPROVEMENTS

3.1 INTRODUCTION

The goal of this chapter is to provide a list with those elements of the concept that have the largest beneficial effect with regards to NOISE reduction. The analysis of the concept is performed at Operational Improvement (OI) step level.

The improvements with respect to environment as mentioned in this document are on a per flight basis, so excluding the effects of traffic growth.

This list can be used in later stages of EP3 WP2.4.4 to indicate which OI step should be investigated in the detailed environmental assessment. The OI steps are described in the SESAR-EPISODE 3 information navigator; the descriptions of the OI steps in this document are taken from the SESAR-EPISODE 3 Information Navigator[6] .

After introducing the OI steps that have an influence on Noise respectively around the airport, the network and the TMA, these will be discussed and their effect on NOISE highlighted. Finally a list of the 10 most influencing OI steps can be found together with the conclusions.

Among the OI steps highlighted by this chapter there are a few which have been defined as enablers. An enabler does not directly deliver Noise benefits on its own and is normally not designed for so, but as part of a system in which noise mitigating procedures are or want to be implemented, it improves the current status and/or "enables" the implementation of new.

In this text, the OI steps and their effect on NOISE will be discussed. In total five different operational contexts are defined:

- Airport;
- En route;
- Information management;
- Network;
- TMA.

The OIs are subdivided into several groups (L01-01 to L10-08). Each OI contains a number of OI steps, with each OI step having a unique code (for example AOM-0701); these codes will be used to refer to the different OI steps.

The chapter is the result of a previous Screening and Scoping step in which the OI steps influencing only Noise (and its relative enablers) were selected, the rest are not mentioned.

None of the OI steps that only contribute to the en route segment are discussed since they do not influence Noise (normally limited to below 7000ft [1]above the ground).

This leaves us with the Airport and TMA operational context as the main areas of interest and partially the Network area since neighbouring TMAs or Military areas can greatly influence the main Noise mitigating OI steps in there design and operation.

The information management OI steps do not influence directly Noise and can be related to a second level of influence on the enablers.

[1] The value of 7000ft is generally adopted for noise impact studies, although higher altitude limitations can be found in such cases as overflight of National Parks, etc..

Finally only the OI steps that have an impact on environmental sustainability are discussed since the other steps do not contribute to NOISE. A total of 10 OI steps are directly linked to Noise mitigation:

AO-0703: Aircraft Noise Management and Mitigation at and around Airports

AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

AUO-0803: Reduced Noise Footprint on Departure

AOM-0602: Enhanced Terminal Airspace with Curved/Segmented Approaches, Steep Approaches and RNAV Approaches where Suitable

AOM-0701: Continuous descent approach (CDA)

AOM-0702: Advanced Continuous descent approach (ACDA)

AOM-0703: Continuous climb departure

AOM-0704: Tailored arrival

AOM-0705: Advanced continuous climb departure

plus six enablers:

- TS-0102, TS-0201 as direct enablers;
- TS-0301, AUO-0504 as indirect;
- AOM-0203, AO-0403 as indirectly influencing noise.

Along this chapter many more OI steps will be found divided into relevance groups, the aim of this introduction is to point out the most important and the ones delivering benefits (or mitigation), rather than those managing or monitoring (i.e. OI steps linked to noise and impact management) the Noise's impact or just enabling the OI steps.

In the following sections the reader finds a short description of each OI step and its expected effect on Noise.

Chapter 3.2 until 3.4 discuss the OI steps that have an effect on respectively the airport, the network and the TMA. Finally chapter 3.5 summarizes all OI steps and orders them in groups that indicate whether they have a direct or indirect effect on NOISE and/or are direct enablers of the Noise mitigating OI steps.

This chapter also gives a list with ten OI steps that have the largest positive impact on NOISE.

3.2 Airport

3.2.1 Optimizing climb/descent

3.2.1.1 AOM-0701: Continuous descent approach (CDA)

Goal is that under specific circumstances (low traffic density), simple CDA is used at airport through adapted procedures (no need for further ground system automation).

Effect[2]:

The conventional approach (Standard Approach):

With the conventional aircraft approach, an aircraft would be given clearance by Air Traffic Control from the bottom level of the holding stack (normally an altitude of 6000 or 7000 feet) to descend to an altitude of typically 3000 feet. The aircraft would then fly level for several miles before intersecting the final 3 degree glide path to the runway. During this period of level flight, the pilot would need to apply additional engine power to maintain constant speed.

The Continuous Descent Approach (CDA):

In contrast to a conventional approach, when a CDA procedure is flown the aircraft stays higher for longer, descending continuously from the level of the bottom of the stack (or higher if possible) and avoiding any level segments of flight prior to intercepting the 3 degree glide path. A continuous descent requires significantly less engine thrust than prolonged level flight.

Benefits:

- Higher for longer:

  Because the aircraft flying a CDA is higher above the ground for a longer period of time, the noise impact on the ground is reduced in certain areas under the approach path.

- Less engine thrust:

  Noise on the ground is reduced further because a CDA eliminates the period of level flight when additional engine thrust would have been used.

- Noise reductions up to 5 decibels:

  Depending on the location and aircraft type, the noise benefit from a CDA compared to a conventional approach could be up to about 5 decibels (a change of 3 decibels is just noticeable to the human ear).

Limitations:

Benefits are only perceived away from the airport, commonly between 10 and 25 miles from the airport's RWY. Benefits are thus limited to certain locations.

Cannot always be flown: It may sometimes not be possible to fly a CDA due to airspace constraints or overriding safety requirements. Also, when flying a CDA an aircraft may still require a short segment of level flight in order to reduce speed or to reconfigure.

3.2.1.2 AOM-0702: Advanced Continuous descent approach (ACAD)

This improvement involves the progressive implementation of harmonized procedures for CDAs in higher density traffic. Continuous descent approaches are optimized for each airport arrival procedure. New controller tools and 3D trajectory management enable aircraft to fly, as far as possible, their individual optimum descent profile (the definition of a common and higher transition altitude would be an advantage).

[2] Refs: - "Basic Principles of the Continuous Descent Approach (CDA) for the Non-Aviation Community" by the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority;

- Sourdine II EC funded Project;

- EUROCONTROL Harmonised Continuous Descent Approach Concept.

Effect:

The implementation of this OI step compared to AOM-0701 solves [3]many of the limitations:

The first improvement is the repeatability of the procedure by nearly all the air traffic in approach, and the possibility to overcome airspace or traffic constraints.

Also the noise mitigation delivered would not be limited to the 10 to 25 miles area but could be delivered up to 3/4NM from the RWY [SII, OPTIMAL].

3.2.1.3 AOM-0703: Continuous climb departure

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. When traffic and the urban areas around the airport permit, continuous climb departure is used to reduce noise by a higher altitude trajectory around the airport. Fuel consumption is reduced by flying optimized profile (no vertical containment required).

Effect:

This OI step provides mitigation to the noise perceived on take-off. The benefits on the other hand will depend upon tailoring the managed procedure to the location of the neighbourhoods surrounding the airport.

3.2.1.4 AOM-0704: Tailored arrival

This procedure is a kind of Continuous Descent Approach (CDA) in which descent is made mostly on idle power. The objective is to minimise fuel consumption (operating cost) as well as noise production. In an operating environment with low traffic volume these optimized approaches can easily be made (as already done at several airports worldwide, especially during night time) but in case of high traffic volume the concept has still to be proven

Effect:

For this OI step the same applies as for the CDA procedure (AOM-0701). Especially if the horizontal segment at or below 3000 ft is not flown. Trials made by ANZ's [4]777-200ERs (Air New Zealand) allowed a/c to make full use of the interlinked onboard and ground technology to descend into San Francisco airport with minimal direct Air Traffic Control (ATC) intervention.

A/C by being able to continuously descend into the airport, rather than flying a series of level segments as required under standard ATC procedures, can reduce noise as well as fuel consumption.

3.2.1.5 AOM-0705: Advanced continuous climb departure

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. The goal is to use continuous climb departure in higher density traffic. This should be enabled by system support to trajectory management.

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[3] Sourdine II and OPTIMAL European funded Projects results.

[4] Source: Air Transport Intelligence news; San Francisco Tailored Arrival Trials Boeing Perspective Brad Cornell, Senior Engineer, 777 Flight Crew Operations, March 21, 2007.

Effect:

For this OI step the same holds as for the continuous climb departure procedure (AOM-0703). If this OI step leads to a higher number of continuous climb departures, this means that the effect of this OI step will be stronger compared to the effect of AOM-0703.

3.2.2 Implementing Environmentally Sustainable Operations

The following OIs are extremely important not on there direct effect on noise as in controlling it, planning in advance its mitigation and solutions, reflect the best solutions to take for the specific locations based on management[5], monitoring and feedback. These OI steps are part of the future Environmental Management System.

3.2.2.1 AO-0703: Aircraft Noise Management and Mitigation at and around Airports

The objectives are to ensure that:

- Aircraft noise emissions are minimised both in the air and on the ground;
- Any noise impact falls on the least number of people;
- Unnecessary noise driven limits, restrictions or non-optimal operations are not imposed;
- Any constraints, non-optimal procedures or economic burdens that are imposed strike the most appropriate balance between social, economic and environmental imperatives.

Where a bigger strategic gain can be won by the voluntary adoption of lesser restrictions, that:

- These are developed following the balanced approach and with the full input from all relevant ATM stakeholders, and
- The option with the best sustainability balance is selected.

3.2.2.2 AO-0706: (Local) monitoring of environmental performance

The environmental performance (compliance to operational procedures, key performance indicators) of ATM stakeholders at the airport is recorded and monitored in support of continuous improvement process. In particular, it is possible to determine the amount of airport related versus external pollution. This improvement involves use of noise monitoring system, flight tracking and air quality monitoring system.

3.2.2.3 AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

4D-Trajectory management is not only about the business intention of the aircraft operator. Environmental sustainability restrictions have to be taken into account. Environmental sustainability restrictions are becoming more and more a significant restriction for the execution and planning of the business trajectories of aircraft operators. It is in the interest of

[5] BAA Heathrow Noise Strategy 2000 - 2005.

all ATM-stakeholders (aircraft operators and airports) to take into account the (most often local) environmental restrictions in the early phase of flight planning.

Effect:

Trajectory management takes the airborne part of a flight into account, and will therefore have a great impact on noise. Being able to plan in advance the flight and its ENV constraints will lead to improvements and reduction in noise.

3.2.3 Monitoring ATM Performance (Indirect)

3.2.3.1 SDM-0103: Sustainability Performance Management of the ATM Network

Network efficiency indicators are developed and monitored to describe the environmental performance of the ATM network.

Sustainability policies shall remain determined at local level, which means that pan-European harmonisation can only be achieved for the definition of a 'Sustainability framework for ATM'. The dissemination of useful practices is facilitated by harmonised framework that takes fully account of the local specificities and pressures exercised by the neighbouring communities, and enables to evaluate the current progress made on this improvement axis by local communities.

Effect:

The main effect of this OI step is to monitor the ATM performance and disseminate as much as possible common best practice taking into account the local environment. This OI does not mitigate noise but it does deliver feedback on the delivery or not of mitigation by other OIs directly linked to NOISE.

3.2.4 Departure traffic synchronisation (Enabler)

3.2.4.1 TS-0201: Basic departure management (DMAN)

Runway capacity is considered as a principal constraint in today's air traffic control system. Several problems exist with regard to optimising departure sequences. Uncertainties of pushback, start-up and taxi times limit the capability of aerodrome control to achieve their preferred sequence. Several actors can influence the sequence of the departures, with each actor seeking to apply local and individual optimisation resulting in a potential for under utilisation of the runway.

Goal is to develop a system that determines the optimum runway for departure (if appropriate) and the optimum order for the departure sequence taking into account departure times, slot constraints, runway constraints such as departure rate, wake vortex separation, distance in trail, etc.

Effect:

This OI step is an enabler since it does not deliver noise mitigation but supports the implementation of OI steps such as AOM-0701 or AOM-0703 which do deliver noise mitigation.

3.2.5 Managing interactions between departure and arrival traffic (Enabler)

3.2.5.1 TS-0301: Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace

Enabling complementary and optimised spacing of arrivals and departures, minimising airborne delays and also minimising departure queuing. The system provides assistance to the controller to manage mixed mode runway operations, and identify and resolve complex interacting traffic flows.

Effect:

By optimising spacing of arrivals and departures the implementation of OI steps such as AOM-0701 can be supported with lower impacts on capacity and maintaining the same safety levels [SII].

3.2.6 Airborne situational awareness

The airborne situational awareness consists of three OI steps, of which only one has an impact on the flight operations level (AUO-0402). The OI step enhances safety and thus will help or support a more fluent implementation of ACDAs (AOM-0702). The OI step can be considered an Indirect Enabler.

3.2.7 Using runways configurations to full potential (Enabler)

3.2.7.1 AO-0402: Interlaced take-off and landing

The goal of this OI step is to provide mitigation for the inherent delays/queuing associated with capacity constrained airports and to gain a significant capacity enhancement without impacting the overall queue management concepts. Instead of segregated use of multiple runways, interlaced take-off and landing procedures can be envisaged.

Effect:

The main effect of this OI step is an increase in capacity, which can lead to a reduction in queuing time if the number of take-offs and landings per day does not increase.

3.2.7.2 AO-0403: Optimized dependent parallel operations

Dependencies between multiple runways determine the practical runway capacity which, in most cases, is lower than the combined single runway capacities. Capacity gains can be achieved by increased utilization of the combined runways. Reducing dependencies between runways by implementing more accurate surveillance techniques and controller tools as well as advanced procedures, will enlarge the capabilities of existing runway configurations (like closely spaced parallel runways).

Effect:

Since this OI step leads to an increase in capacity, the queuing time per flight will be reduced. This will have a positive effect on noise on a per flights base. This will also support the implementation of the AOM 0701 to 06 OI steps which have proved in many research projects (i.e. SII) to be limited by decrease in capacity in their decision to be implemented.

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3.2.8 Maximising runway throughput (Direct ACDA Enablers)

The main effect of the OIs described in this paragraph will be an increased runway capacity for landing aircraft, but if less time is needed for landing aircraft, this time can also be used to increase the number of departing aircraft, which in turn will lead to less ground queuing during which the individual flight can emit Noise.

3.2.8.1 AO-0302: Time based separation for arrivals

The intent is to mitigate the effect of wind on final approach sequencing so as to achieve accurate and more consistent final approach spacing and recover most of the capacity lost under strong headwind. Constant time separations independent of crosswind conditions and wake vortex existence are introduced. Time based separation is an option to replace the distance criteria currently used to separate trailing aircraft on the approach beyond the wake vortex of the leading aircraft.

Effect[6]:

The goal of this OI step is to reduce the time between landing aircraft, thereby increasing the capacity. The implementation of AOM 0701/02 and their benefits are greatly improved by this OI step.

3.2.8.2 AO-0304: Dynamic adjustment of separations based on real-time detection of wake vortex

The controller optimizes aircraft separations by taking the actual wake-vortices strength into account.

Effect:

This OI step leads to an increase in capacity; this will have a positive effect on the AOM-0702 implementation.

3.2.9 Implementing sustainable operations at airports

3.2.9.1 AO-0701: Effective collaboration between ATM stakeholders supported by environmental management systems

The goal is to manage the operation and onward development of an airport in such a way as to effectively curb the facility's impact on the environment. The airport companies have therefore to introduce a modern, long-term environmental management system. This management system creates the foundations for a comprehensive and all-encompassing approach to environmental policy. ATM operational stakeholders adopt a sustainability policy supported by appropriate environmental management system to facilitate standard setting, monitoring and continuous improvement. Sharing best practices between airports, ATC, local airlines is a first step.

[6] Reference: NUP2+ Project and "Green Flights – Time based operations- From research to reality" Author Michael Standar LFV/ANS.

Effect:

The main goal of this OI step is to decrease the impact of air traffic on the environment, by making sure all the actors collaborate and apply the same environmental goals from strategies, to planning to operation. Monitoring of the Noise results, clearly established goals and coordination among all the actors through an integrated system will enhance the use of best practices, make sure the operation of the solutions has the best performance and the least problems; spread awareness on the matter and responsibility on a solid repeatable base. Anything that is done with the consensus and commitment of all and is accountable/supported by results will only make sure the solutions to the noise impact are the most appropriate[7].

3.2.9.2 AO-0702: Improved relations to neighbours

ATM stakeholders have to improve their understanding of the existing and emerging perceptions, and needs and expectations of society, especially in terms of the management of adverse socio-environmental impacts. A better understanding by the local community of the real disturbance is achieved through provision of more accurate and accessible information (noise, tracks, air emission, etc.) as well as through improvements in decision-making, consultation process and impact management (better transparency towards community). A commonly agreed development path for the airport and the surrounding communities is achieved (incl. e.g. noise protection zones, noise protection programs).

Effect:

This OI step does not mitigate noise rather the relationship between the noise producer and the noise receiver trying to make the perception more acceptable: feedback, improved relations with local communities, use of alternative [8]non acoustic measures, common decision making, etc. are part of this OI step.

3.2.9.3 AO-0704: Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance

The airport taxiway design and the associated procedures are optimized in such a way as to reduce the queue and taxiing (dual taxi routes separating inbound and outbound traffic, new taxiways and RET, preferential runway use, standard routing, etc.). The associated procedures for this infra-structure are developed considering reductions to air pollution and noise disturbance levels of aircraft.

Effect:

The effect on noise is limited to preferential RWY use (night-time) depending on airport population distribution and engine test site location inside the airport's perimeter.

3.2.9.4 AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

Time management techniques and aircraft movement technologies are developed which reduce both fuel consumption and noise by taxiing aircraft (e.g. taxiing with not all engines

[7] Airport Noise Advisory Committee (ANAC) San Jose Airport, USA.

[8] Research report Noise Annoyance Mitigation at Airports by Non-Acoustic Measures Inventory and Initial Analysis D/R&D 07/026 version 1.0 Version date: 2-10-2007 Department: R&D/Research.

operating) or towing the aircraft to/from the runway with all engines off. The use of electric (instead of hydro-carbon powered) auxiliary power units and ground handling vehicles further reduces the noise and particulate pollution around parked aircraft.

Effect:

The effect on noise would be limited to the airport and the taxing phase; both influence more the noise delivered to the workers working on the platform than the neighbourhoods.

3.2.9.5 AUO-0803: Reduced noise footprint on departure

The objective is to maintain the necessary safety of flight operations whilst minimizing exposure to noise on the ground. Continuous improvements in engine and airfoil design provides Aircraft operators have to be pro-active in the development of operating techniques which take advantage of technological improvements to shrink the noise footprint on departure. The improvement comes through better rates of climb, reductions in required thrust percentage, quieter engines coupled with better SID route planning and altitude usage. Airspace users work with ATM to develop noise abatement procedures.

Effect:

The main goal of this OI step is to reduce the noise footprint through technological improvements. These enhanced capabilities then help the airspace designers in supporting innovative and improved Noise abatement procedures (NAPs) together with improved operations.

3.3 NETWORK

A large number of the OIs and OI steps that have an impact on the network will not have an impact on the TMA or airport level. This is true if the airspaces or the TMAs are not neighbouring or creating restrictions on arrival and approaches as can be the case for Madrid Barajas and Torrejon de Ardoz Airports, the first Civil the later Military. The grade of influence for noise can range from great to null. Below the OI steps which could influence the implementation of the OI steps directly linked to delivering Noise benefits.

3.3.1 From FUA to Advanced FUA (Enabler)

3.3.1.1 AOM-0203: Cross-Border Operations Facilitated through Collaborative Airspace Planning with Neighbours

National collaborative civil-military airspace planning process is extended with neighbouring States by harmonising, where needed, the ASM rules and procedures for the establishment, allocation and use of airspace structures. National high level airspace policy bodies will enhance their cooperation with neighbours, when so required, to commonly address cross-border activities and to seek to allocate at pre-tactical level on a sub-regional rather than a national basis.

This improvement step refers mainly to bilateral/FAB collaboration. Many military areas are located at the boundaries of States, so the merging of existing national areas into cross-border areas is a possibility for an option. This merging is usually achieved by the addition of existing areas on both sides of the common border. However, the management of such airspace structures is more challenging in order to alleviate the pressure on civil traffic (e.g. synchronisation of training activities throughout neighbouring States is needed).

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Effect:

Airspace design can in many cases be hindered by neighbouring restricted areas or TMAs, collaboration among airspace neighbours (civil or military) would improve the design and full potential of Noise Abatement Procedures (as AOM-0701).

3.4 TMA

The TMA is the airspace where the SIDs, the STARs and the Approach phase of flight are located together with the airport. The Landing and Take-Off cycle of flight takes place here (LTO).

The enhancement, design, management and planning of this airspace integrating environmental goals or at least delivering the needed flexibility for noise mitigating solutions to be implemented is a key element.

The following Operational Improvements enable the implementation/improvement of the OI steps aimed and mitigating the impact of noise.

3.4.1 Arrival traffic synchronisation (Enabler)

3.4.1.1 TS-0102: Enhanced Arrival Management to Support TMA Improvements (incl. CDA, P-RNAV)

Arrival Management support is improved to facilitate the use of PRNAV in the terminal area together with the use of CDA approaches. Sequencing support based upon trajectory prediction will also enhance operations within the terminal area thus allowing a mixed navigation capability to operate within the same airspace and provide a transition to eventual 4D operations. Improved arrival management in combination with optimised runway utilisation procedures and infrastructure will assure the capability to build a safe, continuous, expeditious and optimised flow of arriving aircraft towards, on and vacating the airport runway(s). This enhanced AMAN will help to smooth throughput, and will, in fact, provide consistent spacing - even in very windy weather - because it looks at aircraft-to-aircraft relationship rather than just fixed spacing requirements.

Effect:

This OI step will facilitate the use of continuous descent profiles and will increase the capacity due to better spacing between aircraft.

3.4.1.2 TS-0305: Arrival management extended to the en route airspace

The system integrates information from arrival management systems operating out to a certain distance (e.g. 200 NM) to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by using speed control to absorb some of the queuing time.

Effect:

Since this OI step may decrease the queuing time and the traffic flux in arrival it enables to solve some of the limitations linked to the implementation of noise mitigating OI steps such as AOM-0701 and AOM-0702.

3.4.2 ASAS self-separation (ACDA-aom-0702- Enabler)

3.4.2.1 TS-0105: ASAS sequencing and merging as contribution to traffic synchronisation in TMA (ASPA-S&M)

The benefit of this OI is a decrease in the workload of the controller, and to allow more regular flow to the runway, and increase the runway throughput. The flight crew ensures a spacing from designated aircraft as stipulated in new controller instructions for aircraft spacing. The spacing could be in time or space. The controller remains responsible for providing separation between aircraft. The crew is assisted by ASAS and automation as necessary.

Effect:

This OI step enables ACDA procedures to be flown with great benefit on the Noise side.

3.4.2.2 TS-0107: ASAS manually controlled sequencing and merging

The ASAS sequencing and merging application is used by the flight crew to merge behind an identified target aircraft and then to maintain a defined spacing during descent and approach. Its use reduces controller task load, assists in the conduct of CDAs, and improves the predictability and stability in the flow of traffic for optimum use of an airport runway.

Effect:

The major benefit comes from the ATC decrease of task load and better synchronization of traffic to the runway; This OI step enables ACDA procedures to be flown with great benefit on the Noise side.

3.4.2.3 AUO-0504: Self-Adjustment of Spacing Depending on Wake Vortices (Indirect Enabler)

The spacing is adjusted dynamically by the pilot based on the actual position of the vortex of the predecessor. This implies that aircraft can determine the wake vortex characteristic they generate and broadcast this information to neighbouring aircraft.
Minimum separation will lead to maximum capacity. Furthermore, making the vortices detectable to pilots adds a further layer of protection.

Effect:

The major benefit comes from the ATC decrease of task load and better synchronization of traffic to the runway; this OI step is and indirect enabler for CDA, ACDA procedure implementation as it is not designed to enable these OI steps specifically.

3.4.3 Enhancing Terminal Airspace

3.4.3.1 AOM-0601: Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA where Suitable (Enabler)

Terminal Airspace is adapted in line with the availability of airspace and the capability of aircraft. Airspace organisation is enhanced in some Terminal Airspace with the use of FUA and/or RNAV, where suitable, based on common agreed design criteria for SIDs/STARs and possibly instrument approach procedures. Terminal Airspace Capacity is enhanced by applying best practice and exploiting aircraft RNAV capabilities to optimise all or any of the

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following aspects as appropriate: - placement of SIDs/STARs and instrument approach procedures (as regards distance flown, flight profile, time, cost and flexibility to all users) and exploiting the use of RNAV to those ends; design of terminal airspace structures and ATC sectorisation with a view to evenly distributing ATC and flight crew workload; minimising adverse ATM-related environmental impact.

PRNAV may facilitate improvements in the efficiency and capacity of Terminal Airspace through increased flexibility in design and reduced route separation.

Effect:

Enables the implementation of Noise mitigating procedures as Preferential routing, to contain as much as possible the noise produced by air traffic.

3.4.3.2 AOM-0602: Enhanced Terminal Airspace with Curved/Segmented Approaches, Steep Approaches and RNAV Approaches where Suitable

P-RNAV SIDs and STARs are increasingly used. RNP-based curved/segmented approaches and steep approaches are implemented to respond to local operating requirements (e.g. terrain or environmental reasons).

Where precision approaches are not feasible, reductions in minima decisions with respect to conventional NPA are made it possible through the implementation of RNAV approach procedures with vertical guidance (APV).

Steep approach capability may enable to relax airport constraints due to height obstructions, runway length and/or noise restrictions.

At airports where only NPA is currently feasible, implementation of RNAV approaches with vertical guidance will provide improvements in terms of safety and airport accessibility.

Effect:

Enables the implementation of Noise mitigating procedures as Steep Approaches, etc.

3.4.3.3 AOM-0603: Enhanced Terminal Airspace for RNP-based Operations

Terminal Airspace is further enhanced with the use of advanced RNP 1 terminal routes (incl. A-RNP1 SIDs and STARs).

RNP-based instrument procedures with vertical guidance are used to increase safety and through the provision of stabilised approaches, thus reducing the potential for CFIT (Controlled Flight Into Terrain).

Holding areas are redefined in terms of size and location.

Based on the application of RNP capability and on emerging technology, which may include 3D management on routes, advanced applications are expected from 2015 with metering of aircraft from en-route to Terminal airspace. 4D RNAV aircraft capability will then offer potential further benefits by allowing 4D departure and arrival management to minimise environmental impact and to ensure efficient timing and accurate approach sequence

Effect:

Enables the implementation of Advanced Noise mitigating procedures as ACDAs.

3.5 Conclusions – Noise Screening & Scoping

This section groups the OIs into five groups (direct effect, directly linked to noise management, direct enablers, indirect effect and unknown effect). Finally the OIs with the highest expected positive impact on Noise will be given. These OIs are given in order of expected importance (number 1 is expected to have the largest impact).

3.5.1 OI steps with a direct noise reduction effect

AOM-0701: Continuous descent approach (CDA)

AOM-0702: Advanced Continuous descent approach (ACDA)

AOM-0703: Continuous climb departure

AOM-0704: Tailored arrival

AOM-0705: Advanced continuous climb departure

AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

AOM-0602: Enhanced Terminal Airspace with Curved/Segmented Approaches, Steep Approaches and RNAV Approaches where Suitable

AO-0703: Aircraft Noise Management and Mitigation at and around Airports

AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

AUO-0803: Reduced Noise Footprint on Departure

3.5.2 OI steps which are directly linked to noise management

AO-0701: Effective collaboration between ATM stakeholders supported by environmental management systems

AO-0702: Improved relations to neighbours

AO-0706: (Local) monitoring of environmental performance

3.5.3 OI steps which are direct enablers

Direct enablers are those OIs which enable the OIs directly involved with noise mitigation to be implemented, improved and/or make sure the side effects of their implementation does not influence negatively other key performance areas as Safety, Capacity, etc..

TS-0301: Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace

TS-0201: Basic departure management (DMAN)

TS-0102: Arrival management supporting TMA improvements (incl. CDA, P-RNAV)

AOM-0601: Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA where Suitable

AO-0302: Time based separation for arrivals

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AO-0304: Dynamic adjustment of separations based on real-time detection of wake vortex

TS-0105: ASAS sequencing and merging as contribution to traffic synchronisation in TMA (ASPA-S&M)

TS-0107: ASAS manually controlled sequencing and merging

TS-0305: Arrival management extended to the en route airspace

AOM-0601: Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA where Suitable (Enabler)

AOM-0603: Enhanced Terminal Airspace for RNP-based Operations

3.5.4 OI steps which are indirect enablers

AUO-0504: Self-Adjustment of Spacing Depending on Wake Vortices

AO-0402: Interlaced take-off and landing

TS-0301: Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace

TS-0305: Arrival management extended to the en route airspace

3.5.5 OI steps with an indirect effect

AOM-0203: Cross-Border Operations Facilitated through Collaborative Airspace Planning with Neighbours

TS-0304: Integrated arrival/departure management in the context of airports with interferences (other local/regional operations)

Both OI steps (AOM-0203, TS-0304) aim at the same objective, but resolving the problem from different areas.

AO-0403: Optimised Dependent Parallel Operations

SDM-0103: Sustainability performance management of the ATM network

3.5.6 The 10 most important OI steps with regards to Noise reduction

The ten most important OI steps:.

AOM-0701: Continuous descent approach (CDA)

AOM-0702: Advanced Continuous descent approach (ACDA)

AOM-0703: Continuous climb departure

AOM-0704: Tailored arrival

AOM-0705: Advanced continuous climb departure

AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

AOM-0602: Enhanced Terminal Airspace with Curved/Segmented Approaches, Steep Approaches and RNAV Approaches where Suitable

AO-0703: Aircraft Noise Management and Mitigation at and around Airports

AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

AUO-0803: Reduced Noise Footprint on Departure

The reader will have to bear in mind that many OIs here illustrated actually do depend for their implementation on the enablers described in the document previously.

On the other hand it is also true that the decision to highlight the most important OI steps was based on their direct design and delivery of noise mitigation mostly from the operational side. And always taking into account that the impact is located below the air traffic tracks (7000ft AGL, unless specified by other limitations as Natural Parks, etc.).

As such an improvement in Noise can be achieved by two main improvements:

- The first is technological (Noise Reduction at source);
- The other is through noise focused operations (Noise mitigation).

It is also true that perception of noise is an important factor, OI steps such as AO-0702 have been included but does not reduce or mitigate noise, it rather changes perception and stimulates participation.

Many projects (SII, NUP2+, Basic-CDA) including the SESAR definition phase and trials (TA San Francisco) dedicated to studying Operational Improvements as AOM-0701/X, all highlighted the importance of key enablers which include the combination of AMAN, DMAN, to make sure benefits on the noise side do not hinder capacity (for sustainability) or safety.

For this reason TS-0301 and TS-0304 integrating AMAN and DMAN, means that these OI steps will have a larger effect than OI steps that are solely beneficial for AMAN or DMAN, but will be beneficial not to noise as it is but to the implementation of noise mitigating procedures without their negative effects.

In conclusion, the 10 OI steps presented in section 3.5.1 are regarded as the most influencing and the most intuitively simple to link to the delivery of NOISE benefits.

4 LOCAL AIR QUALITY – SCREENING & SCOPING OF THE OPERATIONAL IMPROVEMENTS

4.1 INTRODUCTION

This chapter is written for Episode 3 WP2.4.4. It gives an impression of several operational improvements (OIs) and their impact on the local air quality (LAQ).

The analysis presented in this chapter is performed at OI step level.

The improvements with respect to environment as mentioned in this document are on a per flight basis, so excluding the effects of traffic growth. Since Episode 3 concerns ATM related items; background concentrations and emissions of buildings and vehicles at or near the airport are neglected in this text, which means that only aircraft emissions are considered.

After this introduction, the OI steps that have an effect on respectively the airport, information management, the network and the TMA will be discussed. Finally all OI steps are summarized and an indication of the effect of the OI steps on the LAQ is given.

The goal of this chapter is to provide a list with the OI steps that have the largest positive impact on the LAQ. This list can be used in later stages of the SES concept environmental performance assessment process to indicate which OI step should be investigated in the detailed environmental assessment. The descriptions of the OI steps in this document are taken from the SESAR EPOISODE 3 information navigator[6].

In this text, the OIs and their effect on the LAQ will be discussed. In total five different operational contexts are defined:

- Airport;
- En route;
- Information management;
- Network;
- TMA.

The OIs are subdivided into several groups (L01-01 to L10-08); these groups cover subjects such as the optimization of climb and approach procedures. Each OI includes a number of OI steps, with each OI step having a unique code (for example AOM-0701); these codes will be used to refer to them.

To limit the size of this chapter not all OI step will be discussed. None of the OI steps that only contribute to the en route segment are discussed since they do not influence the LAQ. For all of the OI steps that have an influence on the network or TMA; the OI steps that have no impact on the LAQ are not mentioned. Finally, only the OI steps that have an impact on efficiency, capacity and environmental sustainability are discussed since the other OI steps do not contribute to the LAQ. Only two OI steps that do contribute to efficiency, capacity or environmental sustainability directly are discussed since they influence the LAQ (TS-0104 and TS-0202).

Each section of this text gives a short description of an OI step and its effect on LAQ.

To give a good indication of the effect on the LAQ of an OI step, not only the direct effect on the LAQ should be considered. A direct way to improve the LAQ is to decrease the amount of fuel burned on the airport surface. This will directly reduce the local emissions and therefore has a positive effect on the LAQ. Besides the direct impact on the LAQ, also the impact on capacity will be discussed since the capacity is directly related to the environment. First of all an increase in capacity can be used to increase the number of aircraft movements. This will lead to an increase in noise impact, local and Global Emissions.

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The second effect of additional capacity can be a reduction of airborne holding and ground queuing, due to the fact that an airport can accommodate more traffic. The decrease in ground queuing will lead to a reduction in local emissions. Also the noise produced by queuing will be decreased. However this noise impact is very small compared to the noise produced by airborne aircraft. A change in capacity only has an effect on the LAQ if capacity refers to runway or airport capacity, the capacity in the air is not relevant for the LAQ as long as the increase in capacity in the air does not indirectly lead to more capacity on the ground.

Also the effect of the OI steps on efficiency will be discussed. If air traffic becomes more efficient at or near an airport this leads to a decrease in flight or taxi time which will have a positive effect on the LAQ since this will decrease the delays on the ground. The described effects on the LAQ of the different OI steps are based on assumptions and in most cases not on research.

Finally it should be noted that the altitude where emissions take place influence the effect on the LAQ. In general local emissions are defined as emissions below 3000 ft. Emissions that take place above 1000 ft only have a limited effect on the LAQ compared to the emissions at lower altitude. However, for consistency reasons 3000 ft are considered the upper limit for Local Air Quality Assessment within the EPISODE 3 Environmental Performance Assessment Approach. This upper limit is aligned with the upper limit of the ICAO standard Landing and Take-Off cycle, an modelling element, which widely recognised and used even beyond environmental modelling and assessment projects.

Summarizing, this means that all OI steps that affect the LAQ and also the OI steps that have an impact on the airport capacity and efficiency will be discussed. Since this text analyses the effects of an OI step per flight; an increase in capacity or efficiency will be considered to have a positive effect on the LAQ. If the increased capacity is used to accommodate more traffic, this will have a negative impact on the LAQ, but this increase in traffic will not be taken into account in this text.

Chapter 4.2. until 4.5 will discuss the OI steps that have an effect on respectively the airport, information management, the network and the TMA. Finally chapter 4.6 summarizes all OI steps and orders them in groups that indicate whether they have a small, medium large, indirect or unknown effect on the LAQ. This chapter also gives a list with ten OI steps that have the largest positive impact on the LAQ.

4.2 AIRPORT

4.2.1 Optimizing climb/descent

4.2.1.1 AOM-0701: Continuous descent approach (CDA)

The goal of this OI is that under specific circumstances (low traffic density) a simple CDA is used at airport through adapted procedures (no need for further ground system automation).

Effect:

British Airways reported that a CDA from 6000ft to touchdown at Heathrow reduces fuel consumption 200-400 kg per approach compared to previous practice. However, during the last part of the approach additional thrust is needed due to the high drag. This means that the largest reduction in fuel consumption is achieved above 3000 ft. Still the CDA procedure will lead to a decrease in fuel consumption below 3000 ft. It should be noted that emissions of for example NO_x are not solely depending on the fuel consumption.

Finally it should be noted that regular approaches have a horizontal segment (usually at 2000 or 3000 ft in the Netherlands). If this segment is flown at or below 3000 ft this means that the time at or below 3000 ft is reduced by the use of a CDA approach. However, since the CDA might start at altitudes largely above 3000ft the effect on the LAQ will be limited.

Taking everything into account, shows that the CDA is expected to have a limited positive effect on the LAQ.

4.2.1.2 AOM-0702: Advanced Continuous descent approach (ACDA)

This improvement involves the progressive implementation of harmonized procedures for CDAs in higher density traffic. Continuous descent approaches are optimized for each airport arrival procedure. New controller tools and 3D trajectory management enable aircraft to fly, as far as possible, their individual optimum descent profile (the definition of a common and higher transition altitude would be an advantage).

Effect:

If this OI step is implemented, more aircraft can fly CDAs, which means that it will further increase the effect of AOM-0701. Since the main effect still will be a reduction in emissions above 3000 ft, the effect on the LAQ will be limited.

4.2.1.3 AOM-0703: Continuous climb departure (CCD)

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. When traffic permits, continuous climb departure is used to reduce noise by a higher altitude trajectory around the airport. Fuel consumption is reduced by flying optimized profile (no vertical containment required).

Effect:

If this OI step leads to a reduction in fuel consumption below 3000 ft, this can have positive effect on the LAQ. However this is also depending on the emissions of for example NO_x, HC and CO. This procedure is expected to lead to a reduction in fuel burn below 3000 ft, since the goal is to fly a higher altitude profile, which means that the flight time below 3000 ft is reduced, however if this is achieved by using higher thrust settings, thus a higher fuel flow, this will reduce this positive effect. Higher thrust settings lead to an increase in NO_x emissions and a decrease of HC and CO emissions. The main effect is expected above 3000 ft which means that the effect on the LAQ is limited.

4.2.1.4 AOM-0704: Tailored arrival

This procedure is a kind of Continuous Descent Approach (CDA) in which descent is made mostly on idle power. The objective is to minimise fuel consumption (operating cost) as well as noise production. In an operating environment with low traffic volume these optimized approaches can easily be made (as already done at several airports worldwide, especially during night time) but in case of high traffic volume the concept has still to be proven

Effect:

For this OI step the same holds as for the CDA procedure (AOM-0701). Especially if the horizontal segment at or below 3000 ft is not flown, this will have a positive effect on the emissions below 3000 ft. The effect on the LAQ will be limited.

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4.2.1.5 AOM-0705: Advanced continuous climb departure

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. The goal is to use continuous climb departure in higher density traffic. This should be enabled by system support to trajectory management.

Effect:

For this OI step the same holds as for the continuous climb departure procedure (AOM-0703). If this OI step leads to a higher number of continuous climb departures, this means that the effect of this OI step will be stronger compared to the effect of AOM-0703. Still this effect is expected the largest above 1000, respectively 3000 ft.

4.2.2 Increasing flexibility of airspace configuration

The increase in flexibility of airspace configuration consists of several OI steps, however only one of these OI steps has an effect at the airport (SDM-0201), while all others affect the en route or TMA traffic. Since SDM-0201 only has an effect on the cost effectiveness and the safety, it does not influence the LAQ.

4.2.3 Management/revision of reference business trajectory (RBT)

The management/revision of RBT contains four OI steps, but only two of these have an impact on airport level (AUO-0302 and AUO-0303), while both others (AUO-0301 and AUO-0304) only have an impact on the en route segment.

4.2.3.1 AUO-0302: Successive authorisation of reference business/mission trajectory (RBT) segments using data link

Pilot's requests to controller for start-up, push back, taxi, take-off clearances, etc. will be transmitted by data link.

Effect:

This OI step is expected to have a limited positive effect on the capacity, since the controller will have better knowledge of the status of an aircraft. This means that the controller can manage the clearances in a better way so that taxi and queuing times are reduced, which has a positive impact on the LAQ.

4.2.3.2 AUO-0303: Revision of business/mission trajectory (RBT) using data link

The pilot will automatically be notified by data link of trajectory change proposals (route including taxi route, altitude, time and associated performance requirements as needed) resulting from ATM constraints arising from, for example, ad hoc airspace restrictions or closing of a runway. ATM constraints may also be expressed in terms of requests such as RTA in support of AMAN operation or runway exit in support of BTV operation. On the other hand, the controller is notified by data link of aircraft preferences in terms of STAR, ETA, ETA min/max, runway exit, etc.

Effect:

This OI step is expected to have a limited positive effect on the capacity, since it supports AMAN.

4.2.4 Departure traffic synchronisation

4.2.4.1 TS-0201: Basic departure management (DMAN)

Runway capacity is considered as a principal constraint in today's air traffic control system. Several problems exist with regard to optimising departure sequences. Uncertainties of pushback, start-up and taxi times limit the capability of aerodrome control to achieve their preferred sequence. Several actors can influence the sequence of the departures, with each actor seeking to apply local and individual optimisation resulting in a potential for under utilisation of the runway.

The goal of this OI is to develop a system that determines the optimum runway for departure (if appropriate) and the optimum order for the departure sequence taking into account departure times, slot constraints, runway constraints such as departure rate, wake vortex separation, distance in trail, etc.

Effect:

By reducing the taxi time and ground queuing, this OI step will have a positive effect on the LAQ; also the runway capacity will be increased.

4.2.4.2 TS-0202: Departure management synchronised with pre-departure sequencing

The collaborative pre-departure sequence is used by ATC while sequencing departing aircraft as and when feasible.

Effect:

This OI step will have a positive effect on the departure management and should lead to better predictable departure traffic. This can lead to a decrease in delay times and therefore to improved LAQ.

4.2.4.3 TS-0203: Integration of surface management constraint into departure management

To improve the effectiveness of DMAN including the optimization of ground movement traffic in order to reduce the additional constraint of the airport surface capacity. This should lead to a more stable departure sequence thanks to a better awareness of traffic situation on ground.

Effect:

This OI step will have a positive effect on the efficiency, since this OI step is expected to reduce the queuing time; it should lead to a better LAQ.

4.2.4.4 TS-0302: Departure management from multiple airports

While basic departure management considers only the distribution of initial departure routes, there is a need for the consideration of the departure traffic flows into the en-route environment and interactions with other traffic flows. The system should provide support to departure metering and coordination of traffic flows from multiple airports to enable a constant delivery into the en-route phase of flight.

Effect:

This OI step will have a positive effect on the efficiency of the en route segment; however it has no effect on the LAQ.

4.2.4.5 TS-0306: Optimized departure management in the queue management process

The take-off sequence is built as predicted take-off times achieve a required level of accuracy. The precise point at which take-off times are known with sufficient accuracy will depend on the accuracy and reliability of the data available on the status of the turn-round process. Initially the required level of accuracy may not be achieved until the aircraft has requested push-back. It is however expected that during the SESAR time-frame the improving view on the status of the turn-round process will enable valid departure sequences to be built earlier. This earlier sequencing will enhance departure and arrival queue management collaboration. With knowledge of the target time of arrival (if applicable), the elapsed time derived from the trajectory, the departure and arrival demand for the runway(s) and the dependent departure route demand from adjacent airports, the system (DMAN) calculates the optimum take-off time and the surface manager will determine the associated start-up and push-back times and taxi route.

Effect:

Goal of this OI step is to minimize queuing time, which has a positive effect on the LAQ.

4.2.5 Managing interactions between departure and arrival traffic

4.2.5.1 TS-0301: Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace

Enabling complementary and optimised spacing of arrivals and departures, minimising airborne delays and also minimising departure queuing. The system provides assistance to the controller to manage mixed mode runway operations, and identify and resolve complex interacting traffic flows.

Effect:

By minimising the taxi time and ground queuing, this OI step will have a positive effect on the LAQ and reduce emissions.

4.2.5.2 TS-0304: Integrated arrival/departure management in the context of airports with interferences (other local/regional operations)

The effectiveness of AMAN-DMAN will improve by including the operations of close airports with interferences. Integration of AMAN and DMAN with the CDM processes between airports with interferences.

Effect:

This OI step will increase the capacity and also have a small positive effect on the efficiency. One of the effects can be a decrease in queuing time, which leads to a better LAQ.

4.2.6 Airborne situational awareness

The airborne situational awareness consists of three OIs, of which only one has an impact on the airport level (AUO-0401), while both others (AUO-0402 and AUO-0503) have an impact on the en route and TMA segment. Since AUO-0401 only has an effect on the safety and not on the LAQ; this OI step will not be discussed in detail.

4.2.7 Self-separation

Self separation consists of two OI steps (AUO-0504 and CM-0704), but only AUO-0504 has an impact on airport level. However, AUO-0504 only affects the safety and will not have an impact on the LAQ and will not be discussed in more detail.

4.2.8 Improving safety of operations on the airport surface

Most of the OI steps that fall under the improvement of the safety of operations on the airport surface only contribute to the safety and will not influence the LAQ. This holds for AO-0101, AO-0102, AO-0104, AO-0202 and AUO-0605. The two remaining OI steps have also an impact on respectively efficiency and capacity.

4.2.8.1 AO-0103: Improved runway-taxi lay-out, signage and markings to prevent runway incursions

Improvements in lay-out of taxiway system as well as location of runways with respect to the terminal/apron, including better placed runway crossings, use of additional perimeter taxiways, avoiding alignment of the main taxiways with entries or exits, use of perpendicular intersections. Includes also enhanced signage, markings and use of red stop bars.

Effect:

The main goal of this OI step is to increase the safety, but it also has a small positive effect on the capacity. The effect on the capacity will be limited, thus the possible effect on the LAQ will also be limited.

4.2.8.2 AO-0201: Enhanced ground controller situational awareness in all weather conditions

The improvement of this service lies in expediting the arrival and departure flows on the runway system and the movement of taxiing aircraft and other vehicles on the manoeuvring area, while reducing the potential for loss of separation. I.e. ground traffic throughput improvements (all vehicles with two-way communication means, e.g. aircraft, including towed a/c, and service vehicles).

Effect:

This OI step will only have a limited effect on the capacity since it only improves the ground capacity during low visibility. Since most ECAC-wide operations do not take place in low visibility conditions; the effect of this OI step on the LAQ will be limited.

4.2.9 Improving traffic management on the airport surface

Several of the OI steps that fall under the improvement of the traffic management of operations on the airport surface only contribute to the safety and will not influence the LAQ. This holds for AO-0204, and AUO-0602. The other OIs will now be discussed.

4.2.9.1 AO-0203: Guidance assistance to airport vehicle driver

The objective is to reduce navigation mistakes that may occur especially in low visibility conditions. The system provides vehicle drivers with an airport moving map showing taxiways, runways, fixed obstacles, and their own mobile position.

Effect:

The main goal of this OI step is to increase the safety; but it will also have a limited positive effect on the efficiency since it has only effect in low visibility conditions and it will not lead to a large increase in efficiency during these conditions.

4.2.9.2 AO-0205: Automated assistance to controller for surface movement planning and routing

This improvement is applicable to airports with a complex layout; the system provides the controller with the best route calculated by minimizing the delay according to planning, ground rules, and potential conflicts with other mobiles. The system informs the ground controller of any deviation from route/plan it has detected.

Effect:

This OI step should lead to a decrease in taxi time, since the delay of aircraft on the ground is minimized. This has a positive effect on the LAQ.

4.2.9.3 AO-0206: Enhanced guidance assistance to airport vehicle driver combined with routing

The system displays dynamic traffic context information including status of runways and taxiways, obstacles, and an airport moving map.

Effect:

This OI step should lead to a decrease in taxi time, since the delay of aircraft on the ground is minimized. This has a positive effect on the LAQ.

4.2.9.4 AO-0207: Surface management integrated with DMAN and AMAN

To improve the aerodrome throughput, AMAN and DMAN need to be considered as a combined entity, itself closely linked to SMAN especially at airports with runways used for both arriving and departing flights. The taxiing process is considered as an integral part of the process chain from arrival to departure and AMAN/DMAN is integrated with CDM processes between airport operator, aircraft operators and air traffic service provider at the same airport.

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Effect:

The achieved reduction in queuing time will have a positive effect on the LAQ.

4.2.9.5 AUO-0603: Enhanced guidance assistance to aircraft on the airport surface combined with routing

The system displays dynamic traffic context information including status of runways and taxiways, obstacles, route to runway or stand. Ground signs (stop bars, centreline lights, etc.) are triggered automatically according to the route issued by ATC.

Effect:

The main goal of this OI step is to improve the safety, the effect on capacity and efficiency will be limited and therefore the effect on the LAQ is negligible.

4.2.9.6 AUO-0604: Improving airport collaboration in the pre-departure phase

Flight crew will be supported by advanced tool for ground operations. The use of advanced aircraft automated systems such as e.g. auto-brake (making it impossible for an aircraft to cross a lit stop bar) and auto-taxi (optimizing speed adjustment).

Effect:

This OI step can have a positive effect on the LAQ if the auto-taxi system is designed in such a way that the aircraft will taxi at a constant speed, instead of applying speed changes during the taxi-procedure. The effect on LAQ will be limited since this OI step has no effect on queuing time.

4.2.10 Improved operations in adverse conditions through airport CDM

Systematic strategies are agreed and applied by CDM partners to deal with predictable (e.g. forecast bad weather, industrial action, scheduled maintenance) or unpredictable adverse conditions (e.g. unforeseen snow or fog, accident). This involves effective methods of exchanging appropriate information on the expected or actual arrival of such conditions, special procedures, and system support to facilitate the sequencing of operations where needed (e.g. de-icing). It is important to notice that the effect of these measures will be limited since they only apply in exceptional conditions that rarely occur (for most airports).

4.2.10.1 AO-0501: Improved operations in adverse conditions through airport CDM

In contrast with today's ad hoc solutions to unforeseen disruptions, prompt decision making, flexibility and adaptability of partners are facilitated during periods of reduced capacity, allowing for a faster recovery to normal operations. Systematic strategies are agreed and applied by CDM partners to deal with predictable (e.g. forecast bad weather, industrial action, scheduled maintenance) or unpredictable adverse conditions (e.g. unforeseen snow or fog, accident). This involves effective methods of exchanging appropriate information on the expected or actual arrival of such conditions, special procedures, and system support to facilitate the sequencing of operations where needed (e.g. de-icing).

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Effect:

This OI step can have a positive effect on the capacity and efficiency and therefore will improve the LAQ.

4.2.10.2 AO-0601: Improved turn-round process through CDM

In the existing environment, there is often no visible link established between the airborne and ground segments of flights, known and shared by all partners. This results in changes in one segment not being communicated to all the partners and hence they are unable to anticipate the impact and take appropriate measures to re-plan resources and necessary activities. This results in poor data quality and predictability especially for departing aircraft. A set of milestones in the turn-round process are established at airport and flight progress is monitored against those milestones. The information is shared by all involved partners, not only at the airport concerned but also in other relevant units such as the CFMU and destination airport. The completion of a milestone triggers decision making processes for downstream events. Shared information on the progress of turn-round will be used to estimate departure demand and enable arrival/departure balancing.

Effect:

Ground emissions are expected to be reduced as a result of less fuel burn in taxiing. The value of this benefit is dependent on the number of flights involved and the taxiway delay saving.

4.2.10.3 AO-0602: Collaborative pre-departure sequencing

The objective is to enable flights to leave their stands in the optimum order based on the operational situation. The pre-departure sequence refers here only to the organization of flights from the stand/parking position. Pre-departure sequences are established collaboratively with the airport CDM partners concerned taking into account agreed principles to be applied for specified reasons (e.g. slot compliance, airline preferences, night curfew, evacuation of stand/gate for arriving aircraft, etc.).

The resulting pre-departure list is used by ATC while sequencing departing aircraft, as and when feasible. In contrast to the other OI steps described in this paragraph, this OI step will not only be beneficial in adverse conditions.

Effect:

The departure sequence should be planned in such a way that the queuing time is minimized; this improves the LAQ.

4.2.10.4 AO-0603: Improved operations de-icing operation through CDM

De-icing stations are managed through CDM procedures enabling airport and ANSP to know the flights to de-ice and establish sequences accordingly.

Effect:

Better taxiing management and avoiding returns for re-icing will have a positive effect on the LAQ. The effect of this OI will be limited since the majority of the flights will not need de-icing.

Finally OI step DCB-0304 has no impact on the LAQ.

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4.2.11 Using runways configurations to full potential

4.2.11.1 AO-0402: Interlaced take-off and landing

The goal of this OI step is to provide mitigation for the inherent delays/queuing associated with capacity constrained airports and to gain a significant capacity enhancement without impacting the overall queue management concepts. Instead of segregated use of multiple runways, interlaced take-off and landing procedures can be envisaged.

Effect:

The main effect of this OI step is an increase in capacity, which can lead to a reduction in queuing time if the number of take-offs and landings per day does not increase. Furthermore the reduced demand for new infrastructure has a positive effect on the LAQ, since no polluting infrastructure projects are needed.

4.2.11.2 AO-0403: Optimized dependent parallel operations

Dependencies between multiple runways determine the practical runway capacity which, in most cases, is lower than the combined single runway capacities. Capacity gains can be achieved by increased utilization of the combined runways. Reducing dependencies between runways by implementing more accurate surveillance techniques and controller tools as well as advanced procedures, will enlarge the capabilities of existing runway configurations (like closely spaced parallel runways).

Effect:

Since this OI step leads to an increase in capacity, the queuing time will be reduced. This will have a positive effect on the LAQ.

4.2.11.3 AUO-0701: Use of runway occupancy time (ROT) reduction techniques

Evidence suggests that there is a measurable difference in the efficiency of both pilots and airlines in the use of runways. Saving just one second on every movement could result in one slot gain every two hours, so it is in the interests of all parties to ensure that vital seconds are not lost. The main flight operations elements that affect the ROT include not only braking distance or runway/taxiway design but also pilot's awareness of ROT requirements, pilot's reaction times to line-up/departure clearances, pre-departure actions, etc. This improvement addresses enhancements to operating practices of airlines and pilots in that respect.

Effect:

Evidence from studies at major, capacity critical airports has demonstrated that enhanced awareness amongst the pilot community improves the way that they are able to operate and can produce significant enhancements in runway capacity, which in turn is beneficial for the LAQ.

4.2.11.4 AUO-0702: Brake to vacate (BTV) procedure

Brake to vacate at a pre-selected runway exit coordinated with ground ATC by voice.

Effect:

Since this OI step leads to an increase in capacity, the queuing time will be reduced. This will have a positive effect on the LAQ.

4.2.11.5 AUO-0703: Automated BTV using data link

Landing aircraft can make optimal use of existing exits (runway exit taxiways or other) by adapting their braking techniques. During blue sky situations the pilot can adapt its braking as he can see the exit from quite a distance. During low visibility conditions this will become more difficult and longer ROTs will occur. Assisting the pilot in optimal braking techniques will result in lower ROTs and thus increasing capacity. Automated braking to vacate at a pre-selected runway exit coordinated with ground ATC through data link, and based on BTV avionics that controls the deceleration of the aircraft to a fixed speed at the selected exit.

Effect:

This OI step improves AUO-0702 and leads to a further increase in capacity, and therefore will have a positive effect on the LAQ.

4.2.12 Maximising runway throughput

The main effect the OIs described in this paragraph will be an increased runway capacity for landing aircraft, but if less time is needed for landing aircraft, this time can also be used to increase the number of departing aircraft, which in turn will lead to less ground queuing.

4.2.12.1 AO-0301: Crosswind reduced separations for departures and arrivals

The objective is to reduce dependency on wake vortex operations, which under suitable weather conditions, will lead to reduced arrival / departure intervals, with a positive effect on delays and runway throughput. Under certain crosswind conditions it may not be necessary to apply wake vortex minima.

Effect:

Since this OI step leads to an increase in capacity, the queuing time will be reduced. This will have a positive effect on the LAQ.

4.2.12.2 AO-0302: Time based separation for arrivals

The intent is to mitigate the effect of wind on final approach sequencing so as to achieve accurate and more consistent final approach spacing and recover most of the capacity lost under strong headwind. Constant time separations independent of crosswind conditions and wake vortex existence are introduced. Time based separation is an option to replace the distance criteria currently used to separate trailing aircraft on the approach beyond the wake vortex of the leading aircraft.

Effect:

The goal this OI step is to reduce the time between landing aircraft, thereby increasing the capacity. This will have a positive effect on the LAQ.

4.2.12.3 AO-0303: Fixed reduced separations based on wake vortex prediction

Separation standards are too conservative for a variety of meteorological situations. The use of a statistical model that gives wake-vortex behaviour with fixed aircraft separations (e.g. from collection of all relevant combinations of wake vortex behaviours in meteorological

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situations) could be an intermediate step towards individual wake-vortex forecasting. In the applicable situations, the controller uses reduced aircraft separations derived from forecasted wake vortex behaviour.

Effect:

This OI step leads to an increase in capacity due to lower separation times; this will have a positive effect on the LAQ.

4.2.12.4 *AO-0304: Dynamic adjustment of separations based on real-time detection of wake vortex*

The controller optimizes aircraft separations by taking the actual wake-vortices strength into account.

Effect:

This OI step leads to an increase in capacity due to lower separation times; this will have a positive effect on the LAQ.

4.2.12.5 *AO-0305: Additional rapid exit taxiways (RET) and entries*

In some cases, where for example backtracking after landing is required or new aircraft types at an airport cannot use existing high-speed exits, infrastructure improvements may be needed. Appropriate runway exits are provided for the aircraft mix using the runway. The ROT as well as the predictability is based on the number of exits, the design/shape of the exit, the location with respect to the landing threshold as well as pilot/airline behaviour policy. Finding a well accepted balance between number, shape and location is necessary. Multiple runway entries and a wide holding area can help to optimize the sequencing process for departing aircraft and can generate significant operational benefits during periods of traffic congestion.

Effect:

Since there will be more possibilities to leave the runway, the ROT will be reduced. This leads to an increase in capacity.

4.2.13 Improving operations under adverse conditions including low visibility

Tthe effect of these measures will be limited since they only apply in exceptional conditions that rarely occur (for most airports).

4.2.13.1 *AO-0502: Improved operations in low visibility conditions through enhanced ATC procedures*

Operations in poor weather are responsible for considerable delays within Europe. There are differences in the ways low visibility procedures (LVP) are applied, and in the procedures used. This gives the potential for considerable short term benefits from the collaborative development and implementation of procedures (e.g. best practices). LVP are collaboratively developed and are implemented at applicable airports involving in particular a harmonized application across airports and the use of optimized separation criteria.

Effect:

A reduction in LVP related delays with up to 20% is expected at those airports where best practice is not already implemented. This means that the capacity will increase during low visibility conditions. Since most ECAC-wide operations do not take place in low visibility conditions; the effect of this OI on the LAQ will be limited.

4.2.13.2 AO-0503: Reduced ILS sensitive and critical areas

ILS tuning will increase runway capacity during limiting visibility conditions (landing aircraft will free the runway earlier). This seems even more important with the introduction of new large aircraft and their effect on the ILS when taxing near/parallel to the landing runway. Smaller ILS sensitive and critical areas in CAT II/III are created through changes in the ILS antenna and ILS interception procedures (due to smaller angle of localizer beam).

Effect:

This OI enables an increase runway capacity in low visibility conditions, thus the overall effect on the LAQ will be limited.

4.2.13.3 AO-0504: Improved low visibility runway operations using MLS

Accurate and sustainable landing systems are necessary for reliable airport operations during all weather operations. MLS (in the short term) is less vulnerable to disruptions/interferences.

Effect:

The introduction of the MLS leads to an increase in capacity, the queuing time will be reduced. This will have a positive effect on the LAQ, however only during low visibility conditions.

4.2.13.4 AO-0505: Improved low visibility runway operations using GNSS/GBAS

The main benefit of using GNSS or GBAS is the increased runway capacity in poor weather conditions as the glide path and azimuth signals will face hardly any interference from previous landing aircraft or other obstacles.

Effect:

Airport restrictions (low visibility procedures / low visibility operations) caused by ILS sensitive and critical areas will be reduced and may even disappear. This offers the potential to perform CAT II and III approaches without the additional low visibility margins between aircraft. This will allow maintaining approach capacity independently of visual conditions. The higher capacity can lead to an improved LAQ in low visibility conditions.

AUO-0403 contributes to safer aircraft operations, but does not have an impact on the LAQ

4.2.13.5 AUO-0404: Synthetic vision for the pilot in low visibility conditions

The system in the cockpit provides the pilot with a synthetic/graphical view of the environment using terrain imagery and position/attitude information.

Effect:

This OI leads to an increase in capacity if the separation on the ground decreases; this can have a positive effect on the LAQ in low visibility conditions.

4.2.14 Visual conducted approaches

4.2.14.1 AUO-0501: Visual contact approaches when appropriate visual conditions prevail

A significant benefit in declared capacity can only be achieved at airports with a low probability of instrument meteorological conditions (IMC) and LVP. Visual contact approaches are applied instead of IFR operations when appropriate visual conditions prevail. The legally approval of this type of VFR procedure for IFR traffic in Europe is a prerequisite.

Effect:

A capacity gain of approximately 10% can be gained, dependent on actual fleet mix. If this OI is introduced, a reduction in fuel consumption can be expected as a consequence of less delay and less go-arounds. The increased capacity and lower number of go-arounds will have a positive impact on the LAQ, however as long as the OI is not legally approved; it will not have any effect. Furthermore this OI only is beneficial for airports with a low probability of instrument meteorological conditions; this will limit the effect of the OI on the LAQ.

4.2.14.2 AUO-0502: Enhanced visual separation on approach (ATSA-VSA)

The objective is to facilitate successive approaches for aircraft cleared to maintain visual separation from another aircraft on the approach. However, applicability within core European airspace appears to be very limited and for airports that do not currently use visual separation on approach, there is unlikely to be a case to introduce Enhanced Visual Separation. The application (ATSA-VSA) helps crew to achieve the visual acquisition of the preceding aircraft and then to maintain visual separation from this aircraft.

Effect:

An increase in efficiency and especially capacity is expected, however this effect will be limited since the applicability of this OI step is expected to be limited due to the low number of airports that use visual separation.

4.2.15 Implementing sustainable operations at airports

4.2.15.1 AO-0701: Effective collaboration between ATM stakeholders supported by environmental management systems

The goal is to manage the operation and onward development of an airport in such a way as to effectively curb the facility's impact on the environment. The airport companies have therefore to introduce a modern, long-term environmental management system. This management system creates the foundations for a comprehensive and all-encompassing approach to environmental policy. ATM operational stakeholders adopt a sustainability policy supported by appropriate environmental management system to facilitate standard setting, monitoring and continuous improvement. Sharing best practices between airports, ATC, local airlines is a first step.

Effect:

The main goal of this OI step is to decrease the impact of air traffic (including ground operations) on the environment; therefore it will be beneficial for the LAQ.

4.2.15.2 AO-0702: Improved relations to neighbours

ATM stakeholders have to improve their understanding of the existing and emerging perceptions, and needs and expectations of society, especially in terms of the management of adverse socio-environmental impacts. A better understanding by the local community of the real disturbance is achieved through provision of more accurate and accessible information (noise, tracks, air emission, etc.) as well as through improvements in decision-making, consultation process and impact management (better transparency towards community). A commonly agreed development path for the airport and the surrounding communities is achieved (incl. e.g. noise protection zones, noise protection programs).

Effect:

The main effect of this OI step will be the limitation of the noise impact of air traffic. The goal is to reduce the environmental effects on the communities in the vicinity of the airport, not on the airport itself. For this reason the effect on the LAQ will be limited.

4.2.15.3 AO-0703: Noise management to limit exposure to noise on the ground

This improvement involves the application of a range of noise reducing measures including:

- Night noise management regimes with restrictions during night (e.g. noise preferential use of runways);
- Implementation of noise quotas (e.g. noise quota for the airport, per runway heading, at several points around the airport) and noise account for each airline;
- Noise limitations on the ground (e.g. engine test forbidden at night, no reverse thrust).

Effect:

This OI step only influences the noise impact; the proposed improvements have no direct effect on the LAQ. Only if the noise quotas lead to a lower number of flights, the LAQ will benefit from this OI step. This is caused by the fact that a decrease in traffic leads to a decrease in the required capacity. This has a positive effect on the LAQ.

4.2.15.4 AO-0704: Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance

The airport taxiway design and the associated procedures are optimized in such a way as to reduce the queue and taxiing (dual taxi routes separating inbound and outbound traffic, new taxiways and RET, preferential runway use, standard routing, etc.). The associated procedures for this infra-structure are developed considering reductions to air pollution and noise disturbance levels of aircraft.

Effect:

Optimizing the taxi routes and procedures with respect to fuel consumption and emissions will have a large impact on the LAQ.

AO-0705 leads to reduced water pollution, but has no impact on the LAQ.

4.2.15.5 AO-0706: (Local) monitoring of environmental performance

The environmental performance (compliance to operational procedures, key performance indicators) of ATM stakeholders at the airport is recorded and monitored in support of

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continuous improvement process. In particular, it is possible to determine the amount of airport related versus external pollution. This improvement involves use of noise monitoring system, flight tracking and air quality monitoring system.

Effect:

Using an air quality monitoring system offers the possibility to assess the effect of the airport on the LAQ and can be used to indicate what improvements are needed. This OI will not directly contribute to a better LAQ.

4.2.15.6 AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

4D-Trajectory management is not only about the business intention of the aircraft operator. Environmental sustainability restrictions have to be taken into account. Environmental sustainability restrictions are becoming more and more a significant restriction for the execution and planning of the business trajectories of aircraft operators. It is in the interest of all ATM-stakeholders (aircraft operators and airports) to take into account the (most often local) environmental restrictions in the early phase of flight planning.

Effect:

Trajectory management only takes the airborne part of a flight into account, and will therefore have a negligible impact on the LAQ; especially since the main focus at low altitude will be the reduction of noise hindrance and not the reduction of the amount of fuel used.

4.2.15.7 AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

Time management techniques and aircraft movement technologies are developed which reduce both fuel consumption and noise by taxiing aircraft (e.g. taxiing with not all engines operating) or towing the aircraft to/from the runway with all engines off. The use of electric (instead of hydro-carbon powered) auxiliary power units and ground handling vehicles further reduces the noise and particulate pollution around parked aircraft.

Effect:

This OI step results in a reduction of local air pollution and noise disturbance at airport and surrounding areas, so it has a positive effect on the LAQ.

4.2.15.8 AUO-0803: Visual reduced noise footprint departure

The objective is to maintain the necessary safety of flight operations whilst minimizing exposure to noise on the ground. Continuous improvements in engine and airfoil design provides Aircraft operators have to be pro-active in the development of operating techniques which take advantage of technological improvements to shrink the noise footprint on departure. The improvement comes through better rates of climb, reductions in required thrust percentage, quieter engines coupled with better SID route planning and altitude usage. Airspace users work with ATM to develop noise abatement procedures.

Effect:

The main goal of this OI step is to reduce the noise footprint; however it can also have an indirect effect on the LAQ. If the required amount of thrust decreases, this will influence the LAQ. For instance the emission index of NO_X (the amount of NO_x emitted per kilogram of fuel burned) will decrease with a decreasing thrust setting.

If new engines are designed, this can have an impact on the LAQ. The use of ultra high bypass engines for instance leads to a reduction of the noise production. However, high bypass engines have a high emission index of NO_x compared to engines with lower bypass rations. Since new generations of engines will be more fuel efficient, the use of future engines is not expected to lead to an increase in NO_x emissions.

4.3 Information management

4.3.1 Improving flight data consistency and interoperability

4.3.1.1 *DCB-0301: Improved consistency between airport slots, flight plans and air traffic flow management (ATFM) slots*

The objective is to ensure realistic scheduling to meet airline demands in line with capacity declarations. Benefits will be found in slot adherence, delay reduction and ultimately cost efficiency. Goal is to ensure convergence between airport slots, ATFM slots together with airport slot monitoring process in order to improve consistency on a daily basis and to reduce delays.

Effect:

The main effect of this OI step is an increase in capacity due to the optimum use of central flow management unit (CFMU) slots and airport runway slots and reduced delays; furthermore the efficiency increases. The main effect of this OI step will be an increase in en route capacity, while the effect on the ground capacity is limited. Therefore, the effect on the LAQ is limited.

4.3.1.2 *DCB-0302: Collaborative management of flight updates*

The objective is to enhance tactical capacity planning for the entire ATM network by ensuring completeness of information between en route and airport operations. Airports need to be seen as being a part of the whole ATM system in a gate-to-gate environment. As the tactical manager of the total network load, ATFCM has to collaborate with air traffic control, aircraft operators, and airport in a genuine partnership.

The goal of this OI step is that the interface between airports and ATFCM is reinforced at the tactical level in order to improve predictability of operations through exchanges of accurate departure and arrival times, CFMU providing airports with arrival estimates up to 3 hours prior landing (taking account of updated information on flight progress) whilst airports provide CFMU with flight data updates before take-off.

Effect:

By improving departure time estimates for all flights processed by CFMU, this OI step contributes indirectly to enhancing the ATFM slot allocation process and therefore, to a better usage of available network capacity; furthermore the efficiency increases. This OI will lead to an increase in airport capacity, but its main effect will be an increase in en route capacity; therefore the effect on the LAQ is limited.

4.3.1.3 *IS-0101: Improved flight plan consistency pre-departure*

Reprocessing and effective dissemination of flight plan amendments before estimated off block times together with defined responsibilities will ensure one single flight plan before departure supporting accurate and updated flight data for airspace users, airports and ATM.

All partners should be able to access this data to calculate local profiles. The process will be sufficiently flexible to allow aircraft operators to take advantage of airspace improvements or changed circumstances. Goal is to assure that airspace users, airport and ATM have a consistent view of the filed flight plan including late updates until departure.

Effect:

This OI step will lead to an increase in efficiency, but its main effect will be an in the en-route segment; therefore the effect on the LAQ is limited.

4.3.1.4 IS-0102: Improved management of flight plan after departure

The process will provide an effective interface between ATC, ATFCM, and Airport with regard to deviations from the current flight plan. The goal of this OI is that the ATFCM is aware of deviations from flight plan incl. Route changes, diverting flights, missing flight plans, change of flight rules (IFR/VFR) or flight type (GAT/OAT). This enables a better assessment of the impact of airspace changes on aircraft while in flight, an improved monitoring of actual traffic situation and, if necessary, the triggering of revisions to the network and airports operations plan.

Effect:

This OI step will have a positive effect on the efficiency, but this effect mainly takes place while the aircraft is airborne. Therefore the effect on the LAQ will be limited.

4.3.2 Improving aeronautical and weather information provision

The OI steps that fall under improving aeronautical and weather information provision will have no effect on LAQ and therefore will not be discussed in detail. Their main effect will be an increase in safety level.

4.3.3 From AIS to AIM

Goal is to introduce an aeronautical information management system (AIM). The OI steps that fall under improving aeronautical and weather information provision will have no effect on LAQ and therefore will not be discussed in detail. Their main effect will be an increase in safety (IS-0202) and interoperability (IS-0203 and IS-0204).

4.3.4 Implementing system wide information management (SWIM)

These OI steps include all aspects of creating, sharing, obtaining, providing, protecting and using information. Includes all aspects related to operations that continue to be airspace based (e.g. military).

4.3.4.1 IS-0701: SWIM – baseline and initial common information model based on existing and consistent standards

An initial common information model covers the existing information models such as AIXM (AIS static part), WXXM (weather information), AMXM (airport mapping), FOIPS (flight information), and ASTERIX (Surveillance Information). It also addresses the information models for demand & capacity and ATFCM scenario. It ensures the overall consistency between all these models. It also looks for an agreement on the data quality requirements for the different partners and different data types/elements. This OI step forms a commonly agreed initial model baseline but the model will continuously evolve from the IOC date onwards (e.g. to complement it with the dynamic aeronautical information, ENXM, Terrain data, aircraft information, etc ...). It does not mean that further OI steps need to be defined after that one which is just provided to show a pre-requisite on which SWIM will be implemented.

Effect:

This OI step will lead to an increase in efficiency on the ground; however the effect on the LAQ is expected to be small since the OI step does not lead to a large decrease in taxi and queuing time.

4.3.4.2 IS-0702: SWIM – European ground communication infrastructure

In order to implement SWIM services and move from a product centric to a data centric approach, SWIM will have to be supported by a Communication network on top of which some basic services provided through an IOP middleware will have to be made available and integrated within each EATMS system having a role & responsibility (at least one of the main ones identified during D3: User, Contributor, Publisher). The communication network can be made available through interconnected national networks first, then through the Pan-European Network (PEN).

Effect:

This OI step will have a positive effect on the efficiency. The effect of the SWIM concept on the LAQ is expected to be limited, as discussed in the previous section (IS-0701).

4.3.4.3 IS-0704: SWIM – ground-ground limited services

This represents the first implementation of some SWIM services between at least two area control centres to exchange flight data information. In order to ensure the efficiency of the information exchanges also the necessary meteo and aeronautical information needs to be shared. It is envisaged also that Surveillance information will start to be shared through dedicated SWIM services.

Effect:

This OI step will have a positive effect on the efficiency. However since the area control centres do not control traffic near the ground the increased efficiency will not have any effect on the LAQ.

IS-0703 has no effect on the LAQ; its main effect will be better access and equity. IS-0705 until IS-0710 will have no effect on the LAQ; their main effect will be better interoperability.

4.3.5 Weather information for ATM planning and execution

The OI steps that fall under improving aeronautical and weather information provision will have no effect on LAQ and therefore will not be discussed in detail. Their main effect will be an increase in safety level (IS-0401), interoperability (IS-0402) and predictability (IS-0501).

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4.4 NETWORK

A large number of the OIs that have an impact on the network will not have an impact on the airport level. Therefore this chapter will only discuss the OI steps that are relevant for the LAQ.

4.4.1 Enhanced seasonal network operational plan

4.4.1.1 DCB-0201: Interactive network capacity planning

The interactive network capacity planning process reflects the cooperative approach indicated in the DMEAN concept of operations to improve the ATM network performance year on year. Up-to-date and comprehensive capacity data and information from ANSPs and airports is available. The process offers an interactive support to stakeholders in the development of medium-term plans. Capacity planning information, data and tools are available on-line. Latent capacity is used to relieve bottlenecks through consolidated capacity planning process based on coordination and network synchronization of ANSPs/airports enabling the adaptation of the capacity delivery where and when required.

Effect:

The analysis of the DMEAN case study at Maastricht UAC in 2005 indicates that average delivered capacity increased by 26%. This provides a useful indicator of the latent capacity that can be released by wide-ranging and co-ordination actions and its benefits. The increase in capacity can be beneficial for the LAQ.

4.4.2 Air traffic flow management (ATFM) slot swapping

4.4.2.1 AUO-0101: ATFM slot swapping

The objective is a more flexible management of departure or arrival regulations especially during an airport critical event, and more freedom of choice for airspace users to adapt their operations. Aircraft operators' tactical priorities are introduced in a cooperative process with the CFMU through ATFM slot exchanges (such slot exchange could be for instance between flights within a single company or within a strategic alliance of companies). CFMU may propose slot exchanges between flights to minimize the overall inconvenience to the community as a whole with the objective of minimizing the total ATFM delay.

Effect:

This OI step is an operational tool for the airspace users especially at major hubs when serious congestion may happen. At these airports it may lead to a higher capacity and efficiency. Since the largest problems with long queuing and taxi times occur at busy hub airports, this OI step can have a significant effect on the LAQ.

4.4.2.2 AUO-0102: User driven prioritisation process (UDPP)

This process can be used in case of disruptions of the network and at congested airports. This process leaves room for airspace users to trade slots if they individually agree to do so, based on agreements and rules that are transparent to the other actors but that respect sets of rules agreed by all parties. The process is permanently monitored by the Network Management function in order to make sure that an acceptable solution is available in due time and that all concerned parties are aware of any adverse network wide effects that may develop.

Effect:

This OI step will increase the efficiency since airspace users will adapt opportunities to their needs. It should be noted that if the users were determining the prioritization process, this would lead to less efficient traffic than traffic optimized without any user preferences. For this reason, the positive effect of UDPP will be limited.

4.4.3 Improving network capacity management process

4.4.3.1 *DCB-0206: Coordinated network management operations extended within day of operation.*

As it is the case today 10 to 40% of the traffic will remain uncertain until tactical phase is reached. This uncertainty suffices to create indeterminacy on the best activation or de-activation times of planned measures. Furthermore, the recourse to ground delays is expected to be considerably reduced thanks to alternative solutions for demand and capacity balancing offered by ATFCM collaborations incl. application of pre-defined scenarios and optimised sectors configurations (thanks to more flexible sector definition enabling dynamic ACC re-sectorisation). After analysis of anticipated capacity shortfalls at local, regional or network wide levels, responses are selected from pre-defined scenarios and adjusted to the planned situation until day of operation. This relies on improved working relationship and processes between CFMU/FMPs/ATC supervisor especially during the anticipating and reacting phases to optimize capacity throughput in sector groups.

Effect:

This OI step is expected to have a positive effect on the ground delays; however the capacity is not expected to increase. The increased efficiency is not expected to lead to a large improvement in the LAQ.

4.4.4 Monitoring ATM performance

4.4.4.1 *SDM-0103: Sustainability performance management of the ATM network*

Sustainability policies shall remain determined at local level, which means that pan-European harmonisation can only be achieved for the definition of a 'sustainability framework for ATM'. The dissemination of useful practices is facilitated by harmonised framework that takes fully account of the local specificities and pressure exercised by the neighbouring communities. It should give the opportunity to evaluate the current progress made on this improvement axis by local communities. Goal is to develop and monitor network efficiency indicators to describe the environmental performance of the ATM network.

Effect:

This OI step can be used to verify whether measures that are taken to improve the LAQ work and, if necessary, what other measures are needed to improve the LAQ further.

4.5 TMA

A large number of the OI steps that have an impact on the TMA will not have an impact on the airport level. Therefore this chapter will only discuss the OI steps that are relevant for the LAQ.

4.5.1 Arrival traffic synchronisation

4.5.1.1 TS-0102: Arrival management supporting TMA improvements (incl. CDA, P-RNAV)

Improved arrival management in combination with optimised runway utilisation procedures and infrastructure will assure the capability to build a safe, continuous, expeditious and optimised flow of arriving aircraft towards, on and vacating the airport runway(s). This enhanced AMAN will help to smooth throughput, and will, in fact, provide consistent spacing (even in very windy weather) because it looks at aircraft-to-aircraft relationship rather than just fixed spacing requirements. AMAN support is improved to facilitate the use of P-RNAV in the terminal area together with the use of CDA approaches. Sequencing support based upon trajectory prediction will also enhance operations within the terminal area thus allowing a mixed navigation capability to operate within the same airspace and provide a transition to eventual 4D operations.

Effect:

This OI step will facilitate the use of continuous descent profiles and will increase the capacity due to better spacing between aircraft. As discussed in paragraph 2.1 (AOM-0701), the effect of a CDA on the LAQ is expected to be limited.

4.5.1.2 TS-0103: Controlled time of arrival (CTA) through use of data link

When initially issued, the CTA represents the current optimised sequence that can still be changed if circumstances dictate. For a short flight the CTA should be very close to the pre-take-off target time of arrival (TTA) and is calculated as soon as the flight is airborne. For longer flights the CTA must be available well before planned top-of-descent and is calculated when the flight passes the AMAN sequencing horizon. The CTA is an ATM imposed time constraint on a defined merging point associated to an arrival runway. The CTA (which includes wake vortex optimization) is calculated after the flight is airborne and published to the relevant controllers, arrival airport systems, user systems and the pilot. All partners in the system work towards achieving the CTA.

Effect:

This OI step will have a positive effect on the LAQ, since the availability of accurate arrival times has a positive effect on the capacity and efficiency.

4.5.1.3 TS-0104: Integration of SMAN constraint into AMAN

To improve the effectiveness of AMAN including the optimization of ground movement traffic in order to reduce the additional constraint of the airport surface capacity. This should lead to a more stable arrival sequence due to a better awareness of the traffic situation on ground.

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Effect:

This OI step leads to a more stable arrival sequence. Due to the fact that an increase in predictability of the arrival flow may lead to a higher capacity; this OI step can have a positive effect on the LAQ.

4.5.1.4 TS-0106: Multiple controlled times of over-fly (CTOs) through use of data link

The CTOs allow to perform precise sequencing not only on arrival (CTA) but also on other intermediate merging points e.g. in en-route. The CTOs are ATM imposed time constraints set on successive defined merging points for queue management purposes. The CTOs are computed by the ground actors on the basis of the estimated times provided by the airspace user (airline operation centre or flight crew). They have to be met by the aircraft with the required performance.

Effect:

Like the previous OI step(TS-0104), this OI step leads to a more stable arrival sequence, which can have a positive effect on the LAQ.

4.5.1.5 TS-0303: Arrival management into multiple airports

Assistance to multiple airport arrival management in the terminal area environment is becoming increasingly necessary especially in view of the emerging use of secondary airports which are located in close proximity to major airport hubs. In a complex terminal airspace environment there may be significant interaction between traffic flows into a number of these airports. The interaction of such traffic flows in relation to arrival management must be analysed. The system provides support to coordination of traffic flows into multiple airports in the vicinity to enable a smooth delivery to the runways.

Effect:

This OI step also leads to a more stable arrival sequence, which can have a positive effect on the LAQ.

4.5.1.6 TS-0305: Arrival management extended to the en route airspace

The system integrates information from arrival management systems operating out to a certain distance (e.g. 200 NM) to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by using speed control to absorb some of the queuing time.

Effect:

Since this OI step may decrease the queuing time it can have a positive effect on the LAQ.

4.5.2 ASAS separation

4.5.2.1 TS-0105: ASAS sequencing and merging as contribution to traffic synchronisation in TMA (ASPA-S&M)

The benefit of this OI is a decrease in the workload of the controller, and to allow more regular flow to the runway, and increase the runway throughput. The flight crew ensures a spacing from designated aircraft as stipulated in new controller instructions for aircraft spacing. The spacing could be in time or space. The controller remains responsible for providing separation between aircraft. The crew is assisted by ASAS and automation as necessary.

Effect:

This OI step can increase the runway throughput, which can reduce the queuing time. A reduction in queuing time is beneficial for the LAQ.

4.5.2.2 *TS-0107: ASAS manually controlled sequencing and merging.*

The ASAS sequencing and merging application is used by the flight crew to merge behind an identified target aircraft and then to maintain a defined spacing during descent and approach. Its use reduces controller task load, assists in the conduct of CDAs, and improves the predictability and stability in the flow of traffic for optimum use of an airport runway.

Effect:

The major benefit comes from the decrease of task load of the ATC and better synchronization of traffic to the runway; this gives an increase in capacity. The reduction in queuing time that is caused by the increased capacity is beneficial for the LAQ.

4.6 Conclusions – LAQ Screening & Scoping

This section first gives some general conclusions and after that five groups of OI steps (no/limited effect, medium effect, large effect, indirect effect and unknown effect) are presented. Finally the ten OI steps with the highest expected positive impact on the LAQ will be given. These ten OI steps are given in order of expected importance (number 1 is expected to have the largest impact).

4.6.1 General conclusion

Since Episode 3 deals with ATM related items; background concentrations and emissions of buildings and vehicles at or near the airport are neglected in this text. This means that the term LAQ only refers to local aircraft emissions in this document.

This chapter has shown the impact on the LAQ of several OI steps. Since the goal of Episode 3 is a reduction in local emissions with 10% per flight; the effect of traffic growth on the LAQ will be neglected in this document. However, it is clear that an increase in traffic has a negative impact on the LAQ due to the pollution of each additional flight.

Since the effect per flight is analysed; improvements of the airport capacity are considered to have a positive effect on the LAQ. This effect is caused by the reduction in queuing and taxi time, which means that the contribution to the local pollution per flight is reduced. Also an increase in efficiency at airport level will lead to an improvement in the local emissions per flight.

The analysis of the different OI steps shows that none of the proposed OI steps is expected to have a negative impact on the LAQ. This can be explained by the fact that all OI steps have the goal to improve the ATM system, which means that the overall performance of the system increases. Therefore none of the OI steps will have a negative impact on the capacity, efficiency and the LAQ.

4.6.2 OI steps with a limited effect

AOM-0701: Continuous descent approach (CDA)

AOM-0702: Advanced Continuous descent approach (ACDA)

AOM-0703: Continuous climb departure

AOM-0704: Tailored arrival

AOM-0705: Advanced continuous climb departure

AUO-0302: Successive authorisation of reference business/mission trajectory (RBT) segments using data link

AUO-0303: Revision of business/mission trajectory (RBT) using data link

AO-0103: Improved runway-taxi lay-out, signage and markings to prevent runway incursions

AO-0201: Enhanced ground controller situational awareness in all weather conditions

AO-0203: Guidance assistance to airport vehicle driver

AO-0206: Enhanced guidance assistance to airport vehicle driver combined with routing

AUO-0603: Enhanced guidance assistance to aircraft on the airport surface combined with routing

AUO-0604: Improving airport collaboration in the pre-departure phase

AO-0501: Improved operations in adverse conditions through airport CDM

AO-0603: Improved operations de-icing operation through CDM

AO-0502: Improved operations in low visibility conditions through enhanced ATC procedures

AO-0503: Reduced ILS sensitive and critical areas

AO-0504: Improved low visibility runway operations using MLS

AO-0505: Improved low visibility runway operations using GNSS/GBAS

AUO-0404: Synthetic vision for the pilot in low visibility conditions

AUO-0502: Enhanced visual separation on approach (ATSA-VSA)

AO-0702: Improved relations to neighbours

AUO-0801: Environmental restrictions accommodated in the earliest phase of flight planning

DCB-0301: Improved consistency between airport slots, flight plans and air traffic flow management (ATFM) slots

DCB-0302: Collaborative management of flight updates

IS-0101: Improved flight plan consistency pre-departure

IS-0102: Improved management of flight plan after departure

IS-0701: SWIM – baseline and initial common information model based on existing and consistent standards

IS-0702: SWIM – European ground communication infrastructure

AUO-0102: User driven prioritisation process (UDPP)

DCB-0206: Coordinated network management operations extended within day of operation

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4.6.3 OI steps with a medium effect

AO-0205: Automated assistance to controller for surface movement planning and routing

AO-0601: Improved turn-round process through CDM

AO-0301: Crosswind reduced separations for departures and arrivals

AO-0302: Time based separation for arrivals

AO-0303: Fixed reduced separations based on wake vortex prediction

AO-0304: Dynamic adjustment of separations based on real-time detection of wake vortex

AO-0305: Additional rapid exit taxiways (RET) and entries

AUO-0101: ATFM slot swapping

TS-0105: ASAS sequencing and merging as contribution to traffic synchronisation in TMA (ASPA-S&M)

TS-0107: ASAS manually controlled sequencing and merging

4.6.4 OI steps with an large effect

TS-0201: Basic departure management (DMAN)

TS-0202: Departure management synchronised with pre-departure sequencing

TS-0203: Integration of surface management constraint into departure management

TS-0306: Optimized departure management in the queue management process

TS-0301: Integrated arrival/departure management for full traffic optimizations, including within the TMA airspace

TS-0304: Integrated arrival/departure management in the context of airports with interferences (other local/regional operations)

AO-0207: Surface management integrated with DMAN and AMAN

AO-0602: Collaborative pre-departure sequencing

AO-0402: Interlaced take-off and landing

AO-0403: Optimized dependent parallel operations

AUO-0701: Use of runway occupancy time (ROT) reduction techniques

AUO-0702: Brake to vacate (BTV) procedure

AUO-0703: Automated BTV using data link

AUO-0501: Visual contact approaches when appropriate visual conditions prevail

AO-0701: Effective collaboration between ATM stakeholders supported by environmental management systems

AO-0704: Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance

AUO-0802: Ground movement techniques to reduce gaseous emissions and noise disturbance

DCB-0201: Interactive network capacity planning

TS-0102: Arrival management supporting TMA improvements (incl. CDA, P-RNAV)

TS-0103: Controlled time of arrival (CTA) through use of data link

TS-0104: Integration of SMAN constraint into AMAN

TS-0106: Multiple controlled times of over-fly (CTOs) through use of data link

TS-0303: Arrival management into multiple airports

TS-0305: Arrival management extended to the en route airspace

4.6.5 OI steps with an indirect effect

AO-0706: (Local) monitoring of environmental performance

SDM-0103: Sustainability performance management of the ATM network

4.6.6 OI steps with an unknown effect

AUO-0803: Visual reduced noise footprint departure

4.6.7 The 10 most important OI steps with regards to LAQ impact

This paragraph provides a list with the 10 most important OI steps in order of importance. This means that the first OI step is expected to have the biggest positive impact on the LAQ. Since emissions below 1000 ft have the largest impact on the LAQ; this list only contains OI steps that have their main effect at or near the airport surface.

An improvement in LAQ can be achieved by two main improvements. First of all increasing runway throughput (this leads to less ground queuing), which can be achieved by minimizing the separation between aircraft. Also reducing the taxi time and the emissions during taxiing have a positive effect on the LAQ.

Several OI steps have to be implemented in combination with other OI steps in order to achieve an optimal result. For instance TS-0301 and TS-0304 both deal with integrating arrival and departure management; one at airport level and the other at TMA level. Since both OI steps have the largest effect if they are combined, they will be mentioned together in the list.

Since several OI steps are combined, a list of 11 OI steps remain with a large impact on the LAQ. The effect of AUO-0501 strongly depends on the legal approval of this procedure, it is not sure whether this OI step really can be implemented. For this reason it is omitted from the 10 most important OIs.

The top ten list is:

AO-0704 Optimized design and procedures for airport manoeuvring areas to reduce gaseous emissions and noise disturbance

AO-0701 Effective collaboration between ATM stakeholders supported by environmental management systems

AUO-0802 Ground movement techniques to reduce gaseous emissions and noise disturbance

AO-0207 Surface management integrated with DMAN and AMAN

AO-0402, AO-0403, AUO-0701, AUO-0702 and AUO-0703 combined
Using runways configurations to full potential

TS-0301 and TS-0304 combined
Managing interactions between departure and arrival traffic

TS-0201, TS-0202, TS-0203 and TS-0306 combined
Departure traffic synchronisation

DCB-0201 Interactive network capacity planning

AO-0602 Collaborative pre-departure sequencing

TS-0102, TS-0103, TS-0104, TS-0106, TS-0303 and TS-030 combined
Arrival traffic synchronisation

AO-0207 combines AMAN, DMAN and SMAN. For this reason this OI step will result more effect than any OI step that only deals with AMAN and/or DMAN. TS-0301 and TS-0304 integrate AMAN and DMAN. This means that these OI steps will have a larger effect than OI steps that are solely beneficial for AMAN or DMAN. Finally DCB-0201 and AO-0602 are a part of DMAN and therefore have less effect than OI steps that have the goal to optimize the whole DMAN process.

DMAN results in a reduction of queuing, while AMAN leads to an increase in runway throughput, but has no direct effect on the LAQ. For this reason, the effect of AMAN is expected to be lower than the effect of DMAN.

If optimal AMAN, DMAN and SMAN integration is implemented; this already leads to an increase in runway throughput. For this reason the effect of maximizing the runway throughput is expected to be smaller than the effect of AMAN, DMAN and SMAN integration.

Finally, AO-0701, AO-0704 and AUO-0802 have the main goal to reduce emissions. For this reason, it is expected that these OI steps have the largest impact on the LAQ. AO-0704 focuses on the design of airports and procedures optimized with respect to local emissions, therefore this is considered to be the most important OI step with regards to LAQ.

5 GLOBAL EMISSIONS – SCREENING & SCOPING OF THE OPERATIONAL IMPROVEMENTS

5.1 INTRODUCTION

The goal of this chapter is to identify the operational improvements (OIs) that have the largest positive impact on the Global Emissions (GE).

The analysis of the concept is performed on OI step level.

The OI steps have been filtered on the basis of their supposed impact on Global Emissions; they have been analysed one by one highlighting why and how they contribute to the Global Emissions.

They have been first grouped on the basis of the original Operational context (airport, TMA, En-Route, Network and Information Management) and then on the basis of the expected benefits (Low, Medium and High), allowing by this way to select the "best ones".

The operational improvements steps with respect to environment as mentioned in this chapter are on a per flight basis, so excluding the effects of traffic growth.

The goal of this chapter is to provide a list with the OI steps that have the largest positive impact on the Global Emissions assessment. This list can be used in EP3 successor projects, such as for example SESAR WP16.3, to investigate the identified OI steps in more detail.

The descriptions of the OI steps in this chapter are taken from SESAR information document. They have been filtered based on their supposed impact on Global Emissions, and then they have been grouped on the basis of the original Operational context:

- Airport;
- TMA;
- En route;
- Network.

For each operational context are reported all OI steps contributing to the Global Emissions. Even if all flight phases contribute to the Global Emissions, from Departure Gate to Arrival Gate, here OI steps relevant only for the ground side have been excluded. About the airport operational context, here are reported only those OI steps that have some influence on the climb, descend or en-route phase. All OI steps related to the ground side of airports, meaning for example reduction in taxi time, or in queues at RHP are here not reported, it is assumed that they are covered in the LAQ Chapter, since their weight is bigger there (below 3000ft).

To have a synthetic picture of the OI steps, at the end of the document (section 5.6), it has been drawn up a list of the most important OI steps with regards to Global Emissions, to give clear indications on the OI steps which are required to be validate in more detail to answer the question, if the high level objectives with regards to "Environmental Sustainability" can be achieved.

Each section of this text gives a short description of an OI its effect on Global Emissions.

It has to be notified, that, in line with SESAR goal, "10% reduction of Environmental impact per flight", here are reported only OI steps that have potential impact on Global Emissions per flight. On the other side, on a global scale, each OI step that generates an increase in airspace/airport capacity, generates increase in the flights' number and then on the Global Emissions.

Chapter 5.2 until 5.5 will discuss the OI step that have an effect on respectively the en-route, the network and the TMA. Finally chapter 5.6 summarizes all OI steps and orders them in groups that indicate whether they have a low, medium, high effect on the Global Emissions. This chapter also gives a list with those OI steps that have the largest positive impact on the Global Emissions.

5.2 AIRPORT

5.2.1.1 *TS-0302: Departure management from multiple airports.*

While basic departure management considers only the distribution of initial departure routes, there is a need for the consideration of the departure traffic flows into the en-route environment and interactions with other traffic flows. The system should provide support to departure metering and coordination of traffic flows from multiple airports to enable a constant delivery into the en-route phase of flight.

Effect:

This OI step will have a positive effect on the efficiency of the en route segment; that means that it has a medium effect on the Global Emissions.

5.3 TMA

5.3.1 Optimizing climb/descent

5.3.1.1 *AOM-0701: Continuous descent approach (CDA).*

Goal is that under specific circumstances (low traffic density), simple CDA is used at airport through adapted procedures (no need for further ground system automation).

Effect:

UPS trials in Louisville (SDF) reported a fuel saving of around 50-150kg per flight, CO reduced by 12,7% (B767), NOx by 34,3%(B767)[9][8] .

Even if only reduced information earlier validation projects on CDA is available, it seems evident, that CDA is promising, so that the OI step “CDA” is expected to have a high effect on the Global Emissions.

5.3.1.2 *AOM-0702: Advanced Continuous descent approach (ACDA)*

This improvement involves the progressive implementation of harmonized procedures for CDAs in higher density traffic. Continuous descent approaches are optimized for each airport arrival procedure. New controller tools and 3D trajectory management enable aircraft to fly, as far as possible, their individual optimum descent profile (the definition of a common and higher transition altitude would be an advantage).

Effect:

If this OI step is implemented, more aircraft can fly CDAs, which means that it will further increase the effect of AOM-0701.

[9] MIT Tech Talk, “Quieter , cleaner airplane landings on the way”, Volumen 49 - Number 15, page 4, 26.01.2005.

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Taking into account the above consideration as well as those done for the OI step "AOM-0701", shows that the ACDA is expected to have a high effect on the Global Emissions.

5.3.1.3 AOM-0703: Continuous climb departure

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. When traffic permits, continuous climb departure is used to reduce noise by a higher altitude trajectory around the airport. Fuel consumption is reduced by flying optimized profile (no vertical containment required).

Effect:

The main effect is expected above 3000 ft. It needs assessment; if speed is lower than the standard climb departure, this could retry flap retraction, thus increasing fuel burn and Global Emissions impact. Medium effect is expected on Global Emissions.

5.3.1.4 AOM-0704: Tailored arrival

This procedure is a kind of Continuous Descent Approach (CDA) in which descent is made mostly on idle power. The objective is to minimise fuel consumption (operating cost) as well as noise production. In an operating environment with low traffic volume these optimized approaches can easily be made (as already done at several airports worldwide, especially during night time) but in case of high traffic volume the concept has still to be proven.

Effect:

For this OI step the same holds as for the CDA procedure (AOM-0701). Taking everything into account, shows that the tailored arrival is expected to have a high effect on the Global Emissions, but it needs further assessment.

5.3.1.5 AOM-0705: Advanced continuous climb departure

Managed Departures, managed thrust on take off, continuous climb departure routes all contribute to fuel efficiency and noise reductions. The goal is to use continuous climb departure in higher density traffic. This should be enabled by system support to trajectory management.

Effect:

For this OI step the same holds as for the continuous climb departure procedure (AOM-0703). If this OI step leads to a higher number of continuous climb departures, this means that the effect of this OI step will be stronger compared to the effect of AOM-0703.

5.3.2 Enhancing terminal airspace

5.3.2.1 AOM-0601: Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA Where Suitable

Terminal Airspace is adapted in line with the availability of airspace, runway configuration and SID/STAR schema in use.

Effect:

Introducing Best Practice, PRNAV and/or FUA where suitable, should let to increase TMA efficiency, that means reduction in fuel burnt. The amount of the benefits cannot be valuated at the moment and it is really depends on the area of application, but, for sure medium effects are expected.

High effect; if TMA are organized in a more efficient way using Best practice, PRNAV and FUA, this could generate a reduction in the fuel burnt and then in the generated emissions.

5.3.2.2 AOM-0602: Enhanced Terminal Route Design using PRNAV Capability

PRNAV may facilitate improvements in the efficiency and capacity of Terminal Airspace through the provision of increased flexibility and reduced route separation. Includes also the development environmental-friendly procedures like steep and curved approaches

Based on current technology and on the application of PRNAV, RNAV SID STAR may be implemented between 2008 - 2010 in specific terminal airspace, and in some terminal airspace may become the one and only way of operating post 2012. Based on the application of RNP capability and on emerging technology, which may include 3D management on routes, advanced applications are expected from 2015 with metering of aircraft from en-route to Terminal airspace. 4D RNAV aircraft capability will then offer potential further benefits by allowing 4D departure and arrival management to minimize environmental impact and to ensure efficient timing and accurate approach sequencing.

Effect:

4D RNAV aircraft capability will then offer potential further benefits by allowing 4D departure and arrival management to minimise environmental impact and to ensure efficient timing and accurate approach sequencing. This OI step is expected to have high effects on the Global Emissions.

5.3.3 Arrival Traffic Synchronisation

5.3.3.1 TS-0102: Arrival Management Supporting TMA improvements (incl. CDA, PRNAV)

Arrival Management support is improved to facilitate the use of PRNAV in the terminal area together with the use of CDA approaches. Sequencing support based upon trajectory prediction will also enhance operations within the terminal area thus allowing a mixed navigation capability to operate within the same airspace and provide a transition to eventual 4D operations.

Effect:

It facilitates the use of continuous descent profile which has a positive environmental effect in terms of noise and fuel usage. This OI step is more an enabler than an OI step for the Global Emissions assessment, for that reason it is considered to have low impact on the Global Emissions

5.3.3.2 TS-0303: Arrival Management into Multiple Airports

The system provides support to coordination of traffic flows into multiple airports in the vicinity to enable a smooth delivery to the runways.

Effect:

Assistance to Multiple airport arrival management in the terminal area environment is becoming increasingly necessary especially in view of the emerging use of secondary airports which are located in close proximity to major airport hubs.

Even in this case it can facilitate the use of continuous descent profile which has a positive environmental effect in terms of noise and fuel usage. This OI step is more an enabler than an OI step for the Global Emissions assessment, for that reason it is considered to have low impact on the Global Emissions

This OI step is expected to have low effects on the Global Emissions.

5.3.3.3 *TS-0305: Arrival Management Extended to En-route Airspace*

The system integrates information from arrival management systems operating out to a certain distance (e.g. 200 NM) to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by using speed control to absorb some of the queuing time.

Effect:

TS-0305 helps in building an enhanced and more consistent arrival sequence, generating a decrease in the number of holding aircraft and then a decrease of emissions in the TMA and to a considerable extent (200NM). This OI step is expected to have medium effects on the Global Emissions.

5.4 EN-ROUTE

5.4.1 Increasing Flexibility of Airspace Configuration

5.4.1.1 *AOM-0801: Flexible sectorisation Management*

Sector configuration management is improved as a function of airspace management (Network Operations Plan) to ensure balance between demand and capacity at European network level through more effective resource utilisation, improved flexibility in staff rostering, adaptation and synchronisation of opening schemes across centres, and more generally speaking through harmonisation of working practices.

Improved agreements with the ATCOs, better working practices and planning tools lead in some cases to a significant reduction of delays without any additional investments. Best practices need to be expanded at European network level in order to make available the latent capacity that still exists in some parts of Europe.

Effect:

AOM-0801 improves efficiency of airspace management. Detailed assessment quantifying the possible benefits coming from the harmonisation of best practise is net yet available.

Medium beneficial effects are expected.

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5.4.2 4D contract

5.4.2.1 CM-0501: 4D Contract for Equipped Aircraft with Extended Clearance PTC-4D

A 4D Contract is a clearance that prescribes the containment of the trajectory in all 4 dimensions for the period of the contract.

The goal of a 4D Contract is to ensure separation between:

- 4DC capable aircraft;
- 4DC aircraft and dynamic special use airspace;

for a segment of the business trajectory in en-route airspace.

Effects:

The containment of Trajectory in all the 4 dimensions could help in minimising fuel consumption and in respecting BT in en-route phase. This OI is expected to have high effect on the Global Emissions.

5.4.3 Airborne situation awareness

5.4.3.1 AUO-0503: In-trail Procedure in Oceanic Airspace(ATSA-ITP)

Procedure applicable in non-radar oceanic environment permitting a 'climb-through' or 'descend-through' manoeuvre to pass a 'blocking' aircraft, using a distance-based longitudinal separation minimum with the blocking aircraft during the ITP manoeuvre.

Effects:

The objective is to enable aircraft that desire flight level changes in oceanic and remote airspace to achieve these changes on a more frequent basis, thus improving flight efficiency and safety. ATSA-ITP is a step to ASEP-ITP. ASEP-ITP will come later as the system requirements are expected to go beyond what is currently available.

This OI step aims to increase flights efficiency on oceanic routes, and then it is expected to contribute to the reduction of emissions on the airborne segment. High effects are expected.

5.4.4 Management/revision of RBT

5.4.4.1 AUO-0304: Initiating Optimal Trajectories through Cruise-Climb Techniques

An optimal thrust setting is selected for the climb and the aircraft climbs as weight is decreased though fuel burn.

Effect:

Implementing this OI step, aircraft fly their individual optimum trajectories to the maximum extent possible, minimising fuel burn. By this way it is possible to reduce emissions in airborne segment to the cruise achievement.

AUO-0304 is expected to have a high effect on the Global Emissions.

5.4.5 Precision Trajectory Operations

5.4.5.1 CM-0601: Precision Trajectory Clearances (PTC)-2D Based On Pre-defined 2D Routes

After allocation of 2D routes, vertical constraint and longitudinal separation is provided by ATC to complement the 2D route. This may be achieved through surveillance based separation and/or the dynamic application of constraints. New support tools (incl. MTCD) and procedures and working methods have to be put in place.

Effects:

The containment of Trajectory in 2 dimensions could help in increasing flight efficiency. This OI step is expected to have a low effect on the Global Emissions. High is the link with CDA and tailored arrivals.

5.4.5.2 CM-0602: Precision Trajectory Clearances (PTC)-3D Based On Pre-defined 3D Routes

After allocation of 3D routes, longitudinal separation is provided by ATC to complement the 3D route. This may be achieved through surveillance based separation and/or the dynamic application of constraints. New support tools and procedures and working methods have to be put in place. This mode relies on aircraft capabilities enabling barometric vertical navigation (VNAV) with the required accuracy (3D cones).

The containment of Trajectory in 3 dimensions could help in increasing flight efficiency. This OI step is expected to have a medium effect on the Global Emissions. High is the link with CDA and tailored arrivals.

5.5 Network

5.5.1 Air traffic flow management (ATFM) slot swapping

5.5.1.1 AUO-0101: ATFM slot swapping

The objective is a more flexible management of departure or arrival regulations especially during an airport critical event, and more freedom of choice for airspace users to adapt their operations. Aircraft operators' tactical priorities are introduced in a cooperative process with the CFMU through ATFM slot exchanges (such slot exchange could be for instance between flights within a single company or within a strategic alliance of companies). CFMU may propose slot exchanges between flights to minimize the overall inconvenience to the community as a whole with the objective of minimizing the total ATFM delay.

Effect:

This OI step is an operational tool for the airspace users especially at major hubs when serious congestion may happen. This is good for efficiency, here the efficiency is time based, then it needs to be assessed. Low effects on Global Emissions is expected.

5.5.2 Optimizing airspace allocation ad usage

5.5.2.1 AOM-0201: Moving Airspace Management into day of Operation

The Flexible Use of Airspace (FUA) process is improved with more dynamic airspace management enabling dynamic responses to short notice military airspace requirements (up to 3 hours before operations) or very short term changes (e.g. bad weather). This relies in particular on increased collaboration between ASM/ATFCM partners, and scenarios providing flexibility with regard to daily airspace and route requirements.

Effects:

There are inefficiencies in current FUA process especially due to poor negotiation process at pre-tactical level (often limited to the notification of CDR-2 availability), low usage of CDR-2 and lack of city-pairs focus on CDR-2.

This OI step is expected to have a medium impact on the Global Emissions, if applied on large scale. Emissions are reduced through the use of more optimum routes/trajectories.

5.5.3 Dynamic Mobile Areas

5.5.3.1 AOM-0202: Enhanced Real-time Civil-Military Coordination of Airspace Utilisation

Real-time coordination is further enhanced through what-if functionalities and automated support to airspace booking and airspace management (e.g. integrated toolset allowing AMC and other parties to design, allocate, open and close military airspace structures on the day of operations).

Effects:

Progress has been made in the recent years to facilitate exchanges between civil and military units through the deployment of a civil-military ATM-air defence coordination tool (integrated civil and military air information picture). However, civil-military interoperability is to be increased especially to cater for the requirements for more dynamic use of airspace. Furthermore, air defence and security concerns remain high, implying the continued need for efficient detection of renegade targets.

This OI step should contribute to achieve the optimum trajectory, with the consequent reduction of fuel burnt, then to the reductions of emissions on airborne. Medium effects are expected.

5.5.3.2 AOM-0203: Cross-Border Operations Facilitated through Collaborative Airspace Planning with Neighbours

National collaborative civil-military airspace planning process is extended with neighbouring States by harmonising, where needed, the ASM rules and procedures for the establishment, allocation and use of airspace structures. National high level airspace policy bodies will enhance their cooperation with neighbours, when so required, to commonly address cross-border activities and to seek to allocate at pre-tactical level on a sub-regional rather than a national basis.

Effects:

This improvement step refers mainly to bilateral/FAB collaboration. Many military areas are located at the boundaries of States, so the merging of existing national areas into cross-border areas is a possibility for an option. This merging is usually achieved by the addition of existing areas on both sides of the common border. However, the management of such airspace structures is more challenging in order to alleviate the pressure on civil traffic (e.g., synchronisation of training activities throughout neighbouring States is needed).

Co-ordination of military training activities/area contributes to the efficiency of airspaces, generating benefits on the Global Emissions. To this end, this OI steps has a medium effect on the Global Emissions.

5.5.3.3 AOM-0204: Europe-wide Shared Use of Military training Area

TSA/TRA sharing concepts - including cross-border operations (CBO) and cross-border areas (CBA) - are extended at European level subject to political endorsement, especially in regard to the dependency on other States (e.g. reciprocity of training opportunities, need to identify and mitigate regulatory and procedural differences).

Effects:

This improvement refers mainly to the multilateral/European/FAB dimension. The objective is to overcome existing national fragmentation in view of the Single European Sky implementation, and the expected harmonisation of airspace design and use at European level and to facilitate military-military cooperation between Armed Forces.

This OI step is expected to have a high impact on the Global Emissions, if applied on large scale. Emissions are reduced through the use of more optimum routes/trajectories.

5.5.3.4 AOM-0206: Flexible Military Airspace Structures

The possibility for ad-hoc structure delineation at short notice is offered to respond to short-term airspace users' requirements not covered by pre-defined structures and/or scenarios. Changes in the airspace status are uplinked to the pilot by the system.

Effects:

The objective is to better respond to military airspace requirements and/or meteorological constraints while giving more freedom to GAT flights to select the preferred route trajectories and to achieve more flexibility from both civil and military partners.

This OI step should contribute to achieve the optimum trajectory, with the consequent reduction of fuel burnt, then to the reductions of emissions on airborne. Medium effects are expected.

5.5.3.5 AOM-0208: Dynamic Mobile Areas(DMA)

DMA are temporary mobile airspace exclusion areas. The size and duration of the volumes of airspace will be kept to the absolute minimum required.

Effects:

The intent is to limit the impact of airspace exclusion to the minimum while allowing the users to be separated from this moving volume. This enables for more optimum routes/trajectories. The effects (medium) of this OI need to be assessed for minimizing them.

5.5.4 Increasing the flexibility of the route network

5.5.4.1 AOM-0401: Multiple Route Options & Airspace Organisation Scenarios

More route options and a greater freedom in profile selection is offered. Cross-border sectorisation is enabled where appropriate to meet changing traffic flows across FIR boundaries reflecting the move towards Functional Airspace Blocks envisaged within the Single European Sky. The revised route structure continues to provide connectivity with major TMAs and accommodates expected traffic demand. The airspace design and pre-determined scenarios provide viable options to airspace users with multiple route options and modular temporary airspace structures. Airspace scenarios are agreed by airspace users, ANSPs, military to enable more efficient routings on the day of operation (e.g. where airspace released by the military is not fully utilised).

Effects:

Dynamic management requires that the European airspace structure changes to a multiple choice route network with pre-determined direct route segments supplemented by suitable planned alternatives, and co-existing with temporary airspace structures meeting all potential specific use airspace requirements.

This OI step is expected to have high impact on the Global Emissions, if applied on large scale. Emissions are reduced using more optimum routes/trajectories.

5.5.4.2 AOM-0402: Further Improvements to Route Network

The route network continues to be developed in accordance with Advance Airspace Scheme principles and taking into account military requirements, with the aim to further optimise airspace structures (route/sector and terminal airspace) across airspace boundaries, to better align routes and sectors with traffic flows and to accommodate more efficiently the various types of airspace users (e.g. specialisation of routes and sectors to enhance productivity and reduce controller workload).

Effects:

This step is unavoidable before the target concept. Flight efficiency is expected to increase, and then medium effects on Global Emissions, reduced through an optimisation of airspace structures are expected. Medium effects on Global Emissions

5.5.4.3 AOM-0403: Pre-defined ATS Routes Only When and Where Required

The route network will evolve to fewer pre-defined routes with the exploitation of advanced navigation capabilities and generalisation of FABs not constrained by FIR boundaries, allowing for more direct routes and free routing. Route constraints are removed along with the development of 4DT based operations. However, it is assumed that some form of route network will be retained to cater for specific requirements (e.g. non capable aircraft, transition of medium complexity operations to/from TMA lower airspace, segregation between managed and unmanaged airspace, military flight planning, etc.).

Effects:

This step is unavoidable before the target concept. High effects on Global Emissions are expected, due to the implementation of more direct routes and free routing.

5.5.5 Use of Free Routes/4D Trajectories

5.5.5.1 AOM-0501: Use of Free Routing for Flight in Cruise Inside FAB Above Level XXX

The goal is to allow free routing inside FAB independent from route network in cruise above level XXX.

Effects:

Flight efficiency is expected to increase, then high effects on the Global Emissions are expected to have a big influence; they are reduced through an optimisation of routes/trajectories.

5.5.5.2 AOM-0502: Use of Free Routing from ToC to ToD

The free routing is from Top of climb to top of descent.

Effect:

High effects on Global Emissions, reduced through use of more optimum routes/trajectories.

5.5.5.3 AOM-0503: Use of Free Routing from Terminal Area Operations-exit to Terminal Area Operations-entry

The free routing is implemented from exit from/ to entry into Terminal Area Operations.

Effect:

High effects on Global Emissions, reduced through use of more optimum routes/trajectories.

5.5.6 Planning the Shared Business Trajectory

5.5.6.1 AUO-0201: Enhanced Flight Plan Filing Facilitation

Airspace users are assisted in filing their flight plans and in re-rerouting according to the airspace availability and ATFM situation, through collaboration with CFMU, ANS providers and airports. Airspace users can make more informed decisions when compromises are needed between delay, re-routing, trajectory limitations or costs. On the basis of the offered routings, they can select the offered routing, which is best suited to their company policy for optimising flight time, fuel burn or other parameters.

Effects:

Finding a valid route in the increasingly complex European airspace has become such a challenge that aircraft operators during their today's way of flight plan preparation efforts usually have visibility of several solutions only if they have access to sophisticated tools.

This OI step allows airspace users to select the best route fitting airlines' policies. This OI can have a high impact on the emissions generations, because a company can opt for a low-emissions route, with high benefits.

5.5.6.2 *AUO-0203: Shared Business/Mission Trajectory*

The conventional flight planning process is complemented by the development and publication by airspace users of a Shared Business / Mission Trajectory (SBT) made widely available for ATM planning purposes to authorized users subject to appropriate subscription mechanisms.

Effects:

Planning of trajectories by the users will allow for making optimum use of the knowledge of opportunities to minimise environmental impact. There is a high opportunity here for all the users to take into account environmental effects. In consequence, a high beneficial effect concerning Global Emissions is expected.

5.5.6.3 *AUO-0204: Agreed RBT/Mission Trajectory through Collaborative Flight Planning*

Airspace users can refine the Shared Business / Mission Trajectory (SBT) in a number of iterations taking into account constraints arising from new and more accurate information. They access an up-to-date picture of the traffic situation with the level of detail required for planning (incl. Historical data, forecasted data, already known intentions, MET forecast, current traffic, ASM situation). The collaborative planning process terminates when the Reference Business / Mission Trajectory (RBT) is published.

Effects:

Collaborative Flight Planning will allow for making optimum use of the knowledge of opportunities to minimise environmental impact. There is a high opportunity here for all the users to take into account environmental effects, minimising them. The OI step is expected to have a strong beneficial effect on Global Emissions.

5.6 CONCLUSIONS – GE SCREENING & SCOPING

This section groups the OIs into three groups (low effect, medium effect, high effect). Finally the ten OIs with the highest expected positive impact on the Global Emissions will be given. These ten OIs are given in order of expected importance (number 1 is expected to have the largest impact).

5.6.1 OI steps with a low effect on GE

TS-0102: Arrival Management Supporting TMA improvements (incl. CDA, PRNAV)

TS-0303: Arrival Management into Multiple Airports

CM-0601: Precision Trajectory Clearances (PTC)-2D Based On Pre-defined 2D Routes

AUO-0101: ATFM slot swapping

5.6.2 OI steps with a medium effect

TS-0302: Departure management from multiple airports

AOM-0201: Moving Airspace Management into day of Operation

AOM-0202: Enhanced Real-time Civil-Military Coordination of Airspace Utilisation

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AOM-0203: Cross-Border Operations Facilitated through Collaborative Airspace Planning with Neighbours

AOM-0206: Flexible Military Airspace Structures

AOM-0208: Dynamic Mobile Areas (DMA)

AOM-0703: Continuous climb departure

AOM-0705: Advanced continuous climb departure

AOM-0801: Flexible sectorisation Management

TS-0305: Arrival Management Extended to En-route Airspace

AOM-0402: Further Improvements to Route Network

CM-0602: Precision Trajectory Clearances (PTC)-3D Based On Pre-defined 3D Routes

5.6.3 OI steps with an High effect

AOM-0501: Use of Free Routing for Flight in Cruise Inside FAB Above Level XXX

AOM-0502: Use of Free Routing from ToC to ToD

AOM-0503: Use of Free Routing from Terminal Area Operations-exit to Terminal Area Operations-entry

AOM-0401: Multiple Route Options & Airspace Organisation Scenarios

AOM-0601: Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA Where Suitable

AOM-0602: Enhanced Terminal Route Design using PRNAV Capability

AOM-0701: Continuous descent approach (CDA).

AOM-0702: Advanced Continuous descent approach (ACDA)

AOM-0704: Tailored arrival

CM-0501: 4D Contract for Equipped Aircraft with Extended Clearance PTC-4D

AOM-0204: Europe-wide Shared Use of Military training Area

AOM-0403: Pre-defined ATS Routes Only When and Where Required

AUO-0201: Enhanced Flight Plan Filing Facilitation

AUO-0203: Shared Business/Mission Trajectory

AUO-0204: Agreed RBT/Mission Trajectory through Collaborative Flight Planning

AUO-0304: Initiating Optimal Trajectories through Cruise-Climb Techniques

AUO-0503: In-trail Procedure in Oceanic Airspace(ATSA-ITP)

5.6.4 The 10 most important OI steps on GE

This paragraph lists the 10 most important OI steps in the order of their importance. This means that the first OI step in the list is expected to have the biggest positive impact on the Global Emissions. As mentioned in the introduction, the assessment here reported excludes those OIs that have been already covered in the LAQ list and that are related to airport emissions.

Looking at the following list, it seems to become clear, that mainly those OI steps making the flight routes/trajectories more efficient, contribute best to reduce Global Emissions. This can explain why all the OI steps referring to 4D contract, or FAB, or Free routing have been selected.

Of course, this initial screening and scoping exercise, sometime based on incomplete descriptions of how an OI step will be implemented and work more precisely, requires a more detailed validation of each OI step to finally better qualify and quantify its potential contribution to the reduction of the environmental impact with regards to Global Emissions (e.g. AOM-0703, AOM-0705).

Some of selected OI steps are more enablers rather like OI steps, because they are required to maximize effects generated by other OI steps; examples is TS-0102 should give support in the implementation of the OI steps AOM-0701 and AOM-0702.

The top ten list is:

AOM-0501, AOM-0502 and AOM-0503

Respectively Use of Free Routing for Flight in Cruise Inside FAB Above Level XXX, Use of Free Routing from ToC to ToD and Use of Free Routing from Terminal Area Operations-exit to Terminal Area Operations-entry

AUO-0203 Shared Business/Mission Trajectory

AUO-0204 Agreed RBT/Mission Trajectory through Collaborative Flight Planning

CM-0501 4D Contract for Equipped Aircraft with Extended Clearance PTC-4D

AOM-0204 Europe-wide Shared Use of Military training Area

AOM-0601 Terminal Airspace Organisation Adapted through Use of Best Practice, PRNAV and FUA Where Suitable

AOM-0602 Enhanced Terminal Route Design using PRNAV Capability

AOM-0702 Advanced Continuous descent approach (ACDA)

AOM-0701 or AOM-0704

Respectively Continuous descent approach (CDA) and Tailored arrival

AUO-0304 Initiating Optimal Trajectories through Cruise-Climb Techniques

At the first place there are three OI steps related the implementation of free routing at different scales respectively at cruise level, from ToC to ToD, and from Terminal Area Operations-exit to Terminal Area Operations-entry. If implemented these could allow airlines to fly their optimal route, minimising the fuel consumption and then most of the emissions. These OI steps require more investigations to assess the influence of each single OI step on the single pollutant.

At the second and third place there are two OI steps related to the SBT, AUO-0203 and AUO-0204, that represent really a new concept in the ATM, that's the reason they are so relevant for the Global Emissions. All the stakeholders have to agree and to work for respecting and applying the SBT, and improve it (if necessary); so if Global Emissions become an issue on the decision table, this is the right place where to work on an “SBT environmental friendly”.

Really important is OI step CM-0501, by this way it is possible to keep controlled the flight in the 4 dimensions, with the option to have the best route on environment point of view and in a network of operations guaranteeing the flights' efficiency.

AOM-0204 is one of the key OI steps; in fact the sharing of military area across Europe should help in making shorter routes for aircraft, with consequent benefits on fuel consumption and then on most of Global Emissions.

AOM-0601 and AOM-0602 both push for improving TMA, using PRNAV capabilities, FUA concept and best practices able to make more efficient flights in the TMAs and at the same time allowing for the full implementation of AOM-0702, AOM-0701 and AOM-0704.

About AOM-0702, AOM-0701 and AUO-0304 they are all OIs aiming at minimize fuel consumption (then most of the emissions) respectively for arrival aircraft (AOM-0702 and AOM-0701) and for departing aircraft. They need to be deeply assessed to evaluate the size of their benefits.

6 REFERENCES AND APPLICABLE DOCUMENTS

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